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A TECHNICAL INVESTIGATION OF PAINTING MEDIUM:  
THE ANALYSIS OF THREE WALL PAINTINGS  
BY CONSTANTINO BRUMIDI IN THE UNITED STATES CAPITOL  
A CASE STUDY

Catherine Sterling Myers

A THESIS

in

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Presented to the faculties of the University of Pennsylvania in Partial  
Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

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# CONTENTS

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<b>List of Figures</b>	<b>iii</b>
<b>Forward</b>	<b>ix</b>
<b>Chapter 1 : Introduction</b>	<b>1</b>
<b>Chapter 2 : Scientific Analysis in Conservation</b>	<b>17</b>
<b>Chapter 3 : Technique</b>	<b>36</b>
<b>Chapter 4 : Methodolgy</b>	<b>66</b>
<b>Chapter 5 : Results</b>	<b>78</b>
<i>Las Casas</i>	<b>80</b>
<i>Bellona</i>	<b>141</b>
<i>Louisiana</i>	<b>211</b>
<b>Chapter 6 : Conclusions</b>	<b>271</b>
<b>Bibliography</b>	<b>274</b>
<b>Appendices</b>	<b>282</b>
<b>Elevation drawings</b>	<b>283</b>
<b>Technical Terms</b>	<b>286</b>
<b>Pigments</b>	<b>289</b>



## LIST OF FIGURES

---

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
Figure 1	Photomicrograph Sample Sheet	76
Figure 2	Sample Data Sheet	77
Figure 3	Photograph <i>Las Casas</i>	90
Figure 4	Photograph <i>Las Casas</i>	91
Figure 5	Photograph <i>Las Casas</i>	92
Figure 6	Photograph <i>Las Casas</i>	93
Figure 7	Photograph <i>Las Casas</i>	94
Figure 8	Photograph <i>Las Casas</i>	95
Figure 9	Photograph <i>Las Casas</i>	96
Figure 10	Photograph <i>Las Casas</i>	97
Figure 11	Measured Drawing <i>Las Casas</i>	98
Figure 12	Measured Drawing <i>Las Casas</i>	99
Figure 13	Photomicrograph A.I.1.a.	100
Figure 14	Photomicrograph A.I.1.a	101
Figure 15	Photomicrograph A.I.2.a.	102
Figure 16	Photomicrograph A.I.2.a.	103
Figure 17	Photomicrograph A.I.2.b.	104
Figure 18	Photomicrograph A.I.2.b	105
Figure 19	Photomicrograph A.I.3.b.	106
Figure 20	Photomicrograph A.I.3.b.	107
Figure 21	Photomicrograph A.I.4.b.	108
Figure 22	Photomicrograph A.I.4.b.	109
Figure 23	Photomicrograph A.I.5.b.	110
Figure 24	Photomicrograph A.I.5.b	111
Figure 25	Photomicrograph A.I.8.b.	112
Figure 26	Photomicrograph A.I.8.b.	113
Figure 27	Photomicrograph A.I.9.a.	114
Figure 28	Photomicrograph A.I.9.a.	115



Figure 29	Photomicrograph A.I.9.b.	116
Figure 30	Photomicrograph A.I.9.b.	117
Figure 31	Photomicrograph A.I.9.b.	118
Figure 32	Photomicrograph A.I.10.a.	119
Figure 33	Photomicrograph A.I.10.a.	120
Figure 34	Photomicrograph A.I.10.b.	121
Figure 35	Photomicrograph A.I.10.b.	122
Figure 36	Photomicrograph A.I.13.a.	123
Figure 37	Photomicrograph A.I.13.a.	124
Figure 38	Photomicrograph A.II.1.b	125
Figure 39	Photomicrograph A.II.1.b.	126
Figure 40	Photomicrograph A.II.3.a.	127
Figure 41	Photomicrograph A.II.3.a.	128
Figure 42	Photomicrograph A.II.4.a.	129
Figure 43	Photomicrograph A.II.4.a.	130
Figure 44	Photomicrograph A.II.4.b.	131
Figure 45	Photomicrograph A.II.4.b.	132
Figure 46	Photomicrograph A.II.6.c.	133
Figure 47	Photomicrograph A.II.6.c.	134
Figure 48	Spectra	135
Figure 49	Spectra	136
Figure 50	Spectra	137
Figure 51	Spectra	138
Figure 52	Spectra	139
Figure 53	Spectra	140
Figure 54	Photograph <i>Bellona</i>	150
Figure 55	Photograph <i>Bellona</i>	151
Figure 56	Photograph <i>Bellona</i>	152
Figure 57	Photograph <i>Bellona</i>	153
Figure 58	Photograph <i>Bellona</i>	154
Figure 59	Photograph <i>Bellona</i>	155
Figure 60	Photograph <i>Bellona</i>	156
Figure 61	Photograph <i>Bellona</i>	157
Figure 62	Photograph <i>Bellona</i>	158



Figure 63	Photograph <i>Bellona</i>	159
Figure 64	Photograph <i>Bellona</i>	160
Figure 65	Photograph <i>Bellona</i>	161
Figure 66	Measured Drawing <i>Bellona</i>	162
Figure 67	Measured Drawing <i>Bellona</i>	163
Figure 68	Measured Drawing <i>Bellona</i>	164
Figure 69	Measured Drawing <i>Bellona</i>	165
Figure 70	Photomicrograph B.I.1.b.	166
Figure 71	Photomicrograph B.I.1.b.	167
Figure 72	Photomicrograph B.I.1.b.	168
Figure 73	Photomicrograph B.I.3.a.	169
Figure 74	Photomicrograph B.I.3.a.	170
Figure 75	Photomicrograph B.I.4.	171
Figure 76	Photomicrograph B.I.4.	172
Figure 77	Photomicrograph B.I.7.a.	173
Figure 78	Photomicrograph B.I.7.a.	174
Figure 79	Photomicrograph B.I.11.	175
Figure 80	Photomicrograph B.I.11.	176
Figure 81	Photomicrograph B.I.12.	177
Figure 82	Photomicrograph B.I.12.	178
Figure 83	Photomicrograph B.I.13.	179
Figure 84	Photomicrograph B.I.13.	180
Figure 85	Photomicrograph B.I.14.	181
Figure 86	Photomicrograph B.I.14.	182
Figure 87	Photomicrograph B.II.1.b.	183
Figure 88	Photomicrograph B.II.1.b.	184
Figure 89	Photomicrograph B.II.3.a.	185
Figure 90	Photomicrograph B.II.3.a.	186
Figure 91	Photomicrograph B.II.3.b.	187
Figure 92	Photomicrograph B.II.3.b.	188
Figure 93	Photomicrograph B.II.4.a.	189
Figure 94	Photomicrograph B.II.4.a.	190
Figure 95	Photomicrograph B.II.5.a.	191



Figure 96	Photomicrograph B.II.5.a.	192
Figure 97	Photomicrograph B.II.5.a.	193
Figure 98	Photomicrograph B.II.5.b.	194
Figure 99	Photomicrograph B.II.5.b.	195
Figure 100	Photomicrograph B.II.8.b.	196
Figure 101	Photomicrograph B.II.8.b.	197
Figure 102	Photomicrograph B.II.9.b.	198
Figure 103	Photomicrograph B.II.9.b.	199
Figure 104	Spectra	200
Figure 105	Spectra	201
Figure 106	Spectra	202
Figure 107	Spectra	203
Figure 108	Spectra	204
Figure 109	Spectra	205
Figure 110	Spectra	206
Figure 111	Spectra	207
Figure 112	Spectra	208
Figure 113a	Spectra	209
Figure 113b	Spectra	210
Figure 114	Photograph <i>Louisiana</i>	219
Figure 115	Photograph <i>Louisiana</i>	220
Figure 116	Photograph <i>Louisiana</i>	221
Figure 117	Photograph <i>Louisiana</i>	222
Figure 118	Photograph <i>Louisiana</i>	223
Figure 119	Photograph <i>Louisiana</i>	224
Figure 120	Photograph <i>Louisiana</i>	225
Figure 121	Photograph <i>Louisiana</i>	226
Figure 122	Photograph <i>Louisiana</i>	227
Figure 123	Photograph <i>Louisiana</i>	228
Figure 124	Photograph <i>Louisiana</i>	229
Figure 125	Photograph <i>Louisiana</i>	230
Figure 126	Photograph <i>Louisiana</i>	231
Figure 127	Photograph <i>Louisiana</i>	232
Figure 128	Photograph <i>Louisiana</i>	233



Figure 129	Photomicrograph C.I.5.b.	234
Figure 130	Photomicrograph C.I.5.a.	235
Figure 131	Photomicrograph C.I.5.a.	236
Figure 132	Photomicrograph C.I.6.a.	237
Figure 133	Photomicrograph C.I.6.a.	238
Figure 134	Photomicrograph C.II.1.b.	239
Figure 135	Photomicrograph C.II.1.b.	240
Figure 136	Photomicrograph C.II.4.a.	241
Figure 137	Photomicrograph C.II.4.a.	242
Figure 138	Photomicrograph C.II.3.a.	243
Figure 139	Photomicrograph C.II.3.a.	244
Figure 140	Photomicrograph C.II.5.b.	245
Figure 141	Photomicrograph C.II.5.b.	246
Figure 142	Photomicrograph C.II.6.a.	247
Figure 143	Photomicrograph C.II.6.a.	248
Figure 144	Photomicrograph C.II.7.a.	249
Figure 145	Photomicrograph C.II.7.b.	250
Figure 146	Photomicrograph C.II.7.b.	251
Figure 147	Photomicrograph C.II.9.b.	252
Figure 148	Photomicrograph C.II.9.b.	253
Figure 149	Photomicrograph C.II.10.b.	254
Figure 150	Photomicrograph C.II.10.b.	255
Figure 151	Photomicrograph C.II.11.a.	256
Figure 152	Photomicrograph C.II.11.a.	257
Figure 153	Photomicrograph C.II.12.a.	258
Figure 154	Photomicrograph C.II.12.a.	259
Figure 155	Photomicrograph C.II.13.b.	260
Figure 156	Photomicrograph C.II.13.b.	261
Figure 157	Photomicrograph C.II.15.b.	262
Figure 158	Photomicrograph C.II.15.b.	263
Figure 159	Spectra	264
Figure 160	Spectra	265
Figure 161	Spectra	266
Figure 162	Measured Drawings <i>Louisiana</i>	267



Figure 163	Measured Drawings <i>Louisiana</i>	268
Figure 164	Measured Drawings <i>Louisiana</i>	269
Figure 165	Measured Drawings <i>Louisiana</i>	270



# FORWARD

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This research was prompted by a commission to conserve one of the Brumidi frescoes at the United States Capitol . I chose the subject for several reasons not least of which because it was familiar to me. The resulting research and interpretation are made through the coupling of empirical evidence offered off- site with the knowledge of the technology of fresco as a painting conservator, and, in particular, Brumidi's technique, gained on-site. Neither exists in isolation nor is mutually exclusive.

A completed study of the technique of execution of Brumidi's work involves the completion of work initiated here as well as further research, a project well beyond the scope of this research effort. That it would be valuable in better understanding the artist is a judgment to be assessed by the curators of Brumidi's work. I believe that it is valuable in shedding light on Brumidi's technique, in particular, and on fresco technique and the methods for studying it , in general .

This research has involved the cooperation of several kind people. Thanks to my advisor, Frank Matero, Associate Professor and to my reader, Alberto Tagle, Conservation Scientist.

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Cassie Myers, June 1992



# CHAPTER 1: INTRODUCTION

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The technical study of wall paintings is a necessary process for documenting fine arts and architectural painting technique. It is also a means for testing the potentialities of materials analysis in the study of art and architectural materials.

In the broadest sense, the following paper is a technical study of fresco painting. In particular, it is a case study examination aimed at illuminating the technique of Constantino Brumidi in his execution of three of the frescoes located in the Senate Corridors of the United States Capitol. This study focuses primarily upon the identification of the painting medium, the single most important factor in determining the working technique of the artist.

This research aims to augment and build upon related research efforts. The analytical methods used in this study have been chosen from among many methods employed in the field of conservation of art and antiquities and have been selected for their appropriateness and availability. In the particular case of fluorescence microscopy, the method for identifying binding medium has been selected as an analytical tool because of its economic feasibility for the private conservator. Also informing the choice of analytical methods were technical studies aimed at characterizing binding medium that have been conducted in recent years. Although few of these have been directed at fresco technique, the identification of medium within fresco painting technical investigations is included.<sup>1</sup>

The paintings examined in this project are among a larger ensemble of fresco paintings by Brumidi located throughout the interior of the United States Capitol. These paintings are one of the important contributions made to the building during the Capitol Extension Project of the 1850's- 1870's, directed by architect, Thomas Ustick Walter. Walter designed the Capitol wings and the cast iron dome nearly doubling the size of the

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<sup>1</sup> The application of fluorescence microscopy to the study of binding media in museum objects has been led by Richard Wolbers, Conservator, University of Delaware. In the United States, the analysis of binding medium in the study of artist' materials is currently the subject of research. Study is being carried out at the Getty Conservation Institute, the Philadelphia Museum of Art, the University of Delaware, the Fogg Art Museum and elsewhere using staining and instrumental analyses such as FT-IR.



building and visually transforming it. Among the products of this important building campaign was an entirely new interpretation of its interior. Montgomery C. Meigs, Supervisor of the Capitol Extension and Dome, championed Brumidi's involvement with the project and was primarily responsible for the artist's long and significant tenure at the Capitol. Brumidi's paintings made an important contribution to the building's interpretation of that period.

Brumidi imported the technology of fresco painting from Italy to the United States in the mid- nineteenth century. Although it is not certain that he was the first to employ fresco technique in the country, it is unquestionable that the product of his prolific twenty-five year career was the most visible and extensive of any application of *buon fresco* in the United States. The paintings he left behind are distinguished examples of wall paintings created in the grand fresco tradition.

While archival documents in the form of journal entries and letters, in the archives of the Architect of the Capitol, support the premise that the paintings are executed in *buon fresco* with lime *secco* passages, the extent of these and other variations in technique is not fully understood. Superficial examination generally indicates that the painting medium was lime, either as a product of fresco or as a result of lime-bound *secco* painting. However, superficially, some passages appear to be in non-lime media suggesting that Brumidi utilized binding media added to either the pigments in the process of fresco painting or within the substrate or on top of it.

Visual examination is complicated by the results of previous "restorations" or other interventions. Extensive overpaint and other films obscure the original surfaces and mingle within the original paint layers through the penetration of the oils, resins or glues into the fresco surface.

This study aims to answer the following questions:

Are the original paintings fresco?

To what extent are they executed in lime -bound *secco* technique?

Were non-calcareous media used in the original execution?

To what extent have overpaint and other surface films altered the original layers?

Have, for example, oil paints penetrated into frescoed substrate?

How are the means of examination and analyses successful or inadequate in answering these questions?



While the research subject primarily concerns fine arts conservation, the subject is also integrally involved with architectural conservation. This research aims to link the professional practices of fine arts and architectural conservation through the application of analytical techniques in the investigation of the building and artistic materials. It also aims to inform associated professionals, particularly the architectural conservator, by offering insight into the specialized technology that has and continues to be adopted by the field of fine arts conservation. Further, by its association, the paper aims to introduce, where applicable, techniques to the study of architectural and decorative painted finishes.

The specific techniques of Brumidi's execution of the three paintings examined will be discussed in some detail. Augmenting previous research, conservation condition studies and treatment reports of Brumidi's work at the Capitol carried out in a conservation treatment campaign initiated in 1982, the research provides an empirical supplement that sheds light on Brumidi's working practices.

The three frescoes used as case studies herein are examples of paintings of Brumidi's late-career at the Capitol. At least two of the paintings chosen for study offer rare examples in the United States of *buon fresco* painting thus providing an unusual opportunity to apply technical research specific to fresco painting to Brumidi's work. The material of Brumidi's paintings is essential for understanding his working methods. This research focuses on the analysis and examination of the painting medium, significant in its illumination of the working technique and in determining the states of conservation. While the study considers the technique of execution of all of the paintings at the Capitol, the scope of technical examination is necessarily limited. Those paintings studied have been chosen for examination because, at the time of this research, they had not yet been conserved and were therefore available for sampling and examination. Furthermore, they were chosen with the assumption that they represent Brumidi's technique of execution found elsewhere in the Capitol.

The technical examination involves on-site and laboratory study. The laboratory research was conducted in two phases: the first employs optical methods of investigation: reflected light, ultra-violet light, and polarized light microscopy for the identification of materials; and in the second phase additional means of instrumental analysis are used for further research and confirmation. This second phase is applied to a very limited extent and principally to one of the paintings, chosen for representing the ensemble. The principle instrumental analysis employed is Fourier Transform Infrared spectrometry for



confirmation of binding medium. Sample analyses have been conducted using X-Ray Diffraction in order to illustrate the broader range of possibilities available.

As an introduction, the paper places the subject of the case study in its physical, historical, artistic and technical context. In order to provide a contextual perspective for this research, techniques of examination and analysis are reviewed for their application in similar studies. Previous studies of Brumidi's work and archival sources that document his working method and use of materials are reviewed. Those techniques for examining the paintings employed herein are also explained and discussed. The methodology is described and illustrated.

Finally, interpretation of the results, including a commentary on the strengths and weaknesses of the techniques, are summarized. Recommendations for further research are given.

Supporting documents in the form of photographs, drawings, photomicrographs and spectra are integrated in the text and assembled in the appendices of the paper.



## HISTORICAL BACKGROUND

In part, the significance of the Capitol frescoes results from the symbolic and architectural significance of the building of which they are a part. That Constantino Brumidi was chosen to decorate the interior walls lends to the artist a preeminence perhaps exceeding his artistic merit. It could hardly be said that, as one of the nation's most important edifices, the paintings that ornament and narrate its interior parallel those at equivalent centers or seats of government. This judgment derives in part from the fact that they do not speak for their time. To the contrary, they reflect a European Baroque tradition associated with the seventeenth century. As such, Brumidi's frescoes at the United States Capitol reflect a pictorial tradition in the United States that associates grand scaled allegorical paintings with important edifices, such as may be seen in Baroque palaces, residences and churches of Europe.

However, Brumidi was an important agent in the mid-nineteenth design conception for the United States Capitol, a building that reflects the development and alteration of classicism in American architecture in the nineteenth century. The artist was instrumental in realizing the designers' conceptions of the building that expanded to include a scheme of ornamentation, primarily by the vision of Montgomery Meigs, that associated it with classical and Renaissance traditions and linked it to European prototypes and the mid-nineteenth century aspirations of a grander national edifice. Brumidi, with his training at handling monumental allegorical wall paintings, was able to comply with and complete an inclusive vision of through wall painting, that attempted to embrace as one all of the arts.

With the Capitol Extension Project, Walter deferred to the existing classical architectural idiom established by Thornton, Latrobe and Bullfinch and also managed to introduce discrete expressions of the architecture of his time. He spent fourteen years on it, from 1851-1865, on shaping the building as we know it today. His work included the addition of the cast iron dome, the House and Senate Wings and decorative treatment of the interiors. The inclusion of the wall paintings in the design was an important fact that reflected the victory amidst an insuing conflict between Walter and Meigs. Against Walter's criticism of the wall painting scheme, Meigs was clearly the victor.



The philosophy that encouraged the inclusion of wall paintings stemmed from classical Vitruvian tenets of order, harmony and the coexistence of all of the arts in the built environment. Revived and disseminated by the Ecole des Beaux Arts in the nineteenth century, joining the earlier century's neoclassical modes, this admiration for wall paintings recalled classical and Renaissance conceptions as the following passages illustrate:

Walter wrote in 1841:

'If architects would oftener aim to think as the Greeks thought, than do as the Greeks did, columnar architecture would possess a higher degree of originality and its character and expression would gradually become conformed to the local circumstances of the country and the republican spirit of its institutions'<sup>2</sup>

In a similar vein, Meigs defended his belief in classical tenets in a letter to the Honorable Caleb B. Smith, Secretary of the Interior in 1862 :

When a new order of architecture is invented more beautiful than the Doric or Corinthian, then an original style of decoration, rejecting all that is beautiful in the great artists who have embellished the cathedrals and palaces of Italy and France may be looked for, But until the time comes the classic, the Pompeian, the Roman, the Greek, the Renaissance and other styles in which the finest buildings in the world are decorated must continue to be used and will gratify men of taste and cultivation...<sup>3</sup>

Meigs continued in the same vein, discussing the role of the wall paintings in the decoration and thus defending Brumidi against a barrage of criticism that resulted from his work:

Those who do not know that the finest models of architectural decorations, the work of Raphael and Da Vinci, are copied and repeated upon the buildings of England and this country, intended for the use of the people, fall into the error of decrying these colored decorations of the Capitol as suitable only for restaurants and demand new and American styles... I do not mean to claim for Mr. Brumidi the genius of Raphael, but he is a modest gentleman, a true and instructed and skillful artist, and I have as yet seen no one who can compare with him as a director of decorations of the interior of the Capitol. ... There are two native artists who, upon a purely American subject, ... would paint a better

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<sup>2</sup> As cited in "Thomas Ustick Walter, FAIA 1804-1887", by George C. Mason Jr. *Journal of the American Institute of Architects*. 8 (1947) : 225-230.

<sup>3</sup> Letter of June 5 to Honorable Caleb B. Smith, Secretary of the Interior, National Archives, Record Group 48 (Interior Records), series 291, box 4, pp. 2-3.



historical picture; but even they would not know how to surround it with those accessories and adjuncts which would fit it for a place as a mural decoration. <sup>4</sup>

Brumidi utilized wall paintings in the spirit of his predecessors and, in as much as he achieved similar ends of the great wall painting programs of Europe, his work succeeded. As eloquently defined by E. H. Gombrich in *Means and Ends*: <sup>5</sup> the artist arrived at the similar results attained in wall paintings programs of the great age of fresco, defined by Gombrich, as existing on three levels: wall paintings enhance and link together the architectural spaces through the unification brought by color and line; they articulate and ornament it by the design and palette; finally, they use the architectural spaces as the canvases for works of art.

While Brumidi brought with him from Italy the technology of fresco painting. Although it is unlikely that he was the first to employ fresco technique in the country, <sup>6</sup> it is unquestionable that the product of his prolific twenty-five year career was the most visible and extensive of any application of *buon fresco* in the United States. At the least, the paintings he left behind are distinguished examples of wall paintings created in the grand fresco tradition and examples of a painting technology rare in Anglo-America.

Historically, the term fresco has been misused in the United States. In nineteenth century Anglo-America, "fresco" is used in the Pickwickian sense to stand for any mural or ceiling painting of an interior. <sup>7</sup> Even as recent as the 1920's, wide misconceptions of the exact meaning of fresco are illustrated by such phrases as "frescoed in tempera" <sup>8</sup> With the last age of fresco having waned with Tiepolo, a century before Brumidi, and the replacement of oil for mural paintings, the difficult technique of fresco became nearly obsolete, with exceptions in small artistic movements in Europe. Wall painting in the United States began after fresco had died and therefore fresco was not the chosen medium for the great artists of their day. American Renaissance murals in the late nineteenth century marked the maturity of mural painting in the United States with the work of Lafarge, Sargent and the mural painters at the Library of Congress. Another surge of

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<sup>4</sup> Ibid p.3.

<sup>5</sup> Gombrich, E. H. *Means and Ends, Reflections on the History of Fresco Painting*. (London: Thames and Hudson, 1976).

<sup>6</sup> A subject that deserves and requires considerable research.

<sup>7</sup> Gombrich, p .

<sup>8</sup> Edward Allen. *Early American Wall Paintings 1710-1850*. (New Haven: Yale University Press, 1926.)



mural painting occurred with the Work Progress Administration projects in the 1930's. Prior to the nineteenth century, wall paintings in the United States tended to be decorative. By the early nineteenth century, there were sophisticated examples of wall paintings linked with the neoclassical mode derived from pattern books from Europe.<sup>9</sup>

Where true fresco did exist, it was linked to Italian artists who brought the technique from abroad. The earliest examples appeared in classically inspired buildings, such as Greek Revival structures.<sup>10</sup> If Brumidi had a place in the artistic and historical movements in art and architecture, it was within a school of primarily Italian artists who were classically trained in Europe and imported their training to the United States. This group worked extensively in the United States and their work in fresco and other media is especially abundant, at a time in Europe, when fresco painting had since faded and the practices of decorating architectural spaces with monumental painting was replaced, if included at all, by decorative painting in oil or glue medium. This practice had also become popular in the United States and generated commissions in churches and other public buildings.<sup>11</sup>

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<sup>9</sup> Earlier examples of wall paintings are also linked with classically inspired buildings, such as the fine example of neoclassical architecture, the Wickham-Valentine House in Richmond, Virginia. Wall paintings of classical subjects of c. 1812 decorate the walls of the public rooms. The paintings are estimated to be executed by George Bridport, English draftsman and painter, whose career was associated with the neoclassical and Greek Revival architects, particularly in Philadelphia, such as Benjamin Henry Latrobe, Robert Mills and the architect of the Wickham-Valentine House, Alexander Parris. Modeled from decorative sources of the time, namely Thomas Hope's English Regency design of the late eighteenth century, Percier and Fontaine and designs by the artist John Flaxman, whose drawings for wedgewood are most well-known, these paintings exhibit a sophistication of technique and refinement in palette and composition that departs from the typical decorative painting of the period. It is interesting to note that the integration of decorative programs, including wall paintings, was seen as important aspect of the design conception of the Greek Revival modes in American architecture, much as a classical perception. The place of wall paintings in American architecture, beginning in the early nineteenth century and continuing to the end of the century deserves further study.

<sup>10</sup> This subject needs to be more thoroughly studied as the work accomplished by Brumidi's compatriots has not been fully researched. It is however, clear, that they generally did not contribute to the modern movements afoot in the United States.

<sup>11</sup> One such noteworthy example is in The Merchant's Exchange Building in Philadelphia of 1831 where frescoes painted by Italian artist Nicola Monachesi, ornamented the ceiling of the Exchange Room. According to the *Guides to the Lions of Philadelphia of 1837*, Monachesi was born in Tolentino, Italy in 1795. He trained at the Accademia di San Luca in Rome, where he won first prize for painting. Monachesi moved to the United States in 1831 and became an American citizen almost immediately. In 1832 he executed paintings in St. John's Roman Catholic Church, then at the Cathedral, which are said to be the first real frescoes, painted on wet plaster, in the country, but there are no records of Monachesi having painted at the



Brumidi's paintings were decidedly baroque. This is particularly true of the figurative fresco paintings in the United States Capitol. His approach to the decorative program however, in the unification of arts and architecture, as mentioned above, derives, as it had in the seventeenth century, from classical precedents. As advocated by Vitruvius, he used color and line to both ornament and articulate the building.

The paintings at the Capitol derive from the grand fresco programs of Italy such as Raphael's Loggia and Stanze at the Vatican and the many Baroque ceiling paintings of Rome by artists such as Carracci, Pozzo and Correggio. While Brumidi did not achieve the greatness of his predecessors, the general decorative effect is sympathetic to the architecture, decoratively successful and iconographically suitable for its time.

## CONSTANTINO BRUMIDI : HISTORICAL REVIEW

Celebrated as "the Michelangelo of the Capitol" by his biographer, Myrtle Cheney Murdoch <sup>12</sup>, Brumidi was claimed to be the first fresco painter in the United States. His work was revered by many in his day. As stated in a 1920 article in the New York Evening Star, "Round About the Capitol", "Brumidi's ...work is decried by everyone to have been truly remarkable and comparable in a way to Michael Angelo's [sic] work in the Vatican, after which the Capitol decorations were modeled." But it was also highly criticized. The monopoly held by the artist under Meigs' watchful supervision incited annoyance and reproach. <sup>13</sup> One journalist criticized: "The best artists of the country, with

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Cathedral Basilica of SS. Peter and Paul in Philadelphia. According to this guide, he additionally painted frescoes and altarpieces for Roman Catholic churches of St. Mary, St. Joseph, St. Augustine and St. Philip in Philadelphia.

Ironically, Monachesi died in 1851, the year before Brumidi's arrival to United States. That the two artists, a generation apart, both trained at the Accademia di San Luca, were acquainted is conjecture but seems likely, since Brumidi was first enrolled there in c. 1818. One wonders if, because of Monachesi's obvious success in this country, he did not encourage the younger artist to move. The subject deserves and requires research.

<sup>12</sup> Myrtle Cheney Murdoch, *Constantino Brumidi, Michelangelo of the United States Capitol*. (Washington: Monumental Press, Inc., 1950).

<sup>13</sup> In fact, it is interesting that Meigs supports Brumidi's employment for the sake of economy, as indicated in a letter from Meigs, stating that it would be cheaper to have the walls painted with compositions than to purchase easel paintings to decorate the walls. Motivated by the fact that the treatment of the architecture fell under his curatorship and that the purchase of movable objects to fill it did not, the expression nonetheless sheds light on the thinking of the day. Wall painting was a less precious form of art. Moreover, Brumidi was



scarcely an exception, have offered their services and asked to be employed upon the Capitol. Without an exception, their applications have been rejected and the work of decoration is going forward under the direction of an Italian whose reputation is little better than that of a skillful scene painter...the poverty of modern invention in architecture obliges us to borrow the external forms of our buildings from the Greeks and Italians but there is surely no necessity in decorating the interiors to reproduce the cast-off absurdities of the old world, which, to us have no meaning.." <sup>14</sup> Referring to Brumidi's use of expertise in execution his work in fresco technique, one defender relied on the technique to counter: "Mediocre artists often use watercolors prepared with glue on a dry wall...". <sup>15</sup>

This debate reflects the heated responses to the interior treatment of the Capitol Extension at that time and later. It is interesting that both the praise and the criticism illustrate the nation's perception of itself : what should be American and what should not be, and the place of classicism in American expression.

Brumidi spent the last part of his career designing and executing wall paintings for the United States Capitol. They adorned Room H-144 of the House and many of the Senate Committee Rooms, the canopy of the dome, and the Patent and other Senate Corridors. Under his direction and by his design, extensive decorative paintings were executed elsewhere throughout the Capitol . While details, such as roundel portraiture, were executed *affresco*, the decorative paintings were generally executed in glue secco by the retinue of artists working after Brumidi's design.

The most important of his Capitol production however was executed *affresco* . These paintings were the figurative compositions, accomplished, according to research done to date, by Brumidi alone.

Constantino Brumidi was born in Rome on July 26, 1805 . He trained at the Accademia di San Luca in Rome, an institution that classically educated students in the fine arts, including drawing, sculpture, fresco and other painting techniques. There, he studied sculpture under the famous sculptor, Antonio Canova as well as fresco painting. After he left the Accademia, Brumidi pursued fresco painting as his craft and enjoyed

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ammnable to a salaried position. According to Meigs, most American artists were not willing to accept such conditions.

<sup>14</sup> "The Decoration of the Capitol" , *New York Tribune*, May 17, 1858.

<sup>15</sup> Guglielmo Gagini, in the *New York Tribune*, May 31, 1858. In fact Brumidi probably did employ glue bound painting technique on the fresco painting. However, his method was principally fresco.



success and recognition. By the age of 30 he was purported to have completed several commissions in Italy. Of these, only one commission has been verified,<sup>16</sup> namely the paintings at the Sanctuary of the Madonna dell'Archetto, a small neoclassical chapel built in 1851 by the Roman architect Virginio Vespignani.<sup>17</sup> By the age of 32 he had been appointed by Pope Gregory XVI in a collaborative commission under his painting teachers,<sup>18</sup> to restore the third loggia by Girogio Nanni, Giorgio Bellunere and Girolamo Amalteo in the Vatican Loggia. Brumidi painted Gregory's portrait and then, after the accession of Pope Pius IX to the papal throne, he painted the new prelate's portrait, both for the Vatican Gallery.

There are various stories of Brumidi's reason for departing from Italy. Substantiated by Court testimony, during an attempt to form a republic, Brumidi stowed away art works for their protection. He was discovered and charged with larceny. When negotiating his release, Brumidi expressed his plan to leave Italy. Brumidi departed to the United States apparently with the assistance of an American named John Norris.

Brumidi departed for the United States after March 20, 1852 and arrived in New York on September 18, 1852. Shortly after his arrival, he traveled to Mexico where it is said that he executed the picture of the Holy Trinity in the Cathedral of Mexico City.<sup>19</sup> He then traveled to Washington and by 1857 was made a naturalized citizen. He settled in Washington, D.C. in 1855 where he spent the rest of his life engaged in commissions at the United States Capitol. These commissions were occasionally interrupted by other projects. He carried out a commission to paint an altarpiece at St. Stephen's Church in New York City in 1871.<sup>20</sup> Brumidi painted frescoes at the Cathedral Basilica of SS. Peter and Paul in Philadelphia and carried out commissions at the Church of St. Aloysius in Washington, Holy Trinity in Georgetown and at Walter's home in Germantown, Pennsylvania.<sup>21</sup>

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<sup>16</sup> Other possible commissions here included wall painting commissions for Prince Torlonia, for whom he worked for eleven years, at both his Villa and the Palazzo Torlonio, formerly located at the Piazza Venezia.

<sup>17</sup> The Palazzo Torlonia is no longer extant; it is not known if the paintings of the Villa Torlonia survive.

<sup>18</sup> Vincenzo Camuccini and Filippo Agricola. Additionally, another young painter, Domenico Toietti, was involved.

<sup>19</sup> Needs to be verified

<sup>20</sup> As verified in a Letter to Edward Clark, April 22, 1871. He was also at St. Stephens in 1872.



His initial contact at the Capitol was with Montgomery Meigs in 1855, to whom he applied for employment as a fresco painter. In an 1856 letter, Meigs recounts the occasion. Meigs offered to allow the artist to demonstrate his work, free of charge, in the execution of a fresco. Meigs volunteered the use of the Committee on Agriculture Room, a room that was near completion within the Capitol Extension project, and suggested to him the subject of *Cincinnatus Called from the Plough*. Brumidi painted the picture to which Meigs replied: "No better picture yet adorns the walls of the Capitol, and I was relieved [sic] from much anxiety by finding our Legislators visited and admired the picture..."<sup>22</sup> This painting remains among Brumidi's best work in the Capitol.

From this point, Brumidi launched a lengthy and productive career at the Capitol. From 1865, a decade after he had begun his Capitol work, he executed his *tour de force*, the fresco in the canopy of the rotunda. He painted the compositions of Fitch, Robert Fulton and Benjamin Franklin between 1873-76.<sup>23</sup>

The frieze paintings for the Rotunda of the U.S. Capitol was Brumidi's final commission with the cartoons for the grisaille paintings completed in 1877 and the paintings begun in 1878 when Brumidi was 73 years of age.

Brumidi's style of painting emulated the great mural painting traditions of Europe. He was inspired by the wall painting of classical antiquity, medieval church paintings, renaissance decorative programs, and, most notably, Baroque dome paintings. These traditions appear in close proximity throughout the building. Classical illusionistic painting, in the spirit of Pompeii, such as those in the Senate Appropriations Committee Room about decorative schemes reminiscent of the Renaissance. At the same time, the spirit of American painting of the period is expressed in the Senate corridor walls where Brumidi borrowed from American paintings for the lunettes, such as those by Benjamin West and others. The ceiling paintings of these corridors recall medieval and renaissance traditions in their relationship to the architecture and articulation of its elements, such as Raphael's Loggia at the Vatican. The grisaille paintings found as part of some of his frescoes and at the frieze of the dome provided an a *tour de force* of technical skill carried out in the spirit of the Renaissance masters. Additionally, and most significantly Brumidi worked in the style of the Baroque monumental painting tradition. Executed in fresco technique, Brumidi

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<sup>22</sup> Letter to J. Durand, Editor of the Crayon. October 11, 1856.

<sup>23</sup> Vouchers indicate that he was paid for the execution of the Fulton painting on November 28, 1873. The Portrait of Fitch was painted in 1876. The Portrait of Franklin was probably painted between them.



adapted the style and technique for allegorical compositions of the history , the political philosophy and the governmental structure of the United States.

There is much legend about Brumidi's death. As an old man, he continued to paint at the Capitol. His last project was the grisaille frieze of the rotunda. Painting from a narrow scaffold, he nearly fell. The accident weakened and upset him leaving him infirm and shaken. He died in 1880.



indications and the fact that the painting is boldly signed : Moberly, Matthews,Held, Weishautt, 1928,<sup>26</sup> the technical and historical placement of the composition as part of the late nineteenth century ensemble is doubtful.

### ***BELLONA ROMAN GODDESS OF WAR***

"Bellona Roman Goddess of War" is located over the door of the Appropriations Offices, originally the Room on Military Affairs, Room S-128, on the west wall of the west corridor, Senate Corridors, ground floor. (See Figures 54 and 55). The painting is documented to have been executed in 1875.<sup>27</sup>

The figure of Bellona is associated with the Roman goddess of war, Bellona, often represented with swords and spears, here adapted with United States patriotic accoutrement, such as the shield with red and white stripes, the drum and the American flag at the proper left of the figure. The original name of Bellona was Duellona, in Roman religion, goddess of war, identified with the Greek Enyo. Bellona was sometimes known as the wife or the sister of Mars. She has also been identified with her female cult partner Nerio. Her temple in Rome stood in the campus Martius, outside the city's gates. The site was used for the meeting of the Senate and discussion of the general's claims to triumphs. Ambassadors were also received there. Declaration of war occurred at the *colonna bellica* located in front of the temple.

The painting is a broader lunette than *Las Casas*. Measured from within the borders, it is 82" at its base and at its highest point, 69 1/2". As elsewhere, the sign below it, *Bellona, Roman Goddess of War* was added around 1959. This label however, is cut out of paper and adhered to the wall.

The painting is composed of a standing female figure centrally located who holds a spear in her right hand. To her right (proper left) is a bundle of bayonets and a drum. A canon and the American flag are located to her left (proper right). The composition is set out of doors, with a blue sky and low hill.

The painting has been heavily overpainted. Additions to the composition are marked by the addition of birds, the mottling of paint in the sky, the emphasis of details,

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<sup>26</sup> Charles Moberly, George Matthews, Held and Weishautt were "restorers" and worked extensively in the Capitol.

<sup>27</sup> *Annual Report of the Architect of the Capitol*, November 1, 1875.



such as the ornament on the drapery, and the alteration of Bellona's hair and features, which are less like Brumidi's hand than George Matthews'.

### C. *CESSION OF LOUISIANA*

*The Negotiation for the Acquisition of Louisiana* sometimes called *Cession of Louisiana* (see Figures 114 and 115) is located above the door of Room S- 124 on the north wall at the west end of the north corridor, ground floor, Senate Corridors. Completed by November 1, 1875, according to primary documents, the painting depicts the acquisition, by sale, of the colony of Louisiana from the France with a gathering of President Thomas Jefferson, seated at the right of the composition, the Secretary of State, James Monroe, center, and Talleyrand, standing, who shows the statesmen a map. A globe, located at the far left of the composition, a table and bookshelves at the right part of the lunette, a map on the wall and a presentation easel with a map of Louisiana are among the other elements in the composition. The scene takes place presumably around 1803, the date on which Napoleon sold the colony to the United States.

The lunette is not labeled. It occupies a wide expanse, measuring 135" wide at its base and 69 1/4" high at the highest point, excluding the banded borders.

The painting is among Brumidi's awkward works. Anatomical proportion and figural gesture are poorly resolved, particularly pronounced in the legs of the seated figures, which are slightly distorted in a manner similar to the figures of the *First Treaty with Great Britain*, located at the east end of the north corridor, and by the unanimated facial expression of all of the figures.

Overpaint appears at the background of the painting and irregularly in small passages of the composition. Otherwise, the paint layer is sound and without major failure.

The introduction above attempts to place the subject of study in context in terms of the artist, the building and the technique employed in the wall paintings. In the following chapter, the subject focus will be narrowed and will result in a report on the materials analysis of the fabric of three of the paintings conducted within this study.



## CHAPTER 2 : SCIENTIFIC ANALYSIS IN THE FIELD OF CONSERVATION

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The scientific study of works of art and archaeology responds to questions posed by the archaeologist, historian and other specialists concerning date, provenance, authenticity, execution technique, materials used and condition of the object studied. Augmenting documentary evidence, scientific analysis provides an empirical approach that tries "... to test actual practice, as against precept, by analysis".<sup>1</sup>

This study aims to utilize physico-chemical analysis for the investigation of fresco technique. Employing a limited array of scientific methods, it considers the application of analytical techniques in the study of art and archaeological objects. The methods were chosen because they represent techniques used in professional practice and because the methods were available to the researcher.<sup>2</sup> The following chapter provides an overview for technical examination by offering a background of those methods most widely recommended for application in the study of cultural and historical material. Of particular interest in this study are techniques useful in shedding light on the artist's technique.

The alliance between science and technology, underlining the growth of conservation as a multidisciplinary profession, has often been noted as the titles of the following publications suggest: "Science and Technology in the Service of Conservation"

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<sup>1</sup> John S, Mills and Raymond White, *The Organic Chemistry of Museum Objects*, (Boston: Butterworths & Company Limited, 1987), 10.

<sup>2</sup> The author has conducted independent study of the application U.V. Fluorescence Microscopy and FT-IR to the identification of binding media at the Conservation Department of the Philadelphia Museum of Art from September 1990 to May 1992.



<sup>3</sup> , "Science in the Service of Art History"<sup>4</sup> "The Work of Art and Scientific Methods" <sup>5</sup>  
"The Contribution of Technical Analysis to the History of Art .<sup>6</sup>

Studies particular to wall paintings have also been conducted. <sup>7</sup> However, the history of scientific analysis in service of conservation has not yet been comprehensively summarized. Reports of techniques useful for the study of wall paintings appear frequently, as cited above and elsewhere. Notable among them are applications of special photographic techniques, advances in pigment analysis, uses of staining for materials identification, and adaptation of methods of instrumental analysis. Research in analytical studies is in active progress, attesting to the prevailing belief that there is a necessity for more precise and expeditiously achieved information.

In the following chapter, methods for examination and analysis that have been frequently applied to the study of wall paintings will be reviewed. Those methods used in the context of this study will be explained in greater detail including special photographic techniques, such as infrared photography, instrumental analytical methods, such as x-ray diffraction and Fourier transform infrared spectroscopy, and microscopical methods such as ultra-violet fluorescence microscopy.

Until the time of the application of analytical techniques, instrumental and otherwise, and scientific method in the service of such queries, early research and comparative studies of painting technology depended solely on literature research. Primary sources, such as artists' handbooks and treatises, and studies of technique and materials based on original documents, provided the authoritative guide to the materials employed and techniques used in the crafting of objects. By the mid-nineteenth century,

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<sup>3</sup> *IIC Preprints of the Contributions to the Washington Congress, 3-9 September, 1982*. Edited by N.S. Brommelle and Garry Thompson, (London: IIC, 1982).

<sup>4</sup> *The Princeton Raphael symposium. Science in the Service of Art History*, edited by Marcia B. Hall and John Shearman, (Princeton, New Jersey: Princeton University Press, 1990).

<sup>5</sup> Chapter title: *Primavera. The Restoration of Botticelli's Masterpiece* Edited by Umberto Baldini, (New York: Harry Abrams Inc. Publishers, 1984.)

<sup>6</sup> Henk W. van Os and J.R.J. van Asperen de Boer, eds. "La Pittura dell'Arte", Vol. 3. *Il Contributo dell'Analisi Technica alla Storia dell'Arte*. (Bologna: C.L.U.B.E.:1979)

<sup>7</sup> The following includes some of those citations: Maurizio Seracini and Giuseppe Centauro, "Indagine Diagnostiche Non-Invasive nella Pittura Murale", *Le Pitture Murale. Tecniche, Problemi, Conservazione* Cristina Danti, Mauro Matteini, Archangelo Moles, editors. (Florence: Opificio della Pietre Dure, 1990; Henk W. van Os and J.R.J. van Asperen de Boer, eds. *La Pittura nel XIV e XV Secolo. Il Contributo dell'Analisi Technica alla Storia dell'Arte*. Vol. 3, (Bologna: C.L.U.B.E., 1979); Madeline Hours, *Conservation and Scientific Analysis of Paintings* (New York: Van Nostrand Reinhold Company, 1976).



publications of ancient treatises and manuals attested to an age old interest in antique technologies that was beginning to be researched through primary sources. In fact, since at least the Renaissance, a profound curiosity guided efforts to uncover ancient wall painting technique, particularly decorative painting technique. In 1844 *Hermencia* by Dionysius of Fourna, of approximately 1692, was translated into French. Cennino Cennini's *Il Libro dell'Arte* was translated and published in English in the same year. Publications concerning historical fine arts techniques appeared as books at the same period, such as *The Art of Fresco Painting as Practiced by the Old Italian and Spanish Masters* by M.P. Merrifield in 1846 and Sir Charles Eastlake's 1869 *Materials of a History of Oil Painting*.<sup>8</sup>

The tools to "test actual practice as against precept by analysis" became available gradually, borrowing from advances in scientific technology. Scientific analysis in the service of conservation probably originated as such in the nineteenth century with pigment analysis. Binding media was more complicated. As methods for identifying organic materials developed in the study of biological materials, so identification of binding media followed.

However, advances in technical studies and the emergence of conservation as a profession developed independently. Conservation as distinct for restoration and acknowledgement of the role of science as integral yet auxiliary to conservation began to be distinguished since the 1930's with the Fogg Art Museum, Harvard University as the focal point in the United States and with the publication of *Technical Studies in the Field of Fine Arts* (1932-42), the precursor to *Studies in Conservation*. With the growing credibility of the profession of conservation and realization of the technologies to aid in questions of historical and scientific importance, progress has been rapidly made in the second half of the twentieth century in identifying artists' materials, deterioration processes and studies of technique.

Practices in the analysis of museum and archaeological objects has generally borrowed from other scientific disciplines, adapting for use instruments and practices employed in the sciences. To this end, significant progress was made beginning in the nineteenth century. With this increasing scientific and technological focus, it became clear

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<sup>8</sup> A more complete overview is offered in :Paolo Mora, Laura Mora and Paul Philippot, *The Conservation of Wall Paintings*, Mora, (Boston: Butterworths & Company, Limited, 1986) from which these references are taken.



that collaboration between the scientist and the conservator was desirable and that the overlapping of widely divergent specialties was necessary in arriving at the sought out information. Thus, in the nineteenth century, the multi-disciplinary approach that had since been cultivated in conservation was defined.

Likewise, in the study of wall painting, the first attempts at analytical work were focused on pigment study. London doctor, John Haslam in carrying out microchemical analysis of pigments in 1800, made the earliest recorded analysis of any artists' materials.

<sup>9</sup> This was followed by pigment analyses carried out on excavations in Rome and Pompeii by Sir Humprey Davy in 1814. <sup>10</sup>

Such inquiries continued. Among the first studies of media were the staining techniques developed in the early twentieth century. An early application of staining methods for media identification was Ostwald in 1905. He was followed by Eibner and others.

Special photographic techniques appeared later and were adapted from other applications.

In the study of pigments, Joyce Plesters's "Cross Sections and Chemical Analysis of Paint Samples" <sup>11</sup> was a seminal publication that spurred further research. Led by Rutherford Gettens, Chemist and Fellow of Technical Research at the Fogg Art Museum and George Stout, editor of *Technical Studies in the Field of Fine Arts*, the development and dissemination of information concerning technical investigation was launched in the United States with the publication of *Painting Materials. A Short Encyclopaedia* in 1942 by Gettens and Stout.

As the collaboration between the chemist, conservator and the historian grew, there were necessary shifts in focus for each of the specialists. For the chemist, there was an alteration in focus from determining chemical structure - as sought out by the organic chemist in industry and academic chemistry - to the identification of a particular raw material which had altered with time and use. The conservator was required to accommodate empirical evidence while the historian learned to benefit from this new knowledge which often cast doubt on previous research. At best, each specialist became more reliant on the

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<sup>9</sup> The subject of study were mid-fourteenth century wall paintings in St. Stephen's Chapel, Westminster.

<sup>10</sup> By microchemical methods; see: Stephen Rees- Jones "Early Experiments in Pigment Analysis, *Studies in Conservation*, Vol. 35, No. 2 (May 1990), 93-101.

<sup>11</sup> *Studies in Conservation*, 2, (1956), pp. 110-157.



other. "At each stage of investigation, the examination and evaluation should be a joint effort of the analyst, conservator and curator/connoisseur".<sup>12</sup> Close and regular collaboration between the historian and scientist would seem to be the prerequisite for a useful application of scientific methods of examination of works of art. Clearly the scientific examination of works of art is an auxiliary discipline for art history just as it is a very much applied science for the scientist"<sup>13</sup> But gaps between that which applies to conservation from the scientific disciplines needs still to be overcome. "...there is a need for ... a compendium, both on the museum side on the side of the academic chemist. The literature of conservation and that of chemistry overlap only to a small extent, and while most conservators and other technical museum personnel are at least aware of the existence of the relevant chemical literature, staff in the universities often know little of the more practical... research scattered through the conservation journals ." <sup>14</sup>

Due to the disproportionate expense of analytical instruments, regular use of instrumental analysis is not widely possible.<sup>15</sup> Because of this, time-honored analytical techniques, such as pigment analysis by polarized light microscopy, microchemical analysis and differential staining, continue to be practiced *in lieu* of more complicated and expensive instrumental methods such as scanning electron microscopy with attached chemical microanalysis, chromatography and spectrometric techniques. These simpler techniques are adequate and, in cases where extremely specific information is not essential, they provide relatively accurate and expedient information.

Technical studies specific to wall paintings have adapted for use methods from the other branches of conservation that include museum techniques as well as those adapted to the special needs dictated by the physical conditions of wall paintings. Because wall paintings exist as part of architecture, they require methods of examination that include their

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<sup>12</sup> *Artists' Pigments, A Handbook of their History and Characteristics*, Robert Feller, Editor, ( Washington: National Gallery of Art, 1986), 12.

<sup>13</sup> J.R.J. van Aperen de Boer, "An Introduction to the Scientific Examination of Paintings.", *Nederlands Kunsthistorisch Jaarboek*, vol. 25 (1975): 2

<sup>14</sup> Preface to John Mills and Raymond White, *The Organic Chemistry of Museum Objects* (Boston: Butterworths, 1987).

<sup>15</sup> A number of institutions have acquired impressive instrumentation for analysis, such as CAL, GCI, the Fogg Center for the Technical Study, Harvard University, and the National Gallery of Art. University Conservation Programs often also have access to an impressive array of instruments. These facilities may provide services to individual conservators, such as the private conservators.



physical location, such as x-radiography, ultra-sound, infrared reflectography and other applications of special photography. Considerations applicable to wall paintings study, such as structure, climate, use, materials, as well as appropriateness in terms of scope, scale and value of the work, present considerations unique to their scale and setting to be accommodated in the analytical process.

## **NON- INVASIVE SURFACE EXAMINATION SPECIAL PHOTOGRAPHIC TECHNIQUES:**

Special photographic techniques utilize methods employed for registering images produced by reflected, transmitted or emitted radiation different from visible light on photographic emulsion. Black and white and color photographs document the character and condition of the study objects. They provide important documentary records of the subject as well as a reference for analytical techniques.<sup>16</sup>

### **RAKING LIGHT :**

In color and black and white images, the use of tangential light cast at angles between 5° - 20° to the picture plane for photographing a planar surface reveals information not clearly perceived in normal light. The light defines surface texture, ranging from that of the plaster to the presence of impasto to the nature of brushstrokes. Raking light also explains the condition of the substrate by emphasizing planar distortion (in the case of plaster detachment), the paint layer (cleavage), and the presence of surface accretions, such as dirt and soot. It is a valuable tool in providing insight into the artist's working technique by revealing brushstrokes, impasto and repainting.

### **MACRO-PHOTOGRAPHY :**

Close-up photography illustrates the interesting phenomenon of what can be seen in detail that cannot be seen in the whole. By focusing on the particular and then enlarging

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<sup>16</sup> For explanation: See: Matteini and Moles. *Scienza e Restauro. Metodi de Indagine*. Nardini Editore, 1990. Third edition. Florence.



it, the macrophotograph offers to an object what a microscope lends to a sample: a focused detail free from surrounding information.

### **AUTORADIOGRAPHY:**

Also known as neutron activated autoradiography, autoradiography illuminates the creative process of the artist by revealing the underlying paint layers. In this process, the painting is briefly exposed to a beam of thermal neutrons that generate mild transient radioactivity . The photographic image is actually attained from the surface of the painting on which photographic films are placed immediately following the exposure. The films are cut and pieced together to constitute the exact dimensions of the painting. The film is sensitized by the Beta particles (electrons) emitted in the decay of the radioactive elements present in the painting. After the film is processed, it will show the presence and location of the pigments and other painting materials that contain radioactive elements at the time of the film exposure.

This technique aids the study of authenticity, by revealing areas of overpaint, and attribution. It exceeds the use of x-radiography in indicating the condition of the painting where x-rays respond and illuminate information primarily about lead pigments and also about pigments containing barium, strontium, mercury and silver depending on the strength of the X-ray.

### **ULTRA-VIOLET LIGHT:**

Ultra-violet illumination of a painting provides useful information in differentiating between picture's materials. It can be particularly useful in identifying evidence of previous restoration and , in some cases, in differentiating between pigments. Ultra-violet light has the property of stimulating the emission of radiation of longer wavelengths causing fluorescence under the proper conditions. Original materials, such as certain pigments and some types of binders, particularly oils and resins, exhibit characteristic fluorescence which aids in their identification on a macroscopic scale. Ultra-violet fluorescence further assists in identifying the location of overpaint and other non-original materials.

Ultra-violet light is after blue light but towards the shorter wavelengths. Certain materials, when illuminated with these wavelengths, undergo a temporary modification resulting from excitation. This results in the emission of a wavelength known as



fluorescence which is different than incident light. Ultra-violet light causes some painting materials to fluoresce in the visible region of electromagnetic spectrum, allowing it to be visible with the unaided eye, and in the near infrared region.

Many painting materials are fluorescent. Their fluorescence ranged in color from light green to yellow to orange. In particular, the natural resins contained in varnishes are fluorescent.

Ultra-violet fluorescence is radiation that is visible and is properly called visible fluorescence generated by ultra-violet excitation. It is directly recordable as a photographic image .

Recommended for this study, ultra-violet fluorescence photography would document the presence of overpaint, provide an interesting auxiliary record to couple with the fluorescence microscopical studies and complete the preliminary special photographic effort carried out.

## **INFRARED PHOTOGRAPHY:**

Infrared color photography reveals the features of a painting in false colors so that its surface appears in colors we do not normally see. Previous retouching, even old retouching in chromatically similar colors which are difficult to see even in ultra-violet light, are apparent with I.R. radiation. Like Ultra- violet illumination, I.R. can be absorbed, reflected and transmitted by various materials in a manner that differs from their absorbance, reflectance and transmission in visible light. For example, an object seen as light in visible light can be dark in infrared light.

## **BLACK AND WHITE INFRARED PHOTOGRAPHY:**

With the use of infrared in black and white film, infrared illumination reveals previous restoration work, such as retouching and distinguishes diverse substances that are sometimes not distinguishable in visible light. The most common use of infrared photography is employed to reveal underdrawing beneath paint layers. It is most frequently applied to the examination of easel paintings as a preliminary method for revealing the the original painting where overpaint had obscured it. Moreover, infrared illumination can often penetrate thin films of materials on the surface of a painting, such as varnishes, and to be reflected on the layers directly below the outermost layers. While the image obtained will not completely supply the design below, it will provide useful



information for the study of the painting in relation to its authenticity prior to restoration intervention. While red and whitish areas can usually be penetrated, blue and green areas appear as black.<sup>17</sup>

## **COLOR INFRARED PHOTOGRAPHY:**

Kodak I.R. film is used for color photographs of infrared illuminated painting. The film is an 135 mm invertible film of which three colors are selectively sensitized, namely green, red, and infrared. The I.R. color emulsion allows one to see the colors falling on the sensitivity of the eye of a pass against the radiation to the major wavelength. The material of the object presents a different appearance with this "prospective chroma" with regard to how one is accustomed to seeing it. Such aspect is determined not only in the intensity with which the object reflects, absorbs or transmits the green, red and I.R. but also the chromatic combination of these three radiations therefore, as they are realized in the mechanism of restitution of the picture. Some colors also appear differently in I.R. than in visible light. Color I.R. can help the conservator in locating the effect of restoration with pigments of the same color but different in nature and it can be valuable help, especially in microphotography, for identifying pigments in the layers of the painting.<sup>18</sup> For photographing paintings, it is most useful to use filter Kodak W CC 50 CYAN, that diminishes the red light component, too intense with regard to the I.R. component.

Conventional infrared photography produces images of radiation between .7 and .9 microns. Where paint layers and other surface accretions are too thick, x-radiography or auto-radiography may be used as alternative.

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17 The following measures must be taken to take a IR illuminated photographs: 1. The object must be illuminated with an I.R. source of light. The majority of visible light, either from Tungsten filament or from flash, contains sufficient quantities of infrared radiation. 2. The radiation of non-infrared light must be blocked. This may be accomplished with the use of filters, namely: Kodak W 15 (orange), W-25 (red), W 29, W 70 (dark red), or W 87, W 88A, W 87C, W 9B. These filters are completely opaque to visible light but transparent to I.R. 3. Use an I.R. sensitive film shown to be appropriate for the given illumination and filter system. 4. Adjust the exposure and focus after having made tests to determine the correction value, (normally it is necessary to increase by 25% the distance between the light source and the object).

18 Like black and white I.R. photography, proper filters and film are needed. Filter F1 yellow serves to block blue and minor wavelengths, such as U.V.



## **INFRARED REFLECTOGRAPHY:**

Infrared reflectography, one of the most recently developed methods for surface examination, also shows underdrawing and compositional alterations otherwise hidden. Like infrared photography, the painted surface is exposed to infrared light but, instead of being recorded on film emulsion, the image is conveyed on a television camera equipped with a tube sensitive to I.R. rays and is transformed into a picture that is reproduced on a monitor screen.<sup>19</sup>

Scientific methods for use in the analysis and examination of fine arts, archaeology and architecture is becoming more widely used in response to the growing demands for information. The methods discussed above provide an introduction to the following empirical research.

While only a few of the techniques described will be included in this study, the above summary is intended to place them in the context of widely used methods. It is hoped that it will provide an overview of those physico-chemical analytical techniques that have successfully been applied to the study of artists' materials.

## **INVASIVE EXAMINATION : SAMPLE STUDY**

### **PIGMENT ANALYSIS:**

The use of pigments in Brumidi's paintings appears to follow a classical fresco palette. As indicated by his materials' requests, he utilized earth and other inorganic pigments known to be stable when in contact with lime. In the previous study of Brumidi's frescoes, it has been suggested that cleavage and powdering of particular colors in frescoes resulted from a high clay content of those pigments. Provided as empirical information, a

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<sup>19</sup> For more detailed discussion, see: R von Shoute and J.R.J. von Asperen de Boer, "A Note on the Examination with Infrared Reflectography of Some Paintings", *ICOM 4th Triennial Meeting Venice, 1979*; I.N. Gilgendorf, "Study and Restoration of Lost Ancient Inscription on the Dry Plaster by the Method of I.R. and U.V. Photography", *ICOM 4th Triennial Meeting Venice, 1979*; *Kodak, IR and UV Photography, 1973*, Eastman Kodak, Rochester, N.Y.



limited amount of pigment analysis is aimed at further illuminating the nature of the pigments in question.

Pigments provides perhaps more information about the object of study than any other component in a painting. They illuminate time, place, character and circumstances of a given work. Their identification is essential in understanding the artist' working technique, the need for restoration (what should be used for compensation), for conservation (how to preserve what is original) and for answering questions regarding authentication.

Pigments have been manufactured since prehistory. Their study marks the advent of technical queries of works of art and antiquity at the nineteenth century, when literature concerning pigment provenance was sought out and published. Identification of pigments by technical means was first carried out using the microscope in the twentieth century.

By around 1910, Laurie published the results of pigment study he had carried out. And then in the 1940's Rutherford Gettens continued this initiative with a systematic study of pigments and the formation an artists' materials collection, the "Gettens Collection", now held at the Fogg Art Museum. Pioneering work in the study of pigments was further accomplished by Joyce Plesters of the National Gallery of Art in London in the 1950's using microchemical analytical techniques. A decade later, Walter McCrone and colleagues systemized the practice of pigment characterization using polarized light and widely disseminated their practices in the United States through their teaching at the McCrone Institute.<sup>20</sup> Both microchemical and optical methods (polarized light microscopy) of pigment identification continue to be practiced today. Both techniques provide affordable and easily obtainable information. However, accurate identification, as with all analytical techniques, requires considerable expertise gained through long experience.

Application of instrumental analytical techniques for pigment identification have been in existence at least since the 1960's. These instruments primarily correlate characteristic spectra with reference spectra for elemental identification. Instrumental methods for pigment identification have included Scanning Electron Microscopy with attached x-ray microanalyzer allowing for evaluation of other information carriers such as qualitative and semi-qualitative analysis .

Scanning electron microscopy has become one of the most useful techniques in conservation. In the field of paintings, the different SEM images produced by secondary

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<sup>20</sup> Polarized light microscopy is less widely used for materials identification outside of the United States.



(S.E.) and/or backscattered electrons (B.E.) allow for a tridimensional image and the primary identification between "light" and "heavy" elements provided by the backscattered electrons. The analysis is completed with the information gained through the X-ray microanalyzers which identify the elements through their characteristic atomic fluorescence processed by electron transition energies. With use of the proper electronic techniques, the X-ray microanalyzers offer a characteristic "map" of the different elements present in the particular zones of the analyzed surface of the sample.

In this study, a limited amount of pigment analysis was carried out with X-Ray Diffraction (XRD). XRD all solid materials (pigments, salts, corrosion products, ceramic, glass, metallic material, etc.). The diffraction of X-rays occurs off of the atomic layer arranged in the crystal lattice of the material. This diffraction from the crystal form a series of variable reflections by position and intensity thereby constituting a characteristic profile of the tested crystal. If the pigment, however, does not have a characteristic crystalline structure, such as cobalt blue, which is an amorphous glass, the material can not be identified. XRD is generally used for qualitative analysis as a confirmatory test, auxiliary to a preliminary method of identification. However, X-Ray Diffraction patterns of multi-component samples and small amounts of single components are more difficult to evaluate.

However, these techniques also have limitations. With the identification of elemental components, XRD provides information useful for the identifying pure pigments but difficult to interpret in pigment mixtures. In the case of amorphous pigments, inorganic infrared spectrometry or microgravimetric techniques provide useful information for pigments. In fact successful pigment identification is aided by having narrowed the pigment identification possibilities prior to XRD.<sup>21</sup>

## **MEDIA ANALYSIS :**

The focus of this research concerns the possible use of medium additional to fresco by the artist and the potentiality for identifying the presence of additional binding material through methods of analysis applied herein. Using analytical methods widely practiced for technical study of art and archaeological materials, this study primarily concerns the use of fluorescence microscopy and Fourier Transform Infrared Spectroscopy . The discussion

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<sup>21</sup> Thin sections allow for pigment identification in cross section by polarized light.



applied to the studies in immunology and histology. Staining for binding media identification was done as early as 1956 by Joyce Plesters of the National Gallery of Art in London who analyzed binding media using the a number of highly colored biological stains; <sup>23</sup> In 1971, staining was further explored by Johnson and Packard and then by Elizabeth Martin in 1977. Most rapid advances have been made with the aid of the fluorescence microscope and fluorescence stains by Richard Wolbers, whose article, co-authored by Gregory Landrey, "The Use of Direct Reactive Fluorescent Dyes for the Characterization of Binding Media in Cross-Sectional Examinations" of 1987 was important in disseminating information and in advocating an alternative staining method. <sup>24</sup>

The authors suggest the use of fluorescent materials based on the greater ease in identifying the positive stains at lower concentration under the microscope than visible light stains (because they readmit a good deal of absorbed light that impinge on them). They emphasize that positive staining occurs when discrete staining appears specific to certain materials and parts of the sample.

When excited by ultra-violet light, organic materials often produce their own intrinsic fluorescence, known as autofluorescence. In particular, natural resins, such as dammar, mastic, rosin, and also carbohydrates and proteins, autofluoresce or can develop autofluorescence on aging. Studies aimed at identifying organic materials based on their autofluorescence were conducted as early as 1911.<sup>25</sup>

Stains used for the identification of paint media are borrowed from other fields. In Wolbers' research, a selection of fluorescent stains were identified for use based on their ability to properly tag the sought out functional group without disturbing the material to which it is attached. Those fluorochromes selected were:

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<sup>23</sup> "Cross-sections and chemical analysis of paint samples", *Studies in Conservation*, vol. 2, no. 3, (April 1956).

<sup>24</sup> Gregory Landrey and Richard Wolbers, "The Use of Direct Reactive Dyes for the Characterization of Binding Media in Cross Sectional Examinations" *AIC Preprints, 1987 Vancouver Conference*, (Washington: AIC, 1987).

<sup>25</sup> G. Clark and F. Kasten, *History of Staining* (Baltimore: Williams and Wilkins, 1983) as cited in Richard Wolbers and Gregory Landrey, "The Use of Direct Fluorescent Dyes for the Characterization of Binding Media in Cross Sectional Examinations", *AIC Preprints, 1987 Vancouver Conference*, (Washington: AIC, 1987), 175.



- for identification of **proteins**: Fluorescein Isothiocyanate (FITC); Lissamine Rhodamine B Sulphonyl Chloride (LISSA); Texas Red Isothiocyanate (TRITC)
- for the identification of **lipids**: Rhodamine B; 2' 7' -Dichlorofluorescein (DCF)
- for the identification of **carbohydrates**: Triphenyltetrazolium chloride (TTC)
- for the identification of **natural resins**: Antimony Pentachloride (APC).

Fluorochromes function such that when they are in contact with a material's characteristic organic functional group coupling is formed with a in such a way as to form a moiety identifiable in fluorescence and color. For proteins containing materials, some organic functional groups react spontaneously in non-aqueous environments with the primary uncharged amines- such as those contained in fluorochromes- to form condensation products covalently bound to the amino bearing moiety.<sup>26</sup> In order to mark the material, the fluorochrome must be dissolved in poor solvent for the material that allows it to react to form a fluorogenic adduct to the protein. This reaction is then visible as a specific fluorescence under special illumination conditions .

For the study of drying oils, known under the broader classification of lipids, Wolbers and Landrey identified two fluorogenic materials, namely Rhodamine B and 2,7 dichlorofluorescein (DCF) . Again, it is necessary to use a carrier solvent that does not dissolve the sample material. Rhodamine B dissolves the drying oil and fluoresces brightly red/orange identifying even small amounts in the sample. In the assessment of the authors, Rhodamine B can be used qualitatively as well as quantitatively.<sup>27</sup> DCF is generally used as a counter -stain or for higher visibility.

Carbohydrates, or reducing sugars can be identified by reaction with mild reducing agents. They reverse to highly colored formazan like compounds. The reaction results in the conversion of the already fluorescent aged gum or starch compound to a darkened color, in a sort of reverse fluorescence reaction. The researchers found triphenyl-tetrazolium chloride (TTC) to be the most appropriate fluorochrome since it can be dissolved in a range of non-aqueous solvents.

The researchers used antimony pentachloride (APC) to identify natural resins, a fluorochrome of considerable toxicity which was not used in this research.

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<sup>26</sup> As opposed to stains required to be in aqueous environments for adsorption to occur, such as the case for acidic dyes.

<sup>27</sup> Landrey and Wolbers, p. 175.



The fluorescent microscope affords for the illumination of microscopical samples with ultra-violet light at invisible radiation of 365 nm to stimulate visible radiation. Light is filtered by two filter types in order to isolate the visible ultra-violet wavelengths in a specific range. The excitation filter suppresses the light of all wavelengths not used for primary fluorescence allowing wavelengths between 360-420 nm to pass through it. The barrier filter further suppresses excess u.v. light and visible light that will not be absorbed by the sample. In new fluorescent systems, the barrier and excitation filters are combined in a filter block which affords for the entry of particular ranges of u.v. light specific to the fluorochrome. <sup>28</sup>

Chromographic and spectrometric methods have been applied to the study of binding media since the middle of the twentieth century. <sup>29</sup> However, there is a scarcity of conservation literature on the subject, <sup>30</sup> a reflection perhaps of ongoing research that attests to the need for publication and continued research.

## CHROMATOGRAPHY

Chromatography affords for the separation, identification and quantification of media mixtures. It is used to separate, identify and quantify individual chemical species by distributing them into two different phases. One of the two phase is in movement with respecting the other. The differentiated distribution through solubility in the mobile phase and the adsorption/desorption process in the stationary phase brings a separation between them.

Originally carried out in a column, chromatographic methods became more able to analyze small samples with the development of paper chromatography in the 1940's and

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<sup>28</sup> For more thorough discussion of fluorescence microscopy see: Gregory Landrey and Richard Wolbers, as above; Richard Wolbers, *Aspects of the Examination and Cleaning of Two Portraits by Richard and William Jennis*, source?; "Fluorescence Microscopy". *American Laboratory*, (April 1982): 65-69; Kate Fletcher, "The Practical Uses of Some Fluorescent Dyes in the Characterization of Varnish Layers in Cross-Sections and the Subsequent Cleaning of Some Paintings Using the Methods Developed by Richard Wolbers" Unpublished monograph, Third Year Project, Courtauld Institute of Art, 1988; Joyce Plesters, "Cross-Sections and Chemical Analysis of Paint Samples", *Studies in Conservation*, vol. 2, no. 3 (April, 1956).

<sup>29</sup> For an overview of these methods see: John S. Mills and Raymond White, *The Organic Chemistry of Museum Objects*. (Boston: Butterworths and Co. Ltd, 1987), ix-xi.

<sup>30</sup> David Erhardt, Walter Hopwood, Mary Baker and David von Endt, "A Systematic Approach to the Instrumental Analysis of Natural Finishes and Binding Media", *1988 New Orleans Conference of the American Institute for Conservation*, (Washington: AIC, 1988).



Transform applications to the conservation field began to appear. Research conducted in 1977-78 was pioneering in the conservation field for the application of FT-IR to the identification of binding media and varnishes. While FT-IR has principally been used to characterize binding media, it has also been used to identify inorganic materials such as pigments.<sup>33</sup> Spectra are matched to existing libraries and interpreted based upon the existence of characteristic peaks. Bonds found in organic materials, such as carbon-oxygen, carbon, hydrogen, etc.) generally fall into the mid-infrared region (2.5 - 256 microns or 4000 to 400  $\text{cm}^{-1}$ ). The combination of bands generated by these bonds produces a spectrum that may be attributed to a material, such as egg white, fish glue, linseed oil or polyvinyl acetate.

As already stated, the benefits of analytical techniques drawn from sample study, such as FTIR, must be tempered by inherent limitations. In order to effectively interpret the sample, one is required already to acquire a great deal of information about it in situ, such as the possible chemical alteration of the materials due to their age or conditions, the juxtaposition of the materials with regard to other layers, and the limitations caused by incomplete separation of the material to be studied.<sup>34</sup> Moreover, aged samples, such as the case with museum and archaeological objects, alter in their chemical composition causing inaccuracy in the analytical results. Samples removed from their context lose their full relevance; conditions such as leaching of a binding or resinous material into adjacent layers, the mixture of pigments in that layer and the juxtaposition of strata to each other are not fully accounted for by the study of the single material alone but rather must be investigated by other means.

For this reason, current research in the study and identification of binding media has joined cross-sectional samples identification techniques with confirmatory testing methods, such as FTIR.

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<sup>33</sup> Richard Newman.

<sup>34</sup> While methods such as chromatography are aimed at separating materials, samples subjected to other analytical methods, such as staining, FTIR, and microchemical tests, rely on raw materials. Since, in actual works of art, materials almost never exist as pure layers, consideration of the mixture must be made. Even in the extraction of material from a relatively pure strata, the effect of the overlying layers must be made, such as penetration and the presence of pigments.



## CHAPTER 3: TECHNIQUE

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" From among all of the other techniques of the pictures made, painting on the wall is the most masterful and beautiful, because it consists of what can be made in a day while the others have many retouches on top of the work". <sup>1</sup>

Credited with having introduced the technique of fresco painting to the United States, Constantino Brumidi the notoreity brought to Brumidi for his paintings at the Capitol occurred years after his death. "Few Americans had ever attempted murals in public buildings; none had ever used *buono fresco* ." <sup>2</sup> That this assertion is improbable does not detract from the mystique, and confusion, that have long surrounded the classically executed paintings in the United States.

While fresco painting had been ubiquitous in Europe for centuries, by the nineteenth century, oil painting on walls began to quickly replace fresco painting due to the greater ease of handling it, its improved vibrancy and brilliance and the fact that, the great fresco tradition was fading. While Europe had enjoyed a climax and experienced a recession of fresco painting, fresco remained practically unknown in the United States. Even among the *conoscenti* in North America, all paintings on the wall were dubbed frescoes, a confusion that endures today and was prevalent as late as the mid-twentieth century. <sup>3</sup> That Brumidi's paintings at the United States Capitol are, in fact, frescoes is significant because they are rare and exotic and because they are also reflections of a

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<sup>1</sup> Giorgio Vasari, *Vite de pui eccellenti pittori, scultori ed architettori*, edited by G. Milanesi. Florence: G.C. Sansoni. 1906. Vol. I pp. 174-195.

<sup>2</sup> Barbara Marinacci. *They Came from Italy. The Stories of Famous Italian Americans*. New York: Dodd, Mead and Company. 1967, p. 59.

<sup>3</sup> In Edward Allen's, *Early American Wall Paintings 1710-1850*. New Haven: Yale University Press, 1926, the author states: " Frescoes in American material history include scenes by the Italian Core, American landscapes in panorama form by native artists; Masonic and Federal emblems...copies in outline of Flaxman's illustrations..." , xiii. Most likely none of the cited subjects were frescoes, but rather tempera or oil bound paintings, executed on the wall. The confusion appears to derive from the architectural setting )



classically derived painting technique, also becoming rare in Italy. Study of the technique therefore holds two very different emphases : the study of a technique unusual in the United States; and the study of a fading European painting technique, with nineteenth century variations. Therefore this technical study considers the combination of both of these emphases: the technical importation of fresco in the United States and its deviation from classical methods and materials.

The following chapter examines Brumidi's technique of executing the frescoes at the United States Capitol through the study of both primary and secondary source material and places his work in its historical and technical context. The purpose of the chapter is to illuminate Brumidi's working practices and to shed light on the materials he employed as preliminary to the empirical discussion of technique, central to this research.

Aiding in documenting Brumidi's working technique, original receipts and vouchers for the materials Brumidi employed and letters and journal entries written at the time that the paintings were executed provide primary source material. Of principle significance are the journal entries made in Pitman shorthand.<sup>4</sup>,<sup>5</sup> by Supervising Engineer , Montgomery Meigs. Recorded during the process of Brumidi's work in the Capitol Extension, these important journals describe the artist's working method.<sup>6</sup>

Secondary source material includes references to the condition of the paintings, including historical descriptions, and notation of intervention, such as artists' interventions in overpainting or "retouching" the paintings. The earliest citations record Brumidi's own retouching while the most recent are contemporary and reflect an on-going conservation campaign of the past decade. The most important information, seen as the starting point from which this technical research departs, are the technical reports resulting from examination by way of conservation reports.<sup>7</sup>

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<sup>4</sup> Pitman shorthand is a shorthand method invented by Englishman Isaac Pitman and first published in 1837. It is characterized by the symbol position in relation to the line and by shading of the strokes. The shorthand method is nearly obsolete today. These citations results form unedited and unverified transcript of work in progress, June, 1992.

<sup>5</sup> *Journals, Montgomery C. Meigs Papers*, Manuscript Division, Library of Congress, transcribed by William Mohr for the United States Senate Bicentennial Commission.

<sup>6</sup> These citations are incomplete since transcription of the journals from shorthand is in progress, 1992.

<sup>7</sup> These reports primarily result from the conservation investigation and treatment carried out by Rabin, Silver and Keck from 1982 to 1989 whose aim was "analyses of the technique of



Historical references to wall painting technology are interwoven in the text as a means for discussing Brumidi in the context of the technical history of wall painting.

In order to organize the chapter, the phases in the execution of fresco painting are arranged in four parts. In a final fifth section, the conservation interventions that have taken place since 1982 are summarized. Sub-topics are arranged as follows:

1. Brumidi's general technical ability
2. Plaster materials and application
3. Drawing technique
4. Painting technique
5. Previous interventions

## 1. BRUMIDI'S TECHNICAL ABILITY

Montgomery Meigs's Pitman journals document Brumidi's earliest work at the Capitol through the important observations made of the artist's style and working technique. Meigs's commentary, rooted in familiarity with painting and technical practices in the building trades, offers an enlightened review of the practice of fresco painting. Meigs marveled at the mixture of pigments in lime, the containers for the paints and application of the plaster with the eyes of an associated professional new to that particular craft. Yet his observations are more astute, and therefore more useful, than those of the average observer, unversed in a practical vocabulary. His writing expresses a keen interest in a pursuit of obvious personal pleasure.

The earliest such account, made on February 12, 1855, occurred when Meigs was unconvinced of Brumidi's abilities. He remarked upon Brumidi's carelessness in drawing the figures and commented upon the awkward proportion and position:

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execution ... to address several technical issues regarding the nature of the artist's materials and the types of reasons for their deterioration, in order to develop and implement appropriate conservation treatments. At the same time, analyses of techniques of execution also have art historical relevance, since these techniques provide many insights into the intent and working method of the artists." p. 8, "U.S. Capitol Building, Frieze of the Rotunda. 1986 Conservation Project", Rabin, Silver and Keck



"... He had not carefully enough studied the figures...His priest is too short for his head. One of the warriors is not standing correctly." The criticism is apt. This tendency in Brumidi's drawing/design execution is characteristic. Disproportionate rendering and awkward gestures may be seen in many of his compositions, particularly late in his career, such as the Treaty of Paris, the Cession of Louisiana, the portrait of Fitch and other figures.

Meigs elaborates further:

" I went also with Mr. Brumidi, the painter in fresco, to look at his cartoon , which he had finished. I did not think that he had carried out the promise of his sketch. He had not carefully enough studied the figures. " <sup>8</sup>

Since the time of the execution of the frescoes, the execution technique of the paintings has provoked verification as evidenced by documentary sources. Commentary appears to respond to the question: "Are the paintings fresco?"

Artist and restorer, Allyn Cox in 1953, after a assessment of the canopy paintings from a distance and work on the frieze paintings, answered this question:

From my actual experience in working on Brumidi's frescoes in the frieze below, I know that he was an extremely competent and careful craftsman. He used a very thick final coat of plaster, which, in the frieze, is solidly attached to the roughcast everywhere... <sup>9</sup>

Similar affirmation resulted from later examinations of the same paintings and others in 1988 <sup>10</sup>.

The reports also include comments of the artist's competence as a fresco painter both in terms of his speed and command of the wall painting type of *di sotto in su*. Commenting about the canopy:

He completed the entire fresco in less than twelve months... He was concerned about the final appearance, particularly the impact of light, especially the impact of the gas lights. <sup>11</sup>

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<sup>8</sup> Journals, Montgomery C. Meigs, Manuscript Division, Library of Congress, transcribed by William Mohr for the United States Senate Bicentennial Commission.

<sup>9</sup> Allyn Cox, 1952 Report

<sup>10</sup> Rabin, Silver and Keck

<sup>11</sup> Ibid, Conservation Report on the Canopy of the Rotunda.



Supported by microscopical study, the conservators contended that Brumidi worked in a "High Baroque Style" with a rough and sandy plaster containing mica combining the use of both confident large *giornate* and free-hand passages with painting with smaller *giornate* and abundant preparatory drawing.

## 2. PLASTER PREPARATION AND APPLICATION

Rabin and Silver suggest in their report for the "Conservation Treatment of the Canopy of the Rotunda" that Brumidi employed a "High Baroque" technique of fresco painting as defined by rough plaster combined with a smoother manipulated render, abundant drawing and large *giornate*. The rough plaster was used to improve the vibrancy of the paint and to emphasize tonal vibrancy and variety. Smooth plaster, manipulated by compressing it with a trowel or spatula, was also used. It was prepared for areas of *impasto* to increase the paint density and therefore its brilliance as a color.

A description of initial preparations for Brumidi's first fresco, <sup>12</sup> illuminate the artist's working methods.

Mr. Brumidi came today to make preparations for the painting of his fresco. The first operation is to wet thoroughly for several days the rough coat of plaster upon the wall. This was done twice today. He says that the common sand used in the mortar is as good as any for the final coat of plastering, or "intonaco". I told Mr. McFarlane to prepare himself getting the necessary tools to do the plastering for the painter as he goes on with his work. ..The lime used in the last coat should be kept a long time in pots; (A-429) so, soon as the weather gets favorable, I must have a large quantity slacked [sic] and run into the cellars to be used in our decorated walls. <sup>13</sup>

Meigs makes note of Brumidi's favorable reaction to the plaster texture and that the rough plaster is good enough for the "intonaco". <sup>14</sup> Mentioning the need for "favorable weather", Meigs says that he must have a large quantity of lime slaked and moved into the

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<sup>12</sup> Meig's Journal, February 14, 1885?;

<sup>13</sup> Meigs Journals,

<sup>14</sup> Keeping the lime for a long time before using it would not in any way alter the condition of the lime unless it was partially drying and therefore carbonating



cellars for use on "our decorated walls". This citation indicates that the lime kilns are not in the building and that there is a need to transport the already slaked lime into the basement for storage.

Referring to the first of Brumidi's compositions at the Capitol, Meigs noted that he instructed the master mason to do the plastering for him. Such a relationship reflects the traditional working roles between the painter and mason that was widely practiced in the Baroque period in Europe. <sup>15</sup> In the case described, for the fresco for the Agricultural Committee Room, the plaster was laid over a well-dried rough plaster. Evidently, the stove or kiln used for slaking the lime had been located in the room the previous summer "The ground of the plaster was laid last summer, and as a hot stove has been burning with the wind in the room, this ground got very dry." Meigs remarks about the walls being "...quite true and have the advantage over many of the walls in Italy which have fine and indeed great paintings on them." <sup>16</sup>

"A coat of lime and sand was laid upon a small part, perhaps a yard square, in the lower left hand corner of the picture. This was laid and with a broom and water till he got a somewhat roughened surface. .. this ground got quite dry . It was well floated when put on..." <sup>17</sup>

According to the spokesman of early eighteenth century Baroque fresco painting traditions, Andrea Pozzo <sup>18</sup> *thearriccio* and *intonaco* of lime and sand composed the rendering with an *intonaco* made of two layers.

Conservation reports indicate the size and number of *giornate*. The number and size varies and reflects Brumidi's practice of patching parts of the composition with small areas of plaster in order to rework the painting.

It is apparent that in the latter part of his career, the artist worked tentatively, reworking parts of the composition often. For the *Portrait of Benjamin Franklin*, it is noted that the eight *giornate* are excessive for such a composition.<sup>19</sup> But more excessive still, seventeen *giornate* were found for the smaller lunette *Authority Consults the Written*

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<sup>15</sup> Mora, Mora and Philippot, *The Conservation of Wall Paintings*. Boston: Butterworths Publishing Company.

<sup>16</sup> 1855, February 19th, Monday, Journal, Meigs Papers

<sup>17</sup> *Meigs Journals*, as above.

<sup>18</sup> Andrea Pozzo, *Perspectiva Dictorum et Architectorum*, 1692.

<sup>19</sup> Constance Silver, *Conservation Report*



Law.. On the other hand, research concerning the sequence and execution of the *giornate* for the canopy illustrate a considerable assurance in the execution. There were 120 *giornate* laid in a non-traditional sequence rather irregularly such that Brumidi neared completion at the top of the canopy, finishing at a scene on the lower register. The size of the day's work of plaster varied. Those at the lowest registers were huge and appeared to have been executed in haste as suggested by the poor condition of both the plaster and the pigments.

It was frequently found in the study of all of the artist's work, that he laid small patches of plaster. These patches were sometimes smaller than one square foot, unusual when compared with his usual *giornate*. For the lunettes, for example, the *giornate* were often several square feet, including the a half or so of a figure and background or other elements in the composition in it. This is noted in the *Conservation Reports of the Portrait of John Fitch and the Frieze for the Rotunda* by Rabin and Silver, "The First Treaty of Great Britain" and in the conservation report of "Authority Consults the Written Law".<sup>20</sup>

The plaster was generally found to be coarse-grained. Variations in texture with smoother plaster were characteristic of Brumidi's technique. In an April 24, 1956 entry, Cox noted:

The plaster underneath was completely hard and firm and the surrounding colors were found thoroughly bound to the lime surface. ... the plaster varied in texture from very rough to sandy to smooth, where highlights are rendered with heavy lime white.<sup>21</sup>

From "Report on the Conservation Treatment of a Portrait of John Fitch in the U.S. Capitol Building," December 14, 1985 Rabin and Silver again noted that the plaster has been manipulated to create different effects.

Brumidi had problems with darkening at the junctures of the *giornate* in the frescoes. This concern is first expressed with regard to the North Wing in 1862 in a letter in which the artist expresses his intention to disguise these dark junctures by overpainting them.<sup>22</sup> To treat the same problem also occurring in the canopy of the rotunda, Brumidi expressed the need for the plaster to be dry, the colors thus unchanging to "...cover the

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<sup>20</sup> See Conservation Reports, The Office of the Architect of the Capitol.

<sup>21</sup> Allyn Cox, "Technical Report on the Condition of the Canopy Fresco in the National Capitol and the Restoration Work Carried Out There in 1959.

<sup>22</sup> Letter from Brumidi to Chairman of the Committee on Public Buildings, Senator Foot". May 8, 1862.



connections of the pieces of plaster... at giving more union to the colors at the said junctures..."<sup>23</sup>

However, the darkened condition appears to have remained, and even worsened in the years that followed. From the conservation examination by Rabin and Silver in 1986-87 to treat the frieze and canopy of the rotunda of the United States Capitol, the conservators used on site examination and laboratory examination (carried out at the McCrone Research Institute) to determine that the junctures of the *giornate* were darkened and discolored because of corrections by Allyn Cox in the 1950's. Aimed at improving this problem, conservation treatment diminished these junctures through cleaning and the removal of overpaint.

The notion that Brumidi retouched these junctures was examined by conservators Rabin, Keck and Silver. Analysis of cross-sectional samples, by scanning electron microscopy with the E.D.S. mode<sup>24</sup> revealed that, in samples taken from the location of the darkening at the *giornate* junctures, there were four layers: intonaco, original fresco layer, paint layer (thought to have been Brumidi's retouching), and a final layer containing titanium white, attributable to Cox. Thus, the dark junctures appeared to be caused by both the accumulation of these layers and their interaction, causing an inconsistency in color with the original color intended to be matched.

A second conservation problem, relevant to technique, long appeared in the powdering flaking paint of passages of the frescoes throughout the Capitol. Aimed at attributing the cause of powdering poorly adhered pigments in the canopy of the rotunda Rabin, Silver and Keck carried out a plaster study. The plaster was found to be 3/4" thick, a classical preparation, with two applications of plaster: an approximately 1/2" thick *arriccio* and 1/4" thick *intonaco*. Visual examination showed there to be large sand particles and three kinds of fibrous fillers: two hair-like fillers and a chaff of grain. The *intonaco* was found to be finer but still, with regard to fine plaster types, relatively grainy.

X-Ray Diffraction was carried out<sup>25</sup> for qualitative and quantitative analysis of the plaster constituents. Results revealed that, by weight, the *intonaco* plaster contains 1:3 calcium carbonate to sand, revealing a typical mixture of binder to aggregate. The composition itself was not believed to be the source of conservation problems.

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<sup>23</sup> Letter from Brumidi to Edward Clark, Architect of the Capitol of September, 19, 1865.

<sup>24</sup> Carried out for the conservators by Dr. Robert Koestler, Objects Conservator, The Metropolitan Museum of Art, August, 1987.

<sup>25</sup> Carried out for the conservators by Gregory Cavallo at the American Museum of Natural History, New York, N.Y., June 10, 1987.



As a second consideration, it was believed that there was insufficient calcium hydroxide in the plaster at the time of application, or at the time of pigment application, causing the poor pigment attachment. Such an occurrence would result from the previous conversion of calcium hydroxide to calcium carbonate by the absorption of carbon dioxide and the evaporation of water prior to the application of the pigments thus preventing the participation of the pigments in this process.

### 3. DRAWING TECHNIQUE

With the demands of Baroque compositions, set as they were in vast cupolas and vaults, and aimed at a achieving illusion, alterations in the methods of drawing transfer to the walls developed by the end of the sixteenth century in Europe. Replacing the traditional *puntini*, or incised points made by a wheel with points rolled over a cartoon, *spolvero* or pouncing and incisions, colored models were used as a preliminary measure in the creation of full size drawings. These models were used for resolving the painting's complexities of illusion, movement and effectiveness within the architectural space. To anticipate the use of *impasto* and the working and reworking of the painting through the addition of *secco*, the artist began to use pouncing and *puntini* less and incisions more, since their presence would not be easily obscured.

Brumidi used a variety of drawing techniques, including incisions, *spolvero* and *puntini* in executing his frescoes at the United States Capitol, as indicated by documentary sources citing Brumidi's practices as well as in previous conservation examination. Apparently his dependence on drawing fluctuated with his career at the United States Capitol; many of the compositions illustrate a strong reliance on the design made prior to the fresco while others indicate that the artist worked freely such as in the paintings of the canopy of the Rotunda.

Throughout his career at the United States Capitol, the artist used *spolvero* as a means for transferring a full scale design to the wall by pouncing charcoal or chalk through perforations that generally follow the contours of a cartoon. This is seen in the frescoes in Room H-144 as noted by Conservators Rabin and Silver. *Spolvero* is also found in the canopy paintings, the frieze paintings and generally in the Senate Corridor paintings.

*Puntini* and incisions were also used for the transfer of the design on the *Portrait of Fitch* and as the method of transfer of the design for the fresco *Portrait of Benjamin*



*Franklin. Puntini, spolvero* and incisions were found to have been used in the execution of *Authority Consults the Written Law* .

For the frieze paintings, Brumidi used traditional Renaissance and Baroque drawing methods, as evidenced by nail holes for securing the cartoons to the wall during transfer and the presence of *spolvero*, and, in general, the limited use of transfer design indicating a spontaneous and assured painting technique.

For the canopy of the dome, as reported in the conservation report, the technique for transferring the drawing onto the plaster was reported to be with incisions, which are most evident at the top of the painting and appear less often at the lower part of the painting.

#### 4 . PAINTING TECHNIQUE

For the purposes of this study, the identification of *secco* technique, especially *secco* with non-lime medium, is of central importance and is preliminary to the empirical research conducted herein. In this chapter, documentary sources are used as a departure point for that discussion.

According to documentary sources, Brumidi employed fresco painting technique in most of the figurative paintings at the United States Capitol. This demanding practice, which requires the application of wetted pigments to a hydrated slaked lime wall, (calcium hydroxide) such that pigments bind with the plaster to form a crystalline lattice, produces a durable painting type with a unique aesthetic. This painting technology has long been exploited. In antiquity, practices such as polishing the painted rendering and creating *trompe l'oeil* scenes were prevalent and carried into later traditions. The Romans converted entire rooms into illusionary spaces with gardens and architecture executed in *trompe l'oeil* fancy around them. In the "great age of fresco" of the Renaissance, the painting technique was revered for the skill required of painting in wet plaster, without finishing in *secco*, and for the beauty of the pastel palette produced by the pigments bonded into the white lime render. From about 1300 to 1450 fresco was the most prestigious technique of painting. An artist's ability to paint *affresco* was the method by which his technical skill was measured. Walls became the canvas for the great geniuses of the early Renaissance who used the architectural setting to narrate, to create illusion, by *trompe l'oeil* and to demonstrate their ability. Since fresco connotes pigments bound to wet lime, executed in



sections with the brief period of a day's work, the larger the *giornata*, the less the drawing, the greater the *bravura* of the artist. Michelangelo, for example, in painting the Sistine frescoes, relied on an incredibly small amount of preparatory underdrawing and, in some cases, executed frescoes, *alla prima*, without cartoon. Furthermore, considering the level of modeling and the sophistication of the figures and compositions, he painted in *largegiornate*, attesting to his technical ability and genius.<sup>25</sup> He finished in a small amount of *secco* but apparently avoided its use. Like the practices of fresco that had endured for three centuries before him, fresco was almost never painted with glazes or varnishes<sup>26</sup>

Brumidi worked liberally with broad confident brushstrokes in the creation of loosely defined forms. He depended on quick painterly impressions for definition, an approach that was generally successful. The artist often created shadows or darkened passages with hatching<sup>27</sup> and he fortified his compositions, adding density to the colors, with the application lime secco paints. He used a traditional frescoist palette, with possible deviations, difficult to assess from documentary sources since the pigments named were used on non-fresco paintings as well.

Brumidi's painting technique may be best described as "Baroque", a style profoundly influenced by oil painting techniques of the late seventeenth and early eighteenth centuries in Europe. In wall painting, this style that became challenged the expansive spaces and curved forms of Baroque architecture. Motion and complexity characterized the style which was celebrated by the achievements of painters such as Annibale Carracci, Antonio Correggio and Andrea Pozzo and other masters with whom Brumidi would have been familiar.

Brumidi emulated Baroque technique. The Capitol fresco technique is characterized by heavy *impasto* and brilliance and density of color applied to a coarse plaster. These methods afforded for the effects of dark and light, or *chiaroscuro*, widely used in Baroque painting, and the opulence and intensity of color exploited with oil painting of the period which influenced fresco.

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<sup>25</sup> Gianluigi Colalucci, "The Frescoes of Michelangelo on the Vault of the Sistine Chapel: Original Technique and Conservation", *The Conservation of Wall Paintings. Proceedings of the Symposium organized by the Courtauld Institute of Art and the Getty Conservation Institute. London, July 13-15, 1987.* (Santa Monica: J. Paul Getty Trust, 1987), 67-76.

<sup>26</sup> Millard Meiss, *The Great Age of Fresco. Discoveries, Recoveries and Survivals* (New York: George Brazillien in association with the Metropolitan Museum of Art. 1970), 5.

<sup>27</sup> This was a technique also employed in the Renaissance.



Because of the complexity of Baroque paintings, artists prepared vast quantities of a color in order to be able to achieve consistency in color. Pozzo cautions:

" Be careful not to begin the painting until the lime is such a consistency with that one can barely dent it with the fingers. Otherwise, if one wields [sic] the brush on too fresh an intonaco, all the work will be weak and can only be used as a sketch.... A peculiarity of fresco painting is that the first colours to touch the hardened lime become weak and lose a great deal of their vivacity. Thus it is necessary to load the brush and repaint a second time and never abandon the part you are working on until it is completely finished because any retouching a few hours later will stain your work.. It is better to wait until the painting is thoroughly dry and then one can retouch it. " <sup>28</sup>

According to Pozzo, the pigments of the Baroque style were applied in an opaque mass in order to strengthen the tones and give body to the painting and, in a manner that emulated oil painting, to exploit impasto by varying its thickness. Moreover, with the addition of lime to pigments, covering power is improved over fresco.

According to Werner, (1781), in order to retain the force and beauty of color, the artist should go over it again immediately. <sup>29</sup>

According to Mora, Mora and Philippot, in the Baroque period, completion, a *secco* "meant something different than in the Trecento or Quattrocento. ... In the Baroque period it was used to modify certain tones in relation to the effect produced by the ensemble. " <sup>30</sup> They further underline Pozzo's indication that *secco* painting was common in his day in Rome. When it was used on a wall, the paint was applied on a glue and gesso rendering over the fresh *intonaco*. The authors suggest, although Pozzo does not mention a binder, that the binders might have been oil casein, a medium that appeared as early as the sixteenth century. <sup>31</sup> From documentary evidence, it appears that Brumidi conforms well to these practices. He mixed quantities of his colors, used a rough plaster, created opacity by exploiting *impasto*, and employed *secco* technique.

As noted in the conservation report for the frieze, Brumidi used a dry brush technique, rough hatching and broadly applied paint to the painting ground thus using a varied technique employed for effect as necessary. Application of the pigment with a dry

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<sup>28</sup> Pozzo "Breve Istruzione" as cited in Mora, Mora and Philippot, *The Conservation of Wall Paintings*, p. 154.

<sup>29</sup> Ibid, p. 155.

<sup>30</sup> Ibid, p. 156.

<sup>31</sup> Ibid, p. 157.



brush afforded for a partial covering with the paint<sup>32</sup> creating an uneven covering of the intonaco and the potential for depth unlike a flat ground. The hatching allows for modeling by serving as shadows. Additionally, the conservators characterize the paintings as being painted with thickly applied paint in high impasto.<sup>33</sup>

In an important passage, Meigs described Brumidi's painting process. He noted that the artist used burnt sienna, umber, ochres, cobalt and smalt and that he mixed his pigments with slaked lime in pots. He marveled at the artist's process, the use of *impasto*, and the *accoutrement* of his craft.

After the coat of plaster was ready, Brumidi proceeded to mix his palette very deliberately. He used the common artist colors - terra di sienna, umber, ochres, smalt and cobalt. These were all mixed with lime which had been slicked [sic] for some days into a paste. This lime, like all his other colors, are kept in pots of various sizes, placed for convenience in a wooden box of about 30"x 18" x 9". Water enough was mixed with that to leave some free water floating on the top of the pot. To make his palette, he takes a spatula and pours out of it every color he wished and pours the lime, mixed that upon a slab of marble to the tint he wanted.<sup>34</sup>

Meigs goes on to note the alteration of colors after their application from being very intense to becoming very light.

The color of the tint changes as it dries to — the effect. He has a brick upon which he dries his brush from time to time; and as that did not dry quick enough, he afterwards went out and bought a lump of umber. The tint applied to this seemed, for its powerful absorptive quality, to sink in at once, and change of color was quite remarkable. I was surprised to see him painting so deliberately and also to see him use his colors with so much impasto. He laid them on, it appeared to me, just as they are used in wall painting. The color did not seem to sink in as quick as I had expected. I asked him if his sky was not going to be too blue for he laid it very thick with some blue, either smalt or cobalt. He said no, that he feared it would be too light, "troppo chiaro".

He began about 10 1/2 a.m. and continued to paint, with the interval during which he went home to dinner until I left the office at 4 p.m. I left him at work. The part of his picture which he was at work upon is a left hand corner....The sky when I left it, was intensely blue as it could well be made by cobalt. I shall look with interest at the changes which drying will make in its

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<sup>32</sup> This must certainly be pigment in lime.

<sup>33</sup> Bernard Rabin, Constance S. Silver and Lawrence Keck, *U.S. Capitol Building, Frieze of the Rotunda. 1986 Conservation Project*, unpublished report, February, 1987.

<sup>34</sup> *Journals, Montgomery C. Meigs Papers*, Library of Congress, transcribed by William Mohr for the United States Senate Bicentennial Commission, 1991. The source is an unedited and unverified transcript of a work in progress.



color. The hand and the forearm ... are the parts of the picture which he was painting upon. When had left him he had merely put the first tint on this hand and arm, and I do not suppose that he touched that again; and he will therefore, I expect, scrape that all the while this morning."<sup>35</sup>

According to documentary evidence, Brumidi used a traditional palette. Meigs' detailed description of the artist's method of painting mention color, the choice of pigment, the technique of painting, the lightening in color of the paintings after drying and many other details important for understanding the artist's working method.

Brumidi used a traditional fresco palette including pigments such as iron oxides, ivory black, green earth and cobalt according to documentary sources. Additionally, he possibly used less commonly employed pigments, such as lead aurite<sup>36</sup>. However, copper carbonate pigments darken on exposure to the alkalinity of calcium carbonate. This effect has long been observed. Lead pigments darken on exposure to heat or strong light. Cases were noted in antiquity with blackening of white and red grounds of Roman wall paintings at Pompeii, and the early Renaissance wall paintings, such as those at the Basilica of Saint Francis in Assisi where white altered to black in the fresco by Cimabue. For white in fresco painting, the most common pigment was calcium carbonate, as opposed to lead white. It is however noteworthy that Brumidi apparently used lead white on the grisaille paintings of the frieze of the dome of the United States Capitol a choice probably inspired by its improved covering power.<sup>37</sup> Although its use was ill -advised, vermilion was more commonly employed in fresco than red lead, again for reasons of apparent alteration. That Brumidi would have known of such cases or that instruction against the use of these pigments was integrated in his training is not known , but seems probable.<sup>38</sup>

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<sup>35</sup> Journals, *Montgomery C. Meigs Papers*, Library of Congress, transcribed by William Mohr for the United States Senate Bicentennial Commission, 1991. The source is an unedited and unverified transcript of work in progress.

<sup>36</sup> Many copper containing pigments, such as and copper pigments. Lead aurite is a basic copper carbonate and is blackened by alkalis, such as calcium carbonate, and are therefore unsuitable for use in fresco painting.

<sup>37</sup> See the Rabin and Silver, *Conservation Report for the Frieze of the Rotunda*, unpublished report, 1987. Lead white however becomes translucent with time.

<sup>38</sup> Research on the methods and information disseminated at the Accademia di San Luca deserves investigation for the purposes of understanding not only Brumidi, but the techniques of other nineteenth century artists who trained there and who made important contributions in Italy and elsewhere in the nineteenth century.



Since much of his work elsewhere in the Capitol was executed in non-fresco technique, bound by oils or glues, the pigments list, (located in the Appendix), does not necessarily reflect the palette employed for use on the frescoes. He utilized mineral pigments in addition to newly synthesized pigments in the nineteenth century, such as synthetic ultramarine<sup>39</sup> and chrome yellow and synthetic vermilion<sup>40</sup>

In spite of the abundant receipts and vouchers for materials, only rarely was a pigment or other material specifically requested for application on the fresco paintings. Therefore, based on documentary evidence, these materials cannot be easily assigned to a particular composition. Instead, they represent a list of possibilities from which to choose.<sup>41</sup> Rather, the materials list provides a broad selection of supplies, against which empirical identification must be tested.

For Brumidi's early work in the House Committee on Agriculture, Room H 144, pigments were found to be of a traditional fresco palette, although those pigments were not analyzed. It was noted that poor adhesion of the pigments to the plaster appeared in the ochres, an occurrence the authors attributed to the presence of clay components of the iron oxide pigments, preventing sufficient bonding.<sup>42</sup> According to polarized light microscopical analysis,<sup>43</sup> in the examination and treatment of the frieze painting of the

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<sup>39</sup> It is highly doubtful that he would have used natural ultramarine, or lapis lazuli, due to its expense. Artificial ultramarine was first manufactured for commercial use in the the 1830's in Europe and would have been a pigment widely available to Brumidi in the years of his work in Italy. It was available in the United States soon after that date. In chemical composition and structure it is identical to natural ultramarine.

<sup>40</sup> It is quite improbable that the artists would have used cinnabar, or natural vermilion, since artificial vermilion was manufactured since the Middle Ages. Its synthesis results from unifying mercury and sulphur. Vermilion is optically and chemically identical to cinnabar and it is difficult to distinguish between the two pigments. Vermilion was frequently found as a pigment in Roman wall paintings and has been found as a pigment in nearly all centuries and countries in the west. See: Gettens and Stout, *Painting Materials. A Short Encyclopaedia*, p. 171.

<sup>41</sup> There are exception to this. In some of the materials requests, materials are designated specifically for fresco. For example: July 9, 1857: "6 ozs. bottles cobalt blue for frescoes [sic]. 1 large lump of umber for testing the colors of fresco".

<sup>42</sup> Rabin and Silver, *Conservation Report, Room H 144*.

<sup>43</sup> conducted at the McCrone Research Institute on request by Rabin, Silver and Keck.



Rotunda, Brumidi used the following pigments: three different whites were found to exist on the frieze paintings. One white was calcium carbonate, the most typical pigment employed in fresco ; another white pigment was determined to be titanium white, an intervention pigment since it appeared after 1920.

A discolored white, found to be lead white in an oil medium, was the most perplexing of the white pigments found. For the classically educated artist devoted to the practice of pure fresco technique, its use is unlikely given the well known fact of its discoloration in the presence of lime's alkalinity and its dramatic conversion precipitated by exposure to sulphur. But most important, its presence in oil medium provided evidence that the artist was painting in a mixed technique of fresco and oil painting. The authors point out that oil painting on the wall was in use since antiquity and that Brumidi himself combined fresco with oil painting elsewhere in the Capitol, namely the President's Room and then in the decorative paintings located on the walls of the Senate Corridors. It was hypothesized by the conservators that Brumidi applied these lead white pigments as a means for strengthening white highlights, a likely assumption since lime is duller and more transparent than fresh lead white.

Elsewhere, red and yellow iron oxides are found with additions of charcoal, exactly as paint mixtures found in the Senate Corridor lunettes. Additionally, vermilion is found, another less frequently found pigment.

A pigment study was conducted as preliminary for the canopy of the rotunda. Twelve pigments were studied with the aim of illuminating Brumidi's palette, confirming if he used pigments inappropriate for fresco, to identify Cox's overpaint from Brumidi's paints and to investigate the dark junctures between the giornate. Analyzed by X-Ray Diffraction, the twelve pigments were found to be: ultramarine, varieties of hematite, terre verte, calcium sulfate, burnt umber, titanium white, and red ochre. Of these, only one pigment, titanium, was certain to result from a post-Brumidi campaign. It was suggested that the poor cohesion of the pigments was associated with the clay constituent in the iron oxide pigments, or earth pigments, in such a way as to have impeded successful fresco bonding. That is, the conservators suggest that some of the pigments were of an inferior quality and contained, for example, in the case of iron oxides, in excess of the 5% clay constituents. It was recommended that the clay-containing pigments, due to their characteristic rheology, or phase changes, in containing excess clay, impeded the pigment

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bonding by absorbing too much water from the intonaco or "by dimensional instability during the drying process". 44, 45, 46

Conservation problems associated with the materials and techniques have been identified in the process of conservation investigation and treatment. Problems have been possibly associated with the execution technique. Study and assessment of the problems have been studied by scientific analysis.

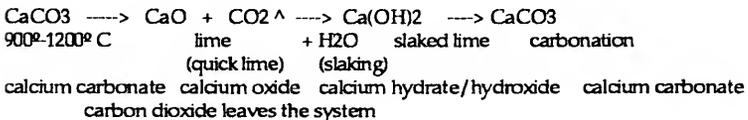
Powdering/flaking paint appears regularly as a problem among Brumidi's paintings. For reasons that have not been clearly established, poor adhesive and cohesive

44 p.20.

45 While it is possible that the clay constituent of the pigments separated themselves from the crystallization process of the formation of calcite, thus resulting in poor cohesion necessary for effective fresco, "dessication" is not directly relevant to successful fresco bonding. Since fresco bonding depends upon the crystallization of pigment particles within the lattice of the calcium carbonate rather than the association with a binding medium, as in the case of solidification by solvent loss, such as glues, or by cross-linking by drying oils, the taking up or the absence of water would not disturb the formation of calcium carbonate from calcium hydroxide, an inevitable process in the presence of air, an altogether different problem that already calcined lime. Other problems inherent in plaster preparation would include poor slaking such that insufficient calcium oxide was formed.

46 Fresco plaster is made by the slaking of lime and then the mixing of that lime with fillers and aggregate. Generally, only the arriccio contains filler, such as hair, while both plasters, arriccio and intonaco, traditionally contain aggregate in the form of sand, generally river sand. For the intonaco and other finer final plaster layers, such as intonachino, fine sand is selected through sieving; in some traditions marble powder was also used.

The slaking of lime is a process that involves the heating, hydrating, carbonation and drying of limestone or other calcareous material, such as oyster shells. Due to its relative purity and the greater ease in forming a smooth paste from it, limestone is traditionally used as the source for wall painting plasters. The result is the conversion of calcium carbonate with heat to calcium oxide and, with the addition of water, to calcium hydroxide, and then, upon drying in air and adsorption of carbon dioxide, to calcium carbonate. Physically, a crystalline network, a solid, softens with heating by way of crystalline alteration and rearrangement; it then becomes a paste, by means of water addition, resulting in further crystalline change and rearrangement. Finally, carbonation occurs after the evaporation of water and the regained crystalline formation of calcium carbonate.



Pigments are bound in the crystalline matrix of calcium carbonate by their addition to the wet plaster - calcium hydroxide.



properties have been noted in passages of Brumidi's frescoes. While discussion of this condition has been detailed for some of the paintings, such as the canopy paintings, the condition, as gathered from conservation reports, appears to be pervasive.

It is not certain when this flaking and powdering began. Frequent notation of it as a problem among Brumidi's frescoes may be found in reports on the artist's paintings. It is likely that this occurrence would have precipitated the interventions that followed. Therefore, the rash of overpainting interventions carried out by various artists, most notably George Matthews, in the years between the 1880's and 1930's, were probably not entirely unmotivated and, in fact provides a date by when the powdering/flaking phenomenon had probably started, an occurrence that is further supported by the fact that many of the overpainted passages include those pigmented with colors indicated to be powdering and flaking, as found in subsequent investigation.

As many as thirty years later, the same condition was found. When Allyn Cox was employed to execute his own mural paintings and to investigate the condition and carry out the treatment of the grisaille paintings in the frieze of the rotunda, an intervention brought about through water damage to the frieze, he took the opportunity to make note of damage to the "The Apotheosis of George Washington", Brumidi's *tour de force* fresco located in the canopy of the dome. In a 1956 report, Cox made the following observations:

Certain small areas, almost completely invisible from below, most often where a yellow pigment was used, are softened, with a sort of crystallization of the plaster surface and a loosening of the pigment. The process has presumably been going on a long time, and the areas do not show any noticeable growth since I first noticed them when I was working in the Capitol in 1953.<sup>47</sup>

In a 1959 entry in the report written after the installation of a scaffold and a closer examination, Cox noted that the plaster appeared to be firm and stable:

On the near view, it was found, however, that the areas of powdery yellow pigment were more extensive and numerous than had appeared than looking from the balcony in 1958. All yellow and brown draperies were affected, more or less, a great many parts of the flesh and almost all the green including foliage. This loose color, as if completely without binding medium, came away from the plaster at a touch. ...

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<sup>47</sup> Allyn Cox, *Technical Report on the Condition of the Canopy Fresco in the Rotunda of the National Capitol and Work Carried Out There*, p.2.



In the examination and treatment of the canopy paintings, by Rabin and Silver in 1986- 87, the conservators found, for example, that some passages of the painting, were badly flaking and powdering. In particular, they found that poor adhesion and poor cohesion existed among certain of the pigments. These pigments included yellow, orange, dark brown, green, and some of the red colors. These colors, corresponding to receipts and pigment order requests, would correspond to : burnt sienna, Venetian red, red ochre, possibly red lead, terra verte and other iron oxides, such as raw and burnt umber.

Binding materials might contribute to the cause of deterioration cited above. If Brumidi added organic material <sup>48</sup> as a medium to the pigments or the substrate, complexities to the conservation condition and possibilities in materials would expand.

"The most problematic question about Brumidi's technique is his possible use of *secco* medium". <sup>49</sup> The presence of organic materials additional to the calcium carbonate and pigments assumed to have been used exclusively in the execution of the frescoes has been suggested through previous scientific analysis.

From original sources in the form of materials' requests and receipts, numerous requests for materials, possibly used for binding media, were made including the following: clear glue, nut oil, honey, white glue, boiled oil (first quality), fat oil, linseed oil, Japan drier, copal varnish and raw oil. While it is probable that these materials were used as binding media for the extensive non-fresco paintings throughout the Capitol, their specific use is not indicated. <sup>50</sup>

As already cited, Brumidi clearly used lime-bound *secco* painting. As cited above from Meig's journals:

After the coat of plaster was ready, Brumidi proceeded to mix his palette very deliberately. He used the common artist colors - terra di sienna, umber, ochres, smalt and cobalt. These were all mixed with lime which had been slicked [sic] for some days into a paste. This lime, like all his other colors, are kept in pots of various sizes, placed for convenience in a wooden box of about 30" x 18" x 9". Water enough was mixed with that to leave some free water floating on the top of the pot.

Although extensive examination to the paintings has not been carried out for all of the paintings, it is estimated that Brumidi finished all of the frescoes in lime bound *secco* technique. Rabin and Silver found, in examining the canopy paintings, with the assistance

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<sup>48</sup> According to Rabin and Silver, Conservation Report for the canopy of the Rotunda

<sup>49</sup> Ibid, p. 20

<sup>50</sup> A list of materials requested by Brumidi may be found in the Appendix.



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"The most problematic question about Brumidi's technique is his possible use of secco medium". <sup>49</sup> The presence of organic materials additional to the calcium carbonate and pigments assumed to have been used exclusively in the execution of the frescoes has been suggested through previous scientific analysis.

From original sources in the form of materials' requests and receipts, numerous requests for materials, possibly used for binding media, were made including the following: clear glue, nut oil, honey, white glue, boiled oil (first quality), fat oil, linseed oil, Japan drier, copal varnish and raw oil. While it is probable that these materials were used as binding media for the extensive non-fresco paintings throughout the Capitol, their specific use is not indicated. <sup>50</sup>

As already cited, Brumidi clearly used lime-bound secco painting. As cited above from Meig's journals:

After the coat of plaster was ready, Brumidi proceeded to mix his palette very deliberately. He used the common artist colors - terra di sienna, umber, ochres, smalt and cobalt. These were all mixed with lime which had been slicked [sic] for some days into a paste. This lime, like all his other colors, are kept in pots of various sizes, placed for convenience in a wooden box of about 30"x 18" x 9". Water enough was mixed with that to leave some free water floating on the top of the pot.

Although extensive examination to the paintings has not been carried out for all of the paintings, it is estimated that Brumidi finished all of the frescoes in lime bound *secco* technique. Rabin and Silver found, in examining the canopy paintings, with the assistance

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<sup>48</sup> According to Rabin and Silver, Conservation Report for the canopy of the Rotunda

<sup>49</sup> Ibid, p. 20

<sup>50</sup> A list of materials requested by Brumidi may be found in the Appendix.



of scientific analysis, that Brumidi intended to blend the *giornate* junctures. These were the only a *secco* passages among those paintings.

It is quite possible that Brumidi would have deviated further from classical fresco technique through the addition of other non-fresco materials, such as glues or oils. At the time Brumidi trained in Italy, such additions were made to fresco paintings.

In the late seventeenth century, glue was often used as a priming coat. Described in the 1692 historical text *Perspectiva Pictorium et Architectorum* by Andrea Pozzo, Baroque wall paintings technique differed from the purer Renaissance practices. Demands made on the artist by the *di sotto in su* perspectives of ceiling paintings, characteristic of the Baroque period, stretched the limits of fresco painting. Artists came to rely on secco technique more heavily than in the past. Pozzo remarks that secco technique was common in his day in Rome and, when used on a wall, the paint was applied on a glue and gesso rendering over the fresh *intonaco*. The author does not mention a binder; but it is probable that oil casein appeared as early as the sixteenth century and was intended for use.<sup>51</sup> This citation is significant. *Perspectiva* was reprinted and widely used in the eighteenth century.<sup>52, 53, 54</sup>

Despite the historical association with failed technical ability in the use of *secco* painting, lime bound or otherwise, Brumidi evidently used secco painting in the execution of his frescoes. Furthermore, as is common knowledge in recent years, Michelangelo was purported to have finished the Sistine frescoes in glue bound secco, an assertion spurned by the knowledge that, by the sixteenth century, fresco painting was often finished later with with paints in a binder in order to create the desired illusionistic effects through vibrancy of paint, effected by opacity, density and *impasto*, that was a part of the technical vocabulary of the muralist by the late Renaissance.

In the scientific investigation of the materials and technique employed in the painting of the frieze of the Rotunda by conservators Rabin, Silver and Keck, medium tests by dispersive staining were conducted at the McCrone Research Institute. Medium tests

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<sup>51</sup> Mora, Mora, Philippot, *Conservation of Wall Paintings*

<sup>52</sup> as cited in Mora, Mora, Philippot Also, Eibner, A., *Entwicklung und Werkstoffe der Wandmaherei van Alterum bis zur Neuzeit*, B. Heller, Munich, 1926. I

<sup>53</sup> In the Royal Hospital at Greenwich in the Painted Hall, J. Thornhill executed the decoration in oil on gesso rendering in 1708 and 1725 in the illusionistic tradition of Pozzo.

<sup>54</sup> and continued to be well-known in the nineteenth century, a fact important to understanding technical trends and practices to which Brumidi would have probably been exposed as a student and practicing artist in Rome



of samples herein, where protein positive staining was also found in the substrate, carried out with FITC was also found.

Samples taken from passages overpainted by Cox exhibit the presence of proteinaceous binder as identified by positive staining with TRITC, perhaps associated, as Wolbers suggested, with a casein binder. However, Wolbers also noted that, in at least one case, there is evidence of two additional layers, existing on top of the protein-bound layer. These thin layers are separated by a dirt layer, indicating that the last one was applied after a lapse of time. Neither exhibit positive staining, suggesting that they are synthetic resinous coatings.

#### 6. Workman: Overpainted Knee

Generally speaking, only three distinct materials or layers were observed in the most complex of the samples from this group: a dark flesh or tan, a lighter transparent orange, and two surface coating suggestive of casein. The orange layer suggested a dark autofluorescence and was unreactive to any of the applied stains. The surface coatings were brightly autofluorescent and a substantial grime layer was noted between them, suggesting that at least one of the coatings had been a presentation surface for some time prior to recoating. Diffusion of a small amount of TRITC-positive material into the older layers suggests an application of the tan or darker flesh layer.<sup>59</sup>

The analysis of this sample suggests that an intervention occurred either after Cox's work in 1957, or that the intervention believed to be Cox was earlier, leaving the last coating to be Cox.

While a parallel is drawn between the absence of positive stains for the coating estimated to be a synthetic material and other non-reactive material, account should be made of the fact that calcium carbonate is not characterized by fluorescent staining and can best be identified by its own autofluorescence, as seen in Figures 18 and 36. Wolbers report indicates:

#### 7. Workman: Overpainted Green Cloth

At least three distinct green layers were noted over the substrate: the oldest is an invasive dark brownish-green layer into the substrate. The next is a thinly applied transparent green glaze. The most recent

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<sup>59</sup> Richard Wolbers as cited in Rabin and Silver, Canopy Report, pp. 24-25.



green, a lighter green than the initial green appears as the represent presentation surface. Both the first and second green layers were non-reactive to any of the applied media stains, and exhibited no autofluorescence, and as such appear similar to the orange layer noted in Sample 6 above. A slight protein positive reaction (TRITC) was noted in the uppermost recent green. Additionally, the substrate itself was positive for protein, at least to a depth of 500 microns.

In the case above, the absence of autofluorescence is confusing. It could be attributed to the pigment presence, possibly a terra verte, (which does not autofluoresce) obscuring the calcite and therefore its autofluorescence. Otherwise, the lack of positive staining in these first and second layers, might be attributed simply to fresco, since calcium carbonate does not stain and is best identified by its autofluorescence. (For example, see Figure 139.)

Some positive stains for lipids appear, as identified by Rhodamine B for unsaturated lipids, or drying oils, such as a sample taken from an uncleaned background, which may or may not have been associated with the medium.<sup>60</sup>

With the intention of revealing the nature of sooty grime accretions on the surface of the fresco, Scanning Electron Microscopy and Energy Dispersive X-Ray analysis was carried out on the samples before and after cleaning.<sup>61</sup> Analysis revealed that the surface matter was a dust composition.

The conservation report furthermore details the condition of the fresco, ascribing cause, in several separate sections. It ascribed damage to the plaster, especially at the lower registers, from water infiltration caused by failure to the drainage system. Flaking and powdering paint are attributed to the possibility of overly dry plaster during the time of execution. Flaking is also ascribed to the inherent pigment defect in the ochers and green earths, rather than the plaster.<sup>62</sup> After review of historical photographs, the conservators also noted that darkening worsened since the Cox intervention in 1959, exacerbating the already problematic darkening at the giornate junctures that had existed since the paintings' execution. Obvious and extensive overpaint is further noted.

The Architect of the Capitol initiated a conservation program in 1982. Begun by Dr. Ann Imelde Radice, it has been directed by Curator, Dr. Barbara Wolanin since 1985. The aim of the program at its onset was to gain an in- depth understanding of the mural

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<sup>60</sup> The positive staining could result from the presence of an oil having migrated into the sample from a surface application.

<sup>61</sup> By Dr. Robert Koestler, Letter of August 10, 1987.

<sup>62</sup> Cox applied casein to the surface as a consolidant in the 1959, as stated above, thus making analysis of the secco passages difficult.



painting technique, the state of conservation and the cost for treatment of a representative selection of Brumidi's paintings at the United States Capitol. The process continues to be aimed at representing the original work of the artist in an effort to illuminate his *oeuvre* most extensively represented at the Capitol, as well as preserving the material fabric of the paintings. Beginning in 1982, conservators Bernard Rabin and Constance Silver, assisted by Lawrence Keck and others carried out the conservation treatment of many of the frescoes including the canopy and frieze of the dome. The initial commission, in 1982, involved a pilot conservation treatment assessment of the condition of paintings in the Patent Corridor, the Senate Corridors and Antechamber to the Senate Dining Room. In 1985, the conservators treated the frescoes in the Senate Dining Antechamber, the lunette of Fitch in the Patent Corridors and the twenty-four painted medallions in the Senate Corridors .

Brumidi painted the composition of Fitch between 1876 approximately contemporary but slightly later with the surrounding lunettes in the Patent Corridors. In one of the first of the professionally conserved frescoes carried out by Rabin and Silver and documented in a report of December 1985,<sup>63</sup> "the painting was studied for the technique of execution by visual examination on site" . Examination indicated that it was executed *affresco* with both small and large *giornate* .

Although the frieze was among the first of Brumidi's work to be conserved, it was the last of the artist's commissions. The cartoons for the grisaille paintings were completed in 1877 and Brumidi began the paintings in 1878 at 73 years of age. The frieze marked the second major conservation commission and was carried out by Rabin, Silver and Keck in 1986-87.

Conservation investigation and treatment of the mural paintings in Room H 144, was carried out under the direction of Bernard Rabin with the assistance of Perry Hurt, Lawrence Keck and Constance Silver from August to September 1987 and then in November 1988 and, in 1987, with the consultation of distinguished Italian Conservators, Laura and Paolo Mora.

Then Rabin, Silver and Keck embarked on the conservation of the canopy of the rotunda from 1987-88, an ambitious year-long contract directed by Rabin and involving the consultation of renowned senior conservators Laura and Paolo Mora. The conservation report produced from the year long conservation commission to treat the canopy of the

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<sup>63</sup> Report on the Conservation Treatment of a Portrait of John Fitch in the U.S. Capitol Building, December 14, 1985 Rabin and Silver.



dome,<sup>64</sup> included studies of the plaster, pigment and medium. An ambitious project and report, the documentation provided valuable insight into the artist's technique and to conservation problems occurring elsewhere in Brumidi's Capitol work. Conservation treatment resulted in a dramatic visual alteration through removal of surface accretions to the most prominent and important paintings in the U.S. Capitol.

As well as cleaning the paintings, the project illuminated Brumidi's working method and underscored conservation problems that were to appear elsewhere in his work at the Capitol. Following this major commission, additional conservation treatments were carried out. They included "Portrait of Franklin" the "First Treaty of Peace", "Columbus and the Indian Maiden" and "Cornwallis Sues for the Cessation of Hostilities under the Flag of Truce".

Conservation campaigns were continued with the treatment of "Robert Fulton", "Authority Consults the Written Law" and a conservation study the north corridor, Senate Corridors, in 1992.

## 5. INTERVENTIONS

Significant to understanding the original technique employed, the presence of media additional to fresco or lime based secco technique, and the chemical and physical nature of the paints, documented interventions provide essential information of the alterations of the Brumidi's original frescoes. This section reviews the technical considerations historical observations and conservation reports.

The work of artist George Matthews and his peers, who "retouched" the frescoes extensively, is important in understanding some of the alterations brought to the frescoes, as cited above. Appropriate to the generous artistic license he exercised in liberally repainting Brumidi's compositions, particularly the Senate Corridor lunettes, he signed several of them, including "Las Casas" and "Authority Consults the Written Law". The extent of Matthews retouching varied. While he usually repainted the background and made alterations to other parts of the painting by changes in color or detail in oil-bound paints, he did not generally alter the composition. There are exceptions. In the case of

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<sup>64</sup> "Conservation Treatment of the Fresco of the Canopy" Bernard Rabin and Constance Silver, August 1988.



"Authority", located at the south end of the west corridor over Room S-134, he repainted more than half of the fresco altering the composition significantly. <sup>65</sup>

Matthews technique was marked by painterly mottling, with brushstrokes in an impressionistic method, a characteristic signature that identifies his intervention such as that on the fresco "Bellona Goddess of War", the "Cessation of Louisiana" and other lunettes in the Senate Corridors.

In the years that followed Matthews work, additional intervention was carried out by U.S. Capitol house painters including the repainting of the banded borders surrounding the lunettes. <sup>66</sup>

Stylistically, Charles Ayer Whipple departed significantly from Brumidi as indicated by the following passage:

"Everyday [Mr. Whipple] can be observed standing on top of a high step ladder, palettes and brush in hand, painstakingly performing a service that will be appreciated.... Mr. Whipple ...[was educated] at the Boston Museum of Fine Arts. These studies led to a long course in Paris under such well known masters as Bougureau [sic]. It is the influence of Bougureau [sic] that shows most strikingly in his portraiture. (p.1).

Whipple also exercised liberal artistic licence in restoring the frescoes. Like Matthews, he signed several of them, including the Portrait of Fitch and of Franklin. In 1953 Whipple's addition to the frieze paintings was replaced by paintings executed in oil paints by artist Allyn Cox (1896-1982). The final three sections of the frieze were replaced with scenes continuing from the existing historical summary. They include scenes from the Civil War, the Spanish-American War and a modern addition with a composition of the development of aviation.

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<sup>65</sup> Matthew altered the composition by changing the central seated figure, bent at the waist and leaning towards the figure to her proper left to an upright seated figure who is uninvolved with the other figures in an evident misunderstanding of the iconography as well as intent.

<sup>66</sup> Before Matthews, Whipple was also employed to "restore" Brumidi's paintings. However, because he was not known to have overpainted or otherwise altered the nature of the original paintings, his interventions are not essential to understanding Brumidi's technique or alterations to it. His work is however noteworthy. According to *The Sunday Star, Magazine Section*: Washington, D.C., "Artist is Restoring Capitol's Great Ceiling Paintings", by H.O. Bishop) of April 13, 1919: "...It has been a keen source of regret...among thousands of American art lovers who appreciated the beauty of Brumidi's great work at the Capitol Wing of the building were permitted to be carelessly treated and, in some instances, practically ruined, possibly in the carelessness of unthinking employees or the hurrying public or the result of the elements."



## FLAKING PAINT

Allyn Cox's documentation of his work on the canopy of the Rotunda is essential in understanding alterations made to the paintings. Significant to understanding the nature of the paint medium, Cox set about to repair the flaking/powdering paint condition, so often cited. In the 1959 report, Cox described application of a fixative:

21 April: Experimented with spraying certain of these powdered bits, some with lime casein solution (five parts moistened powdered casein to one part lime putty, thinned with water), others with lime water. Several applications of each solution were made, and left to harden overnight. <sup>67</sup>

In his next entry Cox reported on unsatisfactory results, a fact that prompted his request for assistance. Cox contacted Dr. George Stout, Conservator at the Isabella Stewart Gardner Museum in Boston, who then referred him to Dr. Rutherford Gettens, Head Curator, Freer Gallery Laboratory at the Smithsonian Institute. <sup>68</sup> Gettens, according to Cox's report, recommended that the loose powdering paint be removed and repainted since any consolidant would darken the area and would not effectively consolidate the pigments to the plaster. The necessary repainting was done with a lime-casein medium. This unfortunate invention resulted in substantial loss to the original paint, confusion regarding fresco and secco passages and considerable complication as a result of the films of casein on the fresco surface. <sup>69, 70</sup>

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<sup>67</sup> p.3

<sup>68</sup> Both George Stout and Rutherford Gettens were leading figures in the conservation profession. Their contributions continue to be used, particularly their studies in pigments, in which Gettens took a leading role, and for their book *Painting Materials, A Short Encyclopaedia*. New York: Dover Publications, Inc, first published by van Nostrand Company in 1942.

<sup>69</sup> It is noted in the conservation report of Rabin and Silver that it is impossible to differentiate between the *secco* passages of Brunnici and the casein of Cox on p.23. For application to future study, such a differentiation could be investigated through differential staining with ultra-violet light microscopy and the use of Fourier Transform Infrared Spectrometry, both of which would assist in illuminating the presence of materials and perhaps in distinguishing between original and non-original materials. Differentiation could be accomplished through the use of SEM with electron probe.

<sup>71</sup> In an unique conservation treatment in 1967, restorer Henri Coutais transferred "Comwallis Sues for the Cessation ..." from the wall to a new support. It is reported on in "A Blind Approach to the Removal of a Fresco Painting", *Studies in Conservation*, 8 (February 1963), pp 10-31.



***STUDY OF SIGNING OF THE FIRST TREATY OF PEACE WITH GREAT BRITAIN, U.S. CAPITOL. 1989. By Constance Silver***

Study of the painting was carried out by Constance Silver and Lawrence Keck to determine the appropriate treatment as assessed from removal of small areas of overpaint, experiments with consolidation of flaking paint, cleaning, structural stabilization through repair and consolidation. The study did not include scientific analysis, as it was deemed to not be useful in determining the condition of the painting. The report did not address the technique of execution.

***CONSERVATION REPORT, BENJAMIN FRANKLIN, U.S. CAPITOL 1989 by Constance Silver***

While the report concerns the damages, causes of deterioration and treatment of the painting, there are new points made with regard to the execution technique. For example, it cites, as other reports, the poor bond of some of the pigments to the intonaco. As found in the canopy of the dome, the browns and greens exhibited such a poor bond. Again, Silver recommends that this poor adhesion is caused by the presence of clay constituents, ill-suited to fresco painting.

Moreover, in a brief discussion of the technique of execution, it was noted that the lunette was executed in true fresco technique. There are eight giornate, an excessive amount for such a composition. The method of transfer of the design is with puntini, or incised points made by a wheel with points rolled over a cartoon, and with incisions.

This observations of the execution technique are consistent with those made of the lunettes as a subject of this study. That is, in inordinate amount of giornate are found, flaking paint appears in the browns and greens, there is a combination of transfer techniques and, generally, an estimation of true fresco technique.

***G. CONSERVATION REPORT. COLUMBUS AND THE INDIAN MAIDEN, January, 1991, by Constance Silver***

The presence of flaking paint and of extensive overpaint were noted.



**H. CONSERVATION REPORT, ROBERT FULTON. U.S. CAPITOL,  
August, 1991, Christy Cunningham-Adams**

The wide lunette was painted between 1871-73. The conservation report treatment noted several points of interest including evidence of pentimento, a presence not previously indicated in other conservation reports; variations in plaster texture as seen elsewhere; variations in impasto texture, from hard and stable to chalky; the possible presence of atypical materials, such as gypsum (calcium sulfate) for white; and discussion of the technique of painting which includes manipulation of the plaster, scumbling, and variations in density of pigment. The identification of pigments is estimated based on archival records and previous identification <sup>71</sup>.

**I. CONSERVATION REPORT , AUTHORITY CONSULTS THE WRITTEN  
LAW ", August, 1991, Catherine S. Myers**

The painting is estimated to have executed around 1875, although there are not vouchers or other accounts to verify the date. As such, the painting is not certainly documented to Brumidi. The conservation report addresses the technique of execution regarding the presence of an inordinate number of giornate, including, as elsewhere, patches (estimated), and variation in plaster texture, which are documented in scale drawings. As observed elsewhere, flaking paint that appeared to be an iron oxide was noted.

**J. CONSERVATION CONDITIONS SURVEY AND TREATMENT  
PROPOSAL FOR THE MURAL AND CEILING PAINTINGS IN THE  
NORTH ENTRANCE CORRIDOR OF THE UNITED STATES  
CAPITOL, Christy Cunningham-Adams, October 14, 1991.**

Documentation indicates that the decorative paintings in the Senate Corridor were executed during two decades beginning in 1857 through the 1870's. The north entrance is a small architecturally contained component of this larger area. It is assumed that a study of its character and problems would yield information representative of the entire Senate Corridors.

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<sup>71</sup> McCrone, 1987, noted above.



Aimed at determining the technique of execution, the state of conservation and the restoration treatment, the survey considered the mural paintings in the entrance corridor, a combination of figurative and decorative paintings in a variety of techniques.

Concerning the frescoes lunettes portraits of Kent and Story, Cunningham- Adams found that punched guidelines (*puntini*), *giornate* and plaster appearance regarding texture likened the painting to the other frescoes. However, mica - characteristic of Brumidi's plaster- was not found to be present in some passages. The remainder of the report details the presence of overpaint and conservation condition.

The information contained above, in outlining the documentation of Brumidi's technique, uses the subject as a point of departure for discussion of technique, gaining primarily from the literature. Within the review, the following technical considerations arise as subjects for empirical study:

1. Brumidi used small *giornate* as correction to the compositions. Were these non-fresco?
2. Flaking powdering paint appears throughout his work. Possibly a paint medium is added; possibly the pigment is defective; perhaps the lime was not properly slaked or was already carbonated when painted.
3. Darkening appears at the *giornate* junctures. These indicate retouching areas and might also be the site of media other than oils.
4. Baroque painting techniques included the use of glues on top of the plaster before painting and widely used *secco* in lime. Additionally, oil casein was employed *a secco*.

In developing the methodology and in carrying out the tests on the study subject, the questions resulting from this review were central to the thesis research and provided a documentary guide for empirical investigation.



## CHAPTER 4 : METHODOLOGY

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This research was carried out over the course of two semesters and concerned the use of both documentary source material and the fabric of the subject itself.

Because the study concerned several dissimilar subjects, archival research reflected divergent sources. Historical information pertaining to Brumidi was gathered from the archives of Architect of the Capitol and elsewhere. Information concerning methodology, methods of investigation and procedure as well as techniques and case study applications were gathered from conservation and related scientific literature and elsewhere. Most of the information on the subject, namely the three frescoes, was gathered from the paintings themselves.

The results are explained and illustrated in Chapter 5: "Results". Photomicrographs, documented drawings, FT-IR spectra and photographs, located within the text, illustrate the chapter. Additional illustrations are located in the Appendix.

Directed at exploring and using analytical tools for the study of the pictorial surface of wall paintings, the research aims to reveal information concerning the artist's technique. As a principle focus, the identification of binding media additional to fresco was studied for the purpose of identifying deviations from traditional fresco practice and of informing the conservator of the presence of interventions.

As the analytical means for examining works of art and architecture vary widely according to need, feasibility and knowledge of the researcher, so the techniques employed herein yielded to such limitations. Choice was primarily dictated by the analytical methods available and review of those methods employed in wall painting study as gleaned from literature review of case studies and other applicable publications. Within the limited schedule of this research, results offer the initial research for a larger future research program.

The study of the binding media was chosen for the following reasons:

1. Identification of the binding medium determines the extent to which the artist employed fresco technique. The presence of *secco* passages, indicating a departure from fresco technique, offer insight into the artist's working process.



2. The study of binding medium is a subject of recent widespread study. Analytical methods therefore stem from those that have been used in the field. As a case in point, this research borrows the application of Fourier Transform Infrared Spectroscopy and ultra-violet fluorescence microscopy from recent studies. Moreover, the study of binding medium addresses conservation treatment issues. *Secco* passages occasionally demand different conservation measures than fresco; identification of media inconsistent the painting technology suggests the presence of interventions and encourages further investigation.

Also studied were the pigments, paint stratigraphy, plaster variations, pattern of plaster application or *giornate*, the drawing technique and presence of restoration interventions as indicated by surface layers and other accretions. The methodology of each of these types of technical studies will be explained below.

In order to conduct the laboratory study, a limited number of samples (twenty to twenty-five samples) were taken from each of the three paintings. The first group of samples ( I.) represent passages in which there appeared to be overpaint. These samples were extracted in order to illustrate both the presence of overpaint and the appearance and quality of the overpaint. The second group of samples, (II) were taken at a later date from passages where it appeared that the original surface was exposed and in order to confirm results from the first samples.

For the purposes of assigning sample numbers, each of the paintings was given a letter as follows: "Las Casas": A; "Bellona": B; "Louisiana": C. The roman numeral following the letter indicates the sample group, I and II. The number that follows indicates the sequential order number in which the sample was extracted. Finally, a lower case letter means that the sample is one of two cross sections of the same sample. For example, A. II. I.b. is from "Las Casas", second group of samples, number I, cross section b (there is an "a" cross section).

## **I. ON-SITE STUDY: MACRO- ANALYSIS: PHOTOGRAPHY**

The paintings were examined on site. Examination was carried out with normal visible light, raking light, low magnification and with ultra-violet visible illumination.

The study began with in situ examination, documented by photography. Color slides (Kodak Tungsten 160 ASA with Tungsten filament lights) and black and white prints



## II. MICRO-ANALYSIS : SAMPLE STUDY MEDIA ANALYSIS

Although the paintings are documented as fresco, the technical study herein affords for the opportunity to verify the technique, as indicated above, "... to test actual practice, as against precept, by analysis".<sup>3</sup> Such verification can be confirmed by the study of cross-sectional samples. Integration of the pigments in calcareous layers suggests that the pigment has combined with the lime as it has converted from calcium hydroxide to calcium carbonate. Furthermore, texture caused by large particles of calcite and pigment, as opposed to discrete paint layers, indicates fresco. The presence of paint layers of a finer and denser texture on top of the calcium carbonate render indicate a change in materials and technique.

Binding medium found in artists' materials are generally limited to lipids, proteins, carbohydrates, natural resins, waxes and, in the twentieth century, a variety of synthetic resins. The chemistry of some of those materials is significant within this study. Therefore, in the following section, binding media expected to be found in the nineteenth century paintings will be described, notably, lipids, proteins, natural resins and carbohydrates.

Lipids, or fatty materials, include oils and fats. For artists' materials, oils are used. Oils are mixtures of glycerides with fatty acids. They are distinguished by the amount of fatty acids they contain. For artists' materials, only drying oils need be considered, such as walnut oil, linseed oil and poppyseed oil. These lipids contain a high amount of linoleic and linolenic acid.

Proteins consist of carbon, hydrogen, oxygen and nitrogen, and possibly sulphur and phosphorus. It is principally because of the presence of nitrogen that they are different than oils, natural resins and gums. All proteins are based upon amino acids and protein types are specified by the arrangement of the amino acids. Protein molecules are large.

In particular, glues, in many forms, egg yolk, egg white and casein comprise the many types of proteins traditionally employed as binder, adhesive and size in the execution of works of art. Glue is prepared from animal skin, cartilage, bones and other collagen containing materials and goes by bone glue, hide glue, parchment glue, fish glue, etc. Egg whites is largely water. The approximately one tenth part protein is composed of fat,

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<sup>3</sup> George Mills and Raymond White, *The Organic Chemistry of Museum Objects* (Boston: Butterworths), p. 10



(Kodak Plus X 100) were taken of the paintings with 35 mm camera.<sup>1</sup> These photographs provide a reference record.

### **MACROPHOTOGRAPHY:**

With the use of zoom lens 80 -200 mm , detailed photographs of the painting were taken. These photographs offer a view of the painting, as under a low powered microscope, illustrating the surface texture - such as the brushstrokes, *impasto*, presence of thin layers - and the condition of the painting in terms of flaking, cracking, and presence of surface accretions.

### **TANGENTIAL LIGHT PHOTOGRAPHY:**

Tangential light, or raking light, photographs were taken in color and black and white as a means for illustrating surface texture as above, on a large scale. These photographs indicate the location of the *giornate* junctures, incisions and *puntini* and of the presence of fills.

### **INFRARED PHOTOGRAPHY**

Infrared radiation photographs were taken with black and white high speed infrared film (Kodak HIE 135-36) and # 87 infrared filter with a 35 mm camera (Pentax K-1000 and Olympus -OM with 35 mm perspective correction lens and 80- 200 mm zoom lens) in order to illustrate the presence of underdrawing or underpainting. Exposure times and aperture adjustment were made in accordance with the film instruction. All exposures were widely bracketed. <sup>2</sup> The information gained from in situ study is explained in the text , illustrated by photographs and represented in drawings. Four separate drawings of each painting document the following: 1. location of *giornate* and plaster texture types 2. technique of drawing: incisions, *spolvero* , *puntini* 3. overpaint 4. sample location

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<sup>1</sup> Pentax K-1000 and Olympus OM-2 with 52 mm lens and 80-200 mm zoom and with 35 mm perspective correction lens.

<sup>2</sup> Working with infrared film requires care. It must be refrigerated until the time of use and then cooled after exposure. Processing should be carried out almost immediately after exposure.



carbohydrates and minerals in addition to protein. Egg yolk is made up of protein and also a significant amount of water. Additionally, it contains 22% fat or oil. This is significant in analyzing proteins because, in the case of fluorescent staining, the oil presence will be apparent. Egg yolk media will stain positively for lipids and for proteins. Casein is the principle protein of milk. It is made water soluble by dissolving it in alkaline solutions, such as ammonium, lime or borax. lime casein is an extremely durable secco medium for wall painting and has been used since antiquity.

Natural resins embrace a very wide range of materials that may be broadly classed as those materials that are secreted from certain plants and are soluble in organic solvents. They are chemically complex. They are composed of resin acids resin esters, resin alcohols and other compounds. <sup>4</sup>

Carbohydrates refer to reducing sugars, notably gums. These are natural plant exudate which are soluble in water. They consist of carbon, hydrogen and oxygen. The main constituents of plant gums are the calcium, potassium and magnesium salts of complex organic acids contained in sugar molecules.

#### **CROSS SECTIONAL SAMPLES:**

In order to analyze the possible presence of organic medium two samples of each paint sample were imbedded in Bioplastic <sup>5</sup>, sectioned, polished and mounted on labeled glass slides as reference samples. As possible, loose reserve sample was retained for instrumental analysis. The cross-sectional samples were studied under low magnification (25X- 200X) in reflected light and noted for their stratigraphy and for the appearance of the paint layers. The samples were also noted for their correspondence with the location from which they were sampled, in terms of color, underlying paint layers and thickness.

The samples were photographed with a 35 mm Nikon camera attached to the Nikon Optiphot polarized light microscope adapted for reflected light with fiber optics illuminated by quartz halogen. Reflected light illumination was used for photographing the samples at 50X - 100X using Kodak Ektar 25 ASA color print film. The resulting photomicrographs were assembled and mounted on information sheets, indicating their location, film, camera, date and magnification with notes concerning the reasons for sampling, conditions of the

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<sup>4</sup> See Hermann Kuhn, *Conservation and Restoration of Works of Art and Antiquities*, (Boston: Butterworths), 1986.

<sup>5</sup> Bioplastic is a polyester resin two part system used for imbedding samples.



paint sample in situ and other notes. (See Figure 1). These photographs are grouped with fluorescent stained photomicrographs in order to facilitate comparison. For interpretation, generalities as well as specific commentary were made.

## ULTRA-VIOLET FLUORESCENCE MICROSCOPY

The application of fluorescence microscopy and direct reactive staining for the identification of media, as explained above, was the principle method of study of the painting medium in this study. It was accomplished at the Conservation Department of the Philadelphia Museum of Art. The fluorescent microscope used was a Leitz Orthoplan microscope with Vario Orthomat 2 automatic camera system equipped for incident light fluorescence and polarized light and for reflected light through the addition of fiber optics quartz light. Illumination was provided by a mercury arc lamp and filtering of the fluorescence was accomplished with vertical illuminators by filter block A (with an exciting band pass filter 340-380 nanometers) and filter block D (with exciting band pass filter from 355- 425 nanometers). As a method for identifying the medium, the paint samples were stained with fluorochromes widely utilized for identifying binding media in the study of fine art and archaeological objects.

Based upon research conducted by Richard Wolbers<sup>6</sup> and case study examples that have resulted from it, fluorochromes used for the study include the following:

For identifying carbohydrates, Triphenyl Tetrazolium Chloride (TTC) indicates reducing sugars, corticosteroids and other reducing compounds. TTC is particularly susceptible to being reduced. When reduced, it changes color to red which, in ultraviolet visible illumination is very dark reddish brown. TTC is made in 4% solution in an appropriate delivery solvent, including water, acetone, alcohols and mixtures of solvents.

For identifying proteins, fluorescein isothiocyanate, FITC, is one of several fluorochromes selected for the identification of proteins. It tags the presence of amino containing materials, such as proteins. It fluoresces yellow-green as a primary azo-adduct to amino containing materials. Spectral values for FITC are between 490 nm and 525 nm.

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<sup>6</sup> Wolbers, Richard and Gregory Landrey, "The Use of Direct Fluorescent Dyes for the Characterization of Binding Media in Cross Sectional Examinations", *AIC Preprints, 1987 Vancouver Conference*, (Washington: American Institute for Conservation), 1987; Wolbers, Richard, "Aspects of the Examination and Cleaning of Two Portraits by Richard and William Jennys", and other studies.



Other protein identifying fluorochromes not used here include: Lissamine Rhodamine B Sulphomnyl Chloride (LISSA), Tetramethyl Rhodamine Isothiocyanate , (TRITC) and Fluorescamine (FLUR).

For the identification of lipids, two fluorochromes were chosen: 2,7 Dichlorofluorescein (DCF) indicates saturated and unsaturated lipids- drying and non-drying oils in particular. The DCF molecule does not change but it can affect the lipids around it. The result is a change in color to pink for saturated lipids to bright yellow for unsaturated lipids. It is generally used at a .2 % solution in a polar solvent.

Rhodamine B was also used for identifying lipids. This fluorochrome exists as a bright red/pink stain. It indicates drying oils or unsaturated lipids. It dissolves into a lipid containing material staining it, in visible light, bright red. It dissolves the triglycerides present in drying oils such as s linseed oil . If the oils however have cross linked and lost their unsaturated character, the stain is no longer appropriate . Other Rhodamine stains, such as Rhodamine 123 and Rhodamine 6G may be used in these cases. The spectral value for Rhodamine B is between 540 nm and 625 nm.

Rhodamine B were reserved for final application due to its brilliance.

1. Identification of Proteins. Fluorochrome: FITC: Fluorescein isothiocyanate, .1% in acetone. The stain, pale yellow in color, tags a protein binder, such as egg, animal glue or casein, through the appearance of a brighter yellow stain indicative of a positive stain. Chosen as an initial stain for its relatively pale color and because it is dissolved in a volatile solvent and therefore is quick to evaporate, retarding its penetration into the sample, it was possible to polish FITC away easily.

Each of the samples was stained with FITC and examined under fluorescent light filtered at the range 340-380 nm with filter block A. Where a positive stain was indicated, the sample was photographed in ultra-violet fluorescent light with 35 mm color print film.

2. Identification of carbohydrates, corticosteroids and other reducing compounds. These include gums, such as gum arabic. Fluorochrome: TTC: Triphenyl Tetrazolium Chloride, 4 % methanol. The stain was chosen for the relative ease in polishing it away after staining. The stain is brownish in color. When it positively stains, the color is becomes darker brown to dark reddish brown in color.

Each of the samples was stained with TTC and examined under fluorescent light filtered to the range of 340-380 nm with Filter Block A. As above, where a positive stain was indicated, the sample was photographed.



3. Identification of Saturated and Unsaturated Lipids, that is, drying and non-drying oils. Lipids indicated would be those commonly used as binding media, including linseed oil, walnut oil, poppy seed oil, etc. Fluorochrome: DCF: 2,7 Dichlorofluorescein, .02-.2% in ethanol. Positive staining is indicated by color alteration of the stain, yellowish upon mixing, to bright yellow. Each of the samples of interest was stained DCF and examined with fluorescent light filtered in the range of 340-380 nm. Those samples exhibiting positive staining were photographed.

4. Identification of Saturated Lipids: as above. Fluorochrome: Rhodamine B, .02-.2% in ethanol. This most pervasive and brilliant of fluorochromes alters from its bright fushia/red to a deeper bright red in the presence of a drying oil. The samples of interest were stained and examined in ultra-violet light filtered by filter block A in the spectral range of 340 to 380 nm is used. Additional viewing with Block D, spectral range of 355 nm to 425 nm, was done. Where positive staining appeared, the sample was photographed with Kodak Gold 200 ASA print film.

The photographs were collected and mounted on identification sheets for reference as described above. Those samples most representative of particular conditions, such as media additional to fresco, or illustrative of stratigraphy, were selected for illustration. The stains used included FITC, for proteins, TTC for carbohydrates, DCF for lipids and Rhodamine B fro unsaturated lipids.

Photomicrographs of cross-sections in visible light are presented in full size photograph (3" x 5"); on a separate sheet following it, details (2" x 2") of the stained cross sections are presented together as a means for providing a comparison between the results of staining. Texts located at the bottom of the photomicrographs explain the cross-section, relating it to the painting and the meaning of the stains. "Positive" staining refers to the appropriate effect of the fluorochrome in tagging a a material's functional group as set out by previous researchers. Within the text, the presence of a "false positive" is occasionally cited. Collection of the fluorochrome in voids, is also distinguished. The texts also often reveal uncertainty about the reaction of the fluorochrome or the effect of staining. These comments reflect both the necessary expertise in interpreting fluorescent staining and the subjective nature of interpretation.



## CONFIRMATORY TEST : FTIR

FTIR was used to identify medium as confirmation to fluorescence staining. A limited number of samples were chosen for further study, principally from one painting, in order to explore the binding medium. Sample material was extracted from the cross sections and from loose samples, placed between microscope slides and labeled. Much of the sample material contained particles from the substrate and pigment particles in addition to the medium. In fact the medium was the difficult component to isolate since, its presence is seen through the pigment. Extraction was accomplished using a small scalpel blade and a pointed glass rod under a binocular microscope at 10 X magnification. Samples were generally chosen from areas with a pigment that had already been identified. Separation of the sample material was accomplished by microchemical methods. Methylene chloride or/and acetone were applied in small quantities to the sample on a slide. After dissolution, the residue was scraped from the slide, also under low magnification, deposited on the diamond cell, and crushed. An appropriate aperture size was selected for viewing the part of the sample for FT-IR analysis. Trial spectra were produced until a recognizable spectra was found. It was then matched with the appropriate reference spectra . When a reference matched, in functional groups, the sample spectrum, a spectrum of both of the materials was made for comparison. These are located in the text of Chapter 5: Results.

Although a number of samples were tested and spectra were produced, many spectra were not recognizable probably because the material analyzed was a mixture. Because such extraction was conducted manually under the microscope from small samples, it was difficult to exclude unwanted material. Moreover, because the solvent could affect all additional material with which it was in contact, such as material not intended for study, the residue produced from it and analyzed, might not represent the desired material. A more exacting method would be desirable, such as the use of microtomed sections, or a better method of extraction. In some cases, partial identification can be estimated. In others, additional analysis would be required.

FT-IR spectra, where produced, are included in the review of each sample and follow, in sequence, the fluorescent stained photomicrographs.



presence. The specimen was then placed on a slide for polarized light identification. The sample was examined in reflected light at low magnification ( 10 X - 25 X). In both cases, the sample was compared with existing dispersed samples of known pigments in reflected light as well as in polarized light.

The samples were then analyzed microchemically. Tests for the presence of broad characteristic elemental constituents were made, such that, for instance, the presence of lead which was a qualifying test for vermilion, or iron for burnt sienna, or calcium carbonate for lime white, etc. Additional sample was extracted and isolated for confirmatory tests.

### **CONFIRMATORY TESTS: X- RAY DIFFRACTION**

X-ray powder analysis was carried out on a Philips X-ray generator PW 1729. Pigment taken from loose samples was placed between slides for use for XRD. The samples was removed from layers where pigments showed characteristic size, shape and color and appeared to exist extensively in each of the paintings studied. These pigment samples also contained small amounts of substrate material and other pigments, as well as, possibly, media. Due to time limitations, representative pigments and media were identified

Results were achieved through the study of the information gained as described above. Those questions posed at the research initiation were restated: in particular, the researcher posed the original questions now with the information in the form of cross sectional photomicrographs, stained and not stained, and pigment analyses and binding medium analyses together with drawings. Are the original paintings fresco? To what extent are they executed in lime -bound secco technique? Were non-calcareous media used in the original execution? To what extent have overpaint and other surface films altered the original layers? Have, for example, oil paints leached into frescoed substrate? How are the means of examination and analyses successful and inadequate in answering these questions?

Information sheets for each sample were made on which each test was recorded. (See Figure 2).

Based upon the methods of examination and analysis described above, interpretation of medium based upon u.v. fluorescence and FT-IR and of the pigments, based upon optical techniques and XRD, were made. These results were then related to broader observations concerning the painting, especially the technique of execution. Observations include evidence of interventions.



## PHOTOMICROGRAPH

SAMPLE TAKEN FROM:  
DATE OF SAMPLING:

SAMPLE LOCATION:  
PURPOSE SAMPLING:

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SAMPLE #:  
MAGNIFICATION:  
OBJECTIVE:

ILLUMINATION:  
CAMERA:  
FILM:

NOTES and REMARKS:

FIGURE 1



**SAMPLE #:**

Sample Location:

Location Description:

Purpose of sample:

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**Cross sectional reflected light Photomicrograph, Kodak Ektar 25 ASA**

Magnification:

Comments:

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**Fluorescence Staining, Photomicrographs, Kodak Gold, 200 Leitz Orthomat**

Magnification:

Autofluorescence:

For Proteins: FITC:

For Reducing Sugars: TTC:

For Lipids: DCF:

For Lipids: Rhodamine B:

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**FTIR: Analyzed:**

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**Pigment I.D.**

Microscopical

Microchemical:

XRD:

FIGURE 2



## CHAPTER 5 : RESULTS

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At the center of this research is a methodology which structures the investigation of Brumidi's technique, particularly his use of painting medium, on a process of technical examination. The "results" of that process are inconclusive but suggest that the artist departed from classical fresco technique. A body of information generated in this phase attests to an effort of several months of analytical investigation and documents the phases of research by way of a text and visual supplements.

The following chapter reports on the case studies of this research, namely the three lunettes indicated above. The text elucidates the investigation by attempting to interpret the technical investigation of each of the three paintings. In order to organize the chapter, each of the paintings is discussed separately with summaries located at the end of each section. The drawings, photographs, photomicrographs, spectra represent critical products of the investigation. They are integrated in the chapter and serve as a starting point from which the text spins. The paintings are discussed in the order in which they were initially studied:

### **A. LAS CASAS ; B.BELLONA; C.LOUISIANA**

For the sake of clarity, the "results" for each painting are ordered in three parts.

Part I concerns macro-analysis, or on-site examination. The on-site study results in observations made with and without the aid of magnification, special illumination, and special photographic techniques. These observations are explained by the text and by way of photographs. The material is further represented in documented drawings.

As a product of this examination, measured drawings, executed on 11" x 17" format on vellum paper, document the following information:

1. the lunette in the architectural setting represented in a detail elevation
2. giornate / plaster types
3. drawing technique: incisions, puntini and *spolvero*
4. presence of overpaint



## 5. sample location

Part II concerns micro-analysis, or laboratory examination as outlined in Chapter 4: Methodology. The principle part of the chapter focuses on the study of the materials as extracted from the paintings and studied in the laboratory. These materials take the form of cross-sectional samples, dispersed pigment samples and media samples. Part II is organized around the information sought. As opposed to discussion according to analytical technique, the results from laboratory analysis are explained by the information sought as follows:

1. **STRATIGRAPHY:** observations regarding the paint layering sequence are given.
2. **MEDIUM:** the paint medium is investigated as a means for exploring the use of fresco, alterations in the technique, and the presence of interventions.
3. **PIGMENTS:** As a necessary subject of investigation in studying technique, especially medium, and as a means for checking documentary sources against empirical evidence.

In Part III, the results are summarized. Micro-analysis is related to the macro-analysis and macro-analysis to the painting. In the broadest view, the summary includes generalizations about Brumidi's technique and use of materials.



## A. LAS CASAS

### I. ON-SITE INVESTIGATION: MACRO- ANALYSIS

After cursory on-site examination, it was apparent that the lunette was probably not fresco. *Giornate* and indications of drawing transfer methods characteristic of fresco were not evident. These absences were noted through the use of raking light and examination at low magnification. (See Figures 5, 6 and 7). Moreover, the general appearance of the painted layers suggested that the paint film was composed of a binding medium and was not composed of pigments integrated in the plaster, despite the extensive overpaint which usually, in the case of Brumidi's frescoes, does not entirely obscure the painting. For example, flaking paint revealed an unpainted ground in several small locations. (See Figure 8).

In texture, the painting is smooth. Alterations in plaster type usually found among Brumidi's frescoes do not exist. The surface texture, save passages of *impasto* and *craquelure*, is uniform. Junctures defining where the plaster sections meet and incisions and punched points outlining the contours of the drawing are also absent. With superficial examination and close inspection with magnification at 10X-20X, there is no evidence of pouncing. The paint film is characterized by hairline crackle, typical of the shrinkage during drying of oil and resinous paint films. Moreover, such crackle often appears in thinly applied layers, that is, with a high solvent ratio where the considerable loss of liquid during drying and a resulting thin paint layer, makes it subject to incompatibilities of ground and film. This crackle pattern is most apparent in the black areas, such as the robe of the figure of Las Casas.

Superficial examination also emphasized the distinction between the heavy application of paint from other passages. Certain passages are overpainted (estimated), with an impressionistic mottling, usually associated with Matthews hand. Such is the case of the upper background, which is painted in gray/greens, the face of the Indian, also mottled in skin colors, and various other more localized passages of the painting. In fact, Moberly, Wieshauth and Held signed the painting at the paper on the desk and dated it 1928. At the lower horizontal margin, an impression approximately 1 1/2" above the existing border bands that enframe the lunette, suggests that the original, or an earlier, border existed 1 1/2" higher than the existing banding.



In subject and style, the painting is tied to Brumidi's other frescoes at the Capitol. It depicts an historical subject, possibly borrowed from an existing composition<sup>1</sup>. It is occupied by a limited number of figures in a defined space and it is also somewhat awkwardly rendered, as seen in the face of the Indian and the gesture and interaction of both figures.

Raking light photographs emphasize these observations as noted above. It is clear from on-site examination that the painting does not have the characteristic features of fresco.

Macrophotographs with and without raking light provide insight into Brumidi's working method. They reveal the rapidity of brushstrokes, the viscosity of the paint, the presence of overpaint, and indications of aging and deterioration, such as *craquelure*, flaking and powdering paint. The macrophotographs of *Las Casas* illustrate a sketchy painting technique, as seen in Figure 9 of the hand of *Las Casas*, and Figure 10, of the scene from the window.

They also document the presence of flaking paint, as seen in Figure as already noted.

In fact, there is extensive flaking of the paint layer, although only in limited passages. Flaking appears to be associated with certain colors, especially browns, yellows and reddish colors. It is significant that the paint layer peels away in a manner uncharacteristic of fresco, separating between what appears to be a paint film and the support, apparently without the presence of lime or sand particles.

In the cursory manner intended, the drawings indicate that the painting is heavily overpainted. (See Figure 11). Since neither drawing techniques nor *giornate* are evident, the only additional drawing documents the sample location. (See Figure 12).

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<sup>1</sup> The source for the composition, if any, has yet to be established. Research carried out by Cliff Young, consultant to the Curator's Office, in 1975 produced only an engraving of *Las Casas*, which did not resemble the lunette. However, elsewhere, it has been established that Brumidi used existing paintings or other pictorial sources for his some of his paintings.



## II. LABORATORY STUDY : MICRO - ANALYSIS

### 1. STRATIGRAPHY

#### CROSS-SECTIONAL SAMPLES:

Thirty samples, approximately 2 mm square, were taken from the painting on two occasions. The first group of samples represent the painting stratigraphy, including the most obvious overpainting, throughout the composition. The second sample group was aimed at representing the original surface as much as possible. Samples were extracted to answer questions: Were the bands original, what is the background color here? Test for medium. What is this pigment? Is there a layer of dirt between this layer and the underpainting? Or is there underpaint?

After preparation, the cross-sectional samples presented the most interesting and varied set of cross sections of any of the paintings studied. Discrete and separate layers of film-forming paint were found to exist throughout the painting, such as Figures 13, 17 and 46 attesting to the probable presence of overpaint and the possibility that the painting was not fresco at all. However, samples also revealed a distinctly fresco-like appearance in cross section. Granular, dense pigment intermingled with calcium carbonate was often found, as seen in Figures 21, 27 and 30.

The stratigraphy of paint layers are inconsistent and confusing.

Generally, a substrate layer is found that resembles a typical *frescointonaco*. It is fine grained and appears to be composed of calcium carbonate and sand. On top of this layer there is often found a pigmented granular thick layer that appears to be the first layer in a fresco ground. In the case of *Las Casas*, this layer is particularly convincing as fresco because lime tests are positive and it is generally the same pink beige color suggesting that the layer was applied as a base coat. (See Figures 17, 19, 23, 30, 34, 36, 38, and 42).

Distinctive from these samples is a second group of samples distinguished by the presence of a layer that appears to be a yellow film-forming paint layer, bound by oil or glue. It is characterized by its relative thinness, density and the absence of crystalline particles associated with lime. In these examples, the layer directly on top of the substrate is often yellow and is then covered with another paint layer or layers which differ. (See Figures 25, 40, 44, and 46).

Other samples that are also of interest do not fall into these stratigraphic typologies. For example, Sample **A.I.10.a** (see **figure 32**) is interesting as it appears to



represent three different painting stratigraphies in one cross section, perhaps corresponding to the juncture of three differently painted parts of the sampled area. On the left side of the sample there is a siliceous substrate and then a thin red/orange layer and then a yellow layer. At the middle, there is instead of the substrate, a pink layer, as mentioned above, with blue pigment particles. This strata is partially covered with a white layer and then covered, as the rest of the sample, with a thin red/orange and then a yellow layer, both of which appear to be paint films other than fresco. The right part of the sample illustrates an orange layer on top of which is a white layer and then the same thin red/orange and yellow layers.

The sample was extracted from a location where impressions of banding at the border were found adjacent to a location of original paint (estimated). It appears that the substrate is most instructive of the painting history: the left and central portions reveal original ground. The right part of the sample instead suggests that the white layer was added. The continuous red/orange and then yellow layers are later additions since they cover all underlying layers. Possibly, these original layers correspond to color changes - namely tan and pink/blue- in the composition that was later altered with the addition of the white layer and then the overpainting in red/orange and yellow.

Sample **A.I.9.a.**, (see Figure 27) a less adulterated sample, provides a good example of fresco. Also extracted at the banding border at the base of the painting, the sample illustrates the presence of the substrate, a red/orange fresco layer, (positive for lime by microchemical tests), a pink layer, also fresco, and a black non-fresco layer, not perceptible in the photograph. The stratigraphy, except below the black layer where it would be difficult to see, is uninterrupted by dirt layers or other indications of the passage of time in between layers.

The sample was taken from a black surface paint layer, as confirmed by the upper black strata seen in cross section. It was expected that a red paint layer existed beneath the black. At the right of the photomicrograph, the pink layer thins to the red layer, perhaps an example of the anticipated stratigraphy. It appears that the black layer was an intervention addition to an original frescoed ground.

Cross-sectional samples of the paint flakes call into question the assertion above that the paint is non-fresco. Sample **A.I.4.b.**, (Figure 21) taken of a flake, appears to be fresco, as evidenced by the density of the pigment, the thickness of the layer and the apparent absence of medium. Without the presence of giornate or other fresco evidence



however, this appearance is confusing. On the other hand, the paint layer might be lime-based *secco*.

Sample A.I.1.a. (Figure 13) deviates from other groups due to the presence of a translucent layer between the substrate and the paint layers that appears to be a glue or wax. The sample was taken from the cushion of the chair seat in a location with red with green shading that appeared to have been overpainted and to have, below the overpaint, original surface. Indeed the cross-section reflects that fact. The uppermost layer is green. Below it are two layers of red/orange that appear to be fresco or lime *secco* and a white paint layer. Below this white layer the tan/yellow translucent layer is found. A fine white substrate exists at the lower margin of the sample. The sample is interesting because it suggests that a layer of a material, perhaps a glue, was used as preparatory to the application of paint layers. This practice, as indicated in Chapter 3, Technique, was used in the Baroque period, and was documented in the writing of Andrea Pozzo.

From review of the cross-sectional samples, it is apparent that the several techniques of painting coexist in the lunette, including lime painting or fresco. These differences may result from the use of several techniques by the artist. More likely, they reflect different campaigns in the history of the painting.

Fluorescent staining provides a clearer picture of the sample stratigraphies.



## **2. MEDIUM**

### **FLUORESCENCE STAINING**

#### **CONFIRMATION: FT-IR**

In general, staining revealed the presence of proteins and lipids, and very rarely, gums or carbohydrates. Of these, oils were most often found to be present. With marked frequency, staining suggested that the samples contained none of these materials and were probably fresco.

In the following discussion, the groups of samples indicated above will be discussed as groups with regard to identification of medium.

In the group **A.I.2.a.**(Figures 15 and 16); **A.I.2.b.**(Figures 17 and 18); **A.I.3.b.** (Figures 19 and 20); **A.I.5.b.**(Figures 23 and 24); **A.I.9.b.**(Figures 30 and 31); **A.I.10.b.9** (Figures 34 and 35) ; **A.I.13.**(Figures 36 and 37) ; **A.II.1.b.**(Figures 38 and 39); **A. II.4.a.** (Figures 42 and 43) as indicated above, the following observations suggest that oils are present in unexpected locations and that proteins appear in limited amounts.

#### **OILS:**

Positive staining for oils with both the use of DCF and Rhodamine B appear in the stratas preparatory to the final layer of several samples. Those identified by Rhodamine B are: **A.II.4.a**, **A.II.1.b.**, **A.I.13.a.**, and **A.I.2.a.**. In all of these examples, it appears that oils have either been applied, mixed or have penetrated into layers below the paint that appear to be fresco layers. Positive lipid staining with DCF appear in the following samples: **A.I.2.b.**, **A.I.3.b.**, **A.I.9.b.**, **A.I.10.b.**, **A.II. 1.b.**, **A.II.4.a.**

#### **PROTEINS:**

However, in some of those same samples, proteins appear to be present. For example, positive stains with FITC occur in Samples **A.II.4.a.** and **A.II.1.b.** In sample **A.II.4.a.** The positive identification occurs in the same layer as the that for oils while, for



Sample **A.II.1.b.**, the positive for proteins appears in a discrete layer between the presentation paint layers and the substrate.

Of this group, one sample was selected for FT-IR analysis. Sample **A.II.4.a.** was further studied for the purpose of confirming positive identification of oil and protein medium through fluorescent staining. A specimen from the layer identified as proteinaceous was extracted, dissolved first in methylene chloride and then in acetone. The solvent evaporated and the residue was scraped from the slide and placed on the diamond cell for analysis. At 200 scans, the resulting spectrum illustrated strong carbonyl bands at 1657 cm<sup>-1</sup> and at 3300 cm<sup>-1</sup> and 1520 cm<sup>-1</sup>, characterizing the material as a protein. (see Figure 48). When coupled with a reference spectrum from the Gettens collection of binding media, the sample spectrum closely matched a spectrum for parchment glue.<sup>2</sup>(See Figure 49).

In order to be assured that oils were not also present, additional sample was dissolved as above. A similar spectrum resulted and matched closely to a reference spectrum of rabbit skin glue. In these and additional trials, the same information was produced. The sample contained proteinaceous material.

That this information can be applied to other samples within the group or to similar locations in the painting is possible. Similar stratigraphies taken at the border banding at the paintings lower margin also stain positive for lipids and might well contain oil medium. This could be a product of the painting technology at that location, or generalized to larger passages of the entire composition.

Of the group samples: **A.I. 8.b.**, **A.II.3.a.**, **A.II.4.b.**; **A.II.6.c.**, a different similarity among the group is found than that described above. Instead of being united by apparent fresco layers, this group has in common the presence of a yellow paint film located directly on top of the substrate, over which additional paint layers exist. The samples were extracted from widely different locations, the banding at the border, the window in the left side of the composition and the black robe of Las Casas, locations that appear to be original surfaces or to retain, beneath overpaint, original paint layers. In the cases of **A.II.8.b.** , **A.I.3.b.** , and **A.II.4.b.**, a pink paint layer, lime secco or fresco, is located on top of the yellow layer. All of these samples also have a final black overpainted layer, that appears to be bound in an oil or other medium other than fresco.

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<sup>2</sup> The Gettens Collection is currently being recorded in FT-IR spectra for reference.



When stained for carbohydrates, reducing sugars, such as gums are generally not indicated in the samples, with the exception of Sample **A.II.4.b.** where a positive result from TTC appears in the material surrounding the yellow layer indicated above.

Oils appear to be present in the substrate and in the yellow layer. The presence of oils in the substrate identified by Rhodamine B is seen in sample **A.II.3.a.** and possibly, **A.II.4.a.** With DCF, positive staining in the substrate is seen in all of the samples of the group, including samples **A.I.8.b.**, **A.II.6.a.**, **A.II.3.a.** and **A.II.4.b.** Staining suggests that an oil, in some form, is present as an addition or as an intervention or original material applied on top and penetrated into the substrate material.

Positive staining for oils appear in the upper paint layers, such as the yellow layer, as might have been expected. If the top black layer stained positive for lipids it would be difficult to detect.

Positive staining for proteins is also indicated in the substrate of samples **A.II.3.a.** and **A.II.4.b.**, suggesting that a glue, egg or casein are present in the substrate material. A positive stain for proteins also appears in the layer below the yellow film of sample **A.I.8.b.**

The results of staining indicate that organic binding materials are present in the substrate material. In particular, oils and proteins appear to exist. Curiously, the thinner layers which would be more likely candidates for the addition of organic materials, appear to be bound in a medium other than those tested and might be lime painting.

Two samples were selected for further analysis by FT-IR. Chosen because of the difficulty in seeing a positive stain on the black upper paint layer and because this stratigraphy represents several of the samples in the group, a specimen from the upper black layer of sample **A.II.3.** was analyzed by FT-IR. The resulting spectrum indicated the presence of carbonyl bands at 1734  $\text{cm}^{-1}$ , on the border of shellacs and oils, and characteristic peaks at 2926  $\text{cm}^{-1}$ , 2825  $\text{cm}^{-1}$ , for oils and at 1448  $\text{cm}^{-1}$  for resins. (Figure 50). When overlaid with a reference spectrum of white linseed oil from the Gettens Collection, the match indicates that the specimen is linseed oil. (Figure 51). Additionally, a natural resin is probably present.

Sample **A.II.4.b.** was also analyzed by FT-IR. It was selected as representative of the group for the presence of proteins. A specimen from the substrate was extracted for analysis. The resulting spectrum with characteristic carbonyl bands at 1560  $\text{cm}^{-1}$  and peaks at 3300  $\text{cm}^{-1}$ , closely matched Gettens samples French Glue "B" and rabbit skin glue spectra. (Figure 52) and a rabbit skin glue (Figure 53).



**PHOTOGRAPH: "LAS CASAS"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA

DATE: 1/92

ILLUMINATION: TUNGSTEN FILAMENT

PHOTO BY: CSM

CAMERA: OLYMPUS -OM WITH 35 MM PERSPECTIVE CORRECTION LENS

---



**FIGURE 3**

COMMENTS: BLACK AND WHITE PHOTOGRAPHS ILLUSTRATE THE SHINELY SURFACE OF *LAS CASAS*, CHARACTERISTIC OF OIL PAINTS, AND THE PRESENCE OF MOTTLED OVERPAINT, PARTICULARLY PRONOUNCED IN THE BACKGROUND.



**PHOTOGRAPH: "LAS CASAS"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA

DATE: 1/92

ILLUMINATION: TUNGSTEN FILAMENT

PHOTO BY: CSM

CAMERA: OLYMPUS -OM WITH 35 MM PERSPECTIVE CORRECTION LENS

---



**FIGURE 4**

COMMENTS: BLACK AND WHITE PHOTOGRAPHS ILLUSTRATE THE SHINELY SURFACE OF LAS CASAS, CHARACTERISTIC OF OIL PAINTS, AND THE PRESENCE OF MOTTLED OVERPAINT, PARTICULARLY PRONOUNCED IN THE BACKGROUND.



RAKING LIGHT  
PHOTOGRAPH: "LAS CASAS"

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS -OM WITH 80-200 MM ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

---



FIGURE 5

COMMENTS: TAKEN OF A PASSAGE WHERE *GIORNATE* AND OTHER INDICATIONS OF FRESCO WOULD BE SEEN IN RAKING LIGHT, AT THE LOWER PART OF THE PAINTING, THIS PHOTOGRAPH DOCUMENTS THEIR ABSENCE.



RAKING LIGHT  
PHOTOGRAPH: "LAS CASAS"

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-1000

DATE: 1/92  
PHOTO BY: CSM

---



FIGURE 6

COMMENTS: WITH RAKING LIGHT, THE ABSENCE OF *GIORNATE*, INCISIONS AND *PUNTINI* IS APPARENT, AS IN THIS DETAIL OF THE INDIAN, AT LOCATIONS WHERE THEY WOULD NORMALLY OCCUR.



RAKING LIGHT  
PHOTOGRAPH: "LAS CASAS"

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-1000

DATE: 1/92  
PHOTO BY: CSM

---



FIGURE 7

COMMENTS: WITH RAKING LIGHT, THE ABSENCE OF *GIORNATE*, *INCISIONS* AND *PUNTINI* IS APPARENT, AS IN THIS DETAIL OF THE CHAIR AND TORSO OF THE CENTRAL FIGURE, LOCATIONS WHERE THEY WOULD NORMALLY OCCUR.



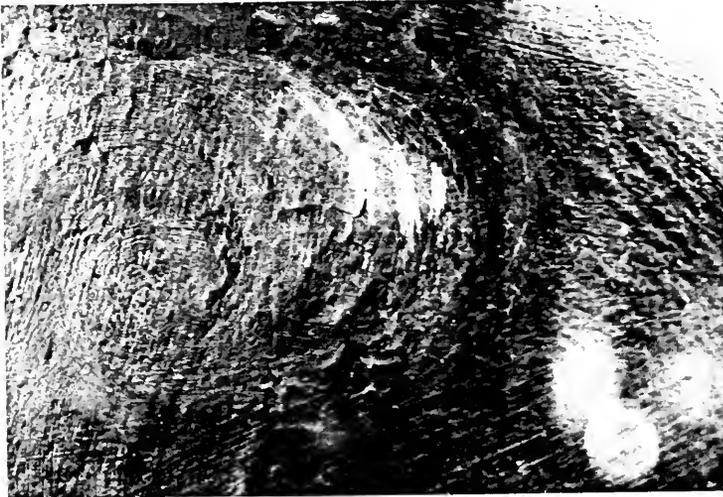
**MACROPHOTOGRAPH: "LAS CASAS"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS -OM WITH 80-200 MM ZOOM

DATE: 1/92  
PHOTO BY: CSM

---



**FIGURE 8**

COMMENTS: CLOSE-UP PHOTOGRAPHS ILLUSTRATE THE OCCURRENCE OF FLAKING PAINT, HERE AT THE ARM OF THE CHAIR IN A BROWN COLORED PASSAGE. THE PRESENCE OF FLAKING PAINT ASSOCIATED WITH BROWN, YELLOWS AND ORANGE/RED COLORS MAY BE FOUND THROUGHOUT BRUMIDI'S WALL PAINTINGS, PARTICULARLY THE FRESCOES, AT THE U.S. CAPITOL.



**MACROPHOTOGRAPH: "LAS CASAS"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS -OM WITH 80-200 MM ZOOM

DATE: 1/92  
PHOTO BY: CSM

---



**FIGURE 9**

COMMENTS: THIS DETAIL OF THE HAND OF LAS CASAS ILLUSTRATES THE PLASTER TEXTURE AND BRUMIDI'S RAPID PAINTING STYLE.



RAKING LIGHT  
PHOTOGRAPH: "LAS CASAS"

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS -OM WITH 80-200 MM ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

---



FIGURE 10

COMMENTS: THIS DETAIL OF THE WINDOW WITHIN THE COMPOSITION REVEALS, AGAIN, A SURFACE WITHOUT DRAWING METHODS PRESENT OR *GIORNATE* AND WITH A SKETCHY HANDLING OF THE FIGURES.



OVERPAINT

 Overpaint



"LAS CASAS"

FIG. 11

Fresco by: CONSTANTINO BRUMIDI  
Ground Floor, Senate Corridors, United States Capitol  
Prepared by: Catherine S. Myers

Washington, D.C.  
May 1992

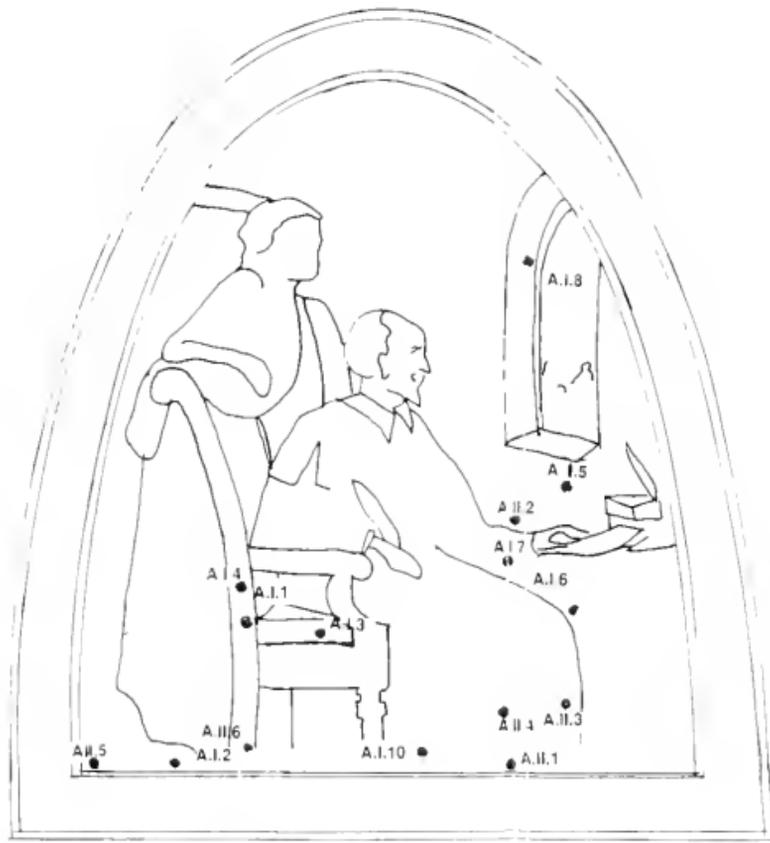


Overprint

OVERPRINT

SAMPLE LOCATION

• Sample Location



"LAS CASAS"

FIG 12

Fresco by: CONSTANTINO BRUMIDI  
Ground Floor, Senate Corridors, United States Capitol  
Prepared by: Catherine S. Myers

Washington, D.C.  
May 1992



• Sample Location

SAMPLE LOCATION

"LAS CASAS" SAMPLE # A.I.1.a.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 13

SAMPLE LOCATION: 23 1/2" --> X 12"

COMMENTS: THE SAMPLE WAS TAKEN FROM THE CHAIR SEAT CUSHION. THE ORIGINAL SURFACE IS DARK RED WITH DARK GREEN SHADOWS. IT APPEARS TO BE ORIGINAL SURFACE. IN CROSS SECTION THE TOP LAYER OF THE PAINTING IS DARK GREEN (A); UNDER IT, THERE ARE TWO RED LAYERS (B). A WHITE LAYER (C), A FILM THAT APPEARS TO BE AN ORGANIC MATERIAL SUCH AS GLUE, AND THE WHITE FINE SUBSTRATE. ALL LAYERS APPEAR TO BE FRESCO OR LIME BOUND PAINT.



"LAS CASAS" SAMPLE # A.I.1.a.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA

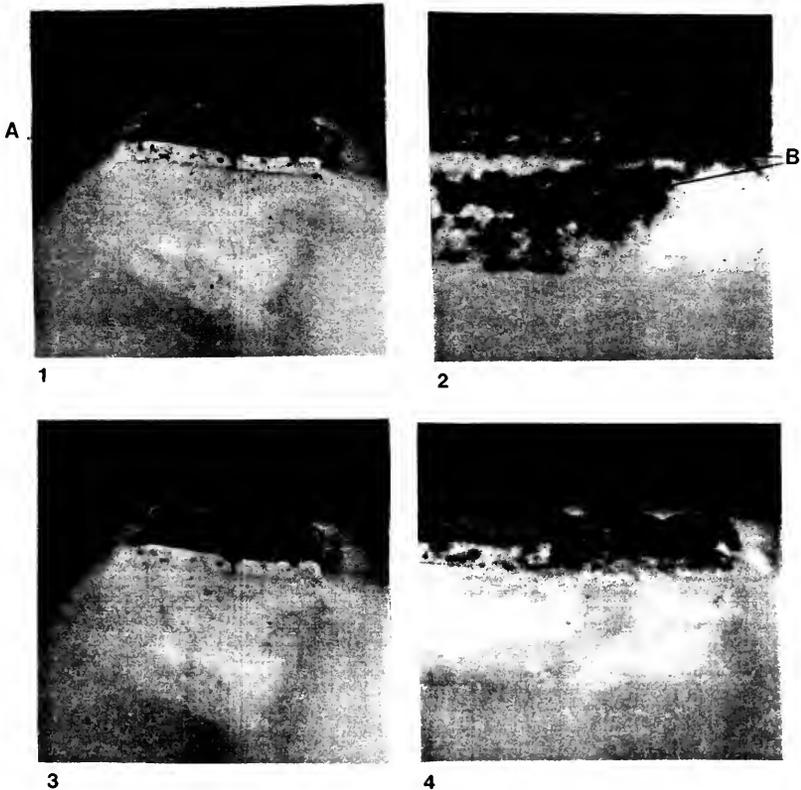


FIGURE 14

COMMENTS: 1. AUTOFLUORESCENCE OCCURS IN THE SUBSTRATE, WHITE LAYER AND IN THE GREEN AND RED LAYERS. THE SECOND RED LAYER IS VERY NON-FLUORESCENT (A). 2. WITH TTC, POSSIBLE STAINING APPEARS WITHIN THE SUBSTRATE (B) 3. FITC STAINS FOR PROTEINS IN THE SUBSTRATE AND WHITE LAYER. 4. WHEN STAINED FOR DCF, SLIGHT POSITIVE APPEARS IN SUBSTRATE AND WHITE LAYER 5. RHODAMINE B DOES NOT REALLY STAIN.



"LAS CASAS" SAMPLE # A.1.2.a.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA

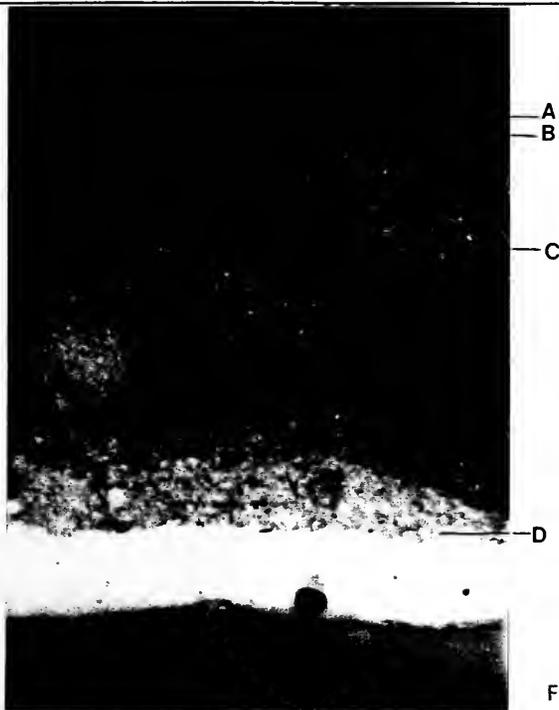


FIGURE 15

SAMPLE LOCATION: 19" --> x 0"

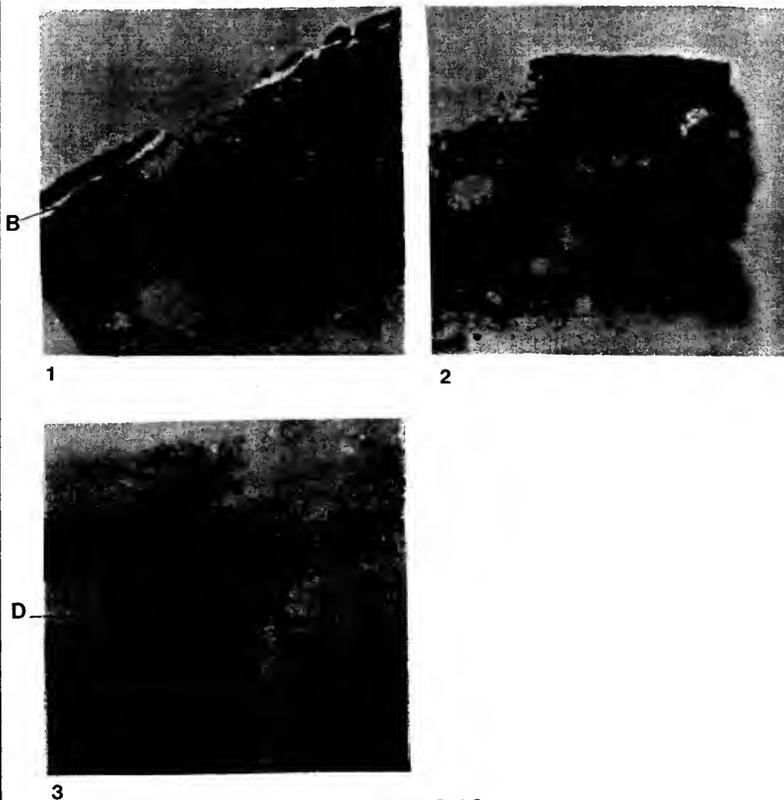
COMMENTS: SAMPLED FROM A SURFACE BULGE, THE SURFACE LAYER WAS RED WITH DARK GREEN MOTTLING. THE SAMPLE INCLUDED THE SUBSTRATE. IN CROSS SECTION, THERE IS A THIN RED SURFACE LAYER (A), A THIN WHITE LAYER (B), A TAN FRESCO THICK LAYER (C), A BEIGE FRESCO LAYER (D) AND A WHITE SUBSTRATE (EST.).



**"LAS CASAS" SAMPLE # A.I.2.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ-35mm  
FILM: KODAK GOLD 200 ASA



**FIGURE 16**

COMMENTS: 1. THERE IS LIMITED AUTOFLUORESCENCE, PRONOUNCED ONLY IN LAYER (B) 2. NO STAINING WITH DCF 3. WITH RHODAMINE B ON A TRACE OF THE REMAINING SAMPLE, STAINING OCCURS IN THE BEIGE FRESCO LAYER (D). IT APPEARS THAT OILS ARE PRESENT IN THE FRESCO LAYER ABOVE THE SUBSTRATE. THE AUTOFLUORESCENT LAYER (B) COULD BE RESINOUS OR OIL-BOUND.



"LAS CASAS" SAMPLE # A.I.2.b.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 17

SAMPLE LOCATION: 14" --> X 0" ↑

COMMENTS: SAMPLED FROM A SURFACE BULGE, THE SURFACE LAYER WAS RED WITH DARK GREEN MOTTLING. THE SAMPLE INCLUDED THE SUBSTRATE. IN CROSS SECTION, THERE ARE MANY LAYERS: DARK GREEN APPEARS ON TOP FOLLOWED BY ORANGE, DARK RED, WHITE ORANGE AND BROWN. EVIDENTLY THE SAMPLE REPRESENTS THE STRATIGRAPHY OF THE BANDING AT THE PAINTING BORDER.. THE BROWN LAYER APPEARS TO BE FRESCO. SUBSEQUENT LAYERS COULD BE LIME BOUND SECCO OR OTHER MEDIUM.



**"LAS CASAS" SAMPLE # A.I.2.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3

**FIGURE 18**

COMMENTS: 1. THE SUBSTRATE AND WHITE LAYER AUTOFLUORESECE. 2. WITH TTC, THERE IS NOT POSITIVE STAINING 3. FITC COLLECTS IN THE FISSURES AND POSSIBLY STAINS POSITIVELY. POSITIVE STAINING (NOT PICTURED) RESULTED WITH RHODAMINE B FOR OILS IN THE SURFACE PAINT LAYERS. APPARENTLY, THE LOWER LAYERS ARE LIME -BOUND WITH PROTEIN POSSIBLY PRESENT; THE UPPER LAYERS APPEAR TO CONTAIN OILS.



**"LAS CASAS" SAMPLE # A.I.3.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 19**

SAMPLE LOCATION: 34" --> X 10" ↑

COMMENTS: SAMPLED FROM THE CHAIR AT THE JUNCTURE OF THE ARM AND THE SEAT, THE AREA APPEARED TO BE OVERPAINTED. THE SURFACE OF THE PAINTING WAS BROWN AND YELLOW OCHER AND WAS FLAKING SLIGHTLY. IN CROSS SECTION, THE PAINT LAYERS APPEAR TO BE NON-FRESCO. A SURFACE FILM ON TOP HAS BENEATH IT A WHITE PAINT LAYER, THEN A YELLOW PAINT LAYER, A PINK PAINT LAYER AND THEN A WHITE PREAPARATION LAYER. AT THE BOTTOM IS A LAYER THAT APPEARS TO BE SUBSTRATE.



**"LAS CASAS" SAMPLE # A.I.3.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3



4

**FIGURE 20**

COMMENTS: 1. AUTOFLUORESCENCE OF THE PREPARATORY LAYER AND SUBSTRATE 2. FITC DOES NOT STAIN 3. TTC COLLECTS IN POOLS. SOME POSITIVE STAINING APPEARS IN THE UPPERMOST LAYER (A). 3. DCF COLLECTS IN POOLS AND POSITIVE STAINING POSSIBLY OCCURS IN THE YELLOW PAINT LAYER (B) THE SAMPLE APPEARS TO BE FRESCO OR OTHER MEDIUM AT THE UPPER LAYERS EXCEPT FOR THE LAYER INDICATED WHICH APPEARS TO BE AN OIL.



**"LAS CASAS" SAMPLE # A.I.4.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 21**

SAMPLE LOCATION: 17" ← X 36 1/4" ↓

COMMENTS: EXTRACTED AT THE EDGE OF A SMALL PAINT LOSS, THE SAMPLE APPEARED TO BE A PAINT FILM, UNLIKE FRESCO, ON SITE. IN CROSS SECTION, IT CERTAINLY APPEARS TO BE FRESCO AS EVIDENCED BY THE DENSITY AND THICKNESS OF THE SAMPLE AND THE APPARENT ABSENCE OF MEDIA.



**"LAS CASAS" SAMPLE # A.I.4.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



2



4

**FIGURE 22**

COMMENTS: THE SAMPLE IS BLACK IN U.V. VISIBLE ILLUMINATION. 2. WITH FITC STAINING 4. AND RHODAMINE B, THE FLUOROCROMES COLLECT IN THE VOIDS AND FISSURES AND DO NOT STAIN THE MATERIAL. APPARENTLY THE SAMPLE IS FRESCO AND IS WITHOUT OTHER MEDIA.



**"LAS CASAS" SAMPLE # A.I.5.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 23**

SAMPLE LOCATION: 17"← X 36 1/4"

COMMENTS: AS ABOVE, THE SAMPLE WAS EXTRACTED FROM THE SITE OF A PAINT LOSS. HOWEVER, IN CROSS SECTION, IT APPEARS TO BE QUITE DIFFERENT. A THIN FILM ON TOP HAS UNDER IT A TAN FRESCO (EST.) LAYER AND A WHITE SUBSTRATE.



"LAS CASAS" SAMPLE # A.I.5.b.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



2



3

FIGURE 24

COMMENTS: AUTOFLUORESCENCE APPEARS IN THE WHITE MATERIAL, SUBSTRATE AND TAN PAINT LAYER AND THE UPPERMOST LAYER IS NON-FLUORESCING 2. WITH FITC, STAINING OCCURS IN THE SUBSTRATE 3. WITH TTC, POSSIBLE POSITIVE STAINING APPEARS IN THE SUBSTRATE, TARGETING THE PRESENCE OF A GUM. THE SAMPLE APPEARS TO BE FRESCO WITH A POSSIBLE ADDITION OF PROTEINS AND GUMS TO THE SUBSTRATE.



"LAS CASAS" SAMPLE # A.I. 3.b.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 25

SAMPLE LOCATION: 4" ← x 8 1/2" ↓

COMMENTS: SAMPLED FROM WITHIN THE WINDOW IN THE OCHER BACKGROUND. THE SURFACE IS PAINTED IN A MOTTLED TECHNIQUE IN COLORS OF OCHER AND BROWNS THAT IS OVERPAINT. IN CROSS SECTION, THESE SAME COLORS APPEAR AS LAYERS IN THE CROSS SECTION, WITH PINK AS THE FIRST LAYER, THEN OCHER AND THEN A WHITE SUBSTRATE. A VERY THIN FILM APPEARS BETWEEN THE TWO PAINT LAYERS. (A).



"LAS CASAS" SAMPLE # A.I. 8.b.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA

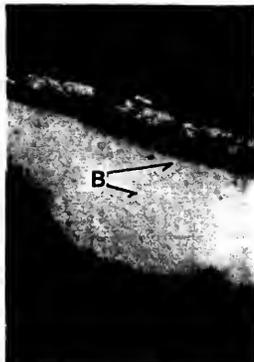
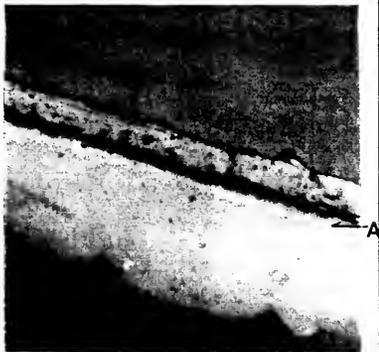
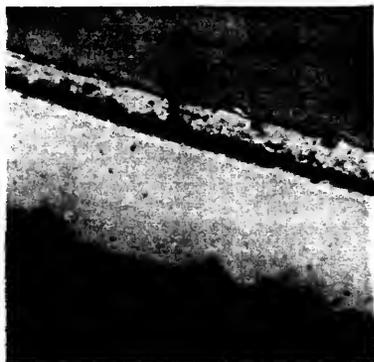


FIGURE 26

COMMENTS: 1. IN U.V. VISIBLE, THERE IS AUTOFLUORESCENCE IN THE SUBSTRATE AND THE UPPERMOST PINK LAYER. 2. WITH FITC, STAINING APPEARS IN THE TWO PAINT LAYERS AND SLIGHTLY AT THE TOP OF THE SUBSTRATE (A) , AS THOUGH A PROTEIN HAD PENETRATED INTO THE SUBSTRATE. 3. WITH TTC, POSSIBLE POSITIVE STAINS APPEARS IN THE SECOND PAINT LAYER, (B). 4. POSITIVE STAIN FOR LIPIDS APPEARS WITH DCF IN THE SUBSTRATE IN STRIATIONS AND SLIGHTLY IN THE LAYER BETWEEN THE PAINT LAYERS AND THE SUBSTRATE. (B). 5. WITH RHODAMINE B, A POSITIVE STAIN APPEARS IN THE SAME LOCATION.



"LAS CASAS" SAMPLE # A.I. 9.a.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 27

SAMPLE LOCATION: 20" ← x 2" ↑

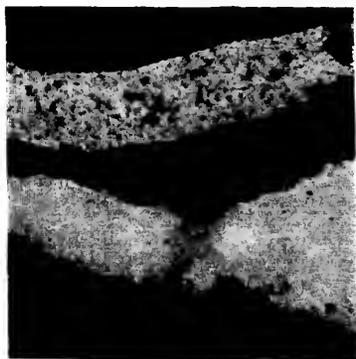
COMMENTS: SHOULD SHOW THE UNDERLYING PAINT LAYER OF RED UNDER BLACK. THE SAMPLE WAS TAKEN NEAR THE BORDER BANDING IMPRESSION AT THE BASE OF THE PAINTING. IN CROSS SECTION, A PINK FRESCO (EST.) LAYER HAS UNDER IT A THIN BLACK FILM/LAYER, AND A RED/ORANGE LAYER. THERE IS A WHITE SUBSTRATE. THERE IS A THIN DARK SURFACE FILM.



"LAS CASAS" SAMPLE # A.I. 9.a.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



3



4

FIGURE 28

COMMENTS: THE SAMPLE DOES NOT STAIN FOR PROTEINS OR GUMS. 3. A POSSIBLE POSITIVE STAIN FOR LIPIDS OCCURS WITH DCF IN THE SUBSTRATE 4. AND WITH RHODAMINE B IN THE RED/ORANGE LAYER. OILS ARE POSSIBLY PRESENT.



**"LAS CASAS" SAMPLE # A.I. 9.b.**

ILLUMINATION:  
MAGNIFICATION:  
OBJECTIVE: 10 X

VISIBLE

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



**FIGURE 29**

AT 200 X MAGNIFICATION, THE AMORPHOUS BLUE PIGMENT PARTICLES APPEAR TO BE COBALT. THE TEXTURE, WITH CALCIUM CARBONATE BLEBS AND SAND PARTICLES INTEGRATED IN THE PAINT LAYER, APPEARS TO BE FRESCO.



"LAS CASAS" SAMPLE # A.I. 9.b.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 30

SAMPLE LOCATION: 20" <-- x 2" ↑

COMMENTS: IT SHOULD SHOW THE UNDERLYING PAINT LAYER OF RED UNDER BLACK. THE SAMPLE WAS TAKEN NEAR THE BORDER BANDING IMPRESSION AT THE BASE OF THE PAINTING. IN CROSS SECTION, A THIN BLACK SURFACE FILM HAS BENEATH IT A WHITE/PINK FRESCO (EST.) LAYER, AND A THEN A LIGHT LAYER, ALSO APPEARING TO BE FRESCO, WITH BLUE PIGMENT PARTICLES IN IT. AN ORANGE LAYER IS ATTACHED TO THE BOTTOM OF THE LAST LAYER. (A).



"LAS CASAS" SAMPLE # A.I. 9.b.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

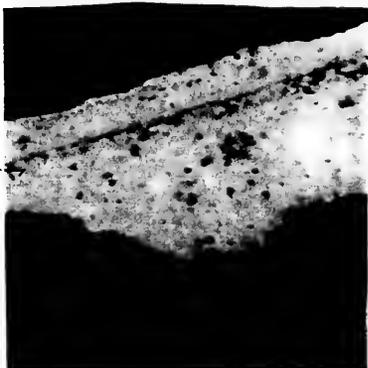
LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ-35mm  
FILM: KODAK GOLD 200 ASA



1



2



3

FIGURE 31

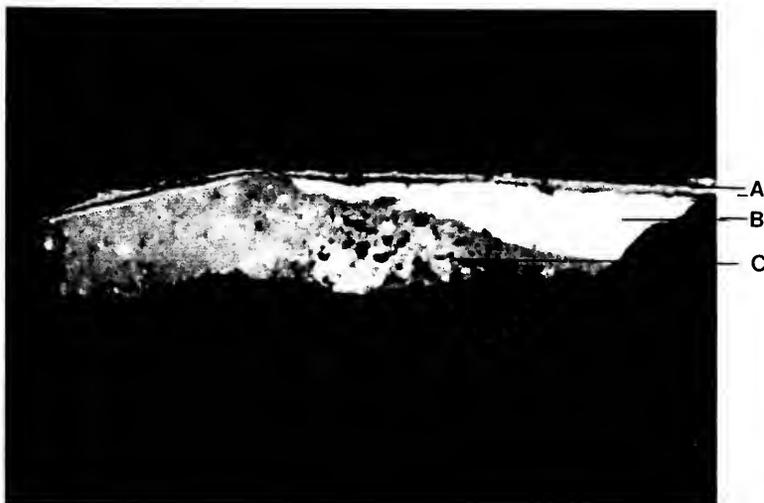
COMMENTS: 1. THE SAMPLE AUTOFLUORESECES IN THE LIME MATRIX. 2. FITC STAINS THE FIRST FRESCO (EST.) LAYER (A) 3. DCF FOR OILS STAINS IN BETWEEN THE TOP PAINT LAYER, AS THOUGH STAINING PENETRATION INTO THE LAYER (B) .



**"LAS CASAS" SAMPLE # A.I.10.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 32**

SAMPLE LOCATION: 34" --> X 2"

COMMENTS: THE SAMPLE WAS TAKEN AT THE CHAIR LEG WITH THE EXPECTATION OF SEEING OVERPAINT SINCE THE SAMPLE IS AT A LOCATION OF PREVIOUS BANDS IMPRESSIONS, LIKE SAMPLE A.I.9.. THE SURFACE COLOR IS YELLOW OCHER. THE ADJACENT BACKGROUND COLOR IS BLACK. IN CROSS SECTION, A THIN YELLOW LAYER APPEARS ON TOP (A), FOLLOWED BY A WHITE LAYER ON ONE SIDE (B). BENEATH WHICH IS AN ORANGE AND BLUE LAYER (C), LIKE SAMPLE A.I.9. ON THE OTHER SIDE, PERHAPS CORRESPONDING TO THE JUNCTURE OF PREVIOUS BANDS, IS A TAN SUBSTRATE-LIKE MATERIAL.



"LAS CASAS" SAMPLE # A.I.10.a.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA

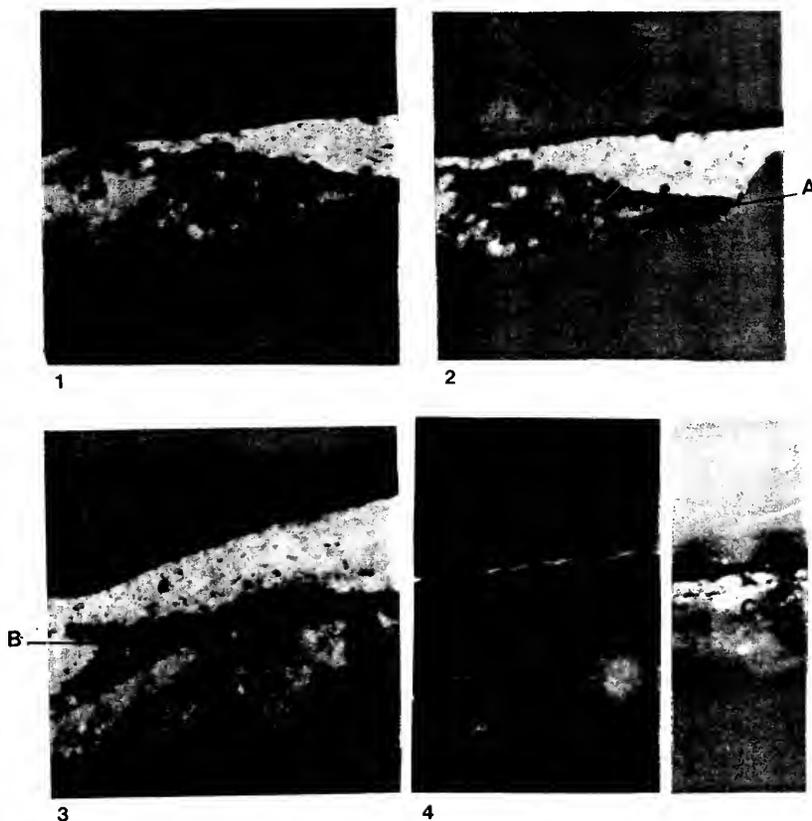


FIGURE 33

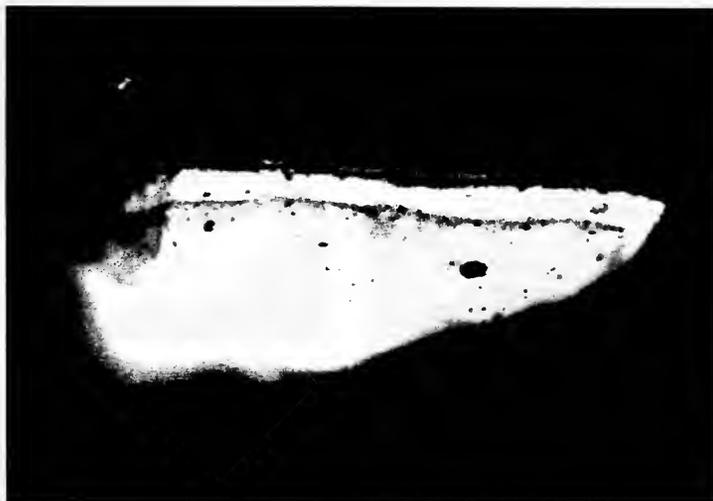
COMMENTS: 1. IN U.V. VISIBLE, THE TOP DARK LAYER IS VERY NON-FLUORESCING AND THE CALCIUM CARBONATE CONTAINING MATERIALS FLUORESC. 2. FITC STAINS ONLY AT THE BOTTOM OF THE SUBSTRATE-LIKE MATERIAL (A). 3. TTC STAINS BETWEEN LAYERS (B) 4. POSITIVE FOR OILS WITH RHODAMINE B APPEARS BETWEEN LAYERS (C). THE SAMPLE MIGHT CONTAIN TRACES OF PROTEIN MATERIAL AND LIPIDS IN A DISCRETE LAYER.



**"LAS CASAS" SAMPLE # A.I.10.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 34**

SAMPLE LOCATION: 34" --> X 2"

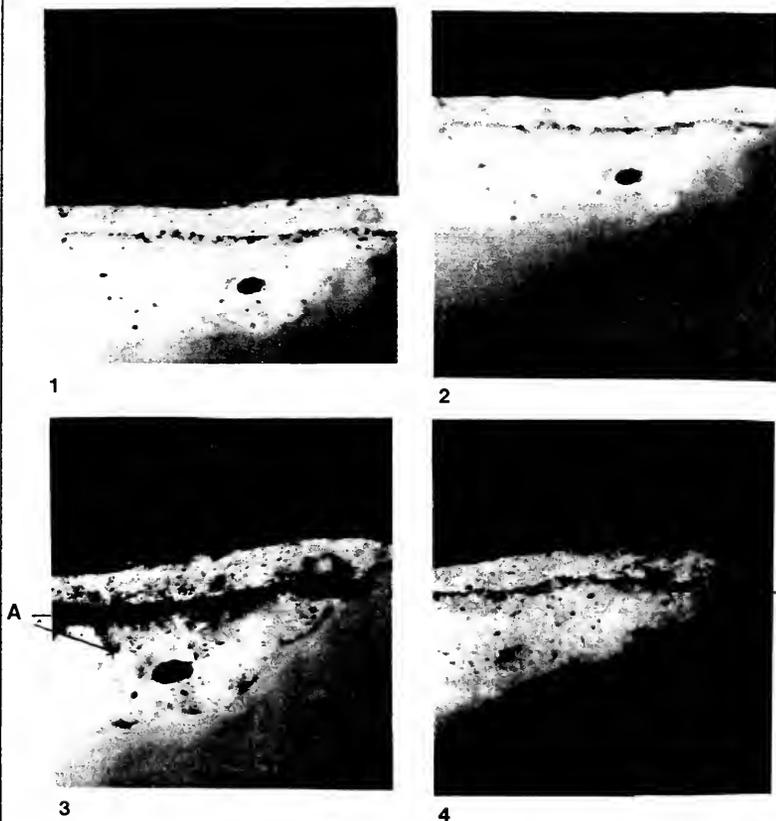
COMMENTS: THE SAMPLE WAS TAKEN AT THE CHAIR LEG. IT WAS EXPECTED TO SEE OVERPAINT BECAUSE THE SAMPLE WAS AT A LOCATION OF IMPRESSION OF PREVIOUS BANDS, LIKE SAMPLE A.I.9. THE SURFACE COLOR WAS YELLOW OCHER. THE ADJACENT BACKGROUND COLOR WAS BLACK. IN CROSS SECTRION, A THIN BROWN LAYER IS ON TOP FOLLOWED BY A WHITE /PINK LAYER , POSSIBLY FRESCO (EST.) , A THIN ORANGE LAYER AND THE PINKISH SUBSTRATE OR PAINT LAYER. THERE ARE CLOSE SIMILARITIES BETWEEN SAMPLES A.I.9 AND A.I.10.



**"LAS CASAS" SAMPLE # A.I.10.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



**FIGURE 35**

COMMENTS: 1. THE LIME CONTAINING MATERIALS AUTOFLUORESCENCE. 2. FITC DOES NOT STAIN. 3. A DEFINITE STAIN FOR GUMS WITH TTC APPEARS IN THE THIN ORANGE LAYER (A) AND WITHIN THE LOWER LAYER. 4. THAT SAME LAYER STAINS POSITIVELY FOR OILS WITH DCF. IT APPEARS THAT OILS OR GUMS ARE PRESENT BETWEEN THE SUBSTRATE AND THE PAINT LAYERS.



**"LAS CASAS" SAMPLE # A.I.13.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 36**

SAMPLE LOCATION: 0" -> X 0"

COMMENTS: THE SAMPLE WAS TAKEN AT THE BORDER BANDING. IT APPEARS TO BE FRESCO. THE OUTERMOST LAYER ON SITE WAS BROWNISH. IN CROSS SECTION, LAYERS ARE FROM THE TOP: DARK BROWN, RED/ORANGE, TAN AND WHITE.



**"LAS CASAS" SAMPLE # A.I.13.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3



4

FIGURE 37

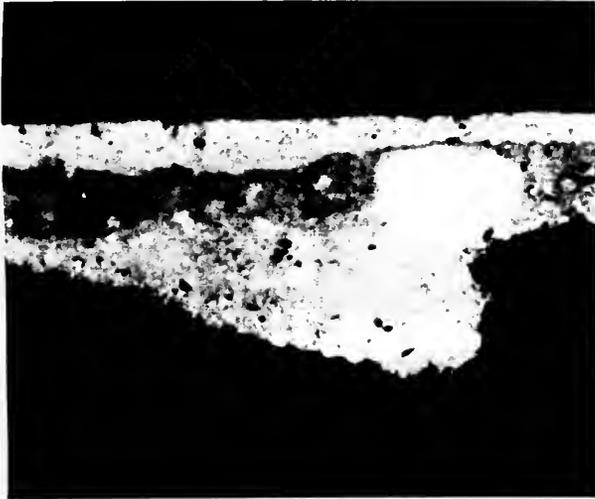
COMMENTS: 1. THE SAMPLE DOES NOT AUTOFLUORESC. 2. FITC DOES NOT STAIN. 3. NOR TTC, EXCEPT POSSIBLY IN THE TOP LAYER (A). 4. RHODAMINE B COLLECTS IN VOIDS WITHOUT STAINING.



**"LAS CASAS" SAMPLE # A.II.1.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 38**

SAMPLE LOCATION: 24" <- X 1 1/2"

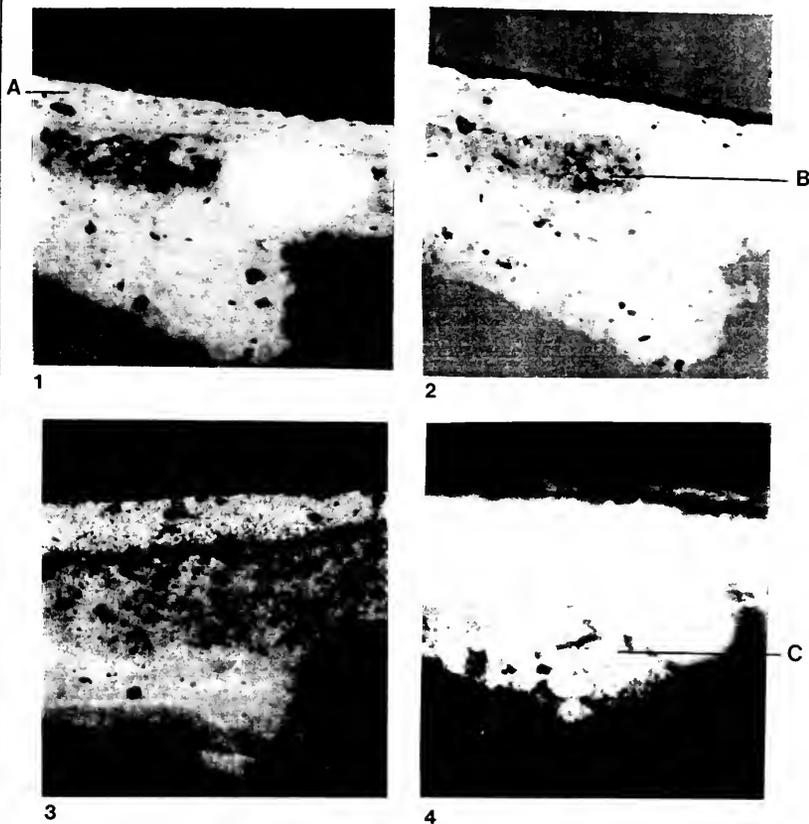
COMMENTS: THE SAMPLE SHOULD SHOW AN UNDERLYING RED PAINT LAYER, BENEATH BLACK. IT WAS TAKEN NEAR THE LOCATION OF EVIDENT PREVIOUS BANDING. IN CROSS SECTION, LAYERS FROM THE TOP ARE AS FOLLOWS: BLACK, PINK, ORANGE/RED WITH BLUE PIGMENT PARTICLES, PINK.



**"LAS CASAS" SAMPLE # A.II.1.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



**FIGURE 39**

COMMENTS: 1. U.V. VISIBLE LIGHT EMPHASIZES THE BLACK TOP LAYER. THE SECOND PAINT LAYER AUTOFLUORESCES. (A). 2. SLIGHT PRESENCE OF PROTEINS WITH FITC (B) 3. OILS APPEAR TO BE PERVASIVE ; STAINS WITH DCF APPEAR THROUGHOUT THE SAMPLE. 4. POSITIVE FOR OILS APPEARS IN THE BOTTOM PAINT LAYER (C).



**"LAS CASAS" SAMPLE # A.II.3.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 40**

SAMPLE LOCATION: 17 1/4" ← X 11 1/2"

COMMENTS: SAMPLED FOR THE BLACK ROBE OF THE FIGURE OF LAS CASAS. THE SAMPLE SHOULD SHOW UNDERLYING PAINT LAYERS AS WELL. IN CROSS SECTION, THE LAYERS ARE, FROM THE TOP: BLACK, PINK, ORANGE, TRANSLUCENT BEIGE LAYER (PERHAPS AN OIL, WAX OR GLUE) AND THE WHITE SUBSTRATE.



**"LAS CASAS" SAMPLE # A.II.3.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3



4

**FIGURE 41**

COMMENTS: THE LOWEST LAYER (SUBSTRATE) AUTOFLUORESCENCES 2. WITH FITC, THIS SAME LAYER STAINS AND FOR OILS BOTH 3. WITH DCF 4. AND WITH RHODAMINE B. THE EXPECTED POSITIVE STAINING FOR THE PAINT LAYERS IS DIFFICULT TO DETECT.



"LAS CASAS" SAMPLE # A.II.4.a.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 42

SAMPLE LOCATION: 24" ← X 8" ↑

COMMENTS: INTENDED TO INDICATE THE COLOR BENEATH THE OVERPAINTED BANDING AT THE PAINTING'S BORDER, THE SAMPLE WAS TAKEN AT THE LOCATION OF A BANDING IMPRESSION. IT SHOULD SHOW RED UNDER BLACK. IMPRESSIONS OF BANDING APPEAR AT THE LOWER HORIZONTAL 1 1/2" ABOVE THE EXISTING BORDER STRIPES UNLIKE THE OTHER MARGINS. IN CROSS SECTION, THE STRATIGRAHY IS DIFFERENT: BROWN, RED/ORANGE, TAN/WHITE, WHITE. ALL ALYERS APPEAR TO BE FRESCO.



"LAS CASAS" SAMPLE # A:II.4.a.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA

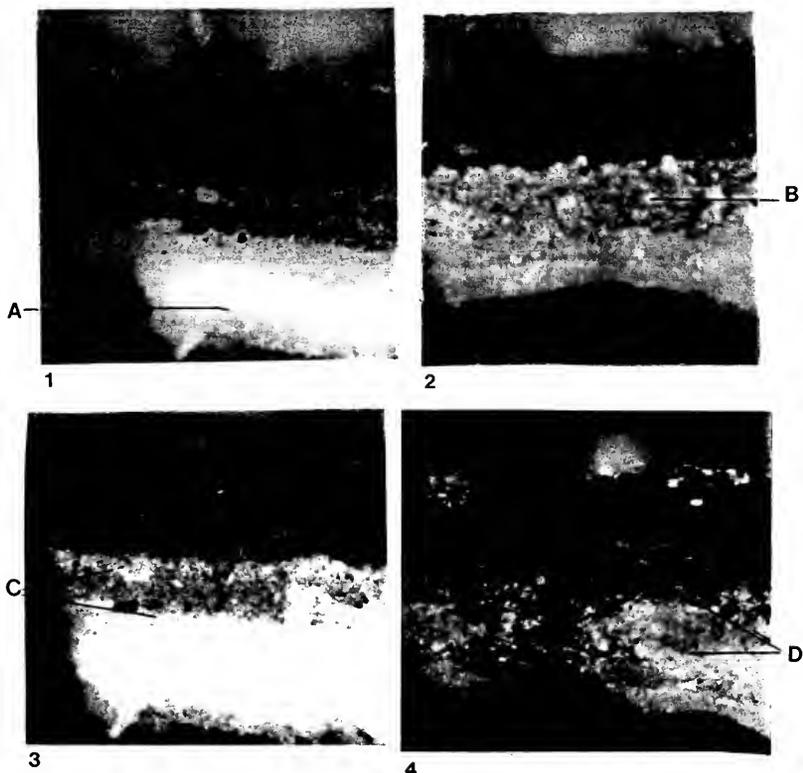


FIGURE 43

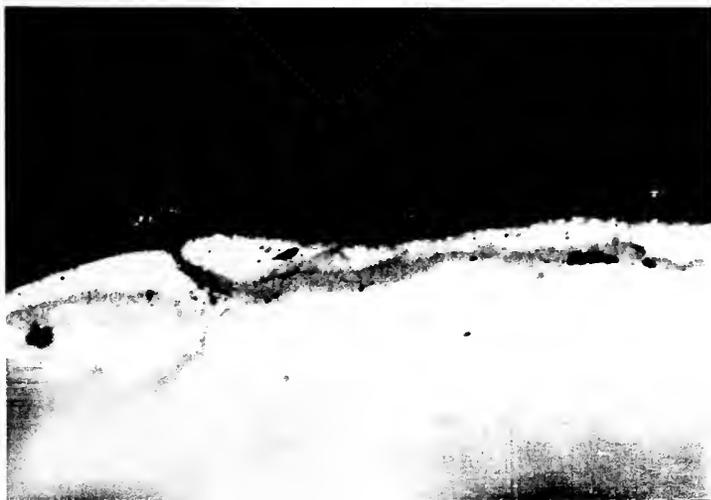
COMMENTS: 1. AUTOFLUORESCENCE AT THE SUBSTRATE (A). 2. POSITIVE STAIN WITH FITC APPEARS AT THE SUBSTRATE AND WITHIN THE LAYER ABOVE IT (B). 3. DCF APPEARS TO STAIN THE LOWER LAYERS (C) 4. POSITIVE STAINING APPEARS WITH RHODAMINE B IN THE LOWER LAYERS (D). THE SAMPLE APPEARS TO CONTAIN TRACES OF OILS AND POSSIBLT SOME PROTEINACEOUS MATERIAL.



**"LAS CASAS" SAMPLE # A.II.4.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 44**

SAMPLE LOCATION: 24" ← X 8" ↑

COMMENTS: INTENDED TO INDICATE THE COLOR BENEATH THE OVERPAINTED  
BANDING AT THE PAINTING'S BORDER, THE SAMPLE WAS TAKEN AT THE  
LOCATION OF A BANDING IMPRESSION. IT SHOULD SHOW RED UNDER BLACK.  
IMPRESSIONS OF BANDING APPEAR AT THE LOWER HORIZONTAL 1 1/2" ABOVE  
THE EXISTING BORDER STRIPES UNLIKE THE OTHER MARGINS. IN CROSS  
SECTION FROM THE TOP: BLACK, PINK, ORANGE AND WHITE SUBSTRATE. THE  
SAMPLE IS LIKE SAMPLE A.III.3.



**"LAS CASAS" SAMPLE # A.II.4.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3



4

**FIGURE 45**

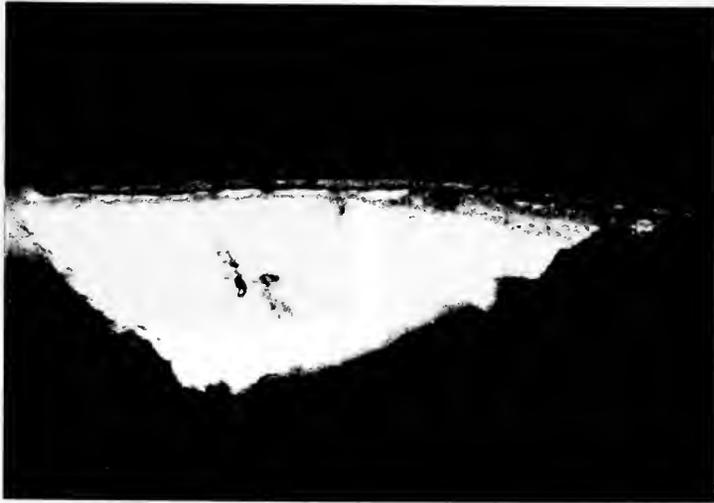
COMMENTS: 1. U.V. VIS. LIGHT SHOWS PRIMARY FLUORESCENCE IN THE CALCIUM CARBONATE CONTAINING MATERIAL. 2. WITH FITC, STAINS APPEAR IN THE SUBSTRATE AND THE PAINT LAYERS (A). 3. DCF POOLS WITHOUT STAINING.



**"LAS CASAS" SAMPLE # A.II.6.c.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 46**

SAMPLE LOCATION: 34"← X 0"↑

COMMENTS: AGAIN THE SAMPLE WAS EXTRACTED FORM THE BANDING IMPRESSION AT THE LOWER MARGIN AIMED AT SEEING ORIGINAL PAINT STRATIGRAPHY. IN CROSS SECTION. THERE ARE THIN LAYERS AND A SUBSTRATE AS FOLLOWS: BLACK, RED/ORANGE, RED/ORANGE, WHITE, TAN WHITE SUBSTRATE.



"LAS CASAS" SAMPLE # A.II.6.c.

ILLUMINATION: ULTRA-VIOLET VISIBLE

LIGHT SOURCE: MERCURY ARC

MAGNIFICATION: 50 X -70X

CAMERA: LEITZ- 35mm

OBJECTIVE: 10 X

FILM: KODAK GOLD 200 ASA

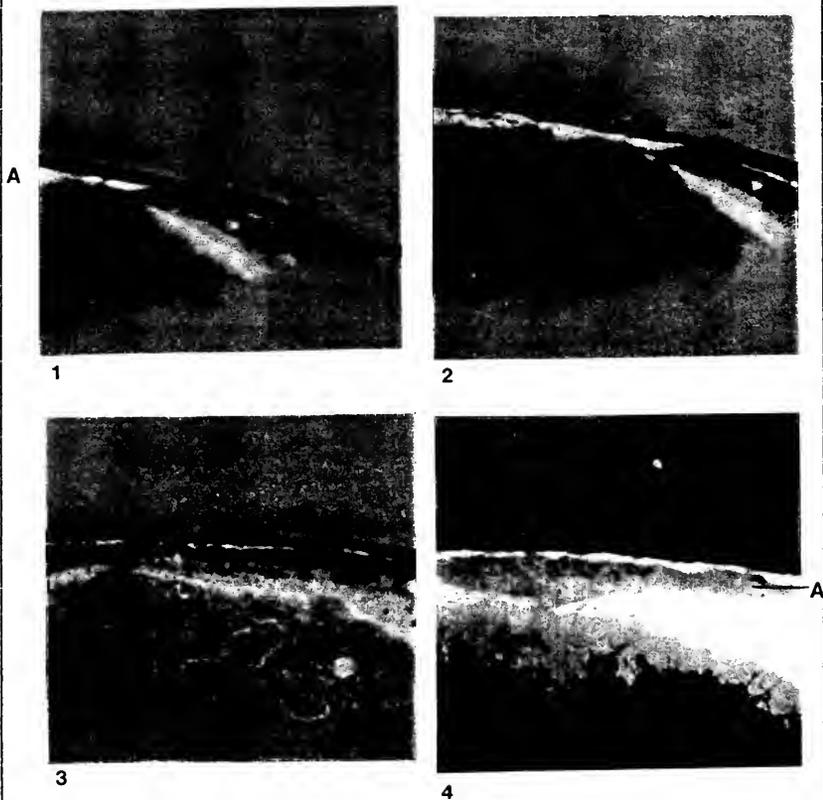


FIGURE 47

COMMENTS: 1. AUTOFLUORESCENCE APPEARS IN THE WHITE LAYER (A) 2. FITC-NEGATIVE 3. WITH DCF, STAINS FLUOROCHROME COLLECTS IN THE FISSURES 4. A POSITIVE STAIN WITH RHODAMINE B FOR OILS APPEARS IN THE ORANGE/RED LAYER (A).



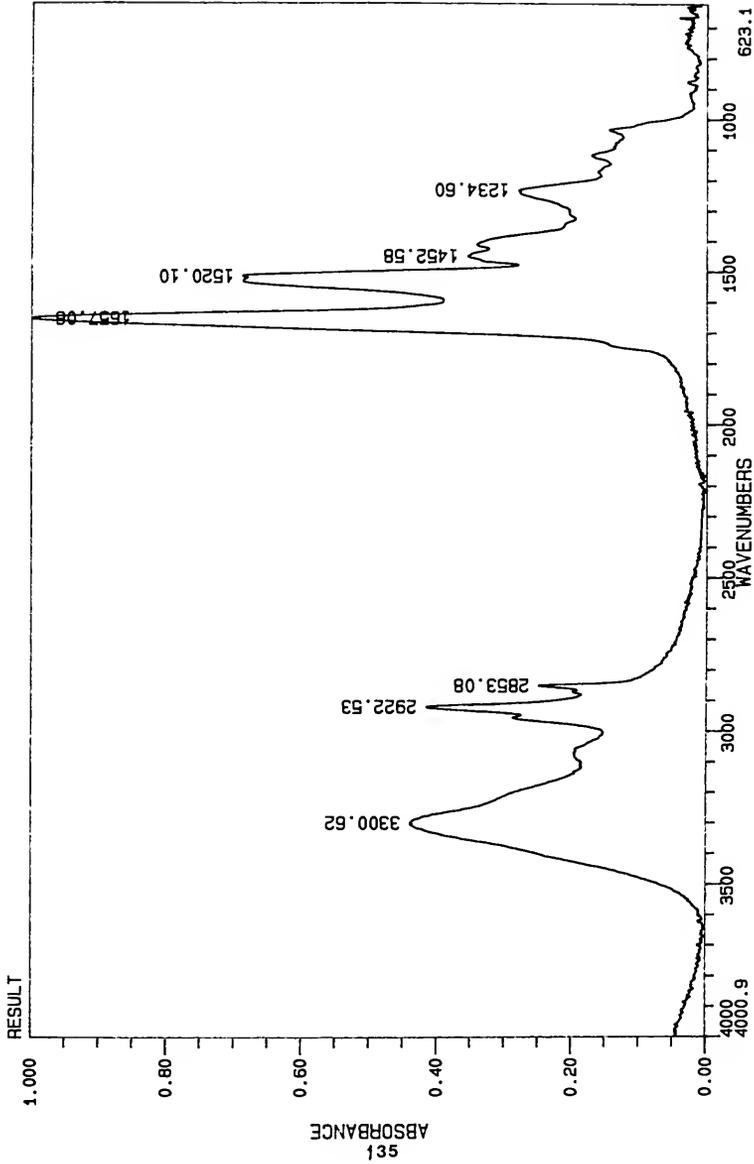


FIGURE 48

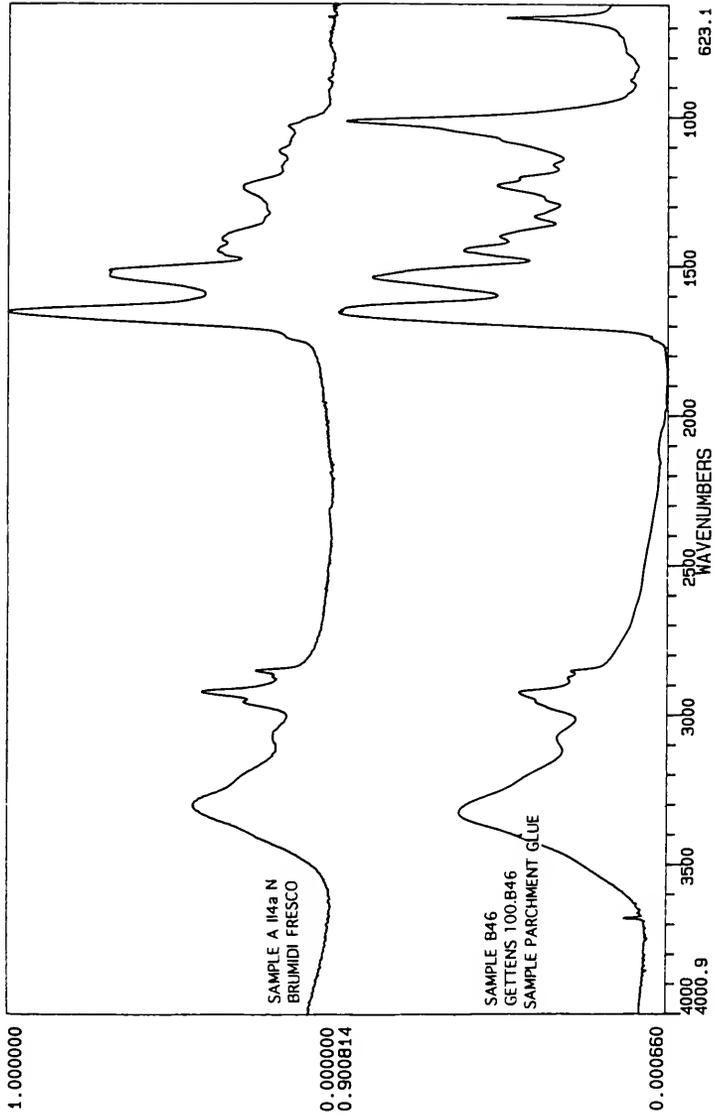
BRUMIDI FRESCO NEAT ON DIAMOND CELL  
A1148

SCANS: 200 RES: 4.0 TIME: 05/15/92 14:18:44

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



RESULT: LAS CASAS, WALL PAINTING BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL



136

FIGURE 49

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT

BRUMIDI SAMPLE A114a N: SUBSTRATE  
GETTENS 100.B46 SAMPLE B46 : PARCHMENT GLUE  
02/18/92 14: 18: 06



RESULT: LAS CASAS WALL PAINTING BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

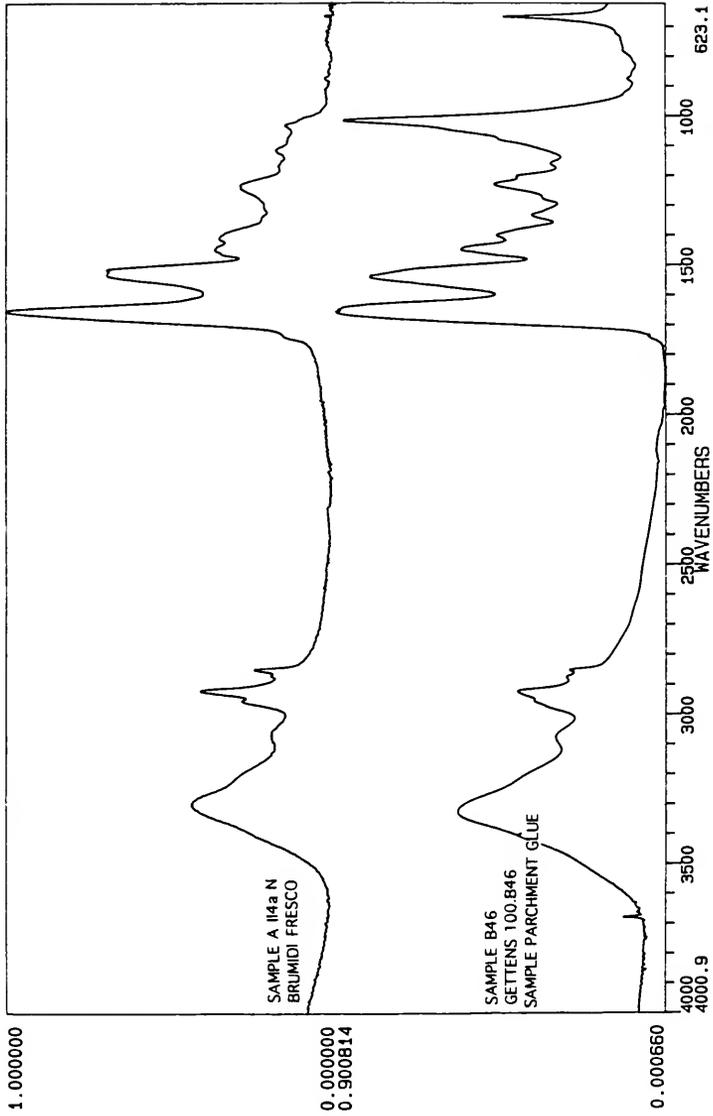


FIGURE 49

BRUMIDI SAMPLE A114a N: SUBSTRATE  
GETTENS 100.B46 SAMPLE B46 : PARCHMENT GLUE  
02/18/92 14: 18: 06

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



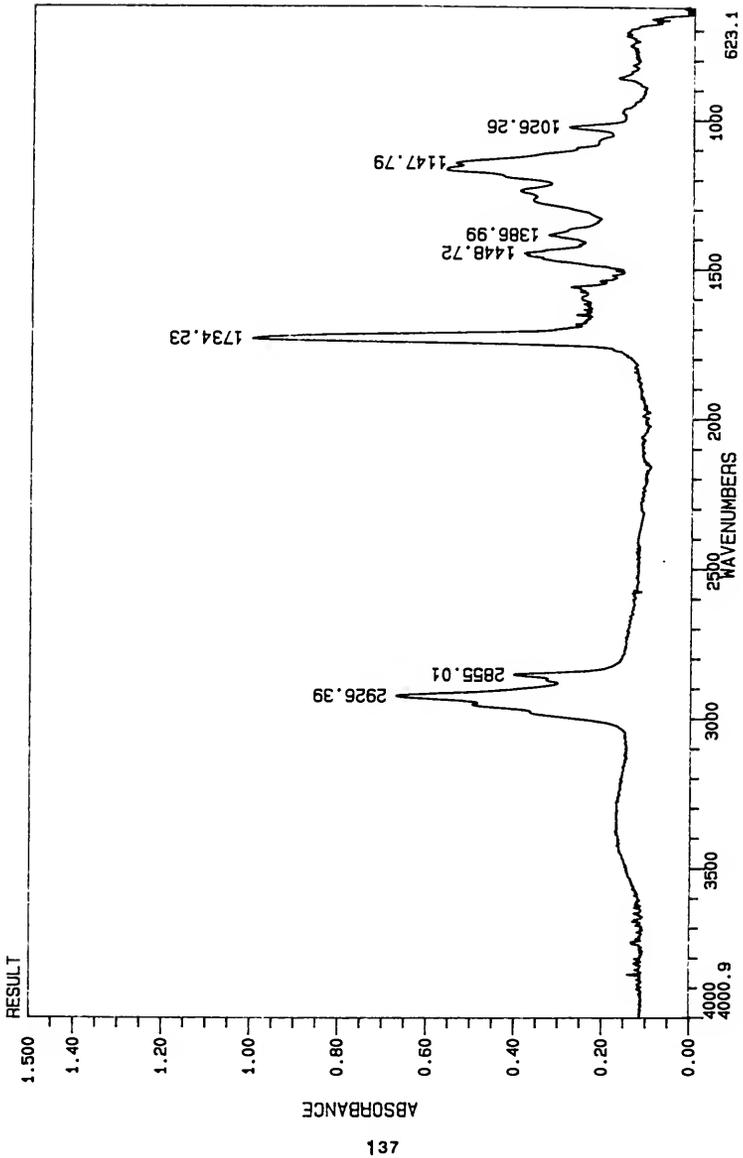


FIGURE 50

PHILADELPHIA MUSEUM  
 OF ART CONSERVATION  
 DEPARTMENT

ALIGN  
 BRUMIDI FRESCO  
 SCANS: 200 RES: 4.0 TIME: 06/22/92 12:32:12



RESULT: LAS CASAS, WALL PAINTING BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

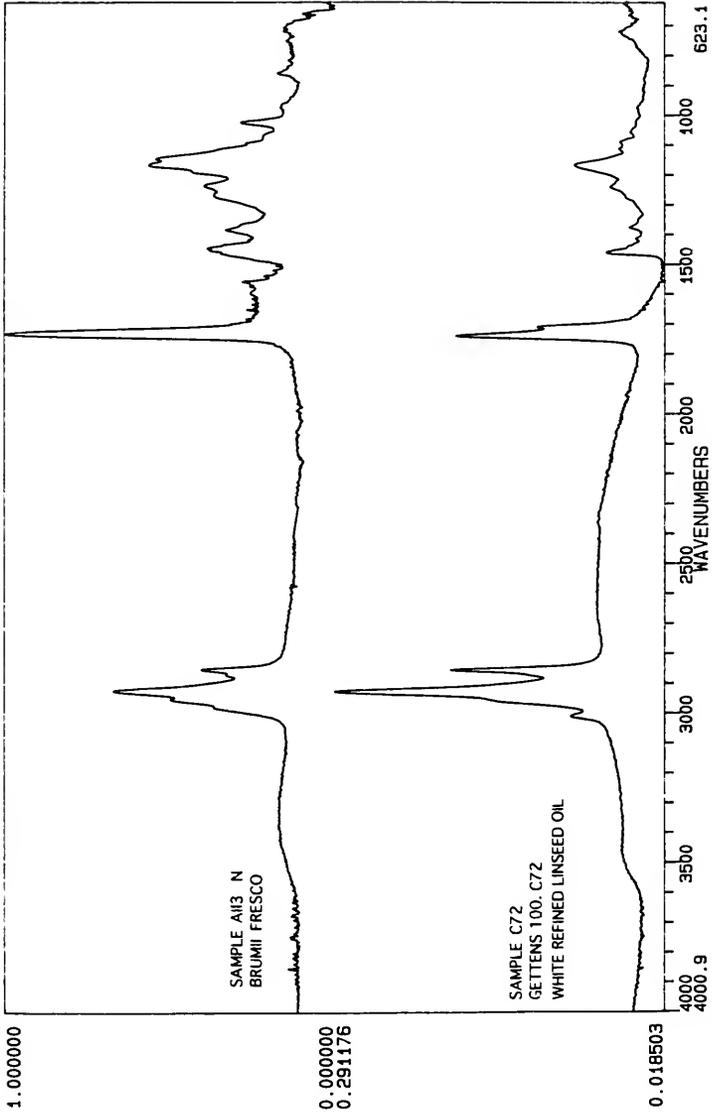


FIGURE 51

BRUMIDI SAMPLE A13 : FROM BLACK PAINT LAYER  
GETTENS 100.C72 SAMPLE C72 : WHITE REFINED LINSEED OIL  
02/19/92 15:36:53

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



RESULT: LAS CASAS, WALL PAINTING BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

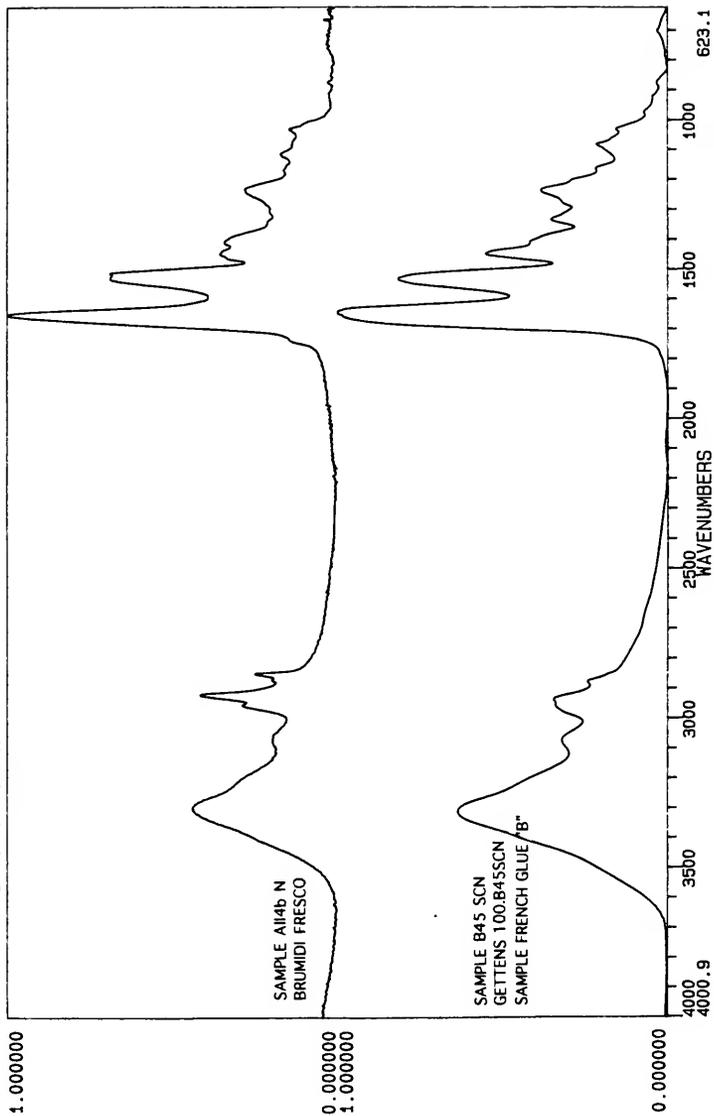


FIGURE 52

BRUMIDI SAMPLE A II 4b: SUBSTRATE  
GETTENS 100.B45SCN SAMPLE FRENCH GLUE "B" (SLOPE CORRECTED)  
02/18/92 13: 52: 16

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



RESULT: LAS CASAS, WALL PAINTING BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

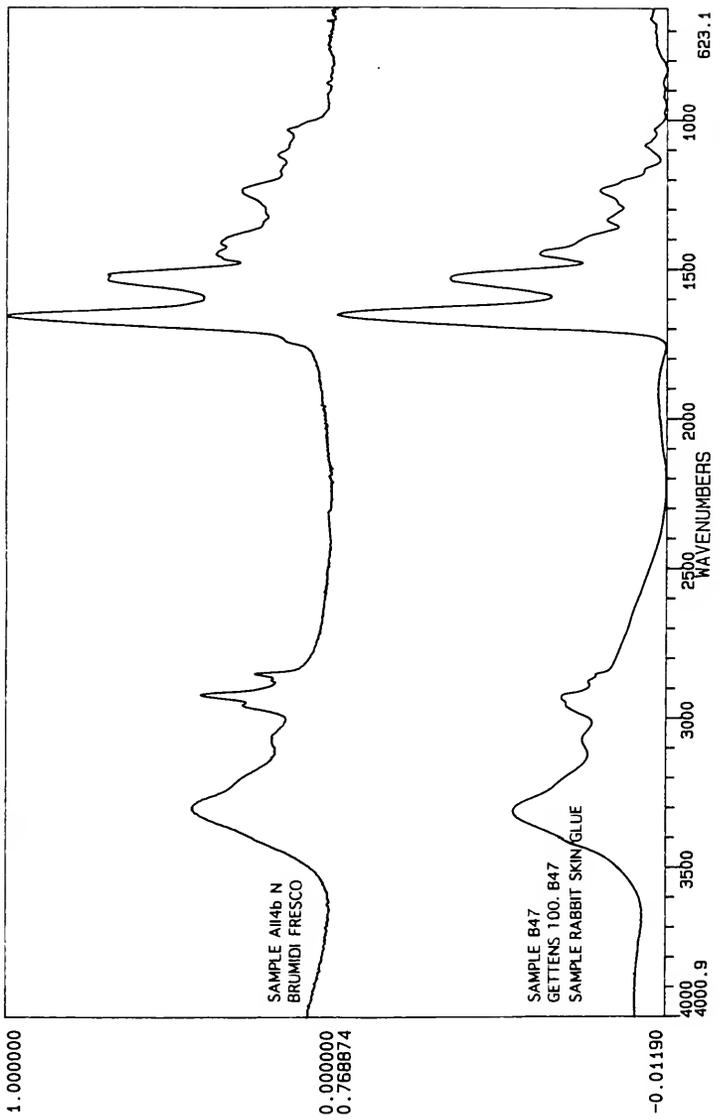


FIGURE 53

BRUMIDI SAMPLE A114b N: SUBSTRATE  
GETTENS 100.B47 SAMPLE B47: RABBIT SKIN GLUE  
02/01/92 11: 54: 02

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



## B. *BELLONA ROMAN GODDESS OF WAR*

### I. ON SITE INVESTIGATION: MACRO- ANALYSIS

Superficial site examination revealed that the painting is fresco as verified by the presence of *giornate*, incisions and *spolvero*. Moreover, it was immediately apparent that the lunette was heavily overpainted. As elsewhere, the painted bands that border the painting perimeters have been repainted on at least one occasion. Although there are indications of age, such as craquelure in the paint layer and obvious surface accretions in addition to overpaint, the painting appears to be stable. (See Figures 54 and 55).

Emphasized by raking light, the plaster texture varies within the composition between smooth plaster and rougher plaster. For example, the background plaster is generally rough while the plaster of the figure of Bellona and the details, such as the shield, the drum and bayonets, is smoother. (See Figures 57 and 59).

An inordinate number of *giornate* attest to Brumidi's common practice of replacing small parts of the composition. He did this by replastering the area to be corrected, a necessary measure for fresco painting. (See Figure 66.)

Brumidi used two drawing techniques for transferring the design onto the plaster: incisions and pouncing. Incisions appear in limited locations on the composition, such as the outlines of the bayonets. Pouncing was used to transfer the design of the leaves that ornament the edges of Bellona's drapery. (See Figure 57). The majority of the painting appears to have been executed without the use of conventional drawing techniques used for fresco painting. This could result from the presence of overpaint which has obscured additional pouncing. From raking light examination additional *puntini* and incisions are not present.

The painting technique is characteristic of Brumidi. It varies between expertly and rapidly rendered details and less expert handling of aspects of the composition, such as the figure of Bellona. The paint is applied in thin veils, such as the application of the foliated design on the drapery, (See Figure 57) and in heavy brushstrokes, evidently thickened with the addition of lime, such as the painting of the shield and the hand (See Figures 56 and 58). Bright yellow brushstrokes highlight and define the edges of the drum, the bayonets and the edges of the blue drapery and yoke of Bellona's gown.



The location of overpaint is not absolutely established and is based upon superficial examination and examination with the aid of 10 x- 20 x magnification and illumination with a small ultra-violet visible lamp. Overpaint appears to exist extensively in the background and to be the product of George Matthews' intervention, characterized mottled paint and broad quick strokes and the addition of clouds and birds to the composition. The face and hair of Bellona are obviously repainted. Additionally, details of the lunette, such as the trumpets, parts of the gown and drapery of Bellona and the flag, appear to have also been overpainted.

Infrared illuminated photography of the painting produced useful results. Having successfully penetrated the most superficial paint layers of the overpainting, the photograph reveals the original face of the figure. (See Figures 64 and 65.) In comparing this photograph with unfiltered illuminated photographs, (See Figure 54 - 55), some of the adjustments to the face are seen, such as alterations to the facial features, the skin color and texture and the hair. Additionally, the I.R. photograph exposes a more limpid sky and a less modeled treatment of the background. The flag also appears to be abraded, perhaps a motive for having overpainted it as well as other parts of the composition. While infrared might as well reveal original underpainting or drawing, in this case, where it is clear that the painting has been heavily retouched, the I.R. photograph reveals original composition. It is possible that additional overpaint was not penetrated and that the photograph represents still an altered picture.



## II. LABORATORY ANALYSIS : MICRO - ANALYSIS

### 1. STRATIGRAPHY

#### CROSS-SECTIONAL SAMPLES:

Twenty-five samples were extracted from various locations of the painting. The majority of the represented the stratigraphy of overpainted passages. The second group included samples taken from the original surface. In general appearance, the cross sectional samples from Bellona differ considerably from those of *Las Casas* by the number and the general appearance of the paint layers. There are fewer layers and all of the samples appear to be fresco, as evidenced by the apparent integration of calcium carbonate particles within the pigments. (See Figures 73, 77, 83, 85, and 95.) Of these, there is often an additional paint layer or layers. In some cases, the layer appears to be original while in others its appears to be the product of interventions. On many of the samples there is a fine white substrate beneath the coarser pigmented layer. (See Figures 93, 98 and 100.) while other thinner paint layers appear to exist on a siliceous coarse plaster, such as senn in Figures 81 and 91). Two colors predominate among the cross sectional samples, distinguished by large pigment particles and thick paint layers: a glassy bright blue, seen in Figures 83, 85 and 91, and a red/orange color, seen in Figure 73, 87 and 91., often mixed with particles of black.

Layers additional to the original, if present, generally exist as thin surface layers. (See Figures 77 and 83.) They are not to be confused with thin original surface layers, such as Figures 70, 93 and 100.

Preparatory paint layer, as *imprimatura* beneath final layers, provide interesting illustrations of the artist's working method. For example, the sequence of layers apparent in sample **B.I.14** and **B.II.4.a.** illuminated where underlying paint layers for adjacent passages exist or as important ground layers for the final thinner layer of paint. In these cases, an orange presentation layer is located near the sampled passage, which is blue. Blue underlies the sampled area as well. For Sample **B.II.5.a.**, taken from the hem of the gown, near the feet, a light pink/orange layer is found beneath the red/orange presentation layer, attesting to the application of the flesh colors prior to the red/orange layer. Likewise, Sample **B.II.4.a.**, taken from the folds on the drapery of Bellona attests to Brumidi's use of a blue underpainting for the fabric which is articulated with red/orange, also seen in



Sample **B.II.14**. Sample **B.I.11**, illustrates that the yellow ground at the yoke of Bellona's dress is integrated with black pigment particles, probably used to articulate the design.

While the samples indicate that the painting is fresco technique, fluorescent staining was carried out to investigate the paint medium.



## 2. IDENTIFICATION OF MEDIUM :

### FLUORESCENT STAINING

#### CONFIRMATION: FT-IR

As indicated above, study of the cross sectional samples indicates that the painting was executed *affresco* . Fluorescent staining was carried out on a selection of samples to test those assumptions by investigating the painting medium.

In general, positive staining appeared in the sample stratigraphy. It was not clear if those samples exhibited positive stains or if the fluorochrome settled within the voids of the sample material between pigment particles, such as Sample **B.I.7.a.**, **B.I.13** and **B.II.14**. A limited number of samples stained positively for either lipids or proteins. In all of these cross sections, it appears that a positive stains occur for both proteins, with FITC, and lipids, with Rhodamine B or DCF. Due to the large pigment size and the potential for the presence of cavities in which the stain could collect, the "positive" stain could be a misleading result.

In cases where overpaint appears, it is interesting to note that it is difficult to decipher if positive staining for oils or proteins in the layers directly beneath it occurs, as expected. One would expect to find that the medium, particularly oils, would penetrate into the underlying layers. As an illustration, Sample **B.I.13**. has a thin overpaint layer, probably oil-based. When stained for proteins, with FITC, and for oils, with Rhodamine B, the overpaint layer stains for proteins and for oils. However, the underlying layers of the original layers are not distinctive from the entire cross-section which exhibits positive stains. This is important because the absence of stain suggests that the oil or protein has not penetrated into the original strata.

Sample **B.I.3.a.** is an interesting example of a cross section. The sample is composed of a red/orange paint layer of the pigment found elsewhere that appears to be fresco. Like other samples, it is on top of a fine white substrate. A milky, translucent layer of unknown material is located above the pigmented layer, on top of which a thinner red/orange paint layer exists. Assuming the translucent layer to be an organic material, such as glue or wax, the sample was stained, expecting positive identification for glues with FITC or autofluorescence for waxes. It was also stained with Rhodamine B for lipids. However, autofluorescence provided the most useful information. The layer in question fluoresced as a wax or resinous material but did not stain with any of the



fluorochromes used. While this result would require confirmation by additional staining<sup>1</sup> to make conclusions and additional sampling to estimate its presence in the painting, the example here indicates that a coating, probably added as an intervention, exists under parts of the overpaint.

Sample material for the layer in question was isolated for FT-IR analysis. Due to the fact that the sample material was limited and that the layer was quite thin, an inadequate sample was extracted, thereby not producing a spectrum.

Sample **B.I.12.**, thought to represent an overpainted passage, was shown to be original surface as indicated by the absence of underlying layers. Positive identification for lipids throughout the sample was found with DCF and on the top layer with TTC for carbohydrates.

Sample **B.II.13.b.** shows the original fresco with blue and black original layers and overpainting in white as the uppermost layer, a color that corresponds to the mottled handling of the sky in blue and white. Identified by positive staining with Rhodamine B, the top layer is identified as an oil.

Sample **B.II.9.b.**, taken from the banded border at the painting perimeter, displays the stratigraphy. The substrate has on top of it a tan fresco layer (estimated), a thin tan layer and then a thicker white layer. Attesting to the presence of oils in the overpainted layers, the thin tan layer stains positively for lipids with Rhodamine B.

## **CONFIRMATION: FT-IR**

Ten samples were tested by FT-IR for medium. Of these, recordable results were found in only five of them. The following report will discuss these results.

Most of the specimens suggest that glue is present but would require additional testing for confirmation.

In an effort to characterize the translucent layer discussed above, Sample B.I. 3.a. was analyzed by FT-IR. The spectrum produced indicated the presence of CH stretching between 2850 -2960 cm<sup>-1</sup> characteristic of gums or waxes with a weak peak at 2924

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<sup>1</sup> This was the only such sample and therefore additional staining was not possible. It is not known to what extent this translucent material exists on the painting.



cm-1. Additional peaks, characteristic of gums appear at 3462 cm-1 and 1622 cm-1. However, other characteristic bands for gums are absent while additional peaks, such as 1116 cm-1 confuse identification. The specimen possibly contains a gum in addition to other material. When compared with a reference spectrum the closest identification was with tragacanth aleppo, a gum. The specimen lacked the characteristic peaks for a certain identification. Additional analysis is required.

Sample B.II.10 was sampled from the substrate where a positive stain for proteins with FITC had appeared. The spectrum produced a weak peak at about 1630 cm-1, characteristic of proteins in addition to other peaks, such as 1136 cm-1, a band in the range of shellac, and 3408, in the range of gums. The closest resemblance to the sample spectrum was to a reference sample of rabbit skin glue. The specimen however, lacked the essential carbonyl bands at 1630-1680 cm-1, characteristic of glues. Possibly, it contained a mixture of materials, including glues. (See Figures 105-106). Additional samples and analysis are required.

Sample B.II.8, taken from the substrate, like Sample B.II.10., displays a close match in part of the spectrum to a glue. It could have a small protein contribution to the spectrum as indicated by weak peaks in the carbonyl band region of 1650-1750 cm-1. A band characteristic of inorganic material appears at 3547 cm-1, probably a pigment. (See Figures 107 and 108.)

Sample A.II.4.a. shows an inorganic material altogether. (See Figures 109 and 110). When paired with a reference spectrum of a gum, the essential fingerprint region is missing at 1600-1650 cm-1.

Sample B.I.7. (Figures 111 and 112) partly matched a gum reference sample. Possibly, the specimen contained gum arabic or the like, with the addition of an inorganic material as seen at peaks at 3545 and 3406 cm-1.

Finally, Sample B.II.5.ii., taken from the orange/red pigment layer of the sample, is absolutely identified as a glue with strong carbonyl bands at around 1700 cm-1, 1550 cm-1 and NH bonds at 3300 cm-1 and alkyd peaks at 2950 cm-1. (See Figures 115 and 116.)



### **3. PIGMENTS**

A number of samples was studied for characterization of pigments. The pigment was extracted for cross-sectional samples and examined under polarized and reflected light. Some of the samples were microchemically tested. Two of the pigments were analyzed by X-ray diffraction.

#### **OPTICAL MICROSCOPICAL ANALYSIS:**

Sample B.I.14: The blue pigment of the thick original layer was studied. In reflected light and polarized light the pigment appeared to be cobalt of smalt as determined by the rounded shape, relative transparency and bright blue color of the pigment particles. In transmitted light the particles are isotropic, characteristic of cobalt.

#### **MICROCHEMICAL**

When the pigment of the upper blue layer, thought to be an overpainted layer, is brought into contact with dilute nitric acid, the blue pigment tests positively for ultramarine blue.

The middle blue layer, that appears to be original, does not respond to microchemical tests.

The substrate beneath the pigmented layer of sample B.I.14. tested positively for calcium carbonate. After dissolution there is no remaining sand or other aggregate, suggesting that the layer is composed of lime without sand.

Likewise, after testing B.II.3 and B.I.13, similar crystalline blue pigments, it was assumed that the pigments were also cobalt or smalt.

The red/orange pigments of samples B.II.1. and B.II.5. were tested. Microchemical tests determined that the pigments were probably iron oxides.

#### **XRD:**

The blue pigment of sample B.II.3. was analyzed in two different attempts by XRD. In both cases bands were produced that did not correspond with any of the possible blue pigments studied. Possibly, these bands correspond to other material present in the



sample. However, the absence of characteristic bands relative to the predominant pigment sample suggests that the pigment is cobalt blue or smalt, materials that do not produce a characteristic band pattern due to the absence of the crystalline structure.

In a third attempt, a limited number of lines characteristic of cobalt silicate, or smalt, were found.

Sample B.II.1. was analyzed and found to be an iron oxide. In this case, the pigment appears to be burnt sienna, a likelihood due to the fact that the pigment was among Brumidi's material requests.

### III. SUMMARY

In summary, study of the materials of the lunette verifies that the painting is a fresco, as substantiated by the presence of *giornate*, incisions and *spolvero* and in the appearance of cross-sectional samples. Additionally, proteinaceous material appears to be present in several of the pigmented layers. However, this is conclusively confirmed in only one test. Because the sample in which proteins are found represents material of the original fabric of the painting and because the sample is like many other samples studied, it is postulated that proteins are present in other such samples. For confirmation of the possible presence of gums or oils, further testing is required. A full assessment of the extent of binding media within the painting would require further study and analysis.



**PHOTOGRAPH: "BELLONA"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA

DATE: 1/92

ILLUMINATION: TUNGSTEN FILAMENT

PHOTO BY: CSM

CAMERA: OLYMPUS -OM WITH 35 MM PERSPECTIVE CORRECTION LENS

---



FIGURE 54

COMMENTS: THE BLACK AND WHITE PHOTOGRAPHS ILLUSTRATE THE GENERAL COMPOSITION. THE SURROUNDING BORDER HAS BEEN REPAINTED ON AT LEAST ONE OCCASION. EXTENSIVE OVERPAINTING OF THE LUNETTE APPEARS IN THE SKY AND ON THE FIGURE HERSELF.



**PHOTOGRAPH: "BELLONA"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA

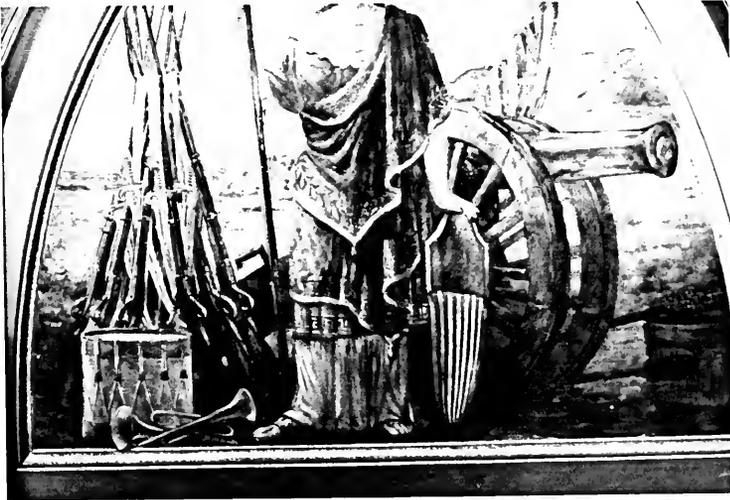
DATE: 1/92

ILLUMINATION: TUNGSTEN FILAMENT

PHOTO BY: CSM

CAMERA: OLYMPUS -OM WITH 35 MM PERSPECTIVE CORRECTION LENS

---



**FIGURE 55**

COMMENTS: THE BLACK AND WHITE PHOTOGRAPHS ILLUSTRATE THE GENERAL COMPOSITION. THE SURROUNDING BORDER HAS BEEN REPAINTED ON AT LEAST ONE OCCASION. EXTENSIVE OVERPAINTING OF THE LUNETTE APPEARS IN THE SKY AND ON THE FIGURE HERSELF.



**RAKING LIGHT MACRO-PHOTOGRAPH  
"BELLONA, GODDESS OF WAR"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S.CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-100

DATE: 1/92  
PHOTO BY: CSM

---



**FIGURE 56**

COMMENTS: THE MACRO-PHOTOGRAPH ILLUMINATED WITH RAKING LIGHT OF THE PROPER RIGHT HAND ILLUSTRATES THE PLASTER TEXTURE, THE ARTIST'S BRUSHSTROKES AND INCISIONS AROUND THE FINGERS OF THE HAND.



MACRO-PHOTOGRAPH  
"BELLONA, GODDESS OF WAR"

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM

DATE: 1/92  
PHOTO BY: CSM

---



FIGURE 57

COMMENTS: THIS MACRO-PHOTOGRAPH REPRESENTS THE JUNCTURE OF THE PROPER LEFT SHOULDER, THE WHEEL OF THE CANON AND THE BACKGROUND DUNE. THE FOLLOWING IS ILLUSTRATED: THE *SPOLVERO*, OR POUNCING, USED IN TRANSFERING THE DRAWING ONTO THE PLASTER FOR THE LEAVES THAT DECORATE THE DRAPERY OF THE FIGURE; THE SUBTLE USE OF TRANSPARENT HATCHING ON THE WHEEL (LOWER CENTER) AND THE SKETCHY LOOSE PAINTING USED IN THE LEAVES. THE PHOTOGRAPH ALSO ILLUSTRATES THE JUNCTURE OF A *GIORNATA* AT THE PERIMETER OF THE WHEEL AND THE USE OF COARSE PLASTER FOR THE DUNES, WHICH HAVE BEEN VERY RAPIDLY PAINTED AND COULD BE OVERPAINTED.



**RAKING LIGHT**

**PHOTOGRAPH: "BELLONA, GODDESS OF WAR"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-100

DATE: 1/92  
PHOTO BY: CSM

---



**FIGURE 58**

COMMENTS: THE RAKING LIGHT PHOTOGRAPH ILLUSTRATES THE JUXTAPOSITION OF PLASTER TEXTURES IN THIS DETAIL, TAKEN AT THE EDGE OF THE SHIELD. IT APPEARS THAT THE PLASTER AT THE RIGHT HAS BEEN TROWLED FOR TEXTURE IN A METHOD DISTINCT FROM THE ADJACENT AREAS OF PLASTER.



**PHOTOGRAPH: "BELLONA, GODDESS OF WAR"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA

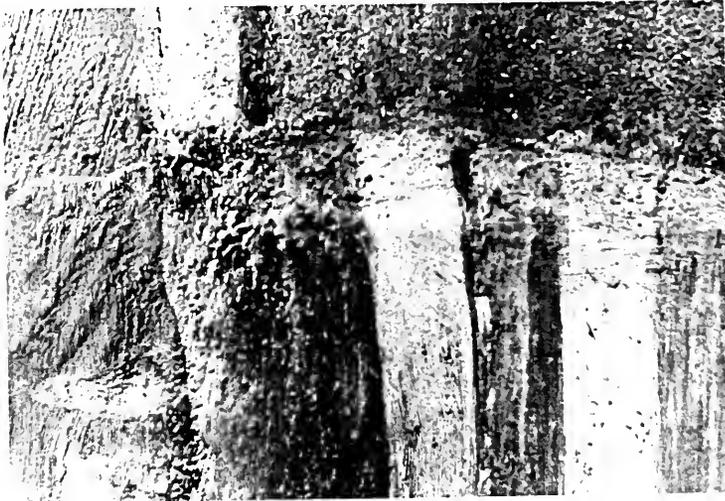
DATE: 1/92

ILLUMINATION: TUNGSTEN FILAMENT

PHOTO BY: CSM

CAMERA: OLYMPUS -OM WITH 35 MM PERSPECTIVE CORRECTION LENS

---



**FIGURE 59**

COMMENTS: THE DETAIL OF THE SHIELD ILLUSTRATES THE JUNCTURE OF THE *GIORNATA*. IT ALSO ILLUSTRATES TWO DIFFERENT TYPES OF PLASTER, BOTH SMOOTH AND COARSE. BRUMIDI OFTEN ALTERNATED BETWEEN PLASTER TEXTURES FOR EFFECT, AS PERHAPS HERE. OR THE TEXTURE MIGHT BE UNINTENTIONAL.



**RAKING LIGHT**  
**PHOTOGRAPH: "BELLONA, GODDESS OF WAR"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-100

DATE: 1/92  
PHOTO BY: CSM

---



FIGURE 60

COMMENTS: THIS DETAIL OF THE FACE OF BELLONA IS ILLUMINATED WITH RAKING LIGHT. IT ILLUSTRATES THE FOLLOWING: THE *GIORNATA* JUNCTURES WHICH FOLLOW THE CONTOUR OF THE HEAD; THE PLASTER TEXTURE WHICH IS COARSE AT THE PROPER LEFT SIDE OF THE FACE ; AND THE PRESENCE OF INCISIONS AROUND THE FOREHEAD, PERHAPS OUTLINING THE HAIRLINE; AND THE PRESENCE OF BRUSHSTROKES AND UNEVEN COLORATION IN THE FACE, PERHAPS AS A RESULT OF OVERPAINTING.



**RAKING LIGHT**  
**PHOTOGRAPH: "BELLONA, GODDESS OF WAR"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-100

DATE: 1/92  
PHOTO BY: CSM

---



FIGURE 61

COMMENTS: THIS DETAIL OF THE FACE OF BELLONA IS ILLUMINATED WITH RAKING LIGHT. IT ILLUSTRATES THE FOLLOWING: THE *GIORNATA* JUNCTURES WHICH FOLLOW THE CONTOUR OF THE HEAD; THE PLASTER TEXTURE WHICH IS COARSE AT THE PROPER LEFT SIDE OF THE FACE ; AND THE PRESENCE OF INCISIONS AROUND THE FOREHEAD, PERHAPS OUTLINING THE HAIRLINE; AND THE PRESENCE OF BRUSHSTROKES AND UNEVEN COLORATION IN THE FACE, PERHAPS AS A RESULT OF OVERPAINTING.



**PHOTOGRAPH: "BELLONA"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA

DATE: 1/92

ILLUMINATION: TUNGSTEN FILAMENT

PHOTO BY: CSM

CAMERA: OLYMPUS -OM WITH 35 MM PERSPECTIVE CORRECTION LENS

---



**FIGURE 62**

COMMENTS: THE BLACK AND WHITE PHOTOGRAPHS ILLUSTRATE THE GENERAL COMPOSITION. THE SURROUNDING BORDER HAS BEEN REPAINTED ON AT LEAST ONE OCCASION. EXTENSIVE OVERPAINTING OF THE LUNETTE APPEARS IN THE SKY AND ON THE FIGURE HERSELF.



**RAKING LIGHT  
PHOTOGRAPH: "BELLONA, GODDESS OF WAR"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS X 124 ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-100

DATE: 1/92  
PHOTO BY: CSM

---



**FIGURE 63**

COMMENTS: THIS DETAIL ILLUSTRATES THE *GIORNATA* JUNCTURE OF BELLONA'S PROPER RIGHT SHOULDER WHERE THE PLASTER SECTIONS ARE DIVIDED BETWEEN THE BACKGROUND, THE HAIR AND NECK AND THE CLOTHED SHOULDER. THE PHOTOGRAPH ALSO REVEALS THE PLASTER TEXTURE, BRUSHSTROKES AND THE PROBABLE PRESENCE OF OVERPAINT.



**INFRARED PHOTOGRAPH:  
"BELLONA, GODDESS OF WAR"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK HIGH SPEED INFRARED FILM HIE 135-36  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-1000 WITH #87 INFRARED FILTER

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 64

COMMENTS: WHEN PHOTOGRAPHED WITH INFRARED ILLUMINATION FOR UNDERDRAWING OR UNDERPAINTING, THE PHOTOGRAPH REVEALED ALTERATIONS TO THE COMPOSITION. THESE ARE MOST APPARENT IN THE FACE OF BELLONA, IN THE SKY AND THE GROUND ALL OF WHICH HAVE BEEN RETOUCHED. COMPARE WITH VISIBLE LIGHT PHOTOGRAPHS. IT IS POSSIBLE THAT THE IMAGE INCLUDES OVERPAINT, NOT PENETRATED BY I.R.



**INFRARED PHOTOGRAPH:  
"BELLONA, GODDESS OF WAR"**

WEST CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK HIGH SPEED INFRARED FILM HIE 135-36  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-1000 WITH #87 INFRARED FILTER

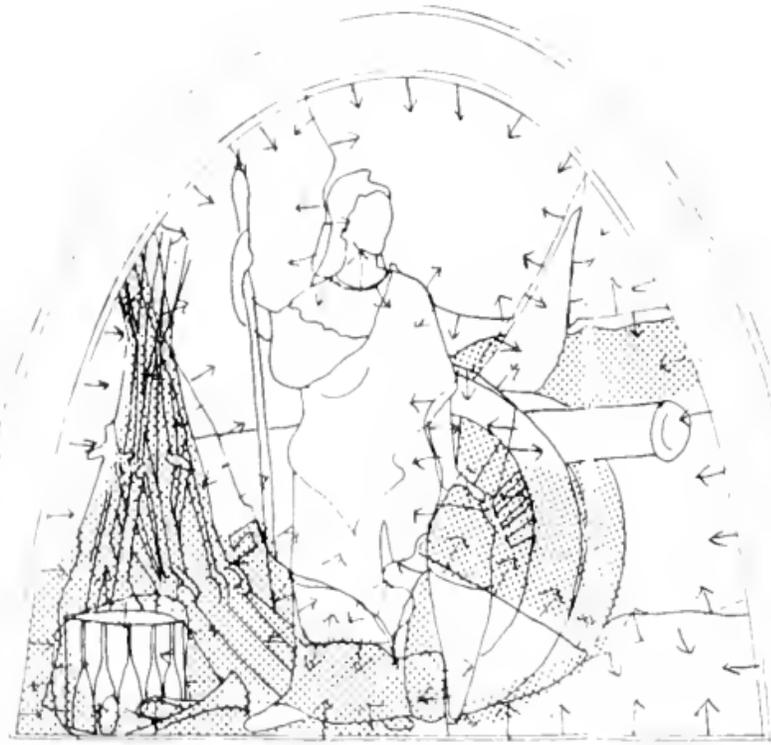
DATE: 1/92  
PHOTO BY: CSM



**FIGURE 65**

COMMENTS: WHEN PHOTOGRAPHED WITH INFRARED ILLUMINATION FOR UNDERDRAWING OR UNDERPAINTING, THE PHOTOGRAPH REVEALED ALTERATIONS TO THE COMPOSITION. THESE ARE MOST APPARENT IN THE FACE OF BELLONA, IN THE SKY AND THE GROUND ALL OF WHICH HAVE BEEN RETOUCHEED. COMPARE WITH VISIBLE LIGHT PHOTOGRAPHS. IT IS POSSIBLE THAT THE IMAGE INCLUDES OVERPAINT, NOT PENETRATED BY I.R.





GIORNATE & PLASTER TYPES

Giornate  Coarse Plaster 

"BELLONA, GODDESS OF WAR"

FIG 66

Fresco by: **CONSTANTINO BRUMIDI**  
 Ground Floor, Senate Corridors, United States Capitol  
 Prepared by: **Catherine S. Myers**

Washington, D.C.  
 May 1992



GIORNATE & PLASTER TYPES

Giornate & Plaster Types



DRAWING TECHNIQUE

Spolvero

Incisions

Puntini

"BELLONA, GODDESS OF WAR"

FIG 67

Fresco by: CONSTANTINO BRUMIDI

Ground Floor, Senate Corridors, United States Capitol

Prepared by: Catherine S. Myers

Washington, D.C.  
May 1992



DRAWING TECHNIQUE

Spolovero

Incision





● Sample Location

SAMPLE LOCATION



"BELLONA, GODDESS OF WAR"

FIG 69

Fresco by: CONSTANTINO BRUIMIDI  
Ground Floor, Senate Corridors, United States Capitol  
Prepared by: Catherine S. Myers

Washington, D.C.  
May 1992

OVERPAINT





Overpaint



OVERPAINT

**"BELLONA" SAMPLE # B. I. 1.b.**

ILLUMINATION: VISIBLE

MAGNIFICATION: 50 X

OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN

CAMERA: NIKON FX 35MM

FILM: KODAK EKTAR 25 ASA



FIGURE 70

COMMENTS: AT 200 X MAGNIFICATION, THE UPPER GREEN LAYER IS VERY APPARENT; BLUE AND ORANGE PARTICLES EXIST IN THE TAN FRESCO LAYER.



**"BELLONA" SAMPLE # B. I. 1.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 71**

SAMPLE LOCATION: 37" ← X 2"↑

COMMENTS: SAMPLES FROM THE LOWER MARGIN OF THE PAINTING. THE SAMPLE SHOWS GREEN OVERPAINT OVER THE OVERPAINTED FOOT. THE SAMPLE WAS TAKEN TO SEE THE UNDERLYING PAINT LAYERS AS AN ILLUSTRATION OF BRUMIDI'S METHOD FOR UNDERPAINTING. IN CROSS SECTION, A FINE WHITE SUBSTRATE (A), HAS A TAN SUBSTRATE ESTIMATED TO BE FRESCO (B) AND A THIN GREEN LAYER, ALSO APPEARING TO BE FRESCO.



**"BELLONA" SAMPLE # B. I. 1.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE

MAGNIFICATION: 50 X -70X

OBJECTIVE: 10 X

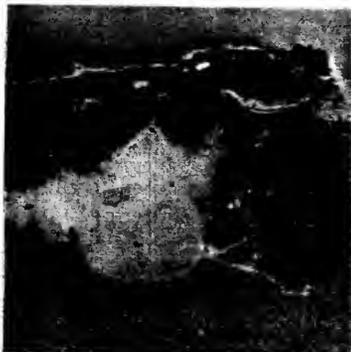
LIGHT SOURCE: MERCURY ARC

CAMERA: LEITZ- 35mm

FILM: KODAK GOLD 200 ASA



1



2

FIGURE 72

COMMENTS: 1. ONLY THE SUBSTRATE AUTOFLUORESCES 2. SOME POSITIVE STAINING OCCURS IN THE SUBSTRATE WITH FITC . FURTHER STAINING WAS NOT CARRIED OUT DUE TO THE DESTRUCTION OF THE SAMPLE.



**"BELLONA" SAMPLE # B. I. 3. a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 73**

SAMPLE LOCATION: 14 1/3" ← X 3"

COMMENTS: THE SAMPLE TAKEN AT THE JUNCTURE OF A GIORNATA, INCLUDING THE SUBSTRATE, FOR STRATIGRAPHY AND MEDIUM. IN CROSS SECTION, A FINE WHITE SUBSTRATE IS COVERED BY A RED/ORNAGE FRESCO (EST.) LAYER, A THIN TRANSLUCENT LAYER AND THEN A RED FRESCO (EST.) LAYER.



"BELLONA" SAMPLE # B. I. 3.a.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA

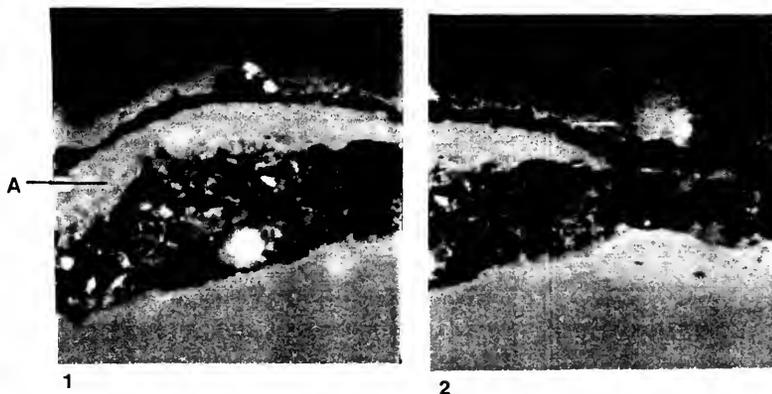


FIGURE 74

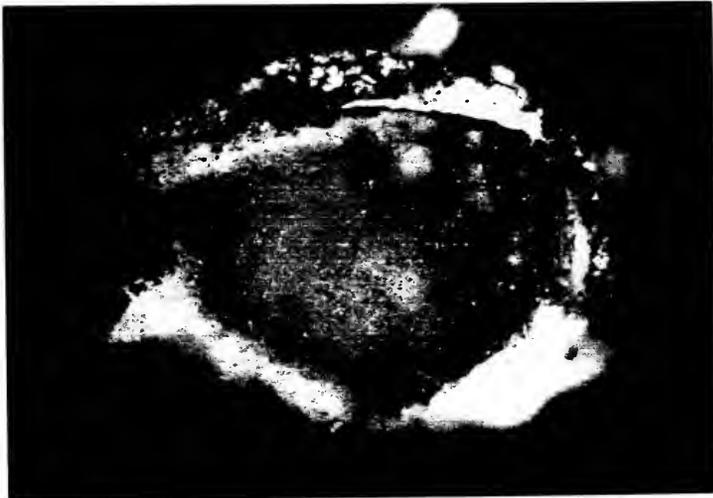
1. AUTOFLUORESCENCE IN TRANSLUCENT LAYER (A). 2. NO ACTUAL POSITIVE STAINING, FITC, FOR PROTEINS. RHODAMINE B COLLECTS IN THE SAMPLE MATERIAL BUT DOES NOT RESULT IN A POSITIVE STAIN. AUTOFLUORESCENCE IN THIS CASE OFFERS THE MOST INFORMATION. THE AUTOFLUORESCENT TRANSLUCENT LAYER APPEARS, IN AUTOFLUORESCENCE AND AS AS SEEN IN VISIBLE LIGHT, APPEARS TO BE A WAX.



**"BELLONA" SAMPLE # B. I. 4.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 75**

SAMPLE LOCATION: 36° ← X 2°↑

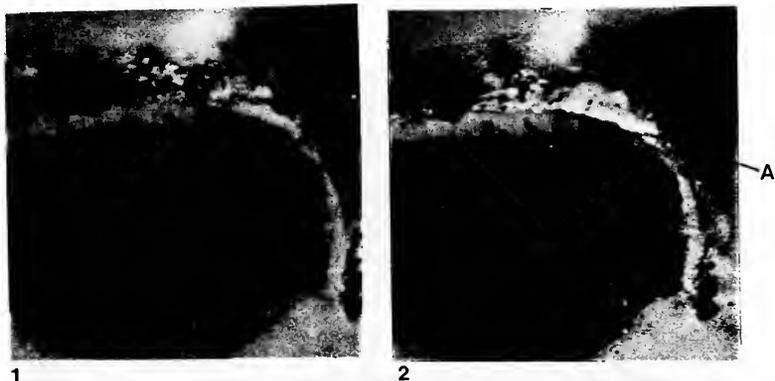
COMMENTS: SAMPLES FROM THE FOOT. IN CROSS SECTION, THE SAMPLE SHOWS A CRYSTAL OF SILICEOUS MATERIAL WITH A THIN TANNISH PAINT LAYER, MAYBE FRESCO AND DIRT/GRIME.



**"BELLONA" SAMPLE # B. I. 4**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



**FIGURE 76**

COMMENTS: 1. IN U.V. VISIBLE LIGHT, THE UPPER LAYER AUTOFLUORESCES.  
2. STAINED WITH FITC, A DISTINCT PART OF THAT LAYER STAINS AS POSITIVE FOR PROTEINS (A) NO STAINING OCCURS FOR GUMS OR LIPIDS. APPARENTLY, A PROTEINACEOUS MATERIAL IS PRESENT IN THE UPPERMOST LAYER.



**"BELLONA" SAMPLE # B. I.7.a**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA

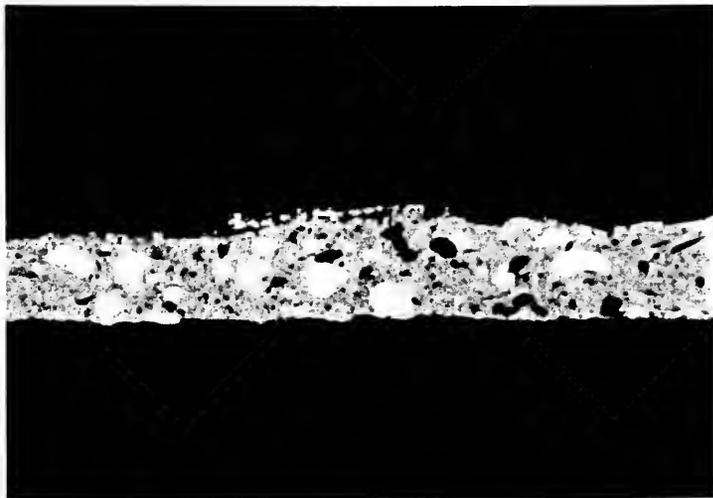


FIGURE 77

SAMPLE LOCATION: 28°--> X 3 1/2"↑

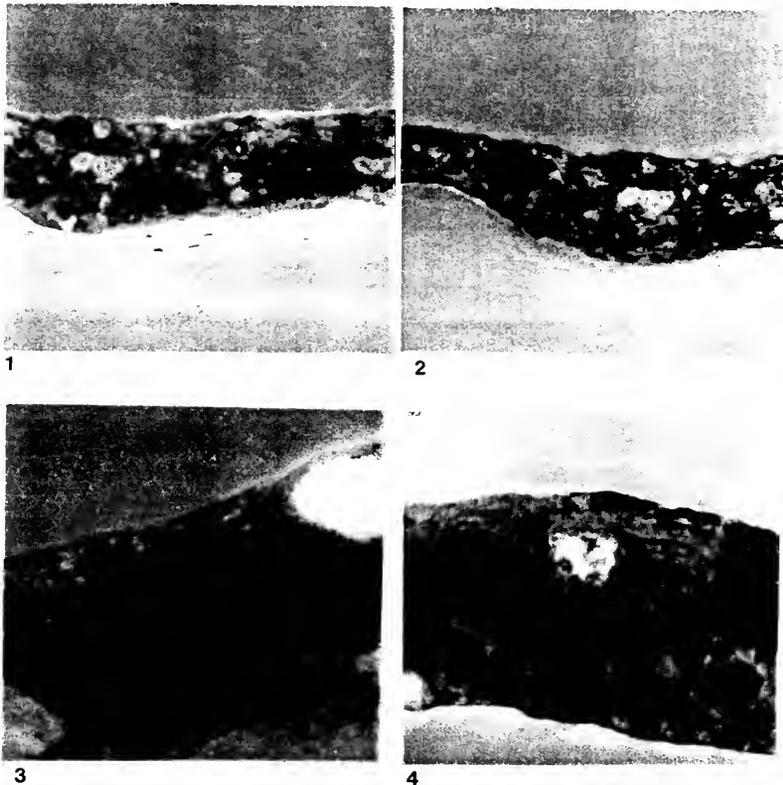
COMMENTS: SAMPLED FROM A BROWN ACCRETION (DRIP) AND THE UNDERLAYING PAINT, INCLUDING THE ORIGINAL SURFACE. IN CROSS SECTION, A YELLOW OCHRE FRESCO (EST.) LAYER WITH A THIN CLEAR LAYER ON IT IS SEEN.



**"BELLONA" SAMPLE # B.I.7.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



**FIGURE 78**

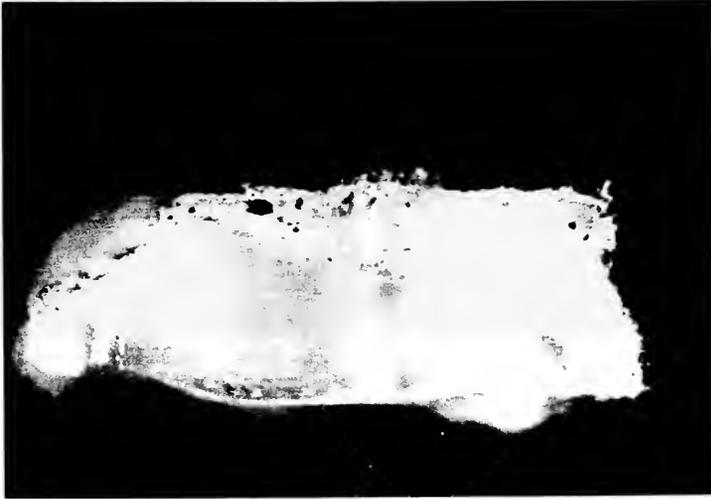
COMMENTS: 1. SLIGHT AUTOFLUORESCENCE CHARACTERIZES THE ENTIRE SAMPLE. 2. WHEN STAINED WITH FITC, A GENERAL POSITIVE STAIN FOR PROTEINS APPEARS. 3. DCF ALSO GENERALLY STAINS THE SAMPLE. 4. RHODAMINE B ALSO GENERALLY STAINS THE SAMPLE. IT DOES NOT APPEAR THAT THE FLUOROCHROMES ARE COLLECTING IN THE FISSURES OR ON THE BIOPLAST. STAINING SUGGESTS THE PRESENCE OF PROTEIN AND OILS.



**"BELLONA: SAMPLE B.I.11.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 79**

SAMPLE LOCATION: 22 3/4" --> X 21" ↓

COMMENTS: THE SAMPLE WAS TAKEN FROM THE YOKE OF THE DRESS OF THE FIGURE IN AN AREA THAT APPEARED TO BE OVERPAINTED. THE CROSS SECTION WAS MADE TO SEE STRATIGRAPHY. IN CROSS SECTION, A SILICEOUS SUBSTRATE IS PAINTED OVER WITH A SINGLE YELLOW PAINT LAYER, WITH PARTICLES OF BLACK. THERE IS EVIDENCE OF A BLACK LAYER ON TOP, PERHAPS PAINT.



"BELLONA" SAMPLE B.I.11.

ILLUMINATION: ULTRA-VIOLET VISIBLE

MAGNIFICATION: 50 X -70X

OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC

CAMERA: LEITZ- 35mm

FILM: KODAK GOLD 200 ASA

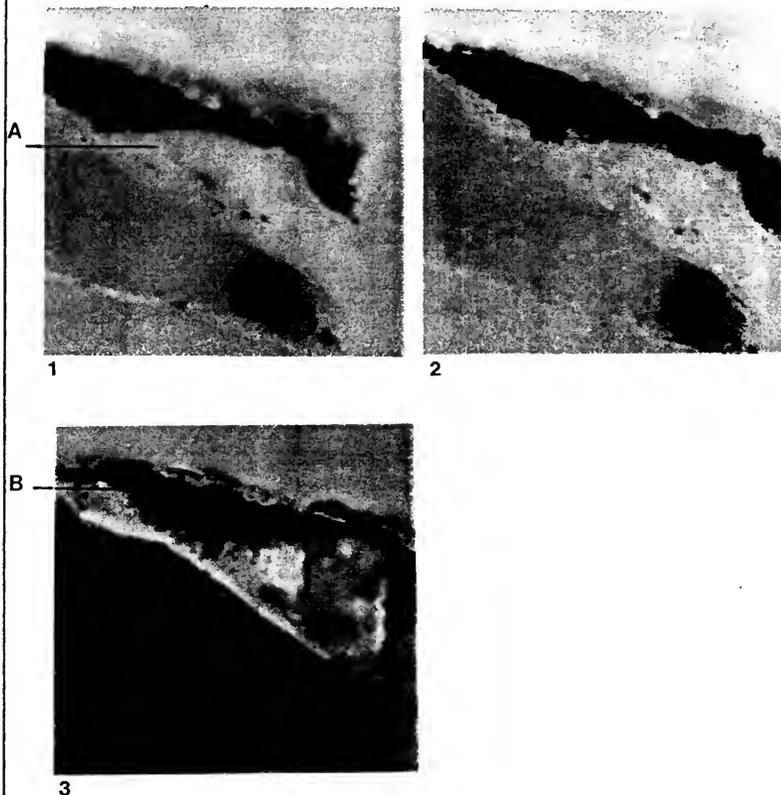


FIGURE 80

COMMENTS: 1. AUTOFLUORESCENCE APPEARS IN THE LAYER (A) BETWEEN THE PARTICLE AND THE PAINT LAYER, WHICH HAD NOT BEEN PREVIOUSLY APPARENT. 2. FITC STAINS SLIGHTLY IN THE PAINT LAYER AND THE MIDDLE LAYER. 3 WITH DCF, THAT SAME LAYER (B) STAINS TO A LIMITED DEGREE. THE BLUE FLUORESCENCE IS NOT EXPLAINED. THE SAMPLE APPEARS TO BE FRESCO WITH A POSSIBLE PRESENCE OF PROTEINACEOUS OR LIPOIDAL MATERIAL IN THE INTERMEDIATE LAYER.



**"BELLONA" SAMPLE # B.I.12.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 81**

SAMPLE LOCATION: 28°-- X 36 1/2°

COMMENTS: THE SAMPLE WAS TAKEN FROM AN OVERPAINTED PASSAGE ON THE FIGURE'S ARM TO ILLUSTRATE THE STATIGRAPHY. IN CROSS SECTION, THE PEACH COLORED PIGMENT LAYER APPEARS TO BE FRESCO AND IS LOCATED ON TOP OF A SILICEOUS SUBSTRATE.



**"BELLONA" SAMPLE # B.I.12.**

ILLUMINATION: ULTRA-VIOLET VISIBLE

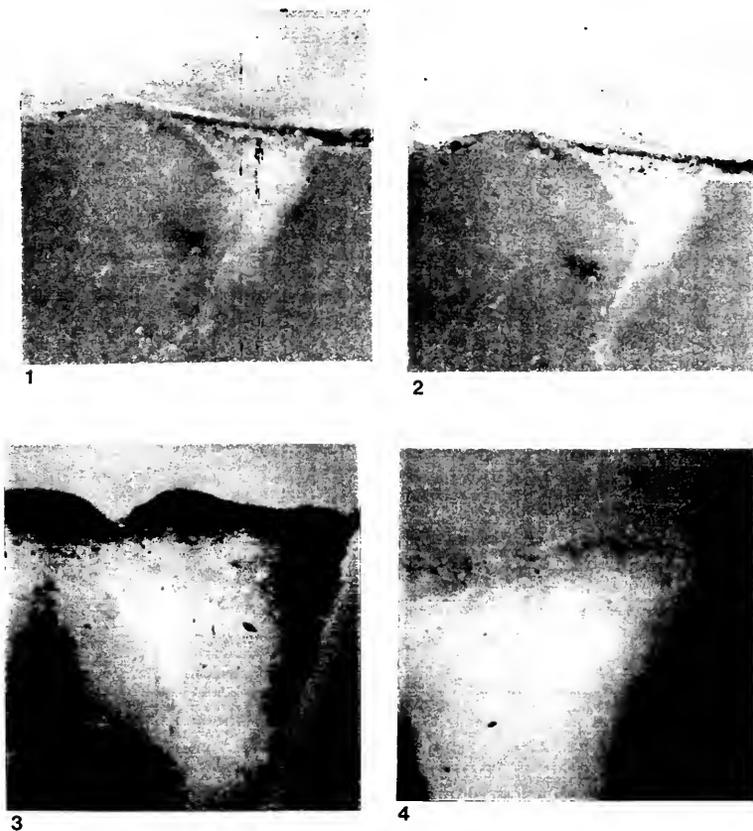
MAGNIFICATION: 50 X -70X

OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC

CAMERA: LEITZ- 35mm

FILM: KODAK GOLD 200 ASA



**FIGURE 82**

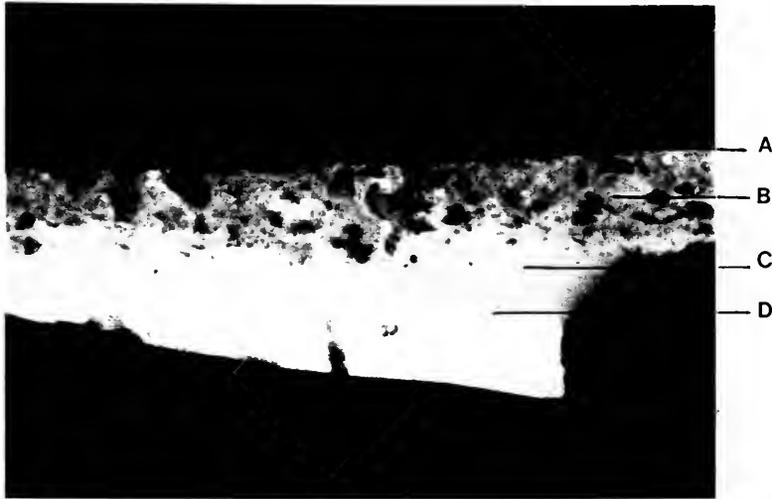
COMMENTS: 1. THE PIGMENTED LAYER AUTOFLUORESCES. 2. WITH FITC THERE IS NO REAL POSITIVE STAINING. THE PIGMENTED LAYER APPEARS TO STAIN POSITIVELY FOR GUMS WITH TTC. 4. THERE IS STAINING THROUGHOUT THE SAMPLE FOR LIPIDS WITH DCF.



**"BELLONA" SAMPLE # B.I.13.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 83**

SAMPLE LOCATION: 10°-- X 16°

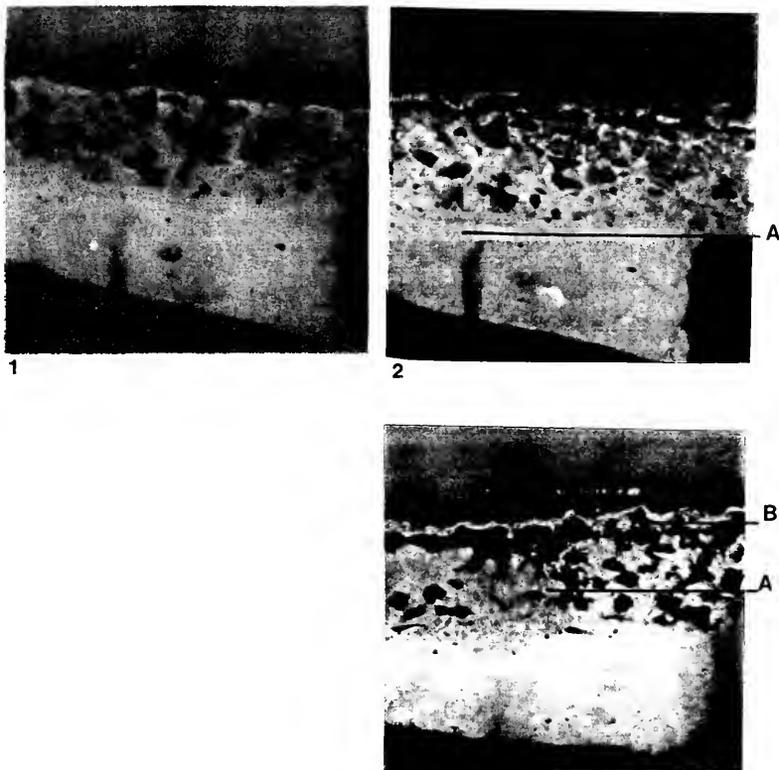
COMMENTS: TAKEN FROM THE SKY-THAT APPEARED TO BE OVERPAINTED- THE SAMPLE WAS TAKEN TO SEE THE STRATIGRAPHY, ESPECIALLY THE UNDERLYING PAINT LAYER. IN CROSS SECTION, A THIN DARK BLUE/GRAY PAINT LAYER EXISTS AS THE TOP LAYER OF THE SAMPLE (A) . A THICKER BLUE LAYER APPEARS TO BE FRESCO AND MUST BE THE ORIGINAL LAYER (B). A FINE WHITE SUBSTRATE , IN TWO LAYERS (C) & (D) APPEARS AS THE RENDERING.



**"BELLONA" SAMPLE # B.I.13.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



**FIGURE 84** <sup>4</sup>

COMMENTS: 1. IN U.V. VISIBLE LIGHT, AUTOFLUORESCENCE APPEARS IN THE CALCIUM CARBONATE. THE DARKER SURFACE LAYER IS CLEARER. 2. WITH FITC STAINING, POSITIVE STAINING APPEARS WITHIN THE BLUE LAYER AND THE SUBSTRATE, PARTICULARLY THE FIRST LAYER OF THE SUBSTRATE. (A) SUGGESTING THAT A PROTEIN IS PRESENT WITHIN THE LIME. 4. WITH RHODAMINE B STAINING, POSSIBLE POSITIVE STAIN APPEARS IN THE BLUE LAYER (A) AND ON THE SURFACE, EVIDENTLY AN OIL SURFACE FILM. (B)



**"BELLONA" SAMPLE # B.I.14.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 85**

SAMPLE LOCATION: TAKEN FROM THE BLUE DRAPERY OF BELLONA'S DRESS, NEAR THE RED/ORANGE UNDERGOWN..

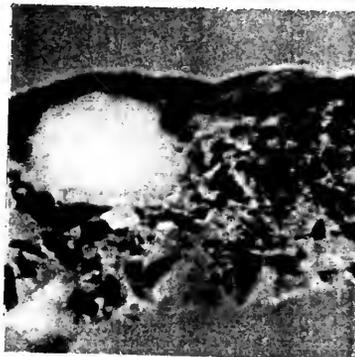
COMMENTS: THE SAMPLE WAS TAKEN IN ORDER TO SHOW BRUMIDI'S WORKING METHOD OF APPLYING PAINT LAYERS. IN CROSS SECTION, IT APPEARS THAT HE FINISHED THE PAINTING IN THIN FRESCO OR LIME SECCO IN ORANGE/RED (A) OVER A BLUE FRESCO LAYER WITH GLASSY PARTICLES. (B) .THE THIN BLUE LAYER AT THE TOP (C) APPEARS TO NOT BE FRESCO AND TO BE MADE OF A DIFFERENT VERY FINE PIGMENT.



**"BELLONA" SAMPLE # B.I.14.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



2



4

**FIGURE 86**

COMMENTS: AUTOFLUORESCENCE APPEARS IN THE LIME MATRIX. 2. WHEN STAINED WITH FITC, THE ORANGE/RED LAYER APPEARS TO CONTAIN PROTEINS. 4. RHODAMINE B COLLECTS IN VOIDS BUT DOES NOT POSITIVELY STAIN.



**'EELLONA" SAMPLE # B.II.1.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 87**

SAMPLE LOCATION: 26" --> X 28" ↑

COMMENTS: SAMPLED AT THE SPEAR HANDLE, THE SURFACE COLOR IS BROWN AND BLACK. IN CROSS SECTION, RED/ORANGE APPEARS AS THE PRINCIPLE COLOR AND IS FRESCO (A). THE SUBSTRATE IS SEEN AT THE BOTTOM OF THE SAMPLE.(B).



**"BELLONA" SAMPLE # B.II.1.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE

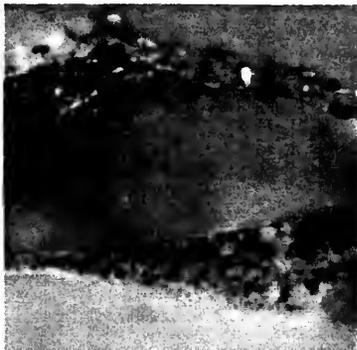
MAGNIFICATION: 50 X -70X

OBJECTIVE: 10 X

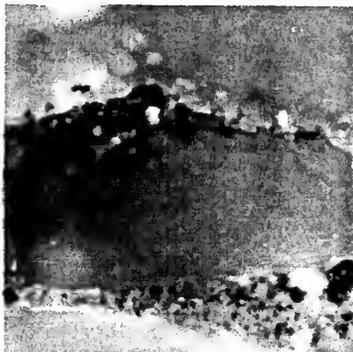
LIGHT SOURCE: MERCURY ARC

CAMERA: LEITZ- 35mm

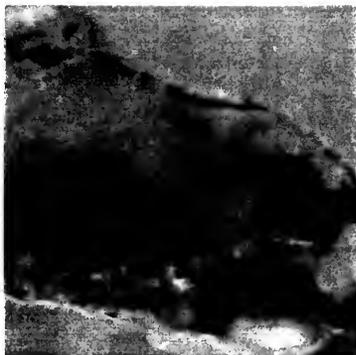
FILM: KODAK GOLD 200 ASA



1



2



3



4

**FIGURE 88**

COMMENTS: 1. AUTOFLUORESCENCE EXISTS ONLY IN THE SUBSTRATE. 2. WITH FITC, THERE IS NOT A REAL POSITIVE STAIN. 3. WITH DCF, THE STAIN COLLECTS IN FISSURES. 4. WITH RHODAMINE B THE STAIN ALSO COLLECTS IN THE VOIDS.



**"BELLONA" SAMPLE # B.II.3. a**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 89**

SAMPLE LOCATION: 27 1/2" --> X 35"

COMMENTS: THE SAMPLE WAS TAKEN FROM THE BACKGROUND OF THE PROPER LEFT OF THE BELLONA FIGURE AT WAIST HEIGHT. AREAS OF OVERPAINT SHOULD SHOW BLUE (THICK) UNDERLYING PAINT AND SUBSTRATE. TEST FOR MEDIUM.



**"BELLONA" SAMPLE # B.II.3.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

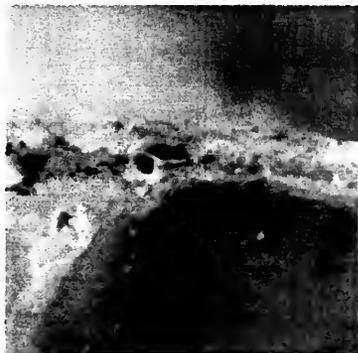
LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3

**FIGURE 90**

COMMENTS: 1. AUTOFLUORESCENCE EXISTS IN THE CALCIUM CARBONATE. 2. WITH FITC, THE STAIN COLLECTS IN THE VOIDS. 3. TTC DOES NOT STAIN. THE SAMPLE APPEARS TO BE ENTIRELY FRESCO SINCE THE STAINS ABOVE AND DCF AND RHODAMINE B FOR LIPIDS DO NOT IDENTIFY OTHER MEDIA.



**"BELLONA" SAMPLE # B.II.3.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 91**

SAMPLE LOCATION: 27 1/2" --> X 35"

COMMENTS: THE SAMPLE WAS TAKEN FROM THE BACKGROUND BESIDE BELLONA'S PROPER LEFT SIDE IN ORDER TO ILLUSTRATE THE STRATIGRAPHY AND TO SHOW UNDERLYING PAINT LAYERS. IN CROSS SECTION, A WHITE LAYER APPEARS ON THE SURFACE (A). UNDER IT THERE ARE BLUE/GRAY (B) FRESCO AND SUBSTRATE LAYERS (C).



**"BELLONA" SAMPLE # B.II.4.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA

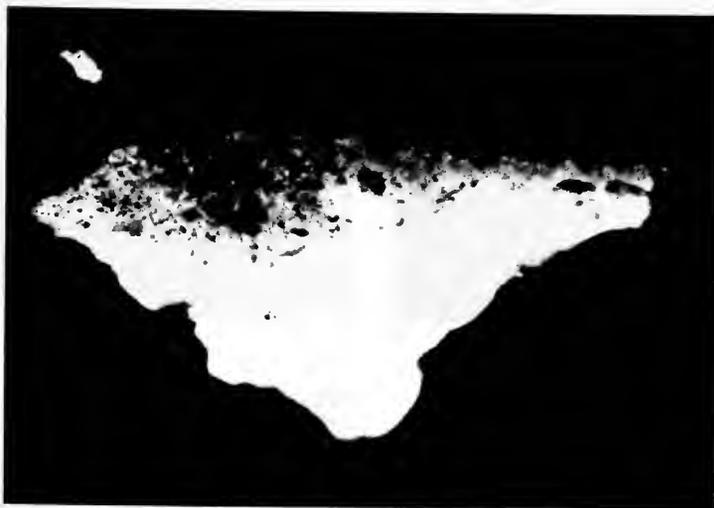


FIGURE 93

SAMPLE LOCATION: 42 1/2" --> X 16 3/4"†

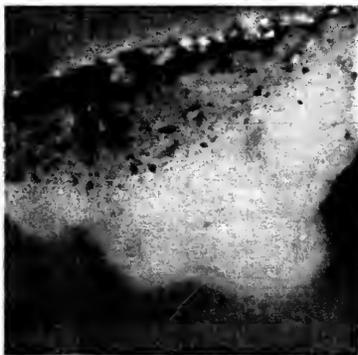
COMMENTS: THE SAMPLE WAS TAKEN FROM THE FOLD IN BELLONA'S DRAPERY. IT SHOULD SHOW BROWN/TAUPE GLAZING LAYERS OVER BLUE AND SUBSTRATE. IN CROSS SECTION THERE IS A RED/ORANGE SURFACE LAYER OVER A BLUE FRESCO LAYER. THESE EXIST ON A SUBSTRATE.



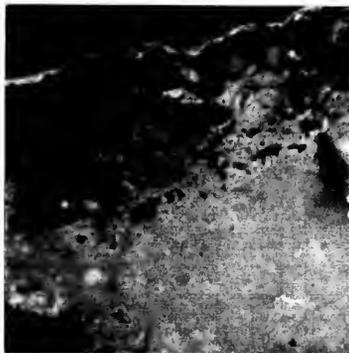
**"BELLONA" SAMPLE # B.II.4.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

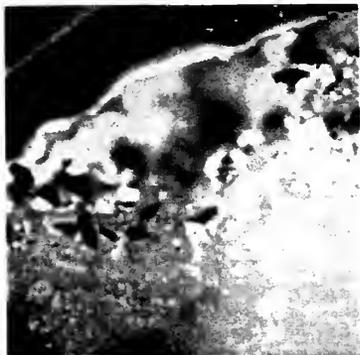
LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3

**FIGURE 94**

COMMENTS: 1. AUTOFLUORESCENCE APPEARS IN THE SUBSTRATE. 2. WITH FITC STAINING, THE FLUOROCHROME COLLECTS IN THE VOIDS BUT DOES NOT STAIN. POSITIVE STAINING APPEARS IN A THIN SURFACE FILM. 3. SIMILARLY, DCF COLLECTS IN FISSURES. THE SAMPLE APPEARS TO BE FRESCO WITHOUT ADDITIONAL MEDIA. A SURFACE FILM APPEARS TO HAVE PROTEINACEOUS MATERIAL.



**"BELLONA" SAMPLE # B.II. 5.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 95**

SAMPLE LOCATION: 35 1/2" -> X 12 1/2"

COMMENTS: SAMPLED FROM THE UNDERGOWN OF THE FIGURE, THE SURFACE COLOR IS RED/ORANGE. IN CROSS SECTION, THE SUBSTRATE IS FINE AND WHITE. THE SURFACE PAINT LAYER, APPEARING TO BE FRESCO, CONTAINS BLACK PARTICLES.



**"BELLONA" SAMPLE # B.II. 5.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



4

**FIGURE 96**

COMMENTS: 1. AUTOFLUORESCENCE APPEARS IN THE SUBSTRATE AND IN A THIN FILM IN THE SURFACE. 2. WITH FITC, STAINING OCCURS ON THE SURFACE FILM (A). 4. WITH RHODAMINE B STAINING OCCURS IN THE PAINT LAYER. PARTICULARLY AS A SURFACE FILM.



**"BELLONA" SAMPLE B.II.5.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 97**

SAMPLE LOCATION: 35 1/2" --> X 12 1/2" ↑

COMMENTS: THE SAMPLE WAS TAKEN FROM THE RED UNDERGOWN OF BELLONA AT THE HEM. IN CROSS SECTION, SHOULD SEE: RED WITH BLACK, SUBSTRATE. IN CROSS SECTION, THERE IS THE SUBSTRATE, A PINK LAYER AND THEN TWO RED LAYERS WITHOUT BLACK PIGMENT APPARENT.



**"BELLONA" SAMPLE # B.II. 5.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 98**

SAMPLE LOCATION: 35 1/2" --> X 12 1/2"↑

COMMENTS: SAMPLED FROM THE UNDERGOWN OF THE FIGURE. THE SURFACE COLOR IS RED/ORANGE. IN CROSS SECTION, THE SUBSTRATE IS FINE AND WHITE. THE SURFACE PAINT LAYER, APPEARING TO BE FRESCO, CONTAINS BLACK PARTICLES.



**"BELLONA" SAMPLE # B.II. 5.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

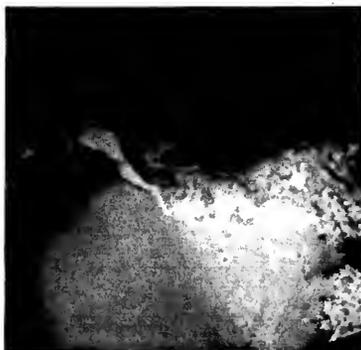
LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



2



3



4

FIGURE 99

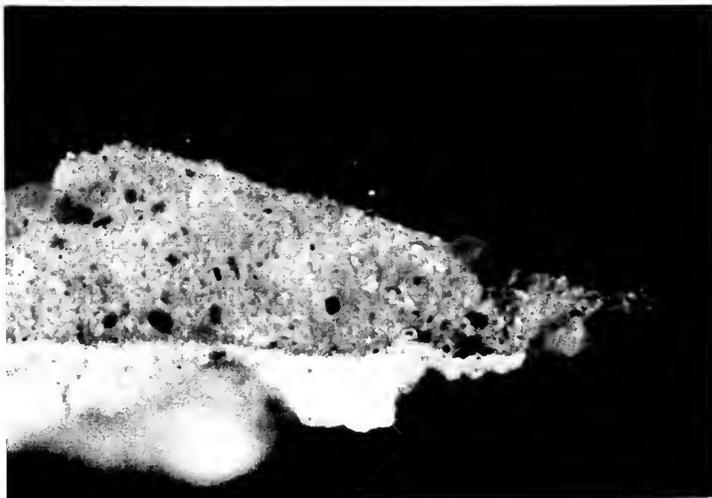
COMMENTS: AUTOFLUORESCENCE OCCURS IN THE SUBSTRATE. 2. WITH FITC, STAINING APPEARS IN AN UPPER THIN SURFACE FILM. 3. WITH DCF FOR LIPIDS, THERE IS NO STAINING. 4. RHODAMINE B COLLECTS IN THE SAMPLE FISSURES.



**"BELLONA" SAMPLE B.II.8.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 100**

SAMPLE LOCATION: 6 1/2"←-X 13 1/2"↑

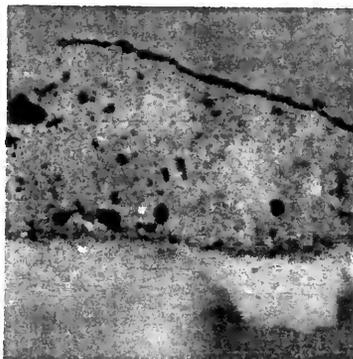
COMMENTS: SAMPLED FROM THE FAR RIGHT OF THE COMPOSITION, THE SAMPLE LOCATION WAS THE LOWER RIGHT QUARTER. EXPECT TO SEE BLACK, TAUPE, SUBSTRATE. IN CROSS SECTION, THE SAME STRATIGRAPHY IS SEEN, AS EXPECTED.



**"BELLONA" SAMPLE B.II. 8.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



3

**FIGURE 101**

COMMENTS: AUTHOFLUORESCENCE IS LIMITED TO THE SUBSTRATE AND CALCIUM CARBONATE PARTICLES OF THE TAN FRESCO LAYER. 3. WHEN STAINED WITH DCF, THE FLUOROCHROME COLLECTS IN THE VOIDS.



**"BELLONA" SAMPLE # B.II.9.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 102**

SAMPLE LOCATION:  $-1/32'' \rightarrow X - 1/32'' \uparrow$ ; MEASURED FROM THE BORDER BANDING PERIMETERS..

COMMENTS: THE SAMPLE WAS TAKEN FROM THE WHITE STRIPE OF THE BANDING AT THE PAINTING PERIMETER TO ILLUSTRATE THE PAINT STATIGRAPHY. IN CROSS SECTION, IT SHOWS A WHITE PAINT LAYER, A THIN GRAY LAYER, A BROWN LAYER AND THEN THE SUBSTRATE.



**"BELLONA" SAMPLE # B.II.9.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE

MAGNIFICATION: 50 X - 70X

OBJECTIVE: 10 X

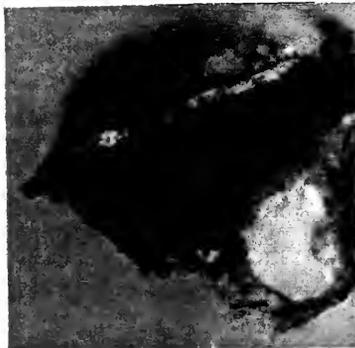
LIGHT SOURCE: MERCURY ARC

CAMERA: LEITZ- 35mm

FILM: KODAK GOLD 200 ASA



1



4

**FIGURE 103**

COMMENTS: 1.AUTOFLOURESCENCE APPEARS IN THE LIME MATRIX. NO STAINING APPEARS WITH FIT C AND DCF 4. RHODAMINE B STAINS IN THE BROWN LAYER.



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

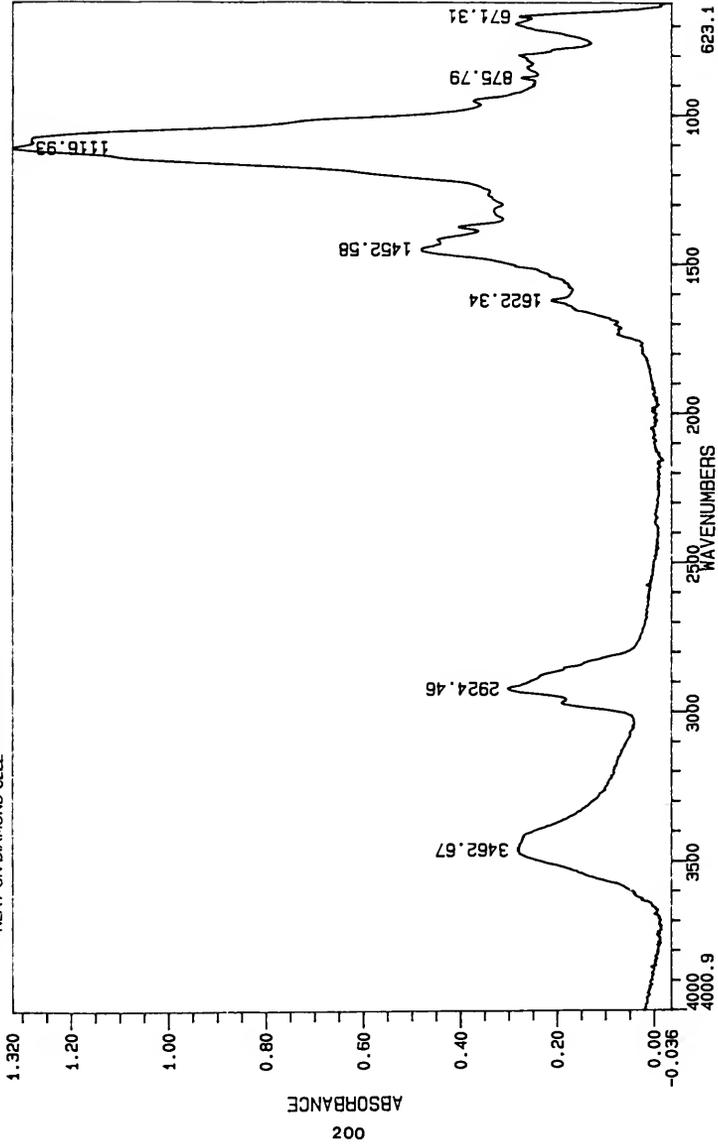


FIGURE 104

BI 3 a  
BRUMIDI FRESCO  
SCANS: 200 RES: 4.0 TIME: 06/26/92 13:59:05

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

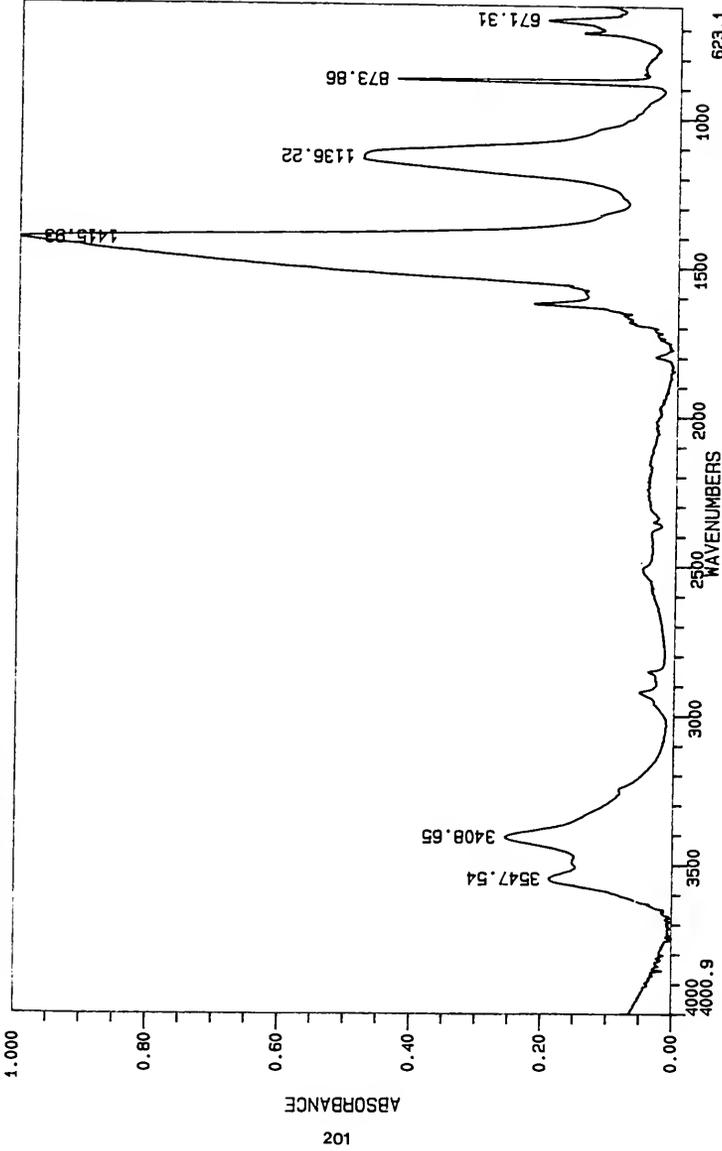


FIGURE 10S

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT

BI110 NEAT ON DIAMOND CELL, BASELINE CORRECTED  
BRUMIDI "BELLONA", SUBSTRATE  
SCANS: 200 RES: 4.0 TIME: 06/22/92 12:13:29 FILE: CSM



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

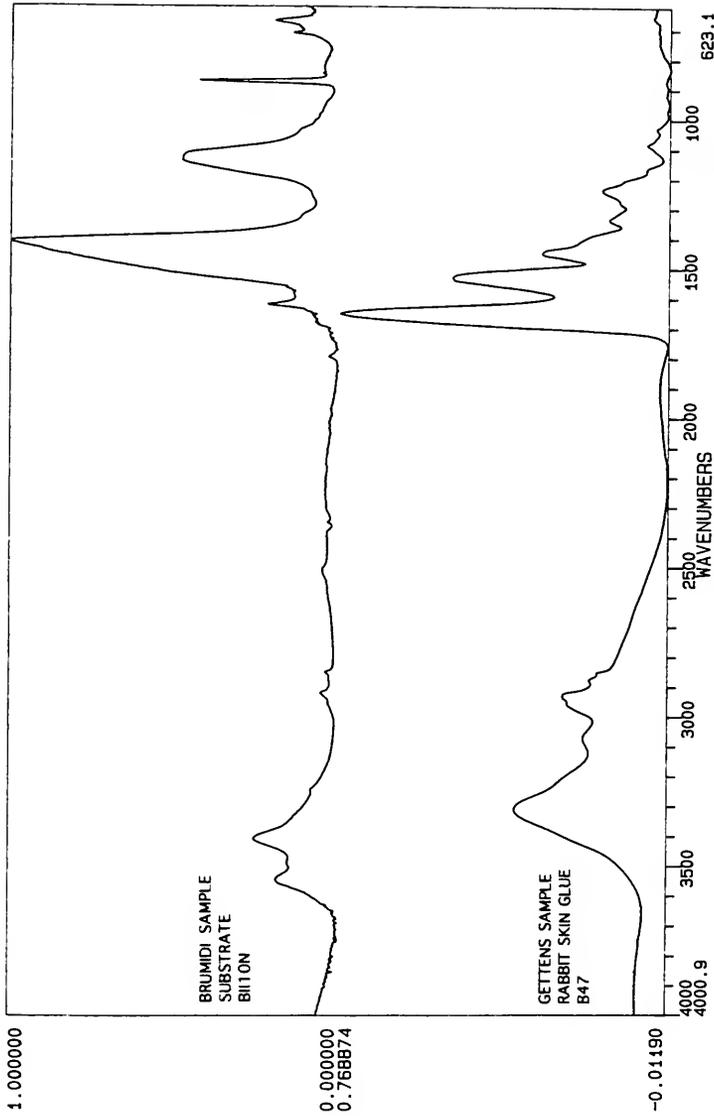


FIGURE 106

BRUMIDI FRESCO, SUBSTRATE, BITON  
B47  
RABBIT SKIN GLUE, GETTENS 100.B47  
02/01/92 11:54:02

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

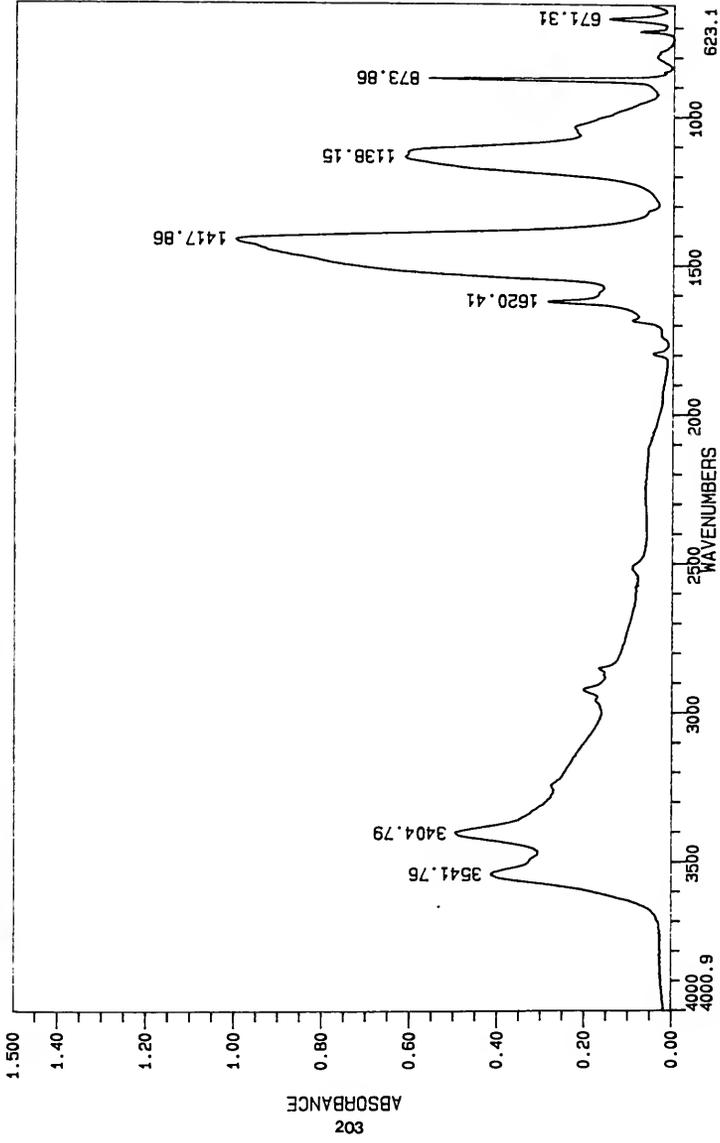


FIGURE 107

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT

BIIGN  
BRUMIDI FRESCO  
SCANS: 200 RES: 4.0 TIME: 06/22/92 12: 59: 55



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

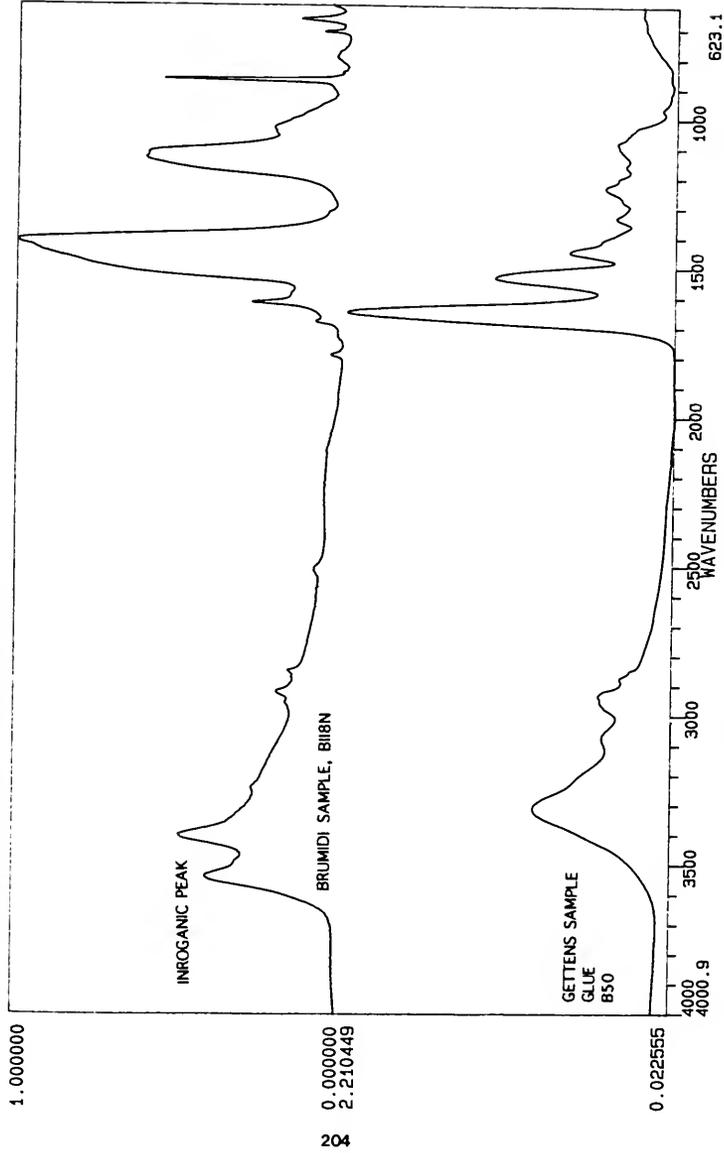


FIGURE 108

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT

BRUMIDI SAMPLE  
BI8N  
B50  
NATIONAL GALLERY SPECIMEN, GETTENS, 100.B50  
02/19/92 10:53:50



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

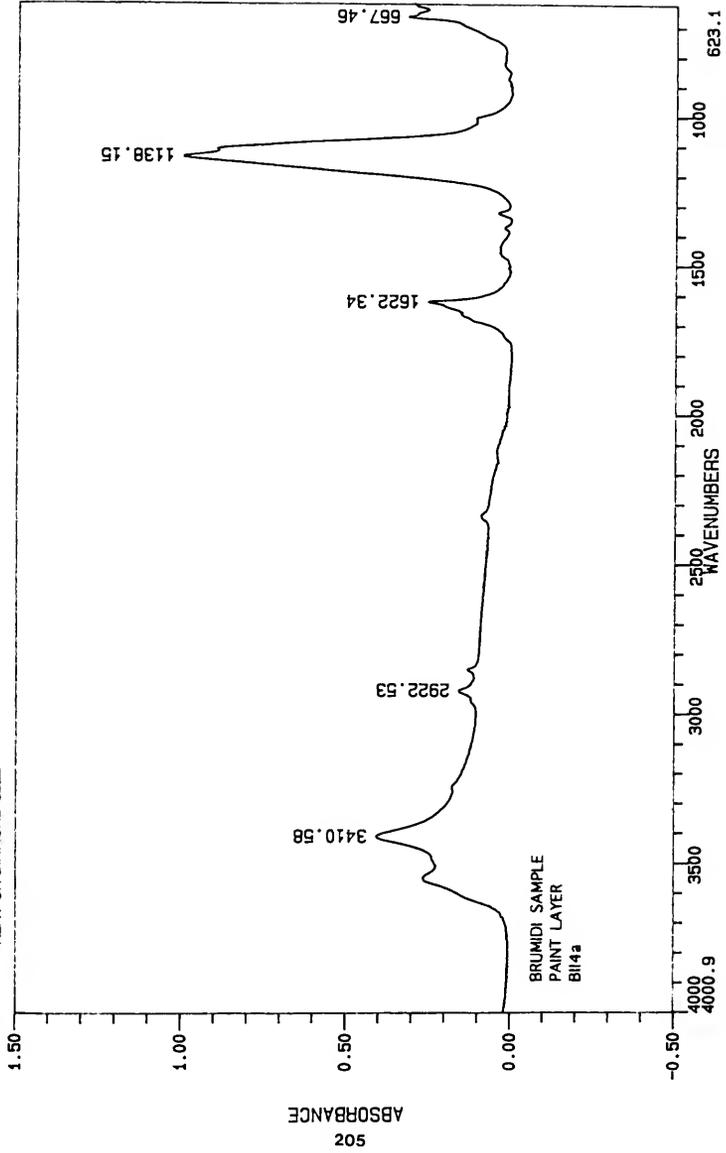


FIGURE 109

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT

BII4aN  
BRUMIDI FRESCO  
SCANS: 200 RES: 4.0 TIME: 06/26/92 14: 15: 28



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

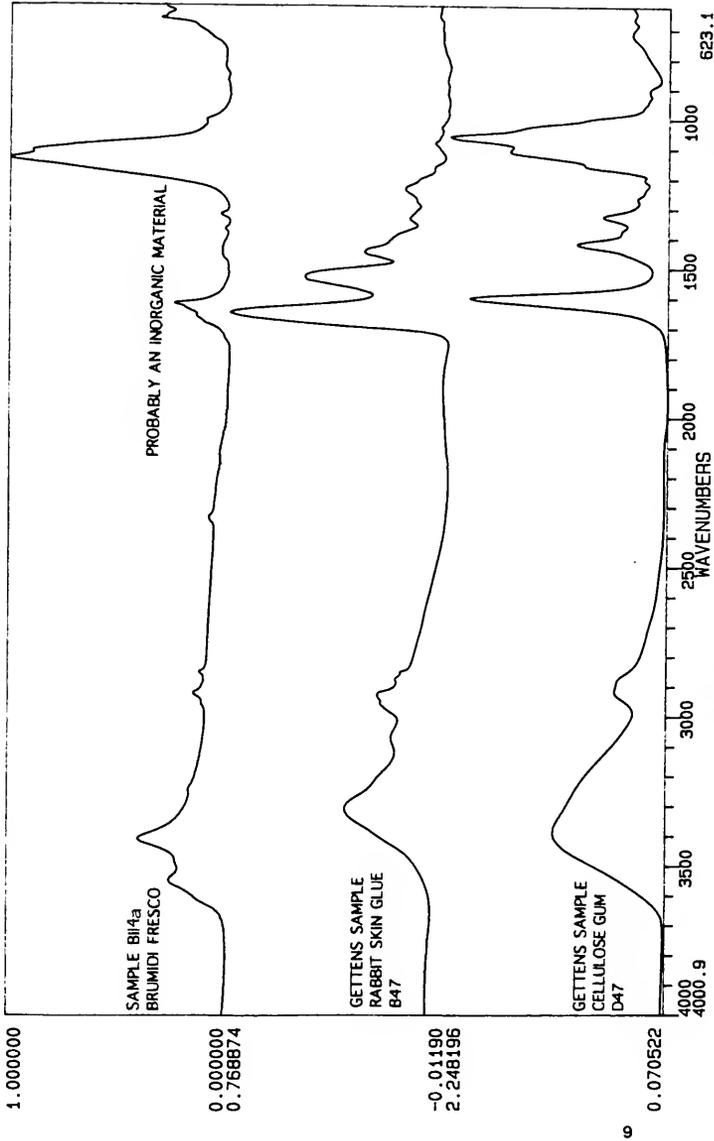


FIGURE 110

BRUMIDI SAMPLE, PAINT LAYER, BII4a  
D47  
CMC, HIGH VISCOSITY CELLULOSE GUM, GETTENS, 100.047  
02/28/92 12:18:45

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

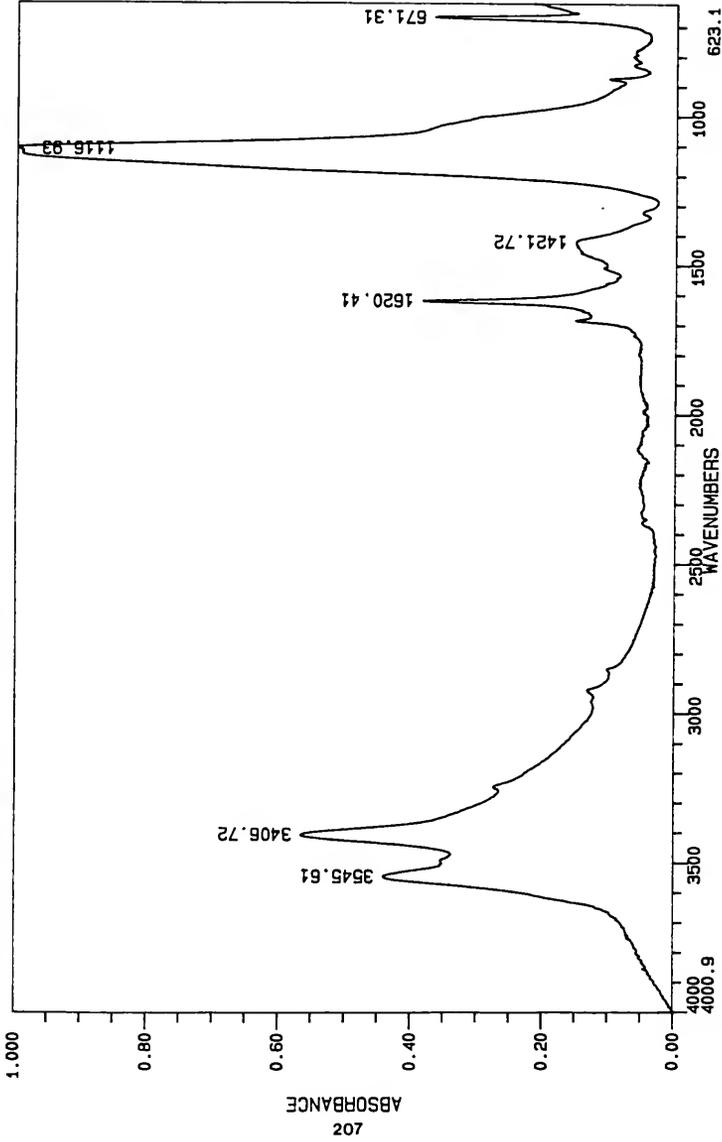


FIGURE 111

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT

BI 7N  
BRUMIDI FRESCO  
SCANS: 200 RES: 4.0 TIME: 06/27/92 14:27:42



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

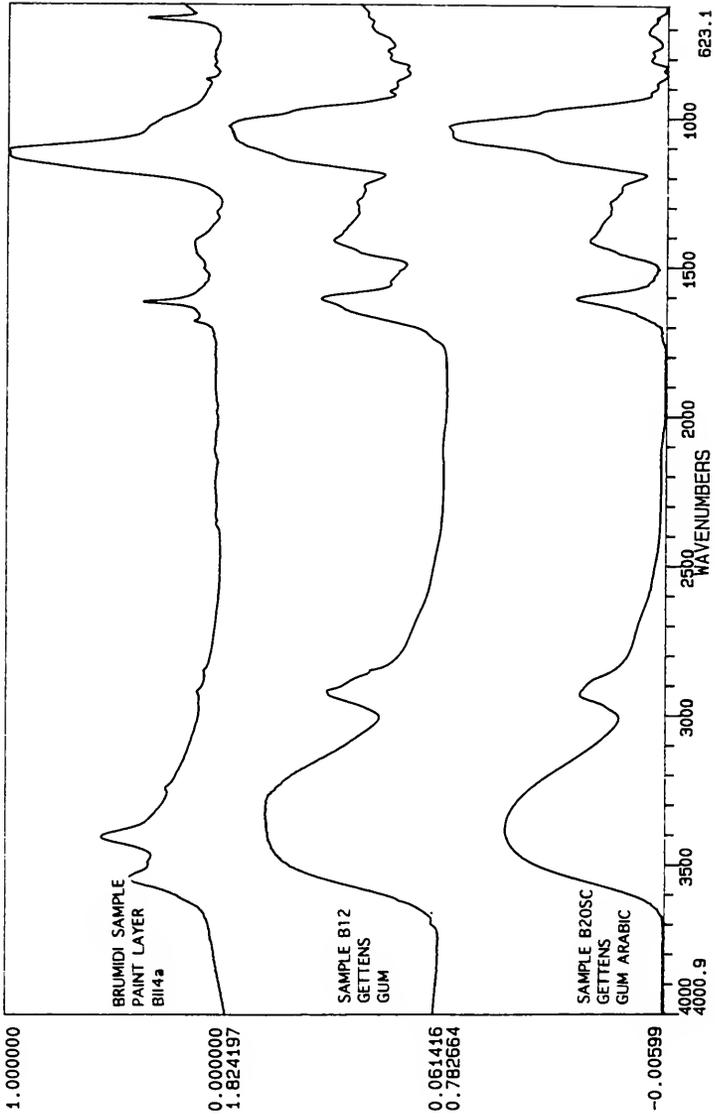


FIGURE 112

B17N  
B20SC  
GUM ARABIC, GETTENS, 100.B20, (SLOPE CORRECTED)  
02/11/92 11:30:44

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



RESULT: BELLOVA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

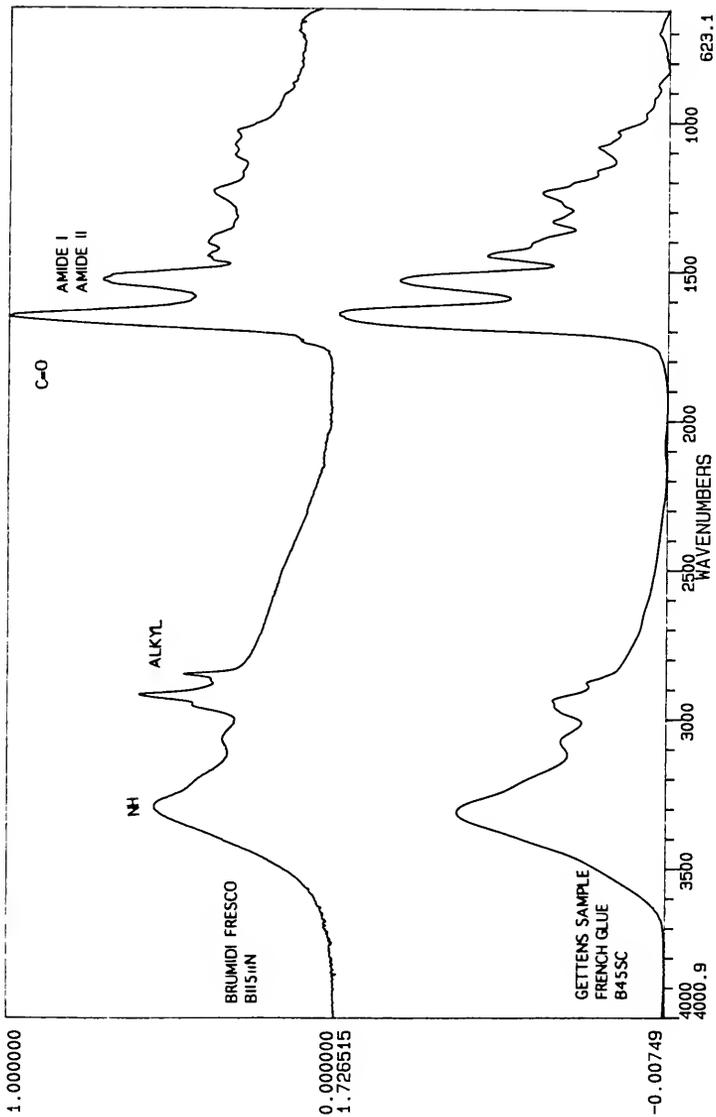


FIGURE 1113a

BRUMIDI FRESCO, BIIS11N  
B45SC  
FRENCH GLUE "B", GETTENS, 100.B45, (SLOPE CORRECTED)  
02/18/92 13:52:16

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



RESULT: BELLONA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

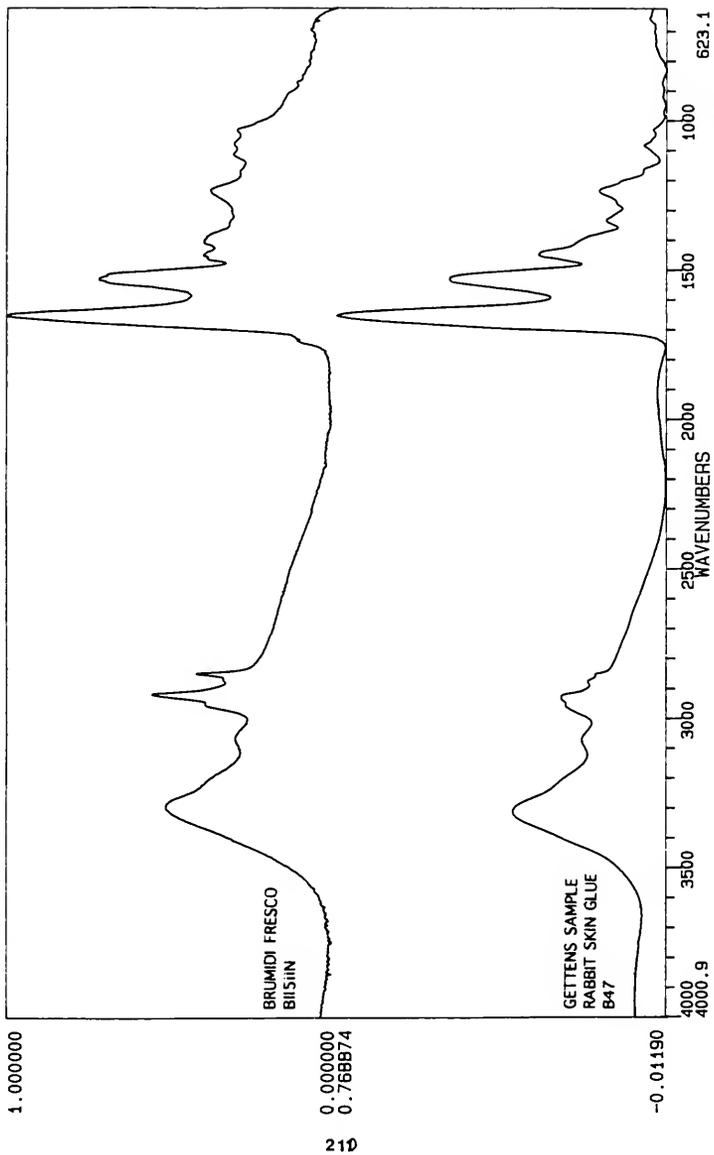


FIGURE 113b

BRUMIDI FRESCO, BIISIIN  
B47  
RABBIT SKIN GLUE, GETTENS 100.B47  
02/01/92 11:54:02

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



## C. THE CESSATION OF LOUISIANA

### I. ON SITE INVESTIGATION : MACRO-ANALYSIS

Superficial site examination revealed that the painting is fresco as verified by the presence of *giornate*, incisions and *puntini* and the appearance of cross-sectional samples. As elsewhere, the painted bands that border the painting perimeters have been repainted on at least one occasion. Although there are indications of age, such as *craquelure* in the paint layer and obvious surface accretions in addition to overpaint, the painting appears to be stable.

Emphasized by raking light, the plaster texture varies within the composition between smooth plaster and rougher plaster. For example, the background plaster and passages of the figures alternates between rough and smooth while the plaster used for the furniture and other elements is generally smooth. (See Figures 119 and 120.) However, it would be difficult to generalize that coarse plaster was used to improve the intensity of color, by providing more particle angles from which to collect the pigment, since these variations are inconsistent and, as it appears, somewhat random. Additionally, as in the case of the other paintings, paint accumulation by the addition of lime bound secco passages, obscures the plaster texture causing a general smoothness in areas of reworking or paint layers, such as the faces and hands, where the texture of the plaster is generally lost to an *impasto* texture.

Superficial examination exhibits obvious *giornate*, (Figures 120 and 126), a varied plaster texture, (Figure 118), sketchy painting technique (Figure 125), and the presence of abundant overpaint. (See the background in Figure 116.) With raking light, *puntini* are emphasized in limited passages of the painting. (See Figure 123.) Additionally, *giornate* are accentuated. (See Figures 116), and the *impasto*, pronounced in white passages such as cuffs and shirt fronts, are apparent. (See Figures 118 and 120). Raking light further details Brumidi's practice of painting, as seen in the face of Monroe, (Figure 121), and the hands, (See Figure 120) where bold rapid brushstrokes, enriched apparently with lime, define the forms within the composition. When photographed with infrared filtered



illumination and high speed infrared film, almost no alteration to the composition is evident. Although evidence of overpaint of an altered composition might have appeared when photographed at closer range, the exposure did not reveal alterations brought through overpainting. (Compare Figure 114 with Figure 128.)



## II. LABORATORY ANALYSIS : MICRO- ANALYSIS

### 1. STRATIGRAPHY

#### CROSS-SECTIONAL SAMPLES:

Twenty-five samples were extracted from the painting, embedded in polyester resin and cross-sectioned for study. Although there is an inadequate number of samples to draw generalities, review of these samples affords for their placement in one of four types of cross-sections:

1. substrate/ pigment
2. substrate (intonaco), substrate (intonachino), pigment
3. single thick pigment layer
4. two or more pigment layers.

In most cases the pigmented layers are crystalline, suggestive of fresco. In some cases, a white strata exists between the substrate and the pigment layer . (See Figure 147.) Dense pigment layers without, as it appears, binding medium, characterize some of the samples (See Figures 140 and 153). As found elsewhere, pigmented layers, as ground layers, underlie some passages. Sample **C.II.3.a.** illustrates a gray paint layer beneath a white layer. The uppermost white layer is associated with the impasto applied to the cuff of the shirt.

Overpaint is seen in cross-section as taken from the background. Green original paint is seen in the cross section over which a lighter green/gray layer, evidently overpaint, is located. (See Samples **C.I.5.a** and **b.** and **C.II.15.b.**).



## 2. IDENTIFICATION OF MEDIUM :

### FLUORESCENT STAINING

#### FT-IR : CONFIRMATION

Fluorescent staining resulted in weak and negative responses. In some cases positive stains were not clearly discernable from "false positives" caused by the collection of fluorochromes in the voids and fissures of the samples. As elsewhere, the fluorochromes also collected in the juncture between the sample and the embedding medium.

Where positive staining did occur, it was limited to the identification of lipids and proteins.

#### OILS:

Sample **C.II.6.a.** also stains positively for lipids in a similar manner as it had stained for proteins.

Sample **C.II.15.b.** also stains at the upper layer, just below a surface film, for lipids with DCF.

For samples **C.II.11.a.** and **C.II. 13.b.**, both representing passages of the skin, stain positively for lipids with both DCF and Rhodamine B and Rhodamine B respectively.

Samples **C.II.3.a.**, **C.II.4.a.** and **C.II.9.b.** appear to have an oil-based surface films. In both cases, a positive stain appears on the surface with Rhodamine B. Additionally, oils appear to be present in the substrate as indicated by positive staining with Rhodamine B.

Samples taken from the red ground at the base of the composition, which appears to be fresco from on-site examination , (see samples **C.I.6.a** and **C.II.1.b.**) illustrate that oils are present. Positive staining appears in the layer between the paint layer and the substrate, suggesting that an oil exists at the top of the substrate. From sample **C.II.7.b.** , taken from the banded border at the painting perimeter, a similar positive stain appears between the paint layer and the substrate. In these samples, possibly, oil from the paint layer has penetrated into the upper margin of the substrate. However, other samples also



taken from the red/orange lower margin of the composition, did not stain positively for lipids such as sample **C.II.5.b.** and **C.II.12.a.**

## **PROTEINS:**

A proteinaceous material in the background of the composition is identified by positive staining with FITC. In two samples representing the upper background area, (See Samples **C.I.5.a.**, and **C.II.15.b.**), presently overpainted green, protein is identified in the layer beneath the overpaint, suggesting that a glue, casein or egg is present.

Sample **C.II.13.b.**, a sample taken from one of the figure's hands, also stains positively for proteins, but, in this case in a surface film layer. In another sample taken from the finger of one of the figures, Sample **C.II.11.a.**, there is also a positive stain. However, in this instance, FITC identifies a protein throughout the sample.

In sample **C.II.6.a.**, a sample taken from the banded border of the painting, stained positively throughout the sample stratigraphy.

Otherwise, the samples appeared to be without organic media, namely those composed of gums, proteins and lipids. As such, the painting appears to be fresco or lime *secco*. For example, sample **C.II.12.a.** a densely pigmented sample taken from the lower margin of the lunette, does not stain at all. Sample **C.II.3.a.** of an impastoed passage, likewise does not stain at all.

## **FT-IR CONFIRMATION**

Only one sample was subjected to FT-IR analysis. A specimen from the substrate of the sample was found to contain proteins as evidenced by alkyl stretch and amides. (See Figure 113.)



### 3. PIGMENTS

A selection of samples were chosen for study based upon the frequency of their occurrence among the cross-sectional samples. The samples were first studied optically and then were subjected to microchemical tests. One sample was analyzed by XRD.

#### OPTICAL:

In transmitted light sample C.II.2 . appeared to be an iron oxide pigment due to the heterogeneous mixture of particles, and the occurrence of isotropic and birefringent particles.

#### MICROCHEMICAL:

Several samples were microchemically tested with positive results for leads and iron oxides.

Sample C.II.5., a yellow/orange pigmented sample, tested negatively for iron oxide and positively for lead. Other red/orange samples , such as sample C.II.1. and C.II.12. tested positively for leads and iron oxides, suggesting perhaps that a combination of pigments existed in the sample studied. These pigments were analyzed by XRD.

Sample C.II 3. tested positively for calcium carbonate, verifying that the *impasto* was composed of calcium carbonate.



## **XRD**

Sample C.II.1. was analyzed by XRD. The result confirmed that the pigment was an iron oxide. The pigment appears to be burnt sienna, a pigment that corresponds with Brumidi's materials requests.

Sample C.II.12. was also analyzed by XRD. The results also confirmed that the pigment was an iron oxide. The pigment, as judged from visual examination, is probably Venetian red, also a pigment Brumidi ordered according to materials requests.



### III. SUMMARY

The *Cession of Louisiana*, like *Bellona*, is undoubtedly a fresco. This conclusion, confirmed by on-site examination and the evidence of *giornate*, *puntini* and incisions and the appearance of cross-sectional samples, is expected. Media analysis by fluorescent staining and confirmed, in one case, by FT-IR, provides evidence of a predominantly inorganic composition, characteristic of fresco. That is, the pigments are integrated in a calcium carbonate matrix, whether by fresco or as a result of lime painting a secco. Cross sectional samples indicate generally, that the painting is fresco.

It appears that glue included in the strata below the pigmented layer, as found in *Bellona* and *Las Casas*. Possibly Brumidi applied a layer of glue to the substrate prior to applying the pigments for fresco, a Baroque practice as indicated above. Since the substrate material revealed the presence of a protein, it is also possible that the artist added glue, egg or casein to the intonaco, or intonachino, also a practice with historical precedent. However, the extent of organic media used is not known and would require extensive testing for proper assessment.

Pigment analysis indicates that the artist employed an expected palette of colors that correspond to those he ordered. A traditional fresco palette was used composed of iron oxides, terra verde and calcium carbonate. As found elsewhere, it is assumed that the blacks are charcoal black and that pigment mixtures, such as those for the skin colors, derive from the pigments named above.



**PHOTOGRAPH  
"THE CESSATION OF LOUISIANA"**

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA

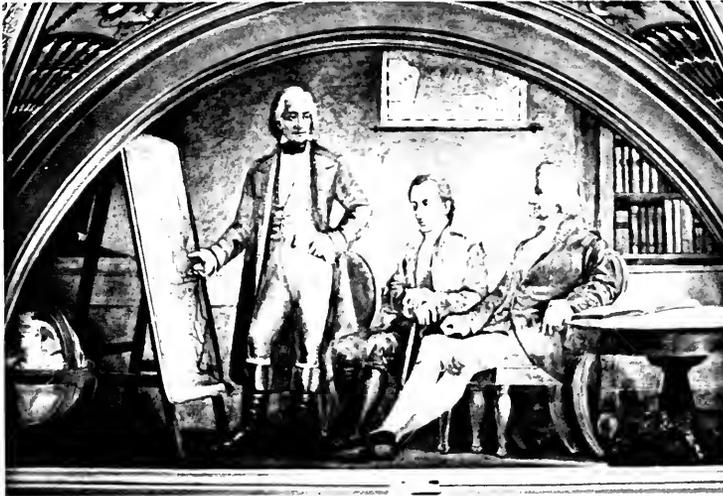
DATE: 1/92

ILLUMINATION: TUNGSTEN FILAMENT

PHOTO BY: CSM

CAMERA: OLYMPUS-OM WITH 35 MM PERSPECTIVE CORRECTION LENS

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**Figure 114**

COMMENTS: THIS BLACK AND WHITE PHOTOGRAPH REPRESENTS THE PAINTING. AS ELSEWHERE, THE BANDED BORDER WAS REPAINTED ON AT LEAST ONE OCCASION. IN GENERAL, THE BACKGROUND HAS BEEN EXTENSIVELY OVERPAINTED AND RETOUCHING OF DETAILS OF THE FIGURES HAS OCCURRED.



PHOTOGRAPH  
"THE CESSATION OF LOUISIANA"  
NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 35 MM PERSPECTIVE CORRECTION LENS

DATE: 1/92  
PHOTO BY: CSM

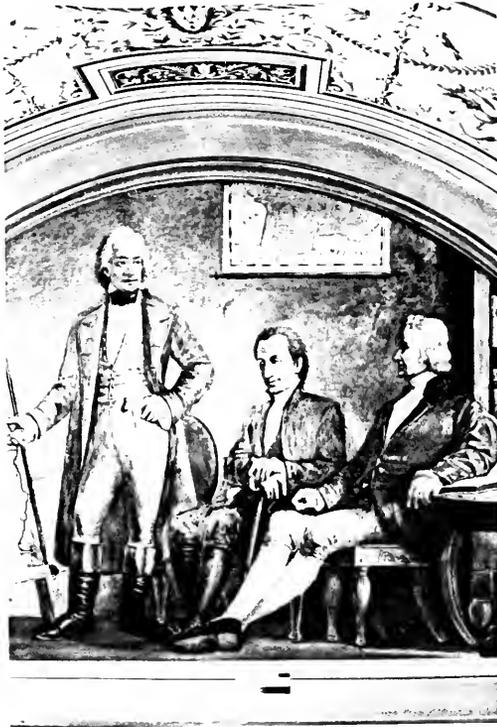


FIGURE 115

COMMENTS: THIS BLACK AND WHITE PHOTOGRAPH REPRESENTS THE PAINTING. AS ELSEWHERE, THE BANDED BORDER WAS REPAINTED ON AT LEAST ONE OCCASION. IN GENERAL, THE BACKGROUND HAS BEEN EXTENSIVELY OVERPAINTED AND RETOUCHING OF DETAILS OF THE FIGURES HAS OCCURRED.



RAKING LIGHT PHOTOGRAPH  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-1000

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 116

COMMENTS: IN RAKING LIGHT, THE PAINT TEXTURE, INCLUDING BRUSHSTROKES AND *IMPASTO*, ARE EMPHASIZED, AS SEEN HERE IN THE FACE OF THE FIGURE OF MONROE.



RAKING LIGHT PHOTOGRAPH  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: PENTAX K-1000

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 117

COMMENTS: RAKING LIGHT ILLUSTRATES THE *GIORNATA* JUNCTURES AT THE SHOULDER OF TALLYRAND. THE MOTTLED BACKGROUND OVERPAINT IS ALSO EMPHASIZED.



RAKING LIGHT: MACROPHOTOGRAPH  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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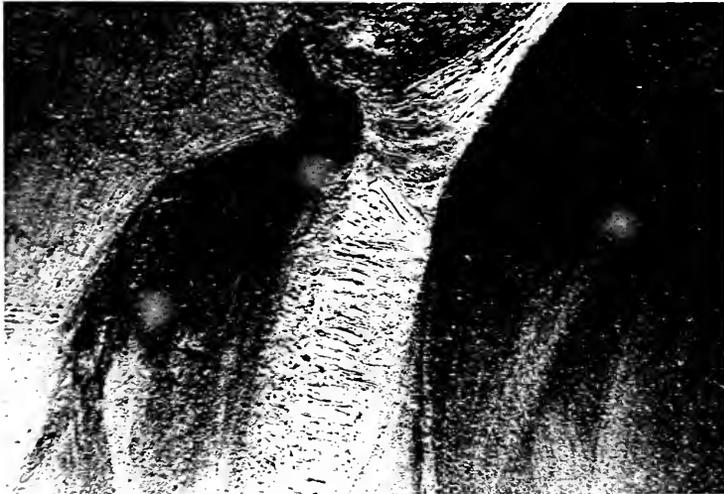


FIGURE 118

COMMENTS: *IMPASTO* AND ROUGH PLASTER ARE ILLUSTRATED BY THIS DETAIL OF THE MONROE.



MACROPHOTOGRAPH  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 119

COMMENTS: A ROUGH PLASTER TEXTURE APPEARS IN THIS DETAIL OF THE BOOT OF TALLYRAND. A *GIORNATA* JUNCTURE IS SEEN TO THE RIGHT OF THE BOOT.



MACROPHOTOGRAPH  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 120

COMMENTS: THE DETAIL OF TALLYRAND'S HAND AGAIN SHOWS A LOOSE AND SKETCHY PAINTING TECHNIQUE, HERE ILLUSTRATING THE ARTIST'S ABILITY TO PRODUCE FORM AND DEFINITION WITH SHADOW.



MACROPHOTOGRAPH: RAKING LIGHT  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 121

COMMENTS: IN THIS DETAIL OF MONROE'S FACE, THE *IMPASTO* OF THE PAINT SHOWS BRUMIDI'S WORKING TECHNIQUE. THE PAINT WAS HEAVILY APPLIED IN A SKETCHY MANNER.



MACROPHOTOGRAPH: RAKING LIGHT  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLMPIUS -OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 122

COMMENTS: MACROPHOTOGRAPHS IN RAKING LIGHT ILLUSTRATE THE *GIORNATE* JUNCTURES, THE PAINT TEXTURE AND THE PLASTER TEXTURE. ILLUSTRATED HERE IS A DETAIL OF TALLYRAND'S AND MONROE'S KNEES.



**MACROPHOTOGRAPH: RAKING LIGHT**  
**"THE CESSATION OF LOUISIANA"**

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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**FIGURE 123**

COMMENTS: RAKING LIGHT ILLUMINATES THE *PUNTINI* USED TO TRANSFER THE DESIGN AT THE HANDS OF MONROE. BRUMIDI USUALLY MIXED TRANSFER TECHNIQUES, USING *PUNTINI*, *INCISIONS* AND *SPOLVERO* ON THE SAME COMPOSITION.



MACROPHOTOGRAPH  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 124

COMMENTS: THIS DETAIL OF THE HAND OF MONROE ILLUMINATES BRUMIDI'S PAINTING ABILITY AND TECHNIQUE. THE HAND IS CRUDELY PAINTED WITH BROAD, SIMPLE OUTLINES. IT ALSO ILLUSTRATES THE PLASTER TEXTURE, WHICH IS ROUGH, AND THE BROAD, LOOSE APPLICATION OF PAINT.



MACROPHOTOGRAPH: RAKING LIGHT  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 125

COMMENTS: THE DETAIL PHOTOGRAPH IN RAKING LIGHT ILLUSTRATES THE PAINT TEXTURE, HERE THE *IMPASTO*, PROBABLY IN FRESCO, OF THE ORNAMENT ON THE CHAIR. BRUMIDI'S LOOSE BUT EFFECTIVE PAINTING TECHNIQUE IS ILLUMINATED BY SUCH DETAIL.



MACROPHOTOGRAPH: RAKING LIGHT  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS -OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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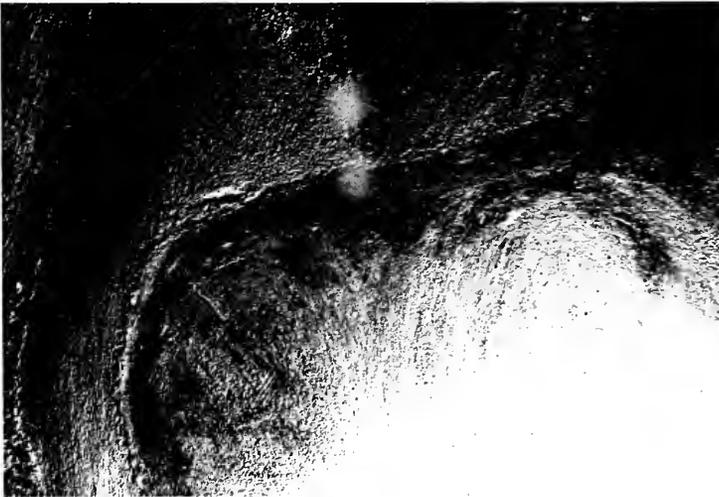


FIGURE 126

COMMENTS: MACROPHOTOGRAPHS IN RAKING LIGHT ILLUSTRATE THE *GIORNATE* JUNCTURES, THE PAINT TEXTURE AND THE PLASTER TEXTURE. ILLUSTRATED HERE IS A DETAIL OF TALLYRAND'S AND MONROE'S KNEES.



RAKING LIGHT: MACROPHOTOGRAPH  
"THE CESSATION OF LOUISIANA"

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS. U.S. CAPITOL

FILM: KODAK PLUS-X 100ASA  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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FIGURE 127

COMMENTS: *IMPASTO* AND POSSIBLE OVERPAINT ARE SEEN OF THIS DETAIL OF THE CUFF OF TALLYRAND.



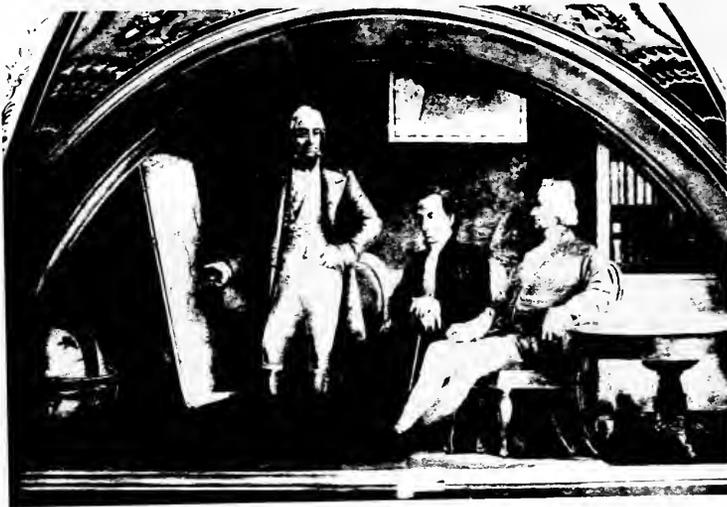
**RAKING LIGHT: MACROPHOTOGRAPH  
"THE CESSATION OF LOUISIANA"**

NORTH CORRIDOR, FIRST FLOOR SENATE CORRIDORS, U.S. CAPITOL

FILM: KODAK HIGH SPEED INFRARED FILM HIE 135-36  
ILLUMINATION: TUNGSTEN FILAMENT  
CAMERA: OLYMPUS-OM WITH 80-200 ZOOM LENS

DATE: 1/92  
PHOTO BY: CSM

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**FIGURE 128**

COMMENTS: WITH INFRARED ILLUMINATION, MINOR DIFFERENCES FROM THE ORIGINAL COMPOSITION ARE NOTED AS FOLLOWS. THE BACKGROUND APPEARS TO BE OF A SOLID, AS OPPOSED TO MOTTLED, FIELD COLOR. THERE APPEARS TO BE SOME ABRASION TO THE BACKGROUND AT THE RIGHT SIDE OF THE COMPOSITION, ABOVE THE FIGURE OF JEFFERSON. OVERPAINTING OF THE FIGURES' FACIAL FEATURES, AS EXPECTED - WHICH WOULD HAVE EXPLAINED THE AWKWARDNESS OF HANDLING THEM - APPEAR TO BE ABSENT. THE FIGURES AS THEY APPEAR TO BE MUST BE ORIGINAL. COMPARE WITH VISIBLE LIGHT ILLUMINATION.



"LOUISIANA" SAMPLE C.I.5h.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA

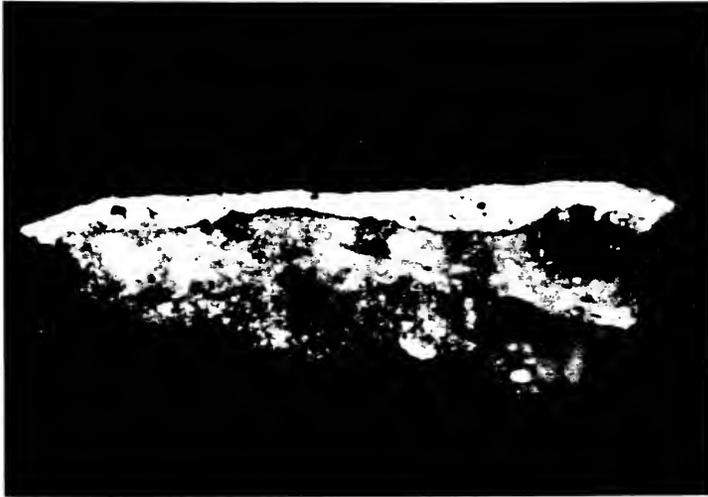


FIGURE 129

SAMPLE LOCATION: 23° <-- X 14° |

COMMENTS: THE SAMPLE WAS TAKEN FROM AN OVERPAINTED LOCATION IN THE GREEN BACKGROUND AIMED AT ILLUSTRATING THE UNDERPAINTING AND THE GENERAL STRATIGRAPHY. THE SAMPLE INCLUDED THE OVERPAINT, ORIGINAL PAINT LAYER AND THE SUBSTRATE. IN CROSS-SECTION, TWO FRAGMENTS APPEAR SITUATED ON TOP OF EACH OTHER WITH THE OVERPAINT LOCATED ON THE INSIDE OF THE SAMPLE. THE LAYERS ARE AS FOLLOWS: (A) GREEN OVERPAINT (B) CREAM/WHITE LAYER (C) GREEN FRESCO LAYER. IT APPEARS THAT THE OVERPAINT IS THIN, PROBABLY OIL-BOUND AND THAT A WHITE/CREAM LAYER WAS EITHER THE PRESENTATION LAYER OR THAT IT IS A LAYER ADDED AT THE TIME OF EXECUTION, SINCE THERE IS NOT A DIRT LAYER. (B) AND (C) ARE CRYSTALLINE AND CONTAIN IRREGULARLY SHAPED AND SIZED PARTICLES INTEGRATED IN THE FRESCO STRATA .



"LOUISIANA" SAMPLE C.I.5.a.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 130

SAMPLE LOCATION: 23° ← X 14° ↓

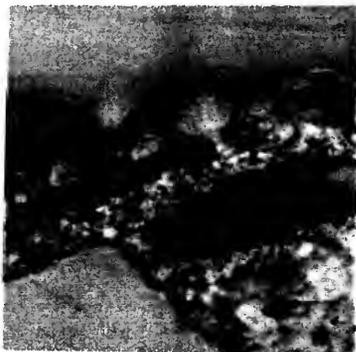
COMMENTS: THE SAMPLE WAS TAKEN FROM AN OVERPAINTED LOCATION IN THE GREEN BACKGROUND AIMED AT ILLUSTRATING THE UNDERPAINTING AND THE GENERAL STRATIGRAPHY. THE SAMPLE INCLUDED THE OVERPAINT, ORIGINAL PAINT LAYER AND THE SUBSTRATE. IN CROSS-SECTION, TWO FRAGMENTS APPEAR SITUATED ON TOP OF EACH OTHER WITH THE OVERPAINT LOCATED ON THE INSIDE OF THE SAMPLE. THE LAYERS ARE AS FOLLOWS: (A) GREEN OVERPAINT (B) CREAM/WHITE LAYER (C) GREEN FRESCO LAYER. IT APPEARS THAT THE OVERPAINT IS THIN, PROBABLY OIL-BOUND AND THAT A WHITE/CREAM LAYER WAS EITHER THE PRESENTATION LAYER OR THAT IT IS A LAYER ADDED AT THE TIME OF EXECUTION, SINCE THERE IS NOT A DIRT LAYER. (B) AND (C) ARE CRYSTALLINE AND CONTAIN IRREGULARLY SHAPED AND SIZED PARTICLES INTEGRATED IN THE FRESCO STRATA .



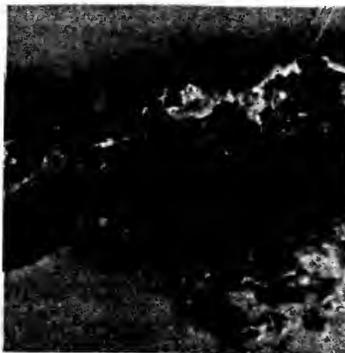
**"LOUISIANA" SAMPLE C.I.5.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



4

**FIGURE 131**

COMMENTS: 1. AUTOFLUORESCENCE IS ASSOCIATED WITH THE CRYSTALLINE PARTICLES. 2. WHEN STAINED FOR PROTEINS WITH FITC, THE FLUOROCHROME SETTLES IN THE FISSURES 4. POSITIVE STAINING WITH RHODAMINE B FOR UNSATURATED LIPIDS RESULTS IN POSITIVE STAIN IN THE LAYER (B) CONFIRMING THE PRESENCE OF A DRYING OIL IN THAT LAYER.



**"LOUISIANA" SAMPLE # C.I.6.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 132**

SAMPLE LOCATION: 21 1/2" <--- X 0" ↑

COMMENTS: THE SAMPLE WAS TAKEN FROM AN ORIGINAL SURFACE LOCATED BELOW THE TABLE IN THE MAROON FIELD COLOR AT THE LEFT SIDE OF THE COMPOSITION. SHOWING A CRYSTALLINE STRUCTURE CHARACTERISTIC OF CALCIUM CARBONATE AND SAND, THE PAINT LAYER EXISTS AS A SEPARATE LAYER FROM THE SUBSTRATE. IT IS BRIGHT RED IN CROSS-SECTION AND CONTAINS BLACK PARTICLES.



"LOUISIANA"

SAMPLE # C.I.6.a.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA

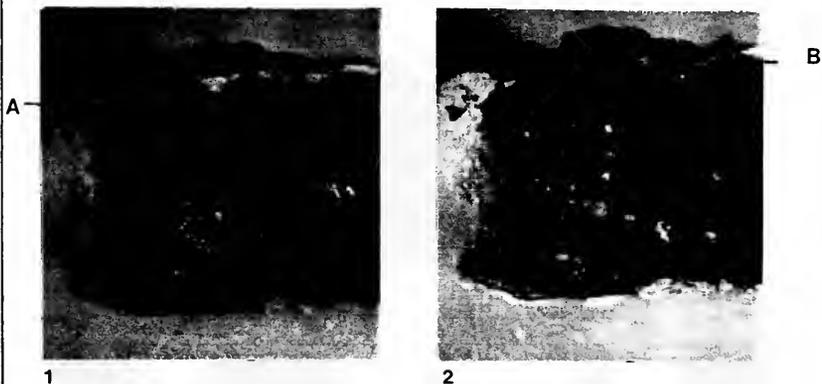


FIGURE 133

COMMENTS: 1. THE LAYER BENEATH THE RED PAINT LAYER AUTOFLUORESCES WHILE THE PAINT LAYER ITSELF HAS NO AUTOFLUORESCENCE. THIS YELLOW FLUORESCENCE (A) SUGGESTS THAT A FLUORESCENT MATERIAL, SUCH AS A LAYER OF MEDIUM OR AN INORGANIC MATERIAL, SUCH AS A PIGMENT, EXISTS BENEATH THE PIGMENT LAYER. 2. POSITIVE STAINING WITH RHODAMINE B APPEARS IN THE SAME AUTOFLUORESCENT LAYER (B) SUGGESTING THAT THE LAYER IS AN UNSATURATED LIPID, A DRYING OIL. WHEN STAINED FOR MEDIUM USING OTHER FLUOROCHROMES, INCLUDING TTC AND DCF, POSITIVE STAINING DID NOT OCCUR.



"LOUISIANA" SAMPLE C.II.1.b.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 134

SAMPLE LOCATION: 7 3/4" <-- X 12" ↑

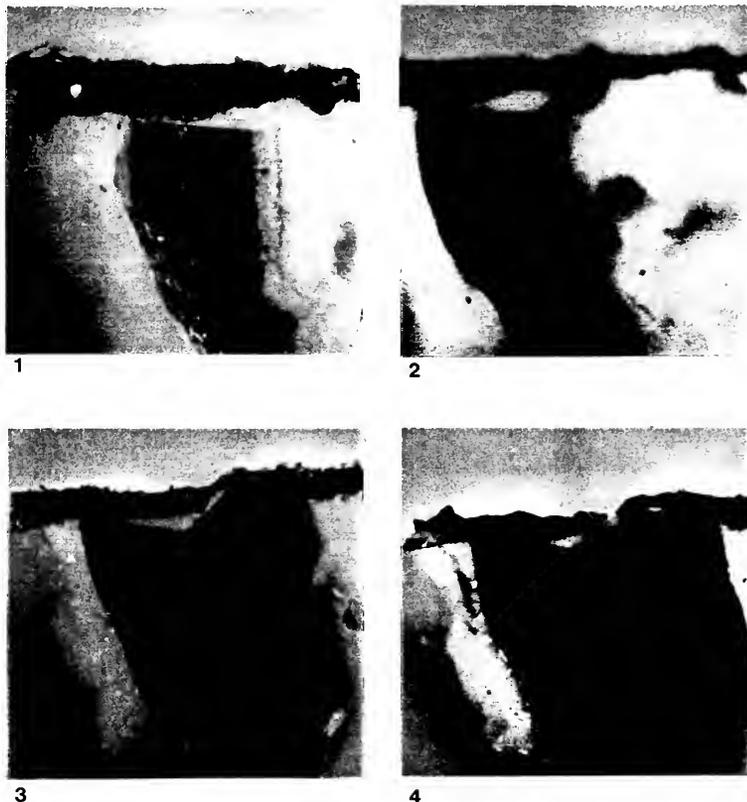
COMMENTS: 1. RED/ORANGE FRESCO LAYER 2. SUBSTRATE. SAMPLED FROM THE BACKGROUND BENEATH THE TABLE AT THE LOWER RIGHT. VISUAL EXAMINATION SUGGESTS THAT THE ORIGINAL LAYER IS PRESENT.



**"LOUISIANA" SAMPLE C.II.1.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



**FIGURE 135**

COMMENTS: 1. AUTOFLUORESCENCE 2. POSITIVE STAINING AT THE PIGMENTED LAYER WITH TTC FOR CARBOHYDRATES 3. POSITIVE STAINING AT THE PIGMENTED LAYERS FOR LIPIDS WITH DCF 4. THERE IS ALSO POSITIVE STAINING FOR UNSATURATED LIPIDS WITH RHODAMINE B. FITC DID NOT POSITIVELY STAIN FOR PROTEINS. THE STAINING INDICATES THAT BOTH OILS AND GUMS ARE PRESENT IN THE SAMPLE.



"LOUISIANA" SAMPLE C.II.4.a.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA

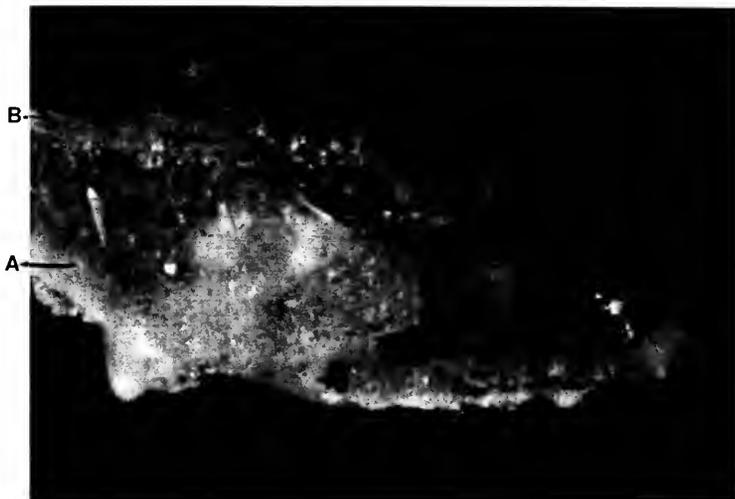


FIGURE 136

SAMPLE LOCATION: 14 1/2" ← X 26" ↑

COMMENTS: THE SAMPLE WAS EXTRACTED FROM THE PAGE ENDS OF THE BOOK ON THE TABLE IN THE PROPER LEFT SIDE OF THE COMPOSITION. THE SURFACE COLOR FROM THE SAMPLED AREA WAS PINK/RED . IN CROSS SECTION THE CRYSTALLINE STRUCTURE OF THE SILICEOUS PARTICLES -SAND- ARE SEEN IN THE SUBSTRATE (A). ON TOP OF THE SUBSTRATE IS A RED/ORANGE PAINT LAYER, PROBABLY FRESCO , WITH SMALL BLACK PARTICLES IN IT.(B)



"LOUISIANA" SAMPLE C.II.4.a.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

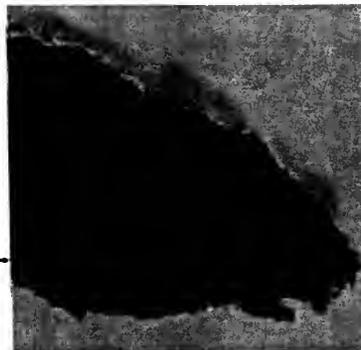
LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3



4

FIGURE 137

COMMENTS: 1. NO AUTOFLUORESCENCE. 2. FITC COLLECTS IN VOIDS AND FISSURES BUT DOES NOT REALLY STAIN. 3. WITH TTC FOR GUMS, WHAT APPEARS TO BE DEFINITE POSITIVE STAIN IS RATHER THE SAMPLE ITSELF (COMPARE WITH THE SAMPLE IN VISIBLE LIGHT). (A) 4. RHODAMINE B COLLECTS IN THE VOIDS. NO REAL STAINING OCCURS.



**" LOUISIANA " SAMPLE C.II.3.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 138**

SAMPLE LOCATION: 30 1/4" --> X 25"†

COMMENTS: THE SAMPLE WAS EXTRACTED FROM THE CUFF RUFFLE OF THE RIGHT ARM OF THE FAR LEFT FIGURE. THE SAMPLE SHOWS CONSIDERABLE PAINT IMPASTO OF THAT AREA WHICH APPEARED TO BE ORIGINAL SURFACE. THE PAINT APPEARED TO BE EITHER LIME BOUND OR BOUND IN OTHER MEDIUM, SUCH AS OIL.



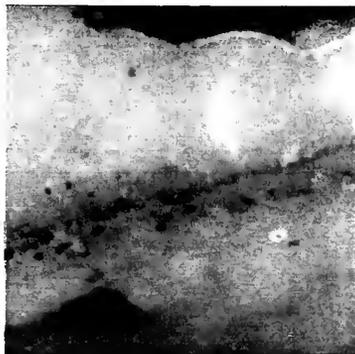
"LOUISIANA" SAMPLE C.II. 3.a.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

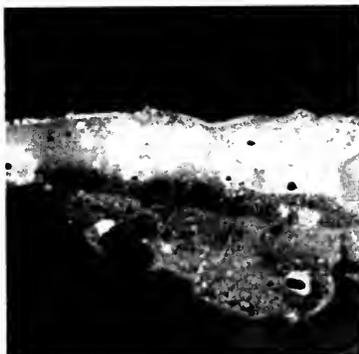
LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3



4

FIGURE 139

1. AUTOFLUORESCENCE, PRONOUNCED IN UPPER WHITE LAYER; 2. FITC STAIN APPEARS ONLY IN SAMPLE FISSURES; 3. POSSIBLE POSITIVE FOR LIPIDS WITH DCF; 4. RHODAMINE B STAINS AT THE UPPER SURFACE FILM. IT APPEARS THAT ALL ARE FRESCO; OILS MAY BE PRESENT AS A THIN SURFACE FILM AND, TO A SLIGHT DEGREE, IN THE OTHER LAYERS OF THE SAMPLE.



**"LOUISIANA" SAMPLE C.II.5.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 140**

SAMPLE LOCATION: 45--> X 14 1/2"†

COMMENTS: SAMPLED FROM THE BACKGROUND, LOWER MARGIN. EXPECT TO SEE ORANGE/RED AND SUBSTRATE. APPEARS TO BE FRESCO. IN CROSS SECTION, THE SAMPLE IS FRESCO. A DIRT LAYER EXISTS ON TOP.



**"LOUISIANA" SAMPLE C.II.5.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE

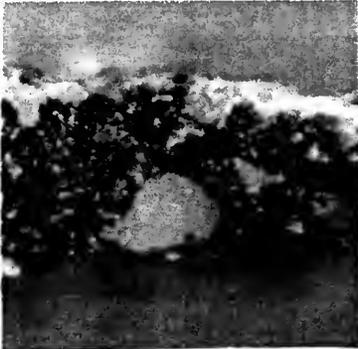
MAGNIFICATION: 50 X -70X

OBJECTIVE: 10 X

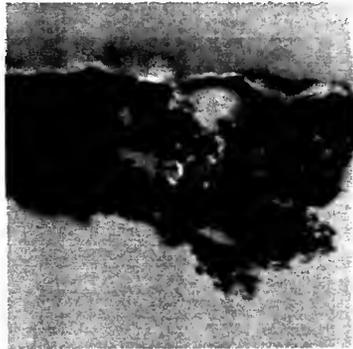
LIGHT SOURCE: MERCURY ARC

CAMERA: LEITZ- 35mm

FILM: KODAK GOLD 200 ASA



1



2

**FIGURE 141**

COMMENTS: 1. AUTOFLUORESCENCE APPEARS IN THE UPPER PART OF THE FRESCO LAYER. 2. STAINING WITH FITC OCCURS IN THE DIRT LAYER.



**"LOUISIANA" SAMPLE C.II.6.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 142**

SAMPLE LOCATION: 2 3/4" --> X 1/4" L

COMMENTS: MEASURED FOR THE INNER PERIMETERS OF THE BORDER BANDING AT THE LOWER LEFT CORNER, THE SAMPLE WAS TAKEN FROM THE OUTER BLACK STRIPE OF THE BORDER BANDING. IN CROSS SECTION, THE STRATIGRAPHY ILLUSTRATES THE PRESENCE OF A FRESCO LAYER BENEATH A NON-FRESCO PAINT LAYER.



**"LOUISIANA" SAMPLE C.II.6.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

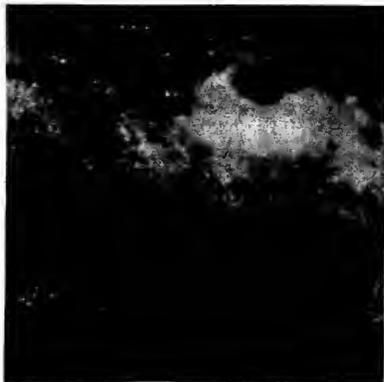
LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



1



2



3



4

**FIGURE 143**

COMMENTS: 1. AUTOFLUORESCENCE OF THE CALCIUM CARBONATE AND SAND PARTICLES 2. POSITIVE STAINING APPEARS IN THE FRESCO LAYER WITH FITC FOR PROTEINS 3. DCF ALSO POSITIVELY STAINS 4. ESTIMATED "FALSE POSITIVE" WITH RHODAMINE B. THE DARK UPPER LAYER THAT DOES NOT STAIN IS PROBABLY LIME SECCO OR A SYNTHETIC MATERIAL.



**"LOUISIANA" SAMPLE C.II.7.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 144**

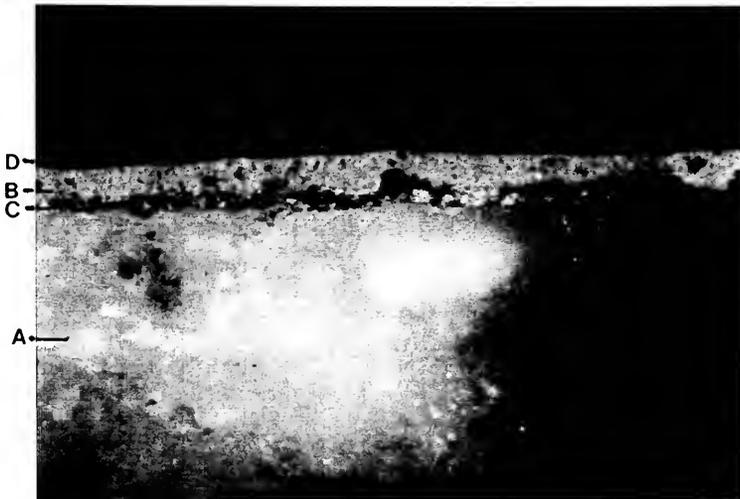
SAMPLE LOCATION: 3 1/2" --> X 3 1/2" ↑ FROM THE BORDER. SAMPLED FROM THE  
OUTERMOST OCHRE STRIPE OF BANDED BORDER.  
COMMENTS: APPEARS TO BE OVERPAINT. IN CROSS SECTION, A CRYSTALLINE  
LAYER IS COVERED WITH A BEIGE PAINT LAYER, NOT FRESCO.



**"LOUISIANA"      SAMPLE C.II.7.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



**FIGURE 145**

SAMPLE LOCATION: MEASURING FROM THE BAND PERIMETERS: 4"← X 3 1/2" ↑  
AT THE LOWER RIGHT CORNER OF THE PAINTING BORDER, SAMPLED FROM THE  
OUTERMOST YELLOW/ TAN STRIPE.

COMMENTS: THE SAMPLED AREA APPEARS TO HAVE BEEN OVERPAINTED. IN  
CROSS-SECTION, A SMOOTH CRYSTALLINE PLASTER, (A) , IS LOCATED  
BENEATH A PAINT LAYER, (B), THAT APPEARS TO BE NON-FRESCO AS IT IS  
LOCATED ON TOP OF THE PLASTER. BETWEEN THE PAINT LAYER AND THE  
PLASTER IS A THIN DARK LAYER OF AN UNKNOWN MATERIAL (C). A THIN  
SURFACE FILM IS LOCATED ON TOP OF THE PAINT LAYER. (D).



"LOUISIANA"

SAMPLE C.II.7.b.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA

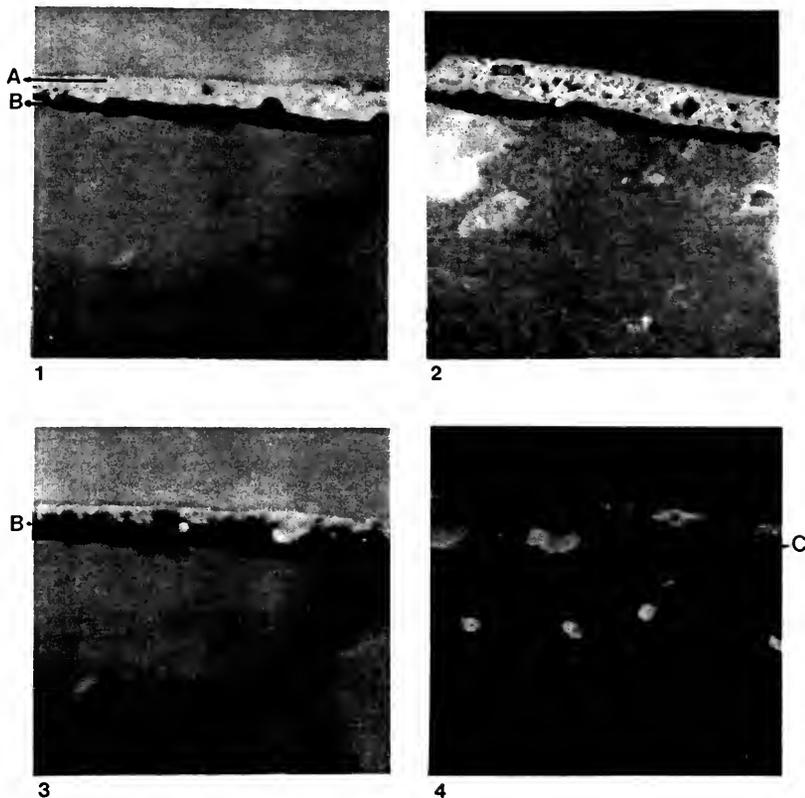


FIGURE 146

COMMENTS: 1. AUTOFLUORESCENCE APPEARS IN THE PAINT LAYER (C). LAYER (B) IS COMPLETELY NON-FLUORESCENT. 2. WHEN STAINED WITH FITC, THE FLUOROCHROME COLLECTS IN VOIDS BUT THERE IS NO POSITIVE STAINING. 3. TTC STAINS SLIGHTLY IN THE LOWER PART OF THE PAINT LAYER SUGGESTING THAT A CARBOHYDRATE, SUCH AS A GUM, IS PRESENT. (B); 4. POSITIVE STAINING FOR UNSATURATED LIPIDS WITH RHODAMINE B OCCURS IN THE LAYER (C) INDICATING THAT IT IS AN OIL. THE PAINT LAYER IS POSSIBLY FRESCO.



" LOUISIANA " SAMPLE C.II.9.b.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA

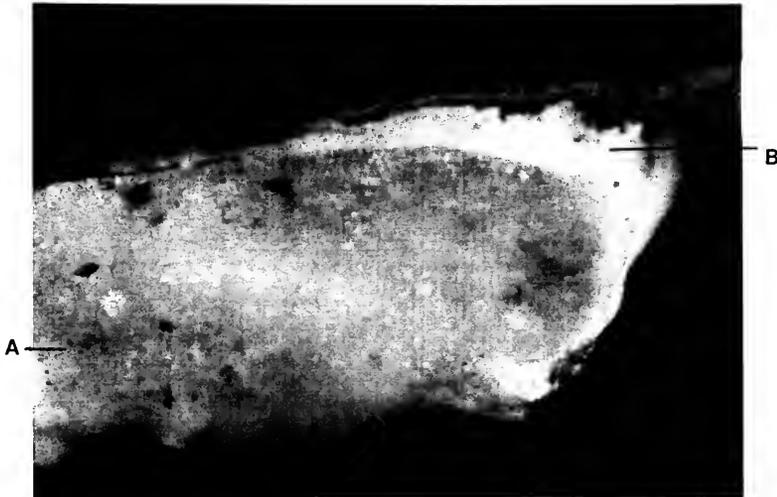


FIGURE 147

SAMPLE LOCATION: 45 3/4" --> X 1" ↑

COMMENTS: THE SAMPLE WAS TAKEN FROM THE ORIGINAL SURFACE (ESTIMATED) OF THE RED CARPET AT THE LOWER MARGIN OF THE PAINTING. THE AIM OF SAMPLING WAS TO SEE THE STRATIGRAPHY OF THE PAINTING AT THAT LOCATION AND IDENTIFY UNDERLYING PAINT LAYERS. IN CROSS-SECTION, THE SUBSTRATE IS CRYSTALLINE, SHOWING SILICEOUS PARTICLES (A), ON TOP OF WHICH IS A FINE WHITE LAYER (B) AND A THIN RED PAINT LAYER.

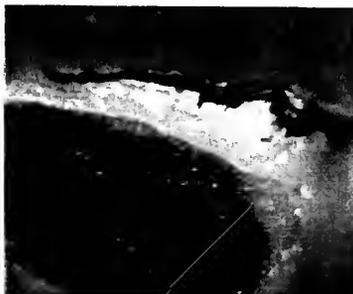


**"LOUISIANA"**

**SAMPLE C.II.9.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ-35mm  
FILM: KODAK GOLD 200 ASA



4

**FIGURE 148**

COMMENTS: THE SAMPLE AUTOFLUORESCES IN THE WHITE STRATA BUT IS OTHERWISE NON-FLUORESCING. WHEN STAINED WITH FITC FOR PROTEINS, AND TTC FOR CARBOHYDRATES, THERE IS NO EVIDENCE OF POSITIVE STAINING, THUS INDICATING THAT NEITHER A GLUE, CASEIN, EGG OR GUMS ARE PRESENT. 4. WHEN STAINED FOR OILS, WITH RHODAMINE B, THERE IS ALSO NO EVIDENCE OF POSITIVE STAINING. THE SAMPLE APPEARS TO BE FRESCO OR LIME PAINTING AND DOES NOT CONTAIN OTHER MEDIA.



" LOUISIANA " SAMPLE C.II.10.b.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 149

SAMPLE LOCATION: 45 1/2" --> X 9 3/4" ↑

COMMENTS: THE SAMPLE WAS TAKEN FROM THE PROPER LEFT BLACK BOOT OF THE FIGURE LOCATED AT THE LEFT SIDE OF THE COMPOSITION. IN CROSS SECTION, A SILICEOUS CALCIUM CARBONATE PLASTER CONSTITUTES THE MAJORITY OF THE SAMPLE (A). A GRAY PAINT LAYER WITH BLACK PARTICLES EXISTS ON THE TOP OF THE SAMPLE (B).



"LOUISIANA" SAMPLE C.II.10.b.

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA

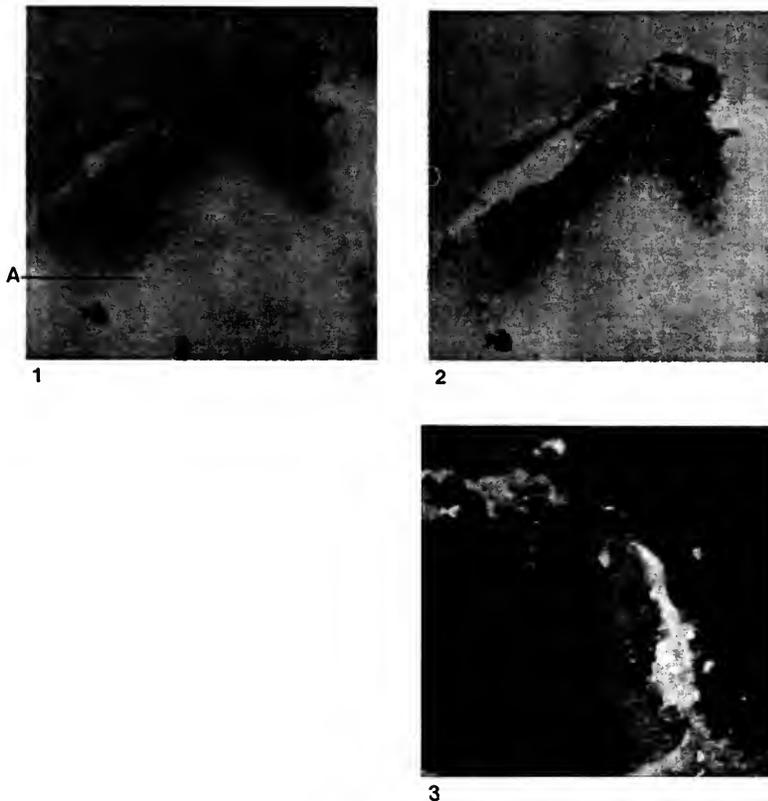


FIGURE 150

COMMENTS: 1. AUTOFLUORESCENCE IS SEEN IN THE LIME MATRIX (A) . 2. WHEN STAINED WITH FITC FOR PROTEINS, MODERATE STAINING APPEARS IN THE LIME MATRIX, SUGGESTING THAT A PROTEIN IS PRESENT. 3. STAINED WITH RHODAMINE B, THERE IS NOT A POSITIVE STAIN BUT RATHER COLLECTION OF THE FLUOROCHROME .



**"LOUISIANA" SAMPLE C.II.11. a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA

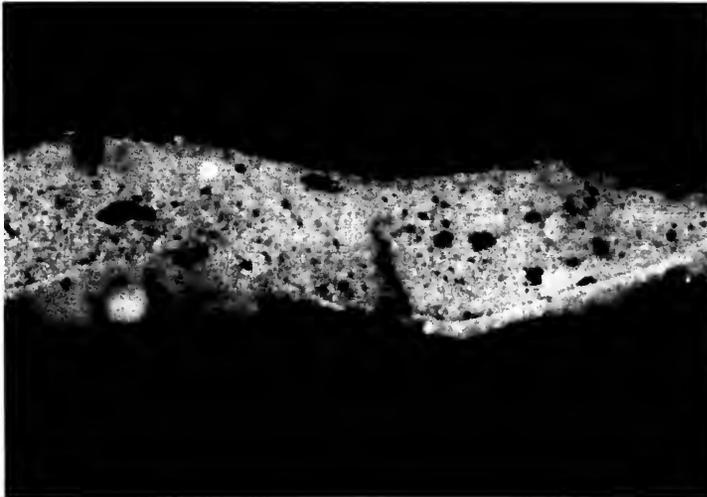


FIGURE 151

SAMPLE LOCATION: 55 1/2" ← X 28" ↑

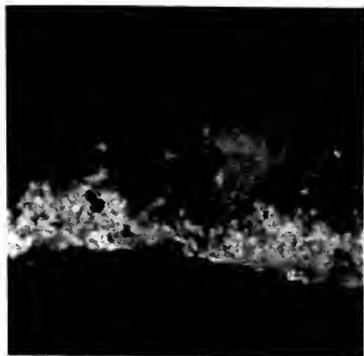
COMMENTS: SAMPLED FROM THE FINGER OF THE UPPER HAND (PROPER LEFT) OF THE CENTRAL FIGURE, THE AREA OF THE SAMPLE APPEARS TO BE ORIGINAL SURFACE, ALTHOUGH THE SURROUNDING PASSAGES ARE OVERPAINTED. THE STRATIGRAPHY SHOWS A THICK FRESCO LAYER WITH EVIDENCE OF RED PIGMENT PARTICLES, AND A THIN WHITISH PAINT LAYER.



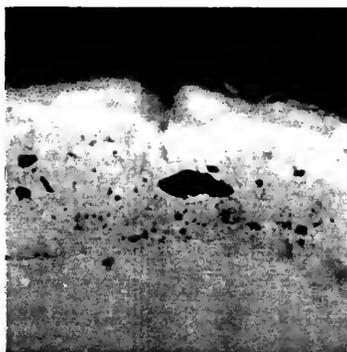
**"LOUISIANA" SAMPLE C.II. 11.a.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

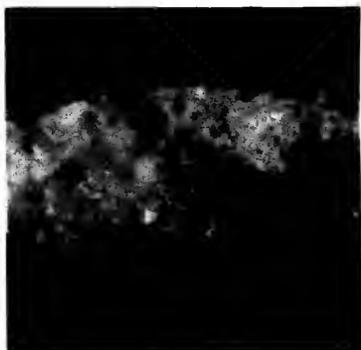
LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



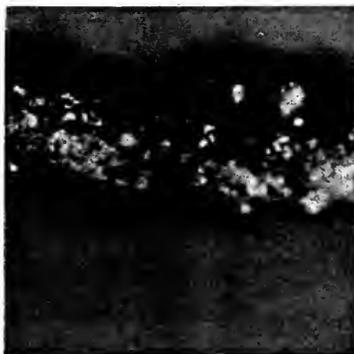
1



2



3



4

FIGURE 152

COMMENTS: 1. THE SAMPLE DOES NOT AUTOFLUORESCES. 2. FITC STAINS THE UPPER THIN LAYER 3. THIS THIN LAYER AND THE UPPER PART OF THE FRESCO LAYER STAIN FOR OILS WITH DCF 4. RHODAMINE B ALSO STAINS THE UPPER LAYER AND EXISTS, IN PORES OF THE BIOPLAST. WITHIN THE SAMPLE. THE RESULT INDICATES THAT AN OIL AND/OR PROTEIN EXIST IN THE UPPER LAYERS OF THE SAMPLE.



**"LOUISIANA" SAMPLE C.II.12.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 153

200 x magnification exhibits the character of the fresco layer.



**"LOUISIANA" SAMPLE C.II.12.a.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 154

SAMPLE LOCATION: 34" --> x 6 1/2" ↑

COMMENTS: 1. THE SAMPLE WAS TAKEN FROM THE RED CARPET ADJACENT TO THE LEG OF THE EASEL AT THE LOWER PART OF THE LUNETTE. FROM ON -SITE EXAMINATION, THE SAMPLE APPEARS TO CONTAIN OVERPAINT. IT WAS TAKEN IN ORDER TO ILLUSTRATE THE STRATIGRAPHY OF PAINT AND TO REVEAL AN UNDERLYING ORIGINAL LAYER. IN CROSS SECTION, A DENSE RED PAINT LAYER THAT APPEARS TO BE ALMOST ENTIRELY PIGMENT IS FOUND. 2. AT HIGHER MAGIFICATION, HERE AT 100 X, THE DENSITY OF THE RED LAYER IS ILLUSTRATED. THE SAMPLE EXHIBITED NO AUTOFLUORESCENCE NOR POSITIVE STAINS FOR PROTEINS, GUMS OR OILS.



"LOUISIANA"

SAMPLE C.II.13.b.

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA

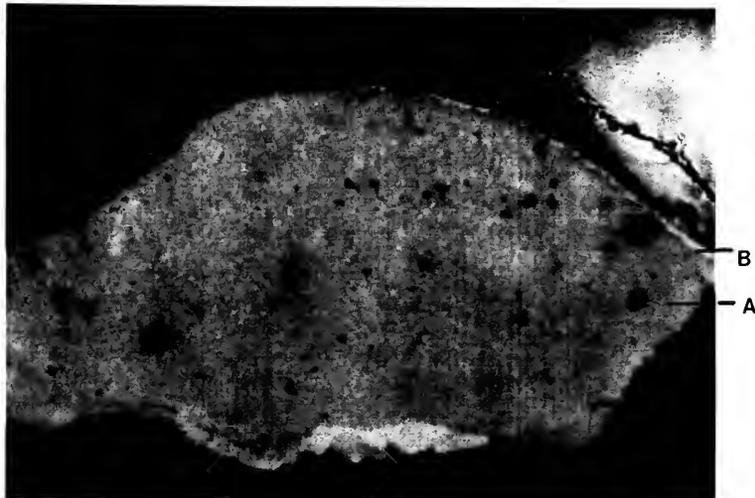


Fig 155

SAMPLE LOCATION: 28°--> X 27° ↓

COMMENTS: THE SAMPLE WAS TAKEN FROM AN AREA OF IMPASTO FROM THE PROPER LEFT HAND FOR STUDY OF THE IMPASTO MEDIUM . IN CROSS SECTION, A PIGMENTED PLASTER WITH RED PIGMENT PARTICLES APPEARS TO BE FRESCO (A) . IT IS COVERED WITH A THIN LIGHTER LAYER OF PAINT (EST.) (B).



"LOUISIANA"

SAMPLE C.II.13.b.

ILLUMINATION: ULTRA-VIOLET VISIBLE

LIGHT SOURCE: MERCURY ARC

MAGNIFICATION: 50 X -70X

CAMERA: LEITZ- 35mm

OBJECTIVE: 10 X

FILM: KODAK GOLD 200 ASA

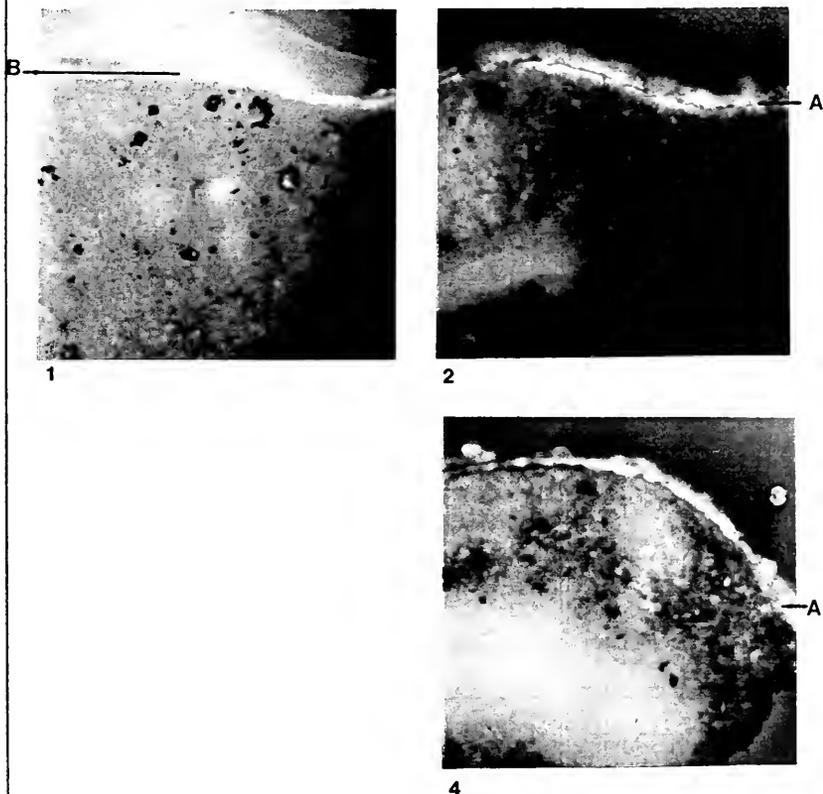


FIGURE 156

COMMENTS: 1. AUTOFLUORESCENCE APPEARS IN THE WHITE LAYER (B); 2. POSITIVE STAINING FOR PROTEINS ALSO APPEARS IN THAT LAYER (B). 3. THE SAME LAYER (B) STAINS POSITIVELY FOR LIPIDS. 4. WHEN STAINED FOR UNSATURATED LIPIDS WITH DCF, POSITIVE STAIN APPEARS IN THE UPPER PART OF THE SAMPLE LAYER (A). STAINING SUGGESTS THAT THE THIN UPPER SURFACE LAYER CONTAINS PROTEINACEOUS/ LIPOIDAL MATERIAL. THE UPPER PART OF THE PAINT LAYER (A) APPEARS TO CONTAIN DRYING OILS.



**"LOUISIANA" SAMPLE C.II.15.b.**

ILLUMINATION: VISIBLE  
MAGNIFICATION: 50 X  
OBJECTIVE: 10X

LIGHT SOURCE: QUARTZ HALOGEN  
CAMERA: NIKON FX 35MM  
FILM: KODAK EKTAR 25 ASA



FIGURE 157

SAMPLE LOCATION: 30" <- X 17" ↓

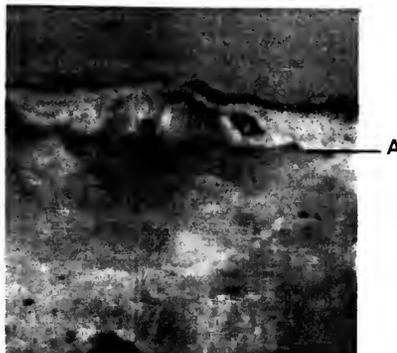
COMMENTS: 1. FRESCO LAYER 2. SUBSTRATE 3. SEPARATE SUBSTRATE LAYER.  
SAMPLE WAS TAKEN FROM THE OVERPAINTED GREEN BACKGROUND. IT WAS  
EXTRACTED FOR EXAMINATION OF THE STRATIGRAPHY, ESPECIALLY FOR  
UNDERLYING PAINT LAYERS.



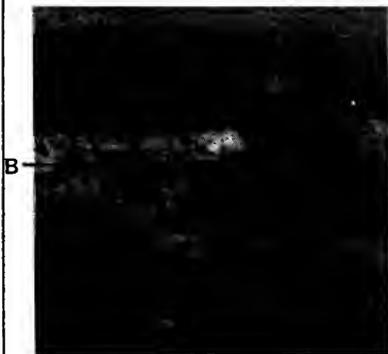
**"LOUISIANA" SAMPLE C.II.15.b.**

ILLUMINATION: ULTRA-VIOLET VISIBLE  
MAGNIFICATION: 50 X -70X  
OBJECTIVE: 10 X

LIGHT SOURCE: MERCURY ARC  
CAMERA: LEITZ- 35mm  
FILM: KODAK GOLD 200 ASA



2



3

FIGURE 158

COMMENTS: AUTOFLUORESCENCE APPEARED IN THE LIME SUBSTRATE. 2. WITH FITC, LIMITED POSITIVE STAINING APPEARS BETWEEN LAYERS 1. AND 2. (A) 3. WITH DCF MORE DISTINCTIVE STAINING APPEARS AT THE LOWER PART OF LAYER 1. (B).



RESULT: LOUISIANA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

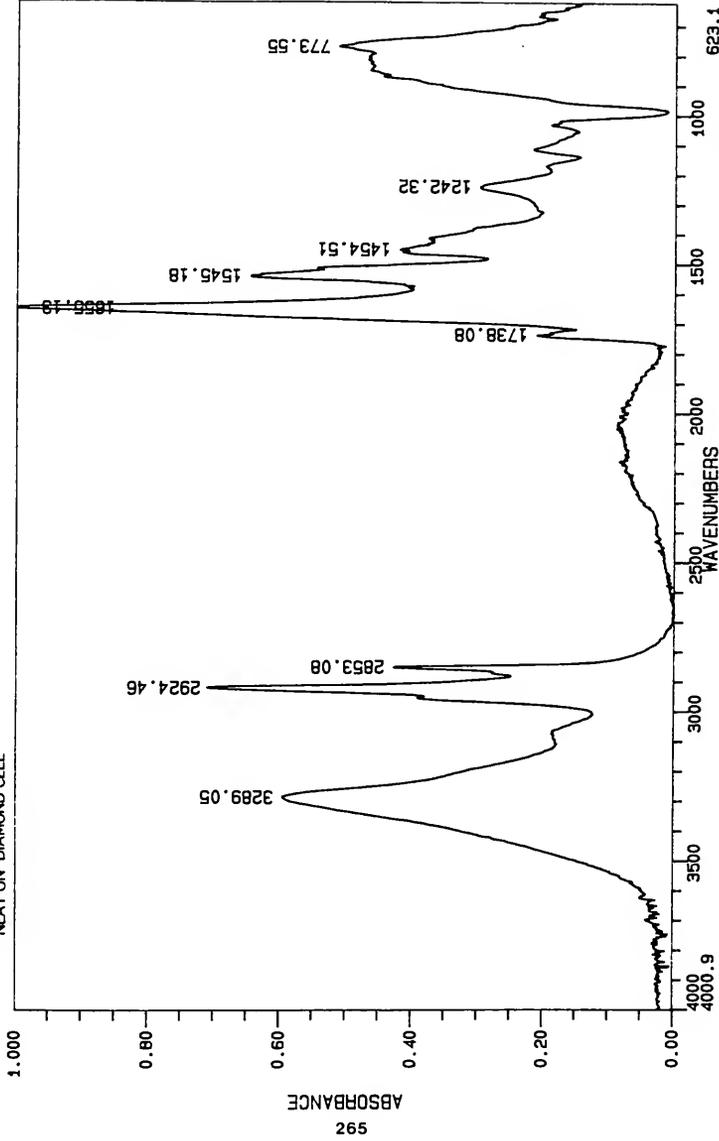


FIGURE 160

CIGAN, SUBSTRATE  
BRUMIDI FRESCO  
SCANS: 200 RES: 4.0 TIME: 06/09/92 11:23:44

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT



RESULT: LOUISIANA, FRESCO BY CONSTANTINO BRUMIDI  
NEAT ON DIAMOND CELL

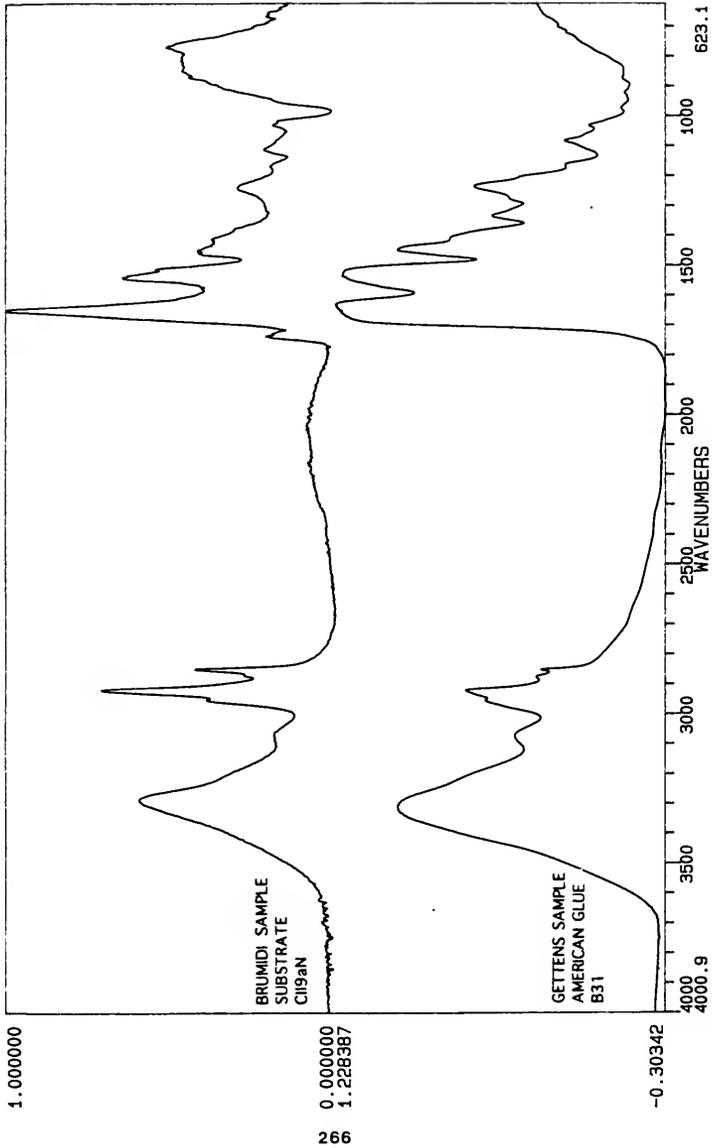
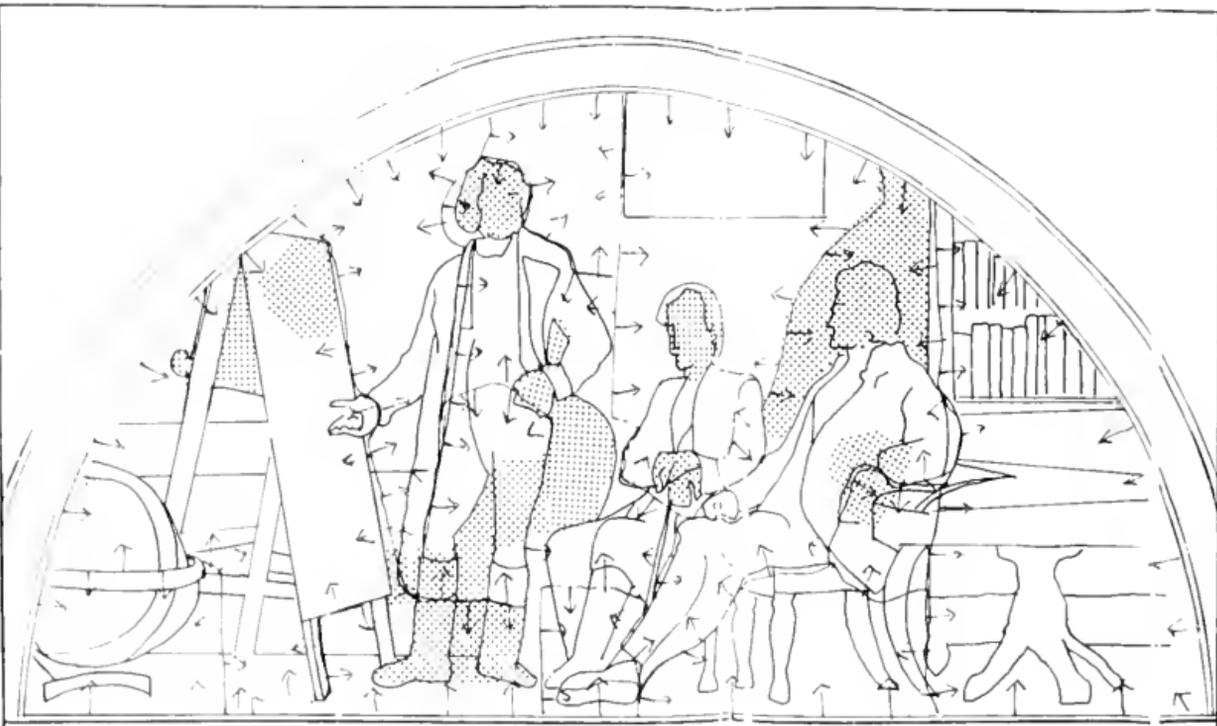


FIGURE 161

BRUMIDI SAMPLE, SUBSTRATE, C19aN  
B31  
AMERICAN GLUE, GETTENS, 100.B31  
02/11/92 16:34:41

PHILADELPHIA MUSEUM  
OF ART CONSERVATION  
DEPARTMENT





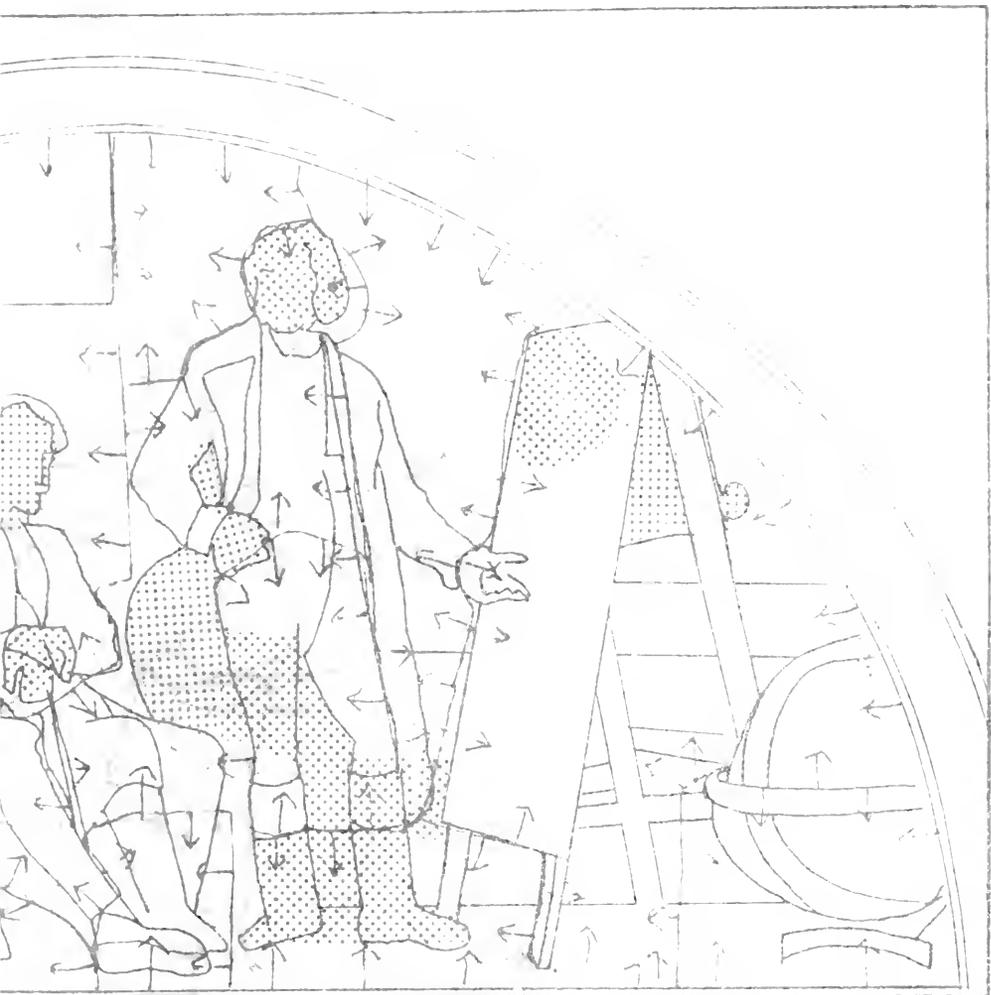
**GIORNATE & PLASTER TYPES**

Giornate  Coarse Plaster 

**"CESSATION OF LOUISIANA"**

FIG 162

Fresco by: **CONSTANTINO BRUMIDI**  
 Ground Floor, Senate Corridors, United States Capitol  
 Prepared by: Catherine S. Myers  
 Washington, D.C.  
 May 1992



GIORNATE & PLASTER TYPES

Giornate



DRAWING TECHNIQUE

Spolvero

Incisions

Puntini

"CESSATION OF LOUISIANA"

FIG 183

Fresco by: CONSTANTINO BRUMIDI  
Ground Floor, Senate Corridors, United States Capitol  
Prepared by: Catherine S. Myers

Washington, D.C.  
May 1992



DRAWING TECHNIQUE

Spolvo 2

Incisid



OVERPAINT

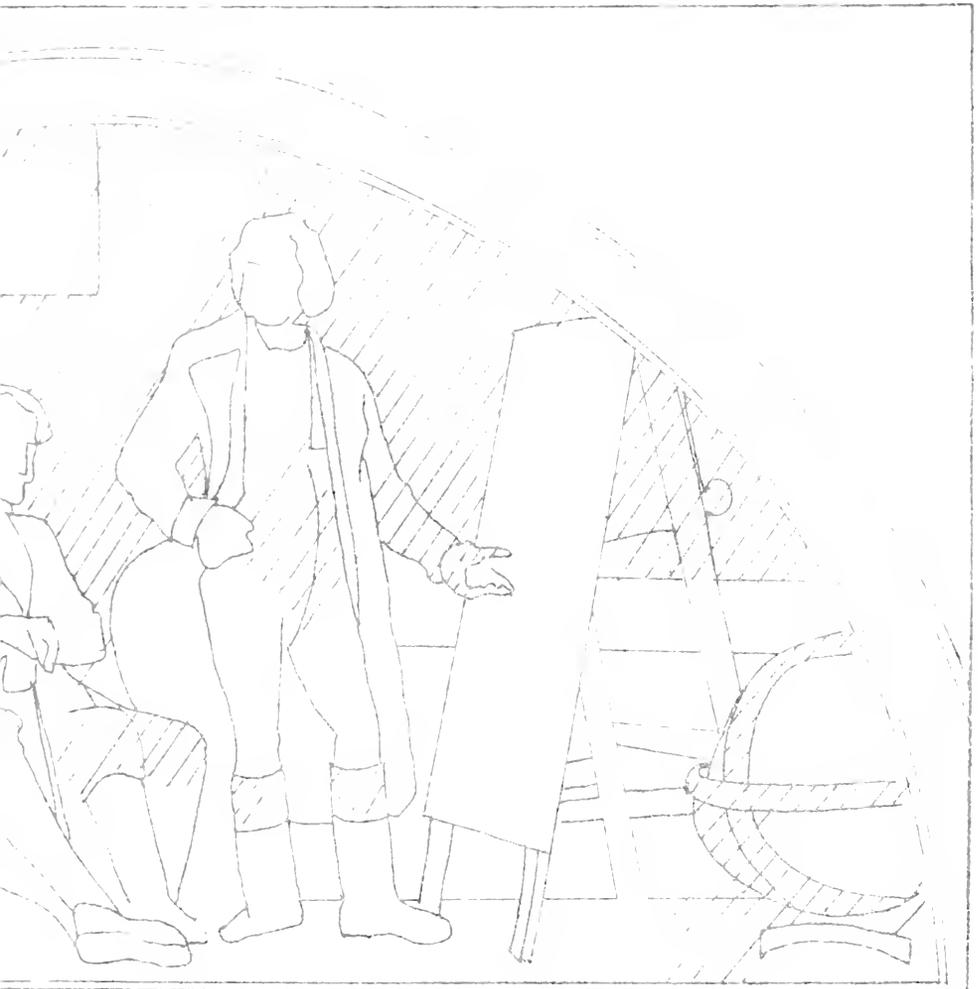
 Overpaint

"CESSATION OF LOUISIANA"

FIG 164

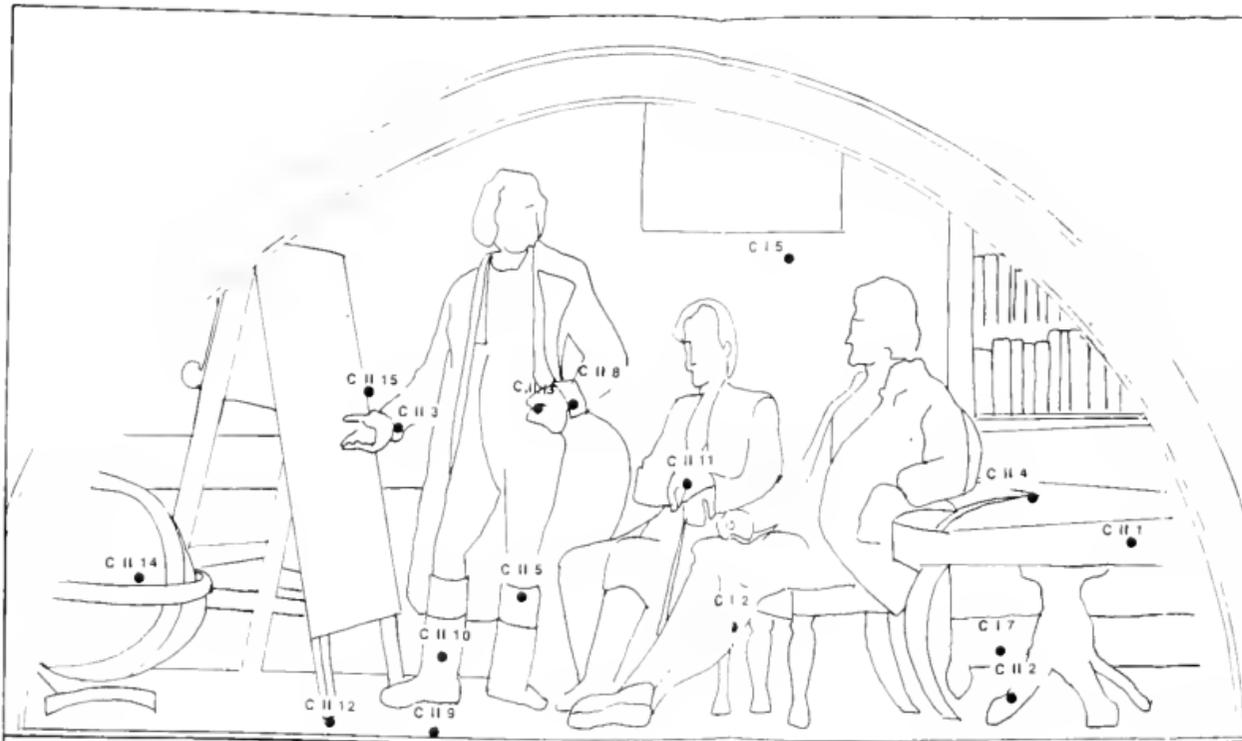
Fresco by CONSTANTINO BRUMIDI  
Ground Floor, Senate Corridors, United States Capitol  
Prepared by Catherine S. Myers

Washington, D.C.  
May 1992



Overprint 

OVERPRINT



"CESSATION OF LOUISIANA"

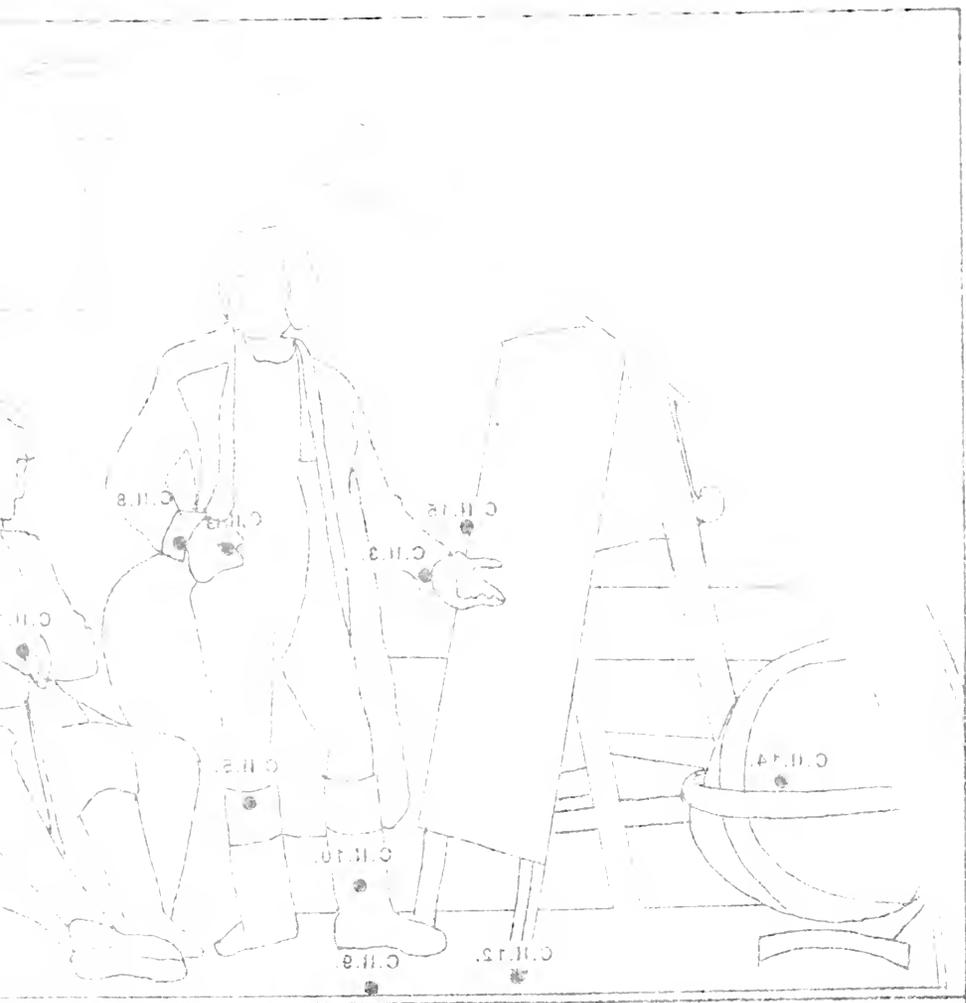
FIG 165

Fresco by: CONSTANTINO BRUMIDI  
 Ground Floor: Senate Corridors, United States Capitol  
 Prepared by: Catherine S. Myers

Washington, D.C  
 May 1992

SAMPLES LOCATION •

C II 6  
 C II 7



• SAMPLES LOCATION

## CHAPTER 6 : CONCLUSIONS

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In this concluding chapter, recommendations for further research are outlined in two sections. The first part concerns recommendations for continued study of the paint medium by the methodology employed in this study. The second part considers extended research in the study of all aspects of Brumidi's technique, touched upon in this study, such as the source for pigments, the preparation and sequence of plaster application, and other broad considerations aimed at shedding light on Brumidi's technique of fresco painting employed in the United States Capitol.

### **PART I : RECOMMENDATIONS FOR FURTHER RESEARCH MEDIA ANALYSIS**

It is recommended that the study of medium be continued as initiated in this study by confirming with FT-IR the interpretation made from fluorescent staining. Additional samples and cross sections should be studied, stained and analyzed.

It is also recommended that, as initiated here, dispersed samples of pigments be studied using polarized light microscopy and microchemical methods and confirmed by XRD.

Additional methods recommended are described below.

#### **ULTRA-VIOLET LIGHT PHOTOGRAPHY**

As indicated in Chapter 2: Scientific Analysis in the Field of Conservation and Chapter 4: Methodology, it is recommended that the study include black and white ultra-violet fluorescent photographs in order to illustrate the presence of overpaint and other films as well as the autofluorescence of the original materials. The photographic document would provide invaluable information with regard to the presence of overpaint and other surface accretions and would be essential in interpreting cross sectional samples.



## **INFRARED PHOTOGRAPHY**

Additional photographs with I.R. illumination as used in this study are recommended.

## **SCANNING ELECTRON MICROSCOPY WITH ELECTRON PROBE**

Also described in Chapter 2, SEM with electron probe used for the study of samples would be very useful for studying the surface texture and for identifying the materials present in the stratas of the sample.

## **PART II : RECOMMENDATIONS FOR EXTENDED RESEARCH: BRUMIDI'S TECHNIQUE OF EXECUTION**

### **MATERIALS SOURCES:**

**PLASTER:** It is recommended that the source of materials for the plaster be researched, including the sand, limestone or other sources of lime, and other materials used for the substrate.

**PIGMENTS:** In the form of materials' requests and vouchers, considerable documentation already exists for the pigments used. It is recommended that the source of the pigments be further investigated in order to determine the source, the manufacturing process and purity of the pigments.

**TOOLS:** For better understanding the execution technique, it is recommended that research be carried out concerning the tools Brumidi and his assistants, such as the mason, used. Information regarding the brushes, trowels, spatulas, palette knives and jars would provide interesting additions to knowledge of the artist's technique.



## WORKING METHOD

It is recommended that further archival research be carried out in order to shed light on the artist's practices. In particular:

**Lime Slaking Process:** It would also be useful and interesting to investigate the slaking process: where was it done? how was it done? were there special preparations involved?

**Sequence of *Giornate*:** A graphic representation of the process of slaking would illustrate the sequence of plaster and of painting and provide an illuminating representation of the artist's working method.

**Drawing Method:** Likewise, further research and a graphic representation of the method of transferring the design for the painting, whether by pouncing, or incising or application of *puntini*, would illustrate Brumidi's method.

In summary, it is recommended that the research initiated here be continued and that additional technical and archival research expand upon this work. It is further recommended that the knowledge gleaned be integrated into extended study in the practices of wall painting in the United States and the technical and historical study of fresco painting in general.



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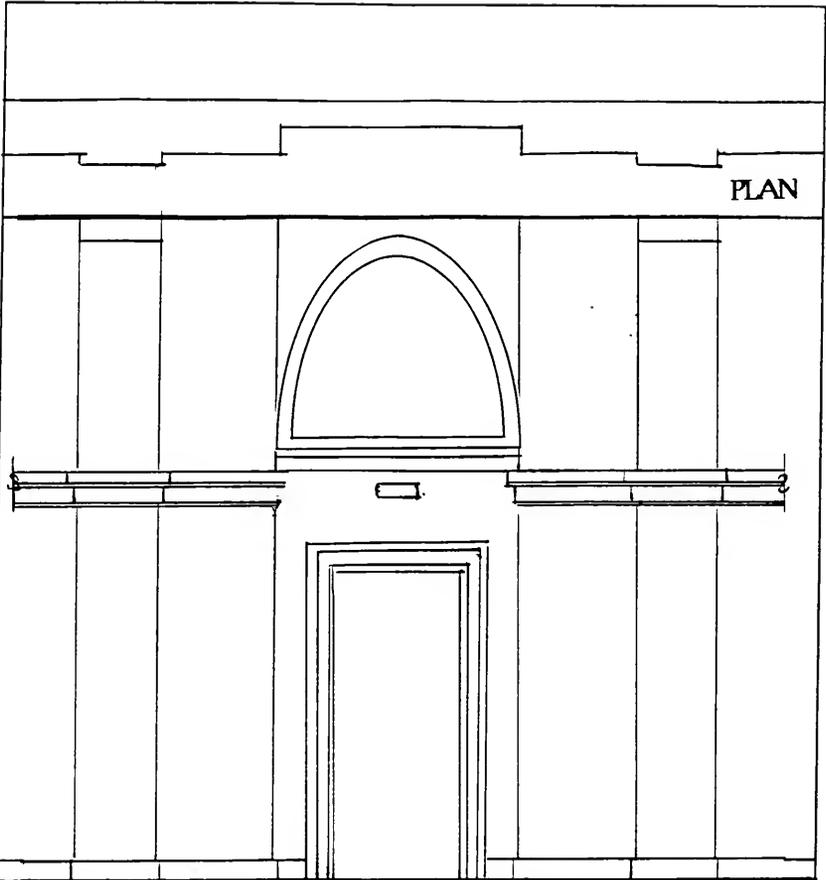
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## **APPENDICES**



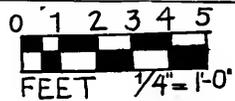


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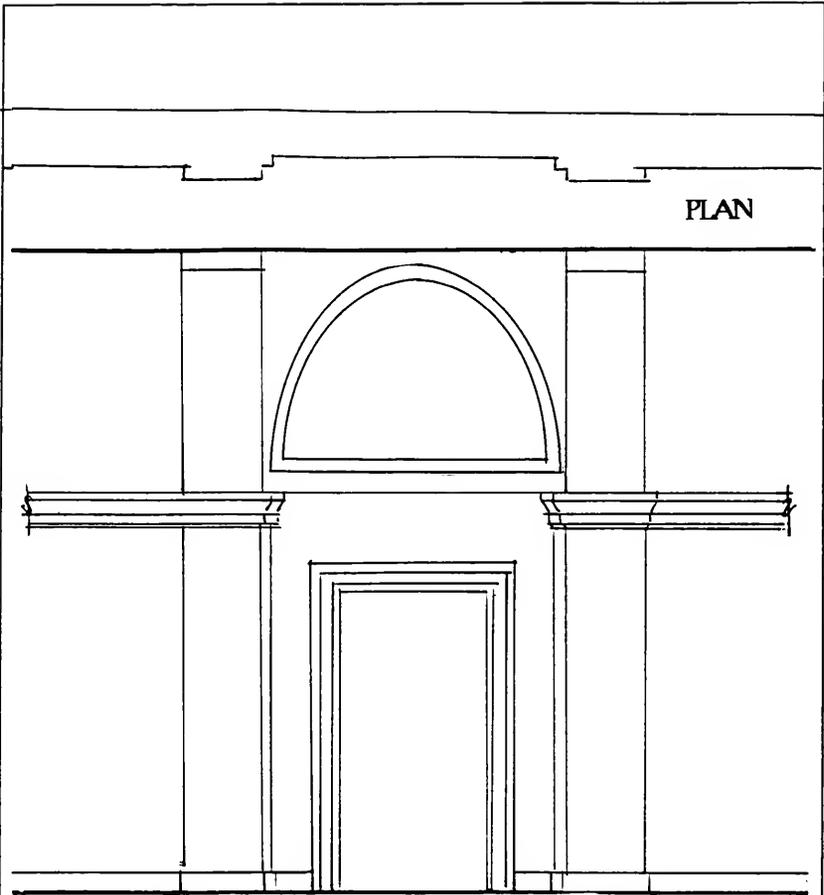
SECTION

"LAS CASAS": CONSTANTINO BRUMIDI  
 Ground Floor, Senate Corridors, United States Capitol  
 Washington, D.C.

Prepared by: Catherine S. Myers  
 May 1992







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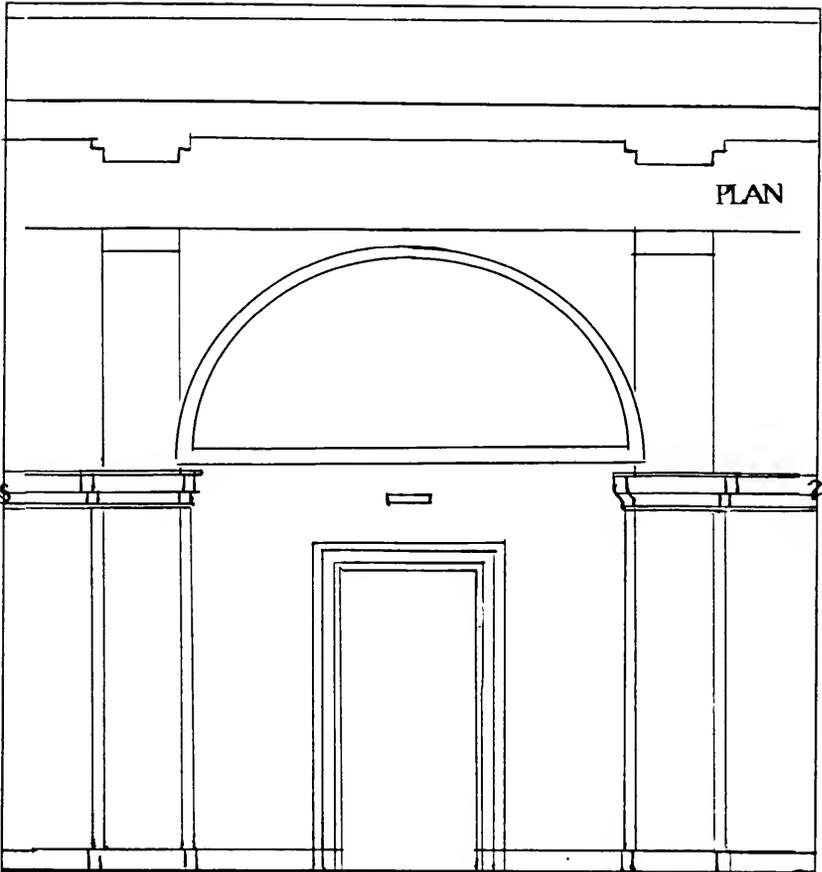
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**"BELLONA GODDESS OF WAR": CONSTANTINO BRUMIDI**  
 Ground Floor, Senate Corridors, United States Capitol  
 Washington, D.C.

Prepared by: Catherine S. Myers  
 May, 1992





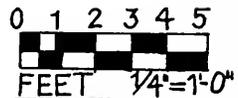


PLAN

SECTION

"SESSION OF LOUISIANNA": CONSTANTINO BRUMIDI  
Ground Floor, Senate Corridors, United States Capitol,  
Washington, D.C.

Prepared by: Catherine S. Myers  
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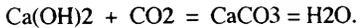


## APPENDIX: TECHNICAL TERMS

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**Arriccio:** the first rough layer of plaster applied on top of the support, or the masonry or other primary structural fabric.

**Fresco:** refers to any painting executed on fresh plaster such that the pigments are bound by the carbonization of the lime. Application of the pigment is accomplished with a brush using either water to liquify the pigments or using a lime water base. When the lime begins to dry, the calcium hydroxide migrates towards the surface and reacts with atmospheric carbon dioxide to form calcium carbonate as the water evaporates.



**Fresco Pigments:** The mineral pigments recommended for fresco painting have been shown to be stable with time; that is, they do not chromatically alter and their adhesion to the plaster is suitable. They include the following:

White : Carbonated slaked lime\*, China white

Black : Ivory\*, bone, carbon blacks\* generally

Ochres : Raw sienna\*, burnt sienna\*

Umbers : raw umber\*, burnt umber\*

Blue : lapis lazuli (natural ultramarine), Egyptian blue, smalt blue

Green : Terra verte\*

The mineral pigments used for fresco painting but not recommended are:

White : lead white\*

Red : Red lead\*, cinnabar (natural vermilion)

Yellow : Yellow lead

Blue : Azurite\*

Green: Verdigris



By the nineteenth century, the introduction of additional pigments added to the traditional fresco palette, such as: Chrome yellow \*(1820), Cadmium yellow (1829), cobalt blue \*(1802), artificial ultramarine \*(1830) , synthetic indigo (1880) , cobalt green (1830), Viridian (1860), Chrome green (1862), Sb vermilion\* (1842), chrome red (1820), cadmium red and other pigments.

\*Among Brumidi's pigments orders. (It is not certain that he used all of the pigments indicated for fresco painting since the materials requested were also used for the oil- bound or glue -bound paintings elsewhere in the Capitol.)

**Fresco Stratigraphy:** The layering sequence of fresco begins with the wall support, often a load bearing masonry wall. This support is then traditionally rendered with a rough plaster later, called the *arriccio*, or a plaster composed of rough river sand, slaked lime, perhaps coarse, and sometimes other constituents to render the plaster hydraulic, such as brick dust, *pozzolana* or tuff. The *intonaco* exists on top of the *arriccio* and is generally smoother, being composed of fine smooth slaked lime and fine grained sand, sometime with the addition of hydraulic aggregates or , in order to make it finer, marble powder. The occasional *intonachino* is a very fine very thin plaster layer that may be applied on top of the *intonaco* in order to create a very smooth surface finish.

In the Capitol corridors, and elsewhere, the frescoes are executed on interior load bearing brick walls. Brumidi painted on an *intonaco* that was rough in texture, an intentional method employed to maximize the effect of color. With the grainy texture, pigments adhere to particles extruding from the picture plane, allowing for application of more pigment.

**Intonaco:** the layer of plaster which receives the pigment. In fresco painting, the *intonaco* is composed of calcium carbonate and, generally, sand, in a proportion of one part lime to three parts of sand, or other inert aggregate. In some cases, a layer of whitewash may be applied on top of the *intonaco*. The *intonaco* is applied to the *arriccio*.

**Modification of Colors in Drying:** Colors lighten considerably in the drying of fresco painting. The expert fresco painter is able to accommodate this alteration by the



application of what appears to be excessive amount of pigment. This quality make it difficult to match colors, especially on large planes of color.

**Secco Techniques:** refers to painting executed on dry plaster with a binder in the pigment mixture such that adhesion to the substrate occurs as a result of a binding medium as opposed to the carbonization of the substrate. The most common secco binder is lime. Thus pigments are mixed in lime milk and applied to the dampened wall. The attachment of the pigmented layer occurs from the adhesion of the pigmented lime milk layer to the wall as opposed to the integration of the pigments in the render, as in fresco. Tempera painting is also a secco technique but connotes the use of an aqueous or emulsion binder, such as animal glue, certain vegetable gums, casein or egg.



## APPENDIX: PIGMENTS

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The pigments listed below were found from among vouchers and materials requests made for the paintings designed by Brumidi at the United States Capitol. These pigments were used for non-fresco and fresco paintings.

### YELLOWS:

bright chrome yellow  
French ochre  
Naples yellow  
yellow ochre

### BLACKS:

ivory black  
charcoal black

### BLUES:

smalt blue  
cobalt blue  
ultramarine

### REDS:

burnt siena  
Indian red  
crimson lake  
red lead  
vermillion  
scarlet lake  
Venetian red  
red ochre

### BROWNS:

raw umber  
burnt umber  
raw sienna





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