HANS HOFMANN'S LAST LESSON:

A STUDY OF THE ARTIST'S MATERIALS

DURING THE LAST DECADE OF HIS CAREER

by

Dawn V. Rogala

A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Preservation Studies

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Approved: ____

Debra Hess Norris, M.S.
Chair of the Department of Art Conservation

Approved: ____

George H. Watson, Ph.D.
Dean of the College of Arts and Sciences

Approved: ____

James G. Richards, Ph.D.
Vice Provost for Graduate and Professional Education

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Joyce Hill Stoner, Ph.D.
Professor in charge of dissertation

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Murray V. Johnston, Ph.D.
Member of dissertation committee

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Roberta K. Tarbell, Ph.D.
Member of dissertation committee

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Christopher A. Maines, Ph.D.
Member of dissertation committee

I certify that I have read this dissertation and that in my opinion it meets the academic and professional standard required by the University as a dissertation for the degree of Doctor of Philosophy.

Signed: ____

Jill Sterrett, M.A.
Member of dissertation committee

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> To me a work is finished when all parts involved communicate themselves, so that they don't need me. —Hans Hofmann, 1950[1]

I was first introduced to the work of Hans Hofmann during Bill Agee's "Research Methods for Art History" seminar in the Spring 2002 semester at Hunter College/City University of New York, and I have been studying Hofmann ever since. I soon found my way to the Renate, Hans and Maria Hofmann Trust and a position as research assistant on the Hofmann catalogue raisonné project and then to the art conservation graduate program at Buffalo State College/State University of New York. The studies of Hofmann's materials I had begun in graduate school continued with a Conservation of Museum Collections Fellowship at the Smithsonian Institution and the study of Abstract Expressionist ground layer materials in collaboration with conservation scientists at the Smithsonian's Museum Conservation Institute and conservators at the Hirshhorn Museum and Sculpture Garden. My work on Hofmann now culminates with this study of the artist's late-career materials, based on my doctoral research at the Preservation Studies Program at the University of Delaware. "Hofmann offers a lesson in patience," said Clement Greenberg. "That lesson, from him and from others, I shall never finish learning."[2] I present this book as a thank you

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[1] Hans Hofmann, in response to moderator Richard Lippold's question "When is the work finished?" on the first day of the Artists' Sessions at Studio 35 (April 1, 1950). *Modern Artists in America,* Robert Motherwell, Ad Reinhardt and Bernard Karpel, eds. (New York: Wittenborn Schultz Inc., 1951), 12.

[2] Clement Greenberg, *Hans Hofmann* (Paris: Editions Georges Fall, 1961), 58.

to the many people and institutions that have supported my work and my journey, and as a testament to your unending generosity, guidance, and faith these many years. The exclusion of any names from the list below is an unintentional oversight on my part and is in no way intended to lessen any individual's role in this project, or my gratitude for their invaluable assistance.

Dissertation Committee and the Hofmann Trust

My thanks to the members of my dissertation committee who have worked alongside me throughout this process: Dr. Joyce Hill Stoner (committee chair), Edward F. and Elizabeth Goodman Rosenberg Professor of Material Culture Studies and Director of the Preservation Studies Doctoral Program, University of Delaware Department of Art Conservation; Dr. Murray V. Johnston, Professor and Chair, University of Delaware Department of Chemistry and Biochemistry; Dr. Christopher A. Maines, Conservation Scientist, National Gallery of Art, Washington; Jill Sterrett, Director of Collections and Conservation, San Francisco Museum of Modern Art; and Dr. Roberta K. Tarbell, Professor Emeritus of Art History, Rutgers University, Camden, and Adjunct Associate Professor, University of Delaware Department of Art Conservation. I owe an equal debt to the current and former trustees, staff, and colleagues of the Renate, Hans and Maria Hofmann Trust for their unwavering support of my work, especially Trustees Patricia Gallagher, John Powers and Robert Warshaw, Collections Manager Stacey Gershon, and Ameringer McEnery Yohe gallery director James Yohe.

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My research would not have been possible without the encouragement, collaboration, and accommodation of staff at numerous art and research institutions. I am deeply grateful to these colleagues who shared my excitement, bore my scheduling conflicts with grace, and generally behaved like superheroes. I would like to express my particular appreciation to the collections staff at the Albright-Knox Art Gallery, especially Registrar Laura Fleischmann; Mark Golden and Sarah Sands, Golden Artist Colors, Inc.; the staff of the Museum Conservation Institute, Smithsonian Institution, especially Director Dr. Robert Koestler, Deputy Director Dr. Paula DePriest, Senior Research Scientist Emeritus Dr. Marion Mecklenburg, and current and former MCI scientific and conservation staff including Jennifer Giaccai, Nicole Little, and Mel Wachowiak; the collections staff at the Memorial Art Gallery, University of Rochester, including former Chief Curator Marjorie Searl and Assistant Curator Jessica Marten; the conservation department staff at the Museum of Modern Art, especially Agnes Gund Chief Conservator James Coddington and paintings conservators Michael Duffy and Anny Aviram; the conservation department staff at the National Gallery of Art, Washington, especially Chris Maines and Head of Painting Conservation Jay Krueger; the collections care staff of the San Francisco Museum of Modern Art, especially Jill Sterrett and conservators Paula De Cristofaro and Alina Remba; and the curatorial and collections staff of the University of California Berkeley Art Museum and Pacific Film Archive, especially Chief Curator Dr. Lucinda Barnes and Director of Registration Lisa Calden, and preparators Gary Bogus, Laura Hansen, Mike Meyers, and Scott Orloff. Others who played a key role in this adventure include Dr. Stuart Croll, Professor and Chair, Department of Coatings and Polymeric Materials, North Dakota State University; Mark Gottsegen, former

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University of California Berkeley Art Museum and Pacific Film Archive[3] that brought the bulk of their Hofmann paintings out of long-term storage for conservation assessment and treatment and provided a brief window of unprecedented access to that comprehensive collection.

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[3] Administered by the National Park Service in partnership with the National Endowment for the Arts (funding agency). Awarded as part of the 2010 grant cycle, the conservation project was completed in 2013.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This dissertation identifies the late-career materials of Abstract Expressionist painter and teacher Hans Hofmann (1880-1966) and examines the relationships apparent among the artist's materials, his signature painting style, and the physical and aging characteristics of his paintings. A representative catalogue of Hofmann's late-career materials has been built from the analysis of over 500 paint and fiber samples focusing primarily on the last decade of the artist's production (1955 through 1965), and a correlation found between condition issues in Hofmann's work and a transitional mix of material and method endemic to Abstract Expressionist painting practice. The results of this research could inform the conservation of Abstract Expressionist and other works that incorporate both traditional and modern paint media by revealing a gap in current research and preservation methodology regarding modernist painting practice.

Chapter One provides context for the technical study of Hofmann's materials. The research goals and resources are outlined and the research structure is presented. An overview of Abstract Expressionism is provided and the difference between abstract and nonobjective painting is delineated. The Abstract Expressionist social network is discussed in relation to shifting focus in artist activism and arts criticism, and the prominent role of materials in Abstract Expressionism is revealed as a transformative step in the modernist shift towards materiality and process art. The relationship between the Abstract Expressionists and their materials is discussed, as are the long-term ramifications of the artists' experimental painting techniques and

materials. Technical studies related to Abstract Expressionist materials are presented as a tool in the preservation of work by the Abstract Expressionists and the generations of artists influenced by their work. Chapter One closes with an overview of Hofmann's position at the center of the Abstract Expressionist community and Hofmann's assignation by critics and practitioners as an Abstract Expressionist exemplar.

Chapter Two traces Hofmann's exposure to the avant-garde arts communities of late-nineteenth and early twentieth-century Europe and the United States, with a focus on Hofmann's years in the modern art centers of Munich, Paris, and New York City. Parallel innovations in modern painting and modern paint technology are highlighted throughout the chapter. Hofmann's early years in late nineteenth-century Munich are discussed, including Hofmann's early interest in modern art, the activities of Munich's modernist arts community, and the Munich artists' exposure to newly developed and experimental painting materials. Hofmann's relocation to Paris is also presented in relation to parallel advances in modern art and art technology and the international dialogue among modernist arts centers. Hofmann's interaction with Paris-based artists and modern art movements is discussed, and the ideological exchange between the Munich and Paris modernist communities is presented. The impact of early twentieth-century paint materials innovation on modern art movements and the continuing modernist embrace of new paint materials is emphasized. Hofmann's return to Munich is primarily discussed in terms of Hofmann's first art school—the Hans Hofmann Schule für Bildende Kunst—and its role in establishing Hofmann as a direct link to avant-garde arts education after World War I. American students' early interest in Hofmann's teaching is presented, along with the resulting relocation of Hofmann to the United States. Hofmann's role in American modern art education is discussed, and Hofmann's relationship to West Coast educators and artists is established. New York City's position as the new center of the international modernist community is discussed. The presence of the Hans Hofmann School of Fine Arts at the center of the mid-twentieth century modernist community is discussed, including the active role played by Hofmann and his students in re-establishing a summer outpost for the modern art community in Provincetown, Massachusetts. Parallel advancements in American modern art and modern paint manufacture are discussed, and Hofmann's schools are presented as a nexus for information exchange regarding experimental materials and techniques.

Chapter Three provides an overview of Hofmann's late-career painting style and existing documentation regarding Hofmann's materials. Critical commentary regarding Hofmann's shifting painting style is refuted and the continuous trajectory of Hofmann's late-career paintings is explored as a melding of Cubist principles and German aesthetic philosophy with modern science. Hofmann's late-career work with mosaic murals is presented as a key factor in the creation of Hofmann's signature visual vocabulary. The material nature of Hofmann's paintings and technique are discussed, and the role of materials in Hofmann's aesthetic philosophy is presented. A tentative outline of Hofmann's materials has been created from a compilation of existing published and unpublished documentation. The selection of twenty-six paintings and eight palettes for the technical study is discussed and the study group selections are presented. Material-related behaviors common to modern paintings and unique to Hofmann's work are discussed, and past and current conservation methodology in the treatment of Hofmann's paintings is reviewed.

Chapter Four presents the results and discussion of the materials analysis performed on the study group paintings. Ground layer stratigraphy and identification of inorganic pigments is obtained using optical microscopy and scanning electron microscopy-energy dispersive spectroscopy, Fourier transform infrared spectroscopy and gas chromatography-mass spectrometry were used to identify binders and organic pigments, and X-ray diffraction was employed to distinguish between selected paints with similar inorganic components.[4] Multiple analytical techniques were employed for the complementary and broad characterization of the binders and pigments. Each technique is discussed, and results are presented. Non-original materials are identified and excluded and Hofmann's late-career materials are catalogued. Hofmann's palette is revealed as a selection of new materials embraced by the modernist communities with whom Hofmann lived in Munich, Paris, and New York. This "modern" palette has been found to be largely traditional artist's oil paints; condition issues in Hofmann's late work appear consistently in association with the artist's use of zinc white oil paint, alkyd paint, and alizarin oil paint. In each of these cases, the modern material chosen by Hofmann performed poorly in response to commonly used painting techniques or to the structural requirements of paintings that combined new and traditional art materials. Examples of mixed traditional and modern painting materials in the work of other Abstract Expressionist painters are provided.

This dissertation concludes with a call for inclusive technical scholarship on Abstract Expressionism that acknowledges the ramifications of transitional arts

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[4] A useful glossary of instrumental methods can be found online in the conservation science section of web site of the National Gallery of Art, Washington at http://www.nga.gov

practice and the role of physical evidence in art historical study. Shifts in conservation methodology for the treatment of modern paintings are discussed. Hofmann's value as a modernist exemplar is reiterated and topics of study that re-establish Abstract Expressionism within the modernist continuum are presented. The related appendix contains representative data for all analyses performed on 519 discrete paint samples and 28 fiber samples.

Chapter 1

BACKGROUND AND METHODOLOGY

The late-career work of renowned Abstract Expressionist painter and teacher Hans Hofmann (1880-1966) shows us why and how we need to change our thinking about the conservation of modern art. Hofmann's materials and technique present an example of period artistic method that is currently underrepresented in conservation research but has direct implications for how conservators should treat Abstract Expressionist and later works. The embrace of new materials and processes is one of the great legacies of Abstract Expressionism, but the idea that these twentieth-century modernist innovators wholly abandoned traditional painting practice is a myth that works against the preservation of that era's artistic legacy. A mix of old and new is more representative of period artistic method than is suggested by the nascent library of technical studies focused on new materials or procedures. Many of the condition problems art conservators face in the treatment of modern paintings are directly related to a mixing of familiar techniques and modern materials that appears in Hofmann's work and throughout Abstract Expressionist production. Through a thorough examination of Hofmann's late-career materials and techniques, this dissertation will re-assess the critical view of Abstract Expressionist painting as material-dependent and reveal how understanding the transitional nature of art practice during this period has ramifications for the future conservation treatment of Abstract Expressionist and later works that incorporate both traditional and modern paint media.

Hofmann's late-career paintings can be seen as a bridge between nineteenth- and twentieth-century modern arts practice. The artist's early years in the burgeoning avant-garde scenes of Munich and Paris gave rise to his life-long belief in the importance of the modernist arts community and its engaged yet discerning interest in innovative materials, techniques, and compositional theory. Hofmann arrived in the United States in the years before the Second World War with both the tools and temperament to educate young American modernists, and his mobilization and support of the next generation of avant-garde artists positioned his schools among the primary centers for advanced arts practice and theory in the United States and made Hofmann simultaneously the influencer and the benefactor of the leading edge of modern American art. Hofmann's own palette can be used a history lesson that includes new materials embraced by sixty years of avant-garde arts communities in the United States and Europe. The study of his materials is an appropriate and informative addition to the research canon.

In this dissertation I will analyze and identify the materials used by Hofmann in his late-career paintings and will assess notable relationships between Hofmann's materials, technique, and the impact of his choices on the long-term stability of his work. This study focuses primarily on the last decade of the artist's production (1955 through 1965), a period that includes the years just prior to and after the 1958 closing of Hofmann's art schools in New York City and Provincetown, Massachusetts, the point at which Abstract Expressionism peaked in popularity and Hofmann's signature style emerged. A representative catalogue of Hofmann's late-career materials has been built from my analysis of over 500 paint and fiber samples from palettes and works on canvas produced from the late 1940s until the artist's death in 1966, and the materials identified through this analysis are compared with existing conservation survey and treatment documentation of Hofmann's work and with both published and anecdotal assessments of Hofmann's rapid stylistic changes during this period. This research defines the role played by new paint materials in Hofmann's signature style and clarifies the impact of mixed traditional and modern painting materials in the study and preservation of Abstract Expressionist paintings. This dissertation expands upon my previous research into the relationship between Abstract Expressionist materials and the physical and aging characteristics of Abstract Expressionist paintings by revealing similarities in materials among Hofmann and his New York School colleagues and by re-evaluating conservation methodology for Abstract Expressionist and later works that incorporate contemporary industrial binders and synthetic pigment formulations into otherwise traditional artists' palettes.

In this first chapter I will explain my choice of Hans Hofmann as an exemplar of Abstract Expressionist practice, outline my research methodology and my selection of research materials for this study, and provide an overview of the topics to be covered in each chapter of the dissertation.

Research Goals and Dissertation Structure

> There are values by which the new can be appreciated but they are not, in the first instance, esthetic values. Thus to appreciate the new *as the new* involves considerations beyond the esthetic.
> —Harold Rosenberg, "The New as Value," 1966[1]

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[1] Harold Rosenberg, "The New as Value," in Rosenberg, *The Anxious Object: Art Today and Its Audience* (Chicago: University of Chicago Press, 1982, rep., originally published by Horizon Press, 1964), 233. The book is dedicated to Hofmann.

Technical scholarship and aesthetic inquiry are not mutually exclusive. As modern materials research has advanced, so too has the call for an inclusive scholarship model that acknowledges the advantages of interrelated conservation and humanities studies. “The two disciplines are complementary,” noted Ysbrand Hummelen, Senior Researcher at the Netherlands Cultural Heritage Agency. “The material-technical expertise of the conservator/restorer and the curator’s art-historical and theoretical knowledge are the foundation upon which we base an understanding of the art work.”[2] Technical studies do not ignore the creative act; they are vital to its full interpretation. “Providing the data is one thing,” Mancusi-Ungaro noted, “but explaining it in context is quite another. . . . It is only through intense collaboration among the distinct but related disciplines that . . . we begin to offer the indeterminate work of art the rigorous yet insightful review it deserves.”[3] Hans Hofmann’s influential role within the American modernist community and his unprecedented access to the leading edge of international arts practice make an interdisciplinary study of his paintings an appropriate and informative addition to Abstract Expressionist scholarship.

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[2] Ysbrand Hummelen et al., “Towards a method for artists’ interviews related to conservation problems of modern and contemporary art,” in *Preprints of the 12th ICOM-Committee for Conservation triennial meeting in Lyon,* 315.

[3] Carol Mancusi-Ungaro, “Material and Method in Modern Art: A Collaborative Challenge,” in *Scientific Examination of Art: Modern Techniques in Conservation and Analysis* (Washington, D.C.: The National Academies Press, 2005), 161.

Goals of the Technical Study

In this dissertation I will analyze and identify the materials used by Hofmann in his late-career paintings and assess relationships between Hofmann's materials, technique, and the impact of his choices on the long-term stability of his work. This research will re-assess the critical view of Abstract Expressionist painting as material-dependent and reveal how understanding the transitional nature of art practice during this period has ramifications for the future conservation treatment of Abstract Expressionist and later works that incorporate both traditional and modern paint media.

Resources and Materials Utilized for This Study

I chose twenty-six paintings and eight palettes for analysis as exemplars of Hofmann's late-career work. The study group includes twenty-three paintings on canvas from the years 1953-65, a period that includes the years just prior to and after the 1958 closing of Hofmann's schools in New York City and Provincetown, Massachusetts. The bulk of the study paintings was selected from the Hofmann collection at the University of California Berkeley Museum and Pacific Film Archive, the world's largest and most comprehensive public collection of the artist's work, with selected additions from the Albright-Knox Art Gallery (Buffalo, New York), the Memorial Art Gallery (Rochester, New York) and the Museum of Modern Art (New York, New York). Palettes were selected from the holdings of the Renate, Hans and Maria Hofmann Trust (New York, New York). Over 500 paint and fiber samples were analyzed to create a substantive catalogue of Hofmann's late-career materials. Analysis was employed for the broad characterization of materials; the primary goals for analysis were (i) to confirm and track Hofmann's use of industrial materials in his ground layers, and (ii) to identify and track Hofmann's use of any newly developed pigments or paint media in his compositional layers. Information regarding ground layer stratigraphy and identification of inorganic pigments was obtained using optical microscopy and scanning electron microscopy-energy dispersive spectrometry (SEM-EDX). Fourier transform infrared spectroscopy (FTIR) and gas chromatography-mass spectrometry (GC-MS) were used to identify binders and organic pigments, and x-ray diffraction (XRD) was used in a limited capacity to assess similar pigment blends. I conducted the materials analysis at the scientific laboratories of the National Gallery of Art, Washington, DC and the Museum Conservation Institute, Smithsonian Institution.[4] Primary sources of information related to the study group paintings utilized for this dissertation include the conservation records of the Berkeley collection

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[4] Access to the SEM-EDS, and FTIR facilities at the Museum Conservation Institute, Smithsonian Institution was granted by Director Robert J. Koestler in a letter dated March 10, 2011. Access to MCI's XRD facilities was granted by Deputy Director Paula DePriest during a meeting on August 22, 2103. Access to the Py-GC-MS facilities at the National Gallery of Art was granted by E. René de la Rie, Head of the Scientific Research Department, communicated in an email from National Gallery of Art Conservation Scientist Christopher Maines dated August 4, 2011. Permission to sample selected paintings from the collection of the University of California, Berkeley Art Museum and Pacific Film Archive was granted by Chief Curator Lucinda Barnes, and communicated in an email from Director of Registration Lisa Calden dated April 25, 2011. Permission to sample selected paintings from the collection of the Museum of Modern Art was granted by Agnes Gund Chief Conservator James Coddington, communicated via paintings conservator Michael Duffy in an email dated August 13, 2010. Permission to sample selected paintings from the collection of the Albright-Knox Art Gallery was granted through Registrar Laura Fleischmann in an email dated November 2, 2011. Permission to sample paintings from the University of Rochester's Memorial Art Gallery was granted by Chief Curator Marjorie Searl in an email dated October 4, 2011. Access to sample selected palettes from the collection of the Renate, Hans, and Maria Hofmann Trust was granted by estate representative James Yohe of Ameringer, McEnery, Yohe in an email dated October 26, 2011 and by Collections Manager Stacey Gershon in an email dated November 7, 2011.

held at the Berkeley Art Museum and the San Francisco Museum of Modern Art, and two unpublished surveys of the collection's condition and treatment history compiled by conservators at the San Francisco Museum of Modern Art and the Intermuseum Conservation Laboratory in Oberlin, Ohio.[5] Archival resources utilized for first-person accounts of Hofmann's materials and methods include the oral history records of the Smithsonian Institution's Archives of American Art and the University of California Regional History Office, and the Hofmann-related collections housed at the Archives of American Art and the University of California Berkeley's Bancroft Library.

Dissertation Structure

My dissertation integrates recent scholarship in art history, conservation, and scientific analysis in defining the relationship between Hofmann's materials, his work, and the preservation of his artistic legacy. In this first chapter I will define Abstract Expressionism, discuss the role of new materials in the creation, interpretation, and preservation of Abstract Expressionist painting, and explain my selection of Hofmann as an exemplar for Abstract Expressionist practice. I will also provide an overview of my study materials and research resources. In Chapter Two I will review Hofmann's exposure to the avant-garde arts communities of early twentieth-century Europe and the United States and assess his access to innovative paint technology. I will also discuss Hofmann's role in America's avant-garde communities and their embrace of

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[5] Tony Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," unpublished report, undated [ca.1982], Elise S. Haas Conservation Department, San Francisco Museum of Modern Art. Carolyn Tallent, "Investigation of the Painting Materials and Techniques of Hans Hofmann—Preliminary Report," unpublished fellowship report, dated August 1, 1988, Intermuseum Conservation Association.

experimental painting practice. In Chapter Three I will assess late-career changes in Hofmann's painting style and review published and anecdotal assessments of his technique. I will also provide an overview of material behaviors and conservation methodology common to Hofmann's work and present the paintings selected for materials analysis. In the final chapter I will explain the goals of each analytical technique used to examine the paint samples, outline the analysis results, and present a chronology of Hofmann's late-career materials. I will end Chapter Four with a discussion of Hofmann's materials in relation to his style and the preservation of his work. I will close this dissertation with an overview of my research, an assessment of Hofmann's materials in relation to Abstract Expressionist art practice, and a re-evaluation of traditional conservation methodology related to the preservation of modern art. I will also suggest additional avenues of research to contribute to our understanding of the Abstract Expressionist period.

A Brief Discussion of Abstract Expressionism

> The painting is both a thing and an event. Ontologically, it exists as a part of nature, not only as a 'esthetic' object, but as behavior in the form of a significant record.
> —Ray Parker, "Direct Painting," *It Is*, 1958[6]

[6] Ray Parker, "Direct Painting, "*It Is* 1 (Spring 1958): 20. Established and edited by sculptor Philip Pavia, *It Is* magazine was published between 1958 and 1965 and featured the artwork and writings of New York's avant-garde artists including Hofmann, whose essays were included in the third and fourth of the magazine's six issues.

Terminology

Abstract Expressionism is an umbrella term commonly used to describe a range of innovative painting practices employed by artists living in, or influenced by, the New York City arts community in the years directly following the Second World War. Years before this American contribution to international modernism drew popular and critical attention, the term "abstract expressionism" was applied to the shifting vanguard of German painting. The term first appeared in a 1919 *Der Sturm* article by painter Oswald Herzog on nature-based abstraction seen in the work of the German Expressionists[7] and within months critic Paul F. Schmidt used the same phrase to describe the innovative Munich paintings of Russian émigré Wassily Kandinsky.[8] In the United States, sporadic references to "abstract expressionist" German modernism began with a 1929 Wellesley College lecture by Museum of Modern Art founding director Alfred H. Barr,[9] but the term failed to gain a footing with American audiences. The first use of the term Abstract Expressionism to describe American modernist painting appeared in a 1946 *New Yorker* review of a Hofmann

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[7] Oswald Herzog, "Der abstrakte Expressionismus in der bildenden Kunst," *Der Sturm*, 10(2) (April/May 1919): 29.

[8] Paul F. Schmidt, "Preface," in Hugo Zehnder, *Wassily Kandinsky* (Dresden: Rudolf Kaemmerer, 1920), 2-3. The nature-based origins of Kandinsky's nonobjective paintings are discussed in Rose-Carol Washton Long, *Kandinsky: The Development of an Abstract Style* (Oxford: Clarendon Press, 1980).

[9] Peter Selz, *German Expressionist Painting* (Berkeley and Los Angeles, CA: University of California Press, 1997, rep., originally published in 1957), 343. Barr mentions Kandinsky's "abstract expressionism" in Museum of Modern Art catalogues in 1929, 1932, 1934, and 1936.

exhibition at the Mortimer Brandt Gallery.[10] In his review, entitled "At the Galleries: At Home and Abroad," critic Robert Coates proclaimed Hans Hofmann to be "one of the most uncompromising representatives of what some people call the spatter-and-daub school and I, more politely, have christened Abstract Expressionism."[11] Abstract Expressionism was thereafter associated with the mix of abstract composition and expressive paint handling that characterized mid-twentieth century modern painting in America. The term Abstract Expressionism was embraced by the press and the general public despite the artists' objections. "This seems to be the old situation," *Art News* critic Harold Rosenberg remarked at the time, "where the critic tries to round up the painters [into categories] and the painter tries to get out."[12] The artists de-emphasized the commonalities in their work and worried aloud that a single descriptor would stifle individual expression. "It is disastrous to name ourselves," Willem de Kooning (1904-97) told a group of prominent modernists assembled in April 1950 for the now-famous Studio 35 roundtable sessions.[13] "Everyone should be as different as possible," agreed

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[10] During this time the contemporary art division of Brandt's gallery was managed by Betty Parsons, who took over Brandt's lease and opened her own gallery at the same location when Brandt moved to England after World War II.

[11] Robert Coates, "The Art Galleries, At Home and Abroad," *New Yorker* 22(7) (March 30, 1946): 83.

[12] Comment made by Rosenberg at a meeting of the Artists Club on April 11, 1952. Cited in William C. Seitz, "Abstract Expressionist Painting in America: An Interpretation based on the Work and Thought of Six Key Figures," (PhD diss., Princeton University, 1955), 404.

[13] Transcript of the 1950 Sessions at Studio 35. Robert Motherwell and Ad Reinhardt, eds., *Modern Artists in America* (New York: Wittenborn, Schultz Inc., 1951), 22.

Hofmann. “There is nothing that is common to all of us except our creative urge.”[14] Throughout this dissertation I refer to the work of Hofmann and his contemporaries as Abstract Expressionist not only because of the term’s familiarity, but also because the composite name highlights the movement’s primary areas of innovation—composition and technique—and emphasizes the communal nature of modernism more successfully than alternatives that promote the movement’s isolating aspects, including “New York School,” “action painting,” or “American-type painting.” Despite de Kooning’s prediction, the term Abstract Expressionism has served to bring public attention to a range of experimental artworks and fix the related achievements of myriad artists within the flow of history.

Early Twentieth-Century American Painting

Early American efforts in modernist painting were significant if less visible to stateside audiences than the subsequent impact of their Abstract Expressionist colleagues. The abstract painting movement in the United States prior to the 1913 Armory Show[15] included the modernist work of artists such as Arthur Dove, John Marin, and Synchromists Stanton MacDonald-Wright and Morgan Russell, all of

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[14] Motherwell and Reinhardt, *Modern Artists in America,* 10. De Kooning’s and Hofmann’s comments were in response to a question by artist Barnett Newman about whether the assembled artists constituted a community.

[15] The 1913 International Exhibition of Modern Art, organized by the Association of American Painters and Sculptors. The three-city exhibition started in New York City's 69th Regiment Armory, at 68 Lexington Avenue between 25th and 26th Streets, from February 17 until March 15, 1913. The exhibition went on to show at the Art Institute of Chicago and then to The Copley Society of Art in Boston, where, due to a lack of space, all the work by American artists was removed.

whom worked in the modernist enclaves of early twentieth-century Paris and exhibited alongside their European colleagues. Dove, for example, traveled to Paris in 1908 and exhibited in the Salon d'Automne in 1908 and in 1909 (with Marin). MacDonald-Wright and Russell met while studying in Paris in 1911, founded their Synchromist movement in 1912, and exhibited their early works in Munich and Paris (1913) before the first Synchromist exhibition in New York (1914).[16] Avant-garde American painting during this period was championed by such influential modernist advocates as critic Willard Huntington Wright[17] and photographer Alfred Stieglitz, whose exhibitions and publications introduced American audiences to avant-garde European artists and the "Stieglitz Circle" of progressive American artists including Dove, Marin, Max Weber, Georgia O'Keeffe and Marsden Hartley. Early American modernism was showcased in the United States in such arenas as the 1910 exhibition Younger American Painters,[18] the 1916 Forum Exhibition of American Painters[19]—whose selection panel included Wright and Stieglitz—and the Brooklyn Museum's

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[16] See Gail Levin, *Synchromism and American Color Abstraction, 1910-1925* (New York: Whitney Museum of American Art and George Braziller, Inc., 1978),

[17] Brother of Stanton MacDonald-Wright. Macdonald-Wright contributed to Wright's 1915 book *Modern Painting: Its Tendency and Meaning* (New York and London: John Lane).

[18] Held March 1910 at the 291 Gallery. Participants included Dove, Marin, Marsden Hartley, Alfred Henry Maurer and Arthur B. Carles.

[19] Held March 13-25, 1916 at the Anderson Galleries, 489 Park Avenue in New York City. "One thing that will surely impress the public more than any other is the struggle that the various committees and individuals are making to swing the movement into different channels." Unknown, "Current News of Art and the Exhibitions," *New York Sun*, March 12, 1916.

1926 International Exhibition of Modern Art,[20] organized by the exhibition arm of the Société Anonyme, a modern art advocacy group founded in 1920 by artists Katherine Dreier, Marcel Duchamp, and Man Ray,[21] where alongside progressive art from France, the Netherlands, Switzerland, and Russia, the selection of American modernist painters included Dove, Marin, and O'Keeffe,

These early modernist efforts stood in contrast with popular realist painting movements, most notable in the socially conscious painting of such groups as the Ashcan school and the idyllic rural environs depicted by regionalist painters.[22] In the 1930s growing modernist support was challenged by the rising popularity of the narrative, regionalist painting produced by such artists as John Steuart Curry, Grant Wood, and Thomas Hart Benton, who completed a commission for the progressive New School of Social Research—a mural entitled *America Today*—in 1930, and a commission for the modernists Whitney Museum of American Art—a mural entitled *The Arts of Life in America*—in 1932. While commissions and teaching positions were still awarded to established modern painters,[23] many modern artists drawn to New

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[20] Held at the Brooklyn Museum. Originally planned to run November 19 through December 26, 1926, popular response resulted in an extension through January 10, 1927.

[21] At the time of the International Exhibition, the officers of the organization were Dreier (president), Wassily Kandinsky (vice-president), and Duchamp (secretary). The Société's collection was donated to the Yale University Art Gallery in 1941.

[22] See Wanda Corn, *The Great American Thing: Modern Art and National Identity, 1915-1935* (Berkeley: University of California Press, 1999).

[23] In 1931, for example, modern painter Stuart Davis was hired by the Arts Students League in New York to join a teaching roster that included such realist painters as Regionalist Benton and Ashcan school member John Sloan.

York's avant-garde community and by the promise of Federal Art Project employment in the 1930s were discouraged from producing abstract work. "I had to scheme to get work for abstract artists," recalled Mural Division head Burgoyne Diller. "I succeeded some of the time, like getting Gorky transferred from the easel project to my mural project. . . . In negotiating for the work I had to agree that it would not be abstract."[24] The new voice in modernism soon emerged, led by a generation of American-born abstract painters that included Barnett Newman (1905-70), Clyfford Still (1904-80), Robert Motherwell (1915-91), William Baziotes (1912-63), and Adolph Gottlieb (1903-74), artists determined to bring a new voice to abstract painting—"to start from scratch," as Newman recalled later, and "paint as if painting never existed before."[25]

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[24] Irving Sandler, *A Sweeper-Up After Artists: A Memoir* (London: Thames & Hudson Ltd., 2004), 104. Diller—a Hofmann student—ran the Mural Division in New York City's Restoration, Installation and Technical Service Division of the Federal Art Project. The range of artists working in the Federal Art Project is captured in a series of contemporaneous essays by Project artists and supervisors in Francis V. O'Connor, ed. *Art for the Millions: Essays from the 1930s by Artists and Administrators of the WPA Federal Art Project* (Greenwich, CT: New York Graphic Society, Ltd., 1973). Artist employment programs available through the United States Department of the Treasury: Public Works of Art Project (December 1933-June 1934, funded by the Civil Works Administration), Section of Painting and Sculpture (October 1934-October 1938, then renamed the Section of Fine Arts; oversight transferred to the new Federal Works Agency in 1939 which administered the program until June 1943). Artist employment available through the Works Progress Administration: Federal Art Project (August 1935-September 1939 when oversight was transferred to the Federal Works Agency which administered the program until March 1942), Treasury Relief Art Project (July 1935-June 1939, funded by the WPA and administered by the Treasury Department).

[25] Barnett Newman, *Selected Writings and Interviews*, ed. John O'Neill (Berkeley and Los Angeles: University of California Press, 1990), 192.

Many, although not all, of the important museums and galleries that were early supporters of modern American painting were located in New York City. Often the artists themselves helped to introduce the public to avant-garde American painting. Duchamp, for example, was instrumental in the formation of several organizations that promoted American avant-garde art. Duchamp immigrated to the United States in 1915 and the following year became a founding member of the Society of Independent Artists (modeled after the French organization of the same name), formed to promote the collection and exhibition of modern art. The Society's inaugural exhibition included more than two thousand artworks by predominantly American artists.[26] In 1920, Duchamp worked with Society of Independent Artists members Man Ray and Katherine Dreier to found the Société Anonyme and along with Society of Independent Artists member Walter Pach, Duchamp consulted with notable collectors including Peggy Guggenheim, Walter Arensberg, and Alfred H. Barr, Jr. In 1929, Barr became the first director of the Museum of Modern Art, the first museum dedicated to "encouraging and developing the study of Modern arts."[27] The museum was founded through the efforts of collectors Mary Quinn Sullivan, Abigail "Abby" Rockefeller, and Lillie Bliss, who had acquired a comprehensive collection of modernist paintings under the guidance of modernist painter Arthur B. Davies and whose large collection

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[26] Held April 10 through May 6, 1917 at the Grand Central Palace on Lexington and Forty-sixth Street in New York City. Participants included Hartley, Maurer, Charles Sheeler, Joseph Stella, Stieglitz, Weber, and Gertrude Whitney. *Catalogue of the First Annual Exhibition of The Society of Independent Artists* (New York: The Society of Independent Artists, Inc., 1917). Duchamp famously quit the Society of Independent Artists following their refusal to include his *Fountain* in their inaugural exhibition.

[27] Provisional charter granted to the Museum of Modern Art on September 19, 1929 by the New York State Board of Regents.

of works by members of the Association of American Painters and Sculptors was a major lender to the Association's 1913 International Exhibition of Modern Art (also known as the Armory Show). The museum opened with exhibitions of European Post-Impressionists and "Nineteen Living Americans," a show of modernist paintings that included work by Marin, O'Keeffe, and Weber.[28] In addition to a succession of successful midtown exhibition spaces run by Stieglitz,[29] a handful of modernist art galleries appeared around New York City's 8th street arts district, including the Whitney Studio, founded in 1907 by sculptor Gertrude Vanderbilt Whitney and husband Harry in an exhibition space in Greenwich Village. The Studio Club provided studio and exhibition space for young local artists while the Whitney Studio exhibited works by living American artists—abstract, nonobjective, and realist. When the Museum of Modern Art was established, Gertrude Whitney offered her collection of modern American art to the Metropolitan Museum of Art, but was refused by director Edward Robinson. The Studio expanded again, and was reopened to the public in 1931 as the Whitney Museum of American Art, with a mission to collect, preserve, interpret and exhibit progressive American art and a core collection of 700 works, many from the Whitneys' personal collection. These key modern arts organizations and exhibition

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[28] Held December 13, 1929-January 12, 1930.

[29] Stieglitz operated the Little Galleries of the Photo-Secession (1905-08) and the subsequent 291 Gallery (1908-1917) at 291 Fifth Avenue, followed by intermittent exhibitions at the Anderson Galleries (1921–1925), The Intimate Gallery (1925–19290 and An American Place (1929–46). Stieglitz also published the modernist periodicals *Camera Work* (1903-1917) and *291* (1915-1916) that were followed thereafter by American surrealist publications *VVV* and *View*, and similar progressive arts publications of the 1940s and 1950s such as *Iconograph*, *The Tiger's Eye*, *Possibilities*, *Instead*, *It Is*, and *Modern Artists in America*.

venues opened the way for similar institutions that appeared in the 1930s and supported the next generation of American modernists—including the Museum of Non-Objective Painting (later the Solomon R. Guggenheim Museum), The Art of This Century Gallery, and the American Abstract Artists group.

The Principal Abstract Expressionist Painters

Abstract Expressionism was born in New York City during World War II, the product of a unique concentration of American and émigré artists exploring the boundaries of painting in isolation from their modernist colleagues abroad. As established American arts communities were joined by a wave of artists and scholars fleeing Europe, New York City emerged as the new global center of modernist experimentation. From the city's polyglot community of innovators emerged the groundbreaking collection of new ideas about art and art-making that we call Abstract Expressionism—an innovative group of seemingly disparate painting styles connected by what historian Timothy J. Clark called "a distinctive patterning of mental and technical possibilities."[30]

In the late 1930s and early 1940s the ranks of American modernists were swelled by an influx of refugee artists and art historians fleeing the war's advancing European front and facilitated by a network of earlier émigrés positioned at museums and academic institutions throughout the United States, but with a particular concentration in New York City.[31] The resulting mix of émigré modernists included

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[30] T. J. Clark, introduction to *Farewell to An Idea: Episodes from a History of Modernism* (New Haven and London: Yale University Press, 1999), 7.

[31] Colin Eisler, "*Kunstgeschichte* American Style: A Study in Migration," in *The Intellectual Migration: Europe and America, 1930-1960*, eds. Donald Fleming and

Surrealists, Dadaists, and artists directly linked to such European movements as German Expressionism, Cubism, Fauvism, and Orphism. These new arrivals brought with them the latest European advances in theoretical aesthetics, physics, and optical science, and American artists now cut off from European travels made New York the new destination for an international arts education. In 1955, Princeton University student William C. Seitz wrote "Abstract Expressionist Painting in America: An Interpretation based on the Work and Thought of Six Key Figures"—a landmark dissertation on modern art focused on emerging styles of American painting. Four of the six New York-based artists chosen by Seitz to represent "the direction taken in modern art in America since the Second World War"[32] were émigrés: the German-born Hofmann, Armenian Arshile Gorky (1902-48), Russian Mark Rothko (1903-70), and Dutchman de Kooning,[33] This cosmopolitan modernist community was the center of a new direction in American art.

The Abstract Expressionists were prominent members of New York City's Eighth Street neighborhood, the social and professional hub that housed many of the

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Barnard Bailyn (Cambridge: Belknap Press of Harvard University Press, 1969, rep.), 598.

[32] Seitz, "Abstract Expressionist Painting in America: An Interpretation based on the Work and Thought of Six Key Figures" (PhD diss., Princeton University, 1955), i. Seitz's dissertation was circulated in Xerox form amongst the arts community before its eventual publication by Harvard University Press in 1983. The other two painters chosen by Seitz were Robert Motherwell and Mark Tobey.

[33] Hofmann taught at multiple schools including his own; Gorky taught drawing at the Grand Central School for Art from 1926-31; Rothko gave lessons at the Subjects of the Artist School; de Kooning taught students privately, including his future wife Elaine Fried. Hofmann's teaching career is discussed in more detail later in this chapter as well as in Chapter Two.

artists' studios, private classrooms, and public schools. The artists met for coffee at the Waldorf Cafeteria and drinks at the Cedar Tavern,[34] and dropped in on Friday critiques and lectures at Hofmann's school at 52 West Eighth Street. Friday lectures by fellow artists were also held at the Subjects of the Artist School, a presentation forum founded in 1948 by Baziotes, Motherwell, Rothko, Still, and David Hare at 35 East Eighth Street. When administration of that space was handed over to faculty from New York University the following year, less formal meetings began two doors down at 39 East Eighth Street, an address referred to as the Eighth Street Club, the Artists' Club, or simply The Club. Assisted by the 1935 opening of Hofmann's summer school on the grounds of the old Charles Hawthorne artists' colony in Provincetown, Massachusetts, the Abstract Expressionists were an integral part of the rebirth of that summer destination for the New York City art world. Notable Provincetown summer residents included Hofmann, Franz Kline (1910-62), Jackson Pollock (1912-56), Lee Krasner (1908-84), Motherwell, and Helen Frankenthaler (1928-2011). Following in the footsteps of the Subjects of the Artist and The Club, notable events at the Cape Cod arts community included "Forum '49," the 1949 summer-long program of exhibitions and debates focused on progressive American art. Abstract Expressionism's West Coast branch was established by visiting artists who taught at influential schools in San Francisco's Bay Area and laid the foundations for two schools of Bay Area Abstract Expressionism. Hofmann students on the faculty

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[34] The Waldorf Cafeteria was located at 390 West Eighth Street at the corner of Sixth Avenue. In 1933 the Cedar Tavern took up position in the neighborhood at 55 West Eighth Street, relocating to 24 University Pace (at the corner of Eighth and University) in 1945. Critics Dore Ashton and Harold Rosenberg also lived in the area.

of the University of California were instrumental in bringing Hofmann to the United States in 1930 to teach at the Berkeley campus, and in establishing the fine arts department at the center of the Berkeley School of Abstract Expressionism. From 1947 through 1949, Abstract Expressionist colleagues Still and Rothko were on the faculty of the California School of Fine Arts (now the San Francisco Art Institute)—the home of San Francisco Abstract Expressionism affiliated with the San Francisco Museum of Art (later the San Francisco Museum of Modern Art).

The Principal Abstract Expressionist Painting Characteristics

Abstract Expressionist paintings share two primary characteristics: abstract compositional elements and expressive painting technique. Seeing these traits in the work of the disparate Abstract Expressionist artists is central to understanding the formative role Abstract Expressionism played in the course of modern art.

Abstract Expressionist painting is at its root representational. Even the most elemental work of such American Abstract Expressionists as Rothko and Newman is primarily abstract—not nonobjective—and despite confusion in the popular press and in some current-day scholarly publications, the terms are not interchangeable. An early description of the differences between these terms appears in the 1943 book *New Frontiers in American Painting* by Samuel M. Kootz, who later ran a successful gallery featuring the work of such prominent Abstract Expressionists as Hofmann, Motherwell, and Baziotes. Kootz described abstract painters as "us[ing] existent reality as a point of departure for their abstractions, and insist[ing] upon a close attachment to life-impulses,"[35] while non-objective artists "attempt to find perfection

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[35] Samuel M. Kootz, *New Frontiers in American Painting* (New York: Hastings House Publishers, 1943), 49.

in geometry alone, with no recognition of humanity."[36] Kootz was the American representative for Pablo Picasso—a lucrative arrangement he used to subsidize the early work of such Abstract Expressionist artists as Motherwell and Baziotes[37]—and Kootz's clarity of thought may be based on insights provided by his renowned client. "You must always start with something," Picasso remarked in 1935. "Afterwards you can remove all appearance of reality; there is no longer any danger, because the idea of the object left an indelible mark."[38] Even the name of the Abstract Expressionists' discussion forum—The Subjects of the Artist—was a nod to that commitment. "The title was Barney's [Newman's]," recalled Motherwell, "[and] we all agreed that it was right because it made the point that our works did have subjects."[39] As their early experiments with subject-based ideographic, biomorphic, and mythic compositions gave way to recognizable signature styles, the mature Abstract Expressionists may at first glance appear to abandon content for construction. However otherworldly Still's topographic paint mounds, Rothko's ethereal glazes, or Newman's monochrome expanses may have appeared to contemporary audiences, these works remained rooted in the exploration of nature and the human experience. "There is no such thing as a

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[36] Kootz, *New Frontiers in American Painting*, 50.

[37] Oral history interview with Samuel M. Kootz, conducted on April 13, 1964 by Dorothy Seckler for the Archives of American Art, Smithsonian Institution.

[38] Pablo Picasso, in Christian Zervos, "Conversation avec Picasso," *Cahiers d'Art* (1935): 183. Translation by Yve-Alain Bois, in "Pablo Picasso: The Cadaqués Experiment," *Inventing Abstraction 1910-1925: How a Radical Idea Changed Modern Art,* ed. Leah Dickerman (New York: Museum of Modern Art, 2012), 40.

[39] Interview with Mark Rothko conducted on August 17, 1977 by E.A. Carmean, Jr. Cited in Carmean, *American Art at Mid-Century: The Subjects of the Artist* (Washington, DC: National Gallery of Art, 1978), 15.

good painting about nothing," claimed Rothko.[40] Through individualistic brushstrokes, paint splashes, and pigment stains, the Abstract Expressionists strove together to distill and convey the human experience. "The creative process," noted Hofmann, "lies not in imitating, but in paralleling nature—translating the impulse received from nature into the medium of expression."[41] While some Abstract Expressionist artists returned to more overt subject matter late in their careers, at its peak Abstract Expressionist painting expanded the boundaries of acceptable subject matter by creating a gateway between literal and experiential representation in modern art.

The innovative application of paint is another recognizable characteristic of Abstract Expressionism. Unconventional painting tools and media were favored by New York artists during this period, including experimental paint formulations and industrial materials previously considered outside the realm of fine arts practice. De Kooning's painting style, for example, incorporated the sign-painting tools of his early career as a commercial artist, while the experimental paint workshops of Mexican muralist David Alfaro Siqueiros played a formative role in Jackson Pollock's embrace of nontraditional paint media. The many Abstract Expressionist painters employed through New Deal programs at the Treasury Department or the Works Progress Administration—including Baziotes, Gorky, Gottlieb, Philip Guston (1913-80), Kline,

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[40] Edward Alden Jewell, "Globalism Pops Into View: Puzzling Pictures in the Show by the Federation of Modern Painters and Sculptors Exemplify the Artists' Approach," *New York Times*, June 13, 1943, X9.

[41] Hans Hofmann, "Painting and Culture," trans. Glenn Wessels, *The Fortnightly* 1(1) (September 11, 1931): 5.

Krasner, Pollock, Ad Reinhardt (1913-67), Rothko, and Mark Tobey (1890-1976)[42]—were regularly exposed to new paints and commercial production techniques.[43] The Abstract Expressionists redefined painting with their monochrome expanses or wall-sized explosions of dripped, splattered, and poured paint. Although their goals were similar, the artists' individual styles were distinct: De Kooning's aggressive brushstrokes stand in stark contrast to Pollock's intricately dripped masses, for example, and the tiny, delicate marks at the edges of Rothko's luminous glazes[44] seem unrelated to Still's tactile, opaque crusts of paint. "If the painting of de Kooning and Pollock may be called one of commission, in which the artist doesn't hesitate to reveal himself," observed *New York Times* critic and former Museum of Modern Art curator Sam Hunter, "that of Still and Rothko is an art of omission, where more is suggested

[42] The WPA did employ foreign artists who had applied for permanent resident status, including Arshile Gorky and Mark Rothko. De Kooning left WPA employment in 1937 when the federal agency began requesting workers for confirmation of their United States citizenship.

[43] Artist employment programs available through the United States Department of the Treasury: Public Works of Art Project (December 1933-June 1934, funded by the Civil Works Administration), Section of Painting and Sculpture (October 1934-October 1938, then renamed the Section of Fine Arts; oversight transferred to the new Federal Works Agency in 1939 which administered the program until June 1943). Artist employment available through the Works Progress Administration: Federal Art Project (August 1935-September 1939 when oversight was transferred to the Federal Works Agency which administered the program until March 1942), Treasury Relief Art Project (July 1935-June 1939, funded by the WPA and administered by the Treasury Department).

[44] See Thomas Crow, "The Marginal Difference in Rothko's Abstraction," in *Seeing Rothko,* eds. Glenn Phillips and Thomas Crow (Los Angeles: Getty Research Institute, 2005), 25-439.

than stated."[45] The work of these groundbreaking artists was at once alien and immediate, both abstract and expressive.

Prominent Exhibition and Publication Venues for Abstract Expressionism

The new wave of American modernism practiced by Hofmann, Pollock, and others was initially ignored by both traditional and progressive exhibition venues at home. Work produced in Germany by Russian painter Kandinsky was a curatorial favorite downtown at A. E. Gallatin's Gallery of Living Art and in the rising midtown gallery district at the Museum of Non-Objective Painting (later the Solomon R. Guggenheim Museum)[46] and the influential Museum of Modern Art. Guggenheim Director (and Baroness) Hilla von Rebay's fascination with Kandinsky was so well-known that Hofmann student Robert De Niro Sr. was said to have included pastiches of Kandinsky's work in his own portfolio in order to secure part-time work at the museum for himself and Pollock.[47] Museum of Modern Art Director Alfred H. Barr—once called "the most powerful tastemaker in American art today" by *New York Times* art critic John Canaday—diagrammed the history of modernism for the museum's seminal 1936 exhibition *Cubist and Abstract Art* with no reference to the contributions

[45] Sam Hunter, *Modern American Painting and Sculpture,* (New York: Dell Publishing, Co., Inc., 1959), 154. At the time of publication, Hunter was acting director of the Minneapolis Institute of Arts.

[46] Established in 1937 at 24 East 54th Street; moved to 1071 Fifth Avenue in 1959.

[47] Interview with Leland Bell conducted by Steven Naifeh and Gregory White Smith. Cited in Naifeh and Smith, *Jackson Pollock: An American Saga* (New York: C.N. Potter, 1989), 446.

of American modernists[48] and was steadfast in his refusal to add the work of many Abstract Expressionists (including Hofmann and Rothko) to the museum's collections during his tenure.[49] Even the Whitney Museum of American Art,[50] a studio-turned-museum dedicated to "collect, preserve, interpret and exhibit progressive American art, and support new artists and emerging art forms," drew criticism for including conventional offerings in its annual (later biennial) emerging artists showcase. Ignored by museums and derided by a press corps wary of radical expression in the shadow of World War II, American modernists previously active in such socialist groups as the John Reed Club, the Artists' Union, and the American Artists' Congress[51] began to join apolitical organizations dedicated to bringing public and critical attention to American abstraction. Rothko and Gottlieb, for example, joined The Ten (also known as the Whitney Ten dissenters)—whose protest exhibitions in nearby galleries were timed to coincide with the museum's emerging art showcase[52]—and prominent avant-garde artists were featured in such experimental American literary and arts

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[48] *Cubism and Abstract Art* (New York: Museum of Modern Art, 1936), cover. The notation "(ABSTRACT) EXPRESSIONISM" in Barr's diagram repeats his use of the term in relation to Kandinsky.

[49] See Sam Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend: Reflections by Sam Feinstein* (New York: Midmarch Arts Press, 2008), 85.

[50] Originally named the Whitney Studio, located at 8 West Eighth Street; moved to West 54th Street in 1954 and then to 945 Madison Avenue in 1966.

[51] In 1939 the American Artists' Congress was instrumental in bringing Pablo Picasso's *Guernica* to New York to raise money for the Spanish Refugee Relief Campaign.

[52] The first exhibition of The Ten was held opened on December 21, 1935 at the Montross Gallery at 550 Fifth Avenue.

publications as *Iconograph, The Tiger's Eye, Instead,* and *It Is*. On April 15, 1940, members of the American Abstract Artists picketed the Museum of Modern Art with placards that included the slogans "How Modern is the Museum of Modern Art?" and "Shouldn't 'Modern' conceivably include the 'Avant-garde'?" and pamphlets that read "The Art Critics! How Do They Serve the Public? What Do They Say? How Much Do They Know? Let's Look at the Record." Recognition by the popular press began on June 13, 1943, when *New York Times* Art Editor Edward Alden Jewell reprinted a letter by Rothko and Gottlieb, part of their ongoing correspondence with the critic seeking "the opportunity to present our views."[53] Despite Jewell's "befuddled" attitude towards the avant-garde, the letter's publication is a notable marker in the slow but steady shift in American recognition of abstract art and the accompanying rise of Abstract Expressionism.

The job of promoting Abstract Expressionism was first shouldered by smaller venues, in particular Peggy Guggenheim's gallery The Art of This Century.[54] Solomon R. Guggenheim's niece opened The Art of This Century in 1942 in a space on Fifty-seventh Street nearby the surrealist Julian Levy Gallery. In a space designed by Dada architect Frederick Keisler and amongst a roster of exhibitions promoting émigré surrealist and dada artists, the Art of This Century also actively promoted emerging abstract artists and produced the first major solo shows for Pollock, Baziotes, Hofmann, Motherwell, Rothko, and Still. The midtown neighborhood three streets north of the Museum of Modern Art and the Museum of Non-Objective

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[53] Jewell, "Globalism Pops Into View," X9.

[54] Located at 30 West Fifty-seventh Street, Guggenheim's gallery operated from 1942 through 1947.

Painting was soon home to a number of prominent galleries showcasing the work of future Abstract Expressionists. Lawyer-turned-art dealer Kootz opened his eponymous gallery a few doors east of The Art of This Century in 1944 with a strong roster of future Abstract Expressionist talent, including Hofmann, Motherwell, Baziotes, and Gottlieb. In 1945, former Guggenheim advisor Howard Putzel organized the exhibition *A Problem for Critics* at his 67 Gallery and challenged members of the press to name the new American movement. The following year artist Betty Parsons took over Mortimer Brandt's lease on a space in the same building occupied by Kootz's gallery, and helped cement the neighborhood's prominence with exhibitions of work by Reinhardt, Rothko, Pollock, Still, and Bradley Walker Tomlin (1899-1953). Charles Egan had a gallery one block to the east of Kootz and Parsons, and one block to the west was a gallery run by Museum of Modern Art advisory board member Sidney Janis.[55] Janis's stable of artists included de Kooning, Kline, Rothko, Motherwell, Guston, Gottlieb and Baziotes. 1946—the year that Coates first used the term Abstract Expressionism—was also the year that the museums began to take notice of the emerging American art form. The work of Baziotes, Gottlieb, Guston, and Motherwell was featured in the Metropolitan Museum of Art's exhibition *Advancing American Art*, and following René d'Harnoncourt's appointment as Director of the Museum of Modern Art two years prior, curator Dorothy Canning Miller featured the work of Gorky and Motherwell in the museum's 1946 showcase

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[55] The Kootz Gallery: original location at 15 West Fifty-seventh Street; The Betty Parsons Gallery: 15 West Fifty-seventh Street; Charles Egan Gallery: original location 63 East Fifty-seventh Street; Sidney Janis Gallery: 110 West Fifty-seventh Street; 67 Gallery: 67 East 57th Street. Hofmann was first represented by Parsons, but then moved to the Kootz Gallery to join Motherwell, Baziotes, and Gottlieb.

Fourteen Americans. That same year, art critic and Museum of Modern Art acquisitions board member Meyer Shapiro convinced the museum to purchase Pollock's painting *The She-Wolf,* one of the works featured in Pollock's first solo exhibition at The Art of This Century. By the time The Art of This Century closed its doors in 1947, the movement that puzzled the critics only two years before was firmly established and Abstract Expressionist artists regularly appeared in such popular magazines as *Look*—which printed a feature on the paint colors used to decorate Hofmann's Provincetown home—and *Life*—which asked if Pollock was "the greatest living painter in the United States."[56] Despite the growing fascination with modern art in the popular press, the group of artists gathered at Studio 35 in April 1950 felt there was still little long-term support for their work at such larger institutions as the Metropolitan Museum of Art, which would wait another decade to hire their first curator of contemporary art.[57] On May 20, 1950, 28 abstract artists (18 painters and 10 sculptors) signed an open letter to the museum's president Roland L. Redmond, protesting the "hostility towards advanced art" shown by the museum in its jury selection for the acquisitions-based exhibition *American Art Today*. The public response to the letter is indicative of the changing climate. The letter was reprinted two days later on the front page of the *New York Times*, and *Life* magazine sent

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[56] Charlotte Willard, "Living in a Painting," *Look* 17(15) (July 28, 1953): 52-55. "Jackson Pollock: Is he the greatest living painter in the United States?" *Life* 27(6) (August 8, 1949): 42-43, 45.

[57] Henry Geldzahler replaced Albert TenEyck Gardner as Curator of American Art at the museum in 1960, and in 1967 was tapped to direct the museum's new Department of Contemporary Arts. In 1970 the Department of Contemporary Arts was renamed the Department of Twentieth-Century Art.

photographer Nina Leen to capture the moment in a group portrait which was published by the magazine in January 1951 with the caption “Irascible group of advanced artists led fight against show.”[58] That same year the United States Information Services office co-sponsored the Parisian exhibition *Introduction à la Peinture Moderne Americaine* organized by Kootz while Gorky, de Kooning, and Pollock were chosen to represent American art at the Venice Biennale. By 1951, the *9th Street Art Exhibition* at the Leo Castelli Gallery showcased the work of the now established Abstract Expressionists, including Baziotes, Gorky, Guston, Hofmann, de Kooning, Motherwell, Pollock, Reinhardt, Rothko, Tobey, and Tomlin, and the Museum of Modern Art featured Abstract Expressionists in its *Abstract Painting and Sculpture in America* and subsequent *Fifteen Americans* exhibitions. Abstract Expressionists were also featured in the 1952 exhibition *Expressionism in American Painting* at board member Conger Goodyear’s former board host, Buffalo’s Albright Art Gallery (now the Albright-Knox Art Gallery). On April 9, 1954, The Club held a meeting with the rhetorical title “Has the situation changed?” By the end of the decade, touring exhibitions and such encyclopedic collections as the Metropolitan Museum of Art were presenting Abstract Expressionism as part of retrospective or historical narrative and the galleries and critics that had helped launch Abstract Expressionism moved on to the next generation of emerging artists.

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[58] *Life* 30(3) (January 15, 1951): 34. The incomplete portrait has become a *de facto* record of prominent Abstract Expressionist artists although the photo depicts only 15 of the painters and none of the sculptors.

The Influence of Abstract Expressionism on Art Criticism

Abstract Expressionism's unfamiliar visual language provoked a new kind of critical discourse. Two of the most influential Abstract Expressionist pundits were Clement Greenberg and Harold Rosenberg, members of the socialist New York Intellectuals group who broke with political commentary following the war and emerged as *de facto* heads of competing formalist and existentialist camps whose ideologies have become critical to the analysis of modern art.

Despite the rising tide of apolitical arts activism in the late 1930s, art criticism of the period was still tied to socialist message. Shapiro wrote for the *Marxist Quarterly*. Rosenberg wrote for *New Masses* and edited the *Art Front*. Greenberg and Rosenberg wrote for the political and literary magazine *Partisan Review*. Shapiro advocated for the purchase of Pollock's *The She-Wolf* by the Museum of Modern Art based on its value as a document of human suffering, while Greenberg's first defense of modern art—a 1939 article entitled "Avant Garde and Kitsch"—lauded abstract painting for its position outside the banality of consumer culture. Yet even in this review, Greenberg hinted at the change in modern art that would pull criticism along with it, as Greenberg praised the abstract artists' ability to fuse content "so completely [in] form [that] the work of art . . . cannot be reduced in whole or in part to anything not itself."[59] By 1940, Rosenberg had noted New York's rising position in the art world, which Greenberg said relied on artists' continuing development of apolitical abstract painting.[60]

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[59] Clement Greenberg, "Avant Garde and Kitsch," *Partisan Review* 6(5) (Fall 1939): 36.

[60] Harold Rosenberg, "On the Fall of Paris," *Partisan Review* 7(6) (November-December, 1940): 440-48. Clement Greenberg, "Review of Exhibitions of Joan Miró,

Greenberg established himself as a champion of formalist criticism with his emphasis on the picture plane. Shortly after Robert Coates applied the term Abstract Expressionism to the new American art, Greenberg's 1947 essay "The Present Prospects of American Painting" proclaimed that the new American abstraction could outperform its European counterpart on the international stage and credited Abstract Expressionist painters with a central role in positioning New York at the center of the modern art universe.[61] Although Greenberg's support of individual Abstract Expressionists including Hofmann and Pollock remained unwavering throughout his career, by 1948 the limits of the picture plane's self-contained universe led Greenberg to discount small-scale easel painting[62] for the oversized canvases of such second-generation Abstract Expressionists as Frankenthaler and the Washington Color School artists Morris Louis and Kenneth Noland, whom Greenberg featured in 1954 edition of the *Talent* exhibition series he and Schapiro curated for Kootz.

Discussions of art as performance gained prominence with the writing of critic Harold Rosenberg, who—positioned by fate or choice as Greenberg's ideological opponent—portrayed art making as an existential struggle for identity. Like Greenberg, Rosenberg was an early champion of Abstract Expressionism. Rosenberg collaborated with Motherwell on the short-lived Abstract Expressionist literary forum

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Fernand Léger, and Wassily Kandinsky," *The Nation* 152(16) (April 19, 1941): 481–82.

[61] Clement Greenberg, "Present Prospects of American Painting and Sculpture." *Art on the American Horizon* 93-94 (October 1947): 20-30.

[62] Clement Greenberg, "The Crisis of the Easel Picture," *Partisan Review* 15(4) (April 1948): 481-84.

Possibilities, and worked with Kootz on the 1949 exhibition *The Intrasubjectives*, considered the first group exhibition of Abstract Expressionist paintings. *The Intrasubjectives* included a range of compositions by such Abstract Expressionists as Gottlieb, Motherwell, and de Kooning, with a catalogue narrative focused on the creative drive that was at the heart of Rosenberg's existentialism. To Kootz's catalogue statement "Intrasubjectivism is a point of view in painting, rather than an identical painting style," Rosenberg replied "all art is, of course, subjective. . . . merely the canvas before it has been painted."[63] Rosenberg's thesis was set in his seminal 1952 *ARTnews* article "The American Action Painters," wherein he argued that abstract art was the result of a dialogue between the artist's mind and body and that "what was to go on the canvas was not a picture but an event."[64] The powerful critics and their followers soon divided the art world along ideological lines. While such critics as Schapiro agreed that "the mark, the stroke, the brush, the drip, the quality of the substance of the paint itself, and the surface of the canvas as a texture and field of operation [are] all signs of the artist's active presence,"[65] Seitz represented the call for a distinction "between the physical fact of the work of art and its total aura of ideas, intuitions, convictions, beliefs, and feeling."[66] In an infamous moment at the Eighth

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63 *The Intrasubjectives* (New York: Samuel M. Kootz Gallery, 1949), n.p.

64 Harold Rosenberg, "The American Action Painters," *Art News* 51(8) (December 1952): 23.

65 Meyer Schapiro, "The Liberating Quality of Avant Garde Art," *Art News* 56(4) (Summer 1957): 38.

66 Seitz, "Abstract Expressionist Painting in America," 408.

Street Club, Pollock criticized the Rosenberg-leanings of *ARTnews* editor Thomas Hess's new book,[67] and threw the book at de Kooning.

By the end of the decade the tastemakers themselves became targets. Leo Steinberg, an early supporter of Rosenberg's existentialist action painting, criticized both Greenberg and Rosenberg for their inability to embrace emerging art forms in a 1960 series of lectures at the Museum of Modern Art entitled "Contemporary Art and the Plight of Its Public"[68] and Rosalind Krauss, a Greenberg disciple, also criticized the inflexible nature of Greenberg's and Rosenberg's theories. One of the most vocal critics of both established and emerging modernism was John Canaday, who became art critic for the *New York Times* in 1959. Canaday's first essay at the *Times* was a calling out of Abstract Expressionist "fakes" and "charlatans"[69] that brought an uproar from modern art circles that culminated in an open letter to the *Times* signed by 49 artists, scholars, and critics including Schapiro, Rosenberg, and Hess, all accusing Canaday of groundless polemic and agitation. According to critic David Shapiro, "letters from academics, artist, and museum people questioned not only [Canaday's] views but his sanity and intelligence. . . . More than 600 letters arrived at the *New York Times* in reaction to this single article, of which 52, both pro and con, were published."[70] Subsequent accounts have, for the most part, stepped outside polemic

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67 Thomas Hess, *Abstract Painting: Background and American Phase* (New York: Viking Press, 1951).

68 Printed as an essay in *Harper's Magazine* 224(1342) (March 1962): 31-39.

69 John Canaday, "Happy New Year: Thoughts on Critics and Certain Painters as the Season Opens," *New York Times,* September 6, 1959, X16.

70 David Shapiro and Cecile Shapiro, "Introduction: A Brief History," in *Abstract Expressionism: A Critical Record*, eds. Shapiro and Shapiro (Cambridge and New

and worked to place Abstract Expressionism within its historical or social context. Influential works include critic Dore Ashton's 1972 book *The New York School: A Cultural Reckoning*[71] and *Art News* senior critic Irving Sandler's three-volume survey: *The Triumph of American Painting* (1970), *The New York School: Painters and Sculptors of the Fifties* (1978), and *American Art of the 1960s* (1988).[72] Historical Abstract Expressionism has not completely escaped controversy, however, as evidenced by attempts by such critics as Serge Guilbaut to position the artists as unwitting government operatives, as in Guilbaut's 1985 work entitled *How New York Stole the Idea of Modern Art: Abstract Expressionism, Freedom, and the Cold War*.[73]

The Role of Materials in Abstract Expressionism

> Sometimes the way out of [an] impasse in historical work comes from proposing another set of possible descriptions that the paintings in question might be seen to "come under". . . . What sorts of new orders

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York: Cambridge University Press, 1990), 23. The letter was initiated by artist John Ferren and critic Irving Sandler. See Sandler, *The New York School: Painters and Sculptors of the Fifties* (New York: Harper & Row, 1978), 281-2. Signatories of the response letter included Gottlieb, Hofmann, de Kooning, Motherwell, and Newman: "A Letter to the New York Times," *New York Times*, February 26, 1961, X19.

[71] Dore Ashton, *The New York School: A Cultural Reckoning* (New York: Viking Press, 1972). Ashton had joined the *Times* staff in 1955 but was fired by Canaday in 1960 for her favorable stance towards Abstract Expressionism.

[72] Irving Sandler, *The Triumph of American Painting; A History of Abstract Expressionism* (New York: Praeger Publishers, 1970), *The New York School: The Painters and Sculptors of the Fifties* (New York: Harper & Row, 1978), and *American Art of the 1960s* (New York: Harper & Row, 1988).

[73] Serge Guilbault, *How New York Stole the Idea of Modern Art: Abstract Expressionism, Freedom, and the Cold War*, trans. Arthur Goldhammer (Chicago: University Of Chicago Press, 1983).

in the objects would be set up, if we chose to look at them *this* way?
—T. J. Clark, "In Defense of Abstract Expressionism," *October*, 1994[74]

Method is, it seems to me, a natural growth out of a need, and from a need the modern artist has found ways of expressing the world about him.[75] —Jackson Pollock, unaired radio interview, 1950

Painters must speak through paint—not through words.
—Hans Hofmann, "Statement by Hans Hofmann," *It Is*, 1959[76]

The technical study of an artist's work has potential far beyond an increased understanding of paint mechanics and degradation; technical studies of mid-twentieth century art also illuminate a pivotal shift in the relationship between materials and art practice. The Abstract Expressionists' relationship with their materials changed the trajectory of modern art. Scholars who place mid-twentieth century painting along a simple figurative/nonfigurative trajectory miss the important link between contemporary arts practice and its roots in the shifting dialogue between artist and artmaking found in the work of Abstract Expressionist painters.

New Materials as New Avenues of Expression

New paint materials do not define Abstract Expressionist painting, but the appearance of new materials in the Abstract Expressionist palette led to changes in

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[74] T. J. Clark, "In Defense of Abstract Expressionism," *October* 69 (Summer 1994): 26.

[75] Interview with Jackson Pollock, conducted in the summer of 1950 by William Wright for a radio station, but never used. Cited in Francis V. O'Connor, *Jackson Pollock* (New York: The Museum of Modern Art, 1967), 80.

[76] Hans Hofmann, "Statement by Hans Hofmann," *It Is* 3 (Winter 1958-Spring 1959): 10.

artistic practice that define modern art history. Modern paints appeared on the scene concurrently with the modern artists' search for a new means of artistic expression, and experimental paints encouraged experimental practices that affected the artists' relationship with both modern and traditional materials. "My opinion is that new needs need new techniques," proclaimed Pollock—one of the most well-known advocates of new paint materials, "and the modern artists have found new ways and new means of making their statements."[77] Through Abstract Expressionism, direct engagement with the materials of painting took precedence in artmaking. The work of the Abstract Expressionists was promoted in contemporary press as the "[direct] experience of paint and canvas"[78] and such rising artists as Philip Guston, who considered himself "a very spiritual man, not interested in paint," now found himself suddenly "very physical and involved with matter."[79] The modern canvas was no longer Greenberg's unbreakable frontal plane, or Rosenberg's arena stage, but now also, as historian T. J. Clark put it, "the intersection of body . . . and medium."[80] Despite this new

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[77] Interview with Jackson Pollock conducted by William Wright, 79.

[78] Robert Goodnough, "Pollock Paints a Picture," *Art News* 50(3) (May 1951): 60.

[79] Philip Guston quoted by Joseph Ablow, from a transcript of a 1966 public forum at Boston University conducted by Joseph Ablow. Cited in *Abstract Expressionism: Creators and Critics, An Anthology*, ed. Clifford Ross (New York: Harry N. Abrams, Inc., 1990), 70-71.

[80] Clark, "The Unhappy Consciousness," in *Farewell to An Idea,* 331. See also Richard Shiff, "Performing an Appearance: On the Surface of Abstract Expressionism," in *Abstract Expressionism: The Critical Developments*, Michael Auping, ed. (New York: Harry N. Abrams Inc. in association with the Albright-Knox Art Gallery, 1987) and Richard Shiff, *Between Sense and de Kooning* (London: Reaktion Books, 2011).

relationship, the idea that mid-twentieth century artists relinquished control to their materials is a myth. The radical painting techniques introduced by Abstract Expressionist artists were facilitated by innovative new paint media and the attendant range of new colors, surface qualities and handling characteristics, but the artists' message was not determined by their materials. "I have a general notion as to what I am about," confirmed Pollock. "I *can* control the flow of paint. There is no accident."[81] Still and Rothko also controlled the conditions under which their works could be viewed, with Rothko often choosing the wall color and lighting design for the exhibition space.[82] "The medium becomes the work of art," said Hofmann, "only when the artist is intuitive and at the same time masters its essential nature and the principles which govern it."[83] Abstract Expressionism is the moment when process became a fundamental language in modern painting. In Abstract Expressionist art, claimed Rosenberg, "the artist became the medium of [their] medium."[84]

The Influence of New Materials on Subsequent Art Movements

The Abstract Expressionists initiated a paradigm shift in art practice from product to process that influenced subsequent generations of artists and changed the

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[81] Pollock, narration in Hans Namuth's 1950 film of the artist at work. Cited in Sandler, *Triumph of American Painting*, 116.

[82] See Briony Fer, "Rothko and Repetition," in *Seeing Rothko*, eds. Glenn Phillips and Thomas Crow (Los Angeles: Getty Research Institute, 2005), 159-175.

[83] Hans Hofmann, "Excerpts from the Teaching of Hans Hofmann: On the Aim and Nature of Art," *The Search for the Real and Other Essays*, eds. Bartlett H. Hayes, Jr. and Sara T. Weeks (Andover, MA: Addison Gallery of American Art, 1948), 59.

[84] Harold Rosenberg, "Art and Words," *The New Yorker,* March 29, 1969, 116.

course of modern art. In his essay on the overt role of media in art produced on the heels of Abstract Expressionism, historian Thierry de Duve noted that "the medium in its specificity is not simply a matter of physical constituents; it comprises technical know-how, cultural habits, working procedures and disciplines—all the conventions of a given art whose definition is throughout historical."[85] Materiality (and conversely, immateriality) rose to prominence in the 1960s and 1970s, but as art historian David Anfam noted, "scarcely any artist of [the next] generation could not have known about the signifying force of paint and touch that was central to Abstract Expressionism."[86]

The Abstract Expressionists' experimental approach to materials had a direct impact on the art movements that followed. The lyrical abstraction that so captivated Greenberg's later criticism, for example, was a direct progression from Abstract Expressionism. Helen Frankenthaler's innovative stain painting was directly influenced by Pollock's experimental relationship to his materials. "Taking hints from his methods and materials," recalled Frankenthaler, "I experimented and proceeded to try other ideas."[87] Emerging artists with an interest in materials focused their gaze on the Abstract Expressionists. "Both Pollock and Hofmann seemed to me to have solved the problem," noted Minimalist painter Stella. "I didn't have to go all the way back

[85] Thierry de Duve, "The Monochrome and the Blank Canvas," in *Kant after Duchamp* (Cambridge, MA: MIT Press, 1996), 210. Adapted from materials originally written in 1986 and published in *Reconstructing Modernism*, ed. Serge Guilbaut (Cambridge, Mass.: MIT Press, 1990), 244-310.

[86] David Anfam, *Abstract Expressionism* (London: Thames and Hudson, Ltd., 1990), 191.

[87] Helen Frankenthaler, in Grace Glueck, "The 20th Century Artists Most Admired by Other Artists," *Art News* 76(9) (November 1977): 85.

and worry again about where I stood in relation to Matisse and Picasso. I could worry about where I stood in relation to Hofmann and Pollock."[88] Reinhardt's search for "color that gives off light"[89] foretold minimalist artist Dan Flavin's rooms literally filled with light just as Newman's monochrome expanses made possible sculptor Richard Serra's bending of sculptures around the viewer and thereafter the viewer's ability to step directly into the earthworks of Walter De Maria and Robert Smithson Tuttle. Similarly, as Rosenberg and Sandler saw in the seeds of performance art in Pollock's attempts to "literally be in the painting,"[90] the trajectory from Pollock leads to the body-as-canvas performances of Yves Klein's living brushes and Gutai artist Kazuo Shiraga's *Challenging Mud*[91] and to the body-as-art performances of such artists as Vito Acconci and Karen Finley. In 1924 the renowned abstract painter Paul Klee noted:

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[88] Frank Stella, in Emile de Antonio and Mitch Tuchman, *Painters Painting: A History of American Modernism in the Words of Those Who Created It* (New York: Abbeville Press, 1984), 84. Book based on transcripts from de Antonio's 1972 film *Painters Painting*.

[89] Ad Reinhardt, in a letter to Sam Hunter in the summer of 1966. Communicated by Barbara Rose to Margit Rowell. Cited in Rowell, *Ad Reinhardt and Color* (New York: The Solomon R. Guggenheim Museum, 1980), 21.

[90] Sandler, *Triumph of American Painting,* 102.

[91] "This full-bodied performance made literal the implied kinesthetic response to a Pollock pouring. . . . It also prefigures the 'living brush' technique that Yves Klein directed around 1960." Lewis Kachur, "The View from the East: The Reception of Jackson Pollock among Japanese *Gutai* Artists," in *Abstract Expressionism: The International Context*, ed. Joan Marter (New Brunswick, NJ and London: Rutgers University Press, 2007), 155.

> Nobody would affirm that the tree grows its crown in the image of its root. Between above and below can be no mirrored reflection. It is obvious that different functions expanding in different elements must produce vital divergencies. . . . And yet, standing at his appointed place, the trunk of the tree . . . gather[s] and pass[es] on what comes to him from the depths."[92]

It would be shortsighted to insist that the history of modern material culture begins when the materials have taken center stage. A prominent role in the ongoing trajectory of modern art should be assigned to the pioneering Abstract Expressionists who, as historian Michael Auping noted, "disregarded the idea of traditional categories and focused on the matter itself and the various procedures suggested by different materials."[93]

The Influence of New Materials on Art History Scholarship

Abstract Expressionism fundamentally changed the course of art criticism. The territorial disputes of Greenberg and Rosenberg have overshadowed their more important commonality: an attention to the material aspects of the avant-garde. Despite latter-day claims by such critics as Rosalind Krauss that Greenberg intentionally sublimated his response to an artist's materials,[94] from the start of his career Greenberg drew attention to the relationship between materials and creativity. As early as "Avant Garde and Kitsch" Greenberg proclaimed that modern painters

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[92] Paul Klee, transcript from a January 26, 1924 lecture. Cited in *Paul Klee on Modern Art*, trans. Paul Findley (London: Faber and Faber Ltd., 1966, org. pub. 1948), n.p.

[93] Michael Auping, "Beyond the Sublime," in *Abstract Expressionism: The Critical Developments,* 152.

[94] Rosalind E. Krauss, *The Optical Unconscious*, (Cambridge, MA: MIT Press, 1994), 243-48. See also Amelia Jones in "Notes from the Field: Materiality," *The Art Bulletin* 95(1) (March 2013): 17.

"derive their chief inspiration from the medium [in which] they work."[95] Likewise, an artist's direct relationship with his materials played a primary role in Rosenberg's definition of the new trend in modern art. "The painter no longer approached his easel with an image in his mind," said Rosenberg, "he went up to it with material in his hand to do something to that other piece of material in front of him."[96] The material components of modern art drew the interest of such period arts journalists as *Art News* editor Thomas Hess, who spearheaded the magazine's series of more than 80 articles focused on modern artists' studio practices.[97] Contemporary explorations of "materiality" by such scholars as Krauss, Yve-Alain Bois, and Richard Shiff have their origins in the new relationship between material and artist explored by the Abstract Expressionists.[98] "In [t]his unapologetic materialism," wrote Hunter in the catalogue for a 1956 exhibition of works by Pollock , "there [is] an effort to breathe spirit into the refractory matter that [is] the substance of [the] art."[99] Critics including Michael Fried and Stephen Foster posited art criticism as a pivotal player in the

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95 Greenberg, "Avant Garde and Kitsch," 36.

96 Rosenberg, "The American Action Painters," 23.

97 The series—sometimes referred to as "X paints a painting"—ran from 1949-1966 with the majority of articles appearing in the 1950s. Abstract Expressionists featured in the series included Elaine de Kooning (December 1960), Willem de Kooning (March 1953), Adolph Gottlieb (March 1955), Hans Hofmann (February 1950), Franz Kline (December 1952), Jackson Pollock (May 1951), and Ad Reinhardt (March 1965).

98 See Yve-Alain Bois and Rosalind Krauss, *Formless: A User's Guide* (Cambridge, MA: MIT Press, 2000).

99 Sam Hunter, "Jackson Pollock," *The Bulletin of the Museum of Modern Art* 24(2) (1956-57): 12.

development of modern art. According to Foster, the critic "makes the first, and presumably freshest, response to the work of art, grasps it when it is still new and strange, and gives us a preliminary hold on its meaning. . . . Indeed, part of the critic's task is to win [modern art] a hearing at the court of history."[100] If this is true, it is Abstract Expressionism that is responsible for placing materials within the grasp of both the artists and critics that fashioned modern art history.

The Conservation Ramifications of Abstract Expressionist Materials

The study of Abstract Expressionist materials not only enhances our understanding of modern art but also assists in the preservation of its legacy. The work of Abstract Expressionist artists set as standard modernist practice a combination of experimental materials and technique, or according to former Mark Rothko Foundation conservator Dana Cranmer, "[the] unpredictable formulations of the . . . medium, and the unconventional techniques [of the artist]."[101] Mid-twentieth century painters were the first to use many new materials and techniques and condition problems endemic to subsequent contemporary art first appear in this earlier work. Caretakers of Abstract Expressionist paintings are faced with complex problems with failing or shifting paint components that appear directly related to the artists' embrace of new paint materials. Key works from this time period are fragile, susceptible to

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[100] Stephen C. Foster, *The Critics of Abstract Expressionism* (Ann Arbor, MI: UMI Research Press, 1980), ix. See also Michael Fried, "Modern Painting and Formal Criticism," *The American Scholar* 33 (Autumn 1964): 642-48.

[101] Dana Cranmer, "Painting Materials and Techniques of Mark Rothko: Consequences of an Unorthodox Approach," in *Mark Rothko: 1903-1970* (London: Tate Gallery, 1987), 196.

accelerated aging, and difficult to treat. "If one is conservator to a museum that . . . adds contemporary art to its permanent collection," said Margaret Watherston, former paintings conservator for the Whitney Museum of American Art, "one must be ready for the problems that are likely to occur with these acquisitions."[102] Tracking the appearance of new and modified paint materials in the work of Abstract Expressionist painters and understanding the artists' use of these materials adds much-needed documentation to the growing catalogue of twentieth-century art studies, assists scientific studies currently underway regarding the long-term behavior of these materials, and directly impacts the future conservation treatment of Abstract Expressionist and later works that incorporate unconventional materials into an otherwise traditional artist's palette. "If we fail to properly research our [modern] collections," warned Stedelijk Museum director Rudi Fuchs, "we neglect our cultural heritage."[103]

The Impact of Modern Paint Formulations

The Abstract Expressionists' embrace of modern paint materials complicates the long-term legacy of their work. Both research by conservator Harriet Standeven

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[102] Margaret Watherston, "Report on the Conservation of Recent Paintings: The Cleaning of Color Field Paintings," in *The Great Decade of American Abstraction: Modernist Art 1960-1970*, ed. E. A. Carmean, Jr. (Houston: Museum of Fine Arts, 1974), 119.

[103] Interview with Rudi Fuchs conducted on December 19, 1997 by NRC-Handelsblad, reprinted in Ysbrand Hummelen et al., "Towards a method for artists' interviews related to conservation problems of modern and contemporary art," in *Preprints of the 12th ICOM-Committee for Conservation triennial meeting in Lyon, 23 August – 3 September, 1999*, ed. Janet Bridgland (London: James & James, 1999), 312.

and Susan Lake, chief conservator and director of collections care at the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, document the progressive appearance in Abstract Expressionist paintings of new paint formulations developed during and following the world wars[104] and early advocates of the new paint materials approached this expanded palette with confidence. "Every artist wants his work, his creation, to have durability," noted Mexican muralist and Siqueiros colleague José Gutiérrez in the 1959 compilation of his North American workshops and lectures. "Oil painting must be handled carefully, as even a layman knows. . . . Quite the reverse is true of pictures made with the new materials, plastics. . . . I am confident that [they] will outlast any oil paint."[105] Yet despite their faith in industrial innovation, mid-twentieth century artists were experimenting with changeable materials, products in the early stages of commercial production, or designed for the transitory needs of a mass market. Zinc oxide house paints, for example, were a favorite choice for Abstract Expressionist ground layers[106] during a period of experimental zinc oxide formulation that produced stiff and brittle commercial paints ill-suited to supporting heavy

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[104] Harriet A. L. Standeven, "The Historical and Technical Development of Gloss House Paints, with Reference to their Use by Twentieth-Century Artists" (PhD diss., Royal College of Art, 2003), and Susan F. C. Lake, "The Relationship Between Style and Technical Procedure: Willem de Kooning's Paintings of the Late 1940s and 1960s," (PhD diss., University of Delaware, 1999), 388.

[105] José Gutiérrez, *From Fresco to Plastics* (Ottawa; National Gallery of Canada, 1959, rev.), 58-59.

[106] Dawn Rogala et al., "Condition Problems Related to Zinc Oxide Underlayers: Examination of Selected Abstract Expressionist Paintings from the Collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution," *Journal of the American Institute for Conservation* 49(2) (Fall/Winter 2010): 96-113.

Abstract Expressionist compositions.[107] "Many of the materials employed in the making of a contemporary painting are known to have been designed for a very limited useful life sufficient for a special need," cautioned conservator Louis Pomerantz at a 1962 Artists Equity meeting in Chicago, "not always for that of the artist, whose work is intended for greater permanence."[108] Other vagaries of early industrial paint formulation include such World War II-era substitutions as formaldehyde biocides and post-war surplus styrene-butadiene rubber plasticizers,[109] or shifts in formulation resulting from war-time innovation that include the change in Pollock's familiar "Duco" automotive paint from a cellulose nitrate base to the

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[107] See Rogala, "Condition Problems Related to Zinc Oxide Underlayers," and Christopher Maines et al., "Deterioration in Abstract Expressionist Paintings: Analysis of Zinc Oxide Paint Layers in Works from the collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution," in *Materials Issues in Art and Archaeology IX: Symposium held November 29-December 3, 2010, Boston, Massachusetts*, Materials Research Society Symposium Proceedings 1319, eds. Pamela B. Vandiver et al. (Pittsburgh, PA: Materials Research Society, 2011), 275-86. See also Gillian Osmond, "Zinc white: a review of zinc oxide pigment properties and implications for stability in oil-based paintings," in *Australian Institute for the Conservation of Cultural Material Bulletin* 33 (Canberra: AICCM, 2012), 20-29.

[108] Louis Pomerantz, *Is Your Contemporary Painting More Temporary than You Think?* (Chicago: Artist's Equity, 1962), 54.

[109] The period inclusion of oil-soluble additives and acrylic plasticizing agents including alkyd resins, nitrocellulose, and vinyl polymers must also be considered. See Dwight Weldon, *Failure Analysis of Paints and Coatings* (New York: John Wiley & Sons, Ltd., 2001), and Thomas J. S. Learner, *Analysis of Modern Paints* (Los Angeles: Getty Conservation Institute, 2004).

polyester-modified oil medium that was a specialty of the Delaware-based explosives-maker-turned-paint-maker E. I. du Pont de Nemours and Company.[110]

The mid-twentieth century introduction of acrylic paint binders created a new group of paintings with complex aging characteristics, and conservation efforts to preserve these works are hampered by a lack of information about the new material. "When looking up the details we had on [Newman's] *Cathedra*" following its vandalism in 1997, Fuchs recalled, "I found that the painting was made of oil paint and 'Magna.' No one in our museum knew exactly what Magna was."[111] Paintings made from solution acrylics—including the Magna paints used by such artists as Rothko and Louis[112]—are difficult to treat because they remain vulnerable throughout their lifetime to a wide range of solvents. Condition issues in paintings made with dispersion acrylics—solvent-containing polymers suspended in a water solution[113]—are equally difficult to address because this paint becomes less sensitive to solvents over time and requires more aggressive treatment methods that may be hazardous to

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110 Duco's commercial formulation was switched from a cellulose nitrate base to an alkyd base in the mid-1930s. See Harriet A. L. Standeven, "The Historical and Techical Development of Gloss House Paints," 9.

111 Rudi Fuchs, in "Towards a method for artists' interviews," 312.

112 Other mid-twentieth century painters known to have used Magna paints include Darby Bannard, Helen Frankenthaler, Philip Guston, Alex Katz, Alfred Leslie, Robert Motherwell, Barnett Newman, Raphael Soyer, Mel Stomas, and Roy Lichtenstein. See Robert G. Lodge, "A History of Synthetic Painting Media with Special Reference to Commercial Materials," in *American Institute for Conservation Preprints of the 16th Annual Meeting, held in New Orleans, Louisiana, June 1–5, 1988* (Washington, DC: American Institute for Conservation, 1988), 118-27.

113 Dispersion acrylics are often referred to by the generic term emulsion, which describes one liquid suspended within another.

other components of the painting.[114] Additionally, surfactants used to aid dispersion of the acrylic polymer in water leave a new acrylic dispersion paint film initially vulnerable to water-based treatments[115] but migrate to the surface of the paint film during drying, which can create cleavage between paint layers and soften the exposed paint surface on a paint layer now resistant to solvent cleaning yet vulnerable to changes in temperature.[116] A recent study by conservators and scientists at London's Tate Galleries concluded that "acrylic paint films [are] more vulnerable to surface damage [than traditional oil paintings] . . . dirt and dust remaining on the paint surface can even become embedded in the paint film . . . . Conversely, if the temperature drops . . . acrylic paint films will stiffen and harden considerably, making them far more liable to crack."[117] Acrylic paints were not immune to the formulation changes common to mid-twentieth century paint manufacture. Early formulations of acrylic paints utilized varying acrylate:methacrylate ratios unrelated to either solution or dispersion formulations, and such small-run manufacturers as New York's Samuel

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[114] Oscar Chiantore et al., "Ageing studies of acrylic emulsion paints. Part II. Comparing formulations with poly(EA-co-MMA) and poly(*n*-BA-co-MMA) binders," in *Preprints of the 14th ICOM-Committee for Conservation triennial meeting in The Hague, 12-16 September 2005*, Isabella Sourbès-Verger, ed. (London: James & James, 2005), 350.

[115] Elizabeth Jablonski et al., "Conservation Concerns for Acrylic Emulsion Paints: A Literature Review," *Reviews in Conservation* 4 (2003): 3-12.

[116] Shawn Digney-Peer et al., "The Migration of Surfactants in Acrylic Emulsion Paint Films," in *Modern Art, New Museums: Contributions to the 20th International Institute of Conservation Congress in Bilbao, 13-18 September 2004*, Ashok Roy and Perry Smith, eds. (London: International Institute for Conservation, 2004), 202-07.

[117] Bronwyn Ormsby et al., *Caring for Acrylics: Modern and Contemporary Paintings* (London: Tate and AXA Art Insurance, 2007), 11.

Golden and Leonard Bocour changed their Magna paint to match requests for different handling characteristics." Henry Levison of Cincinnati's Permanent Pigments, Inc. frequently used artists to test new formulations,[118] Bocour and Golden produced old-recipe or custom formulations for Morris Louis,[119] and Pollock is reported to have received custom batches of oil-based paint from DuPont.[120] Shifts in formulation can produce different aging behavior in period works by the same artist, or made with paints from the same manufacturer. "Knowledge regarding how well any of these modern paint media will withstand the passing of time remains extremely limited,"[121] notes Thomas J. S. Learner, Senior Scientist and Head of Contemporary Art Research at the Getty Conservation Institute.

The Impact of Artists' Modifications of Their Materials

Condition issues related to experimental paint formulations are compounded in Abstract Expressionist work by the artists' unconventional manipulation of their materials. The drying and aging characteristics of Abstract Expressionist paintings are

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[118] Janet Lee Ann Marontate, "Synthetic Media and Modern Painting: A Case Study in the Sociology of Innovation," (PhD diss., University of Montreal, 1996), 223.

[119] Glenn Gates et al., "What Makes the Color Field? A Technical Examination of Magna Paint," in *Modern Paints Uncovered*, *Proceedings from the Modern Paints Uncovered Symposium at the Tate Modern, London 16-19 May 2006,* Thomas J.S. Learner, ed. (Los Angeles: Getty Conservation Institute, 2007), 277.

[120] See Barbara Rose, "Jackson Pollock at Work: An Interview with Lee Krasner," *Partisan Review* 47(1) (Winter 1980): 82-92. DuPont is the common name for E. I. du Pont de Nemours and Company.

[121] Thomas J. S. Learner et al., "Modern Paints: A New Collaborative Research Project," *Getty Conservation Newsletter* 17(3) (Fall 2002): 18.

directly influenced by overly thick or thin paint layers, paints with purposefully altered pigment-binder ratios, and paints mixed with non-paint materials. Abstract Expressionist compositions that push the boundaries of paint application likewise test the physical limits of their material components, for example, in compositions constructed with heavily applied layers of paint. Pomerantz warned artists that the "piling up of cement-like loads of pigmented matter on flexible supports"[122] promoted widespread cracking and lifting of paint layers. The work of such Abstract Expressionists as Still and Hofmann regularly pushed the limits of canvas and ground layer supports by alternating open expanses of canvas with heavy paint layers in compositions described by Seitz as "run[ning] the gamut from the uncovered canvas to a reckless loading, which forms a veritable cliff of pigment."[123] Many of Hofmann's signature works are composed of multiple heavy paint layers, described as "sculptures-in-paint" by historian Frederick S. Wight. According to Wight, "[Hofmann] almost literally weights the surfaces and seems to be composing in depth by means of the differing specific gravities of the colors on his palette."[124] Research into the behavior of paintings that fail under their own weight is ongoing. Early explanations of lamellar paint and support behavior were provided by Marion Mecklenburg and Charles Tumosa from the Smithsonian Institution's Museum

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[122] Pomerantz, *Is Your Contemporary Painting More Temporary than You Think?,* 19.

[123] Seitz, "Abstract Expressionist Painting in America," 21.

[124] Frederick S. Wight, *Hans Hofmann* (Berkeley and Los Angeles: University of California Press, 1957), 44.

Conservation Institute,[125] and recent research has revealed additional susceptibility to paint layer failure in heavily painted works composed atop industrial priming materials,[126] or supported by incompatible modern paint media.[127]

On the opposite side of the paint application spectrum were Abstract Expressionists who achieved vibrant colors and subtle surfaces through extreme thinning of their paints. While modern paint manufacturers strove to avoid pigment-binder separation,[128] a new approach to color was achieved by Abstract Expressionist painters through direct manipulation of manufacturer formulations. According to reports by Greenberg and others, the artists' groundbreaking stain painting technique was achieved by "dilut[ing] paint to an extreme and soak[ing] it into unsized and unprimed canvas."[129] Cranmer noted how Rothko's use of solvent-thinned paint

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[125] Jonah D. Erlebacher, et al., "The Effects of Temperature and Relative Humidity on the Mechanical Properties of Modern Painting Materials," in *Materials Issues in Art and Archaeology III: Symposium held April 27-May 1, 1992, San Francisco, California*, Materials Research Society Symposium Proceedings 267, eds. Pamela B. Vandiver et al. (Pittsburgh, PA: Materials Research Society, 1992), 359-70.

[126] Rogala, "Condition Problems Related to Zinc Oxide Underlayers."

[127] Christina Young et al., "The Physical Properties of Modern Commercially Available Primings and Their Interaction with Subsequent Paint Layers," in *Modern Art, New Museums*, 244.

[128] Oral history interview with Mark Golden, conducted March 10, 2003 by Joyce Hill Stoner for the Foundation of the American Institute for Conservation, n.p.

[129] Clement Greenberg, "Post Painterly Abstraction," *Post Painterly Abstraction: An exhibition organized by the Los Angeles County Museum of Art and sponsored by the Contemporary Art Council* (Los Angeles: Los Angeles County Museum of Art, 1964), 14.

"ignored the limits of physical coherence to achieve a translucency"[130] unique to thin layers of underbound pigment, which allowed light "to penetrate directly, its passage unencumbered by medium, to strike the individual pigment particle and bounce back, affording the viewer a rare experience of clear, resonant color."[131] The resulting surfaces are brittle, easily abraded, and leave underbound pigments vulnerable to environmental exposure. Many of the "fulsome . . . reds, pinks, purples, oranges, lemons, [and] lime greens"[132] proclaimed by Clark as integral to Abstract Expressionist work were composed of light-sensitive pigments that have suffered widespread color shifting and fading from long-term exposure to ultraviolet radiation and atmospheric pollutants and shifted critical focus from the artists' original message. "Today we tend to remark [on the paintings'] chequered histories," historian David Anfam noted.[133] Thinned paints applied directly to unprimed canvas supports leached binder from already underbound paint layers and left raw canvas fibers vulnerable to abrasion and degradation from acidic paint materials and surface dirt. A 2002 survey by Lake and conservator Tatiana Ausema of Abstract Expressionist works on unprimed canvas from the collection of the Smithsonian Institution's Hirshhorn Museum and Sculpture Garden "revealed a variety of concerns, including general

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[130] Dana Cranmer, "Painting Materials and Techniques of Mark Rothko," 192.

[131] Dana Cranmer, "Ephemeral Paintings on 'Permanent View': The Accelerated Ageing of Mark Rothko's Paintings," in *Preprints from the 8th ICOM-Committee on Conservation Triennial Meeting in Sydney, Australia, 6-11 September 1987*, Kirsten Grimstad, ed. (London: James & James, 1987), 285.

[132] Clark, "In Defense of Abstract Expressionism," *Farewell to An Idea*, 387.

[133] In the case of Rothko's oeuvre, "notably the fugitive Lithol Red pigment now faded to blue at Harvard." David Anfam, *Abstract Expressionism,* 187.

weakening and darkening of the exposed canvas, brown 'ghosting' along the edges of unprimed canvas due to migrating acids from the stretcher, embedded surface dirt, dust and grime."[134]

The surface vulnerabilities of thinned paints films are also seen in works by Abstract Expressionists who encouraged pigment-binder separation in order to obtain heavily pigmented paint films. Solomon R. Guggenheim Museum chief conservator Carol Stringari noted that in Reinhardt's studio, paint cans "would be left undisturbed, allowing the pigments to settle to the bottom of the jar, leaving the oil/turpentine extract above the dense pigment phase. This oil would then be poured off, with only enough retained to allow the paint to be brushable."[135] This technique gave the artist's paintings "a beautiful . . . suede-like surface, similar in appearance to pastel,"[136] but like the underbound surfaces of work by colleagues Rothko and Frankenthaler, Reinhardt's delicately balanced surfaces are vulnerable to abrasion and easily absorb the oils and dirt in fingerprints and atmospheric pollutants. Reinhardt once noted, "the picture leaves the studio as a purist, abstract, non-objective work of art [but] returns as a record of everyday (*surrealist, expressionist*) experience ('chance' spots, defacements, hand-markings, accidents, 'happenings,' scratches)."[137] Cranmer and

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134 Tatiana Z. Ausema and Susan F. C. Lake, "Examination and Treatment of Color Field Paintings at the Hirshhorn Museum and Sculpture Garden," in *Modern Art, New Museums*, 216.

135 Carol Stringari et al., "Reversal Versus Retirement: Study and Treatment of *Black Painting, 1960-66* by Ad Reinhardt," in *Modern Art, New Museums*, 165.

136 Stringari, "Reversal Versus Retirement," 165.

137 Ad Reinhardt, in Lucy R. Lippard and Sam Hunter, *Ad Reinhardt: Paintings* (New York: The Jewish Museum, 1967), 22.

conservator Mary Gridley have noted "in many contemporary paintings featuring very smooth, flat, monochromatic surfaces, the presence of small [anomalies] creates a visual disruption out of proportion to the size of the damage."[138]

Some Abstract Expressionists added their own materials to commercial formulations. Jackson Pollock and Willem de Kooning, for example, added everything from studio trash to seawater to their compositions. "Less recognized is the extent to which [de Kooning] consciously employed unconventional materials in his paintings," Lake noted. "During the late 1940s and into the 1950s [he] used a range of house paints and sign painters' enamels along with artists' paints, often mixed with sand, charcoal, plaster of Paris, calcite, wax, and ground glass . . . . During [the 1960s and 1970s] he began making his own colors from artists' paints that he called 'mineral colors' . . . . sometimes mixed with large amounts of an organic pigment or dye . . . . then [he] added safflower oil, water, and a solvent, whipping the ingredients with a brush to a fluffy consistency."[139] Mark Rothko not only thinned solvent-sensitive

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[138] Mary H. Gridley and Dana Cranmer, "Unforgiving Surfaces: Treatment of Cracks in Contemporary Paintings," from *Modern Paints Uncovered*, 143. See also Carol Stringari et al., "Laser Cleaning of a Study Painting by Ad Reinhardt and the Analysis/Assessment of the Surface after Treatment," *Modern Paints Uncovered*, 208-216.

[139] Susan Lake et al., "A Technical Investigation of Willem de Kooning's paintings from the 1960s and 1970s," in *Preprints of the 12th ICOM-Committee for Conservation triennial meeting in Lyon,* 381-383. In reference to a 1972 catalogue essay by Thomas Hess in *Willem de Kooning: Drawings* (Greenwich, CT: New York Graphic Society, 1972), Susan Lake noted that "Reports that de Kooning's unusual medium included mayonnaise may be an extrapolation of the vivid descriptions of the artist's temporary emulsion as having the 'consistency of heavy sauces' and 'a good mayonnaise.'" No evidence of egg protein has been found in Lake's analysis of de Kooning's paint. Lake et al., "A Technical Investigation of Willem de Kooning's paintings," 383.

paints with water and turpentine, but also experimented with a home-made egg-oil emulsion that conservator Carol Mancusi-Ungaro reported as "consist[ing] of unmeasured amounts of the tube oil paint, whole beaten eggs, turpentine and dammar resin."[140] Rothko's experimental components migrated out of his mixtures as the paints aged and settled as crystalline deposits on the surface of his works, defacing many of Rothko's signature works within a decade of their completion. According to historian Briony Fer, the Rothko murals originally intended for the Park Avenue building of beverage company John Seagram and Sons began deteriorating while the artist was still negotiating their sale. "In *Red and Maroon*," Fer noted, "gray was applied lightly with a dry brush, [but] today looks like a bloom [mold] on a plum."[141] The conservation of paintings by Abstract Expressionists Reinhardt and Rothko are complicated by the same modified formulations and surface finishes that leave the works most vulnerable to damage. Conservators of modern paintings at Amsterdam's Stedelijk Museum have noted that preservation of many Abstract Expressionist surfaces is particularly complicated, as "Even the smallest damage is immediately obvious."[142]

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[140] Carol Mancusi-Ungaro, "The Rothko Chapel: Treatment of the Black-Form Triptychs," in *Cleaning, Retouching and Coatings: Technology and Practice for Easel Paintings and Polychrome Sculpture. Preprints of the Contributions to the International Institute of Conservation Congress in Brussels 3-7 September 1990*, eds. John S. Mils and Perry Smith (London: IIC, 1990), 135.

[141] Briony Fer, "Rothko and Repetition," 169.

[142] Elisabeth Bracht et al., "Barnett Newman's *Cathedra* (1951): The Restoration of Slash Damages in a Colourfield Painting," in *Alternatives to Lining: The structural treatment of paintings on canvas without lining*, eds. Mary Bustin and Tom Caley (London: United Kingdom Institute for Conservation, 2003), 21.

Hans Hofmann as an Exemplar of Abstract Expressionist Practice

> What you're going to hear tonight is a defense of Abstract Expressionism, [and] if there is to be a defense of Abstract Expressionism at all . . . it will have to be cast as a defense of Hofmann in particular. —T. J. Clark, typescript, 1992 lecture preceding the 1994 essay "In Defense of Abstract Expressionism"[143]

> You cannot help it. You belong to a certain time. You are yourself the result of this time. You are also the creator of this time.
> —Hans Hofmann, 1966[144]

Hans Hofmann was an influential artist and teacher positioned at the center of the Abstract Expressionist community at a pivotal time in modern art. Hofmann's authority with practitioners and critics alike positioned his schools as one of the primary destinations for advanced arts practice and theory in the United States and made Hofmann simultaneously the influencer and the benefactor of the leading edge of modern art practice. Hofmann produced late-career work of vitality and critical acclaim in an atmosphere of unparalleled access to experimental painting theory and technique. The study of Hofmann's work provides insight into not only the style but also the literal substance of this formative period of artistic and material innovation.

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[143] T. J. Clark, transcript of his October 15, 1992 lecture to celebrate the reinstallation of the Hofmann paintings at the Berkeley Art Museum and Pacific Film Archive, museum education department files, n.p. This lecture is the starting point for Clark's essay "In Defense of Abstract Expressionism," published in *October* 69 (Summer 1994) and in a revised format in *Farewell to An Idea: Episodes from a History of Modernism* (New Haven and London: Yale University Press, 1999).

[144] Hans Hofmann, in Irma Jaffe, "A Conversation with Hans Hofmann," *ARTFORUM* 9(5) (January 1971): 37.

"Hofmann's art," Hunter said, "is surely one of the remarkable examples in the century of modern artistic style of consciousness reporting objectively on itself."[145]

Hofmann's Position within the Abstract Expressionist Community

Hofmann provided a vital link in the continuum between nineteenth- and twentieth-century arts practice. He lived from 1880 to 1966 and painted and taught in Europe and the United States. He studied in Munich and Paris during formative moments in those cities' modernist movements and shared this first-hand knowledge with American colleagues and students at the center of the innovative painting practices that changed the course of modern art. Hofmann was a living thread running through nineteenth- and twentieth-century modernism whose signature late-career paintings tie together the efforts of his colleagues, progenitors, and descendants—"which is to say," according to artist Frank Stella, "all of the twentieth century."[146]

Hofmann played a pivotal role in the creation of America's modernist community. Like many of his Abstract Expressionist colleagues, Hofmann was part of what historian Colin Eisler called the twentieth-century's "intellectual migration": the influx of émigré artists and scholars whose flight from Europe to the United States in the years preceding the Second World War permanently raised the cultural profile of America in general and New York City in particular.[147] Hofmann was older than

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[145] Sam Hunter, "Hans Hofmann," in *Hans Hofmann: Revised and Expanded*, ed. James Yohe (New York: Rizzoli, 2002), 31.

[146] Frank Stella, "The Artist of the Century." *American Heritage* 50(7) (November 1999): 16.

[147] See Eisler, "*Kunstgeschichte* American Style: A Study in Migration."

many of the Abstract Expressionists—he was already an established artist and teacher when he moved to the United States at age 42—and those years in Europe provided him with an exposure to European modernism that went far beyond that of his American colleagues. "As time passes," reflected Barbara Rose, "the seminal role of Hans Hofmann in the development of Abstract Expressionism as an international style that fused elements derived from the major European modern movements becomes increasingly clear."[148] Hofmann spent his early years surrounded by the experimental arts scene of late nineteenth-century Munich, followed by a decade in Paris among the principle American and European modernist painters in the years just prior to World War I. It was Hofmann's reputation as a direct link to the seminal theories and practices of European modernism that brought American students to his European school and later prompted those students to facilitate his move to the United States in advance of the war. "As a German linked with Kandinsky, and committed to French aesthetics as early as Fauvism," recalled critic Max Kozloff, "Hofmann was like a walking compendium of modern art."[149] Hofmann's life-long grounding in modernist methodology mobilized a generation of young avant-garde artists and positioned him at the center of America's emerging modern arts scene. "Through him more than any other one individual," read Rosenberg at Hofmann's funeral, "[this] was also a communion of artists."[150] Through his own efforts and those of his students positioned

[148] Barbara Rose, "Hans Hofmann: From Expression to Abstraction," *Arts Magazine* 53(3) (November 1978): 110.

[149] Max Kozloff, "The Critical Reception of Abstract-Expressionism," *Arts Magazine* 40(2) (December 1965): 30.

[150] Harold Rosenberg, from eulogy delivered at Hofmann's funeral on February 20, 1966. Reprinted as "Hans Hofmann, 1880-1966," *Art News* 65(2) (April 1966): 21.

at the forefront of art movements and institutions throughout the United States, Hofmann became simultaneously the influencer and the benefactor of the leading edge of American modern art. "[Hofmann] was," according to former Hofmann student Frankenthaler, "a strong influence on the New York School and in turn was influenced by it."[151]

Hofmann was situated at the center of Abstract Expressionist activity. During the 1940s and 50s his painting studio was located the midst of the Eighth Street neighborhood, nearby fellow artists Kline[152] and Reinhardt[153] and modern art critics Rosenberg and Ashton,[154] close to his own school as well as to The Subjects of the Artist school and The Club.[155] Hofmann's studio from 1941 through 1945 was located at 44 East Eighth Street, adjacent (although located in the building next door) to that

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[151] Helen Frankenthaler, "Thoughts about Hans," in *Hans Hofmann: A Retrospective*, ed. Karen Wilkin (Naples, FL: Naples Museum of Art in association with George Braziller, 2003), 47.

[152] 473 6th avenue, 1944-57

[153] 732 Broadway, between Waverly Place and 8th street

[154] Ashton and Rosenberg lived in the 10th street neighborhood

[155] Hofmann's first New York City studio was located at 177 West Fourth Street. In 1940, Hofmann moved his studio to 59 East 9th Street and in 1941 moved again to 444 East 8th Street. From 1945 to 1956, Hofmann's studio was located at 53 East 9th Street, and included a semi-private bath he shared with his student Robert de Niro, Sr. (Hofmann is godfather to the actor Robert de Niro, Jr.). In 1959 Hofmann moved his studio into the space at 52 West Eighth Street previously occupied by the Hans Hofmann School of Fine Arts. Information compiled from Tina Dickey, *Color Creates Light: Studies with Hans Hofmann* (Salt Spring Island, BC: Trillistar Books, 2011), 163, 171, 184, 240.

of his student Krasner and her partner Pollock,[156] through whom Hofmann met younger artists including Motherwell:

> Pollock was living with Lee Krasner, who was a pupil and admirer of Hofmann, who lived only a few doors from them. I think it was at Lee's behest that Pollock took me over after dinner to see Hofmann. It was the first time I had met him, and I at once realized that my being 26 years old – Hofmann was already in his 60's – it would be impertinent for a young apprentice artist to tell him about what painting was. As it turned out, Pollock got drunk on a big jug of red wine, and we all had to carry him down four flights into the street and then up four flights to his place. It was a helluva job.[157]

Hofmann was an active participant in the modernist cause. He was part of the renowned "Artists' Sessions at Studio 35," a closed-door meeting of artists and critics centered around discussions of Abstract Expressionist work and community, and one of the so-called "Irascibles," a group of 18 painters and 10 sculptors who penned an infamous public letter to Metropolitan Museum of Art president Roland L. Redmond protesting the museum's "hostility to advanced art."[158] Hofmann was an early member of the Betty Parsons Gallery, and later part of the stable of artists promoted by Picasso

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[156] 46 East 8th street, 1935-46

[157] Sidney Simon, "Concerning the Beginnings of The New York School: 1939-1943 (Interviews with Busa, Matta and Motherwell, conducted by Sidney Simon)," *Art International* 11(6) (Summer 1967): 22.

[158] The open letter was published on May 22, 1950 in the *New York Times* under the heading"18 Painters Boycott Metropolitan; Charge 'Hostility to Advanced Art'." The painters who signed the letter were: Jimmy Ernst, Adolph Gottlieb, Robert Motherwell, William Baziotes, Hans Hofmann, Barnett Newman, Clyfford Still, Richard Pousette-Dart, Theodoros Stamos, Ad Reinhardt, Jackson Pollock, Mark Rothko, Bradley Walker Tomlin, Willem de Kooning, Hedda Sterne, James Brooks, Weldon Kees and Fritz Bultman. Sculptors who signed the letter were Herbert Ferber, David Smith, Ibram Lassaw, Mary Callery, Day Schnabel, Seymour Lipton, Peter Grippe, Theodore Roszak, David Hare and Louise Bourgeois.

representative Samuel M. Kootz.[159] Hofmann's first solo painting exhibition took place in March 1944 at Peggy Guggenheim's The Art of This Century Gallery, one of the early exhibitions that Greenberg later said had signaled the future of "American-type painting."[160] Hofmann's work was included in Sidney Janis's 1944 touring show "Abstract and Surrealist Art in America"[161] and Howard Putzel's showcase that same year of emerging and early American modernist painting entitled "Forty American Moderns."[162] Hofmann's work was also featured in Howard Putzel's 1945 proto-Abstract Expressionist exhibition "A Problem for Critics"[163] and a similar 1947 showcase curated by Barnett Newman at the Betty Parsons Gallery entitled "The Ideographic Picture," exhibitions notable for their focus on the new direction of

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159 "I have had a very bad shock to find that I could no longer hold Hans Hofmann," Parsons wrote to collector Wright Ludington. "Sam Kootz, the crocodile, has gobbled him." Betty Parsons to Wright Ludington, March 10, 1947. Betty Parsons Gallery records and personal papers, circa 1920-1991, bulk 1946-1983. Archives of American Art, Smithsonian Institution. See also Marcia Bystryn, "Art Galleries as Gatekeepers: The Case of the Abstract Expressionists," *Social Research* 45(2) (Summer 1978): 390-408.

160 March 7-31, 1944. Greenberg cites the gallery's 1943-46 solo shows of works by Pollock, Hofmann, Baziotes, Motherwell, Rothko, and Still in "American-Type Painting," *Partisan Review* 12(2) (Spring 1955): 179-96.

161 Opening exhibition from November 29–December 30, 1944 at the Mortimer Brandt Gallery. Hofmann was also included in Janis's earlier touring version of the exhibition, entitled "Abstract and Surrealist Art in the United States."

162 December 1944. Also exhibited: Milton Avery, Stuart Davis, Adolph Gottlieb, Morris Graves, Robert Motherwell, Jackson Pollock, Richard Pousette-Dart, Mark Rothko, and Mark Tobey.

163 May 14-July 7, 1945. Also exhibited: Hans Arp, Arshille Gorky, Adolph Gottlieb, Lee Krasner, André Masson, Matta, Miró, Picasso, Jackson Pollock, Richard Pousette-Dart, Mark Rothko, Charles Seliger, and Rufino Tamayo.

modern art. “Spontaneous and emerging from several points, there has arisen during the war years a new force in American painting,” proclaimed Newman in the exhibition announcement. “It is now time for the artist himself . . . to make clear the community of intent that motivates him and his colleagues.”[164]

Hofmann’s first American paintings are a reflection of popular Abstract Expressionist experimentation. Following years dedicated to establishing his schools, Hofmann’s return to painting and his exploration of evolving Abstract Expressionist technique coincided with what Greenberg saw as a universal impetus in modern American art. “It was as if a new current of critical as well as creative activity had emerged” said Greenberg, “almost suddenly, to raise the collective level of our advanced art to a point of awareness and performance beyond anything it [had] known before.”[165] Hofmann’s shifts in style during the 1940s mirrored prevailing trends in technique and composition, lessons Hofmann used to build a personal and contemporary vocabulary. “I can’t overemphasize this as an element in his character,” recalled former student and University of California, Berkeley fine arts faculty member Glenn Wessels, “[Hofmann] was a researcher; he was trying new things, he wanted to see if they would work.”[166] Hofmann’s paintings were also material

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[164] Barnett Newman, *The Ideographic Picture* exhibition announcement (New York: Betty Parsons Gallery, 1947), n.p. Exhibition ran January 20-February 8, 1947. Also exhibited: Barnett Newman, Ad Reinhardt, Mark Rothko, Theodoros Stamos, Hedda Stern, and Clyfford Still.

[165] Clement Greenberg, “Art [a review of the 1947-48 gallery season],” *The Nation* 168(24) (June 11, 1949): 669.

[166] Oral history interview with Glenn Wessels, conducted in 1967 by Suzanne B. Riess for the University of California Berkeley Regional Oral History Office and compiled under the title “Education of an Artist,” 129.

constructions that symbolized the changing relationship between artists and art practice. "Hofmann's powerful handling . . . called attention to the physical nature of the paint matter," recalled Hunter, "and thus propelled it forward."[167] Greenberg attended Hofmann's public lectures in the winter of 1938/39 and shortly thereafter proposed a direct relationship between modern artists and their materials in his first article, "Avant-Garde and Kitsch." "I owe this formulation to a remark made by Hans Hofmann . . . in one of his lectures," noted Greenberg.[168] Hofmann's lectures on the material nature of painting played a pivotal role in the work of such critics as Rosenberg and Greenberg, whose focus on art materials and art practice changed the trajectory of modern art criticism, as discussed above. "Hofmann has not yet published his views [on modern art]," Greenberg would later comment, "but they have already directly and indirectly influenced many, including this writer—who owes more to the initial illumination received from Hofmann's lectures than to any other source."[169] The relationship between artist and material was also fundamental to the theories of Greenberg's ideological opponent Harold Rosenberg, who placed Hofmann among the first of his "action" painters.[170] Hofmann's popular late-career works—most produced

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[167] Hunter, "Hans Hofmann," 30.

[168] Greenberg, "Avant Garde and Kitsch," 36.

[169] Clement Greenberg, "Art: Review of an Exhibition of Hans Hofmann and a Reconsideration of Mondrian's Theories," *The Nation* 160(16) (April 21, 1945): 469.

[170] Rosenberg's article "The American Action Painters" initially named several early "action" painters that were removed when the article was published for a foreign audience. "I was going to put some names in . . . like Pollock, Hofmann, and de Kooning, but then I didn't want to put in too many names because it would confuse the issue. . . . So I took all names out." Oral history interview with Harold Rosenberg,

well after his seventieth birthday—are pulsing networks of color that at once recall and transcend his influences, physical plays on paint and light that are simultaneously referential and singular. "Whether Hofmann splashes paint onto the canvas, or brushes it in heavy impasto," proclaimed Peter Selz, former Museum of Modern Art curator and founding director of the University Art Museum at the University of California, Berkeley, "he turns the surface into a seemingly living witness to his manipulation of paint."[171] Hofmann's overt partnership with his medium is ultimately Abstract Expressionist. "The moment it leaves [Hofmann's] hand," noted *New York Times* critic Brian O'Doherty, "the paint is alive and kicking."[172]

Hofmann produced his most recognizable work in the decade preceding his death at age 86.[173] "Hofmann's optimism bursts through like the sun," proclaimed Kootz. "You cannot view this man's painting without recognition of his exuberance in living."[174] In 1963 Hofmann donated forty-seven of his paintings, along with a quarter

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conducted on April 7, 1972 with Paul Cummings for the Archives of American Art, Smithsonian Institution, n.p.

[171] Peter Selz, "Hans Hofmann: Selections from the Artist's Gift to the University," *American Art Review* 5(2) (Winter 1993): 130.

[172] Brian O'Doherty, "Hans Hofmann: A Style of Old Age. Museum Holds Ten Year Retrospective of Veteran's Work," *New York Times*, (September 15, 1963): 149.

[173] Hofmann died on the afternoon of February 17, 1966; Hofmann's second wife Renate marked the hours between 5:00 and 6:30pm with a heart and a cross in Hofmann's datebook. Hans Hofmann papers, [ca. 1904]-1978, (bulk 1945-1965), Archives of American Art, Smithsonian Institution.

[174] Samuel Kootz, "The Credibility of Color. Hans Hofmann: An Area of Optimism," *Arts Magazine*, 41(4) (February 1967): 37. Hofmann himself proclaimed: "I can't understand how anyone is able to paint without optimism." In Katherine Kuh, *The Artist's Voice: Talks with Seventeen Modern Artists*, (Cambridge, MA: De Capo Press, 2000; orig. pub. by Harper & Row, 1962), 119.

of a million dollars, to the University of California at Berkeley in recognition of the university's role in helping Hofmann build a new life in the United States. Paintings were chosen for the collection by Hofmann's gallery representative Samuel M. Kootz and University of California Berkeley fine arts faculty member and former Hofmann student Erle Loran, in consultation with Hofmann and with the assistance of curator William C. Seitz who worked to help select paintings from Hofmann's retrospective show then on exhibit at the Museum of Modern Art. The Berkeley Art Museum's comprehensive collection includes important examples of Hofmann's early work as well as a large selection of the artist's late-flowering signature style as examples of what University of California Berkeley fine arts faculty and former Hofmann student Erle Loren called Hofmann's "brilliant present and promising future."[175] "Creation without Hofmann, if it is to go on," posited Rosenberg at Hofmann's funeral, "will require greater effort." [176]

The Influence of Hofmann's Schools and Teaching

The arts community that grew around Hofmann's American schools placed him at the center of contemporary art theory and practice. Hofmann taught continuously from 1915 to 1958 but is best known as the teacher who energized American artists in the 1940s and 1950s with lectures and theories that drew on his first-hand experience with European modernism. "[Hofmann] interpreted the ideas of

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[175] Erle Loren, from a draft of Loren's June 8, 1965 letter to Kootz regarding the selection of paintings for the university's collection. Berkeley Art Museum and Pacific Film Archive curatorial files, folder marked "Agreement," n.p.

[176] Rosenberg, "Hans Hofmann, 1880-1966," 21.

Fauvism and Cubism, as well as those of German Expressionism and Surrealism, in terms of . . . the radical post-World War II approach to painting," claimed Sandler. "In fact, Hofmann was in large measure its originator."[177] Hofmann's schools in New York and Provincetown drew artists and critics from around the country to study with the renowned teacher and learn his method of adjacent color and form placement to achieve the appearance of dimensionality, a methodology better known as "push and pull." Hofmann quickly became the "foremost figure in the education of modern artists in America," noted Seitz, and Hofmann's schools emerged as "primary centers for the study of modern painting."[178]

> I was walking on Eighth Street and along came one of the people from the [Art Students League] class who said 'The greatest art teacher in the world is coming." . . . You can be sure the first day that Hans Hofmann appeared . . . I was there together with sixty other people.
> — Lillian Olinsey Kiesler, Hofmann student, 1932-47[179]

Hofmann's New York school was "by all accounts a magnet that drew visitors constantly" according to Ashton.[180] Friday evening critiques at the school—situated between The Club and the Cedar Street Tavern—were a popular destination for artists and critics. "Many of the evening sessions during which Hofmann offered impromptu

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177 Irving Sandler, "In the Art Galleries," *New York Post Magazine*, September 15, 1963, 14.

178 Seitz, "Abstract Expressionist Painting in America," 12.

179 Lillian Kiesler, transcript from "Hans Hofmann: Students Talk about Hofmann as Teacher," a panel discussion held on March 17, 1978 as part of the Artists Talk on Art Series, n.p. Panelists included Kiesler, Fritz Bultman (moderator), Nell Blaine, Jim Gahagan, Cynthia Goodman, George McNeill, and Selina Trieff.

180 Ashton, *The New York School,* 79.

lectures," recalled Ashton, "were attended by the artists in the neighborhood who would then move on to the local cafeteria to continue the discussion."[181] The downtown location of Hofmann's school were also nearby the progressive collections of A.E. Gallatin and the contemporary American art exhibitions of the Whitney Studio/Whitney Museum of American Art,[182] and the school's convenient location brought frequent visitors that kept Hofmann and his students abreast of current trends and community interests. "Around the corner was Hans Hofmann's school," recalled sculptor Philip Pavia. "Everybody went to his school and picked up the language of Hofmann. With that started this nucleus."[183] In 1935, Hofmann opened his Provincetown location in the former Cape Cod studios of painter Charles Hawthorne (1872-1930) and fashioned a summer arts center that educated "not only a generation of artists," according to *New York Times* critic Hilton Kramer, "but also a number of critics, museum directors, and collectors too. His school was a cultural force."[184] "Mr. Hofmann was, in effect," said Kramer, "one of the forces that completed America's

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[181] Ashton, *The New York School*, 79.

[182] A. E. Gallatin's Gallery of Living Art was originally located in a New York University study hall adjacent to Washington Square Park. The Gallery was renamed the Museum of Living Art in 1936. The Whitney Studio was located at 8 West Eighth Street. Renamed the Whitney Museum of American Art in 1931; moved to West 54th Street in 1954 and then to 945 Madison Avenue in 1966. The Eighth Street building became the home of the New York Studio School of Drawing, Painting, and Sculpture, founded by Hofmann student Mercedes Matter.

[183] Phillip Pavia, in *Painters Painting,* 39.

[184] Hilton Kramer, "Symbol of Change: Hofmann, Teacher, Theorist and Artist, Codified and Passed on Modern Legacy," *The New York Times,* February 18, 1966, 33.

education in modern art."[185] Capacity audiences at Hofmann's lectures and public critiques spilled into the street and drew regular crowds of onlookers[186] and his students reported that when Hofmann participated in the opening panel for the summer-long exhibition and seminar series *Forum 49*—entitled "What Is an Artist?"—500 people were turned away for lack of space.[187]

> I stopped off in . . . Albuquerque to visit a couple of friends in the spring and they en masse were loading themselves into two automobiles to come back into Provincetown and study with this man, Hans Hofmann. . . . I jumped in the car with them and came right back again. —James Gahagan, Hofmann student, 1952-58[188]

Unofficial tallies of school rosters number Hofmann alumni in the thousands. Hofmann's former students include more than half of the founding members of the American Abstract Artists group[189] including Josef Albers,[190] Ray Eames, and New

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[185] Kramer, "Symbol of Change," 33.

[186] James Gahagan, interviewed on March 30-31, 1991 by Tina Dickey. Cited in Tina Dickey, *Color Creates Light,* 307. Also Cynthia Goodman, *Hans Hofmann* (New York: Abbeville Press, 1986), 57.

[187] Dorothy G. Seckler, *Provincetown Painters: 1890s-1970s* (Syracuse, NY: Everson Museum of Art, 1977), 64-65.

[188] James Gahagan, "Hans Hofmann: Students Talk about Hofmann as Teacher."

[189] Hofmann students who were founding members of the American Abstract Artists: Josef Albers, Rosalind Bengelsdorf, Ilya Bolotowsky, Harry Bowden, Burgoyne Diller, Ray Kaiser Eames, Carl Holty, Harry Holtzman, Leo Lances, Mercedes Carles Matter, George McNeil, , Albert Swinden, Vaclav Vytlacil, and Wilfred Zogbaum (registered for classes between 1915-33); Byron Browne, George Cavallon, John Opper, and Esphyr Slobodkina (1933-45); and Agnes Lyall and Carl Holty (1945-onward). Hans Hofmann student registries 1918-1958; compiled by Tina Dickey for the Renate, Hans, and Maria Hofmann Trust, 1991-2000. Archives of American Art, Smithsonian Institution. Although Hofmann was not a member of the American Abstract Artists, he was invited to address the organization, most notably on February

York Studio School founder Mercedes Matter. “Half of the avant-garde in the 1930s was enrolled in [Hofmann’s] classes,” noted Sandler.[191] Students at the Hofmann school were also founding members of the Flatiron district and Tenth Street cooperative galleries[192] that promoted the emerging Pop and environmental art movements. Former Hofmann students include artists of note in a wide range of experimental media, including installation art pioneer Red Grooms, Happenings creator Allan Kaprow, and minimalist Daniel Flavin. “If a teacher’s stature is measured by the number of students who achieve national and international renown in their own right,” proclaimed Sandler, “then that of Hofmann is without equal.”[193]

16, 1941 at a symposium on abstract art held during the American Abstract Artists’ Fifth Annual Exhibition presented at the Riverside Museum, New York City. See Richard W. Lizza, *The American Abstract Artists: Thirties’ Geometric Abstraction as Precursor to Forties’ Expressive Abstraction* (Ann Arbor, Michigan: University Microfilms International, 1986).

[190] "I studied painting technique with Max Doerner [in the] Munich Academy. . . . And then I also went to the Hofmann School in the evenings - Hans Hofmann. He was there too." Interview with Josef Albers conducted on June 22, 1968 by Sevim Fesci for the Archives of American Art, Smithsonian Institution, n.p.

[191] Irving Sandler, *Abstract Expressionism and the American Experience: A Reevaluation* (New York: Hudson Hill Press, 2009), 56.

[192] Hofmann students who were founding members of the Tenth Street cooperative galleries: Margaret Bartlett, , James Billmyer, William Freed (registered for classes between 1933-45); Cecily Barth, Robert Beauchamp, Jacques Beckwith, James Billmyer, Nieves Billmyer, Barbara Forst, Miles Forst, James Gahagan, , Charles (Red) Grooms, Tom Hannan, Myrna Harrison, Robert Henry, , Wolf Kahn, Allan Kaprow, John Kazann, John Krushenick, Nicholas Krushenick, Charles Littler, , Marcia Marcus, Alvin Most, Haynes Ownby, Patricia Passlof, Don David, Peter Stander, Richard Stankiewicz (1945 onward). Hans Hofmann student registries 1918-1958, *op.cit*.

[193] Irving Sandler, “Hans Hofmann: The Pedagogical Master,” *Art in America* 61(3) (May-June 1973): 49.

Hofmann directly influenced thousands of students and indirectly affected countless others through the teachings of former students at the forefront of art movements and institutions throughout the United States. "[Hofmann] influenced the curriculum [of] generations of students," said land artist Walter De Maria. "He taught all the teachers . . . . [who then] could go out and teach it to a thousand other people."[194] Generations of influential modernists were trained by Hofmann students. "I was a Hofmann student without knowing I was one," recalled Stella, who studied at Princeton University under the mentorship of Hofmann scholar Seitz.[195] At the age of 78 and after 43 consecutive years of teaching, Hofmann closed his schools and began to paint full-time, but the ties that bound Hofmann to the course of modern art remained intact. "We can derive novel conclusions," Rosenberg posited shortly before Hofmann retired, "from reflections of [Hofmann] sent back to him by artists whose inventions have been in debt to his techniques."[196] The technical study of Abstract Expressionist materials can do no better than to look to Hofmann for access to the *zeitgeist* of this period in modern American painting.

In this first chapter I provided a brief overview of Abstract Expressionism and the role of new materials in the creation, interpretation, and preservation of Abstract Expressionist painting, and explained my selection of Hofmann as an exemplar for

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[194] Oral history interview of Walter De Maria conducted on October 4, 1972 by Paul Cummings for the Archives of American Art, Smithsonian Institution, n.p.

[195] Interview with Frank Stella conducted on January 6, 2000 by Madeline Amgott for the documentary *Hans Hofmann: Artist/Teacher, Teacher/Artist* (New York: Amgott Productions, 2002), n.p.

[196] Harold Rosenberg, "Hans Hofmann: Nature into Action," *Art News* 56(3) (May 1957): 56.

Abstract Expressionist practice and influence. In Chapter Two I will review Hofmann's position within the avant-garde communities of early twentieth-century Europe and the United States and his related exposure to new ideas about art making and art materials. I will discuss Hofmann's schools as a nexus for information regarding modern arts practice and the role of Hofmann's students in the ongoing dialogue between artists and art materials.

Chapter 2

HOFMANN'S EXPOSURE TO MODERN PAINTING AND PAINT MATERIALS

> Every intelligent painter carries the whole culture of modern painting in his head. It is his real subject, of which anything he paints is both a[n] homage and a critique.
> —Robert Motherwell, *The School of New York*, 1951[1]

> A painting . . . is an act inseparable from the biography of the artist. The painting is a "moment" in the adulterated mixture of his life.
> —Harold Rosenberg, "The American Action Painters," 1952[2]

Hofmann's life is simultaneously a reflection and a foretelling of the modernist community's role in the course of art history. Hofmann's formative years in the burgeoning avant-garde scenes of Europe brought him into contact with ground-breaking advances in modern art and science and gave rise to his life-long support of emerging artists and the community environs that facilitated their exposure to innovations in art-making materials, techniques, and theory. Hofmann's schools in Germany and the United States functioned as community centers for like-minded artists and provided students and teacher with ongoing exposure to the leading edge of art innovation. Rosenberg stated that any study of the arts "must maintain a continuing

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[1] Robert Motherwell, *The School of New York* (Beverly Hills, CA: Frank Perls Gallery, 1951), n.p.

[2] Harold Rosenberg, "The American Action Painters," *Art News* 51(8) (December 1952): 22-23.

sensitivity to major characteristics peculiar to the modern epoch that affect the situation of art."[3] A primary characteristic of mid-twentieth century art is the evolving relationship between artist and material, and any thorough investigation of Hofmann's paintings must consider his exposure to new materials and the avenues of informational transfer regarding those materials. "It's not merely what you show," recalled Hofmann shortly before his death, "It's the process which is inherited in the created work that makes it a work of art."[4] The receptiveness to aesthetic and technical innovation that solidified Hofmann's reputation as "the dean of the abstract-expressionist movement"[5] was grounded in the artist's formative years in the avant-garde communities of Munich, Paris, and New York.

In Chapter One I provided a brief overview of Abstract Expressionism and the role of new materials in Abstract Expressionist painting, and explained my selection of Hofmann as an exemplar for Abstract Expressionist practice and influence. In this chapter I will review Hofmann's relationship with the avant-garde communities of early twentieth-century Europe and the United States and through them, his exposure to new ideas about art making and concomitant industrial innovation in art materials. I will also discuss Hofmann's schools as a nexus for the full range of modern arts

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[3] Harold Rosenberg, "Criticism and Its Premises," part of a 1966 seminar at Pennsylvania State University entitled *A Seminar in Art Education for Research and Curriculum Development*. Reprinted in Rosenberg, *Art on the Edge* (New York: Macmillan, 1975), 135.

[4] Irma Jaffe, "A Conversation with Hans Hofmann," *ARTFORUM* 9(5) (January 1971): 35.

[5] Museum of Modern Art, *1963-65 Biennial Report* (New York: Museum of Modern Art, 1965), 6. Also "The Age of Experiment," *Time Magazine* 67(7) (February 13, 1956): 64.

practice and the role of Hofmann's students in the ongoing dialogue between artists and art materials manufacturers.

Hofmann's Years in Europe (1880-1931)

Hofmann's Early Years in Germany (1880-1904)

Hofmann's Exposure to Avant-garde Art and Aesthetics

Hofmann was positioned at the right historical place and time to become a modern painter. Johann (Hans) Georg Albert Hofmann was born on March 21, 1880, the second of five children born to Franziska Manger and Theodor Hofmann in the Bavarian town of Weissenburg, where Hofmann's father worked as a city clerk. After a brief move to Forchheim in 1883, the family settled in Munich in 1886 when Hofmann's father took a position as a district clerk with the Bavarian Ministry of the Interior. Information about Hofmann's artistic beginnings is complicated by anecdotal recollection and Hofmann's flair for self-promotion, but one oft-repeated story indicates that at the age of sixteen Hofmann received a thousand-mark gift from his father to pursue his engineering interests[6] and instead used that money to enroll in art classes in Munich's Schwabing arts district, the center of the German avant-garde.

Many formative influences on the aesthetic and compositional philosophies of Hofmann and his Abstract Expressionist colleagues can be traced to turn-of-the-century Munich, which—along with Paris—was one of the most important modernist centers before World War I. Despite growing pressure from conservatives to suppress

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[6] Tina Dickey, *Color Creates Light: Studies with Hans Hofmann* (Victoria, British Columbia: Trillistar Books, 2011), 35. No records have been found of patents related to these inventions.

the promotion of nontraditional art they considered “decadent,”[7] the Munich of Hofmann’s youth was at the forefront of modern aesthetics—a city with “an artistic life of extraordinary activity and variety” according to Selz, whose dissertation provides an in-person account of the period.[8] In the final years of the nineteenth century, Universität München professor Theodor Lipps lectured on the relationship between artist and subject while Heinrich Wölfflin completed his dissertation on the psychological response to architectural forms.[9] Hofmann’s early years as an artist also coincided with Munich sculptor Adolf Hildebrand’s influential 1893 treatise *Das Problem der Form in der Bildenden Kunst (The Problem of Form in Painting and Sculpture)*[10] in which he laid out the concepts of planar depth and motion that influenced artists and critics alike. “Hildebrand’s[text] was epoch-making in its effect on art criticism, which entered a new era with its publication,”[11] noted Selz. Hofmann cautioned against the limits of Hildebrand’s theories yet continued to recommend the

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[7] Maria Makela, “The Politics of Parody: Some Thoughts on the “Modern” in Turn-of-the-Century Munich,” in *Imagining Modern German Culture 1889-1910,* ed. Françoise Forster-Hahn (Washington, DC: National Gallery of Art, 1996), 185-207.

[8] Peter Selz, *German Expressionist Painting,* (Berkeley and Los Angeles, CA: University of California Press, 1997), 173. Reprint; originally published in 1957. Book based on his 1954 University of Chicago dissertation on the same topic.

[9] Heinrich Wölfflin, “Prolegomena zu einer Psychologie der Architektur” (“Introduction to a Psychology of Architecture”) (PhD diss., Universität München, 1886).

[10] Adolf Hildebrand, *Das Problem der Form in der Bildenden Kunst (The Problem of Form in Painting and Sculpture,* (Strassburg: J. H. E. Heitz, 1893). Hildebrand was ennobled by the King of Bavaria in 1904 and he is therefore later listed in the literature as Adolf von Hildebrand.

[11] Selz, *German Expressionist Painting,* 6.

publication to his students well into the 1930s.[12] "Art education, art history and the artist [had] been merely ignorant about space as the predominant problem in the visual arts," Hofmann would later write to one of Meyer Schapiro's graduate students, "up to the appearance of Adolf Hildebrand's book."[13]

Munich at the end of the nineteenth century was a fertile environment for progressive artists. The Munich Glaspalast and the Secession Gallery exhibited the work of local avant-garde artists while the Munich-based arts magazine *Simplicissimus* encouraged progressive aesthetics and kept Munich's artists abreast of news from avant-garde communities throughout Europe. Students with an interest in modern art also had ample options for study, as a rising number of art schools appeared in Munich in response to German population growth.[14] The new schools transformed the neighborhood surrounding the Akademie der Bildenden Künste München—also known as the Munich Academy— until it seemed to novelist Thomas

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[12] Although Hofmann is reported to have alternately embraced and rejected Hildebrand's text, *The Problem of Form* (first translated into English in 1907) was assigned reading for Hofmann's students through the 1930s, when it was replaced by Sheldon Cheney's *Expressionism in Art*. The Hildebrand book requirement is also cited in Cynthia Goodman, *Hans Hofmann* (New York: Whitney Museum of American Art, and Munich: Prestel-Verlag, 1990), 78, 97. Cheney's book is subsequently listed on a 1940s supply list distributed to Hofmann's students. Lillian and Frederick Kiesler papers, [circa 1910]-2003, bulk 1958-2000, Archives of American Art, Smithsonian Institution.

[13] Hans Hofmann, handwritten draft of a letter, ca. 1965. Estate of Renate Hofmann. Cited in Tina Dickey, "Spatial Constellations: Rhythms of Nature," in *Hans Hofmann* by Helmut Friedel and Tina Dickey (New York: Hudson Hills Press, 1997), 83.

[14] Charles E. McClelland, "'Young Germans, Not Young Greeks and Romans': Art, Culture, and Educational Reform in Wilhelmine Germany," in *Imagining Modern German Culture 1889-1910,* 37-51.

Mann that "every fifth house had studio windows blinking in the sun."[15] Artists who took advantage of Schwabing's concentration of studios and studied with multiple teachers were exposed to a range of modernist styles and influences. While studying Impressionist technique under Willi Schwarz at Moritz Heymann's studio, Hofmann learned of Michel-Eugène Chevreul and Ogden Nicholas Rood and their theories of contrasting and adjacent color; when studying with former Academy professor Anton Azbé, Hofmann was introduced to the optical science of Munich physicist Hermann Ludwig Ferdinand von Helmholtz. "Helmholtz's studies on the physiology and psychology of color vision," according to Selz, "acted upon much of German artistic production"[16] of the period. Azbé's popular Farbkristallisation (color crystallization) technique drew a large contingent of modernist students to his 16 Georgenstrasse studio, including nonobjective painting pioneer Wassily Kandinsky. Kandinsky's arrival was part of an influx of Russian modern artists active in the Munich arts scene. Kandinsky's classmates at Azbé's school, for example, included fellow Russian modernist Alexej von Jawlensky, who with Kandinsky later founded the first modernist secession group in Munich—Neue Künstlervereinigung München (also known as NKVM, or the New Munich Artist's Association)[17]—whose annual exhibitions at the Moderne Galerie in Munich included work by group members, such

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[15] Thomas Mann, "Galdius Dei," *Stories of a Lifetime*, vol. 1 (London: Secker & Warburg, 1961), 142-44.

[16] Selz, *German Expressionist Painting,* 3.

[17] NKVM was founded in 1909. The other founding members were Munich art students Marianne von Werefkin, Gabriele Münter, Adolf Erbslöh, and Alexander Kanoldt.

French and Russian avant-garde artists as Pablo Picasso and Georges Bracque, and members of NVKM splinter group Der Blaue Reiter (The Blue Rider).[18] NVKM and Der Blaue Reiter artists—along with colleagues from other German modernist colleagues such as Die Brücke (The Bridge)[19]—were among the international community of artists whose publications and artistic production energized modern art centers in Europe and the United States.[20] Kandinsky colleague and writer Michel Seuphor (pseudonym of Belgian painter Fernand Berckelaers) later noted that Munich's studios served as a training ground for many painters later associated with influential avant-garde movements. "Abstract Expressionism was and is just as European," claimed Seuphor, "since it was born in Munich."[21]

During his early years in Schwabing, Hofmann built lasting friendships with such fellow artists as painter and Heymann classmate Jules Pascin and poet Rainer

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[18] NKVM exhibitions were held in 1909, 1910, and 1911. Members of Der Blaue Reiter held a parallel exhibition in 1911 and were not included in the NKVM exhibition. Kandinsky and von Jawlensky were also founding members of Der Blaue Reiter. Other founding members included von Werefkin, Münter, Franz Marc, and August Macke.

[19] Die Brücke was a German Expressionist group formed in Dresden in 1905 by architecture students Fritz Bleyl, Erich Heckel, Ernst Ludwig Kirchner, and Karl Schmidt-Rottluff. The group expanded with the later addition of such modern artists as Emil Nolde, Max Pechstein, and Otto Mueller.

[20] Der Blaue Reiter was originally organized to publish an annual book of modernist thought and art, and the group's first exhibition was entitled "First Exhibition of the Editors of *Der Blaue Reiter*." The were actually only two editions of *Der Blaue Reiter Almanach* (*The Blue Rider Almanac*), one published in 1912 and another in 1914, edited by Kandinsky and Marc and published by Munich's R. Piper and Co. Verlag.

[21] Michel Seuphor, *Dictionary of Abstract Painting with a History of Abstract Painting* (New York: Tudor Publishing Company, 1957), 77.

Maria Rilke, and met Maria (Miz) Wolfegg, his future wife.[22] Hofmann began studying with Azbé in 1902,[23] the same year that Kandinsky left the studio to organize the cooperative arts group Phalanx, and while Kandinsky's art group (and associated school) were active in Munich's arts scene, there is no evidence that Hofmann and Kandinsky knew each other personally during this period. Wolfegg and Kandinsky's partner Gabriele Münter maintained a life-long friendship, yet there is no existing correspondence between Hofmann and Kandinsky. When both artists decamped to France, Hofmann stayed in the city and Kandinsky stayed in the country and it was again Wolfegg and Münter who maintained contact.[24] Even the storage of Kandinsky's work in Hofmann's studio during World War I (discussed later in this chapter) was arranged and facilitated through correspondence between Wolfegg and Münter. Despite Hofmann's life-long association with prominent modernist communities, Hofmann never openly acknowledged the influence of Kandinsky (or German avant-garde painting) on his own painting style. Similarities between the two artists' late-career compositional elements were noted by critics such as Max Kozloff and Gail Levin[25] and both Ellen Landau and Greenberg saw parallels between

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[22] Hans and Maria were married on June 5, 1924.

[23] By coincidence, Hofmann submitted his registration for Azbé's classes at an office at 40/1 Georgenstrasse, the address where a little over a decade later Hofmann would establish his own school. Dickey, *Color Creates Light,* 38.

[24] Kandinsky and Münter spent a year in France beginning in the summer of 1906. Münter is known to have traveled back and forth to Paris for classes and to meet with friends, while those wishing to meet with Kandinsky traveled to their rented house in Sèvres.

[25] See Max Kozloff, "The Critical Reception of Abstract-Expressionism," *Arts Magazine* 40(2) (December 1965): 27-33, and Gail Levin, "Miró, Kandinsky, and the

Hofmann's published writings and Kandinsky's *On the Spiritual in Art,*[26] but it was Hofmann's first travels abroad that made their mark on his public memory and methodology. Hofmann's early art lessons focused on French Impressionism and, throughout his career, in lectures and interviews Hofmann chose as modernist exemplars the artists with whom he studied and worked during the decade he spent as a young artist in the modernist enclaves of Paris. It was not until the final years of Hofmann's career that reflections of Munich modernism appear in the artist's work (see Chapter Three, "The origins of Hofmann's late-career color planes").

Coatings innovation in Germany and Artists' Exposure to Information about Paint Materials

In the late nineteenth century, Germany was also a leading hub for coatings development. Following the discovery of aniline purple dyes by German chemist

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Genesis of Abstract Expressionism" (27-40) and "Hans Hofmann" (78-81) in Robert C. Hobbs and Gail Levin, *Abstract Expressionism, The Formative Years* (Ithaca, NY: Herbert F. Johnson Museum of Art, Cornell University, 1978).

[26] See Ellen G. Landau, "The French Sources for Hans Hofmann's Ideas on The Dynamics of Color-Created Space." *Arts Magazine* 51(2) (October 1976): 76-81, and Clement Greenberg, *Hans Hofmann* (Paris: Éditions Georges Fall, 1961). *Über das Geistige in der Kunst: insbesondere in der Malerie (On the Spiritual in Art, and painting in particular)* was first published in 1911 (Munich: R. Piper), the same year as the inaugural exhibition of Der Blaue Reiter. The text was quickly translated into French and Russian and excerpts of the text appeared in English translation in Stieglitz's periodical *Camera Work* in 1912; an English translation of the full text was published in 1914 as *The Art of Spiritual Harmony* (London: Constable and Company, trans. Michael Sadleir); in 1946 the Solomon R. Guggenheim Museum published an English translation of the text, edited by Kandinsky acolyte Hilla von Rebay. A heavily annotated copy of Kandinsky's *Concerning the Spiritual in Art* was among Hofmann's possessions at the time of his death.

August Wilhelm Hofmann in 1856,[27] the establishment of chemical manufacturers Badische Anilin- & Soda-Fabrik (BASF) and Friedrich Bayer (Friedr. Bayer & Co., later Bayer AG) made Germany a leading center for color research and development. While Hofmann was studying modern color theory in Munich, German manufacturers added a range of new organic and inorganic color options to artists' palettes. Contemporary painters had access to bright zinc whites and bold cadmium yellows and oranges[28] as well as synthetic organic colors built from red and purple alizarin and rhodamine dyes and the range of azo, diazo, and fluorescein yellows and oranges.[29] German-manufactured synthetic blues, greens, and cadmium yellows were embraced by many of the progressive Impressionist and Cubist painters including Cézanne and Monet.[30] As a member of the Munich arts community, Hofmann had unique exposure

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[27] A patent for the color was obtained three years later by August Hofmann's student William Henry Perkins, who is credited improperly with the discovery. See Philip Ball, *Bright Earth: Art and the Invention of Color* (New York: Farrar, Straus and Giroux, 2001) and Suzanne Quillen Lomax and Thomas J. S. Learner "A Review of the Classes, Structures, and Methods of Analysis of Synthetic Organic Pigments," *Journal of the American Institute for Conservation* 45(2) (Summer 2006): 107-125.

[28] Zinc (oxide) white was introduced in watercolor paints in 1834 and became commercially available as an artist's oil paint in the 1850s. Cadmium yellows and oranges were available shortly before Hofmann's birth, but cadmium red was not commercially available until 1910, and the now-familiar shades of cadmium reds were probably not available until Bayer introduced them in 1919.

[29] Alizarin dyes were discovered in 1869; Fluoresein dyes, 1871; and Rhodamine dyes, 1887 (all manufactured by BASF). See Philip Ball, *Bright Earth,* and J. Boxall, "A History of Paint Technology, Part Three. Mid-19th Century to 20th Century," *Paint Manufacture* 48(6) (1978): 25-30. Diazo dyes entered commercial production in 1859, and mono-azo colors in 1869 (a second group of mono-azo colors were formulated in 1889). Boxall, "A History of Paint Technology, Part Three": 25-30.

[30] Philip Ball, "The Making of Cézanne's Palette," *Helix* 10(2) (2001): 34-41, and Ball, *Bright Earth*.

to dramatic advances in the development of paint technology and the related growth of the artists' materials industry. According to sociologist Janet Marontate: "There was a strong tradition of interest in the study of art materials in Germany and there were important precedents for the collaboration of artists, paintmakers and other interested parties."[31] In 1881, chemists Adolf Wilhelm Keim and Ernst Berger installed their Versuchsanstalt für Maltechnik (Research Institute for Painting Techniques) at the Munich Academy as a "laboratory and information office for painting techniques" where three years later Keim produced a workable version of his potassium silicate paint. Keim's lectures on "mineral painting" were thereafter added to the Academy curriculum.[32] Along with painter Franz von Lenbach and chemist Max Joseph von Pettenkofer, Keim was instrumental in the 1886 formation of the Deutsche Gesellschaft zur Beförderung rationeller Malverfahren (German Society for the Promotion of Rational Painting Techniques). Established to include members from artistic, industrial and scientific circles in Munich, the Society was created, according to conservator Katherin Kinseher, to "counteract the lack of objective technical knowledge regarding the production of durable paints" and create a network of professors, painters, scientists, and manufacturers in "an alliance of interests."[33]

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[31] Janet Lee Ann Marontate, "Synthetic Media and Modern Painting: A Case Study in the Sociology of Innovation," (PhD diss., University of Montreal, 1996), 267.

[32] A. Bayersdorfer, et al., "Expert Report," *Technische Mitteilungen für Malerei* 11 (1894): 32.

[33] Kathrin Kinseher, "Paintings are Made of Paint: The Exhibition of Painting Techniques in the Munich Glaspalast, 1893," in *The Object in Context, Crossing Conservation Boundaries: Contributions to the International Institute of Conservation Congress in Munich, 28 August – 1 September 2006,* eds. David Saunders and Joyce Townsend (London: International Institute for Conservation, 2006), 41.

Because the Society's founders felt that an institutional infrastructure for research into painting materials and techniques and the durability of artworks was lacking, in 1892—fifty years before similar efforts in the United States—members of the Society petitioned the German government to establish national standards for testing and labeling of artists' paints, and began efforts to educate the community on artmaking materials. "German artists have for many years taken an active interest in artists' materials," Society member and Academy professor Max Doerner (or Dörner) later noted in the introduction to his compiled lectures, "and their activities have resulted in advantages to all artists."[34] In 1893 the Munich Glaspalast was chosen as host to the Society-sponsored Exhibition of Painting Techniques, an international exposition of the latest advances in paint technique and technology. The journal *Technische Mitteilungen für Malerei (Technical Instructions for Painting)* called upon "artists, decorators, manufacturers, inventors, and material, art and teaching-aid suppliers"[35] to contribute to the sampling of traditional and experimental paint media and tools and the presentation of experimental paint techniques. Over forty German textile mills, paint, and brush suppliers participated in the exhibition, joined by representatives from chemical manufacturers and technical journals. The Exhibition underscored Munich's

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[34] Max Doerner, *The Materials of the Artist and their Use in Painting, with Notes on the Techniques of the Old Masters*. (New York: Harcourt Brace and Company, 1984, rep.), 94-95. Originally published as *Malmaterial und seine Verwendung im Bilde: nach den Vorträgen an der Akademie der bildenden Künste in München* (Munich: Verlag für praktische Kunstwissenschaft, 1921).

[35] Kinseher, "Paintings are Made of Paint," 41.

position at the center of advanced paint and painting, and its art community's access to "all kinds of technical progress and human creativity."[36]

Hofmann's Years in Paris (1904-1914) and Return to Germany (1914-1931)

Hofmann's Exposure to Avant-garde Art and Aesthetics

Hofmann arrived in Paris during a time of what Henri Matisse called "artistic cosmogony,"[37] a dawning sentience in modern art. In 1903 Hofmann quit his government job and his teacher, Willi Schwartz, brought Hofmann's early work to the attention of art dealer Paul Cassirer, who secured for Hofmann the patronage of German department store magnate Philipp Freudenberg.[38] Freudenberg's financial support facilitated Hofmann's move to Paris in 1904, a year that also marked the arrival of modern artists Pablo Picasso and Constantin Brancusi. Wolfegg joined Hofmann within six months at their home for the next ten years—artists' housing at 9 rue Campagne Première constructed from materials salvaged from the 1889 Exposition Universelle.[39] Hofmann's arrival coincided with an influx of modern painters to the French capital around the time of the 1905 Salon d'Automne. The Salon's public unveiling of bold Fauvist color was followed by a second exhibition of Cézanne's

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[36] Martin Wörner, *Vergnügung und Belehrung, Volkskultur auf den Weltausstellungen 1851-1900* (Münster: Waxmann Verlag, 1999), 1.

[37] Henri Matisse, "Statements to Tériade: Matisse Speaks," *Matisse on Art*, ed. Jack D. Flam (Berkeley: University of California Press, 1995, reprint), 205.

[38] Hofmann's patron is alternately referred to in the literature as the owner of the department store or as the owner's son.

[39] Dickey, *Color Creates Light,* 40.

ground-breaking fractured perspective at the 1906 Salon and signaled an experimental period in painting that made Paris the new center of the modern art world. Students flocked to Parisian ateliers in search of training and as in Munich, Paris responded to the increase in students with an increase in private art schools. Popular schools in the Montparnasse neighborhood included Henri Matisse's short-lived but well-known school at the Couvent des Oiseaux at 56 rue de Sèvres and the Académie Julian within the Passage des Panorama in Montmartre.[40] In his early days in Paris, Hofmann trained at ateliers along rue de la Grande Chaumière and participated in classes at both the Académie de la Grand Chaumière and the neighboring Académie Colarossi,[41] whose evening class attracted notable students including Matisse and American painters Lyonel Feininger and Max Weber. "France has fertilized the ideas of the whole world," Hofmann later declared, in a pamphlet distributed by Hofmann and his students to audiences at a "Forum '49" panel discussion entitled "French Art vs. U.S. Art Today."[42] Hofmann summarized the international nature of the Parisian modernist community in a subsequent article in *Arts & Architecture* magazine:

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[40] Matisse operated his school from 1908 to 1911. The Académie Julian was established by Rodolphe Julian in 1868 and merged with ESAG Penninghen in 1968.

[41] The Académie de la Grand Chaumière was founded in 1902 by Martha Stettler and operated open drawing classes at 14 rue de la Grande Chaumière until its sale to the Charpentier family in 1957; the school is now called the Académie de la Charpentier. The Académie Colarossi was founded by sculptor Filippo Colarossi, who purchased a school established in 1815 on the Île de la Cité, and relocated the academy to 10 rue de la Grande-Chaumière in the 1870s; the school closed in the 1930s and Madame Colarossi destroyed the school's archives.

[42] The pamphlet, entitled "Against Ostrich Attitudes in the Arts," was distributed by Hofmann and student Fritz Bultman. The pamphlet is discussed in Paul Ellsworth, "Hans Hofmann: Reply to Questionnaire and Comments on a Recent Exhibition," *Arts*

> The greatness of Paris is to offer an invitation of participation to the spirit. . . . Paris' humanism has given the opportunity for free development of such artists as the Spaniards, Picasso, [Juan] Gris, [Joan] Miró; the Swiss, [Paul] Klee, [Jean] Arp, [Le] Corbusier, [Alberto] Giacometti; the Russians, Kandinsky, [Marc] Chagall; the Rumanian, [Constantin] Brancusi; the Irishman, [James] Joyce; the Americans, [Gertrude] Stein, Man Ray, [Arthur B.] Carles; the Pole, [Jacques] Lipschitz; and many others. Still today many of them are living masters of Paris.[43]

Hofmann's years in the French capital coincided with a conspicuous concentration of German artists who placed Hofmann within the center of the Parisian arts community and the social circle of influential art dealer Wilhelm Uhde. Uhde was at the center of the "who's who of Schwabing" gathered at the Café du Dome,[44] and his home at 21 Quai de la tournelle was a meeting place that gave Hofmann direct contact with the city's modernist innovators. According to Glenn Wessels, who accompanied Hofmann on his first trip to the United States, a chance conversation with collector Leo Stein confirmed Hofmann's close association with the era's art elite. Stein told Wessels that "Hofmann had been one of . . . the same group that was made up of pretty near all the early Cubists, Picasso, [Robert] Delaunay, [Juan] Gris, [Francis] Picabia, Matisse, all these men, and had known them, rubbed shoulders with them, and had argued with them."[45] Hofmann may have met Uhde through Jules

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& Architecture 66(11) (November 1949): 22-27, 45-47. The pamphlet is illustrated on pages 24-25.

[43] Ellsworth, "Hans Hofmann: Reply to Questionnaire and Comments on a Recent Exhibition," 45.

[44] Dickey, *Color Creates Light,* 42.

[45] Oral history interview with Glenn Wessels, conducted in 1967 by Suzanne B. Riess for the University of California Berkeley Regional Oral History Office and compiled under the title "Education of an Artist," 117. Hofmann reconnected with prominent

Pascin—Hofmann's friend from Moritz Heymann's school in Munich—and during the Hofmanns' years in Paris Wolfegg was friends with Pascin's wife Hermionette David and through her was introduced to Uhde's wife, the painter and designer Sonia Terk. Wolfegg's close friendship with Terk may have led both to Hofmann's association with Uhde and his close friendship with Terk's second husband, the influential Orphist painter and color theorist Robert Delaunay.[46] The strong network of German artists living in Paris during this period stood in contrast to what Selz recounted as diminishing communication among trendsetting modernists within Germany itself:

> In 1910, during an exhibition of the New Secession in Berlin, [Die Brücke painter Emil] Nolde was riding with [a Munich] artist on a streetcar in Berlin and "speaking more than usual about our young, budding art. 'What are the names?' he said, somewhat excitedly. . . . He knew nothing of them as I knew nothing of the concurrent young Munich artists."[47]

Regular communication and travel between modernists in Germany and France gave Hofmann and his Paris associates direct contact with the avant-garde communities in pre-World War I Germany. Cassirer, who had studied in Munich and

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Parisian colleagues including Picasso, Georges Braque, and Hans Arp in days surrounding Hofmann's 1949 Kootz-organized solo show at the Galerie Maeght, 35 years after Hofmann left the art circles of Paris and established his first school in Munich. See Tina Dickey, *Color Creates Light: Studies with Hans Hofmann* (Salt Spring Island, BC: Trillistar Books, 2011), 251-53.

[46] According to Dickey, Terk met Uhde in 1906 and entered into a marriage of convenience with him in 1908. Seven months pregnant with Delaunay's child in 1911, Terk and Uhde divorced and she married Delaunay. Dickey, *Color Creates Light,* 44. See also Fritz Bultman in conversation with Cynthia J. Goodman, October 1976, cited in "The Hans Hofmann School and Hofmann's Transmission of European Modernist Aesthetics to America" (PhD diss., University of Pennsylvania, 1982), 21.

[47] Emil Nolde, *Jahre der Kämpfe* (Berlin: Rembrandt, 1934), 140.

was co-editor of *Simplicissimus* from 1896 to 1898, opened a Berlin gallery in 1908 at 35 Viktoriastrasse to promote the work of Berlin Secession artists alongside that of their avant-garde colleagues in Paris. Hofmann exhibited with the Secession artists at Cassirer in 1908 and 1909, and in 1910 at a joint exhibition at Cassirer's new Berlin gallery with expressionist painter Oscar Kokoschka. Matisse's enthusiastic reaction to Hofmann's work during a visit with Cassirer secured the continued patronage of Freudenberg during Hofmann's decade abroad.[48] The Berlin magazine *Der Sturm* (The Storm)—published by artist and former *Der neue Weg* editor Herwarth Walden under the pseudonym Trust—also reinforced the connections between the German and French arts communities with cover designs by Terk and expressionist writings by French poets Guillaume Apollinaire and Blaise Cendrars. The first *Der Sturm* exhibition, held in 1912 in connection with the magazine's 100th issue, included a strong contingent of Fauve paintings. Munich's Moderne Galerie Heinrich Thannhauser at 7 Theatinerstrasse showcased works by emerging German modernists alongside such French contemporaries as Picasso and Juan Gris, Russian Rayonist and Suprematist artists, and members of the short-lived Swiss group Der Moderne Bund. Works by Berlin's expressionist Die Brücke artists, and members of Munich-based groups Der Blaue Reiter and Neue Künstlervereinigung München (Munich New Artist's Association) were regularly featured in Thannhauser's exhibitions. Hofmann's friends the Delaunays were members of Der Blaue Reiter—whose founding members included Kandinsky, Franz Marc, and August Macke—and visits to the Delaunays' studio at 3 rue des Grands Augustins brought Marc and Macke into contact with

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[48] Frederick S. Wight, *A Retrospective Exhibition of Hans Hofmann*. (Berkeley and Los Angeles, California: University of California Press, 1957), 30-31.

influential members of the French avant-garde and like-minded modernists including American painters Russell and MacDonald-Wright, whose abstract "synchromies" were on view in both Munich and Paris.[49] "I will speak to you sometime about the subject of painting" Robert Delaunay wrote to Kandinsky as Sonia's translation of Kandinsky's influential *On the Spiritual in Art* was circulated in Paris, "[and] about an exciting conversation at the home of Apollinaire, who has begun to believe in us."[50] The mix of international modernism on view at Germany's 1912 International Exhibition of the Sonderbund[51]—organized by a Working Committee of museum directors, councilmen, and art dealers that included Berlin's Paul Cassirer and Paris's Josse Bernheim-Jeune—was the direct model for the 1913 International Exhibition of Modern Art organized by New York's Association of American Painters and

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[49] The first exhibition of Synchromist painting was displayed at the Neue Kunstsalon in Munich in June 1913; the second exhibition took place at the Bernheim-Jeune Gallery in Paris in October –November 1913.

[50] Robert Delaunay, "Letter to Kandinsky (1912)," in *The New Art of Color: The Writings of Robert and Sonia Delaunay,* ed. Arthur A. Cohen, trans. Cohen and David Shapiro (New York: The Viking Press, 1978), 111-12. *Über das Geistige in der Kunst: insbesondere in der Malerie (On the Spiritual in Art, and painting in particular)* was first published in 1911 (Munich: R. Piper), the same year as the inaugural exhibition of Der Blaue Reiter. The text was quickly translated into French and Russian and excerpts of the text appeared in English translation in Stieglitz's periodical *Camera Work* in 1912; an English translation of the full text was published in 1914 as *The Art of Spiritual Harmony* (London: Constable and Company, trans. Michael Sadleir); in 1946 the Solomon R. Guggenheim Museum published an English translation of the text, edited by Kandinsky acolyte Hilla von Rebay.

[51] The Sonderbund westdeutscher Kunstfreunde und Künstler (Separate League of West German Art Lovers and Artists) was established in 1909 and dissolved in 1916. The Sonderbund is best known for the early modern art displayed at their "International Art Exhibitions" in 1910 and 1911 (Düsseldorf) and 1912 (Cologne).

Sculptors, also known as the Armory Show. Artist and Association secretary Walter Kuhn recalled that while traveling in Nova Scotia:

> I received from [Arthur B. Davies, president of the Association] by mail the catalogue of the "Sonderbund" Exhibition then current in Cologne, Germany, together with a brief note, stating, "I wish we could have a show like this."[52]

The ongoing dialogue between arts communities in France and Germany also kept modern artists in Paris abreast of advancing German aesthetic theory. The year before Picasso exhibited *Desmoiselles d'Avignon*, Munich art historian Wilhelm Worringer (1881–1965) advanced the theories of Schopenhauer and Lipps in a publication entitled *Abstraktion und Einfühlung: Ein Beitrag zur Stilpsychologie (Abstraction and Empathy: A Contribution to the Psychology of Style)*. Reprinted twice in two years,[53] the 1906 Berne University thesis was an immediate topic of discussion among members of the avant-garde[54] and permanently fixed the term "empathy" within the vocabulary of such modernist artists and educators as Hofmann. "To experience visually, and to transform our visual experience into plastic terms requires the faculty of empathy," Hofmann later told his students. "The artist possesses the means to create only after he has effective command of his faculty of

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[52] Walt Kuhn, *The Story of the Armory Show* (New York: Joseph H. Hirshhorn Foundation, 1938), 8.

[53] Worringer published the work privately in 1906. Munich publisher Reinhard Piper produced the first commercial edition in 1908, and had released a third edition by 1910. Worringer's work was first published in English in 1953. *Abstraktion und Einfühlung* and Worringer's 1911 book *Formprobleme der Gotik (Form in the Gothic)* were widely owned and read by American modernist artists.

[54] Selz, *German Expressionist Painting,* 8.

empathy."[55] The "practical" section of *Abstrakion* included references to Heinrich Wölfflin's 1886 dissertation, which was followed in 1915 by Munich publisher Hugo Bruchmann's printing of Wölfflin's *Kunstgeschichtliche Grundbegriffe: Das Problem der Stilentwicklung in der neueren Kunst (Principles of Art History: The Problem of Style in Modern Art)* in which he codified emerging trends in art analysis with the opposing pairs of formalist precepts later seen in discussions of painterly/linear composition and open/closed form found in the writings of such formalist critics as Greenberg. "All in all," historian Wolfgang Sauer noted, "a survey of the intellectual scene [for artists] prior to 1914 reveals a picture of almost boundless creativity."[56]

Coatings Innovations and Evidence of New Paints in Modern Art

Technology advanced as dynamically as aesthetics during Hofmann's years in Paris. Progressive French painters already familiar with the color theories of Michel-Eugène Chevreul and Ogden Nicholas Rood had likewise embraced innovative paint formulations by the time Hofmann arrived in Paris. Synthetic pigments were commonplace on the post-Impressionism and Pointillist palettes of such artists as Vincent van Gogh and Georges Seurat;[57] according to science writer Philip Ball, of

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[55] Hans Hofmann, "Excerpts from the Teaching of Hans Hofmann," in *Search for the Real and Other Essays*, eds. Sara T. Weeks and Bartlett H. Hayes, Jr. (Cambridge and Andover, Massachusetts: The M.I.T. Press and the Addison Gallery of American Art, 1948), 61.

[56] Wolfgang Sauer, "Weimar Culture: Experiments in Modernism," *Social Research* 39(2) (Summer 1972): 257.

[57] See Maarten van Bommel et al., "An investigation of organic red pigments used in paintings by Vincent van Gogh (November 1885 to February 1888)," in *ArtMatters: Netherlands Technical Studies in Art* 3(2005): 111-137 and Jo Kirby et al., "Seurat's

the twenty principal pigments identified by analysis in Impressionist paintings, twelve were recent synthetic formulations[58]—primarily deep shades of blue and green. According to research scientist Matthijs de Keijzer, "[today's] pigment lists of the well-known paint manufacturers such as Royal Talens [Netherlands], Winsor & Newton [England], Daler-Rowney [England], Schmincke [Germany], Lukas [Germany] and Société Lefranc & Bourgeois [France] show that . . . half of the quality A artists' paints contain one or more organic and inorganic compounds discovered in the 20th century."[59] The continued innovation in paint technology that took place during Hofmann's years in Paris made possible the striking shift in palette seen in the avant-garde paintings of the Fauves and members of Der Blaue Reiter, and the new, modern color that held a primary creative function in Orphism and Synchromism. Such artists as Matisse, Delaunay, and André Derain embraced the expanding range of bold Hansa (arylide) yellows[60] and cadmium colors shunned by more established colleagues including Impressionist painter Pierre-Auguste Renoir, who according to

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Painting Practice: Theory, Development and Technology." *National Gallery Technical Bulletin* 24(2003): 4-37.

58 Ball, *Bright Earth,* 181.

59 "For the B quality this proportion may be up to 70%." Matthijs de Keijzer, "The History of Modern Synthetic Inorganic and Organic Artists' Pigments," in *Contributions to Conservation: Research in Conservation at the Netherlands Institute for Cultural Heritage* (Amsterdam: ICN, 2002), 42.

60 Hansa yellows (also from the nitrogen-based "azo" or "arylide" color group) were introduced in Germany in 1911, and became popular throughout Europe by the 1920s. Diarylide yellows and oranges were introduced shortly after the arylid yellows. Lomax and Learner "A Review of the Classes, Structures, and Methods of Analysis of Synthetic Organic Pigments," 109.

art historian John Gage "refused to try even the sample of cadmium Matisse gave him, saying that he did not want to change his ways."[61] Arylide enamel colors found in the paintings of Picasso and Vaclav Vytlacil made use of both the new colors and the oil-modified alkyd polymer resins that began to appear in paint formulations in 1911.[62] These innovative materials were also featured three years later at an exhibition of commercial paints and dye-based pigments sponsored by the Munich-based industrial advocate group Deutsche Werkbund and organized by chemist Wilhelm Ostwald, a consultant to the German paint industry and author of the 1904 book *Malerbriefe: Beiträge zur Theorie und Praxis der Malerei (Letters to a Painter: Contributions to the Theory and Practice of Painting)*.[63] The activities of the Munich-based Deutsche Gesellschaft zur Beförderung rationeller Malverfahren during this period included a 1905 conference on paint adulteration organized in part by Doerner, who served as the organization's president from 1910 through 1913. Doerner would include the organization's list of recommended artists' colors (Normalfarben) in the compiled lecture notes on artist's health and safety practices that would become his influential treatise *The Materials of the Artist and their Use in Painting*. While Doerner

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[61] John Gage, *Color and Culture: Practice and Meaning from Antiquity to Abstraction* (Berkeley: University of California Press, 1993), 223. Cadmium red was not available until 1910, although lighter shades of cadmium were being introduced in the years prior to the release of cadmium red. Scholar Philip Ball has since noted "Since this was 1904, however, [Matisse] was presumably speaking of whatever pigment it was that Field had investigated, whose orange tint would have resembled vermilion more closely than the deeper modern variety." Ball, *Bright Earth,* 303.

[62] Boxall, "A History of Paint Technology, Part Three," 25-30 and J. Boxall, "Part Four, The 20th Century," *Paint Manufacture* 48(7) (1978): 18-23.

[63] Published in Leipzig by Verlag von S. Hirzel.

suggested that early commercial aniline pigments were not stable and deemed their commercial release "precipitous and ill-advised," he considered other modern formulations to be improvements on traditional materials and encouraged all artists to maintain an open yet discerning attitude towards new paint media. "The laws which govern the materials of the artist," Doerner stated in the original preface, "are the same for all artists, to whatever schools they may belong."[64]

Hofmann's Return to Germany and his New Role as a Teacher of Avant-garde Art

Hofmann returned to Munich as advancing war scattered his French and German colleagues. He and Wolfegg were in Munich visiting his sister Rosa when war broke out and forced them to abandon their Paris studio. Upon their arrival Wolfegg's friend Münter asked the Hofmanns to hold some of the artwork gathered up by Kandinsky before his departure and in an interesting twist, while Hofmann lost his own paintings left behind in Paris, he himself was responsible for preserving many of Kandinsky's formative Munich creations. "I would of course very gladly take advantage of your kind offer to choose a Kan[dinsky] for myself, " Hofmann later wrote to Münter. "Up to now, the watercolor no. 5 has been hanging in our apartment-cum-studio. . . . I am especially fond of this picture."[65] World War I also marked an end to his support from Freudenberg, a change in situation that forced Hofmann to

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[64] Doerner, *The Materials of the Artist,* 90, v.

[65] Letter from Hans Hofmann to Gabriele Münter, 3 June 1927, Gabriele Münter- und Johannes Eichner-Stiftung, Cited in Helmut Friedel and Tina Dickey, *Hans Hofmann,* 8-9. See also Lorenz Eitner, "Kandinsky in Munich," *The Burlington Magazine* 99(651) (June 1957): 192-197, 199.

look for alternate means of support. Excused from military service by a recent lung infection, Hofmann applied to the German government for permission to open an art school and was granted a government license on the condition that the school provided art therapy for shell-shocked veterans.[66] The Hans Hofmann Schule für Bildende Kunst opened in 1915 at 40 Georgenstrasse, in the Schwabing neighborhood building where Hofmann himself had registered for art classes years earlier.

Hofmann's school filled the void left by foreign artists forced by war to close their schools and return home. As communication among artists broke down and art communities disbanded, Worringer accused the war of destroying France and Germany's most promising art movements[67] and Hofmann's first-hand experience with the formative art movements of both countries quickly established his schools as a direct connection to the lost zeitgeist of avant-garde painting. "Students can probably learn more at the moment from Hofmann [in] Munich" American arts writer Sheldon Cheney later noted, "than any school in Paris."[68]

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[66] Wessels in conversation with Cynthia Goodman, in Goodman, "The Hans Hofmann School and Hofmann's Transmission of European Modernist Aesthetics to America," 26.

[67] In a November 1920 lecture to Munich's *Deutsche Goethegesellschaft* (Goethe Society), published as *Künstlerische Zeitfragen* (Munich, 1921). Selz, *German Expressionist Painting,* 318.

[68] Sheldon Cheney, *A Primer of Modern Art* (New York: Boni and Liveright, 1924), 155. Cheney's nephew Warren participated in the Munich school's summer sessions in St. Tropez in the late 1920s.

According to historian Dore Ashton, American painter Carl Holty "went all the way to Germany in 1925 to study with Hans Hofmann in order to satisfy his need for contact" with the modernist painting community. Dore Ashton, *The New York School: A Cultural Reckoning* (New York: Viking Press, 1973, rep.), 13.

Hofmann's school was a wartime destination for students who wished to study modern painting in Europe. "With the sole exception of the short-lived school of Henri Matisse in Paris," Hofmann later recounted, "there was then not any avant-garde school in existence."[69] Enrollment was low during the war, but improved in the 1920s with relaxed post-war travel restrictions and what educator Jennifer Cho called Hofmann's drive to "create his own student body" by recruiting from outside the traditional pool of local students.[70] Hofmann's open enrollment policy offered student scholarships and welcomed older and female students, both barred from attending the Munich Academy.[71] The school's government license—which allowed enrolled students legal residency in Germany—swelled the school's post-war ranks with American students and created what student John Haley recalled as an atmosphere of "celebrities" arriving every weekend.[72] As the school's reputation grew, a stop at the Hofmann school became a part of many serious modernist students' European itineraries. Prominent American artists who traveled abroad to study with Hofmann in Munich included Louise Nevelson (1931), Vaclav Vytlacil (1922-1927), scholarship

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[69] Hofmann, from a speech delivered at the inauguration of the Hopkins Center at Dartmouth College, Hanover, New Hampshire, on November 17, 1962. From "Selected writings on art assembled by Dr. William Seitz with the cooperation of the artist," unpublished typescript, (New York: The Museum of Modern Art, 1963), 2.

[70] Jennifer M. Cho, " Hans Hofmann and Josef Albers: The significance of their examples as artist-teachers" (PhD diss., Columbia University Teachers College, 1993), 91.

[71] Sandra L. Singer, *Adventures Abroad: North American Women at German-Speaking Universities, 1868-1915* (Westport, CT and London: Praeger, 2003). 166.

[72] John Haley interviewed by Lawrence Dinnean on July 30, 1973. Bancroft library, University of California. Typescript, 7.

student Alfred Jensen (1926-1927), and Wolfgang Paalen (1927), who left his studies in Paris to come to Hofmann's Munich school.[73] The school also recruited secondary and university art teachers for their summer sessions and soon established a reputation as a training ground for future educators. "Word had already gotten around," recalled American student Ludwig Sander, "that if you studied with Hofmann you'd get a good job teaching somewhere."[74]

Hofmann's Exposure to New Paint Materials and Avant-garde Art During the Early Years of his School

Hofmann may have been exposed to advances in paint manufacture and avant-garde painting during the early years of his school, but the direct influence of these innovations was limited or delayed. It was nearly a decade before many of the new paint materials introduced in the 1920s were adopted by Hofmann and his Abstract Expressionist colleagues. Titanium (dioxide) white, for example, that entered mass production in 1921, does not appear on the German-language pigment lists found among Hofmann's papers. However a titanium/zinc blend manufactured by the Philadelphia-based art materials manufacturer F. Weber Co., Inc. under the trade name Permalba appears on the earliest English-language list of recommended paints for students of Hofmann's American school and on every subsequent student supply list and purchase record thereafter.[75] In contrast, Indanthrene blue, a synthetic pigment

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[73] Gustav Regler, *Wolfgang Paalen* (New York: Nierendorf Editions, 1946), 15.

[74] Oral history interview with Ludwig Sander, conducted February 4-12, 1969 by Paul Cummings for the Archives of American Art, Smithsonian Institution, n.p.

[75] Hans Hofmann papers, Archives of American Art. Permalba was initially available as a dry pigment mixture and as a tube oil color. A 1921 advertisement for Permalba states is contains no zinc or lead, but does not clarify if the material advertised is the

discovered by BASF in 1901 and released by the German pigment company IG. Farbenindustrie AG in 1924 with accompanying praise by Doerner,[76] does not appear on any of Hofmann's pigment lists. The nitrocellulose/alkyd paint blends (also known as pyroxylin paints) which entered commercial production in 1925[77] were embraced by American artists only after their introduction at the 1930s experimental paint workshops held in New York City by Mexican muralist David Alfaro Siqueiros, and the German formulation of oil/rosin medium that allowed phenol formaldehyde resins to enter commercial coatings production in 1928[78] played a similarly limited role in fine art until the embrace of phenol resin paints by such Abstract Expressionist painters as Mark Rothko.[79] Hofmann showed little early interest in new paint binding

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dry pigment or the tube paint. Analyses of Permalba tube paints on works by Hofmann and his contemporaries consistently contain titanium and zinc pigments. The current formulation of Permalba tube paint also contains titanium and zinc pigments. Advertisement, *Arts & Decoration* magazine 16(2) (December 1921): 142. Lance Mayer and Gay Myers, *American Painters on Technique: 1860-1945* (Los Angeles: J. Paul Getty Museum, 2013), 227 (footnote from page 196). Louise Wijnberg et al., "A Study of the Grounds used by Three Post-War American Artists (1954-1975): Barnett Newman, Ellsworth Kelly and Brice Marden," in *Preprints of the 16th ICOM-Committee for Conservation triennial meeting in Lisbon, Portugal, 19-23 September 2011*, eds. Janet Bridgland and Catherine Antomarchi (London: The International Council of Museums – Committee for Conservation, 2011), CD-ROM. Sandra Hons, "Alfred J. Jensen: An Art Technological Profile, 1952-1981" (MA thesis, Hochschule der Künste Bern, September 2006), 34.

[76] De Keijzer, "The History of Modern Synthetic Inorganic and Organic Artists' Pigments," 51 and Doerner, *Materials of the Artist.,* 92.

[77] Boxall, "A History of Paint Technology, Part Three," 26, and "A History of Paint Technology, Part Four," 18.

[78] Boxall, A History of Paint Technology, Part Four," 18.

[79] Harriet Standeven, *House Paints 1900-1960: History and Use* (Los Angeles: Getty Conservation Institute, 2011), 7.

media or early synthetic organic pigments. Hofmann may have been able to attend the Stuttgart conferences on color theory established by Ostwald in 1919,[80] although Hofmann's existing class and lectures notes do not reference the chemist and color theorist's 1916 publication *Die Farbenfibel* (*The Color Primer)*, which was better received by the Dutch artists of de Stijl than by Ostwald's fellow Germans or Hofmann's subsequent American colleagues. There is also no evidence to suggest that Hofmann associated with members of Berlin's Die Brücke or Munich's Neue Sachlichkeit (New Objectivity) German Expressionist groups. The school curriculum—what Hofmann called "a re-won understanding of the principles of fine art . . . rooted in the work of our time"[81]—was built largely on the Cubist compositional theories and bold Fauvist and Orphist colors to which Hofmann was exposed in Paris just before the war. Although brochures for Hofmann's Munich school advertise the program as "Expressionist,"[82] common usage of that term was fluid. "The term suddenly appeared in relation to French painters and their exhibit in the Berlin Secession of 1911," recalled Selz, who confirmed that when Walden invited "expressionist" artists to participate in the exhibition, "the term still impl[ied] the contemporary French group, primarily Fauves."[83] "We call the art of this century

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[80] Ostwald was awarded the Nobel Prize in Chemistry in 1909.

[81] Transcript of lecture delivered at University of Minneapolis, pencil annotation: "written by H.Hm in german, translated by G. Wessels, on shipboard, on first trip to U.S," Hans Hofmann Archive, Bancroft Library, University of California.

[82] Hans Hofmann papers, Archives of American Art.

[83] Selz, *German Expressionist Painting,* 256-57.

Expressionism," wrote Walden, "in order to distinguish it from what is not art."[84] Hofmann's use of the term "Expressionist" in school advertisements was intended to align his school with French—or more broadly modern—aesthetics. It appears that Hofmann's interest in new paint materials and techniques took a secondary role during this period to the more pressing needs of establishing his fledgling modernist academy.

Munich's changing political climate endangered its avant-garde artists, including Hofmann. The conservative nationalism that followed World War I raised alarms within the avant-garde arts community throughout Germany. "We often ask ourselves," painter Ernst Toller wrote in 1930, "can art influence reality? . . . There are authors who answer this question in the negative; I in the affirmative." The political impact of the modernists was short lived. In the spring of 1919, a group of Munich artists that included Erich Mühsam, and Gustav Landauer, and Toller—who was then the leader of the pacifist Cultural-Political Union of German Youth—took over the Bavarian Council's Republic and according to Wessels, "[they] immediately . . . appointed Hofmann as the head of the Munich Academy. Then two or three weeks later the Whites [the Soviet Räterepublik] took over again, and they ousted him, and he went back to his school in Georgenstrasse."[85] Hofmann's popularity did not outweigh the dangers of his association with liberal activists and modern art. Hofmann was a leader of French modernism operating at a time in German society when, according to historian Patricia Berman, "foreign, and particularly French, art was

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[84] Herwarth Walden, "Kunst und Leben," *Der Sturm* 10(1919): 2.

[85] Wessels, "Education of an Artist," 123.

considered dangerous."[86] In 1925, the Nazi party set up offices at a 50 Schellingstrasse building nearby Hofmann's school and the artist's American students began in earnest their efforts to bring Hofmann to the United States.

Hofmann's Life in the United States (1930-1966)

> I enjoy the wrong reputation: that I love to teach. What I really love in the function as a teacher is the steady contact with new possibilities in the future—with new generation[s].
> —Hans Hofmann, "About Myself," 1956[87]

> You didn't learn only from Hofmann. You learned from other students too. . . . It was the largest classroom in the world.
> —Haynes Ownby, Hofmann student from 1952-1956[88]

Hofmann arrived in the United States at a pivotal moment in American art practice. Hofmann played a central role in the American modernist community and his schools provided generations of artists with new ideas about art making and art materials.

Hofmann's Arrival in the United States and his Influence on America's Avant-garde Community

Hofmann made his first trip to the United States in 1930 to teach a summer session at the University of California at Berkeley, at the invitation of Hofmann

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86 Patricia G. Berman, "The Invention of History: Julius Meier-Graefe, German Modernism, and the Genealogy of Genius," in *Imagining Modern German Culture 1889-1910*, 91.

87 Typescript dated January 25, 1956, entitled "A reply to the demand to name some of my students who have come into prominence." Hans Hofmann papers, Archives of American Art.

88 Dickey, *Color Creates Light,* 272.

student and art department faculty member Worth Ryder and with the assistance of fellow Hofmann alumni John Haley and Glenn Wessels. Wessels acted as translator and shared the driving duties with Hofmann from New York to California. Their drive was punctuated with lecture stops organized by Hofmann students on art school faculties in such cities as Chicago and Minneapolis.[89] The Cubist painter and sculptor André Lhote had been scheduled to teach at the California School of Fine Arts that same summer, and the cancellation of Lhote's classes made Hofmann the sole focus of students seeking a teacher with first-hand experience of Europe's formative modern art movements. More than 200 students were turned away from Hofmann's oversubscribed classes at Berkeley[90] despite the extension of his summer session, and Hofmann was invited to return to Berkeley the following summer. Hofmann taught at Los Angeles's Chouinard School of Art a full year before the arrival of the modern muralist Siqueiros, and as in Munich and Berkeley, Hofmann's Chouinard classes were heavily attended by audiences the local press described as "all heads of art departments in universities, colleges and high schools."[91]

Hofmann was an early influence on modern art education in California. Hofmann's first teaching manual was entitled *Form und Farbe in der Gestaltung: Ein Lehrbuch für den Kunstunterricht (Creation in Form and Color: A Textbook for*

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[89] Former Hofmann students teaching in Minneapolis at the time included Cameron Booth, Vaclav Vytlacil (who also taught at the Art Institute of Chicago and the Art Students League in New York City), John Haley (soon to be faculty at Berkeley) and Edmund Kinzinger.

[90] "Hofmann at Chouinard," *Art Digest* 5(14) (February 15, 1931): 29.

[91] Frank Quinlan, "Art Colony Springs Up on Coast at San Pedro," 1932. Unknown publication. Cited in Dickey, *Color Creates Light*, 104.

Instruction in Art). Hofmann began the text in Munich in 1915 and completed the manuscript in Berkeley in the summer 1931[92] after which he sent the manual to Berlin's Piper Publishing House (publishers of both the *Blaue Reiter Almanac* and *On the Spiritual in Art*),[93] and gave copies to Wessels—then teaching at the California College of Arts and Crafts in San Francisco, and Worth Ryder—who sought Hofmann's advice on department curriculum.[94] Although Hofmann's manual was never published, student notes were widely circulated and sections of the manual were reproduced in the West Coast arts publication *The Fortnightly* in 1931 and 1932.[95] Hofmann's principles were disseminated in publications by University of California Berkeley professor Erle Loran and by arts writer Sheldon Cheney, whose 1934 book *Expressionism in Art* replaced Hildebrand's text as required reading for Hofmann's students in his American classes. "My largest debt," wrote Cheney, "is to Professor Hans Hofmann. It was study of his two articles in *The Fortnightly*, doubtless, and the reading of a part of his unpublished work on *Creation in Form and Color*, that

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[92] Hans Hofmann, *Form und Farbe in der Gestaltung / Creation in Form and Color: A Textbook for Instruction in Art,* unpublished manuscript, dated 1904-1948. Hans Hofmann Papers, 1929-1976. Bancroft Library, University of California, Berkeley, 3.

[93] Hans Hofmann, *Form und Farbe in der Gestaltung*, i.

[94] Wessels, "Education of an Artist," 290.

[95] "Painting and Culture," trans. Glenn Wessels, *The Fortnightly* 1(1) (September 11, 1931): 5-7; "On the Aims of Art," trans. Ernst Stolz and Glenn Wessels, *The Fortnightly* 1(13) (February 26, 1932): 7-11; "Plastic Creation," trans. Ludwig Sander, *The League* 5(2) (Winter 1932-33): 11-15, 21 and reprinted in *The League* 22(3) (Winter 1950): 3-6.

crystallized in its present form my "theory of plastic orchestration."[96] Loran's book *Cézanne's Composition: Analysis of His Form, with Diagrams and Photographs of His Motifs,*[97] which summarized the university's fine arts curricula, was used for many years as a textbook for the department.[98] Loran did not study with Hofmann until 1955, and while he did not credit Hofmann's teaching in the first editions of his book, the diagrams included in Loran's text replicate those found in *Creation in Form and Color* and in general use amongst the Berkeley faculty. "General acknowledgement should be made to that great teacher of painting," Loran noted in a 1963 reprint of *Cézanne's Composition*. "[Hofmann's] ideas about space have been so widely disseminated by former students that anyone searching along similar lines necessarily owes a great deal to him."[99] Hofmann's impact on university curricula influenced the subsequent Berkeley School of Abstract Expressionism, but also influenced the rival

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[96] Sheldon Cheney, *Expressionism in Art* (New York: Liveright Publishing Corporation, 1948, rev.), ix.

[97] First published by the university's press in 1943.

[98] University of California Berkeley history professor and Regional Oral History Office Director Richard Cándida Smith in email correspondence with the author, December 1, 2010.

[99] Erle Loran, *Cézanne's Composition: Analysis of His Form, with Diagrams and Photographs of His Motifs*, (Berkeley: University of California Press, 1963, rep.) In his July 25, 1963 letter to University of California president Clark Kerr in support of Hofmann's donation to help establish the University Art Museum, Loran says that Hofmann's manual will soon be printed in Italy, although this also did not come to pass. Hofmann files, Curatorial Department, University of California Berkeley Art Museum and Pacific Film Archive, 5. Interestingly, when an illustration from Loran's book was later used by artist Roy Lichtenstein for his 1962 painting *Portrait of Mme. Cézanne*, Loran consulted with lawyers about the unauthorized use of his work. See Erle Loran, "Pop Artists or Copy Cats?" *Art News* 62(5) (September 1963): 48-49, 61.

abstract painting scene in San Francisco. The nexus of the San Francisco School of Abstract Expressionism was the California School of Fine Arts, where 1940s faculty included Hofmann's fellow Abstract Expressionists Rothko, Reinhardt, and Still,[100] who perhaps unwittingly passed along Hofmann's distillation of Cubist composition. Still, for example, wrote his 1935 Master's thesis on Cézanne's "synthetic development of color-form" using the principles outlined by Cheney the previous year[101]—assessments that were directly influenced by Hofmann's teachings. According to Wessels, "Still got some of his ideas from Cheney's book . . . . Thus Still is a 'student' by the extended influence of Hofmann."[102] Hofmann's presence at Berkeley in the 1930s connected New York and the Bay Area more than a decade before the arrival of his colleagues in San Francisco. "Hofmann taught at Berkeley and he taught all the teachers there, so in a sense Berkeley was an extension of the whole Hofmann . . . school," recalled land artist and Berkeley alumnus Walter De Maria, "so that we were very attuned to what New York's mind was like [when Hofmann was teaching there] in the Fifties."[103] "It wasn't just Clyfford Still. . . . At the [San

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100 Still taught at the California School of Fine Art from 1946; Rothko taught there in the summers of 1947 and 1949; Reinhardt taught there during the summer of 1950. See Irving Sandler, *The New York School: The Painters & Sculptors of the Fifties* (NY: Harper & Row, 1978).

101 Clyfford Still, "Cézanne, A Study in Evaluation" (Master of Fine Arts thesis, State College of Washington, 1935), n.p. Sheldon Cheney's 1934 *Expressionism in Art* is listed in the limited bibliography.

102 Wessels, "Education of an Artist," 110. Still also studies with Hofmann student Vytlacil in the summer of 1946 before teaching in San Francisco. See Dickey, *Color Creates Light,* 241.

103 Oral history interview with Walter De Maria, conducted on October 4, 1972 by Paul Cummings for the Archives of American Art, Smithsonian Institution, n.p.

Francisco] Art Institute in '46," concurred painter and Art Institute alumnus Elmer Bischoff. "This New York influence was already there. . . . [Berkeley] started that early."[104]

Hofmann traveled from California to the east coast of the United States and took up a six-week teaching post at New York's Art Students League in the autumn of 1932, the same session in which Pollock was elevated to class monitor in the mural class run at the League by Thomas Hart Benton. Hofmann was part of an influx of French modernist influence in 1930s New York, where the modern art community included American artists trained in Paris—Arthur Dove and Arthur B. Carles,[105] for example, and Lyonel Feininger, who received an invitation to join Die Brücke[106]—as well as members of the Parisian avant-garde now settled in New York. Artists formed European-style art societies and transmitted their ideas through public exhibitions and symposia and the French Société des Indépendents and the Salon d'Automne were models for both the Society of Independent Artists and the influential Société Anonyme, an itinerant museum of European modernism founded by American artist

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[104] Oral history interviews with Elmer Bischoff, conducted in 1977 and 1990 by Paul J. Karlstrom and Suzanne B. Riess for the University of California Berkeley Regional Oral History Office and compiled under the title "Two Conversations with Elmer Bischoff," 8, 9.

[105] Hofmann and Carles became close friends during their time in Paris. Carles and his daughter Mercedes Matter subsequently played a prominent role in Hofmann's shift from a period of experimental drawing to a dedicated return to painting. See Barbara Wolanin, "Prelude to Provincetown: Hofmann, Matter, Carles, and the Legacy of their 1934 Gloucester Summer," in *From Hawthorne to Hofmann: Provincetown Vignettes, 1899-1945* (New York: Hollis Taggart Galleries, 2003), 40-57.

[106] Lyonel Feininger, in an interview with Peter Selz, Cambridge, MA, Aug 11, 1952. Cited in Selz, *German Expressionist Painting,* 131.

and collector Katherine Dreier with the assistance of émigré artists Marcel Duchamp and Man Ray for the purpose of educating the public about experimental art. The primary avenues of exposure available for progressive American artists—notably the galleries and publications of Alfred Stieglitz—sought to educate a more limited audience. "I feel," Stieglitz wrote in 1916, "that the system now in vogue of bringing the public into contact with the painting of today is basically wrong."[107] By the time Hofmann arrived at the Art Students League, the home of American artists Thomas Hart Benton and Stuart Davis had become a destination for students seeking exposure to European modernism. "We want foreign instructors," demanded students in letters to the editor of the League's paper. "Few of us can afford to go abroad to study and learn what it is all about."[108] Advance promotion by such former Hofmann students as League faculty member Vytlacil once again created for Hofmann an overflow audience, and extra class sessions were added to accommodate his growing roster of art students and members of the art elite that included Gertrude Henry (granddaughter of Gertrude Whitney) and Pegeen Guggenheim (daughter of Peggy Guggenheim). "Everybody studied with Hofmann," recalled Davis, who saw some of his own classes cancelled due to low enrollment that season.[109] In the fall of 1933 Hofmann opened a

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[107] Alfred Stieglitz, forward to *Forum Exhibition of Modern American Painters* (New York: Anderson Galleries, 1916), 35.

[108] I.K. and A.G.B., letters to the editor, *League* 5 (Winter 1932-33): 17-18.

[109] Stuart Davis quotation via Romare Bearden in conversation with Cynthia Goodman, December 18, 1981. Cited in Goodman, "The Hans Hofmann School and Hofmann's Transmission of European Modernist Aesthetics to America," 246. George McNeil regarding class cancellation: Oral history interview with George McNeil conducted June 3, 1965 by Dorothy Seckler for the Archives of American Art, Smithsonian Institution, n.p.

year-round school at 444 Madison Avenue, a location suggested by Mercedes Carles (later Mercedes Carles Matter), one of Hofmann's League students and the daughter of Hofmann's friend painter Arthur B. Carles. The Hans Hofmann School of Fine Arts spent a year at its inaugural location and brief periods at 137 East 57th Street and 52 West Ninth Street before settling at 52 West Eighth Street in 1937 for the remainder of its operation. Hofmann lived in hotels or with students until the arrival of his wife, Miz, who traveled to the United States under the family sponsorship of Munich school student Fritz Bultman just days before France and England officially declared war on Germany in the fall of 1939.[110]

Hofmann's arrival in New York again placed him both temporally and physically at the center of modern art practice. The nexus of the art world had shifted from Paris to New York, but the dissolution of artist communities in advance of approaching war had fractured the engaged arts dialogue of Hofmann's youth. "The general social premises that used to guarantee [art's] functioning have disappeared in [war-time] Europe," Greenberg noted, "and the main premises of Western art have at last migrated to the United States."[111] The post-war nationalism of French critics reluctant to cede their capital's primacy in the art world[112] further isolated Abstract Expressionist artists desperate for community. "So urgent was the need for

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110 Dickey, *Color Creates Light,* 156-160.

111 Clement Greenberg, "The Decline of Cubism," *Partisan Review* 3 (Spring 1948): 369.

112 "French critics, as it turned out, were nearly unanimous in turning thumbs down on the works of the Americans." Serge Guilbault, *How New York Stole the Idea of Modern Art: Abstract Expressionism, Freedom, and the Cold War* (Chicago: University of Chicago Press, 1983), 148.

discussion," recalled Irving Sandler, "that private conversations in the studios and homes of artists, or even in the bars and restaurants that they frequented, did not seem adequate, and the artists established forums where they could address audiences, composed mainly of themselves, but also of critics, curators, dealers, collectors, professors, advanced art students, and the avant-gardes of the other arts."[113] It was "a mutual kind of search," according to painter Friedel Dzubas. "The search was conducted individually, but when you were together with people, you felt that there was a dynamic process of growth."[114] The position of Hofmann and his schools at the center of the New York arts community made Hofmann simultaneously the influencer and the benefactor of the leading edge of modern American art. "I think that the center [of Post World War II art] was influenced by the consciousness among artists in New York," Mercedes Matter later noted, "and that consciousness had a great deal to do with Hofmann."[115] At the height of Hofmann's popularity as a teacher, his schools in New York and Provincetown provided members of the modern arts community with access to aesthetic and technological advances in art. "It was [no longer] us against the world," recalled Hofmann student Leatrice Rose, "we were the world."[116]

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[113] Irving Sandler, *The New York School: The Painters & Sculptors of the Fifties* (New York: Harper & Row, 1978), 30.

[114] Max Kozloff, "An Interview with Friedel Dzubas," *Artforum* 4(1) (September 1965): 49.

[115] Mercedes Matter, interview with Tina Dickey and Madeline Amgott, June 7, 1998. Cited in Dickey, *Color Creates Light,* 322.

[116] Leatrice Rose, interview with Tina Dickey, May 27, 1998. Cited in Dickey, *Color Creates Light,* 245.

Coatings Innovation and Artists' Exposure to Information about Paint Materials

America's mid-twentieth-century artists benefited from both advancing paint technology and the concentrated effort of American manufacturers to promote new materials directly to artists. War-time restrictions on the phenol- and alkyd-based paints embraced by such French modernists as Picasso limited, but did not erase, Abstract Expressionist painters' access to experimental formulations. In 1936 for example, Jackson Pollock and Morris Louis worked with synthetic paint binders at a Laboratory for Experimental Techniques in Art held by Siqueiros at 5 West Fourteenth Street,[117] a forum in which artists could speak with paint chemists and work with both Keim's ethyl silicate paint[118] and the new pyroxylin-based paints of military coating manufacturer E. I. du Pont de Nemours and Company (the company name was later shortened to DuPont).[119] Shortly thereafter, researchers for the Works Progress Administration developed their Glyptal mural paint based on the alkyd house paint of the General Electric Company (now known as GE), whose patent on the formulation had run out in 1935.[120] The origin of Glyptal is alternately attributed to paint teacher Frank Sterner, Director of the Works Progress Administration's Boston

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[117] Marontate, "Synthetic Media and Modern Painting," 60.

[118] According to conservator Ralph Mayer, Keim's technique was also attempted for decorations in the New York City subway system. "Subway murals, 1937-1938," Ralph and Bena Frank Mayer papers, [ca. 1920]-1964, Archives of American Art, Smithsonian Institution, n.p.

[119] The pyroxylin brand name was thereafter associated with Siqueiros through his nickname: "il Duco."

[120] Glyptal paint resin was subsequently produced by General Electric. See *Schenectady Works Welcomes You!* (New York: General Electric Company, 1949).

Paint Testing and Research Laboratory,[121] and to Raphael Doktor, head of the Administration's Restoration, Installation and Technical Service Division in New York City.[122] Artists in the Painting and Sculpture portion of the government program—including Baziotes, de Kooning, Gorky, Gottlieb, Guston, Krasner, Pollock, Reinhardt, and Rothko—would likely have worked with Glyptal and similar commercial resin paints in the execution of Administration projects, and some artists were still using the material years later in their own work. "His medium is a mixture of one part of stand oil to two parts of damar varnish and two parts of oil of gum turpentine," recounted Fairfield Porter of Jack Tworkov's technique in the 1953 *ARTnews* article "Tworkov Paints a Picture": "[Tworkov] dissolves areas to be removed with Glyptal thinner, and adds Gyptal in small quantities to the paint to make it dry faster."[123] Commercial materials were in common use among the Abstract Expressionists, many of whom had worked in commercial trades. De Kooning, for example, supported his early years in New York with work as a sign painter, while Rothko's training in scenery production was adapted to his signature painting technique, which according to Hess utilized the staining of canvases with "scenery

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[121] Robert G. Lodge, "A History of Synthetic Painting Media with Special Reference to Commercial Materials," in *American Institute for Conservation Preprints of the 16th Annual Meeting, held in New Orleans, Louisiana, June 1–5, 1988* (Washington, DC: AIC, 1988), 121.

[122] Marontate, "Synthetic Media and Modern Painting," 94. See also Raphael Doktor papers, 1931-1942, Archives of American Art, Smithsonian Institution.

[123] Fairfield Porter, "Tworkov Paints a Picture," *Art News* 52(3) (May 1953): 73. Porter's reference to "Glyptal thinner" likely refers to a proprietary solvent mixture appropriate for use with alkyd-containing paints.

paints cooked over a hot-plate."[124] Pollock and Kline became associated with preferred commercial paint brands—DuPont and Behlens, respectively[125]—despite the efforts such commercial gallerists as Sidney Janis, who according to Sandler once broke into Kline's studio and replaced the artist's house paint with tubes of traditional Winsor and Newton oil colors.[126] Press coverage at the height of the movement's popularity even carried news of the "countless numbers of pot-pouring painters now practising[sic] in America" to audiences around the globe through such publications as *Arts News and Review* (London) and *L'Art D'Aujourd'hui* (Paris).[127]

The growing commercial paint market was not lost on post-war coatings manufacturers who found themselves with idle factories and a surplus of materials. The range of art materials available to New York's modernist painters expanded dramatically after 1945 with both an increased number of commercial coatings manufacturers and the introduction of small-run and custom paints marketed directly to artists by local paint makers that included Leonard Bocour and Sam Golden (Bocour Artists Paints Inc.) and Henry Levison (Permanent Pigments Inc.).[128] These

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124 Thomas B. Hess, "de Kooning Paints a Picture," *Art News* 52(1) (March 1953): 30-33, 64-67 and "Editorial: Mark Rothko, 1903-1970," *Art News* 69(2) (April 1970): 29.

125 Robert Goodnough, "Kline paints a picture," *Art News* 51(8) (December 1952): 38-39.

126 Irving Sandler, phone conservation with the author, August 27, 2012.

127 Albert Garrett, "Gimpel Fils" *Art News and Review,* January 24, 1953, 2.

128 Marontate, "Synthetic Media and Modern Painting," and Joyce H. Stoner, "America's Colormen: Bocour, Levison, Gamblin, and Golden" in *Modern Art, New Museums: Contributions to the 20th International Institute of Conservation Congress in Bilbao, 13-18 September 2004*, Ashok Roy and Perry Smith, eds. (London: International Institute for Conservation, 2004), 189-92.

small-run paint makers played a pivotal role in the development of acrylic artists paints and their use by Abstract Expressionists and other members of the New York arts community. The use of poly(vinyl-acetate)-based paints by New York artists was noted in a 1939 article in *The Art News* (later *Art News*) article on painter Lue Osborne entitled "A Successful Practitioner in a New Medium,"[129] but their popularity was limited and artists' use of vinyl emulsion paints waned with the post-war introduction of acrylic paint media. As with vinyl resin paints, acrylic resin paints were first available only in resin-in-solvent formulations, followed later by the commercial distribution of waterborne acrylic emulsion paints. In 1947, Golden and Bocour released Magna paint, an acrylic resin-in-solvent paint marketed as "the first new painting medium in 500 years" and anecdotally based on a sample of Acryloid F-10 resin then in use on Works Progress Administration projects.[130] The new paint was included in Bocour's lectures around the country and in "Bocour Workshop" classes at the Brooklyn Museum Art School and the Skowhegan School of Painting and Sculpture, and samples of paint were given to artists who tested the material. Notable Abstract Expressionist users of Magna paints include Newman, Rothko and Motherwell, as well as Louis and fellow Washingtonian Kenneth Noland. In 1954 Levison began commercial production of Liquitex—an artist's emulsion paint based

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[129] Doris Brian, "New Exhibitions of the Week: A Successful Practitioner in a New Medium," *The Art News* 37(37) (June 10, 1939), 15.

[130] The origin of that sample has been attributed to several artists, who said the sample was a resin they were using on murals for the Federal Arts Project. See oral history interview with Leonard Bocour, conducted June 8, 1978 by Paul Cummings for the Archives of American Art, Smithsonian Institution, n.p. See also Lodge, "A History of Synthetic Painting Media," 125.

on Rohm and Haas AC-33 acrylic resin[131]—that was a contributing factor to the change in Helen Frankenthaler's style when she switched from oil to acrylic paints in 1963. "When first introduced, Liquitex was rather thin and runny, and was not immediately successful," according to conservators Jo Crook and Thomas Learner. "However, several artists did experiment with it, such as Andy Warhol and Helen Frankenthaler. . . . Frankenthaler's second trial with acrylic emulsion paint in the early 1960s [Liquitex introduced a new formulation in 1963] was successful and from then on she continued to paint with it."[132] Paint makers were an active part of the New York arts community; they made presentations, taught classes, hired artists, and visited artists' studios. "Everybody who was anybody came, passed through [our] doors," recalled Bocour.[133]

American manufacturers also played a role in the development and standardization of new paint materials. In 1937—the same year Doerner was appointed director of the new *Staatliche Prüf- und Forschungsanstalt für Farbentechnik* (State Testing and Research Institute for Colour Technology, later the Doerner Institute)— Sterner hired Fogg Art Museum scientist Rutherford J. Gettens to assist the Works Progress Administration's efforts to institute national standards for artist's oil paint manufacture. From the collaboration of Sterner and Gettens came both the 1937 establishment of the Works Progress Administration's Boston Paint Testing

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131 Lodge, "A History of Synthetic Painting Media," 124.

132 Jo Crook and Thomas J. S. Learner, *The Impact of Modern Paints* (London: Tate Gallery Publishing Ltd., 2000), 29.

133 "Interview with Leonard Bocour," 1985, Morris Louis and Morris Louis Estate papers, 1937-2001, Archives of American Art, Smithsonian Institution.

and Research Laboratory and the Recommended Commercial Standard for Artist's Oil Paints published in 1942 by the National Bureau of Standards. The Bureau's voluntary labeling guidelines were supported by the efforts of paint manufacturers including Levison, who was an early advocate of art materials labeling, a founding member of the National Art Materials Trade Association, and an early member of the American Society for Trade and Testing Materials (ASTM).[134] Important pigments developed or modified during this period included organo-metallic blues such as copper phthalocyanine (first introduced in artist's paints as Monastral Fast Blue) and manganese blue, which were developed for use artist's paints in the mid-1930s, and the 1950s production of arylides compatible with the new acrylic paint binders.[135] A lightfast alizarin substitute became available with the introduction of quinacridone colors, first formulated in Germany in 1935 but developed for the commercial paint market by DuPont in 1958,[136] followed the next year by the company's introduction of a rutile form of titanium white more compatible with acrylic paints than previous lead- and zinc-based alternatives.[137]

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[134] Mark Gottsegen, "ASTM International Standards for Artists' Materials and Their Effects on Modern Paints," in *Modern Art, New Museums,* 193-196.

[135] Suzanne Quillen Lomax and Tom Learner, "A Review of the Classes, Structures, and Methods of Analysis of Synthetic Organic Pigments," *Journal of the American Institute for Conservation* 45(2) (Summer 2006): 109. See also Lomax, "Phthalocyanine and Quinacridone Pigments: Their History, Properties and Use," *Reviews in Conservation* 6 (2005): 19-29.

[136] De Keijzer, "The History of Modern Synthetic Inorganic and Organic Artists' Pigments," 49.

[137] De Keijzer, "The History of Modern Synthetic Inorganic and Organic Artists' Pigments," 45; Boxall, "A History of Paint Technology, Part Four," 21.

The Role of Hofmann's Schools in the Transmission of Information about New Art Materials

Hofmann's art schools were built on modernist ideals of exchange and community that encouraged the transfer of information about avant-garde materials and procedures. "He didn't so much create painters," recalled Hofmann student and neighbor Lee Krasner, "as a milieu in which painting could exist."[138] Hofmann's classrooms were a place of active dialogue between art manufacturers and practitioners as experimental media entered mid-twentieth century art practice—fertile environs for both students and colleagues to examine and influence the world around them. "To avoid being academic," Hofmann claimed, "a school of art must be a vital participant in contemporary aesthetics."[139] As in Munich, Hofmann's American schools were a bridge between the experimental nature of his progenitors and descendants. The new styles and techniques of émigré modernists and American innovators all passed through Hofmann's schools, recalled fondly by students as "a place where such ideas were aired, tried and discussed."[140] Hofmann's schools were also a crossroads for information about advancing paint technology. Although

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[138] Lee Krasner, cited in "Hans Hofmann, Artist, 85, Dead. Abstract Expressionist led a Generation of Painters through His Teachings," *New York Times,* February 18, 1966, 33.

[139] Brochure, Hans Hofmann School of Fine Arts, New York, 1937. Hans Hofmann papers, Archives of American Art. In Chapters Three and Four of this dissertation I will provide anecdotal and analytical evidence of Hofmann's use of pigments from this list.

[140] Student Fritz Bultman, lecture at Parsons School of Design, New York, 11 December 1980, reproduced in Tina Dickey, "Spatial Constellations, Rhythms of Nature," *Hans Hofmann* by Helmut Friedel and Tina Dickey (New York: Hudson Hills Press, 1997), 82.

Hofmann briefly stopped painting after his arrival in the United States (he worked exclusively in water-based media on paper until 1934), there exists a paint list from his mid-1930s return to painting which is notable for a strongly Fauvist selection of colors that includes the full range of cadmium pigments introduced while Hofmann was in Paris.[141] In comparison, the supply list for students attending Hofmann's early Provincetown classes[142] a combination of paints introduced during Hofmann's years in Europe with those of innovative American paint manufacturers. The titanium/zinc Permalba white of Philadelphia-based paint maker F. Weber and Company is listed as a required pigment, for example, and oil paints manufactured by the nascent American manufacturer Permanent Pigments (established in 1933) are recommended alongside those of established European manufacturers including Winsor & Newton, Rembrandt, and Blockx. Hofmann indirectly influenced his students' exposure to developing paint technology through the classroom visits of paint makers Bocour and Levison,[143] and through information provided by fellow Hofmann students in leadership positions at institutions experimenting with new paint media. Current and former Hofmann students in positions of authority within the Works Progress Administration during this period included Glenn Wessels and Cameron Booth in the

[141] Hand written English/German palette. Hans Hofmann papers, Archives of American Art.

[142] Hans Hofmann papers, Archives of American Art, and Rose Kuper collection of Hans Hofmann miscellany, 1932-1964, Bancroft Library, University of California Berkeley. The supply list can be tentatively dated between the 1934 publication of Sheldon Cheney's *Expressionism in Art* (on the list) and Kuper's studies with Hofmann in the late 1930s.

[143] Marontate, "Synthetic Media and Modern Painting," 225, and October 23, 2012 email correspondence between Tina Dickey and Dawn Rogala.

San Francisco region (Wessels as Bay Area Technical Supervisor and Booth as a supervisor in Oakland), and Harry Holtzman and Burgoyne Diller in New York (where they shared a supervisory post in the Federal Art Project's mural division).[144] "Whether they were influenced by Hofmann or not, doesn't matter," recalled Julian Levy. "[The school] was the meeting place for a tremendously stimulating group."[145] The school was at the center of a social scene that both attracted and influenced those interested in modern arts practice.

The atmosphere of Hofmann's schools encouraged the transfer of both theoretical and practical information. The school curriculum offered an environment that was simultaneously structured and open, where personal expression was built on a foundation of rigid practice that initially allowed only limited access to materials. "The ultimate principle of the Hofmann school was freedom," claimed Harold Rosenberg, "though freedom based on knowledge."[146] Students progressed slowly from drawing to painting classes and formed close relationships. "The very way the school was set up was good for teaching and learning," according to Hofmann student and studio assistant Wolf Kahn. "[It] helped the students create a community and an

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[144] Virginia Admiral, interview with Dickey. Cited in Dickey, *Color Creates Light,* 174, and John Lane, *Abstract Painting and Sculpture in America, 1927-1944* (New York: Harry N. Abrams, 1984), 28.

[145] Oral history interview with Julian E. Levi, conducted on October 7, 1968 by Colette Roberts for the Archives of American Art, Smithsonian Institution, n.p.

[146] Harold Rosenberg, inaugural lecture, University Art Museum, University of California, Berkeley, November 7, 1970. Reprinted as Rosenberg, "The Teaching of Hans Hofmann," *Arts Magazine* 45(3) (December 1970): 18.

esprit de corps."[147] The restrictive class structure was balanced by open studio time in an atmosphere that encouraged experimentation and dialogue amongst the close-knit generation of modernists that included such innovators as Helen Frankenthaler, Joan Mitchell, Robert Goodnough, Larry Rivers, and Richard Stankiewicz. "Meeting day after day in a small school, it was natural for Hofmann's students to develop close associations," noted Sandler. "But Hofmann himself fostered their communal inclinations."[148] The classroom was a testing ground for the new techniques and materials learned from visiting artists and manufacturers but the exposure of Hofmann's students to new ideas and materials was also increased with the enrollment of students from other art disciplines. Hofmann's teaching and the atmosphere of his school were directly influenced by the influx of new ideas and practitioners, and the school "changed continuously in response to the needs and suggestions of students"[149] according to Hofmann biographer Tina Dickey. "Instead of closing doors, he opened them," recalled student Robert Richenburg, who had arrived from his studies in Europe with Cubist painter Amédée Ozenfant to study with Hofmann.[150] Hofmann's classroom welcomed not only critics and educators, but also students from emerging art disciplines—including Happenings creator Allan Kaprow and installation art

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[147] Wolf Kahn, "Hans Hofmann's Good Example." *Art Journal* 42(1) (Spring 1982): 22.

[148] Irving Sandler, *The New York School: The Painters & Sculptors of the Fifties* (New York: Harper & Row, 1978), 33.

[149] Dickey, "Spatial Constellations," 85.

[150] Robert Richenburg, interview with Tina Dickey. Cited in Dickey, *Color Creates Light,* 249.

pioneer Red Grooms, whose experimental modes of expression were seen by Hofmann as yet another art material. “As important to students [as his compositional theories] was Hofmann’s ability to criticize the work of each in its own terms” student Richard Stankiewicz recounted, “[and] from within its [own] intentions and parameters.”[151] Kaprow celebrated the fertile environs of Hofmann’s classroom with “Push and Pull: A Furniture Comedy for Hans Hofmann,” a temporary installation of furnished rooms erected on the occasion of the Museum of Modern Art’s 1963 Hofmann retrospective and in conjunction with its corollary traveling exhibition “Hans Hofmann and His Students.” Like Hofmann’s school, Kaprow’s installation mirrored a modernist sensibility at once built by and shaping the community around it. “Everyone else can come in,” the exhibition pamphlet announced, and “accommodat[e] themselves as they see fit.”[152] Hofmann’s school was a place of active dialogue as experimental media transformed modern art practice, and through Hofmann a generation of artists and educators absorbed their teacher’s engaged yet discerning attitude towards new ideas and materials. “In addition to conserving starting points and ideals” noted Rosenberg, “the Hofmann School spread a high quality of appreciation of contemporary art which provided support for the new American painting and sculpture.”[153]

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[151] Richard Stankiewicz, statement excerpted from the Hofmann Students Dossier. Irving Sandler, “Hans Hofmann: The Pedagogical Master,” *Art in America* 61(3) (May-June 1973): 52.

[152] Allan Kaprow, “Push and Pull (a furniture comedy for Hans Hofmann).” Prepared for the Museum of Modern Art’s traveling exhibit “Hans Hofmann and His Students,” April 1963. First published in dé-coll/age 4 (January 1964): n.p.

[153] Harold Rosenberg, "Hans Hofmann's 'Life' Class." *Art News Annual* 6 (Autumn 1962): 110.

In this chapter I reviewed Hofmann's years among the avant-garde arts communities of early twentieth-century Europe and the United States and assessed his exposure to new ideas about art making and concomitant industrial innovation in art materials. I also discussed Hofmann's schools as a crossroads for wide-ranging modern arts practice and the role of Hofmann's students in the ongoing dialogue between artists and art materials manufacturers. In Chapter Three I will assess Hofmann's late-career painting style and review published and anecdotal assessments of his technique and materials, provide an overview of material behaviors and conservation methodology common to Hofmann's work, and present the late-career paintings selected for my materials analysis.

Chapter 3

THE STUDY OF HOFMANN'S LATE-CAREER PAINTINGS

> Creation is dominated by three absolutely different factors: first, nature, which affects us by its laws; second, the artist who creates a spiritual contact with nature and with his materials; and third, the medium of expression through which the artist translates his inner world.
> — Hans Hofmann, "Painting and Culture" 1931?[1]

Hofmann's life-long interest in the nature of existence guided his journey from literal to experiential representation in art. The late-career culmination of Hofmann's efforts is aided by a more comprehensive understanding of the materials at the heart of the artist's late paintings (1953-66), the selection and behavior of those materials as the artwork was created, as it ages, and as it is preserved. In Chapter Two I reviewed Hofmann's relationship with the avant-garde communities of early twentieth-century Europe and the United States and his exposure to new ideas about art making and art materials. I also discussed Hofmann's schools as a crossroads for modern arts practice and the ongoing dialogue between artists and art materials manufacturers. Chapter Three provides documentary information to support the analysis, identification, and assessment of materials to be presented in Chapter Four. In Chapter Three I will introduce the late-career paintings chosen for examination and analysis, present published and unpublished documentation regarding Hofmann's techniques and

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[1] Hans Hofmann, "Painting and Culture," trans. Glenn Wessels, *The Fortnightly* 1(1) (September 11, 1931): 5.

materials, and provide an overview of material-related behaviors common to Hofmann's work. I will also reveal the consistency among Hofmann's late paintings in terms of construct and content. In the first section of Chapter Three I will outline a compositional continuity visible across the breadth of Hofmann's late-career production that illuminates the artist's life-long thematic focus. A similar consistency among the accounts of Hofmann's practice and palette are presented in the next section of Chapter Three. These accounts provide important comparative information for scientific and art historical scholarship but thus far remain largely unpublished; they are compiled for the first time in this dissertation. Accounts of condition issues in Hofmann's work are similarly useful in highlighting patterns within the analytical data but the information contained within individual conservation reports is rarely compiled for this purpose. In order to examine the analytical data provided in Chapter Four for unique relationships between Hofmann's late-career materials and the condition of his paintings, Chapter Three includes an overview of material-related behaviors commonly seen in works on canvas and those condition issues observed in Hofmann's late-career paintings. Any materials-based interpretation of Hofmann's practice hinges on excluding non-original materials from those identified as part of the artist's palette. Chapter Three therefore concludes with an overview of conservation materials specifically noted or in common use during the preservation of the study group paintings.

The Origins and Development of Hofmann's Late-Career Style

> A thing in itself never expresses anything. It is the relation between things that gives meaning to them. —Hans Hofmann, 1948[2]

There is an intentional consistency hidden in Hofmann's late-career works. The paintings produced by Hofmann from the mid-1950s onward are the most acclaimed and collected of the artist's work. Critical and scholarly attention is commonly focused on the "signature" works of this late period that feature boldly colored rectangles, but discussions of these compositions has thus far been limited to literal interpretations of these geometric forms. The symbolic nature of these forms becomes apparent when viewed within the breadth of Hofmann's late-career oeuvre. The appearance and evolution of the artist's colored rectangles highlight a thematic signature of depth and complexity that ties together seemingly disparate compositions. Hofmann's rectangles allude to—but do not define—the artist's signature endeavor.

The Origins of Hofmann's Late-career Color Planes

The colored rectangles associated with Hofmann's late-career oeuvre emerged in the mid-1950s, shortly before the artist retired from teaching. Although Hofmann was painting in the United States as early as 1934,[3] his early work was restless and

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[2] Hans Hofmann, "The Search for the *Real* in the Visual Arts," in *Search for the Real and Other Essays*, eds. Sara T. Weeks and Bartlett H. Hayes, Jr. (Cambridge and Andover, Massachusetts: The M.I.T. Press and the Addison Gallery of American Art, 1948), 46.

[3] Hofmann's early years in the United States were spent drawing instead of painting. For Hofmann's return to painting, see Barbara Wolanin, "Prelude to Provincetown: Hofmann, Matter, Carles, and the Legacy of their 1934 Gloucester Summer," in *From Hawthorne to Hofmann: Provincetown Vignettes, 1899-1945* (New York: Hollis Taggart Galleries, 2003), 40-57.

lacked focus. The establishment and supervision of art schools in Munich and the United States imposed time and budget constraints on Hofmann that limited progress in his personal work well into the 1940s. "The school as long as she not works as she should [sic] is always a great hindrance in the personal work," Hofmann confided in a July 1941 letter to student Alice Hodges.[4] Landscape drawings and interior studies comprised much of the artist's personal work during his early years in the United States. "For fifteen years [Hofmann] hardly picked up a brush," Greenberg noted later, "but drew obsessively."[5] Despite his frustration, Hofmann sought value in this exploratory period. "The main thing is always to work and work," Hofmann in 1941 explained to Hodges and fellow student Lillian Olinsey Kiesler. "My work comes along in a rather experimental period [in] which I find myself [placed] on the way to the highest freedom."[6]

For more than a decade following Hofmann's return to painting in 1934, the artist worked primarily on inexpensive plywood panels. Few examples of works on canvas exist prior to 1947, when canvas returned as a primary support material in

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[4] Letter, Hans Hofmann to Alice Hodges, July 14, 1941. Lillian and Frederick Kiesler Papers, [circa 1910]-2003, bulk 1958-2000. Archives of American Art, Smithsonian Institution (hereafter AAA, SI).

[5] Greenberg, *Hans Hofmann*, 12.

[6] Letter, Hans Hofmann to Alice Hodges and Lillian Olinsey Kiesler, September 5, 1941. Hans Hofmann papers, [ca. 1904]-1978, (bulk 1945-1965), AAA, SI.

Hofmann's paintings.[7] The range of styles explored in Hofmann's early American paintings has subsequently placed the artist among every mid-century modernist movement outlined in Irving Sandler's compendium *The Triumph of American Painting: A History of Abstract Expressionism*.[8] During the 1940s in New York avant-garde European and American artists transformed oil paintings with experimentation in materials, technique, and composition. The range of experimentation was noted by Museum of Modern Art curator William Seitz in his catalogue for the museum's 1963 Hofmann retrospective. "When one looks back at the years after 1945, when the "New American Painting" was taking form," noted Seitz, "it is apparent that one of its aesthetic determinants was the desire felt by many artists to incorporate in their work tendencies of style and feeling previously thought to be contradictory."[9]

Critical reception of Hofmann's work also suffered due to the artist's use of small-scale canvases. Hofmann continued to work with conventionally sized canvases—those that could fit on an artist's easel and hang on a modestly sized wall—long after his Abstract Expressionist colleagues had shifted to the large-scale

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[7] Both oil paint and water-based materials appear in Hofmann's paintings from the 1930s and 1940s. See Tony Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann" (unpublished report with editing marks, S. Haas Conservation Department, San Francisco Museum of Modern Art, 1982). Works on canvas appear among the limited extant examples of Hofmann's painting during his years in Europe. Works on panel continue to appear into the early 1950s.

[8] Irving Sandler, *The Triumph of American Painting; A History of Abstract Expressionism* (New York: Praeger Publishers, 1970), 67, 79, 92.

[9] William C. Seitz, *Hans Hofmann: With Selected Writings by the Artist* (New York: Museum of Modern Art, 1963), 7. Seitz was Curator of the Department of Painting and Sculpture at the Museum of Modern Art from 1960-70.

compositions associated with an artist's direct engagement with painting. "To paint a small picture," Rothko told a 1951 audience at a Museum of Modern Art symposium, "is to place yourself outside of your experience."[10] Hofmann's lingering loyalty to what Greenberg called "the easel convention"[11] was seen as an impediment to Hofmann's direct engagement with nature, the ultimate source of abstract subject matter. "You see, Hofmann separates himself from nature," Lee Krasner recalled, "he puts nature out there, and he is the observer."[12] The rising prominence of a bold palette and a distinctive compositional vocabulary in Hofmann's paintings soon overpowered concerns regarding the size of the artist's work. "[Hofmann's] canvas, in point of fact, is man-sized," Seitz noted in 1955, "[but] there is no doubt that . . . his best canvases scale larger."[13] Hofmann's vivid palette and bold compositions soon set his works apart from those of his Abstract Expressionist colleagues. Although

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[10] Mark Rothko, "Statement," *Interiors* 110(10) (May 1951): 104. Excerpt of Rothko's statement at the March 19, 1951 Museum of Modern Art symposium "How to Combine Architecture, Painting, and Sculpture."

[11] Clement Greenberg, "American-Type Painting," *Partisan Review* 12(2) (Spring 1955): 184.

[12] Barbaralee Diamonstein, "An Interview with Lee Krasner," series of interviews conducted at the New School of Social Research, New York; reprinted in Diamonstein, *Inside New York's Art World* (New York: Rizzoli, 1979), 202. This quotation refers to an oft-repeated exchange between Hofmann and Pollock in which Hofmann suggests that Pollock's painting would improve if he derived his subject matter from the natural world, and Pollock flippantly replied "I am nature." See Oral history interview with Lee Krasner, conducted on November 2, 1968 by Dorothy Seckler for the Archives of American Art, Smithsonian Institution, n.p.

[13] Seitz, "Abstract Expressionist Painting in America: An Interpretation based on the Work and Thought of Six Key Figures" (PhD diss., Princeton University, 1955), 233, 240.

Hofmann's canvases never grew to the size of those by Pollock or Rothko, the distilled color and form of Hofmann's larger, late paintings often overpowered nearby works by other artists. "At more than one group show," recalled Greenberg, "I have had the experience of seeing even a rather indifferent Hofmann make all the other works present, including those by more cried-up artists, seem a little less than present by contrast."[14] Hofmann's late-career paintings are a distillation of both medium and message—fundamental truths explored through the fundamental materials of painting. "When I myself not so long ago complained in print that Hofmann was failing to realize his true potentialities," Greenberg later admitted, "it was because I had not caught up with him."[15]

Hofmann's late-career style disassembled and recombined the influences of his modernist training into a completely new visual vocabulary. Hofmann advanced the studies of his Cubist and Fauvist forebears by using the relational effects of neighboring colors to create dimensionality, a phenomenon Hofmann called "push and pull." "Push and Pull is a colloquial expression" Hofmann explained in his teaching manual *The Painter and His Problems*, "applied for movement experienced in nature or created on the picture surface to detect the counterplay of movement in and out of depth."[16] Hofmann's signature style is distinguished by the primacy of relational

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14 Greenberg, *Hans Hofmann* (Editions Georges Fall, 1961), 28.

15 Greenberg, "American-Type Painting," 184.

16 Hans Hofmann, "The way we see: analysis of eyesight in relation to physical experience of nature," *The Painter and His Problems: A Manual Dedicated to Painting,* unpublished typescript, March 21, 1963. Special Collections, Museum of Modern Art. The manual is a compilation of teaching used throughout Hofmann's career.

color; in melding the structural planes of Cubism with the symbolic color of Fauvism, Hofmann's compositions are driven by "symbolic structure"—color that shapes and energizes the picture plane. "Much as [Hofmann] relied on Cubist design throughout his career," Sandler noted, "he was one of the first to loosen it by opening its closed planes and by using color in itself to determine structure. . . . At the same time that Hofmann maintained surface tension, he invested each area with a suggestion of the third dimension that made it feel ample "[17] Hofmann said that he constructed his compositions from planes of color representing "the space *in front* of the object, the space *in* the object, and the space *in back* of the object,"[18] but maintained that the relationship of these planes to each other and to other elements of the composition was ultimately determined by the relationship between colors. "It is the color *development*," Hofmann emphasized, "that determines the form."[19]

The breakthrough in Hofmann's use of color planes emerged concurrently with the artist's work in mosaic. In 1955, Kootz arranged for Hofmann to create a mosaic mural for the lobby of 711 Third Avenue, a building designed by architect William Lescaze and builders William Kaufman and Jack D. Weiler. The Third Avenue project was the first of the artist's mosaic designs to be produced[20] and the experience of

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[17] Sandler, *The Triumph of American Painting*, 138-39.

[18] Hans Hofmann, "Plastic Creation," trans. Ludwig Sander, *The League* 5(2) (Winter 1932-33), 4.

[19] Hans Hofmann, "The Color Problem in Pure Painting—Its Creative Origin," *Hans Hofmann: New Paintings* (New York: Kootz Gallery, 1955), 3.

[20] Hofmann had previously worked with architects José Luis Sert and Paul Lester Weiner to produce unrealized mural designs for a church in Chimbote, Peru in conjunction with the October 1950 exhibition "The Muralist and the Modern Architect," for which Samuel Kootz paired artists with architects to work on site-

translating sketch to full-size mosaic directly influenced Hofmann's work on canvas. Hofmann enlisted the help of students such as James Gahagan and Max Spoerri to translate the Third Avenue sketches into a full-sized design plan[21] and during the 1956 phase of mural preparations, painted papers used by Gahagan as place-markers caught Hofmann's attention and became permanent components of the mural design. "One morning [Gahagan] painted up a pile of rectangle sheets of paper and laid them flat on the mural [plan]," Tina Dickey reported. "Hofmann arrived and began to move them about with excitement. Once they established the rhythmical structure of that section, Gahagan expected to pick up the papers to fill in the area with paint. But Hofmann insisted they remain part of the composition"[22] Hofmann had previously torn and rearranged portions of student drawings to demonstrate the effect of shifting compositional planes, but it was around the time of the Third Avenue project that blocks of solid color became a central presence in Hofmann's teaching. According to Dickey:

> During the summer 1956 session, at one Friday critique in Provincetown, seventy people crowded close in rapt attention. Students

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specific designs. Other pairings for this show included William Baziotes and Philip Johnson, Adolph Gottlieb and Marcel Breuer, David Hare and Frederick Kiesler, and Robert Motherwell and The Architect's Collaborative (a firm led by Walter Gropius).

[21] Other students working on the mural project included William Freed and Robert Fisher.

[22] Interview with James Gahagan conducted on March 30-31, 1991 by Tina Dickey. Cited in Dickey, "A Decisive Moment: Hofmann's Mosaic Murals," *Hans Hofmann: Revised and Expanded*, ed. James Yohe (New York: Rizzoli, 2002), 274. Similar colored papers were used for Hofmann's 1958 design for a mural at the New York School of Printing (now the High School of Graphic Communication Arts) at 439 West 49th Street.

> mingled with critics, collectors, dealers, writers, and poets, all by invitation. Gahagan stood by a table full of colored paper rectangles. Haynes Ownsby had never seen big rectangles of colored papers used in a Friday critique before.[23]

In 1956, free-floating planes of color appeared in Hofmann's paintings, and while some attention has been paid to the prevalence of color papers in Hofmann's teaching after this period, little has been written about the correlation between Hofmann's mural designs and the appearance of one of the most recognizable elements of his late-career paintings. Critical inquiry has acknowledged similarly shaped elements in Hofmann's earlier compositions—"the rectangles started poking through the Cubist space of Hofmann's paintings around 1954," artist/historian Walter Darby Bannard noted in a 1969 *ARTFORUM* essay, "but gained no solid purchase"[24]—and the sudden transformation of colored forms into fundamental components of the artist's late work—"solidified rectangles first figure as a major compositional element in 1956," historian Cynthia Goodman wrote, "and from this time on, [Hofmann] was irrevocably committed to their use"[25]—without reference to the transformative link provided by the colored papers used in Hofmann's mural projects. The link between Hofmann's murals and his signature compositional elements remains largely ignored despite direct physical evidence of the mural

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[23] Frank Crott, "Expert in Abstract Is Hans Hofmann, 76," *Worcester Sunday Telegram,* November 18, 1956, 29; interview with Sam Feinstein conducted on October 15, 1998 by Tina Dickey; interview with Haynes Ownby conducted on November 30, 1992 by Tina Dickey. Cited in Tina Dickey, *Color Creates Light: Studies with Hans Hofmann* (Salt Spring Island, BC: Trillistar Books, 2011), 317.

[24] Walter Darby Bannard, "Hofmann's Rectangles," *ARTFORUM* 7(10) (Summer 1969): 39.

[25] Cynthia Goodman, *Hans Hofmann* (New York: Abbeville Press, 1986), 70.

projects' impact on Hofmann's late-career paintings. The colored papers Hofmann used in laying out his mural designs were enlisted in composing the artist's late works on canvas, and anecdotal and photographic records of Hofmann at work document colored papers pinned to works in process. Evidence exists that Hofmann continued to utilize commercial and homemade color swatches as compositional aids for the rest of his career.[26] An inventory of the artist's studio contents following his death in 1966 includes a list of commercially available "Color-aid" papers, "[a] portfolio of 100 excellent pieces of construction paper," and "several hundred color blends [by] Mr. Hofmann on 3 x 5 cards."[27]

The prominent geometric shapes in Hofmann's late paintings bear limited similarity to the hard-edged figures employed by contemporaneous nonobjective painters. Hofmann's use of rectangles, for example, should not be confused with the geometric work of his former student Josef Albers. Hofmann's signature compositions employ abstract figuration tied to objects in the natural world, while paintings such Albers's *Homage to the Square* series are devoid of corporeal subject matter (see Chapter One, "The principal Abstract Expressionist painting characteristics"). Albers replicated a set series and compositions and measured and recorded his color formulations like laboratory experiments, in contrast with the emotion and empathy at the core of Hofmann's relationship to color and form. "[His] color has to do with feelings" scholar William Agee noted of Hofmann's late work, "and Hofmann is

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[26] Max Spoerri in conversation with the author on October 19, 2011, at a gathering following a lecture by Tina dickey at the New York Studio School of Drawing, Painting and Sculpture.

[27] "Estate inventory of Main Studio and School," September 1972. Hofmann Papers.

nothing but feelings."[28] There is more likely a connection between Hofmann's use of geometric shapes to create dimension and environment within the flat picture plane and the work of Albers's Bauhaus colleague and nonobjective pioneer Wassily Kandinsky. As noted previously (see Chapter Two, "Hofmann's return to Germany and his new role as a teacher of avant-garde art"), Hofmann stored dozens of Kandinsky's early, more nature-based abstract works in his studio when he returned to Munich.[29] Elements of Kandinsky's geometric vocabulary are most evident in Hofmann's mosaic projects of 1956 and 1958,[30] but this potentially latent expression of his fellow Münchner's influence is quickly subsumed into Hofmann's resolutely representative compositions.[31] The moment Hofmann's color planes move from the

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[28] William C. Agee, "Hans Hofmann: Art Like Life is is Real," in *Hans Hofmann: Art Like Life is Real* (New York: Ameringer McEnery Yohe, 2012), 7.

[29] Accounts differ of the exact number of works stored by Hofmann and Wolfegg. At least two dozen works are listed in a letter to Münter dated June 3, 1927. Gabriele Münter and Johannes Eichner Foundation, Lenbachhaus, Munich. Cited in Tina Dickey, *Color Creates Light,* 73. As noted in previously, the abstract foundations of Kandinsky's early work are discussed in Rose-Carol Washton Long, *Kandinsky: The Development of an Abstract Style* (Oxford: Clarendon Press, 1980).

[30] This is particularly evident when Hofmann's mural designs are compared to such large-scale compositions as Kandinsky's installation for the 1922 Juryfreie Kunstschau Berlin (Jury-free art exhibition Berlin). Installation drawings and images are now part of the Kandinsky Library at the Musée national d'art moderne/Centre de creation industrielle, Centre Pompidou, Paris. See Maria Gough, "The Abstract Environment" in *Inventing Abstraction 1910-1925: How a Radical Idea Changed Modern Art,* ed. Leah Dickerman (New York: Museum of Modern Art, 2012), 310-23.

[31] Kandinsky himself showed an early affinity for abstraction. According to German art historian Will Grohmann, Kandinsky's early use of bold color and abstract, emotional compositions caused friction with his teachers at the Munich Academy. See Will Grohmann, *Wassily Kandinsky: Life and Work*, trans. Norbert Guterman (New York: Harry N. Abrams, 1958), 33-34. See also "Wassily Kandinsky," in Nicholas F.

wall to the canvas they become aspects of the artist's established personal vocabulary —abstractions of form with direct ties to identifiable subject matter. If Hofmann's rectangles are evidence of the artist's nonobjective experimentation, that influence is like all of Hofmann's formative experiences—interpreted and advanced at the hand of the master modernist.

The Role of Color Planes in Hofmann's Late-career Paintings

Formal analysis of Hofmann's color planes reveals an underlying continuity in the artist's late-career work. Terms previously used to describe the planes—from Goodman's "substantial slabs of color"[32] to Bannard's "large-scale small-piece all-over Cubism [LASPAC]"[33]—imbue the planes with specifics of appearance or function that limit their inherent flexibility. As noted above, Hofmann's compositions are driven by relational color. The term "color planes" is therefore appropriate, as it reflects the primacy of the planes' colors in determining the function of the planes. Formal analysis of Hofmann's late-career paintings sheds light on the evolving function of these color planes and in doing so reveals a consistent theme running throughout the artist's late-career oeuvre.

Each of Hofmann's late paintings can be sited along two abstract, formalist trajectories: open/closed composition, and overt/obscure figuration (the figures in this case being Hofmann's abstracted color planes). The first trajectory is defined by the

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Weber, *The Bauhaus Group: Six Masters of Modernism* (New York: Alfred A. Knopf, 2009), 204-58.

[32] Goodman, *Hans Hofmann*, 86.

[33] Bannard, "Hofmann's Rectangles," 38.

concentration of color planes and the second trajectory is defined by the physical boundaries of those planes. The 1961 diptych *Combinable Wall I and II* (figure 3.1), for example, is a closed composition, filled with interlocked planes of heavy paint through which no open space is visible. *Combinable Wall I and II* also represents overt figuration in the presentation of the color planes. The boundaries of each color plane are clearly defined, the thick paint of each plane applied with a palette knife to a hard-edged border that gives physical presence to these primary compositional elements. "[These] planes are paint loaded," noted Sandler. "The vivid, dissonant colors . . . strain to burst the stable rectangular containers."[34] In contrast, Hofmann's 1962 painting *Memoria in Aeternum*—dedicated to the memory of Arthur Carles, Arshile Gorky, Jackson Pollock, Bradley Walker Tomlin, and Franz Kline—combines open composition with overt figuration, floating a handful of hard-edged planes over an open area of brushy color (figure 3.2).

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[34] Sandler, *The Triumph of American Painting*, 144.

Figure 3.1 (left): Hans Hofmann, *Combinable Wall I and II*, 1961, oil on canvas, 84.5 x 112.5" (214.6 x 285.8 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1963.10). Figure 3.2 (right): Hans Hofmann, *Memoria in Aeternum*, 1962, oil on canvas, 84.0 x 72.1" (213.4 x 183.2 cm.). Gift of the artist, collection of the Museum of Modern Art (399.1963). Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These paintings are examples of overtly figured color planes presented in closed (left) and open (right) compositions.

Hofmann's open compositions typically feature large areas of exposed ground and brushy color that support a handful of thickly painted color planes or splashes of heavy paint. In *Memoria in Aeternum,* two glowing color-planes of the style seen in *Combinable Wall I and II* float within a murky background that partially obscures remnants of luminescent color atop a bright white ground. "I cannot think of another painting that intimates immortal hopes by such strictly abstract means," proclaimed Rosenberg, who said the painting gave "the impression of being inside the earth."[35]

Figure 3.3 (left): Hans Hofmann, *Ruby Gold*, 1959, oil on canvas, 55.4 x 40.5" (140.7 x 102.9 cm.). Marion Stratton Gould Fund, collection of the Memorial Art Gallery, University of Rochester (60.37). Figure 3.4 (right): Hans Hofmann, *Indian Summer*, 1959, oil on canvas, 60.1 x 72.2" (152.7 x 183.4 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1965.11). Images courtesy of the Memorial Art Gallery, University of Rochester and the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These paintings are examples of obscurely figured color planes in closed compositions.

Color planes with organic shapes or indistinct borders also appear in both closed and open compositions. Examples of Hofmann's obscurely figured

[35] Harold Rosenberg, "The Art Galleries: Hans Hofmann and the Stability of the New," *The New Yorker* 39(37) (November 2, 1963): 104.

compositions range from the brushy-edged rectangles packed into *Ruby Gold* and *Indian Summer* (both 1959, figures 3.3 and 3.4) to the floating bursts of color that punctuate the open expanses of *Tormented Bull* (1961, figure 3.5) and *Struwel Peter* (1965, figure 3.6). Obscurely figured planes do not always fall parallel to the picture edge,[36] but remain leading characters in the color relationships that anchor and activate Hofmann's compositions.


Figure 3.5 (left): Hans Hofmann, *Tormented Bull*, 1961, oil and enamel on canvas, 60.1 x 84.3" (152.7 x 214.1 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1963.6). Figure 3.6 (right): Hans Hofmann, *Struwel Peter*, 1965, oil on canvas, 72.1 x 60.3" (183.1 x 153.2 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1966.5). Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These paintings are examples of obscurely figured color planes in open compositions.

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[36] The tilted color plane in Hofmann's *Imperium in Imperio* (1964, collection of the Berkeley Art Museum and Pacific Film Archive) is the only overtly figured plane that is not positioned parallel to a canvas border.

Other works fall between the formalist polarities described above. Obscurely figured splashes of paint, for example, appear in concert with overtly delineated color planes in 1959 painting *The Vanquished* (figure 3.7), just as soft-edged rectangles mix with brushy paint strokes to envelop more geometric shapes in *The Clash* (1964, figure 3.8).

Figure 3.7 (left): Hans Hofmann, *The Vanquished*, 1959, oil and enamel on canvas, 36.1 x 48.1" (91.7 x 122.2 cm.). Bequest of the artist, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1966.49). Figure 3.8 (right): Hans Hofmann, *The Clash*, 1964, oil on canvas, 52.1 x 60.3" (132.3 x 153.2 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1965.8). Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These images represent a mixing of formalist approaches often seen in Hofmann's late-career work.

Although Hofmann continued to produce painting along this formalist spectra throughout his career there is a distinct progression in the artist's late work from closed to open compositions, as the closed works of the late 1950s (including *Ruby Gold, Indian Summer,* and *the Vanquished*) give way to a preference for open compositions in the early 1960s (such as *Memoria in Aeternum, The Clash,* and *Struwel Peter*). 1961 is a transitional year, featuring both the closed/overt *Combinable Wall I and II* and the open/obscure *Tormented Bull*.

Despite the formalist range of Hofmann's compositions, there is a consistency in the artist's drive to explore and distill his subject matter. The exploratory thread connecting Hofmann's work was missed by contemporaries such as art historian Peter Selz, who claimed that "unlike most of the New York painters . . . Hofmann did not work in series nor cultivate a single, signature style."[37] The variations of composition seen in Hofmann's late works are more reflections of changing emotion than of changing purpose. "As an artist I must conform to my nature," Hofmann told colleagues at the Studio 35 Sessions. "My nature has a lyrical as well a dramatic disposition."[38] These formalist variations should not be confused with a lack of focus on the part of the artist. Hofmann's late work is a distillation of methods and materials in search of the essential reality behind his subject matter. "Artistic creation," according to Hofmann, "is the metamorphosis of the external physical aspects of a thing into a self-sustaining spiritual reality."[39] In this sense, even the most obscurely figured colors function as color planes in Hofmann's work, actively participating in the relational environment at the heart of Hofmann's paintings. "There's not always a

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[37] Peter Selz, "Hans Hofmann: Selections from the Artist's Gift to the University," *American Art Review* 5(2) (Winter 1993): 130.

[38] Hans Hofmann, excerpted from the transcript of the 1950 Sessions at Studio 35, in *Modern Artists in America,* eds. Robert Motherwell et al. (New York: Wittenborn Schultz Inc., 1951), 21.

[39] Hofmann, "The Search for the *Real* in the Visual Arts," 40.

rectangle to be found," Bannard noted, "but . . . when physically absent they [leave] the imprint of their authority."[40]

Hofmann's Late Pictorial Achievement

In the last year of his life Hofmann took a significant step forward in his compositions. After nearly a decade spent exploring the energetic relationships between objects, Hofmann produced a handful of works that depict the forces at play within energy itself.

In the first phase of this journey, Hofmann's color planes reflect and then advance Cubist principles. The still life origins of Hofmann's 1955 painting *Exuberance* (figure 3.9) can be seen in the artist's static blocks of color, but just two years later Hofmann moved beyond the literalness of Cubist composition to illustrate relationships between objects and their surroundings in works such as *Sommernachtstraum* (figure 3.10). The color planes in this work still perform a representative function, but are no longer tied to the physical contours of the object. Hofmann asserted that his subject had not been abandoned, but had instead transformed. "I have never given up on the *object*," Hofmann said the year he painted *Sommernachtstraum*. "When you analyze nature in regard to a picture, then the object is absorbed through light, or shadow, or color."[41] In *Sommernachtstraum* Hofmann's color planes emerge as symbolic descriptors of an object, as noted by Seitz in his catalogue essay for the artist's 1963 retrospective at the Museum of Modern Art.

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[40] Bannard, "Hofmann's Rectangles," 39.

[41] Hans Hofmann, cited in Frederick S. Wight, *A Retrospective Exhibition of Hans Hofmann* (Berkeley: University of California Press, 1957), 23.

“Hofmann is attentive to physical bodies of all categories, from mountains and buildings to still life and the posed model, but he sees them simplified and essentialized,” Seitz said. “Following this interpretation, even Hofmann’s most abstract paintings can be seen as a dialogue between stripped ‘objects.’”[42] Hofmann’s metaphysical underpinnings are clear. “The artist’s technical problem is how to transform the material with which he works back into the sphere of the spirit,” Hofmann noted:

> This two-way transformation proceeds from metaphysical perceptions . . . the search for the essential nature of reality. And so artistic creation is the metamorphosis of the external physical aspects of a thing into a self-sustaining . . . reality. Such is the magic act which takes place continuously in the development of a work of art.[43]

Sommernachtstraum is an early example of what can be called Hofmann’s essentialist portraiture, compositions that explore the essence of their subject matter. In *Sommernachtstraum* Hofmann depicts the energetic relationships between object and environs through the relational energies of neighboring colors. “The creative process lies not in imitating, but in paralleling nature,” wrote Hofmann, “[in] translating the impulse received from nature into the medium of expression through which the artist translates his inner world.”[44]

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[42] Seitz, *Hans Hofmann*, 11.

[43] Hofmann, “The Search for the *Real* in the Visual Arts,” 40.

[44] Hans Hofmann, "Painting and Culture," trans. Glenn Wessels, *The Fortnightly* 1(1) (September 11, 1931): 5.


Figure 3.9 (left): Hans Hofmann, *Exuberance*, 1955, oil on canvas, 50.0 x 40.0" (127.0 x 101.6 cm.). Gift of Seymour H. Knox, Jr., collection of the Albright-Knox Art Gallery (1955:8). Figure 3.10 (right): Hans Hofmann, *Sommernachtstraum*, 1957, oil on canvas, 52.0 x 60.0" (132.1 x 152.4 cm.). Gift of Seymour H. Knox, Jr., Collection of the Albright-Knox Art Gallery (1958:4). Images courtesy of the Albright-Knox Art Gallery. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These works illustrate Hofmann's early use of color linked to an object's physical form.

By the early 1960s Hofmann's focus had shifted from external to internal relationships. In the 1962 painting *Heraldic Call* (figure 3.11), for example, the still life environs of the artist's earlier work fall away as the viewer is pulled deeper into the composition. The hard-edged color planes of *Heraldic Call* do not interact with the black background form—they *emerge* from it. "The space in the object incorporates our objective world in its limits," wrote Hofmann, "and space in front of and behind the object, infinity."[45] The viewer is now positioned within the relational compositions they had previously observed from a distance. The relationships that define this painting are distilled from a more fundamental environment than the artist's earlier compositions. These works simultaneously move beyond the object and position that object at the heart of the painting.

Figure 3.11 (left): Hans Hofmann, *Heraldic Call*, 1962, oil on canvas, 60.3 x 48.4" (153.2 x 122.9 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1965.17). Image courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Image used with permission of the Renate, Hans & Maria Hofmann Trust. As the splashed paints of Hofmann's earlier work moved from foreground to background, the focus of Hofmann's compositions shifted from external to internal relationships.

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[45] Hans Hofmann, "Plastic Creation," trans. Ludwig Sander, *The League* 5(2) (Winter 1932-33), 4.

In a similar manner, these paintings advance beyond the object-based color and compositional theories that remain central to their execution. In a late 1950s article entitled "Hans Hofmann: Grand Old Rebel," Greenberg blamed Hofmann's delayed adoption of a personal style on the artist's "Cubist trauma,"[46] but by the early 1960s Greenberg recognized in the artist's work an evolution of Cubist principles. Greenberg's 1961 monograph on the then eighty-one year-old artist includes the suggestion that "Hofmann's Cubism, while becoming more outspoken than ever before . . . began at the same time both to vindicate and transcend itself—as if to purposefully refute what I had already said about it."[47]

Hofmann's final paintings are the culmination of his artistic journey. In the last months of his life Hofmann turned his gaze to the forces at play within energy itself. In 1965, Hofmann explored the building blocks of existence in a handful of powerful works such as *Struwel Peter* (figure 3.6). The culmination of Hofmann's search for an object's essence, this primordial composition depicts the burst of energy from which all other relationships originate. These late pictures complete the viewer's journey into the object—from the energy of the object's environs to the energetic structure of the object, perceiving at last the interactive energies upon which the object's existence is founded. These unique compositions simultaneously exist in and out of the picture plane; they are self-contained and in balance with all creation. "These teeming canvases," critic Jesse Murray noted, "become not only metaphors of nature but of the

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[46] Clement Greenberg, "Hans Hofmann: Grand Old Rebel," *Art News* 57(9) (January 1959): 27.

[47] Greenberg, *Hans Hofmann*, 37.

fullness of life in the universe."[48] The relational nature of Hofmann's "push and pull" color theories are a metaphor for the essence of reality at the heart of Hofmann's painting. "We experience totality of space as the result of forces and counter-forces that make a vital, force-impelled dynamic space," Hofmann told a Dartmouth College audience in 1962.[49] "These forces and counter-forces reveal each other in varied but precisely defined tensions, which leads me to the conviction that space itself is energy."[50] In a lecture at the Smithsonian Institution ten years after Hofmann's death, student Fritz Bultman divulged that Hofmann sometimes called his works "quantum paintings,"[51] using a physics term defined as the smallest physical entity necessary for interaction. The distillation of relationships to their primary forces is an apt profession for the artist who lived in Munich when German physicist Albert Einstein received the Nobel prize for work that defined the building blocks of energy, one of many advances

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[48] Jesse Murry, "Hofmann's Use of Nature as Aesthetic Norm," *Arts Magazine* 55(6) (February 1981), 106.

[49] Hofmann received honorary doctoral degrees from three American institutions: Dartmouth College in New Hampshire (Doctor of Fine Arts, 1962), the University of California at Berkeley (Doctor of Fine Arts, 1964), and Pratt Institute in New York (Doctor of Fine Arts, 1965). Hofmann was awarded honorary membership in the Akademie der Bildenden Künst in 1962 and became a member of the National Institute of Art and Letters (now the American Academy of Arts and Letters) in 1964.

[50] Hans Hofmann, excerpted from his November 17, 1962 inaugural lecture for the Hopkins Center at Dartmouth College. Reprinted as "Hans Hofmann on Art," *Art Journal* 22(3) (Spring 1963): 180, 182.

[51] Fritz Bultman, excerpt from a lecture delivered in October 1976 at the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution. Cited in Goodman, *Hans Hofmann*, 89.

in science and psychology that influenced contemporary modern artists.[52] Like Einstein, Hofmann chose an essential act—creation—and harnessed it, explored it in the world around him, and turned it in on itself. Hofmann explained this distillation in a handwritten passage entitled "Motto," found among Hofmann's personal papers:

> Art is not an aesthetical manifestation only. Spiritual profoundness is inward orientation. . . . It is through empathy in the spirit of nature and empathy in the spirit of the [painting] medium that this . . . is realized. When the message is truly profound and great[,] the aesthetical communication on which it is based is truly simple and pure.[53]

Critical interest in the thematic and compositional consistency in Hofmann's late work arose shortly after his death. "If the terms in which those [early and late] styles are presented differ slightly," posited historian Charles Millard in 1977, "the problems to which they address themselves are roughly the same."[54] "These works . . .

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[52] Einstein was awarded a 1921 Nobel Prize for his discovery of the law of the photoelectric effect, central to the study of quantum physics (he received the award in 1922). Hofmann discussed the fourth dimension in his 1930 *The Art Digest* essay "Art in America," 4(19) (August 1930): 27. Einstein's Theory of Relativity and other forward-thinking scientific innovations were influential among Hofmann's European and American modernist colleagues, as noted in the subsequent *Art Digest* publication of a 1950 manifesto released jointly by the Institute of Contemporary Art, Boston, and the Museum of Modern Art and Whitney Museum of American Art in New York. "Art which explores newly discovered levels of consciousness, new concepts of science and new technological methods is contributing to humanism in the deepest sense, by helping humanity come to terms with the modern world." "A Statement on Modern Art," March 1950. Reports and Pamphlets, Museum of Modern Art Archives. Excerpt also published in Peyton Boswell, "Comments: 'Modern Manifesto,'" *Art Digest* 24(13) (April 1, 1950): 5.

[53] Hans Hofmann, "Motto," handwritten note dated August 30, 1948. Hofmann papers.

[54] Charles W. Millard, "Hans Hofmann," *The Hudson Review* 30(3) (Autumn 1977): 404.

remain as dense and complex as when we first saw them," concurred Metropolitan Museum of Art curator Henry Geldzahler in his catalogue for a 1977 exhibition of Hofmann's late paintings, "but they are beginning to look more and more like Hofmann's. . . . It is now easier to recognize the qualities of style and personality that bind the individual works together."[55] The early roots of Hofmann's work have also begun to draw attention, as historians such as Barbara Rose ascribe the power and directness of Hofmann's late-career canvases to his early lessons in the modernist distillation of color and form. "Hofmann achieved his own personal style not through a sudden existential epiphany," Rose noted, "but through a lifetime of laborious, painstaking progress toward a synthesis of the modernist tradition he had encountered along the way."[56] This lifelong effort was also acknowledged by Samuel Kootz, the gallery owner who promised Hofmann lifetime representation and closed his gallery one year after the artist's death with an *Arts Magazine* article entitled "The Credibility of Color":

> I was happy for Hans, these past ten years. He was creating master work after master work, among which were the squares and rectangles, those "irrational" areas of brilliance in color and final placements in space. "These," said Hans, "are not easy. I work hard on them."[57]

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[55] Henry Geldzahler, *Hans Hofmann: The Renate Series* (New York: The Metropolitan Museum of Art, 1972), 10.

[56] Barbara Rose, "Hans Hofmann: From Expressionism to Abstraction," *Arts Magazine* 53(3) (November 1978), 110.

[57] Samuel M. Kootz, "The Credibility of Color. Hans Hofmann: An Area of Optimism," *Arts Magazine* 41(4) (February 1967): 38.

Hofmann's Materials as a Feature of His Late-career Paintings

The success of Hofmann's most metaphysical compositions is that these works simultaneously engage the viewer on a physical level. Hofmann's bold pigmentation and extremes of technique—what Thomas Hess once referred to as "making a painting with almost nothing [to] making a painting with almost everything"[58]—emphasize the material construction of his artwork. As Greenberg noted in his 1961 monograph on the artist, "the weight and density of [Hofmann's] paint—attributes it has even when it is not thickly impastoed—contribute to the presence his pictures have as *objects* as well as pictures."[59] The transcendent message of Hofmann's canvases was achieved through ultimately corporeal means. "In those canvases that really "come off,"" recalled Seitz, "the whole ensemble floats wonderfully before you: color, pigment, and the insistent geometry declaring themselves to the point where the surface is blasted even as it stresses the fact of its own physical existence."[60] Hofmann saw no conflict in his simultaneous investigation of philosophy and materiality and applied his materials with the same enthusiasm he showed for the message they conveyed. "At the end of the day, he'd have [paint] all over his belly," recalled studio assistant Wolf

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[58] Thomas B. Hess, "The Mystery of Hans Hofmann," *Art News* 63(10) (February 1965): 54.

[59] Greenberg, *Hans Hofmann*, 31.

[60] Seitz, "Abstract Expressionist Painting in America," 113.

Kahn, "like a palette himself."[61] For Hofmann, making a painting was both "a physical and metaphysical performing"[62]:

> An idea can only be materialized with the help of a medium of expression, the inherent qualities of which must surely be sensed and understood in order to become the carrier of an idea. . . . To explore the nature of the medium is part of the understanding of nature, as well as part of the process of creation .[63]

Hofmann's paintings are a synthesis of Abstract Expressionist interest in the making and meaning of art, a creative dialogue in which both the artist and his materials are active participants. Hofmann's work provides insight into not only the style but also the literal substance of this formative period of artistic innovation.

Existing Information Regarding Hofmann's Materials

Hofmann's students and colleagues are remarkably consistent in their accounts of the artist's materials. Anecdotal accounts regarding Hofmann's studio practice and the limited scientific publications referencing Hofmann's work provide an incomplete picture of the artist's materials but play an important supplementary role in the investigation of Hofmann's late-career paintings. The information provided below makes available for the first time a comprehensive accounting of existing documentation related to Hofmann's materials and allows established beliefs

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[61] Interview with Wolf Kahn, conducted on May 15, 2000 for the PBS documentary *Hans Hofmann: Artist/Teacher, Teacher/Artist*. http://pbs.org/hanshofmann/wolf_kahn_002.html

[62] Hans Hofmann, typescript dated January 12, 1956. Hofmann papers.

[63] Hans Hofmann, "On the Medium of Expression" and "Terms: Expression Medium," in *Search for the Real and Other Essays*, 64, 71.

regarding the artist's materials and techniques to be assessed in comparison with the materials analysis data provided in Chapter Four.

Documentation by Hofmann or others regarding the artist's materials is limited. Despite the prominent role of materials in fashioning Hofmann's compositions, the artist left little written documentation regarding his studio practices, and the specifics of Hofmann's materials are rarely mentioned in reproductions of his writing or in interviews with the artist. Accounts of Hofmann's teaching and student notes from his lessons and lectures do not discuss the artist's own work—"Hofmann did not teach [about] himself," said Glenn Wessels.[64] According to Hofmann, discussions focused on technical matters took away from more important aspects of the final artwork:

> To the critic: Only the result counts
> not how it is done
> the means in themselves mean nothing
> as long as they expresses [sic]
> not something 'higher' in their relation
> they are the carriere [sic] only
> of the message.[65]

The scant information provided by Hofmann regarding his materials is further reduced by contemporary editing trends in arts-related literature. The omission of detailed materials information was common in mid-twentieth-century publications despite the important role of materials in modern art. "[Although] the meaning of art

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[64] Glenn Wessels, statement excerpted from the Hofmann Students Dossier: Scrapbook of replies to questionnaires on Hofmann as a teacher by his students [in conjunction with the 1963-64 MoMA exhibition "Hans Hofmann and His Students."] Museum of Modern Art Special Collections.

[65] Loose notepage dated 11.10.55. Hofmann Papers.

and its material form [were] inextricably linked," Carol Mancusi-Ungaro noted, "editors . . . tend[ed] to skip over information about the minutiae of studio practice."[66] For example, a long-running *Art News* series that brought audiences into the studios of Abstract Expressionist artists including Hofmann and Willem de Kooning—a series dedicated specifically to artists' practice—provided generalized or exaggerated accounts of the artists' working methods or materials. The difference between the actual and reported practices of de Kooning, for example, has been well documented by Susan Lake. "Despite the extent to which the general character of de Kooning's methods and materials have been broadly described," Lake noted, "writers confuse de Kooning's actual practices and tend to repeat [*Art News* editor Thomas] Hess's observations without confirming them through technical examination."[67] The era's dismissive attitude towards technical documentation also extends to scholarly archives. According to Janet Marontate, "The records [federal projects] saved were selected to provide information on arts administration policies and . . . political history, not to document technical or substantive aspects of the art produced."[68]

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[66] Carol Mancusi-Ungaro, "A Sum of Corrections," in *Jasper Johns: An Allegory of Painting, 1955-1965*, ed. Jeffrey Weiss (Washington, DC and New Haven, CT: National Gallery of Art in association with the Yale University Art Gallery, 2007), 236.

[67] Susan F. C. Lake, "The Relationship Between Style and Technical Procedure: Willem de Kooning's Paintings of the Late 1940s and 1960s," (PhD diss., University of Delaware, 1999), 11-12.

[68] Janet Lee Ann Marontate, "Synthetic Media and Modern Painting: A Case Study in the Sociology of Innovation," (PhD diss., University of Montreal, 1996), 74. See also Francis V. O'Connor, *Federal Support for the Visual Arts: The New Deal and Now* (Greenwich, CT: New York Graphic Society, 1971, rep.).

Among the surprising practices catalogued by Marontate is the selective archiving of period technical records by the very government agencies established to compile and disseminate information about art materials:

> A "special skills" division was established in Washington to deal with practical questions confronting artists and craftsmen. This became the Handicraft Laboratory in Washington, DC and was renamed the Technical Services Laboratory in 1938. . . . [One] function of the Laboratory was to review all technical instruction bulletins prepared or planned by state programs. . . . In one month alone a report states that 47 technical bulletins sent by the Education Division were reviewed, yet *not one* of these or other technical bulletins mentioned in the correspondence has been found in the archives of the Laboratory.[69]

The accounts of Hofmann's former students, studio assistants, and colleagues have likewise been marginalized or conflated with other documentation in subsequent publications about the artist. Artist and teacher Sam Feinstein, for example, when he studied with Hofmann from 1949 through 1952 filmed the artist at work, but the information he obtained regarding Hofmann's materials was edited from both the final film and the posthumous publication of an interview with Feinstein entitled *Portrait of Hans Hofmann as Painter, Teacher, and Friend*.[70] The only other substantive discussion of Hofmann's studio practice—a chapter devoted to Hofmann's technique in Cynthia Goodman's 1983 monograph on the artist—is a discontinuous mixture of information obtained from recollections by his students collected forty years after their studies with Hofmann, a 1962 essay recounting a curator's visit to Hofmann's studio,

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69 Marontate, "Synthetic Media and Modern Painting," 92.

70 Sam Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend: Reflections by Sam Feinstein* (New York: Midmarch Arts Press, 2008). Portions of the unedited interview were provided to me by Feinstein's son Sascha.

and the observations of conservators viewing the artist's work nearly twenty years after his death.[71] The empirical information in Goodman's chapter is not differentiated from the anecdotal information—the use of the conservator's report is mentioned only as a footnote—and the conflated identifications have the appearance of fact without the support of technical analysis.

The available documentation regarding Hofmann's late-career materials is presented below and will be compared with the technical analysis of Hofmann's materials at the end of Chapter Four. First-hand documentation has been collected from Hofmann's publications, interviews, and personal papers. All references to materials in the artist's personal notes are in the artist's handwriting unless otherwise noted. Other sources of information include interviews with former students and colleagues, the unedited transcripts of previous interviews, published articles or essays, and empirical observations in collection surveys and treatment reports related to the Hofmann Collection of paintings at the University of California Berkeley Art Museum and Pacific Film Archive. My own previous research regarding Hofmann's materials is also included.

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[71] Cynthia Goodman, "Notes on Technique" in *Hans Hofmann* (New York: Abbeville Press, 1986), 113-116. The information is drawn from Lillian Olinsey Kiesler's January 9, 1983 interview with Goodman, a section on Hofmann in Katherine Kuh's 1962 book *The Artist's Voice: Talks with Seventeen Modern Artists* (New York and Evanston: Harper & Row), and a 1982 unpublished conservation survey by Thornton Rockwell on the Hofmann Collection at the Berkeley Art Museum and Pacific Film Archive.

Artist's Records and the Accounts of Students and Colleagues

Hofmann was famously private about his studio practice. Students of Hofmann were rarely influenced by the artist's own working methods because they had little chance to see them. Hofmann student and American Abstract Artists co-founder Rosalind Bengelsdorf Browne said that Hofmann was so reticent to share information about his studio practices that some early members of the artists group who studied with Hofmann did not even know that he was a practicing artist.[72] Although Hofmann held private critiques in his studio with colleagues including Franz Kline,[73] he did not welcome visitors when he himself was working. Painter Sam Feinstein—whose Provincetown studio was next door to Hofmann's—recalled that even in those collegial summer environs, students and colleagues had few opportunities to observe Hofmann at work:

> I kept on pounding and finally [Hofmann] did come—I could hear the footsteps approaching—and he opened the door. He appeared before me like some dreadful apparition. He was covered in paint, as if he'd fallen into a vat with many colors. . . . His eyes were wild. He saw that it was me, and said, "Ah, but at the moment I am not in the position to receive company. Perhaps you will come back."[74]

On the few instances when Hofmann was observed his behavior was influenced by the presence of an audience. "Hofmann himself was almost impossible

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[72] Oral history interview with Rosalind Bengelsdorf Browne, conducted on January 29, 1968 by Irving Sandler for the Archives of American Art, Smithsonian Institution, n.p.

[73] Interview with James Gahagan, conducted on September 28, 1997 by Tina Dickey. Cited in Dickey, *Color Creates Light*, 325. For a few years Hofmann's Provincetown studio was located in a barn at the corner of Nickerson and Commercial Streets, next door to Kline's studio.

[74] Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend,* 18.

to photograph," recalled Feinstein. "The phrase we use, of course, is 'self-conscious,' and what it really means is 'others-conscious'. . . . So if he was aware that he was being photographed, he would ham it up out of sheer nervousness and awareness of the filming."[75]

In 1950, two artists documented their observations of Hofmann at work. Elaine de Kooning made a series of visits to Hofmann's studio to watch the artist work on the painting *Fruit Bowl: Transubstantiation No. 1* and recounted the artist's progress in an *Art News* article entitled "Hans Hofmann Paints a Picture;"[76] Feinstein subsequently filmed Hofmann's work on the painting *The Window* for *Hans Hofmann: A Film by Sam Feinstein*, which Feinstein continued to edit until its first screening in 1999 at the Metropolitan Museum of Art.[77] Despite focusing on the artist at work, neither account provides specific information about Hofmann's materials. "Because Hofmann was so well known as a teacher," recalled Feinstein, "the emphasis in the film is on his teaching principles even though it shows him making a painting."[78] De Kooning's

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[75] Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend,* 23-24.

[76] Elaine de Kooning, "Hofmann Paints a Picture," *Art News* 48(10) (February 1950): 38-41, 58-59. De Kooning's article mentions six versions of the painting, while Hofmann's painting ledger for the period lists versions two-five and a "final" (likely version six, now in the collection of the Neuberger Museum of Art, Purchase College, State University of New York). Hofmann's ledger of works consigned to Kootz likewise mentions only works versions two-five. The whereabouts of *#1* are unknown.

[77] Sam Feinstein, *Hans Hofmann: A Film by Sam Feinstein*, 1950 documentary film (New York: Samuel L. Feinstein Trust, 2008). Feinstein notes that his filming of Hofmann was prompted by de Kooning's article in Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend*, 21. Hans Hofmann, *The Window*, 1950, oil on canvas, 48.0 x 36.1" (121.3 x 91.8 cm.); Gift of Mr. and Mrs. Roy R. Neuberger, 1951; Collection of the Metropolitan Museum of Art.

[78] Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend,* 28.

article mentions only one specific painting material—the artist's oil paint Permalba[79]—and like Feinstein, de Kooning's description of Hofmann is skewed towards ideological rather than practical matters. "Any discussion of Hofmann's technique," wrote de Kooning, "must revolve around his theories."[80] Feinstein and de Kooning also provide inconsistent information about Hofmann's technique. For example, de Kooning reported that Hofmann said he "no longer has the patience to work with pen, pencil or crayon"[81] yet Feinstein's film shows Hofmann carefully plotting out his composition in pencil. Feinstein later said "I was photographing it thinking: "Well, I suppose I could blackmail him with this some day because who would believe Hofmann did such a thing?""[82] Neither account may reflect the artist's true methods, as both were susceptible to Hofmann's bouts of theatricality. "It was really difficult to get really decent photographs of Hofmann," concluded Feinstein, "unless he was totally unaware of what was happening."[83] Reports of Hofmann's methods also contain elements of stagecraft. Kahn (Hofmann's studio assistant from 1947 through 1948) and Max Spoerri (studio assistant from 1956 through 1958), for

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79 Permalba is a white pigment oil color manufactured by the Philadelphia-based art materials manufacturer F. Weber Co., Inc. The name Permalba is commonly associated with a blend of titanium and zinc white pigments. See Chapter Two, "Hofmann's Years in Paris (1904-1914) and Return to Germany (1914-1931)."

80 De Kooning, "Hofmann Paints a Picture," 38.

81 De Kooning, "Hofmann Paints a Picture," 39.

82 Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend,* 21.

83 Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend,* 24.

example, have claimed that assistants stretched all of Hofmann's canvases,[84] yet a planned visit from curator Katherine Kuh in 1958 was greeted by the artist stretching his own supports:

> To my amazement, I found Hans stretching canvases, most of them five to eight feet. There he was, kneeling, panting, hauling and with craftsman-like concentration turning out finished products of enviable precision. What astonished me was to see this artist then in his seventies expending energy on a physical chore than many younger men delegate to others.[85]

"I always stretch my own canvases, glue them, and prepare them in every way," Hofmann told Kuh. "It takes time but I simply cannot paint on commercial canvases . . . I've been working on the canvas for a long time before I start to paint it."[86] This particular event may have been staged for Kuh's benefit, but clues to Hofmann's materials and technique are found in all accounts of the artist's production and these accounts provide important supplemental information to the scientific analysis presented in Chapter Four. The accounts of Hofmann's materials provided below are primarily drawn from the contemporary observations of Feinstein (published and unpublished) and de Kooning, interviews I conducted between 2002 and 2013 with Hofmann's former students and colleagues, and the transcripts of

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84 Interview with Wolf Kahn conducted in January 2005 by the author. Interview with Max Spoerri, January 2005 by the author. Kahn was a studio assistant and school monitor from 1947-48, and Spoerri was a studio assistant from 1956-58.

85 Katherine Kuh, "Hans Hofmann in Provincetown: A Memoir," in *My Love Affair with Modern Art: Behind the Scenes with a Legendary Curator,* ed. Avis Berman (New York: Arcade Publishing, 2006), 257.

86 Katherine Kuh, *The Artist's Voice: Talks with Seventeen Modern Artists* (New York and Evanston: Harper & Row, 1962), 128.

similar interviews conducted by Goodman and Dickey and cited in their publications or housed at the Archives of American Art, Smithsonian Institution.[87]

Conservation Assessments and Research

Limited information related to Hofmann's materials exists in the conservation and research literature. Empirical observation—but no technical analysis—of Hofmann's materials is available in two unpublished surveys of the University of California's Hofmann Collection performed in the 1980s. In 1982, San Francisco Museum of Modern Art conservator and former Hofmann student Thornton (Tony) Rockwell surveyed the treatment history and condition of the Hofmann collection at the Berkeley Art Museum and Pacific Film Archive and compiled the information into an unpublished report entitled "Conservation Problems Present in Paintings by Hans Hofmann."[88] Six years later conservator Carolyn Tallent performed a similar condition assessment of the Berkeley collection as part of her postgraduate fellowship at the Intermuseum Conservation Association in Oberlin, Ohio (now located in Cleveland) and produced an unpublished report entitled "Investigation of the Painting

[87] Clips of Hofmann at work also appear in Madeline Amgott's documentary *Hans Hofmann: Artist/Teacher, Teacher/Artist* (New York: Amgott Productions, 2003) and Warren Forma's 1962 film *The Americans: Three East Coast Artists at Work* (Contemporary Films, 1963), although no substantive information regarding Hofmann's methods or materials is provided. Forma's film also features clips of painters Milton Avery and Jack Tworkov.

[88] Tony Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," unpublished report with editing marks, 1982, Elise S. Haas Conservation Department, San Francisco Museum of Modern Art.

Materials and Techniques of Hans Hofmann—Preliminary Report."[89] No scientific analysis was performed for either survey.[90]

The only published scientific analysis of Hofmann's materials appears in my own previous research on the artist's work. In 2005, I undertook a preliminary study of Hofmann's late-career ground layer materials as part of a conservation graduate research project at Buffalo State College (State University of New York), entitled "Hans Hofmann from the Ground Up: Looking at the Artist's Preparatory Methods as a Window to Condition."[91] The unpublished project report includes limited scientific data related to the ground layer materials of a small number of Hofmann's late-career palettes.[92] Six of Hofmann's late-career paintings were among the 20 paintings examined for my 2007-09 study of Abstract Expressionist ground layer materials in

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[89] Carolyn Tallent, "Investigation of the Painting Materials and Techniques of Hans Hofmann—Preliminary Report." Unpublished fellowship report, dated August 1, 1988. Intermuseum Conservation Association. Tallent's survey also included two Hofmann works from the collection of the Albright-Knox Art Museum then on site in Oberlin. The two works, *Exuberance* (1955) and *Sommernachstraum* (1957), are both included in the group of paintings selected for this dissertation study.

[90] Although Tallent obtained forty-seven ground and paint layer samples from the Berkeley collection for later analysis, her identification of Hofmann's materials was based solely on visual examination of the paintings and optical microscopy of selected paint samples. All forty-seven samples were subsequently discarded and were therefore not available for inclusion in my dissertation research. Sample disposal confirmed in a note to the author dated January 23, 2005.

[91] Dawn Rogala, "Hans Hofmann from the Ground Up: Looking at the Artist's Preparatory Methods as a Window to Condition," unpublished senior specialization project, dated May 2005. Art Conservation Department, Buffalo State College, State University of New York.

[92] The ground layers and compositional paint materials on those palettes have been re-examined in this dissertation research.

the collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, a project undertaken in collaboration with the Smithsonian's Museum Conservation Institute and the National Gallery of Art, Washington, DC. Data from that research was reproduced in several conference postprint publications, as well as in two peer-reviewed articles in publications from the Materials Research Society and the American Institute for the Conservation of Historic and Artistic Works.[93] No other analysis related to Hofmann's materials has been found in recent searches of the conservation and scientific literature.[94] My own observations of materials used in the study group paintings are provided throughout this chapter; presented below are the contemporary accounts of Hofmann's students and colleagues.

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93 Dawn Rogala et al., "Condition Problems Related to Zinc Oxide Underlayers: Examination of Selected Abstract Expressionist Paintings from the Collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution," *Journal of the American Institute for Conservation* 49(2) (Fall/Winter 2010): 96-113. Christopher Maines et al., "Deterioration in Abstract Expressionist Paintings: Analysis of Zinc Oxide Paint Layers in Works from the collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution," in *Materials Issues in Art and Archaeology IX: Symposium held November 29-December 3, 2010, Boston, Massachusetts*, Materials Research Society Symposium Proceedings 1319, eds. Pamela B. Vandiver et al. (Pittsburgh, PA: Materials Research Society, 2011), 275-86. None of Smithsonian Institution paintings are included in my current dissertation research.

94 Databases searched include Art and Archaeology Technical Abstracts and the related Getty Conservation Institute project bibliographies database, the Bibliographic Database for the Conservation Information Network, JSTOR, the Materials Research Society publications database, ProQuest Dissertations and Theses database, SpringerLink, and the Web of Science.

Fabric Supports and Preparatory Materials

Contemporary accounts of Hofmann's late-career paintings mention the artist's use of both linen and cotton fabric supports. Spoerri said that Hofmann used "Belgian linen,"[95] which Erle Loran recalled as "Utrecht linen,"[96] a likely conflation of Belgian canvas with the canvas supplier Feinstein referred to as "Utrecht linens,"[97] a Brooklyn-based importer now known as Utrecht Art Supplies. Conversely, de Kooning's 1950 article notes the artist's contemporaneous use of softer, cotton fabrics. "[Hofmann] usually paints on heavy [cotton] duck," said de Kooning, "originally for the sake of economy, but now because he finds it holds up better than linen."[98] Kahn also recalled Hofmann's use of cotton fabrics,[99] and the term "Heavy Duck" appears amongst the artist's papers on a loose, undated notepage as well as on a page within a journal marked "Provincetown 1951."[100] The loose notepage includes the notation "Rosenth." in a likely reference to Rosenthal's Art Supply at 47 East Ninth Street. No information regarding the artist's use of cotton or linen fabrics was available from the local art stores frequented by Hofmann. Kiesler (Hofmann's school

95 Spoerri, interview with the author.

96 "Notes from one hour interview with Erle Loran, June 1987," courtesy Carolyn Tallent, n.p.

97 Interview with Sam Feinstein, conducted in December 1989 by Sascha Feinstein, n.p. Courtesy of Sascha Feinstein.

98 De Kooning, "Hofmann Paints a Picture," 40.

99 Kahn, interview with the author.

100 Both notations include measurements for stretcher bars. Another note reads "For strecher[sic]: Clinton Schwab & Co., Manf. Of Moldings, 29-33 Lowell Str. Arlington [illeg], Mass." Hofmann Papers.

administrator from 1932 through 1947) said that Hofmann bought prepared canvases from Louis Rosenthal at his eponymous art stored located nearby Hofmann's studio at 53 East Ninth Street.[101] Kahn said that Hofmann purchased only rolled, unprimed fabrics, and obtained materials from both Rosenthal and from Joseph Torch's store at 148 Fourteenth Street, above which Miz maintained an apartment.[102] No archived records were available from either store. Rosenthal, who handled materials for Hofmann's students studying under the Veterans Administration G.I. Bill of Rights and stretched canvases for many local artists, did not archive his records and in a recent interview could not recall if he prepared any canvases for Hofmann.[103] A sample of Hofmann's tax records—in this case, for the 1948-49 school year—lists stretcher sets and rolls of fabric under the heading "Demonstration Materials" and an estate inventory of the "Main Studio & School" following the artist's death includes "1 large roll canvas 10' wide (Approx. 1000 sq. ft.)" and "several hundred sq. feet of canvas in pieces,"[104] but neither reference identifies the material as linen or cotton, and fabric rolls and remnants were not retained by the Hofmann Trust. In my own observation, fabric supports for the study group paintings produced in the late 1940s exhibit the soft surfaces and bright fibers associated with cotton materials, while all of

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[101] Typescript of interview with Lillian Olinsey Kiesler conducted on January 9, 1983 by Cynthia Goodman, 3. Lillian and Frederick Kiesler Papers.

[102] Kahn, interview with the author. See also Dickey, *Color Creates Light*, 195.

[103] Interview with Louis Rosenthal conducted in February 2005 by the author. Rosenthal as GI Bill supplier is mentioned in Kiesler, interview with Cynthia Goodman, 3.

[104] "Estate Inventory," 10. Hofmann Papers.

fabric supports for study group works produced from 1953 onwards exhibit the stiff, friable, and discolored materials common to aged linen canvases. Cotton fabrics are too flexible for the larger paintings produced by Hofmann in these later years, although the appearance of linen fabrics also coincides with Hofmann's growing financial success (and his ability to afford the more expensive linen canvases). Both cotton and linen fabrics were discovered in the analysis of the study group paintings presented in Chapter Four.

Contemporary accounts of Hofmann's painting practices reflect a late-career shift from traditional to modern methods and materials. Traditional painting preparation includes "sizing" a raw canvas with glue to stiffen and seal the fabric fibers, followed by the application of a ground layer material to create a smooth painting surface and further isolate sensitive and absorbent fabric fibers from applications of acidic paint and varnish materials. Hofmann's 1930s studio practice was reported by Kiesler as very traditional, including the use of aqueous glue and chalk-based gesso[105] to prepare the painting surface of his plywood supports. According to Kahn, this traditional ground layer material disappeared from Hofmann's palette with the artist's return to canvas in the late 1940s. "No gesso," Kahn said. "I never saw gesso in his studio."[106] Gesso is not mentioned in the artist's 1948-49 tax returns, although the undated "Rosenth." note includes a notation for "Chesso,"[107] likely a generic (and misspelled) reference to the preparatory material. Some

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[105] Kiesler, interview with Cynthia Goodman, 3.

[106] Kahn, interview with the author.

[107] Hofmann Papers.

clarification in terminology is necessary here. Once Hofmann switched from wooden panels to paintings on canvas, the term "gesso" no longer applied to his ground layer materials. Gesso more exactly refers to the calcium sulfate ground layer material applied to wooden panels (usually associated with early Italian panel paintings; gesso is the Italian word for gypsum), but the term was commonly misapplied by twentieth-century writers and artists to the oil-based (and later, after the 1940s, acrylic) ground layer materials used to prepare paintings on canvas (another loose term meant to apply to linen fabrics but commonly used in reference to both cotton and linen materials). "[Hofmann] prepares the raw canvas himself with flat white to close the pores," de Kooning reported in her *Art News* article, "then a gesso ground, which he maintains is the only ground that does not turn yellow."[108] In this case the term "gesso" likely refers to zinc white oil paint, a favored replacement for traditional lead white oil grounds that contained toxic materials and often discolored with age, but should not, strictly speaking, be called "gesso." Spoerri, for example, recalled Hofmann using "zinc white oil over rabbit skin glue [used to size the canvas]"[109] to prepare his fabrics for painting. The casual use of language in de Kooning's account—likely the terminology used by Hofmann during de Kooning's visit—confuses the terminology used to delineate the preparatory layers of a painting. The base layer of paint applied to a stretched fabric is properly called a ground layer while subsequent overall layers of white paint are referred to as priming. These terms are conflated in de Kooning's account of the artist's initial (ground) application of flat white followed by an overall

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[108] De Kooning, "Hofmann Paints a Picture," 38.

[109] Spoerri, interview with the author.

application (priming) of “gesso” [sic] (likely zinc white oil). When possible, parenthetical notations will be used throughout this chapter to help elucidate loose terminology.

The “flat white” ground layer mentioned in de Kooning’s article may have been one of the oil-based alkyd house paints then popular with Hofmann’s Abstract Expressionist colleagues. These alkyd paints did not stray far from the artists’ familiar oil painting materials. The commercial alkyd house paint used by mid-twentieth century artists was a long-oil mixture (more than 60% drying oil) of oil painting medium and synthetic polymers that cured in the same manner as oil paint, but at increased speed.[110] The artist’s personal papers contain a 1958 brochure for Benjamin Moore & Co.’s Alkyd Sani-Flat paint and a loose, handwritten note that reads “Alkyd Santa[sic] Flat / White 20401 / Benjamin Moore & Co.,”[111]and accounts of Hofmann’s use of house paint grounds appear in the anecdotal accounts of Loran and Feinstein:

> When Utrecht Linens, which is now a big artists’ supply house, were really starting in business, they sent two young men who came around to Provincetown to sell artists’ materials. They came to me and said “Listen, we know that you’re Hofmann’s friend. Won’t you tell him that he’s doing the wrong thing to his canvas?” Hofmann, you see, used to buy raw canvas, and then would paint it white with oil house paint but without . . . any other preparation underneath it. This, naturally, was a bad thing to do to the fibers of the canvas. But they came to me rather than to somebody else to tell him about it.[112]

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[110] See Thomas J. S. Learner, “A Review of Synthetic Binding Media in Twentieth-Century Paints,” *The Conservator* 24 (2000): 99.

[111] Hofmann Papers.

[112] Feinstein, interview with Sascha Feinstein. Note card titled “Conversation with Earl [sic] Loran, originator of UC Berkeley Art Dept. and student of Hans Hofmann,”

A reference to “flat white” paint appears in the only detailed statement by Hofmann regarding his materials. Typed and dated “Spring 1950” and presumably created in response to a curatorial inquiry, the statement parallels de Kooning’s account of Hofmann’s methods. In the statement, the artist explains that “*Magenta and Blue* is painted in Rembrandt oil on heavy [cotton] duck on a gesso ground [likely zinc white oil priming] prepared by myself with flat white as underpainting [ground].”[113] *Magenta and Blue* was produced the same year as de Kooning’s article, and both accounts note Hofmann’s application of both ground and priming layers. Spoerri likewise said that it was not unusual for Hofmann to use a priming layer over an inadequately bright ground layer or to re-ground a discarded painting before beginning a new composition.[114]

The preparatory materials mentioned in the conservation literature concur with the accounts of Hofmann’s students and colleagues. Conservators Rockwell and Tallent both note a transition from plywood to fabric supports in the late 1940s and confirm Spoerri’s account of glue sizing on Hofmann’s canvases. Rockwell bases his identification of an isolating glue-size layer on the lack of binding media bleed-through to absorbent canvases, while Tallent based her sizing identification on an observed ultraviolet-induced visible fluorescence consistent with similar protein-based

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dated June 9, 1981. University of California, Berkeley, Berkeley Art Museum and Pacific Film Archive, unpublished records related to the conservation of Hofmann works in the collection, 1966-present.

[113] Typescript, Hofmann Papers. Hans Hofmann, *Magenta and Blue*, 1950, oil on canvas, 48.0 x 58.0" (121.9 x 147.3 cm.). Purchase, collection of the Whitney Museum of American Art.

[114] Spoerri, interview with the author.

sizing in paintings examined under ultraviolet illumination.[115] Hofmann's possible embrace of house paint ground materials is also mentioned in the conservation literature. Rockwell suggested that during the 1950s, "alkyd white interior house-paint replaced glue gesso [used on earlier plywood panels] primings [grounds] to become the principal ground used on Hofmann's canvases,"[116] and Tallent noted that the thin, matte ground materials applied during this period conformed to the underlying support fabric in a manner consistent with alkyd paint.[117] Handwritten notes accompanying Tallent's research materials also state that she observed ultraviolet-induced visible fluorescence consistent with alkyd paints in Hofmann's work from the mid-1950s onward.[118] Analysis performed for my own graduate research identified alkyd ground layers on two paperboard palettes from Hofmann's studio.[119] In that study, pyrolysis-gas chromatography-mass spectrometry and Fourier

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115 Tallent, "Investigation of the Painting Materials and Techniques of Hans Hofmann," 6. Also "Notes from one hour interview with Erle Loran, June 1987."

116 Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 10, 14. Rockwell's use of the term "gesso" is more accurate here, since he is referring to the ground layers Hofmann's used while working on wooden panels. When discussing the preparatory materials Hofmann used for works on canvas, Rockwell switches terminology and uses the term "ground."

117 Noted by Tallent during examinations in collaboration with Robert Lodge, Tallent's supervisor for the internship during which her report was prepared.

118 Tallent, "Investigation of the Painting Materials and Techniques of Hans Hofmann," 7, as well as handwritten compilation chart in Tallent's research papers. Courtesy Carolyn Tallent.

119 The palettes, numbered M536-45 and M536-03 in the collections inventory of the Renate, Hans and Maria Hofmann Trust, had ground layers applied prior to the paperboard support. Both palettes are included in the group of paintings selected for this dissertation study.

Transform infrared spectroscopy were used to confirm a close match between the ground layers applied to the palettes and paint found under the lip of a paint can lid also used by Hofmann as a palette.[120] The can lid bore a series of embossed numbers which were identified by archivists at Benjamin Moore & Company as a match for a March 17, 1957 batch of Benjamin Moore Alkyd Sani-Flat (20401 Ultra White),[121] the same paint material noted above as appearing in notes and brochures found among Hofmann's papers. The fabric and preparatory materials identified in the study group paintings are discussed in Chapter Four.

Compositional Paints

Contemporary accounts of Hofmann's compositional materials describe an exclusively oil-based palette. Elaine de Kooning notes Hofmann's use of water-based "tempera" paints for the paper-based preparatory sketches preceding his work on *Fruit Bowl: Transubstantiation No. 1* but mentions only artist's oil paints in descriptions of Hofmann's work on the actual painting.[122] Aside from Hofmann's alkyd ground

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[120] Paint can lid, diameter 6 inches (8.2 cm.) Trust number M536-49, collection of the Renate, Hans and Maria Hofmann Trust.

[121] Rogala, "Hans Hofmann from the Ground Up," 8.

[122] De Kooning, "Hofmann Paints a Picture," 39. When Hofmann first moved to the United States he worked exclusively in crayon and water-based paints on paper. Tempera paints are mentioned in two photo captions: "his materials for tempera painting" and "working on tempera sketches as a "warm-up" prior to painting in oils." There is no other mention of traditional egg tempera paints in Hofmann's studio practice; this is another loose application of terminology that likely refers to the watercolors and water-based gouache or casein paints Hofmann used for his works on paper. Tempera painting materials are not mentioned in the main article text.

materials, Feinstein's accounts of the artist likewise mention only oil paints.[123] A rare description of the paint colors and brands utilized by Hofmann is provided by Lillian Kiesler, who posed for the artist in the 1940s:

> I can remember [that] I looked at him with something that amounted to awe and even a kind of greed at the number of boxes which he had—the cobalt violet, cadmium yellows, many, many cadmium yellows, and I can still see the labels on the Winsor [&] Newton and the Rembrandt. And the cadmium reds, and all the cadmium colors, and all the cobalt colors—large numbers of boxes. . . . He turned to me and said: "[With] color Lillian, one is never stingy."[124]

The colors and brands mentioned by Kiesler are in keeping with the artist's own records, including the earliest extant first-person documentation of Hofmann's materials—a handwritten list of paints in a combination of German, French and English that reflects Hofmann's early artistic influences:

> Weiß
> Perm[alba] weiß [brand name not legible]
> Green light ([F.] Weber [and Co.])
> Verte Compose [terre verte] (Blockx)
> Verte
> Emeraude
> Viridian (Rembrandt)
> Cobalt (Rembrandt)
> Light ultramarine/French ultramarine (Rembrandt)
> Preuß[isch] blaü
> Schwarz
> Yellow (Blockx)
> Cadmium yellow pale (Rembrandt)
> Yellow light (F. Weber [and] Co.)
> Yelllow mittel
> Ocher

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[123] See Sam Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend*.

[124] Kiesler, interview with Cynthia Goodman, 1, 2.

Cad[mium] orange [adjective not legible] (Winsor & Newton)
Cadmium rot deep (Le Franc)
Vermilion
Yellow ocher
Laque de Garance [Madder lake; brand name not legible]
Kobalt violette (Rembrandt)[125]

The list features colors and brands favored by Hofmann's German and French modernist colleagues. Colors on the list introduced shortly before or during Hofmann's lifetime include Permalba (1920), the range of cadmium colors (1880-1909), cerulean blue (1862), cobalt violet (1859), and alizarin crimson (1869).[126] "Weiß" is likely a reference to zinc white, as Hofmann's refusal to use lead white was well known. "He used to tell me about all the artists in Paris who lived and worked in the same area," recalled Kiesler, "who got poisoning by using lead white. I can't remember all the ones that he named, but he had a certain fixation about being poisoned."[127] The reference to "Perm. Weiß" may refer to Permalba, whose Philadelphia-based manufacturer appears elsewhere on the list. Many of these same colors appear in a typed list of paint colors recommended to Hofmann's Provincetown students through the mid-1940s. The colors below are listed under the heading "Necessary materials for painting"; the colors with asterisks are noted as "essential":

*Permalba or zinc white [two separate options]
*Cadmium lemon, light, medium, orange, and red light
Vermilion
*Cerulean deep

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[125] Hofmann Papers. The combination of German, French and English is frequently seen in documents from Hofmann's early years in the United States.

[126] See Philip Ball, *Bright Earth,* and J. Boxall, "A History of Paint Technology, Part Three. Mid-19th Century to 20th Century," *Paint Manufacture* 48(6) (1978): 25-30.

[127] Kiesler, interview with Cynthia Goodman, 2.

*Cobalt blue deep
*Ultramarine blue deep
*Emerald green
 Cobalt violet
*Alizarin crimson
*Yellow ochre
*Light red
*Burnt sienna
 Mars violet
*Burnt umber
*Ivory black[128]

This list is leaner, with an added selection of neutral brown and black pigments likely intended for the painting exercises assigned to students following their transition from drawing to painting curricula. Cerulean blue and mars violet are new additions that do not appear on the 1930s list. Alizarin crimson is the synthetic substitute for the previously listed madder lake; Emerald green remains despite the existence of synthetic alternative such as viridian green. European paint manufacturers Winsor & Newton, Rembrandt, and Blockx reappear (in a sidenote) as recommended brands for high-quality oil paints. "I remember the first time when I was there when he was starting the portrait," recalled Kiesler, "that he took one of those tubes, Winsor & Newton cobalt violet and it seemed to me in one squeeze he emptied the entire tube on

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[128] Duplicate copies of the supply list were found in the Kiesler Papers and also in the Rose Kuper collection of Hans Hofmann miscellany, 1932-1964, Bancroft Library, University of California Berkeley. An origination date for the supply list can be tentatively located between the 1934 publication of Sheldon Cheney's *Expressionism in Art* (on the list) and Kuper's studies with Hofmann in the late 1930s. The reverse of the supply list in the Smithsonian's Hofmann papers contains a partial draft of an October 31, 1944 letter from Hofmann to Federal Security Agency attorney Harry N. Rosenfield inquiring about application of the Veterans Administration GI Bill of Rights to registrants of his school, which suggests that the supply list was in still in use in the mid-1940s.

that palette. I was aghast [at the expense]."[129] European manufacturer Schmincke and American manufacturers Permanent Pigments and F. Weber and Company are also recommended as less expensive options. Loran said he thought Hofmann occasionally may have used Grumbacher oil paints and according to Kahn, in at least one instance Hofmann utilized a set of the Bellini brand oil paints made by manufacturer Leonard Bocour and given to Hofmann by the paint maker when he attended classes in Provincetown.[130] Permalba appears on both lists and is one of the few pigments regularly mentioned in both published and unpublished accounts of Hofmann's materials. Both Kiesler and Elaine de Kooning noted Hofmann's use of the popular white paint, a color Spoerri specified was used by the artist for compositional painting only (not for priming).[131] "He [used] a mountain of Permalba," recalled Kiesler. "[He] squeeze[d] out what seemed to me to be half a tube or an entire tube of [it]."[132] 22 tubes of Permalba paint are included in the artist's tax records for the 1948-49 school season.[133]In addition to the tubes of Permalba paint, Hofmann's account of oil paints

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[129] Kiesler, interview with Cynthia Goodman, 2.

[130] Interview with Wolf Kahn conducted on October 26, 1998 by Tina Dickey. Cited in Dickey, *Color Creates Light*, 243. Also noted by Kahn, interview with author. "Notes from one hour interview with Erle Loran," n.p.

[131] Kiesler, interview with Cynthia Goodman, 1,2. De Kooning, "Hans Hofmann Paints a Picture," 58. Spoerri, interview with the author.

[132] Kiesler, interview with Cynthia Goodman, 2.

[133] "SUMMER Course" / Consumable Instructional Supplies for the Period: June 14-September 3, 1948" and "FULL DAY and EVENING Courses / For the Period: January 30-May 28, 1948 (Spring Session) / And October 4-January 28, 1949 (Winter Session) / Consumable Instructional Supplies," Hofmann Papers.

used as "Demonstration Material" during the 1948-49 school year included 120 tubes of oil paint valued at 50 cents each and 60 tubes of oil paint valued at 75 cents each. 10 tubes are noted as "Cad[mium] Color"; no other colors are specified. Trust inventory records note "several hundred tubes of oils (still in good condition)" among the contents of the "Small Workroom of Studio,"[134] but do not provide further identification of the materials; none of the artist's paints are in current Trust holdings. No pigment lists remain from the 1950s or 1960s.

Limited information regarding Hofmann's compositional paints appears in the conservation literature. Notable exceptions are Rockwell's mention of a "black enamel 'stove' paint" and "poured black paint" in works from 1959-62,[135] alizarin-like colors in works produced as early as 1947 and as late as 1965, and the late 1950s appearance of "magenta or rose-red lake pigments, "an attribution Rockwell credits to Berkeley Art Museum archivist Larry Dinnean.[136] Rockwell's use of the term "stove" may be a generic reference to industrial alkyd paints of that period, many of which were dried under heat, or "stoved." Rockwell also refers to Hofmann's poured paints as "Duco" enamels, another often used appellation for the alkyd paints brought to public attention through their use by Jackson Pollock.[137] Rockwell does not recall the source of these

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[134] "Consumable Instructional Supplies," Hofmann Papers. "Estate Inventory," 10.

[135] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 13-A.

[136] Rockwell, "Conservation Problems," 14, 16.

[137] Duco's commercial formulation was switched from a cellulose nitrate base to an alkyd base in the mid-1930s. See Harriet A.L. Standeven, ""The Historical and Technical Development of Gloss House Paints, with Reference to their Use by Twentieth-Century Artists," (PhD diss., Royal College of Art, 2003), 9.

identifications.[138] The only other mention of alkyd compositional paints in the conservation literature is found in a loose note among Tallent's research papers regarding a single instance of alkyd priming materials used in the mixed color of a single color plane.[139] A small number of Hofmann's pigments were analyzed for my Smithsonian research. *In situ* X-ray fluorescence, as well as sampling and subsequent analysis through optical microscopy and scanning electron microscopy-energy dispersive spectroscopy were used to identify zinc oxide white, cadmium yellow and red, and cobalt blue in the five canvas works produced by Hofmann between 1957 and 1963.[140] These same pigments are among the paint colors identified in the study group works and presented in Chapter Four.

Solvents, Mediums, and Varnishes

Accounts by and about Hofmann include the use of thinners and other additives to manipulate the handling characteristics of the artist's paints. In addition to

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[138] Rockwell, interview with the author.

[139] Loose notepage among Tallent's research materials, notation of alkyd fluorescence within a rectangle of white paint in the Hofmann Collection painting *Lucidus Ordo*. Courtesy Carolyn Tallent. Hans Hofmann, *Lucidus Ordo*, 1962, oil on canvas, 84.1 x 78.0 (213.6 x 198.1 cm.). Bequest of the artist, collection of UC BAM/PFA.

[140] In addition to *Radiance*, samples were also obtained from the following works by Hofmann: *Flowering Swamp*, 1957, oil on canvas, 48.1 x 36.1 inches (122 x 91.5 cm.), gift of the Joseph H. Hirshhorn Foundation; *Prelude of Spring*, 1958, oil on canvas, 58.3 x 84.3 inches (127.7 x 214.0 cm.), gift of the Joseph H. Hirshhorn Foundation; *Oceanic*, 1958, oil on canvas, 60.3 x 48 inches (152.7 x 121.9 cm.), gift of the Joseph H. Hirshhorn Foundation; and *To J.F.K.: A Thousand Roots Did Die With Thee*, 1963, oil and enamel on canvas, 60.0 x 72.0 inches (152.4 x 182.8 cm.), gift of Mr. andMrs. Leigh B. Block. All paintings collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution.

general cleaning uses, solvents/diluents can be used to thin the consistency of the paint film while varnishes and extra paint medium can be added to paint in order to thicken a paint film, increase the transparency of a color, or alter the surface sheen of the dried paint. As more additives are used, less paint is needed. "[I] may use a hundred tubes for one picture," Hofmann told de Kooning, "or one tube for a hundred pictures; lots of medium or none at all."[141] Kiesler, Loran, and Spoerri all recall turpentine among the artist's painting supplies, and this common diluent also appears in the accounts of both Feinstein and de Kooning:

> [Hofmann] picked up one of the paint-soaked pieces of gauze that had accumulated on his palette table, wrung it out so that it was almost dry, dragged it across the coarse-grained duck for a dry-brush effect; dipped another piece into turpentine (the only medium used for this picture) and washed on a glaze.[142]

Other thinners and additives appear in Hofmann's records and reports of his studio practice. "Anything can serve as a medium," Hofmann joked to de Kooning, "kerosene, benzine, turpentine, linseed oil, beeswax . . . even beer."[143] Hofmann student Erik Koch recalled that a popular artist's medium in the late 1940s and early 1950s combined turpentine, linseed oil, and stand (thickened) oil or varnish, a mixture mentioned in contemporary articles on the studio practice of Abstract Expressionists

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[141] De Kooning, "Hans Hofmann Paints a Picture," 40.

[142] De Kooning, "Hans Hofmann Paints a Picture," 58. Feinstein, *Portrait of Hans Hofmann as Painter, Teacher, and Friend*, 22.

[143] De Kooning, "Hans Hofmann Paints a Picture," 40. Hofmann's use of the term "medium" is again loose terminology on the part of the artist, as oil and beeswax are the only true mediums in that list (the rest are diluents).

Jack Tworkov and John Ferren.[144] Turpentine, benzine (petroleum ether), and linseed oil appear in Hofmann's 1948-49 tax records, and both "rectified spirits of turpentine" and "purified linseed oil" are listed on the student supply list under the heading "Necessary materials for painting."[145] The potential ramifications of altered paint media are discussed below (see "Condition issues in Hofmann's late-career paintings").

There are no accounts of varnish in Hofmann's painting practice, and the artist made his opinion regarding varnish very clear in the *Magenta and Blue* statement when he asserted "I never glaze or varnish a painting.[146] Two documents in the artist's papers are in conflict with this statement. The estate inventory lists "4 large bottles retouching varnish" among the contents of the "Small Workroom of Studio," and there is a loose page among the artist's financial records that contains the following notations in an unknown hand: "methacrylate (final picture varnish—can be made mat or dull with addition of aluminum stearate)" and "varnish put out by Ralph Mayer (dull or mat)."[147] These references to synthetic varnish may be posthumous and

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[144] Erik Koch, interview conducted on September 26, 2012 by the author. When Koch studied with Hofmann in Provincetown he also worked at an art store owned by painter Jim Forsberg called "the studio shop" where he frequently sold the components for this medium. See also Fairfield Porter, "Tworkov Paints a Picture," *Art News* 52(3) (May 1953): 73. and Lawrence Campbell, "Ferren Paints a Picture," *Art News* 52(10) (February 1954): 35.

[145] "Consumable Instructional Supplies," Hofmann Papers.

[146] Hofmann Papers.

[147] "Estate Inventory," 11. Tina Dickey was involved in the gathering and review of the artist's papers and confirmed that the handwriting on the methacrylate varnish note is not in keeping with the recognized writing of Hofmann, his family, or his students.

unrelated to Hofmann's own studio practice. The inventory of Hofmann's studio, for example, was not completed until six years after his death and may include materials used to varnish the works before distribution by the Trust.[148] The artist's papers were also compiled during this period[149] and may contain documents related to the posthumous care of Hofmann's paintings. While this information may not relate directly to Hofmann's use of materials, it may be useful in distinguishing between original and non-original material during the scientific analysis of Hofmann's paintings. A history of conservation varnishing of Hofmann's work is provided below (see "Conservation history of the study group paintings").

Selection of the Study Group Paintings

Understanding Hofmann's material preferences and late-career shifts in his palette required the collection of a large amount of data. Many of Hofmann's paintings were analyzed and the resulting data assessed in combination with the available documentary and archival resources in order to obtain an accurate picture of the artist's late-career materials. I therefore chose a group of paintings representative of

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148 According to James Yohe, it was common practice in that period to varnish works before they were shipped and some of Hofmann's works may have been varnished in that manner, although no records exist regarding this practice in relation to the works held by the Hofmann Trust. Yohe was the executive director of André Emmerich Gallery (Emmerich had worked with Samuel Kootz and represented Hofmann after Kootz closed his gallery) until 1998 when he joined Jim Ameringer (a former director at Emmerich) at the Ameringer gallery now Ameringer Yohe McEnery, which represents the Hofmann Trust and houses all archives related to the sale and treatment of works owned by the Trust.

149 Hofmann's personal papers were donated to the Smithsonian Institution's Archives of the American Art in 1997.

the range of materials noted in the available literature for more comprehensive examination and analysis. The study group was also fashioned to reflect Hofmann's stylistic evolution and the condition history of his paintings in order to reveal any relationship between the artist's materials and these aspects of his late work. The selection of the study group works is discussed below.

The Hofmann Collection at the University of California Berkeley

The bulk of the late-career paintings chosen for this study came from the Hans Hofmann Collection at the University of California Berkeley Art Museum and Pacific Film Archive. The Berkeley collection is the world's largest public collection of Hofmann paintings and contains a large and representative sampling of the artist's late-career work accompanied by lengthy archival records of the paintings' condition and conservation treatment histories. The university's Hofmann Collection was established by a direct gift from the artist. Three years before his death Hofmann promised forty-seven of his paintings, along with a donation of a quarter of a million dollars, to the University of California at Berkeley in recognition of the university's role in helping Hofmann to escape the deteriorating situation in Germany and build a new life in the United States. "If I had not been rescued by America," Hofmann confided to Peter Selz, "I would have lost my chance as a painter."[150] Hofmann's

[150] Hans Hofmann, in Peter Selz, "Forming with Color," *Hofmann: Evolution/ Revolution* (San Francisco, CA: Hackett Freedman Gallery, 2002), 5. Hofmann's political views are not discussed in interviews with the artist, although Hofmann's affiliation with modern art and liberal activists was not in line with Nazi politics. See Chapter One, "Hofmann's Exposure to New Paint Materials and Avant-garde Art During the Early Years of his School."

intentions were first communicated in a July 1963 letter from former Hofmann student and University of California Berkeley art department faculty Erle Loran to university President Clark Kerr:

> The magnificent generosity of Mr. Hofmann toward the University at Berkeley can only be understood when he tells you in his own words of the momentous change that occurred in his life when the late Professor Worth Ryder recommended that [Hofmann] should be invited to teach at Berkeley in 1930. He is convinced that he would have been eliminated by the Nazi government had he stayed in Germany.[151]

Hofmann's gift was also intended to jump-start the university's fundraising for a purpose-built art museum to house their growing collection. The monetary portion of Hofmann's gift was granted through partial interest in a selection of the artist's works to be sold through dealer Samuel Kootz, who helped select the paintings to be gifted to the university. The initial selection of works for the Hofmann Collection coincided with a retrospective of the artist's work at the Museum of Modern Art organized by Seitz, who allowed Hofmann, Loran, and Kootz to walk the exhibition galleries and selection paintings for donation and sale.[152] "Both Kootz and Mr. Hofmann suggested that the three of us work together in choosing the best paintings for the University before the exhibition opens to the public," Loran explained to Kerr. "Mr. William Seitz, the painting curator of the Museum of Modern Art, who is responsible for organizing and writing the catalogue for the Hans Hofmann exhibition has very

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[151] Letter, Erle Loran to University of California President Clark Kerr, July 25, 1963, 4. Curatorial archives, UC BAM/PFA.

[152] The exhibition ran from September 11-December 1, 1963.

graciously offered to make the galleries available to us for this purpose."[153] Ownership of the first group of paintings transferred to the university on December 27, 1963, after which selection of additional works was delayed by disagreements between Kootz and Loran regarding the prioritization of paintings for donation versus those to be sold in order to fulfill Hofmann's monetary promise to the university. Hofmann's intervention was required to resolve the dispute, and in February 1964 Kootz wrote to Loran:

> Hans has just come up with a wonderful suggestion: that we allow you before every show to pick a certain number of pictures from that show which will be designated as intended for the University collection. . . . The proviso that Mr. Hofmann suggests is that in the event any one of these pictures is selected for purchase by another museum for their own collection, only then will we be permitted to sell that picture.[154]

Ownership of additional paintings was transferred to the museum on March 5, 1964 and on January 20 and May 21, 1965. In 1965 Selz left his curatorial position at the Museum of Modern Art to become founding director of the university's new museum and assisted in the final selection of paintings from Hofmann's studio; ownership of this last group of works transferred to the university on January 26, 1966, just weeks before Hofmann's death.[155] When the University Art Museum

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153 Letter, Erle Loran to University of California President Clark Kerr, July 25, 1963, 2.

154 Letter, Samuel M. Kootz to Erle Loran, February 13, 1964. University Art Museum collection of Hans Hofmann papers, 1929-1976, Bancroft Library, University of California Berkeley.

155 Peter Selz, "Hans Hofmann: Selections from the Artist's Gift to the University," *American Art Review* 5(2) (Winter 1993): 127. Physical transfer of the final group of paintings was slowed by complications that arose from the transfer of Hofmann's

opened to the public in 1970 it was in possession of forty-eight works by Hofmann—the original group of promised works plus a painting Hofmann donated to the university art department in memory of Worth Ryder.[156] Today the museum—now the University of California Berkeley Art Museum and Pacific Film Archive—holds a total of fifty paintings by Hofmann, exhibited in rotation in the Hans and Maria Hofmann Gallery on the museum's main floor.[157] The comprehensive collection includes a large selection of the artist's well-known color plane paintings, and several of the late essentialist works included as examples of what Kootz called Hofmann's "brilliant present and promising future."[158] Hofmann's gift to the university is distinguished by the unique provision that twenty-five years after the opening of the museum, the university need only exhibit the artist's works for one month each year, and is free to sell works from the Hofmann Collection in order to "purchase modern art considered to be avant-garde at the time of such purchase" and to fund

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estate to his second wife, Renate, shortly before his death. Selz was Curator of the Department of Painting and Sculpture at the Museum of Modern Art from 1958-65.

[156] Hans Hofmann, *Summer Bliss*, 1960, oil on canvas, 60.1 x 72.3" (152.7 x 183.5 cm.). Gift of Hans Hofmann in memory of Worth Ryder, collection of the Berkeley Art Museum and Pacific Film Archive.

[157] In 1997 a university engineering survey of the Mario Ciampi-designed museum determined that the building did not meet current seismic safety standards and could not be appropriately adapted without compromising the museum's open exhibition spaces. Plans for a new museum facility in the nearby University of California Press printing plant do not include a designated Hofmann gallery, although Hofmann paintings will continue to be exhibited in the new building.

[158] Letter, Samuel M. Kootz to Erle Loran, June 8, 1965. Curatorial archives, UC BAM/PFA.

"scholarships [for] deserving art students."[159] As of 2013, no paintings from the Hofmann Collection have been sold by the University of California.

Selection of the Study Group Paintings

The majority of the study group paintings were selected from the University of California Berkeley Museum and Pacific Film Archive, with small gaps in style or period covered by selected additions from the collections of the Albright-Knox Art Gallery (Buffalo, New York), the Memorial Art Gallery (Rochester, New York) and the Museum of Modern Art (New York, New York).[160] Twenty-six paintings and eight palettes were chosen for study and analysis as exemplars of Hofmann's late-career work. The paintings selected for this study represent the range of late-career materials and paint application methods noted in the available literature. Each variation in the artist's painting style discussed earlier in this chapter (see "Origins and Development of Hofmann's Late-Career Style) is represented by at least one painting in the study group; when possible, two examples of each style are included. The study group includes twenty-three paintings on canvas from the years 1953-65, a period that includes the years just prior to and after the 1958 closing of Hofmann's schools in New York City and Provincetown, Massachusetts. Two works on canvas from the late

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[159] Article 8d, "AGREEMENT made and entered into, in duplicate, as of the 27th day of December, 1963, by and between HANS HOFMANN (hereinafter referred to as "Hofmann"), party of the first part, and THE REGENTS OF THE UNIVERSTIY OF CALIFORNIA, a California corporation, (hereinafter referred to as the "University"), part of the second part," 8-9. Hans Hofmann Papers, Bancroft Library, University of California Berkeley.

[160] The two paintings selected from the Albright-Knox Art Gallery are also included in Carolyn Tallent's unpublished 1988 study of Hofmann's work.

1940s were included in order to note any change in materials between these earlier experimental works and the artist's more established late-career style. Paintings on panel were eliminated from consideration because reactive plywood panel supports would impede the observation of paint-related condition issues. Eight palettes on various supports found in Hofmann's studio at the time of his death were included in order to note any late experimentation with new materials. Figure 3.12 is a timeline spread of the study group. The first half of the timeline includes the years when Hofmann was at the height of his popularity as a teacher;[161] the second half of the timeline includes Hofmann's most prolific and recognizable period of artistic production. Table 3.1 is a chronological listing of the study group paintings.

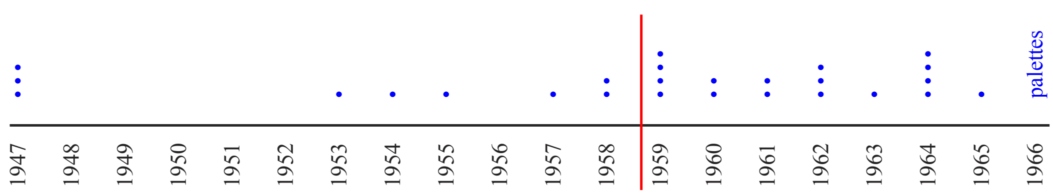

Figure 3.12: Timeline spread of study group paintings; palettes found in Hofmann's studio at the time of his death have been dated 1966. Red line indicates the year Hofmann closed his schools and began to paint full time.

[161] Jim Gahagan: "In the New York School that at any given time in the last year[s] there were a minimum of seventy-five to a hundred students working in the studio—roughly twenty-five and thirty in each session. . . . In the summer school. . . . we averaged—it became a good production problem—about 250 students studied there each summer." From the transcripts of "Students Talk about Hofmann as a Teacher," Artists Talk On Art panel discussion, March 17, 1978. http://www.atoa.org/3-17-78.htm

Table 3.1—Hofmann Paintings Selected for Study Group

Year	Title	Collection	Acc. No.	Size
1947	*Delight*	MoMA	2.1956	50.0 x 40.0" (126.9 x 101.6 cm.)
	Ecstasy	BAM	1963.2	68.0 x 60.0" (172.7 x 152.4 cm.)
	The Third Hand	BAM	1966.48	60.1 x 40.0" (152.7 x 101.6 cm.)
1953	*Le Gilotin*	BAM	1965.15	58.0 x 48.0" (147.3 x 121.9 cm.)
1954	*Scintillating Space*	BAM	1966.47	84.1 x 48.4" (213.6 x 122.9 cm.)
1955	*Exuberance*	AKAG	1955:8	50.0 x 40.0" (127.0 x 101.6 cm.)
1957	*Sommernachtstraum*	AKAG	1958:4	52.0 x 60.0" (132.1 x 152.4 cm.)
1958	*Equinox*	BAM	1965.12	72.1 x 60.3" (127.0 x 101.6 cm.)
	Morning Mist	BAM	1966.45	55.1 x 40.4" (140.0 x 102.6 cm.)
1959	*Above Deep Waters*	BAM	1965.13	84.2 x 52.0" (213.9 x 132.1 cm.)
	Indian Summer	BAM	1965.11	60.1 x 72.2" (152.7 x 183.4 cm.)
	Ruby Gold	MAG	60.37	55.4 x 40.5" (140.7 x 102.9 cm.)
	The Vanquished	BAM	1966.49	36.1 x 48.1" (91.7 x 122.2 cm.)
1960	*Bald Eagle*	BAM	1964.3	60.3 x 52.3" (153.2 x 132.8 cm.)
	In the Wake of the Hurricane	BAM	1965.6	74.3 x 60.0" (153.2 x 132.8 cm.)
1961	*Combinable Wall I and II*	BAM	1963.10	84.5 x 112.5" (214.6 x 285.8 cm.)
	Tormented Bull	BAM	1963.6	60.1 x 84.3" (152.7 x 214.1 cm.)
1962	*Heraldic Call*	BAM	1965.17	60.3 x 48.4" (153.2 x 122.9 cm.)
	Magnum Opus	BAM	1963.7	84.1 x 78.1" (213.6 x 198.4 cm.)
	Memoria in Aeternum	MoMA	399.1963	84.0 x 72.1" (213.4 x 183.2 cm.)
1963	*Polyhymnia*	BAM	1964.1	72.1 x 60.3" (183.1 x 153.2 cm.)
1964	*The Clash*	BAM	1965.8	52.1 x 60.3" (132.3 x 153.2 cm.)
	Imperium in Imperio	BAM	1966.43	84.1 x 52.0" (213.6 x 132.1 cm.)
	And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light	BAM	1965.4	84.1 x 60.3" (213.6 x 153.2 cm.)
	Silent Night	BAM	1965.5	84.0 x 78.3" (213.4 x 198.9 cm.)
1965	*Struwel Peter*	BAM	1966.5	72.1 x 60.3" (183.1 x 153.2 cm.)
1966	palette on plywood	Trust	M536-12	7.5 x 7.5" (19.1 x 19.1 cm.)
	palette on board	Trust	M593-12	4.8 x 9.0" (12.1 x 22.9 cm.)
	palette on board	Trust	M537-10	41.0 x 8.0" (104.1 x 20.3 cm.)
	palette on board	Trust	M536-53	6.5 x 8.0" (16.5 x 20.3 cm.)
	palette on glass	Trust	no #	24.0 x 24.0" (61.0 x 61.0 cm.)
	palette on paint can lid	Trust	M536-49	6.0" (15.2 cm.) diameter
	palette on board	Trust	M536-45	6.0 x 11.8" (15.2 x 29.8 cm.)
	palette on board	Trust	M536-03	4.0 x 11.0" (10.2 x 27.9 cm.)

AKAG: Albright-Knox Art Gallery (Buffalo, New York)
BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California)
MAG: Memorial Art Gallery, University of Rochester (Rochester, New York)
MoMA: Museum of Modern Art (New York, New York)
Trust: Renate, Hans and Maria Hofmann Trust (New York, New York)

Condition and Conservation History of the Study Group Paintings

> Hofmann has ~~often~~ *frequently* remarked of his ~~media~~ *materials*, with a mixture of respect and mock irritation, that "they fight back."
> —Draft of an essay by Sam Hunter, with editorial changes by Hofmann, 1964[162]

Hofmann's late-career paintings test both the aesthetic and physical limits of his materials. The paintings selected for this study were chosen to represent not only the artist's wide-ranging paint application methods but also the condition issues common to Hofmann's late works. An overview of the condition history of the study group paintings is presented below. The review of material-related condition issues in Hofmann's paintings works in combination with the materials analysis presented in Chapter Four to differentiate between aging behaviors common to works on canvas and those that may be directly tied to Hofmann's choice of materials. In order to exclude non-original materials from those identified as part of the artist's palette, an overview of conservation materials specifically noted or in common use during the preservation of the study group paintings is also provided. Most of the condition issues that appear in the study group paintings have been addressed during more than thirty years of conservation intervention and are no longer visible. Information regarding the condition and conservation of the study group paintings was therefore compiled from my own observations during selection and sampling of the study group works as well as the archived conservation records of the Albright-Knox Art Gallery, the Memorial Art Gallery, the Museum of Modern Art, and particularly the conservation records related to the Hofmann Collection at the University of California Berkeley Museum

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[162] Sam Hunter, "Hans Hofmann," typescript with Hofmann's corrections, 37. Hofmann Papers.

and Pacific Film Archive. These Berkeley records were drawn from the University of California Berkeley Art Museum and Pacific Film Archive curatorial files (Hofmann Collection treatment and administration records), and the San Francisco Museum of Modern Art conservation files (Elise S. Haas Conservation Department records). The conservation staff at the San Francisco Museum of Modern Art has undertaken the preservation of the university's Hofmann Collection since 1974 and maintains an archive of conservation assessment and treatment records for the collection. The Berkeley Art Museum also maintains a curatorial archive related to the Hofmann Collection's administration and preservation. The discussion presented below is the first comprehensive compilation of information from these unpublished sources.

Condition Issues in Hofmann's Late-career Paintings

Problems observed in Hofmann's late-career work appear in his support materials, within his paint layers, and on the surface of his paintings. Caretakers of Hofmann's work are faced with complex problems of distorted canvas, lifting paint, and slow- or improperly drying paints yet little information exists regarding the origins of these phenomena. Condition issues in Hofmann's late paintings were evident during his lifetime. On January 24, 1964, the Museum of Modern Art Exhibitions Director wrote to the Associate Counsel for The Regents of the University of California to express his concerns regarding *Tormented Bull* (1961) then traveling in Hofmann's retrospective exhibition and destined for donation to Berkeley: "As you will see from the attached copy of a letter from Mr. Hofmann," the letter reads, "that painting has an inherent flaking condition whose further deterioration cannot be covered by insurance."[163] An insurance waiver signed by the artist was enclosed with Rasmussen's letter. Overall cracks related to this flaking were still visible in the work during selection of the study group paintings.

In order to examine the analytical data provided in Chapter Four for unique relationships between Hofmann's late-career materials and the condition of his paintings, an overview of material-related behaviors commonly seen in works on canvas is presented below and illustrated with examples from the study group paintings. Condition issues observed or reported in the individual study paintings are compiled in Table 3.2. Information for Table 3.2 was drawn from my own observations and the conservation records of the respective collections, including ten separate condition surveys of the Hofmann Collection undertaken between 1974 and 2009 by the conservation staff of the San Francisco Museum of Modern Art.[164]

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163 Waldo Rasmussen, Museum of Modern Art Executive Director, Department of Circulating Exhibitions, to John E. Landon, Associate Counsel, The Regents of the University of California, January 24, 1964, 1. Curatorial archives, UC BAM/PFA.

164 Surveys of the Hofmann Collection were performed in 1974, (by Rockwell, then Chief Conservator at the San Francisco Museum of Modern Art), 1979 (Richard Lorenz, conservator at the San Francisco Museum of Modern Art), 1982 (Rockwell), 1986 (two surveys by San Francisco Museum of Modern Art conservator Jim Wright), 1988 and 1989 (Lorenz, as an independent contractor), 1991 (William J. Shank, then SFMOMA Chief Conservator, with SFMOMA conservator Neil Cockerline), 1999 (SFMOMA conservators Paula De Cristofaro and Dawne Steele Pullman), and 2003 and 2009 (Paula De Cristofaro and contractor Alina Remba).

Table 3.2—Condition Issues Observed in the Study Group Paintings

Title	Acc. No.	Distortions	Localized Distortions	Cracking/Cleaving Paint	Pin Holes/Tape Marks	Surface Wrinkling	Crystalline Exudates, Black Paints	Crystalline Exudates, Other Colors	Soft Paint/Liquid Exudates, Magenta	Soft Paint/Liquid Exudates, Other Colors	Underbound/Desiccated Paints
Delight	MoMA 2.1956			X							X
Ecstasy	BAM 963.2	X		X							X
The Third Hand	BAM 1966.48			X							X
Le Gilotin	BAM 1965.15	X		X					X		
Scintillating Space	BAM 1966.47	X		X							
Exuberance	AKAG 1955:8	X		X							
Sommernachtstraum	AKAG 1958:4	X		X				X			
Equinox	BAM 1965.12	X		X	X				X		
Morning Mist	BAM 1966.45		X	X	X						X
Above Deep Waters	BAM 1965.13	X		X				X			X
Indian Summer	BAM 1965.11		X	X				X	X		X
Ruby Gold	MAG 60.37		X	X					X		X
The Vanquished	BAM 1966.49	X		X		X					X
Bald Eagle	BAM 1964.3	X		X		X	X	X	X		X
In the Wake of the Hurricane	BAM 1965.6	X		X					X		X
Combinable Wall I and II	BAM 1963.10		X	X	X			X		X	
Tormented Bull	BAM 1963.6			X	X						
Heraldic Call	BAM 1965.17			X			X	X			
Magnum Opus	BAM 1963.7			X	X		X	X	X		
Memoria in Aeternum	MoMA 399.1963			X	X						
Polyhymnia	BAM 1964.1			X	X		X		X	X	X
The Clash	BAM 1965.8	X		X		X		X	X		X
Imperium in Imperio	BAM 1966.43	X		X	X			X			X
And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light	BAM 1965.4	X		X	X			X	X		
Silent Night	BAM 1965.5	X		X	X						
Struwel Peter	BAM 1966.5			X				X	X	X	X

AKAG: Albright-Knox Art Gallery (Buffalo, New York)
BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California)
MAG: Memorial Art Gallery, University of Rochester (Rochester, New York)
MoMA: Museum of Modern Art (New York, New York)
Information regarding the condition and conservation of the study group works was compiled from the conservation records of the respective collections, and from *in situ* assessment of the paintings during study group selection and sampling.

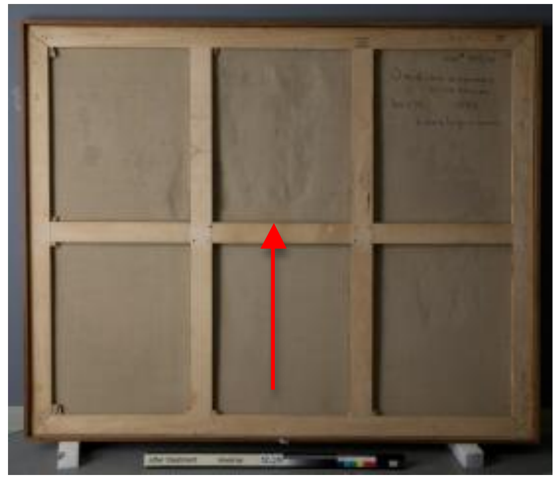
Fabric Supports and Preparatory Materials

Traditional support and preparatory materials were often inadequate for the heavy, sculpted surfaces of Abstract Expressionist paintings. Aging cotton canvases stretched and linen canvases became slack and brittle under the weight of heavy paint layers. This distortion exaggerated, rather than diminished, the stress imposed on absorbent but weak ground layer materials and wooden commercial stretchers designed to maintain tension in only two dimensions. Hofmann's late-career paintings are physical as well as optical constructions that, according to conservators, tested the limits of their wooden support structures. "Although the stretchers [Hofmann] used were generally sound, with cross bars appropriate to size," noted Rockwell, "they were sometimes not sturdy enough to support [his] larger works with weighty paint films."[165] Canvas distortion is advanced in Hofmann's paintings that exhibit absorbent grounds or unsized canvas materials that leach paint medium and place acidic materials in contact with canvas fibers. Despite assertions that Hofmann sized his canvases (see "Existing Information Regarding Hofmann's Materials"), references to unsized canvases do appear in the conservation records[166] and examination of the study group paintings has revealed purposefully uneven ground layer preparation (see Chapter Four, "Hofmann's manipulation of materials"). Distorted or unevenly weakened canvases exhibit uneven responses to environmental factors such as humidity, imposing further imbalanced stress on the painting structure. According to condition survey reports, eighteen of the twenty-six study group paintings have exhibited some level of canvas distortion and examples of localized distortion appear

[165] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 9.

[166] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 9.

in at least four works produced by Hofmann in the two years following his retirement (1959-60, see figures 3.13 and 3.14).



Figures 3.13 (left) and 3.14 (right): Hans Hofmann's *Indian Summer* (1959), photographed in oblique light. Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These images illustrate the regional distortion related to orange paints in some of Hofmann's late-career paintings.

Paint Layers

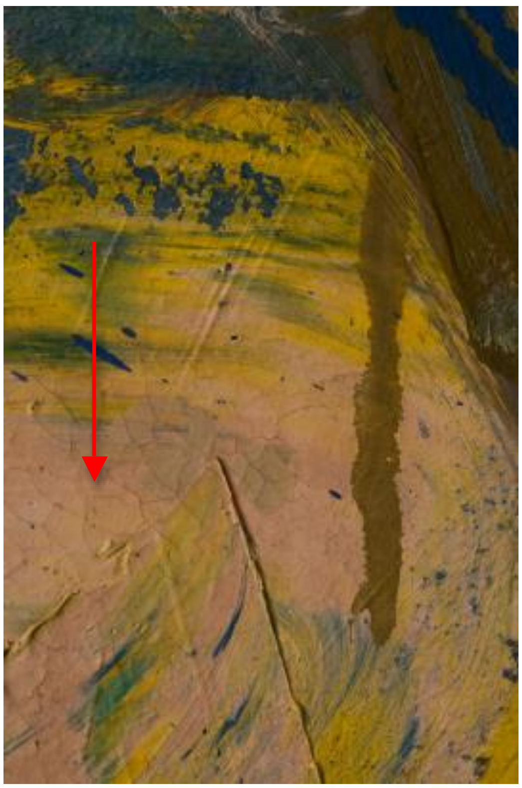
The compositional layers of a painting can exhibit a variety of condition issues from varying causes. Stress imposed on a painting before, during, or after application of a paint layer can result in internal failure of the paint film (intralayer cleavage) or failure of the bond between the paint film and neighboring materials (interlayer cleavage). Stresses normally absorbed by the failed paint film may then transfer to neighboring materials in a chain reaction that propagates the stress and creates related material failure throughout the painting. A range of paint and ground layer problems are commonly seen in all aged paintings and conservation records indicate that all the study group paintings have exhibited some level of paint cracking, cleavage, or loss.

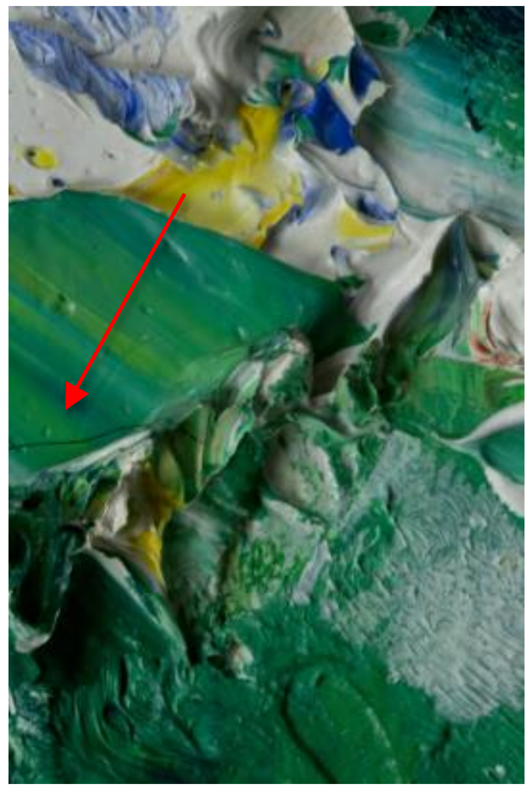
Stress can originate from within the painting or be applied by an external source. Weak or brittle paint films will fail under stress; tough or flexible materials may transfer their stress to weaker paint films. All oil paint films are stressed during the expansion-contraction behavior associated with oxidative drying.

Figures 3.15 (left) and 3.16 (right): Details of Hans Hofmann's *Struwel Peter* (1965) and *The Clash* (1964), photographed with normal illumination. Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. . Images used with permission of the Renate, Hans & Maria Hofmann Trust. These images illustrate two types of drying cracks commonly seen in oil paint films. The violet paint film on the left exhibits traction cracks related to oxidative drying, which can curl and lift in thin paint films. The thicker paint film on the right exhibits cracks that have developed deep within the film and appear first as depressed lines in the paint surface. This paint film also exhibits a surface wrinkling phenomenon discussed below.

Some paints exhibit contraction, or "traction" cracks in response to this stress. Traction cracks in thin paint films may curl or pull away from neighboring paint layers (figure 3.15), while cracks in thicker paints may develop deep within the film and appear first as depressed lines in the paint surface (figure 3.16). Brittle films may show widespread cracking (figure 3.17) while tougher paint films exhibit less frequent, deeper cracks (figure 3.18).





Figures 3.17 (left) and 3.18 (right): Details of Hans Hofmann's Third Hand (1947) and Scintillating Space (1954), photographed with normal illumination. Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These images illustrate the contrasting cracking behaviors commonly seen in brittle and tough paint films. The brittle white paint film on the left exhibits widespread micro-cracking in response to stress, while stress imposed on the equally thick but tougher green paint film on the right results in deeper, less frequent cracks.

The stress of drying paint films can also crack adjacent, weaker paints, or cause failure in weak bonds between paint layers. Hofmann's practice of reworking paintings over several months created a similar problem, as lack of adhesion between wet and dry paint layers creates additional opportunities for cracking, lifting, and cleavage.[167] One inventory erratum among the artist's papers identifies six works completed by Hofmann between 1953 and 1958 as completely "repainted."[168] Both intralayer and interlayer cleavage may lie beneath the surface of a paint layer. This "blind" cleavage continues to affect—and be affected by—various stresses to the paint structure. Underbound ground materials, paint films, and thinned washes of pigment have micro-fissured structures that have little internal strength to support or adhere to surrounding materials. The sheer weight of heavy paint layers also stresses absorbent and weak ground layer materials. The hazards of heavy paint layers were a topic of discussion even as Hofmann created his works, as evidenced by a 1961 talk by conservator Louis Pomerantz entitled "Is Your Contemporary Painting More Temporary Than You Think?":

> The piling up of cement-like loads of pigmented matter on flexible fabric supports is frequently encountered in avant-garde paintings. . . . Often, due to the obvious incompatibility of the extremely flexible support and the extravagantly thick, rigid paint film, which contributes

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[167] For one example of Hofmann re-working a composition, see Arthur Coleman Danto, "Hans Hofmann," *The Nation* 251(7) (September 10, 1990): 248-51. Danto juxtaposes a work signed by Hofmann in 1959 with a 1960 photograph by Arnold Newman of Hofmann re-visiting the work, several colored papers pinned to its surface.

[168] Hofmann Papers.

> to even further sagging of the support, large scale cleavage [interlayer cracking] and losses result.[169]

The physical action of painting can also stress the structure of an artwork. Hofmann's actions while painting were notoriously physical. "Depending on his concept," recalled Kiesler, "sometimes [Hofmann's] movements, as he painted, were delicate and lyrical. Other times, he was caught in a frenzy of painting, his movements were frightening. . . . It gave me the aspect of a person spinning into space, but somehow the central axis was out of joint."[170] Elaine de Kooning reported Hofmann using his brush "like a dagger,"[171] a practice that could distort the canvas support, crack dried paint materials, and expand existing cracking and cleavage. Such physical painting practice left its mark on both compositional and preparatory layers; the marks may appear immediately or over time. The stress normally absorbed by these paint layers is then transferred to surrounding materials and creates uneven stresses throughout the painting. Newly applied paint or varnish materials can also seep through previous cracks in already dried paint, altering the drying or aging characteristics of surrounding materials. Uneven drying of paint materials can also contribute to canvas distortion. Uneven thickness of paint or uneven distribution of materials within a paint layer can lead to uneven drying of the paint layer that further warps the canvas support and places additional stress on canvas and paint layers where distorted and planar surfaces meet.

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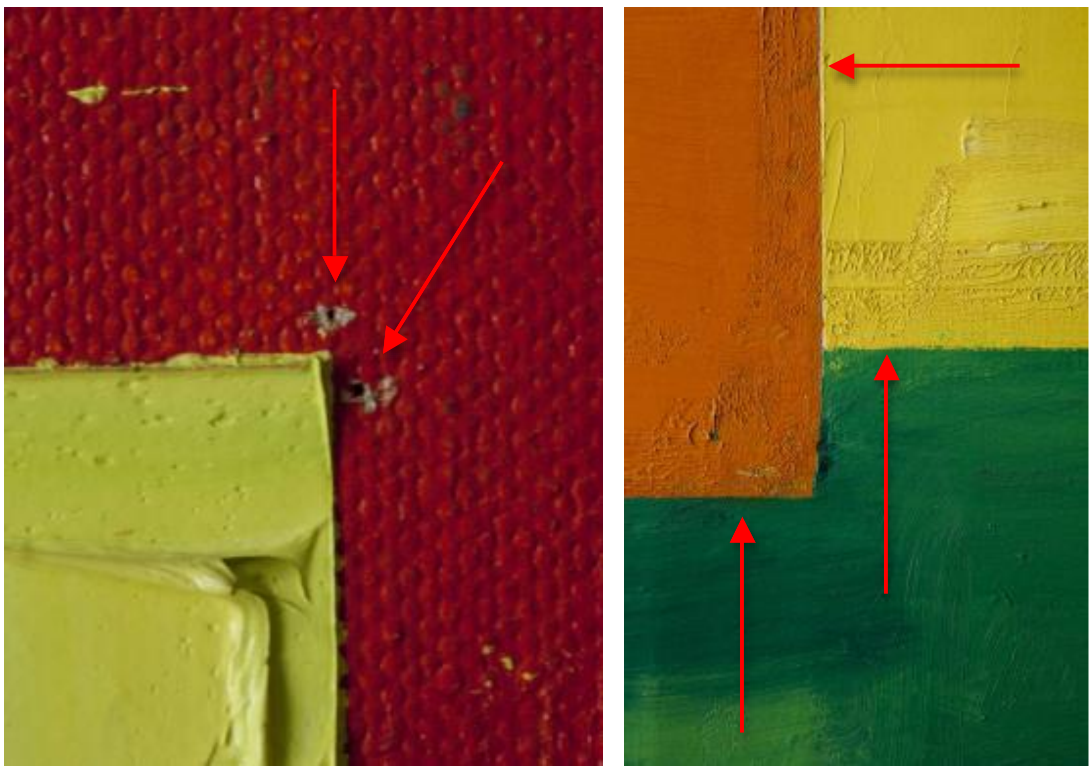
169 Louis Pomerantz, *Is Your Contemporary Painting more Temporary than You Think? Vital Technical Information for the Present-Day Artist* (Chicago: International Book Company, 1962), 19.

170 Lillian Kiesler, "As a Painter," typescript interview notes, undated and interviewer unacknowledged, 1. Lillian and Frederick Kiesler Papers.

171 De Kooning, "Hans Hofmann Paints a Picture," 40.

Less physical painting practices also impact the structure of a painting. Pinholes and burnished impasto often result from Hofmann's attachment of paper compositional aids, for example, and are often accompanied by minor cracking of dried paint (figure 3.19). Similarly, evidence of the tape Hofmann used to edge his colored rectangles can be seen in altered paint surfaces and the lifting of underlying paint layers resulting from the tape's removal (figure 3.20).



Figures 3.19 (left) and 3.20 (right): Details of Hans Hofmann's *Magnum Opus* (1962) and *Silent Night* (1964), photographed in oblique light. Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. The images illustrate the minor cracking and cleaving of paint layers associated with Hofmann's use of push pins (left) and the altered paint surface and lifting paint layers resulting from tape removal along the edges of Hofmann's rectangles (right, borders of the orange and yellow rectangles).

Although Hofmann is said to have occasionally buried whole pieces of colored paper between paint layers,"[172] no adhesion gaps indicative of this practice are visible or have been recorded in the study group paintings.

Environmental changes also impose stress on paint materials. Expansion and contraction of a canvas in response to shifts in humidity or temperature exaggerate the stresses imposed on neighboring materials and expand existing cracking and cleavage. Environmental changes are experienced by paintings during transitions such as exhibition-related travel, which may include environmental extremes and the physical stresses imposed by increased handling and transport. When a painting is moved for exhibitions off-site or in house or subjected to changes in heat and humidity, paint materials are stressed. Of the twenty-six paintings included in the study group, twenty-one paintings have been loaned out for exhibition at least once, sixteen paintings have loaned for exhibit at least twice, and ten of the paintings have been loaned out for exhibit three or more times.[173] Four of the study group paintings are considered too fragile to travel and have been placed on a permanent "do not loan" list, while five of the study group paintings are allowed only limited travel due to unstable materials and a high potential in transit.[174] These figures do not include the numerous times

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[172] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 8.

[173] These figures include both national and international exhibitions; multi-venue touring exhibitions are counted as a single exhibition.

[174] Information regarding travel of Hofmann paintings from the collection of the Albright-Knox Art Gallery was provided by Acquisitions Assistant Lindsay Nikisher in an email dated March 7, 2014. Information regarding travel of Hofmann paintings from the collection of the University of Rochester Memorial Art Gallery was provided by Curatorial Assistant Kerry Schauber in an email dated February 3, 2014. Information regarding travel of Hofmann paintings from the collection of the Museum

paintings may be moved in storage or during installation and de-installation for in-house exhibition.

Paint Surfaces

Works on canvas exhibit several surface phenomena related to the uneven drying of paint materials, including wrinkling and extremes of saturation or desiccation. Hofmann's heavily painted or poured paints, for example, are often distinguished by wrinkling related to the premature surface expansion-contraction drying of the paint surface. Surface wrinkling—usually associated with heavy layers of quick-drying industrial paint formulations—can be seen in Hofmann's black enamel-type paints (see figure 3.21) but is also found in heavily applied layers of other colors (see figure 3.16). Surface wrinkling is for the most part an aesthetic concern, although airborne contaminants can become trapped in the wrinkles, and the dried skins of wrinkled paints can inhibit the transfer of oxygen needed for continued drying of the underlying paint layer. Soft paints do not have the internal strength of fully dried paint films, and can readily transfer stress to neighboring materials.

Thick lines of paint applied directly from the tube (figure 3.22) can exhibit a delayed drying pattern similar to that of wrinkled paints, but with the added complication of uneven composition. Pigment and binder can also separate during storage, emerging from the tube as an uneven mix of pigment paste and binder with

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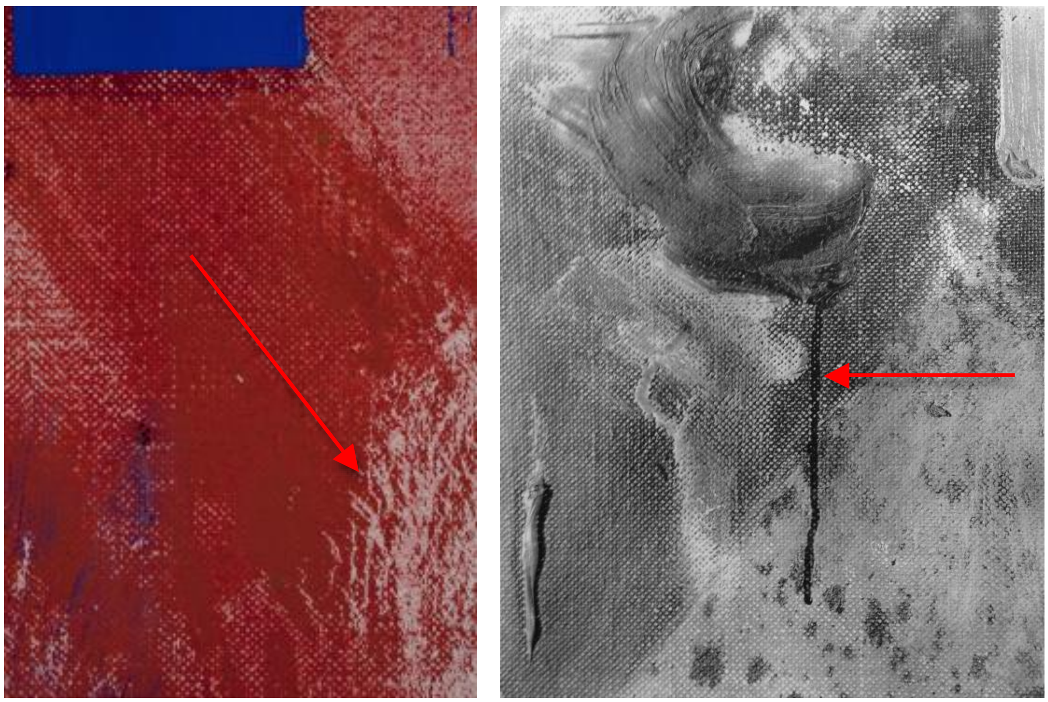
of Modern Art was provided by Collection Specialist MaryKate Cleary in an email dated March 10, 2014. Information regarding travel of Hofmann paintings from the collection of the University of California Berkeley Art Museum and Pacific Film Archive was provided by Director of Registration Lisa Calden in an email dated February 10, 2014.

the attendant problems characteristic of alternating saturated and underbound materials. In works where Hofmann applied paint directly from the tube or can to areas wet with thinner, the leaching of excess binder into surrounding materials creates regional alterations in the composition of neighboring paint layers.

Figures 3.21 (left) and 3.22 (right): Details of Hans Hofmann's *The Vanquished* and *Indian Summer* (both 1959), photographed with normal illumination. Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. Circumstances that retard the drying of thick paint layers include surface wrinkling (left) and the uneven mix of materials that commonly accompanies paints applied directly from the tube (right).

Surface alterations related to shifting binder concentration are seen in Hofmann's use of paints applied directly from a tube or can, and in thinned applications of paints that lose their limited binder to absorbent grounds or adjacent underbound materials. Desiccated paint surfaces commonly appears in conservation records in connection with Hofmann's alizarin colors (figure 3.23).



Figures 3.23 (left) and 3.24 (right): Details of Hans Hofmann's *Polyhymnia* (1963) and *The Clash* (1964), photographed with normal illumination. Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. Surface phenomenon related to the movement of paint materials in Hofmann's alizarin paints. Absorbent ground and paint layers can leach binder from thinned paints and cause cracking and desiccation (left), and migrating paint material can form liquid droplets on the surface of paint layers and drip or flow to other areas of the painting (right). The black and white detail of *The Clash* is reproduced from Rockwell's xerox of photographs that originally accompanied the 1992 report "Conservation Problems Present in Paintings by Hans Hofmann." The image is labeled "Non-drying oil component running down from magenta paint. Sinking in of oil medium is evident in upper part of this paint area." The original photograph has not been located.

"For the alizarin crimson applied to *The Third Hand,* 1947, with its absorbent gesso ground and to *Struwel Peter,* 1965, with its porous alkyd ground," Rockwell noted, "the loss of oil medium from this lake pigment left it desiccated, cracked, crumbling, and flaking."[175] Underbound paint films form poor bonds with surrounding materials and exposed pigment particles on the painting's surface are susceptible to fading from exposure to ultraviolet radiation and atmospheric pollutants. According to conservation records, fourteen of the twenty-six study group paintings have exhibited underbound or desiccated paint; there are no records of examination or analysis related to the potential fading of pigment color. Conversely, fourteen of the study group paintings have a history of soft or slow-drying paints: "Some paint surfaces remain tacky to the touch," noted Rockwell, with "sticky, almost fluid underpaint."[176]During my examination of the paintings, four of the study group works continued to exhibit softened or sticky paint films.[177]

Exudation is another distinctive surface phenomenon exhibited by oil paintings. Exudation is the surface migration of mobile paint components, although the cause and mechanism of this migration is not clear. The migrating components appear on the surface of the paint film (and on film surfaces between paint layers) in forms ranging from crystalline fatty acids[178] to expressed liquid oils.[179] Crystalline

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[175] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 14.

[176] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 16.

[177] As of my examination of the paintings in December 2011. Sticky paint was also observed on one Trust palette during my visit that same month.

[178] Kathleen A. Martin et al., "A New Approach to the Treatment of Fatty Acid Crystals in Oil Paintings," in *American Institute for Conservation Paintings Specialty*

exudates form a hazy film that obscures the underlying paint layer and hardens to a tough and opaque crust; liquid exudates form sticky masses that trap airborne contaminants and flow into or drip onto other paint materials. Like desiccation, exudation—particularly the exudation of liquid materials—is commonly reported in association with Hofmann's late-career use of alizarin paints (figure 3.24). "A few years ago, we received a distressed phone call from the [museum] registrar," Rockwell reported in the late 1980s, "informing us that a droplet of amber oil had been expressed from magenta paint on *The Clash*. . . . The upper portion of the magenta area had grown chalky, while lower portions were progressively more saturated with oil.[180] Of the fourteen slow-drying paints noted above, eleven were alizarin-like colors that were soft and/or expressed liquid exudates.

Conservation History of the Study Group Paintings

A materials-based interpretation of Hofmann's practice relies on the accurate identification of original materials as well as the exclusion of non-original materials from a catalogue of the artist's late-career palette. In order to create an accurate catalogue of Hofmann's late-career materials based on scientific analysis of samples from the study group paintings, it is necessary to differentiate Hofmann's use of

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Group Postprints, Milwaukee, Wisconsin, May 11-14, 2010 (Washington, DC: AIC, 2013), 18-22.

[179] Both dry and liquid exudates are sometimes loosely referred to using the crystalline exudation descriptive "efflorescence"; this should not be confused with the glowing appearance of some exudates under ultraviolet illumination—not all efflorescence fluoresces.

[180] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 16.

traditional and modern paint materials from those materials that may appear in samples as a result of conservation treatment. Treatment records and visual examination can be used to avoid most localized regions of conservation treatment during sampling, but samples taken from paintings that have undergone widespread or overall treatment are likely to contain non-original materials that should be excluded from consideration. The conservation treatment records for the study group paintings assist this effort by providing information regarding non-original conservation materials employed in the treatment of the paintings but even the detailed Hofmann Collection conservation records retained in Berkeley and San Francisco exhibit gaps in documentation or limited detail regarding some conservation materials. It is therefore important to take into account other materials commonly used in the conservation treatment of mid-twentieth-century paintings. Conservation methodology regarding the treatment of modern paintings has changed significantly in the forty-eight years since Hofmann's death. Treatment accounts of the study group works reflect a shift from overall to localized application of materials, the introduction of removable synthetic materials, and a growing emphasis on artist's intent and the optical qualities of the modern paint surface.[181] A wide array of materials has therefore been employed in the study group paintings' preservation.

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[181] See Ysbrand Hummelen et al., "Collecting and Archiving Information from Living Artists for the Conservation of Contemporary Art," in *Conservation of Easel Paintings,* Joyce Hill Stoner and Rebecca Rushfield, eds. (Oxon and New York: Routledge, 2012), 39-48. See also Weisman Art Foundation, *Conservation and Contemporary Art*, transcript (Los Angeles: Frederick R. Weisman Art Foundation, 1991); and Paulien 'T Hoen et al., eds., *Contemporary Art: Who Cares? Research and Practices in Contemporary Art Conservation. Preprints of the symposium held in Amsterdam, 9-11 June 2010* (Amsterdam: ICN, 2010).

Inherent and chronic condition issues in Hofmann's late-career paintings—in conjunction with regular requests for the artist's work for exhibition at other venues—have left many of the study group paintings with lengthy conservation assessment and treatment histories. According to the University of California's 1992 conservation grant application to the Getty Trust, "since their arrival on the UC Berkeley campus, the Hofmann paintings have required almost constant supervision."[182] The earliest existing treatment records for the Hofmann Collection paintings are dated 1973, although there is evidence of earlier conservation intervention. New York-based paintings conservator Daniel Goldreyer examined several of the University of California's Hofmann Collection paintings in October 1966 and his treatment recommendations were documented by University Art Museum curator Lawrence Dinnean[183] in a handwritten note entitled "Goldreyer's Visit, 19 Oct 1996 / Examination w Mr, Mrs Goldreyer / MA Craft / L. Dinnean."[184] A penciled sidebar from Dinnean in the margins of a May 1972 memo from curator Brenda Richardson subsequently noted that Goldreyer had treated several of the Hofmanns in the

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[182] "University Art Museum and Pacific Film Archive Proposal to The Getty Grant Program, Conservation Treatment," 3. Pencil inscription 1992. Elise S. Haas Conservation Department, San Francisco Museum of Modern Art.

[183] Dinnean is alternately referred to as Curator of Conservation and as Curator of the Hofmann Collection. The museum's curatorial files contain a January 21, 1976 cover sheet by registrar Joy Feinberg noting that conservation records for the Hofmann Collection were turned over to Feinberg when Dinnean left the museum in November 1974 and that the records may be incomplete.

[184] Lawrence Dinnean, ""Goldreyer's Visit, 19 Oct 1996 / Examination w Mr, Mrs Goldreyer / MA Craft / L. Dinnean," handwritten note. Curatorial archive, UC BAM/PFA.

intervening period.[185] It appears that Goldreyer was not the only person to work with the collection in its early years, as a November 1972 treatment proposal contains a penciled note by Dinnean which reads "preliminary procedure already performed by Prof. Loran; Mr. Goldreyer is requested to examine, make conservation proposal, and perform further necessary conservation procedures."[186] Of the twenty-six paintings included in the study group, all have undergone at least one treatment campaign, seven paintings have undergone conservation treatment at least twice, and nine of the paintings have undergone conservation treatment three or more times.[187] The purpose of identifying non-original materials is to exclude them from those materials associated with the artist's original palette. A compilation of the conservation materials noted in the treatment records is provided in Table 3.3.

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185 May 25, 1972 memo "TO: Larry / FROM: Brenda." "Hofmann varnishing project" file, curatorial department, UC BAM/PFA.

186 November 1972 treatment checklist. Dinnean's sidebar appears next to the entry for a painting designated for treatment on November 10. "Hofmann varnishing project" file, curatorial department, UC BAM/PFA.

187 Information compiled from the UC BAM/PFA curatorial files (Hofmann Collection treatment and administration records), San Francisco Museum of Modern Art conservation files (Elise S. Haas Conservation Department records, including Rockwell's 1982 survey report), Intermuseum Conservation Association records (treatment files for study group paintings from the Albright-Knox Art Gallery and Memorial Art Gallery and Tallent's survey records of the Berkeley collection, plus Tallent's personal notes related to the survey and summary information communicated to the author on January 23, 2005), and the conservation records of the Albright-Knox Art Gallery, Memorial Art Gallery, and Museum of Modern Art.

Table 3.3—Conservation Materials Mentioned in Treatment Documentation

			Lining/Consolidation					Varnishing/Inpainting						Re-saturation	
Year	**Title**	**Acc. No.**	**wax-resin**	**PVA**	**pEVA***	**p*n*BMA**	**other****	**p*n*BMA**	**p*i*BMA**	**p(EMA-MA)**	**PVA**	**acrylic paints**	**aqueous media*****	**acrylic resins *******	**polycyclohexanone**
1947	*Delight*	MoMA 2.1956		X				X							
	Ecstasy	BAM 963.2	X		X		X		X						
	The Third Hand	BAM 1966.48	X	X	X				X				X		
1953	*Le Gilotin*	BAM 1965.15	X	X	X			X	X	X					
1954	*Scintillating Space*	BAM 1966.47	X		X		X	X	X	X		X			
1955	*Exuberance*	AKAG 1955:8	X		X						X		X		
1957	*Sommernachtstraum*	AKAG 1958:4			X								X		
1958	*Equinox*	BAM 1965.12	X	X	X		X	X	X	X					
	Morning Mist	BAM 1966.45	X		X		X						X		
1959	*Above Deep Waters*	BAM 1965.13		X			X	X	X						
	Indian Summer	BAM 1965.11													
	Ruby Gold	MAG 60.37		X							X			X	
	The Vanquished	BAM 1966.49			X	X	X	X	X			X	X		
1960	*Bald Eagle*	BAM 1964.3	X		X			X	X						X
	In the Wake of the Hurricane	BAM 1965.6			X			X	X						
1961	*Combinable Wall I and II*	BAM 1963.10		X											
	Tormented Bull	BAM 1963.6	X		X		X	X	X				X		
1962	*Heraldic Call*	BAM 1965.17													
	Magnum Opus	BAM 1963.7						X							
	Memoria in Aeternum	MoMA 399.1963			X							X			
1963	*Polyhymnia*	BAM 1964.1			X										
1964	*The Clash*	BAM 1965.8		X	X		X	X	X	X					
	Imperium in Imperio	BAM 1966.43			X	X									
	And Out of the Caves . . .	BAM 1965.4	X					X	X						
	Silent Night	BAM 1965.5	X						X				X		
1965	*Struwel Peter*	BAM 1966.5	X	X	X		X						X		

AKAG: Albright-Knox Art Gallery (Buffalo, New York); BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California); Estate: Renate, Hans and Maria Hofmann Trust (New York, New York); MAG: Memorial Art Gallery, University of Rochester (Rochester, New York); MoMA: Museum of Modern Art (New York, New York). Wax-resin: A mixture of natural and synthetics waxes and synthetic resins; PVA: poly(vinyl acetate), noted as AYAA and AYAC formulations in consolidation, AYAB for inpainting, AYAA and AYAC in re-saturation; pEVA: poly(ethylene vinyl acetate), noted as BEVA 371 and BEVA D-8 in consolidation; p*n*BMA: poly(*n*-butyl methacrylate), noted as Bedacryl 122-X in consolidation, Lucite 44 and Solvar in varnishes, Magna Plastic Colors in inpainting; p*i*BMA: poly(iso-butyl methacrylate), noted as Paraloid B-67 in varnishing and inpainting; p(EMA-MA): ethyl methacrylate methyl acrylate, noted as Paraloid B-72 in varnishing and inpainting; acrylic paints noted include Golden MSA Conservation Colors and LeFranc & Bourgeois Restoration Color (acrylic/ketonic mixture); Polycyclohexanone: a ketonic resin noted as Winton Retouch Varnish in re-saturation.

* As a component of BEVA 371 and BEVA D-8 adhesives, also contains polycyclohexanone resin and wax.

** Local fill materials noted include adhesive putty, latex spackle, polyfix. Old glue lining noted on *Equinox.*

*** Including gouache, watercolors, and pastels.

**** Noted as “various synthetic resins.”

Note: Information provided by archived conservation treatment reports is not complete; additional materials may have been used prior to or during treatments. Volatile conservation materials (solvents, etc.) not listed.

Analytical data cannot differentiate between similar adhesive or resinous materials utilized in different conservation procedures; materials are therefore grouped together according to the procedures with which they are most associated. Volatile conservation materials such as solvents are not listed.

The treatment practices whose materials are most likely to be found in the analysis of Hofmann's paintings are discussed below. As in Table 3.3, practices utilizing similar materials are grouped together in the discussion below. The materials commonly used in these practices are noted, along with a synopsis of related materials documented in the treatment of Hofmann's work.

Lining and Consolidation

Various adhesive materials may be found in paint samples as a result of either lining or consolidation procedures. Preferred lining and consolidation materials and techniques have changed over the period during which Hofmann's paintings have been treated, therefore multiple lining or consolidation materials may appear in individual study group paintings.

Lining is the practice of securing a painting onto a secondary support structure. The secondary support may be a flexible material like canvas, or a solid material such as a wooden or aluminum panel. The lining of canvas paintings is usually performed to address canvas degradation or distortion that cannot be sufficiently reduced by other means. Early lining treatments typically adhered the lining material across the back of the entire painting; subsequent variations on the practice include edge-lining and lining without adhesives. Early lining treatments for Abstract Expressionists paintings did not differ significantly from lining treatments performed on paintings from other periods and many works by Hofmann were first lined using the wax-resin lining procedures recommended by conservators such as George Stout, Morton C. Bradley, and Caroline Keck.[188] Infusion with wax-resin adhesive and lining onto a solid wooden support was seen as a dependable alternative to earlier glue-paste lining systems for dealing with compound problems of lifting paint, blind cleavage, and distorted canvas. Similar treatments were undertaken to address early problems with distortion and lifting paint in Hofmann's paintings. Infusion of Hofmann's paintings with wax-resin not only reestablished the bond between the artist's paint and support materials, but also addressed the extreme distortions common to Hofmann's late work. "During the process of lining and panel mounting," noted Rockwell, "it is possible to eliminate some of the extensive planar distortions of the canvas which develop in many areas of [Hofmann's] thickly applied paint. . . . The original canvas was stabilized by the wax-resin, which greatly reduced its dimensional responses to atmospheric humidity fluctuations."[189] Infusion with wax-resin also saturated the original canvas material, altering its color, texture, composition, and behavior. Canvases saturated with wax-resin are visibly darker and heavier, with local infusions

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[188] George L. Stout, *The Care of Pictures* (New York: Columbia University Press, 1948); Morton C. Bradley, *The Treatment of Pictures*, (Cambridge, MA: Art Technology, 1950); Caroline Keck, *How to Take Care of Your Pictures: A Primer of Practical Information* (New York: Museum of Modern Art and Brooklyn Museum, 1954) and *Exposition of Painting Conservation: Materials—Methods—Machines* (Brooklyn, NY: Brooklyn Museum, 1962). These popular practices were themselves similar to those described in the conservation literature a decade earlier in the Fogg Art Museum's *Technical Studies in the Field of Fine Arts* (1932-42; Stout was the managing editor), the first English-language journal dedicated to conservation methodology and practice.

[189] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 13-A, 7.

creating localized changes in behavior. According to treatment records for the study group paintings, six works have been wax-resin infused overall and five received local wax-resin infusion. Wax-resin materials are still visible in the fabric support materials of all these works.

As lining techniques have changed, so too have the materials used in the lining of Hofmann's paintings. Many of the early wax-resin linings performed on Hofmann's paintings have been removed, and paintings lined to heavy Masonite panels have been re-lined onto light-weight aluminum hollow-core panels or secondary canvas fabrics using synthetic adhesives which do infuse the original canvas material or darken canvas or chalk-based paint extenders. Early synthetic resins used as alternative lining adhesives included Plextol B500, a aqueous butyl-Methacrylate copolymer emulsion,[190] and Gustav Berger's BEVA 371, introduced by Berger and conservator Orrin Riley in a 1971 article entitled "New Development in the Conservation of Works of Art."[191] Anecdotally said to be named in homage to the 370 formulations that came before it, BEVA 371 was a mixture of ethylene vinyl acetate, polycyclohexanone, and wax that was less prone to the problems associated with wax-resin linings but still required application under heat and pressure that could alter the texture and sheen of delicate paint surfaces and exposed canvas fibers. The heat and pressure endemic to lining treatments can damage or distort thick paint layers and

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[190] *Conference on Comparative Lining Techniques*, Caroline Villers, ed. (Greenwich, UK: National Maritime Museum, 1974). See also Vishwa R. Mehra: "The Cold Lining of Paintings," *The Conservator* 5(1981): 12-14.

[191] Gustav A. Berger and Orrin H. Riley, "New Developments in the Conservation of Works of Art," *Art Journal* 31(1) (Fall 1971): 77-86.

delicate impasto, a serious concern in the treatment of Hofmann's architectonic constructions. "Heavy, multilayered paint buildup ranges in thickness from ¼" to over 1"," recalled Rockwell, "[and] require[s] extensive impasto packing during its lining and panel mounting on the vacuum hot table."[192] Packing of the impasto involved localized use of paper fibers and aqueous adhesives:

> One of the first concerns was the need to protect the delicate crests and point of paint impasto during treatment. . . . Protection was accomplished by packing moist paper fiber combined with aqueous adhesives around the vulnerable impasto with tweezers and fine spatulas. . . . After consolidation the pulp was softened again with moisture and carefully removed.[193]

The 1980s brought about a more dramatic change in attitudes towards the lining of modern paintings. Between the 1970s and 1990s popular conservation methodology embraced low-heat or low-pressure lining techniques in response to rising concerns regarding the aesthetic and physical impact of invasive lining treatments on modernist paint surfaces. Full lining treatments became less prevalent as conservators embraced alternative procedures and materials. Goldreyer's 1986 treatment of a vandalized Barnett Newman painting in the collection of the Stedelijk Museum of Art, for example, involved a full relining but when the same vandal attacked another of the museum's works by Newman in 1997 museum conservators

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[192] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 9.

[193] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 12.

used synthetic adhesive and wire support threads to reweave damaged fabric threads, but did not apply a new overall lining.[194]

The adhesives used in lining are similar to those adhesives used to consolidate cracking or lifting paint films, a procedure that commonly precedes a lining treatment. Both traditional and modern adhesives may appear in localized or widespread regions of a painting, depending on the conservation procedure performed and the era in which the conservation treatment occurred. Multiple adhesives may be present in samples from paintings on which multiple treatments were performed. According to treatment records for the study group paintings, six of the study group paintings were lined at least once to secondary support materials including linen canvas, aluminum panel, birchwood panel, and semi-transparent fiberglass sheet or fabric. These secondary support materials are still visible on the study group paintings.[195] All but six of the study group paintings have records of local consolidation with materials that include poly(vinyl acetate) mixtures AYAA and AYAC,[196] a water-based poly(vinyl acetate) emulsion known as BEVA D-8, BEVA 371, n-butyl methacrylate (Bedacryl 122-X), and “adhesive putty.” Hofmann’s dedication to a primarily oil-based palette makes it somewhat easier to separate the artist’s original materials from the disparate conservation media that may appear during analysis of his paintings.

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[194] *Barnett Newman: Cathedra* (Amsterdam: Stedelijk Museum of Art, 2002). The publication was preceded by a December 8, 2001 symposium entitled “Restoration of Cathedra - Considering the Restoration of a Monochrome Painting.”

[195] Photographs were taken of the original canvas backs prior to lining, although these materials were not accessible during my examination of the paintings.

[196] Poly(vinyl acetate) resins with varying glass transition temperatures are usually mixed to customize handling and structural characteristics. Poly(vinyl acetate) formulations commonly used in conservation include AYAA, AYAB, and AYAC.

Structural lining treatments are now infrequently employed in the treatment of paintings by Hofmann and his Abstract Expressionist colleagues. Examples of current techniques presented at a 2003 conference dedicated to lining alternatives include the reweaving of torn threads performed on the Stedelijk painting, the de-acidification of brittle canvas materials, and strip lining—the practice of attaching strips of fabric to reinforce or replace the tacking edges needed to properly attach a painting to its stretcher.[197] A lining alternative currently in favor is the use of a secondary support fabric that is not directly adhered to the original support canvas. The stretching of a painting over a pre-stretched secondary canvas is called “loose” lining and relies on friction to create a bond between the primary and secondary fabric, but the technique still requires manipulation of the original painting. In “cami-lining” (also known as stretcher bar lining), the painting remains on its stretcher and the secondary fabric is passed behind crossbars and attached to the inside edges of the stretcher. Cami-linings maintain limited contact between the primary and secondary support fabrics and rely on a pocket of air to cushion the original canvas during handling and transport. Cami-linings were among the preventive, minimally invasive treatments highlighted at the 1990 *Art in Transit* conference at the National Gallery of Art in Washington, DC.[198] By the mid-1990s, full linings no longer appear on treatment records for Hofmann

[197] Mary Bustin and Tom Caley, eds., *Alternatives to Lining: Structural Treatment of Paintings on Canvas without Lining. Preprints of a Conference Held Jointly by the British Association of Paintings Conservator-Restorers and the United Kingdom Institute for Conservation Paintings Section on 19 September 2003* (London: United Kingdom Institute for Conservation of Historic & Artistic Works, 2003).

[198] Marion Mecklenburg, ed., *Art in Transit: Studies in the Transport of Paintings* and *Art in Transit: Handbook for Packing and Transporting Paintings* (Washington, DC: National Gallery of Art, 1991).

Collection paintings; records of all works requested for loan were thereafter required to be cami-lined before travel.[199] Cami-lining materials were visible on two of the study group paintings during my examination of the works.

Varnishing and Inpainting

Similar groups of materials are utilized in conservation varnishing and inpainting procedures. As with lining and consolidation adhesives, the type of varnish applied to the study group paintings has changed with evolving conservation research, and contemporary methodology guiding conservation varnishing treatments has become more cautious and more responsive to the desires of the artist. Varnishing media can be found over the entire surface of individual study group paintings, applied locally, and/or in conservation inpainting materials.

Varnish is commonly used to re-saturate and consolidate friable paint, and protect exposed pigment surfaces from exposure to light and environmental contaminants. Early varnishing treatments for Abstract Expressionists paintings did not vary significantly from the nineteenth-century practice of varnishing paintings in situ before a salon exhibition. As late as the 1970s many institutional labs were still following the universal varnishing recommendations of Stout, Bradley, and Caroline Keck , who promoted varnishing as a preventive measure that "sealed" the paint layer against dirt and enriched the paint colors. "In many oil paintings of the twentieth century the effect desired by the artist is a mat or unshiny surface," Keck noted, but asserted that "to leave these paintings without protection is to condemn them to an

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[199] Hofmann Collection records, Elise S. Haas Conservation Department, San Francisco Museum of Modern Art.

early death."[200] In the 1950s synthetic poly(vinyl acetate) varnish rose in popularity as an alternative to oil-based varnish resins which discolored over time, and were difficult to remove without affecting the underlying paint layer. The low refractive index of poly(vinyl acetate) also produced a matte surface alternative more in keeping with modernist aesthetics, as noted by Pomerantz:

> Today it is fashionable to have a mat or non-varnished appearance. . . . Today we are very conscious of the aesthetic quality of surface textures. If one wishes to duplicate a mat or unvarnished appearance and emphasize the surface texture of the painting, one should employ a methacrylate or vinyl acetate resin type of varnish.[201]

Early synthetic coatings were embraced by conservators with mixed results. Low molecular weight poly(vinyl acetate)[202] was later found to exhibit lower glass transition temperatures, resulting in soft varnish surfaces susceptible to gathering surface dirt or shifting position at room temperature, a behavior also known as "cold flow."[203] Many popular varnishes were based on n-butyl methacrylate resins, which were found to form cross-linked brittle films which micro-fissured and appeared hazy, and exhibited reduced solubility that limited subsequent removal of the film without disturbing underlying paint layers.[204] Methacrylate varnishes in widespread use until

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[200] Keck, *How to Take Care of Your Pictures*, 24.

[201] Pomerantz, *Is Your Contemporary Painting More Temporary Than You Think?,* 31.

[202] Poly(vinyl acetate) formulations are designated by the coding AYAA, AYAB, AYAC, etc.. AYAA has the lowest molecular weight; AYAF is the highest molecular weight formulation commonly used for conservation purposes.

[203] Most prevalent in AYAC formulations.

[204] Robert L. Feller et al., “"Photochemical Studies of Methacrylate Coatings for the Conservation of Museum Objects," in *Photodegradation and Photostabilization of*

the late 1970s were produced by DuPont (Lucite 44 and 45, Elvacite 2044), Rohm and Haas (Plexisol P550, Acryloid F10, and Acryloid B-66, a copolymer of poly(n-butyl methacrylate) and an ethyl methacrylate/methyl acrylate copolymer), Ralph Mayer (M Varnish), Permanent Pigments (Soluvar), and F. Weber and Company (Synvar).[205] Popular varnishes containing iso-butyl methacrylates included Acryloid B-67 and Elvacite 2045. More stable ethyl methacrylate methyl acrylate polymer varnishes such as Acryloid B-72 (now Paraloid B-72) replaced poly(n-butyl methacrylate) varnishes in the 1980s. Synthetic varnishes were commonly applied to Abstract Expressionist compositions despite the artists' solidarity with their Cubist predecessors' rejection of varnishes. The popular use of unprimed canvases by mid-twentieth-century artists posed additional challenges when varnished, damaging delicate surfaces and capturing underbound pigment in the new surface coating, and saturating and darkening the exposed canvas support. Questions regarding the varnishing of content-laden modernist paint surfaces entered public discourse with a 1982 article by John Richardson entitled "Crimes Against the Cubists" in the critic proclaimed "The surface of a [modern] painting *is* the subject—all the more reason to respect every

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Coatings, ed. R.H. Winslow and S.P. Pappas, *American Chemical Society Symposium Series* 151(1981): 183-196.

[205] Suzanne Quillen Lomax and Sarah L Fisher, "An Investigation of the Removability of Naturally Aged Synthetic Picture Varnishes," *Journal of the American Institute for Conservation* 29(2) (1990): 181-91. See also Robert L. Feller and Mary Curran, "Solubility and crosslinking characteristics of ethylene/vinyl acetate copolymers," *Bulletin of the International Institute for Conservation-American Group* 11(1) (1970): 42-45.

detail of that surface."[206] The change brought on by varnishing unprimed canvases was so significant that color field painter Robert Motherwell famously bought back and destroyed one of his own paintings because it had been varnished. Similarly damaged, varnish-stained Kenneth Noland paintings at the Smithsonian Institution's Hirshhorn Museum and Sculpture Garden are the subject of a multi-year varnish removal research project. Throughout the 1990s varnish removal campaigns for late nineteenth- and early twentieth-century modernist paintings took place at major institutions such as the Museum of Modern Art, which has thus far removed coatings from works in their collection by Picasso, Monet, and Matisse and are currently removing varnishes from works by Abstract Expressionists such as Pollock.[207] Today, varnishes are commonly applied to Abstract Expressionist paintings as selective coatings, applied locally to replicate original surface characteristics or to re-saturate

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[206] John Richardson, "Crimes Against the Cubists," *The New York Review of Books* 30(10) (June 16, 1983): 32. In a footnote to this comment Richardson stated "For the purposes of this article I have restricted myself to the Cubist paintings of Braque and Picasso. However, my strictures equally apply to the insensitive way many other twentieth-century artists' work has been treated." I have substituted "modern" for "Cubist" in the quote. Highlights from the response of conservators to Richardson's comments about both varnishing and lining were published in "Letters," *New York Review of Books* 30(17) (November 10, 1983): 60-64. Gustav Berger's response was entitled "Saving the Cubists."

[207] Analysis by conservators at the Solomon R. Guggenheim Museum revealed that early application of a synthetic varnish to one of Ad Reinhardt's *Black Series* paintings may have protected the original paint—although not the original paint surface—from subsequent layers of extensive overpaint. See Carol Stringari et al., "Reversal Versus Treatment: Study and Treatment of *Black Painting, 1960-66* by Ad Reinhardt," In *Modern Art, New Museums*, *Modern Art, New Museums: Contributions to the 20th International Institute of Conservation Congress in Bilbao, 13-18 September 2004*, eds. Ashok Roy and Perry Smith (London: IIC, 2004), 165-69.

degraded or damaged paint layers. Synthetic coatings are now more likely to be applied in the form of conservation inpainting materials formulated by paint manufacturers such as Robert Gamblin and Mark Golden (the son of Magna-manufacturer Sam Golden). Golden Artist Colors offers one line of retouching paints based on polyhexanol resin (Mineral Spirit-borne Acrylic Colors), and another based on a mixtures of poly(vinyl acetate) (PVA Colors).[208] Gamblin Artists Colors offers a urea-formaldehyde line of retouching paints (Gamblin Conservation Colors, developed in collaboration with the National Gallery of Art in Washington, DC) and a synthetic styrene copolymer version of damar varnish (Gamvar).

Changing attitudes towards the varnishing of modern paintings are reflected in the conservation history of the study group paintings. Varnish treatments common to the late 1960s were also applied to Hofmann's work during this period, despite the artist's own refusal to varnish his own paintings.[209] Dinnean's hand-written record of a visit to the Berkeley collection made by Goldreyer eight months after Hofmann's death includes the notation that "Goldreyer believes all Hofmanns should be varnished."[210] The first archived correspondence regarding varnishing of the university's Hofmann Collection is an October 1972 letter from Dinnean to Goldreyer requesting that the conservator "undertake the surface cleaning and sealing of a

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[208] AYAA and AYAC formulations

[209] "I never glaze or varnish a painting." From *Magenta and Blue* typescript, Hofmann Papers. See above, "Existing Information Regarding Hofmann's Materials: Solvents, Mediums, and Varnishes."

[210] Dinnean, "Goldreyer's Visit, 19 Oct 1966." "Hofmann Varnishing Project" file.

limited number of the 'White' Hofmanns during your visit to Berkeley this month."[211] Eight paintings were selected for varnishing to treat efflorescence and widespread flaking of paint,[212] although evidence suggests previous varnish campaigns. "Goldreyer has 'varnished' several of our Hofmanns," Dinnean penciled in the margins of a May 1972 memo, "over the past 6 or 7 years."[213] The memo is a lengthy inquiry from curator Brenda Richardson to Dinnean—copied to museum staff including director Peter Selz and registrar Joan Feinberg[214]—regarding the proposed varnishing project. "I know that you believe varnishing is the only sure-fire way to preserve the Hofmanns," wrote Richardson. "I also know that this is a controversial position.[215] The matter came up over a year ago in a curator's meeting, and there was a wide range of opinion, including Erle Loran's position to the contrary,[216] that Hofmanns should never be varnished."[217] Richardson's note reveals that Hofmann's opinion was known, but balanced against concerns arising early in the university's

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211 Letter, Lawrence Dinnean, Curator of Collections, to Daniel Goldreyer, October 16, 1972, 1. "Hofmann Varnishing Project" file.

212 Letter, Dinnean to Goldreyer, October 16, 1972, 1. "Hofmann Varnishing Project" file.

213 May 25, 1972 memo "TO: Larry / FROM: Brenda." "Hofmann Varnishing Project" file.

214 The memo is copied to "Peter, David, and Joan." The identity of David could not be definitively ascertained.

215 Dinnean's penciled sidebar reads: "Not controversial among informed persons."

216 Dinnean's penciled sidebar reads: "Erle states unequivocally that they <u>should</u> be varnished"

217 May 25, 1972 memo "TO: Larry / FROM: Brenda."

conservatorship of the artist's work. "We know of course that Hofmann himself did not want the paintings varnished," Richardson noted, "but I at least do not view that to be particularly relevant . . . if that were to imply their ultimate deterioration."[218] Richardson also suggested obtaining the advice of another conservator, "since institutions throughout the world may follow our methods, based on the fact that we have the largest single holding of Hofmanns anywhere and thus could be assumed to have expert judgment on this issue."[219] Selz concurred in a memo the following day that the opinion of another conservator would be reassuring. "I agree with Brenda," noted Selz, "that whatever we do will set a precedent for the treatment of Hofmann's work."[220] No documentation exists in the curatorial archives regarding assessment of the paintings by other conservators, and an April 1973 letter from Goldreyer to Dinnean notes that all eight paintings listed in the October 1972 letter were "sealed" with a poly(n-butyl methacrylate) varnish,[221] later identified by Goldreyer as a mixture of DuPont's Lucite 44 and 45.[222] "The proportions are varied," Dinnean noted later. "They must always be mixed to suit the particular painting."[223] According to

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[218] May 25, 1972 memo "TO: Larry / FROM: Brenda."

[219] May 25, 1972 memo "TO: Larry / FROM: Brenda."

[220] May 26, 1972 memo "TO: Larry / FROM: Peter." "Hofmann Varnishing Project" file.

[221] April 24, 1973 from Daniel Goldreyer to Lawrence Dinnean notes that all eight paintings were "sealed with B.M.P." "Hofmann Varnishing Project" file.

[222] Lawrence Dinnean, handwritten noted dated "Nov. 72." "Hofmann Varnishing Project" file.

[223] Dinnean, "Nov. 72," and undated note. These notes document an exchange with Goldreyer requesting information regarding the varnish materials.

existing treatment records for the study group paintings, six paintings have been varnished overall at least once, five of the works have been varnished multiple times, and at least three works have received local applications of varnish. By the mid-1980s only localized varnishing was recommended for treatment of the Hofmann Collection. "None of the paintings should be varnished overall and none require linings at this time," San Francisco Museum of Modern Art conservator Jim Wright wrote to university curator Sidra Stich in February 1986. "The variation[s] in the surfaces are important to the pieces. . . . [Some] medium has sunken into the structure [and i]n order to bring out the original harmony of the pieces, these areas could be [locally] varnished."[224]

Hofmann's luminous palette is visibly altered in areas where heavy varnish application has neutralized inherent differences between Hofmann's paint colors and subsequently thrown off balance the masterful color relationships at the heart of Hofmann's compositions. While no varnish-related staining is currently visible in these paintings' white expanses or transparent color washes, underbound paint surfaces are likely encased in synthetic varnishes that would be difficult to remove without disturbing original paint material and the original paint surface.
No varnish removal campaigns are noted in the treatment records for the Hofmann Collection paintings.

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[224] Letter, San Francisco Museum of Modern Art conservator Jim Wright to Senior Curator Sidra Stich, University Art Museum, February 7, 1986. Curatorial archives, UC BAM/PFA.

In addition to the four study group paintings varnished in 1972,[225] local or overall varnish materials were encountered during sample removal from four additional study group paintings. Varnish materials listed in the treatment documentation include n-butyl methacrylate (Lucite 44 or Solvar), iso-butyl methacrylate (Paraloid B-67), ethyl methacrylate methyl acrylate (Paraloid B-72), and polycyclohexanone (Winton Retouch Varnish). According to existing treatment records, media employed for conservation inpainting of the study group works has included n-butyl methacrylate (Magna Plastic Colors), ethyl methacrylate methyl acrylate (Paraloid B-67 and B-72), the poly(vinyl acetate) mixtures noted above, acrylic mixtures (Golden MSA Conservation Colors), acrylic and ketonic mixtures (LeFranc & Bourgeois Restoration Colors), gouache, watercolors, and pastels. Poly(vinyl acetate) formulations AYAA and AYAB were also mixed with dried pigments by conservators for use in the inpainting of the study group paintings.

Re-saturation and Exudate Removal

Some of the materials used in the procedures described above may also appear in Hofmann's paintings as a result of restorative treatments intended to return the original balance of paint surfaces. As discussed earlier (see "Condition issues in Hofmann's late-career paintings"), underbound paints—or those paints whose binding media has leached into other paint layers or expressed onto the surface of the painting—develop rough surfaces that scatter light and cause colors to appear faded. A variety of replacement binding media are used by conservators for the re-saturation of

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[225] Four of the eight Hofmann Collection paintings varnished by Daniel Goldreyer in 1972 are included in the study group for this dissertation.

underbound paints. Locally applied varnishes surround underbound pigment particles, smoothing the surface and increasing the visible depth and intensity of the colors, but the effect can diminish as the oxidizing varnish layer shrinks and conforms to the paint layer's rough surface or as varnish materials are removed during subsequent conservation treatment. An alternate solution is to replace the missing oil or synthetic binding components of the paint mixture. This treatment re-saturates more of the original material and is less prone to inappropriate surface sheen or solvent vulnerability than local varnishing. According to Rockwell, the color of the underbound pigment has played a role in determining the proper saturation material for use in treating Hofmann's late-career works:

> Stand oil, a particularly stable form of linseed oil . . . may be allowed to penetrate the medium deficient paint in several applications. . . . . This works well for warm colors such as reds, oranges, yellows, and browns, where the slight yellow tone of the stand oil won't affect the color significantly. However, for cool colors and whites, polyvinyl acetate, a colorless, durable, synthetic resin, may be a better addition.[226]

Materials documented in the re-saturation of paints in the study group paintings include linseed oil, stand oil, and the poly(vinyl acetate) formulations AYAA and AYAC. In some instances, the synthetic resin was used to both saturate and consolidate friable paint. Materials used to re-saturate underbound paint materials were not visible during selection of the study group paintings.

A variety of materials may appear in modern paintings in relation to surface exudates, for which no successful treatment protocol has yet been established. "You will probably not be surprised," Dinnean reported to Goldreyer four months after

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[226] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 14.

Hofmann's "White" paintings were varnished, "to know that a few areas of heavy impasto are continuing to bloom [exhibit hazy exudates]."[227] Local treatment with heat has shown some success in reintegrating crystalline materials into a paint film, but the procedure is not appropriate for all paintings as heat can produce unexpected softening of paint or changes in the surface sheen of some paint materials. Liquid exudates and crystalline solids can also be removed mechanically or with solvents, and while this treatment has less impact on the original paint surface or sheen and leaves little non-original residue there are concerns regarding the efficacy and long-term ramifications of this procedure, especially since the process must be repeated as materials continue to migrate to the paint surface. Several presentations at the 2006 conservation symposium *Modern Paints Uncovered* raised questions about the effect that the removal of exudates has on the overall composition of paint films, with papers by conservators and conservation scientists including Aviva Burnstock, Klaas Jan van den Berg, and Julia Nagle focusing on the issue of exudates in oil paint films.[228] Varnish and wax barriers have shown some success in retarding the progress of exudates, although recent research by conservator Bonnie Rimer in collaboration with scientists from McCrone Associates, Inc. suggested that the exudates were in fact removed by the varnish's solvent carrier or remain in place but were temporarily

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227 Letter, Lawrence Dinnean to Daniel Goldreyer, March 12, 1973. "Hofmann Paintings Project" file.

228 Aviva Burnstock et al., "An Investigation of Water-Sensitive Oil Paints in Twentieth-Century Paintings," in *Modern Paints Uncovered*, eds. Thomas J.S. Learner et al. (Los Angeles: The Getty Conservation Institute, 2007), 177-88. Julia Nagle and Miguel d'Almeida, "Conservation Treatment of Ultramarine Oil Paint on Michael Craig-Martin's *Full Life*," in *Modern Paints Uncovered*, 288-89.

saturated by the varnish or wax and will re-appear with time.[229] According to the treatment records, procedures utilized for recurring crystalline and liquid exudates in the study group paintings have included mechanical removal and removal using solvents such as benzine, varnishing with poly(vinyl acetate) mixtures AYAA and AYAC, and the local application of heat. With the exception of local varnish applications (which are not distinguishable for other localized varnish treatments), no materials used in the treatment of exudates were visible during examination of the study group paintings.

In this chapter I assessed Hofmann's late-career painting style and the role of materials in his arts practice, presented the late-career paintings selected for my materials analysis, reviewed published and unpublished accounts of Hofmann's materials, and provided an overview of behaviors commonly addressed through the conservation of Hofmann's work contextualized within some of the changes in conservation practice, and the variety of non-original conservation materials that may appear during analysis of samples from Hofmann's paintings. In the final chapter of my dissertation I will outline the methodology used in the sampling and scientific analysis of materials from Hofmann's late-career paintings, explain the goals of each analytical technique used and outline the analysis results, present a chronology of Hofmann's late-career materials, and discuss the artist's materials in relation to his style and the preservation of his work.

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[229] See Kathleen A. Martin et al., "A New Approach to the Treatment of Fatty Acid Crystals in Oil Paintings."

Chapter 4

THE IDENTIFICATION OF HOFMANN'S LATE-CAREER MATERIALS

> The medium must not be separated from the content which it embraces.
> —William Chapin Seitz, "Abstract-Expressionist Painting in America," 1955[1]

The material constructions of Hofmann's last decade cannot be thoroughly understood without an examination of the materials themselves. If Hofmann's late-career paintings catalogue the breadth of his modernist influences then we must understand how Hofmann's choice of materials reflected his early years in Europe and how the signature paintings Hofmann created in the United States advanced contemporary arts practice in an era William Agee recently characterized as "[a] burst of investigation into the material world around us."[2] In this chapter I present the first comprehensive identification and analysis of Hofmann's late-career materials. This large-scale compilation of materials data corroborates the anecdotal accounts and empirical observations reviewed in the previous chapter and sheds light on an aspect of mid-twentieth century arts practice that directly impacts the condition of work produced by Hofmann and his Abstract Expressionist colleagues. In Chapter Three I presented the paintings chosen for materials analysis as representative examples of

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[1] William C. Seitz, "Abstract Expressionist Painting in America: An Interpretation based on the Work and Thought of Six Key Figures" (PhD diss., Princeton University, 1955), 29.

[2] William C. Agee, "Hans Hofmann: Art Like Life is Real," in *Hans Hofmann: Art Like Life is Real* (New York: Ameringer McEnery Yohe, 2012), 6.

Hofmann's stylistic evolution and as examples of condition issues and conservation intervention techniques commonly observed in works by Hofmann. I also reviewed published and unpublished documentation of Hofmann's materials and techniques, presented material-related condition issues that appear in Hofmann's work and outlined the range of non-original conservation materials that may appear during analysis of the study group paintings. In this chapter I will present an overview of my scientific analysis of more than 500 paint and fiber samples from twenty-six of Hofmann's late-career paintings and eight of his palettes and assess relationships between the artist's materials, technique, and the impact of his choices on the long-term stability of his work. I will review the goals and results of each analytical technique used to examine samples from the study group paintings and use that information to outline the continued embrace of modern materials in Hofmann's late-career work. I will then combine documentary and scientific evidence to reveal unique relationships among Hofmann's materials, style, and the aging characteristics of his late-career paintings.

Methodology for Analysis and Sampling

The goal of my materials analysis is to provide a significant and representative accounting of Hofmann's materials and then use that information to shed light on unique aspects of the artist's style and the aging behavior of his paintings. The confident identification of relationships between Hofmann's palette and his paintings requires data from a large sample set of materials representing all of the artist's late-career styles and painting techniques, but there is currently a dearth of analytical data regarding Hofmann's materials. The large sample set required precludes detailed identification of each material; my initial cataloguing of Hofmann's late-career palette is therefore based on the broad characterization of the binders and pigments on a large number of paint samples.

Selection of Analytical Methods

In this research I employ analytical data primarily to (i) confirm and track the appearance of industrial materials in Hofmann's ground layers, and (ii) identify and track Hofmann's use of newly developed pigments or paint media in his compositional paint layers. Although detailed identification of individual binder and pigment formulations in such a large sample set is not possible during my research time frame, the analytical methods utilized in my research provide data that can be used for future detailed identification of materials without renewed sampling of the study group paintings.

Information regarding Hofmann's late-career materials was obtained using complementary analytical techniques that provided corroborating information. In every instance, the complementary information gained using different techniques was consistent. Ground layer stratigraphy and identification of inorganic pigments was obtained using optical microscopy and scanning electron microscopy-energy dispersive spectroscopy (SEM-EDS). Fourier transform infrared spectroscopy (FTIR) and gas chromatography-mass spectrometry (GC-MS) were used to identify binders and organic pigments, and X-ray diffraction (XRD) was employed to distinguish between selected paints with similar inorganic components. I performed GC-MS analysis at the scientific laboratories of the National Gallery of Art, Washington and the remaining analysis at the scientific laboratories of the Museum Conservation

Institute at the Smithsonian Institution.[3] Table 4.1 presents an overview of the analytical techniques employed in this research; table 4.2 tallies the number of separate analysis locations examined on each painting.

Table 4.1—Complementary Anaytical Techniques Used in the Identification of Hofmann's Materials

	Chemical Characterization		Materials Identified		Spatial Resolution			Complementary Information				
	Elemental	Molecular	Pigments	Binding media	Pigment particle	Individual paint layer	Multiple paint layers	Optical microscopy	SEM-EDS	XRD	Py-GC-MS**	FTIR
Visual Analysis												
Optical microscopy	–	–	X	X		X	X		X	X	X	X
Scanning electron microscopy (SEM)	–	–	X	X	X	X	X	X		X		
Inorganic Analysis												
Energy dispersive spectroscopy (EDS)	X		X		X	X		X		X		
X-ray diffraction (XRD)		X	X		X			X	X			
Organic Analysis												
Gas Chromatography-Mass Spectrometry (GC-MS)*		X	X	X		X	X	X				X
Fourier transform infrared spectroscopy (FTIR)*		X	X	X		X	X	X			X	

* Analysis of individual paint layers using GC-MS or FTIR requires separation of the paint layers prior to analysis.
** Pyrolysis is commonly coupled with GC-MS for the analysis of large-molecule modern paint binders. GC-MS can also be used to identify some organic pigments, but cannot identify inorganic pigments.

[3] GC-MS analysis was performed by the author under the supervision of National Gallery of Art conservation scientist Christopher Maines; SEM-EDX analysis was performed by the author under the supervision of Smithsonian Institution Physical Scientist Nicole Little; FTIR analysis was performed by the author under the supervision of Smithsonian Institution Conservation Scientist Jennifer Giaccai; XRD analysis was performed by the author in collaboration with Little; microscopy was performed by the author under the supervision of Smithsonian Institution Senior Conservator Melvin Wachowiak.

Table 4.2—Number of Analysis Locations for Each Study Group Painting

Title	Acc. No.	Sampling*	SEM-EDS**	Py-GC-MS	FTIR***	XRD
Delight	MoMA 2.1956	9	19	4	6	–
Ecstasy	BAM 963.2	9	18	4	3	–
The Third Hand	BAM 1966.48	10	16	5	10	–
Le Gilotin	BAM 1965.15	11	39	–	19	–
Scintillating Space	BAM 1966.47	9	16	2	9	–
Exuberance	AKAG 1955:8	11	16	7	10	–
Sommernachtstraum	AKAG 1958:4	10	14	5	10	–
Equinox	BAM 1965.12	11	19	2	12	2
Morning Mist	BAM 1966.45	10	16	–	13	–
Above Deep Waters	BAM 1965.13	12	23	6	15	2
Indian Summer	BAM 1965.11	9	14	2	10	3
Ruby Gold	MAG 60.37	13	25	8	11	2
The Vanquished	BAM 1966.49	10	35	3	13	–
Bald Eagle	BAM 1964.3	13	21	8	11	–
In the Wake of the Hurricane	BAM 1965.6	9	30	4	10	2
Combinable Wall I and II	BAM 1963.10	13	24	1	13	4
Tormented Bull	BAM 1963.6	4	6	4	3	–
Heraldic Call	BAM 1965.17	4	5	4	–	–
Magnum Opus	BAM 1963.7	6	9	4	6	–
Memoria in Aeternum	MoMA 399.1963	11	25	2	9	–
Polyhymnia	BAM 1964.1	6	14	3	5	1
The Clash	BAM 1965.8	9	14	4	10	–
Imperium in Imperio	BAM 1966.43	8	16	–	7	–
And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light	BAM 1965.4	5	13	2	6	1
Silent Night	BAM 1965.5	14	24	6	17	–
Struwel Peter	BAM 1966.5	11	18	9	10	–
palette on plywood	Trust M536-12	1	1	1	1	–
palette on board	Trust M593-12	1	5	–	1	–
palette on board	Trust M537-10	8	16	–	9	1
palette on board	Trust M536-53	5	9	–	6	4
palette on glass	Trust no #	5	8	3	6	–
palette on paint can lid	Trust M536-49	3	6	2	4	–
palette on board	Trust M536-45	3	6	1	4	–
palette on board	Trust M536-03	4	6	1	5	–

AKAG: Albright-Knox Art Gallery (Buffalo, New York); BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California); Trust: Renate, Hans and Maria Hofmann Trust (New York, New York); MAG: Memorial Art Gallery, University of Rochester (Rochester, New York); MoMA: Museum of Modern Art (New York, New York); SEM-EDS: Scanning Electron Microscopy-Energy Dispersive Spectroscopy; Py-GC-MS: Pyrolysis-Gas Chromatography-Mass Spectrometry; FTIR: Fourier Transform Infrared Spectroscopy; XRD: X-ray Diffraction

* Cross-sections are counted here as a single sample. Figure does not include fiber samples.

** Three points within each analysis location were examined using EDS.

*** FTIR analysis did not differentiate between cross-section layers; large cross-sections were analyzed in sections.

Selection of Samples

A total of 284 single and layered paint samples and 28 fiber samples were removed from the study group paintings and palettes. Compositional paints were sampled from each painting; support materials and preparatory layers were sampled where possible. When possible, samples were taken of every paint material appearing on every study group painting. Sampling of actual palettes from the artist's studio was limited to priming materials and examples of unusual colors or colors used to obtain color mixes. Sample sites were chosen to limit visible alteration of the composition and, when possible, to avoid noticeable areas of previous conservation treatment. All samples were stored in inert glass vials to avoid contamination from storage materials prior to analysis.[4] 83 of the paint material samples contained stratigraphy that made a total of 235 additional paints available for analysis. A total of 519 discrete paint layers from the study group paintings were analyzed for this research. Written and photographic documentation of the individual samples and sampling sites are provided in Appendix B.

Samples were obtained from the individual study group paintings on site in the galleries, storage areas, or conservation facilities of their respective collections. I sampled the two study group paintings from the collection of the Albright-Knox Art Gallery in situ at the museum and in on-site storage; I sampled the one study group painting selected from the collection of the University of Rochester's Memorial Art Gallery in a gallery staging area; I sampled the two study paintings from the collection

[4] Plasticizer transfer from some storage containers can give false positive results for alkyd paint in GC-MS and FTIR analysis.

of the Museum of Modern Art in the museum's conservation department.[5] I sampled the majority of the study group paintings chosen from the Hofmann Collection at the University of California Berkeley Art Museum and Pacific Film Archive in a gallery provided by the museum for that purpose; Hofmann Collection paintings selected for the study group but stored off-site were sampled by myself and by staff from the San Francisco Museum of Modern Art's conservation department as the paintings arrived on a rotating basis for assessment and treatment as part of the university's 2011 Save American's Treasures grant.[6] I sampled all of the study group palettes in the storage facilities of the Renate, Hans and Maria Hofmann Trust.[7]

Implementation and Results of Analyses

The implementation and results of each analytical method employed in my examination and identification of Hofmann's materials are summarized below.

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[5] Sampling of paintings at the Museum of Modern Art was performed under the supervision of conservator Anny Aviram on October 26, 2011; sampling of paintings at the Memorial Art Gallery was performed under the supervision of Chief Curator Marjorie Searl and Assistant Curator Jessica Marten on November 29, 2011; sampling of paintings at the Albright-Knox Art Gallery was performed under the supervision of Registrar Laura Fleischmann on November 30, 2011.

[6] Sampling of paintings at the University of California Berkeley Art Museum and Pacific Film Archive was performed under the supervision of Director of Registration Lisa Calden on December 12-13, 2011. Sampling of paintings at the San Francisco Museum of Modern Art was performed under the supervision of conservator Paula De Cristofaro on December 14, 2011. Sampling of *Ecstasy, Heraldic Call,* and *Imperium in Imperio,* was subsequently conducted at the San Francisco Museum of Modern Art by De Cristofaro and conservator Alina Remba.

[7] Sampling of palettes from the Renate, Hans, and Maria Hofmann Trust was performed at an off-site storage facility under the supervision of Collections Manager Stacey Gershon on December 29, 2011.

Complementary analytical techniques were employed whenever possible. The analytical methods are presented in the order of their application. Instrumental set up information and representative images and data from the analysis of individual samples are presented in Appendix B.

Optical Microscopy[8]

Optical microscopy is typically used in paintings conservation for the basic identification of paint and support materials. Optical microscopy uses transmitted and reflected illumination to highlight different features in a sample material. Cross-section microscopy can provide information about stratigraphy and paint application (with the blending of wet-on-wet paint application, for example), as well as pinpoint the location (inter- or intra-layer) of film failure. Ultraviolet-induced visible fluorescence of certain pigments and binders can be used to enhance stratigraphy, provide basic identification (protein vs. synthetic binders, for example, or the sparkle of zinc under ultraviolet illumination) and guide additional sampling and analysis.

Optical microscopy was utilized in my research primarily for initial examination and photodocumentation of the study group samples. All 284 single and layered paint samples and 28 fiber samples were examined and photographed using both normal and ultraviolet illumination sources. 83 of the 284 paint samples presented multilayered stratigraphy and were selected for mounting and analysis as cross-sections. Multilayered paint samples were embedded as cross-sections prior to

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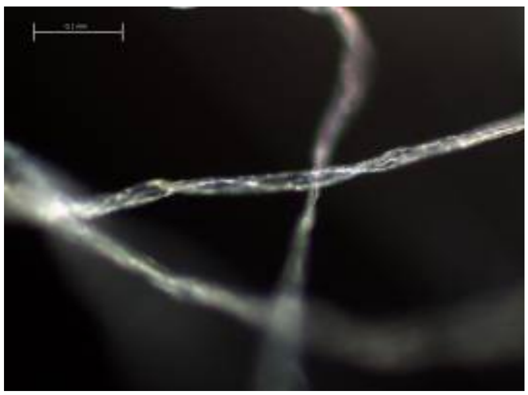
[8] A useful glossary of instrumental methods can be found online in the conservation science section of web site of the National Gallery of Art, Washington at http://www.nga.gov

photography. The remaining paint samples were photographed in their storage vials and subsequently analyzed in their loose form.

Optical microscopy reveals a distinct late-career shift in Hofmann's preparatory materials. Reports of the artist's late-career preference for linen canvas are supported by examination of warp and weft fibers from the study group paintings.



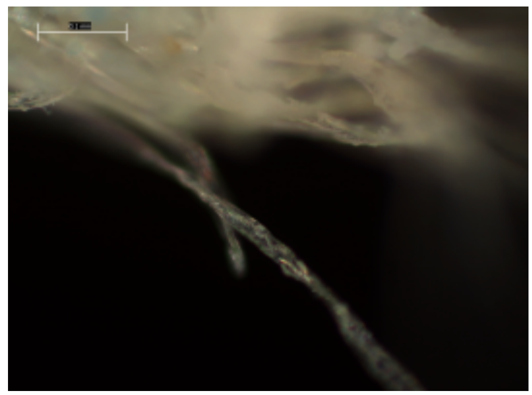


Figure 4.1 (left): Photomicrograph of cotton warp fibers, 11.15 magnification, sample no. N17. Hans Hofmann, *Delight*, 1947, oil on canvas, 50.0 x 40.0" (126.9 x 101.6 cm.). Gift of Mr. and Mrs. Theodore S. Gary, collection of the Museum of Modern Art (2.1956). Figure 4.2 (right): Photomicrograph of cotton warp and weft fibers, 11.15 magnification, sample no. Ecs04. Hans Hofmann, *Ecstasy*, 1947, oil on canvas, 68.0 x 60.0" (172.7 x 152.4 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1963.2). Images used with permission of the Renate, Hans & Maria Hofmann Trust. Cotton fibers display characteristic twisted infrastructure.

While the twisted, ribbon-like morphology consistent with cotton fibers is found in the warp and weft threads from both 1947 paintings from which samples were available (figures 4.1 and 4.2), the segmented nodal structure associated with linen fibers is found in the warp and weft threads from all 14 of the late-career paintings from samples were available (figures 4.3 and 4.4).

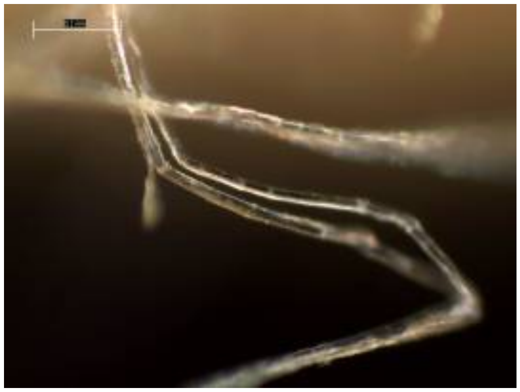
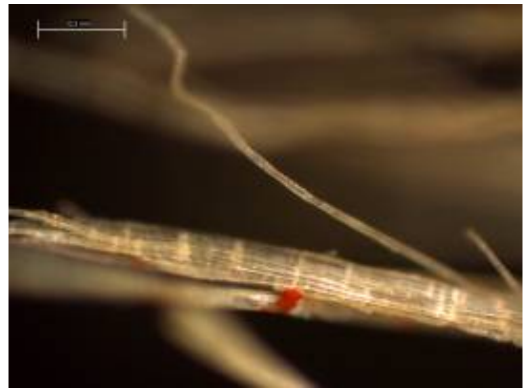
 

Figure 4.3 (left): Photomicrograph of linen warp fibers, 11.15 magnification, sample no. R01. Hans Hofmann, *Ruby Gold*, 1959, oil on canvas, 55.4 x 40.5" (140.7 x 102.9 cm.). Marion Stratton Gould Fund, collection of the Memorial Art Gallery of the University of Rochester (60.37). Figure 4.4 (right): Photomicrograph of linen warp fibers, 11.15 magnification, sample no. N01. Hans Hofmann, *Memoria in Aeternum*, 1962, oil on canvas, 84.0 x 72.1" (213.4 x 183.2 cm.). Gift of the artist, collection of the Museum of Modern Art (399.1963). Images used with permission of the Renate, Hans & Maria Hofmann Trust. Linen fibers display a characteristic segmented, or nodal, structure.

A shift in Hofmann's late-career ground and priming materials is also apparent. Under polarized light illumination, all samples of Hofmann's compositional white paints exhibit a speckled fluorescence common to zinc oxide pigment. While similar fluorescence is observed in Hofmann's early preparatory layers, it is not present in the ground and priming layer materials that appear in the artist's late-career works (figures 4.5 and 4.6).

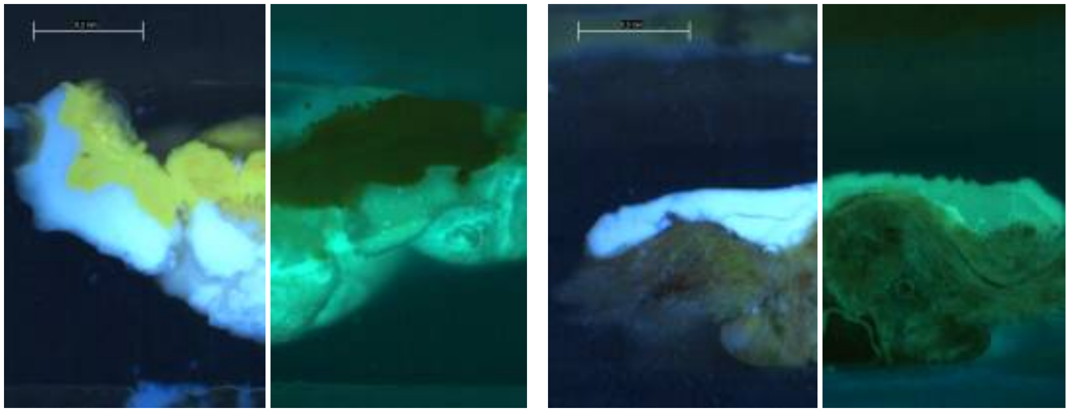


Figure 4.5 (left): Photomicrograph of cross-section containing compositional white paint, dark field and ultraviolet illumination (355-425 nm.), 2.79 magnification, sample no. C115. Speckled fluorescence of zinc oxide pigment is visible in compositional white layer. Hans Hofmann, *Above Deep Waters*, 1959, oil on canvas, 84.2 x 52.0" (213.9 x 132.1 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1965.13). Figure 4.6 (right): Photomicrograph of cross-section containing commercial ground and artist priming layers, dark field and ultraviolet illumination (355-425 nm.), 2.79 magnification, sample no. C058. No speckled fluorescence is visible in either preparatory layer. Hans Hofmann, *Tormented Bull*, 1961, oil and enamel on canvas, 60.1 x 84.3" (152.7 x 214.1 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1963.6). Images used with permission of the Renate, Hans & Maria Hofmann Trust.

Pyrolysis-Gas Chromatography-Mass Spectrometry

In paintings conservation, Py-GC-MS is typically used for the identification of large-molecule modern paint materials. GC is a separation technique used to identify component materials in a mixture based primarily on differences in each component's volatility; pyrolysis is used to thermally fragment large component materials into smaller and more volatile components for analysis. GC is often coupled with MS, which uses high-energy electrons to ionize and fragment components and then sort the resulting charged fragments according to their mass-to-charge ratio and relative intensities. Material identification is then based on the resulting characteristic combination of ions. Py-GC-MS identification of modern paint materials should proceed with caution. The appearance of azelaic acid (a degradation product of oleic acid) in paint spectra is associated with aged paint films, but mid-twentieth century commercial paint formulations include partially polymerized oils (so-called "boiled" or "blown" oils), which give small azelaic acid peaks to the Py-GC-MS spectra of freshly applied paints. Similarly, derivatized phthalic acid (a GC indicator for alkyd paint) can also result from the transfer of commercial plasticizing agents in sample storage containers. Additionally, the industrial paints favored by mid-twentieth century painters typically contain a blend of different drying oils according to manufacturer preference, availability of raw materials, handling properties of individual pigments, or consumer application methods. Consequently, the palmitic:stearic acid MS ratios used to identify specific drying oil materials cannot be viewed as definitive evidence of the presence of any particular drying oil within the paint formulation.

GC-MS analysis was utilized in my research in order to differentiate between modern and traditional binding media in Hofmann's materials. A pyrolysis (Py) attachment was used for all GC-MS analyses to meet the thermal dissociation requirements of high-molecular-weight and heavily cross-linked polymers in modern paints reportedly used by Hofmann, including alkyds and modern industrial blends that contain alkyd or acrylic modifiers.[9] Samples of Hofmann's materials selected for Py-GC-MS analysis included those materials expected to contain modern polymer

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[9] Alkyd resins, nitrocellulose, and vinyl polymers were used as modifying agents in some 1950s-era acrylic paint formulations. See Thomas J. S. Learner, "A Review of Synthetic Binding Media in Twentieth-Century Paints," *The Conservator* 24 (2000): 96-103.

formulations—ground layer materials reported by others to contain house paints—and those paints exhibiting the flow characteristics or surface sheen associated with industrial paints. All white and black paints were analyzed using Py-GC-MS in order to differentiate suspected industrial paints in Hofmann's palette from traditional materials of similar color. GC-MS binding media analysis was performed on a total of 106 discrete paints.

Py-GC-MS analysis of Hofmann's paint materials confirms Hofmann's preferential use of oil-based paint materials and his late-career shift to oil-based alkyd paints in his ground and priming layers. Py-GC-MS chromatograms of all 106 paints contain peaks consistent with the palmitic, stearic, oleic, and azelaic fatty acid components of oil paint and 27 chromatograms also contain peaks consistent with the phthalic anhydride component of oil-based alkyd paints.[10] This alkyd subset includes all of Hofmann's late-career preparatory layers and several of Hofmann's splashed black paints. No alkyd paint indicators were identified in any of the colored paints analyzed using Py-GC-MS. No acrylic or water-based paint indicators such as polymeric acrylates or proteins were present in any of the samples analyzed using Py-GC-MS. While Hofmann's paintings do not present the conservation challenges of layered oil- and water-based paint media, degradation patterns in Hofmann's work can be traced to the artist's use of layered oil and alkyd paint materials (see "Discussion of Analyses" below).

[10] J. Bentley, and Gerald P. A. Turner, *Introduction to Paint Chemistry and Principles of Paint Technology* (London and New York: Chapman & Hall Ltd., 1998, rev.), 61.

White and Ground/Priming Layers

Py-GC-MS analysis of the study group samples reveals a late-career shift in Hofmann's ground and priming layer materials and confirms anecdotal reports of alkyd paints in the artist's work. All three of the study group paintings produced by Hofmann in 1947 gave positive results for oil grounds using Py-GC-MS analysis, while chromatograms from all 20 of the late-career paintings and palettes from which ground or priming layer samples were available exhibited peaks consistent with the phthalic anhydride component of oil-based alkyd paints.[11] This tally includes a priming layer applied by Hofmann over the commercially applied ground observed in the painting *Tormented Bull* (1961). Py-GC-MS analysis was not possible on the limited ground layer sample obtained from *Bald Eagle* (1960), but SEM-EDS analysis of that material (discussed below) reveals a bulked titanium white paint consistent with Hofmann's alkyd ground and priming paints and inconsistent with the artist's zinc white compositional paints.[12] Table 4.3 presents a summary of all binding media identified during my analysis of Hofmann's late-career ground and priming layer materials and the method(s) that enabled these identifications. When more than one method is listed, the methods gave complementary (and consistent) information.

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[11] Thomas J. S. Learner, *Analysis of Modern Paints* (Los Angeles: Getty Conservation Institute, 2004), 57. See also Learner, "A Review of Synthetic Binding Media in Twentieth-Century Paints," 99.

[12] Zinc white alkyd formulations were unstable and not commercially viable, and given Hofmann's preference for zinc oxide pigment, a zinc-lacking paint in Hofmann's work is a good indicator of an alkyd paint formulation.

Table 4.3—Summary of Ground and Priming Layer Analysis

Year	Title	Acc. No.	Sample No.	Result	Method(s)
1947	*Delight*	MoMA 2.1956	N21	oil	Py-GC-MS
	Ecstasy	BAM 1963.2	Esc01	oil	Py-GC-MS
	The Third Hand	BAM 1966.48	C071	oil	Py-GC-MS
1954	*Scintillating Space*	BAM 1966.47	C072	alkyd	Py-GC-MS
1955	*Exuberance*	AKAG 1955:8	B03	alkyd	Py-GC-MS, ATR-FTIR
			B04	alkyd	Py-GC-MS
1957	*Sommernachtstraum*	AKAG1958:4	B17	alkyd	Py-GC-MS, ATR-FTIR
1958	*Equinox*	BAM 1965.12	C057	alkyd	Py-GC-MS
1959	*Above Deep Waters*	BAM 1965.13	C121	alkyd	Py-GC-MS, ATR-FTIR
	Ruby Gold	MAG 60.37	R07	alkyd	Py-GC-MS
			R11	alkyd	Py-GC-MS
1960	*Bald Eagle*	BAM 1964.3	C026b	alkyd	SEM-EDS
	In the Wake . . .	BAM 1965.6	C180	alkyd	Py-GC-MS
1961	*Combinable Wall I/II*	BAM 1963.10	C085	alkyd	Py-GC-MS, ATR-FTIR
	Tormented Bull	BAM 1963.6	C059	alkyd*	Py-GC-MS
1962	*Heraldic Call*	BAM 1965.17	Hera01	alkyd	Py-GC-MS
	Magnum Opus	BAM 1963.7	C151	alkyd	Py-GC-MS, ATR-FTIR
			C153	alkyd	Py-GC-MS, µFTIR
	Memoria in Aeternum	MoMA 399.1963	N04	alkyd	Py-GC-MS, ATR-FTIR
1963	*Polyhymnia*	BAM 1964.1	C137	alkyd	Py-GC-MS, ATR-FTIR
1964	*The Clash*	BAM 1965.8	C003	alkyd	Py-GC-MS, ATR-FTIR
	And Out of the Caves . . .	BAM 1965.4	C169	alkyd	Py-GC-MS, ATR-FTIR
	Silent Night	BAM 1965.5	C101	alkyd	Py-GC-MS, ATR-FTIR
1965	*Struwel Peter*	BAM 1966.5	C145	alkyd	Py-GC-MS, µFTIR
1966	palette on board	Trust M536-45	S26	alkyd	Py-GC-MS, ATR-FTIR
	palette on board	Trust M536-03	S29	alkyd	Py-GC-MS, ATR-FTIR

AKAG: Albright-Knox Art Gallery (Buffalo, New York)
BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California)
Trust: Renate, Hans and Maria Hofmann Trust (New York, New York)
MAG: Memorial Art Gallery, University of Rochester (Rochester, New York)
MoMA: Museum of Modern Art (New York, New York)
Py-GC-MS: Pyrolysis-Gas Chromatography-Mass Spectrometry
SEM-EDS: Scanning Electron Microscopy-Energy Dispersive Spectroscopy
ATR-FTIR, µFTIR: Attenuated Total Reflectance- and Micro- Fourier Transform Infrared Spectroscopy
* This alkyd priming was applied by Hofmann over a commercially applied ground layer.

Paint under the lip of a paint can lid retained by Hofmann for use as a palette was also found to be alkyd paint, and the embossed markings on the can lid were traced to a batch of alkyd interior house paint produced on March 17, 1957 by Benjamin Moore & Company.[13] Brochures for this paint were found among Hofmann's studio papers.[14]

Black and Colored Paints

Not all of Hofmann's splashed black paints are alkyds. Py-GC-MS analysis identified black paints with alkyd binding media on *Bald Eagle, Tormented Bull*, and *Heraldic Call*, but other examples of splashed black paints on the same three paintings contained only oil paint binders (see figure 4.7). No alkyd binder was found in the splashed black paint on *The Vanquished*. No alkyd binders were found in any samples of colored paints analyzed using Py-GC-MS. The large oleate peaks observed in figure 4.7 were commonly found in the chromatograms plots of paints containing zinc pigments; recent research by conservation scientist Christopher Maines linked high levels of oleate acids with the unique aging characteristics of zinc white paint layers in the work of Hofmann and his Abstract Expressionist colleagues (see "The relationship between condition issues and Hofmann's use of new materials," later in this chapter).[15]

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[13] The embossed code on the can lid relates to a paint batch produced on March 17, 1957. Courtesy Benjamin Moore & Company. See Dawn Rogala, "Hans Hofmann from the Ground Up: Looking at the Artist's Preparatory Methods as a Window to Condition" (unpublished senior specialization project, Art Conservation Department, Buffalo State College, State University of New York, May 2005), 8.

[14] Hans Hofmann papers, [ca. 1904]-1978, (bulk 1945-1965), Archives of American Art, Smithsonian Institution.

[15] Christopher Maines et al., "Deterioration in Abstract Expressionist Paintings: Analysis of Zinc Oxide Paint Layers in Works from the collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution," in *Materials Issues in Art and Archaeology IX: Symposium held November 29-December 3, 2010, Boston,*

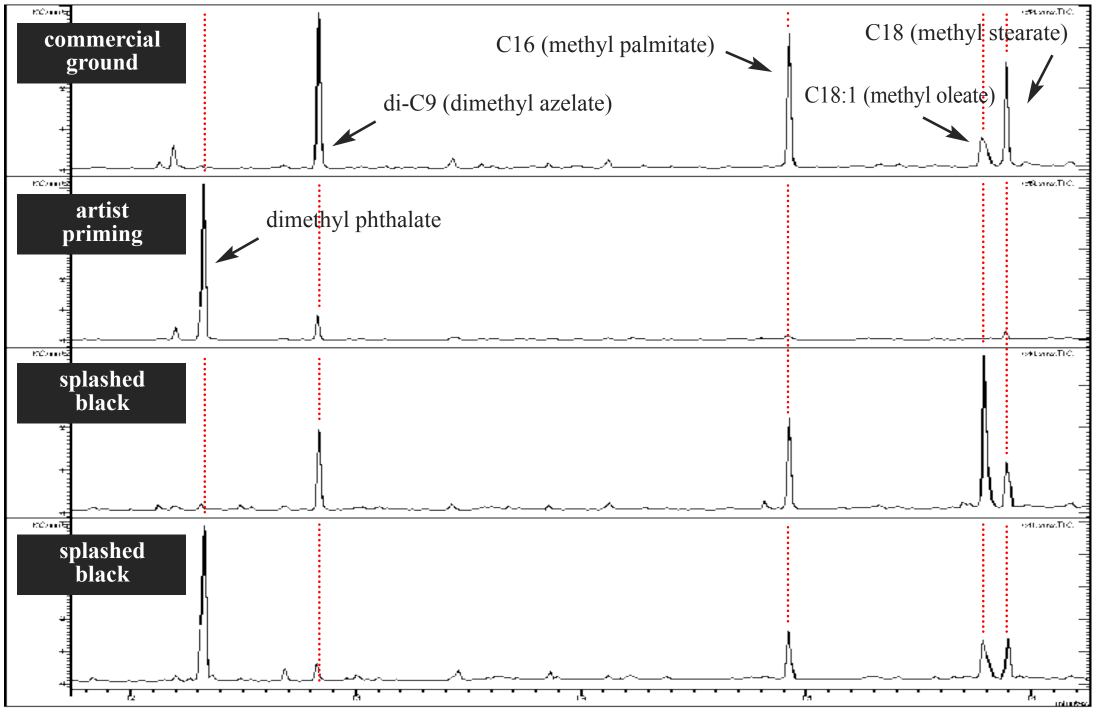

Figure 4.7: Gas chromatogram plots of methylated paint samples from Hans Hofmann's *Tormented Bull*, 1961. Dimethyl phthalate is indicative of the phthalic anhydride component of oil-based alkyd paints; dimethyl azelate, methyl palmitate, methyl oleate, and methyl stearate are the methylated fatty acid components of oil binders. Dimethyl phthalate is present in Hofmann's applied priming layer (sample no. C059) but not in the underlying commercially applied ground layer (sample no. C058). The splashed black areas of the composition contain both oil paints (sample no. C060) and alkyd paints (sample no. C061). Similar combinations of oil and alkyd black paints are also visible on other study group paintings; see figures 4.20 and 4.21.

Other Materials

Py-GC-MS analysis also provides some evidence of Hofmann's use of paint thinners or subsequent conservation intervention. Although colored compositional paints were largely excluded from Py-GC-MS analysis of Hofmann's ground and

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Massachusetts, Materials Research Society Symposium Proceedings 1319, eds. Pamela B. Vandiver et al. (Pittsburgh, PA: Materials Research Society, 2011), 275-86.

priming layers, peaks consistent with the terpenoid components of paint solvents appear in Py-GC-MS chromatograms of a handful of colored paints from thirteen of the twenty-six study group paintings and five of the eight Trust palettes. Py-GC-MS chromatograms from eight of the study group paintings contained peaks consistent with the wax or acrylic polymer components of conservation consolidation or varnishing materials mentioned in the collection treatment records. Additional non-original materials were later confirmed using FTIR analysis (see below).

Scanning Electron Microscopy-Energy Dispersive Spectroscopy

Scanning electron microscopy is typically combined with energy-dispersive spectroscopy to answer questions about paint stratigraphy and artist's technique. The resolution in a microscope is directly proportional to the wavelength of the light being employed, and electron microscopes have much greater magnification and depth of field than optical microscopes. Information regarding the inorganic materials present in a sample is obtained through images produced from back-scattered electrons by SEM in combination with the characteristic x-ray emission patterns of individual elements by EDS. In paintings conservation, SEM imaging can help determine the extent of wet-on-wet paint mixing, or differentiate between optically similar white lead carbonate and white lead sulfate. In combination, SEM-EDS can provide stratigraphic and elemental information in areas of paint degradation, provide detailed information about pigment distribution and morphology, and be used to differentiate between application layers of the same paint (by thin layers of dirt that settled on one layer before the next was applied).

SEM-EDS analysis was utilized in my research to identify inorganic pigment families appearing in Hofmann's paints. EDS was utilized as a qualitative technique, as superficial pigment identification was sufficient to group the samples into inorganic pigment families and highlight potential organic pigments requiring additional analysis. Accurate selection of analysis location is aided by the increased resolution of electron microscope and by elemental imaging that allows for more accurate discrimination between individual paint layers or individual paints within paint mixes. Backscatter electron images were taken of all 284 loose and mounted paint samples, and EDS inorganic materials analysis was performed on each of the 519 discernable paint layers within those samples.[16] EDS analysis was performed on at least three disparate points within each paint layer. EDS analysis of visible inclusions—such as mordant materials for dye-based pigments—was also performed but not included in the analysis tally provided in Table 4.1. Representative EDS spectra from each paint layer are included in Appendix B. Table 4.4 presents a summary of the inorganic pigments identified in the study group paintings. Many of the pigment identifications obtained through EDS were confirmed using other analytical methods such as FTIR (discussed below). Although sampling of the study group paintings was extensive, it is possible that additional pigments may be present. A limited number of paints were sampled on the Trust palettes; it is likely that colors in consistent late-career use also appear on the palettes.

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[16] For the use of microscopy and SEM-EDS in the interpretation of Abstract Expressionist-era paint layers, see Carol Stringari et al., "Reversal Versus Treatment: Study and Treatment of *Black Painting, 1960-66* by Ad Reinhardt," In *Modern Art, New Museums*, *Modern Art, New Museums: Contributions to the 20th International Institute of Conservation Congress in Bilbao, 13-18 September 2004*, eds. Ashok Roy and Perry Smith (London: IIC, 2004), 165-69.

White Pigments

The pigments identified in Hofmann's ground and compositional materials are consistent with reports of the artist's shift from oil- to alkyd-based ground layers. Mixed zinc and titanium white pigments consistent with zinc oxide oil paint formulations (distinguishing elements: Zn, Ti) were identified in the ground layers of all three of the study group paintings produced in 1947. No zinc pigments were identified in the ground layer materials of the 17 late-career paintings from which ground layer samples were available, but all of available late-career ground layer samples were found to contain a mix of titanium and calcium components consistent with the formulation of house paints such as the Benjamin Moore Alkyd Sani-Flat referenced in Hofmann's papers.[17] EDS analysis of Hofmann's compositional paints also confirms accounts of the artist's preference for zinc white paints over toxic lead-based whites. Zinc/titanium pigment mixes consistent with zinc oxide oil paint formulations were found on all of the paintings and palettes from which compositional white paint samples were available.[18] No titanium white paints were identified in any of the compositional layers of the study group paintings or palettes. No lead white pigments were identified anywhere on the study group paintings or palettes.

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[17] Hofmann Papers. A label from a paint can provided by the Benjamin Moore archives and date stamped "June 9, 1959" lists the paint's inorganic components as 49.9% titanium calcium, 31.7% calcium carbonate, and 18.4% silicates.

[18] No compositional white paints were present in *Heraldic Call* or on Trust palette M536-03.

Yellow Pigments

Cadmium yellow (distinguishing elements: Cd, S) is the primary yellow pigment appearing in Hofmann's late-career work. Cadmium yellow paint appears in nearly every study group painting and palette, alone or mixed with zinc/titanium white or ultramarine blue.[19] Yellow ochre (distinguishing element: Fe) appears infrequently throughout the study group. Cadmium yellow and yellow ochre both appear in the 1947 painting *Delight*, and in the later works *Sommernachtstraum* (1957), *Morning Mist* (1958), *Combinable Wall I and II* (1961), *Silent Night* (1964), as well as the unnumbered Trust palette on glass. In *Combinable Wall I and II*, a secondary shade of cadmium yellow appears in the form of the pigment extended with calcium sulfate. In *Imperium in Imperio* (1964), a secondary shade of cadmium yellow is extended with barium sulfate.[20] Zinc yellow (distinguishing elements: Zn, Cr) appears twice in the study group. Cadmium yellow and zinc yellow both appear in *Ecstasy* (1947) and *Equinox* (1958). EDS analysis of the yellow paint in the 1963 painting *Polyhymnia* identified a combination of cadmium and possible trace elements.

Orange Pigments

Cadmium orange (distinguishing elements: Cd, S, Se) is the only orange pigment found in the study group samples. Cadmium orange paint appears consistently in the study group paintings and palettes beginning in 1954, usually alone

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[19] Sampling from palettes was limited to priming layers and components of mixed colors. Other colors in consistent late-career use may also appear on the palettes.

[20] The high levels of barium found through elemental analysis suggest barium sulfate over lithopone as an extender, although the primary point is that an extender other than calcium sulfate is present in this sample.

but sometimes mixed with zinc/titanium white. A secondary shade of cadmium orange appears in the form of the pigment extended with calcium sulfate in the 1959 painting *Ruby Gold*. In *Combinable Wall I and II* (1961) a secondary shade of cadmium orange appears in the form of the pigment extended with barium sulfate.

Red Pigments

Cadmium red (distinguishing elements: Cd, S, Se) is another cadmium pigment that appears consistently throughout the study group paintings and palettes. Cadmium red paints appear regularly in compositions containing other cadmium colors. In the 1959 paintings *Above Deep Waters* and *Indian Summer*, a secondary shade of cadmium red appears in the form of the pigment extended with barium sulfate. Cadmium red extended with barium sulfate also appears on Trust palette M536-53. Additional reds in *Combinable Wall I and II* (1961) are achieved through a mix of cadmium red with zinc/titanium white or with the titanium white ground material. Both cadmium red and oxide red-brown paints (distinguishing element: Fe) appear in *Sommernachtstraum* (1957).

Green Pigments

Cadmium also appears in the majority of Hofmann's green paints. Many of Hofmann's greens are a visible mix of cadmium yellow and ultramarine blue, although a more homogenous green mix containing components of cadmium green (elements: Cd, Zn, S) also appears in the study group paintings and palettes beginning in 1953 (see figure 4.5). The cadmium-containing green often appears along with phthalocyanine green (distinguishing elements: Cl, Cu), and may therefore be the phthalocyanine-containing "[permanent] green light" that appears on pigment lists among the artist's papers.[21] The cadmium-containing green appears alone on *Exuberance* (1955), *Sommernachtstraum* (1957), *Morning Mist* (1958), *Memoria in Aeternum* (1962), and *Polyhymnia* (1963). Phthalocyanine green appears alone on the 1947 paintings *Ecstasy* and *The Third Hand*, and on the later work *The Clash* (1964). A secondary cadmium-containing green appears in *Above Deep Waters* (1959) in the form of the pigment extended with barium sulfate.

A handful of other green pigments appear sporadically throughout Hofmann's late-career work. Viridian, also known as chrome green (distinguishing element: Cr) appears infrequently. Chrome-based green was the only green pigment used in *Delight* (1947), but was used along with cadmium and phthalocyanine greens on *Silent Night* (1964). Iron oxide green (distinguishing element: Fe) also appears infrequently. Iron oxide green pigment appears along with cadmium green in *Ruby Gold* (1959), and with cadmium and phthalocyanine greens in the 1964 painting *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*. A possible cobalt green (distinguishing elements: Co, Zn) appears along with cadmium green in *Memoria in Aeternum*, with cadmium, phthalocyanine, and chrome greens in *Silent Night*.

Blue Pigments

Ultramarine blue (distinguishing elements: Na, Al, Si) is the primary blue pigment appearing in Hofmann's late-career work. Ultramarine blue pigment appears in every study group painting except the 1961 black-and-white composition

[21] Hofmann Papers.

Tormented Bull.[22] Ultramarine blue paint appears both as a stand-alone color and as part of a color mixture, frequently in combination with cadmium yellow. Another blue pigment found in Hofmann's late-career work is phthalocyanine blue (distinguishing element: Cu). Both phthalocyanine and ultramarine blue paints were identified on three works from the 1940s and 1950s: *Ecstasy* (1947), *Le Gilotin* (1953), and *Morning Mist* (1958). Phthalocyanine blue also appears on the unnumbered Trust palette. Cobalt blue (distinguishing elements: Co, Al) appears in four study group works from the 1960s: *Bald Eagle* (1960), *Magnum Opus* (1962), and the two 1964 paintings *Imperium in Imperio* and *Silent Night*. Cerulean blue (distinguishing elements: Co, Sn) appears in only one study group painting, the 1958 work *Equinox*. Likewise, Prussian blue (distinguishing element: Fe) appears in only one study group painting, the 1957 work *Sommernachtstraum*. Prussian blue also appears in one of the Trust palettes.

Violet/Magenta/Purple Pigments

Both inorganic and organic purple pigments appear in Hofmann's work. Cobalt violet (distinguishing elements: Co, P) appears numerous times throughout the late-career study group paintings, beginning with *Le Gilotin* (1953) and continuing through the last study group painting, the 1965 work *Struwel Peter*. A heavily extended violet pigment in *Ruby Gold* (1959) presented inconclusive EDS spectra but similar SEM morphology to cobalt violet (see figures 4.8 and 4.9) and after excluding information related to potential conservation materials, the FTIR spectra for the violet pigment in

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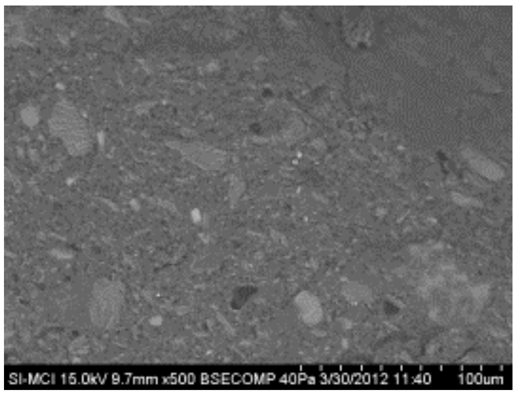
[22] The blue in *Heraldic Call* was not sampled but is a visual match to other paints in Hofmann's oeuvre identified as ultramarine blue.

Ruby Gold matched the FTIR spectra of EDS- and XRD-identified cobalt violet pigments in *Indian Summer* (1959), *In the Wake of the Hurricane* (1960), and *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light* (1964) (see figure 4.10).



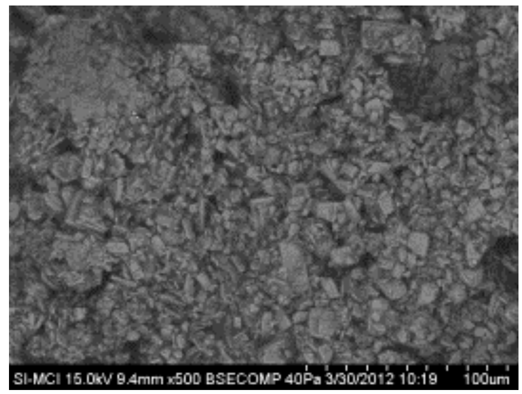


Figure 4.8 (left): Backscatter electron image of sample no. R06, an unidentified violet pigment from Hans Hofmann, *Ruby Gold*, 1959, oil on canvas, 55.4 x 40.5" (140.7 x 102.9 cm.), Marion Stratton Gould Fund, collection of the Memorial Art Gallery, University of Rochester (60.37). Figure 4.9 (right): Backscatter electron image of sample no. C129, a pigment with visual similarities to sample no. R06 and identified as cobalt violet. Sample from Hans Hofmann, *Indian Summer*, 1959, oil on canvas, 60.1 x 72.2" (152.7 x 183.4 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1965.11). Images used with permission of the Renate, Hans & Maria Hofmann Trust.

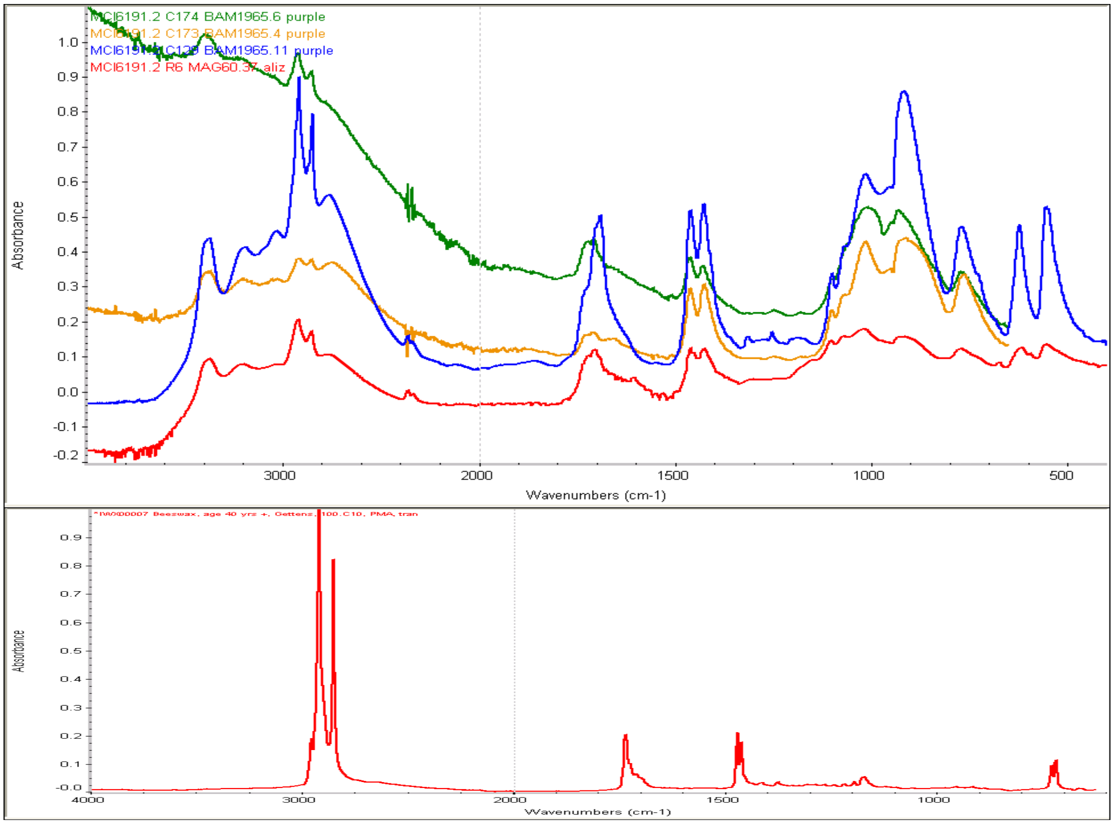


Figure 4.10: Comparison of similar FTIR spectra (top) for the violet pigment sample identified as cobalt violet from Hans Hofmann, *Indian Summer*, 1959 (blue, sample no. C129) and similar unidentified violet pigments from *Ruby Gold*, 1959 (red, sample no. R06), *In the Wake of the Hurricane*, 1960 (green, sample no. C174) and *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964 (yellow, sample no. C173). The heavily extended violet pigment in *Ruby Gold* presented inconclusive EDS spectra but similar FTIR spectra to EDS- and XRD-identified cobalt violet pigments in other paintings, and excluding information related to such conservation materials as waxes or wax-containing adhesives (bottom, Infrared & Raman Users Group database standard for beeswax, aged 40+ years, Gettens collection 100.C10, Philadelphia Museum of Art).

Ultramarine violet (distinguishing elements: Na, Al, S) appears only once in the study group, in the 1958 painting *Morning Mist*. EDS analysis of magenta paint samples from 12 of the 23 study group paintings identified levels of aluminum or barium consistent with mordant materials used in natural and synthetic dye-based colors. Further information regarding these pigments was obtained through organic analysis (see below).

Black Pigments

Hofmann's late-career paintings exhibit limited use of black pigment. Ivory black, also known as bone black (distinguishing elements: Ca, P) appears in eight of Hofmann's late-career study group paintings, beginning with the 1947 painting *Ecstasy* and including *Le Gilotin* (1953), *Above Deep Waters* (1959), *Bald Eagle* (1960), *Combinable Wall I and II* (1961), *Polyhymnia* (1963), and *The Clash* (1964). Mixtures of ivory black and phthalocyanine green were identified in all of these paintings except *Polyhymnia* and *The Clash*.[23] Ivory black pigment appears in both the oil- and alkyd-based black paints in *Heraldic Call* (1962). Neither the oil- nor the alkyd-based black in *Tormented Bull* has a discernable EDS signature, which suggests the presence of carbon black pigment, which is difficult to distinguish with elemental analysis. The alkyd paint in *Bald Eagle* may also contain carbon black pigment, while the oil-based black paint contains ivory black pigment. Potential carbon black pigments also appear on *Delight* (1947), the 1959 paintings *Ruby Gold* and *The Vanquished*, and *Bald Eagle* (1960). Carbon black pigment may be present in complex pigment mixtures or in black paints appearing alongside or mixed with any of the ivory black paints.

[23] Some paints that appear black were later identified as phthalocyanine green.

Table 4.4—Pigments Identified Using Energy Dispersive Spectroscopy

Title	Acc. No.	Zinc White	Titanium White	Cadmium Yellow	Yellow Ochre	Zinc Yellow	Cadmium Orange	Cadmium Red	Red Ochre	Cadmium Green	Phthalocyanine Green	Viridian/Chrome Green	Iron Oxide Green	Cobalt Green	Ultramarine Blue	Phthalocyanine Blue	Cobalt Blue	Cerulean Blue	Prussian Blue	Ultramarine Violet	Cobalt Violet	Ivory Black	Carbon Black**
Delight	MoMA 2.1956	X		X	X			X					X		X								X
Ecstasy	BAM 963.2	X		X		X		X			X				X	X						X	
The Third Hand	BAM 1966.48	X		X				X			X				X								
Le Gilotin	BAM 1965.15	X		X				X		X	X				X	X					X	X	
Scintillating Space	BAM 1966.47	X	X	X			X	X		X	X				X								
Exuberance	AKAG 1955:8	X	X	X				X		X					X								
Sommernachtstraum	AKAG 1958:4	X	X	X	X		X	X	X	X					X				X				
Equinox	BAM 1965.12	X		X		X	X	X		X	X				X			X			X		
Morning Mist	BAM 1966.45	X		X	X		X	X		X					X	X				X			
Above Deep Waters	BAM 1965.13	X	X	X			X	X		X	X				X							X	
Indian Summer	BAM 1965.11	X		X			X	X		X					X								
Ruby Gold	MAG 60.37	X	X	X			X	X		X			X		X						X		X
The Vanquished	BAM 1966.49	X		X			X	X		X	X				X						X		X
Bald Eagle	BAM 1964.3	X	X	X			X	X		X	X				X		X				X	X	X
In the Wake of the Hurricane	BAM 1965.6	X	X	X			X	X		X					X						X		
Combinable Wall I and II	BAM 1963.10	X	X	X	X		X	X		X	X				X							X	
Tormented Bull	BAM 1963.6	X	X																				X
*Heraldic Call**	BAM 1965.17		X					X														X	
Magnum Opus	BAM 1963.7	X	X	X				X							X		X						
Memoria in Aeternum	MoMA 399.1963	X	X	X			X	X		X				X	X								
*Polyhymnia**	BAM 1964.1	X	X					X		X					X							X	
The Clash	BAM 1965.8	X	X	X			X	X			X				X						X		
*Imperium in Imperio**	BAM 1966.43	X		X			X	X		X	X				X		X						
And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light	BAM 1965.4	X	X		X			X		X	X		X								X		
Silent Night	BAM 1965.5	X	X	X	X		X			X	X	X		X	X		X						
Struwel Peter	BAM 1966.5	X	X	X			X	X		X					X						X		
palette on plywood*	Trust M536-12	X																					
palette on board*	Trust M593-12	X									X												
palette on board*	Trust M537-10	X		X			X	X		X	X				X								
palette on board*	Trust M536-53	X					X	X															
palette on glass*	Trust, no #	X		X	X					X					X	X							
palette on paint can lid*	Trust M536-49	X	X												X								
palette on board*	Trust M536-45	X	X												X				X				
palette on board*	Trust M536-03		X								X												

AKAG: Albright-Knox Art Gallery (Buffalo, New York); BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California); Trust: Renate, Hans and Maria Hofmann Trust (New York, New York); MAG: Memorial Art Gallery, University of Rochester (Rochester, New York); MoMA: Museum of Modern Art (New York, New York).
* Not all paint materials were sampled from this study group item.
**Carbon black is not detectable using EDS and may be present along with other black pigments.

Fourier-Transform Infrared Spectroscopy

FTIR analysis was utilized in order to identify organic pigments and other organic materials present in the study group paintings. FTIR uses radiation in the mid-infrared region (4000 to 600 cm^{-1}) to identify the chemical bonds within organic materials. Material identification is then based on the functional groups resulting from characteristic combinations of these bonds. The identification of modern paints using FTIR is complicated by the complex paint formulations of the industrial paints favored by mid-20th century artists, which included experimental early paints and the use of other paint materials as modifying agents. Alkyd resins, nitrocellulose, and vinyl polymers, for example, are common plasticizers for acrylics, and oil-soluble additives can appear in non-oil formulations. Some short-lived mid-20th century modifiers may be used to determine the date of manufacture—tin and formaldehyde biocides for example, or alkyd plasticizers in poly(vinyl acetate) formulations and the post-WWII use of surplus styrene-butadiene rubber as a plasticizing agent.

A total of 248 loose and mounted samples from the study group paintings were analyzed using FTIR. Each of the existing 83 embedded cross-section samples was re-polished to remove the carbon coating from previous SEM-EDS analysis and examined using an FTIR microscope attachment (micro-FTIR). FTIR information for small paint samples in seven of the cross-sections was overwhelmed by the spectra of organic components in the surrounding epoxy mount medium and provided no useful data. Useful FTIR data was acquired from 76 of the re-polished cross-sections. Loose paint samples were examined using an attenuated total reflectance (FTIR-ATR) platform, which incorporates infrared beam reflection from the surface in contact with the sample in order to allow examination of solid paint samples without additional preparation. Carbon coating could not be sufficiently removed from the loose samples previously used for SEM-EDS analysis, therefore FTIR analysis of loose samples was performed on excess sample from 167 loose paints, as well as excess sample of the same materials appearing in the five cross-sections deemed too small for micro-FTIR.

My FTIR analysis of samples from the study group paintings is limited to the general location of identified organic materials within a painting or palette. The microscope aperture required to produce adequate FTIR spectra from mounted cross-section samples encompassed multiple paint layers could not produce separate spectra for individual paint layers within the sample. The information provided by FTIR analysis therefore cannot be used to site organic materials within a particular paint layer. Loose paint samples are crushed during FTIR-ATR analysis and if careful separation of individual paint layers is not performed in advance, composite spectra for different materials contained in the sample may also be produced during analysis. Additionally, the refractive index of different paint materials affects the penetration depth of the infrared beam and may therefore vary the physical depth from which information is gathered during analysis. This phenomenon impacts the analysis of both loose and cross-sectioned materials. While a large number of samples were analyzed for this research using FTIR, the limited number of analyses performed on each individual sample dictates that the FTIR analysis of Hofmann's materials be viewed as a qualitative, not quantitative, technique.[24]

My identification of organic pigments in Hofmann's work is based on the comparison of FTIR spectra from study group samples with the organic materials databases of the Infrared & Raman Users Group (IRUG), including IRUG standards

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[24] Bentley and Turner, *Introduction to Paint Chemistry and Principles of Paint Technology*, 153.

for the epoxy medium used to embed cross-section samples and IRUG standards for conservation materials noted in the treatment records for the study group paintings. Pigments identified in the study group paintings are organized below according to the categories presented in the international *Colour Index* (CI). Tables 4.5 and 4.6 present a summary of the organic materials identified in the study group paintings. In all cases, FTIR results were consistent with those obtained using other analytical methods.

Organic Pigments, Blue and Green

Two phthalocyanine-based pigments were identified in the study group paintings. The *Colour Index* categorizes phthalocyanine colors as organic pigments, defined as "concentrated organic colouring matters containing no salt forming groups."[25] Phthalocyanine pigments contain both organic and inorganic components and can therefore be identified using multiple analytical techniques—in the case of this study, by both FTIR and SEM-EDS (results noted above). FTIR analysis identified organic materials consistent with IRUG standards for the phthalocyanine-based CI Pigment Blue 15 (PB15, also known by the CI numeral designation 74160[26]) in samples from two paintings—*Le Gilotin* and *Morning Mist* (1958)—and two of the Trust palettes. Samples of pre-1953 phthalocyanine paints in Hofmann's work were either too heavily extended or contained too small a sample to be confirmed using

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[25] "Pigments," in vol. 3 of *Colour Index* (Yorkshire, England and Lowell, Massachusetts: The Society of Dyers and Colourists in association with The American Association of Textile Chemists and Colorists, 1957, rep.), 3267.

[26] "Phthalocyanine Dyes and Pigments," in vol. 3 of *Colour Index*, 3569-74.

FTIR analysis although samples of phthalocyanine blue in the 1947 painting *Ecstasy* exhibited SEM-EDS peaks for Cu consistent with those paints identified as phthalocyanine blue by FTIR. The designations PB15.1-15.6 noted in table 4.5 reflect the related IRUG spectra for the pigment's standard crystalline variations.[27]

FTIR analysis identified organic materials consistent with IRUG standards for the phthalocyanine-based CI Pigment Green 7 (PG7; also CI 74260[28]) in paint samples from ten paintings—*Le Gilotin* (1953), *Scintillating Space* (1954), *Sommernachtstraum* (1957), *Equinox* and *Morning Mist* (1958), *Above Deep Waters* and *Indian Summer* (1959), *Combinable Wall I and II* (1961), *Imperium in Imperio* and *Silent Night* (1964)—and two of the Trust palettes. Samples from three additional paintings and one additional palette had SEM-EDS results to support the identification of phthalocyanine green paints on a total of 14 paintings and three palettes. The nonpolymorphous pigment appears as a single column in table 4.5.

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27 Willy Herbst and Klaus Hunger, *Industrial Organic Pigments: Production, Properties, Applications* (Weinheim, Germany: Wiley-VCH Verlag GmbH & Co. KGaA, 2004, rev.), 8, 418-45.

28 "Phthalocyanine Dyes and Pigments," in vol. 3 of *Colour Index*, 3569-74.

Table 4.5—Pigments Identified Using Fourier-Transform Infrared Spectroscopy

Year	Title	Acc. No.	Phthalocyanine Blue PB 15	PB 15:1	PB 15:2	PB 15:4	PB 15:6	Phthalocyanine Green PG 7	Likely**	Alizarin PR 83	Likely***	Rhodamine PR 81
1947	*Delight*	MoMA 2.1956									X	
	Ecstasy	BAM 963.2									X	
	The Third Hand	BAM 1966.48								X		
1953	*Le Gilotin*	BAM 1965.15	X	X				X	X	X		
1954	*Scintillating Space*	BAM 1966.47						X				
1955	*Exuberance*	AKAG 1955:8										
1957	*Sommernachtstraum*	AKAG 1958:4							X			
1958	*Equinox*	BAM 1965.12						X				
	Morning Mist	BAM 1966.45	X	X					X	X		
1959	*Above Deep Waters*	BAM 1965.13										
	Indian Summer	BAM 1965.11						X				
	Ruby Gold	MAG 60.37										
	The Vanquished	BAM 1966.49										
1960	*Bald Eagle*	BAM 1964.3										
	In the Wake of the Hurricane	BAM 1965.6										
1961	*Combinable Wall I and II*	BAM 1963.10							X			
	Tormented Bull	BAM 1963.6										
1962	*Heraldic Call**	BAM 1965.17										
	Magnum Opus	BAM 1963.7									X	
	Memoria in Aeternum	MoMA 399.1963										
1963	*Polyhymnia**	BAM 1964.1									X	
1964	*The Clash*	BAM 1965.8								X		
	*Imperium in Imperio**	BAM 1966.43							X			
	And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light	BAM 1965.4										
	Silent Night	BAM 1965.5						X				
1965	*Struwel Peter*	BAM 1966.5										
1966	palette on plywood*	Trust M536-12										
	palette on board*	Trust M593-12	X	X	X	X	X					
	palette on board*	Trust M537-10						X				
	palette on board*	Trust M536-53										X
	palette on glass*	Trust, no #	X	X			X					
	palette on paint can lid*	Trust M536-49										X
	palette on board*	Trust M536-45										
	palette on board*	Trust M536-03						X	X			X

AKAG: Albright-Knox Art Gallery (Buffalo, New York); BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California); Trust: Renate, Hans and Maria Hofmann Trust (New York, New York); MAG: Memorial Art Gallery, University of Rochester (Rochester, New York); MoMA: Museum of Modern Art (New York, New York).

* Not all paint materials were sampled from this study group item.

** Samples not directly identified as the pigment but matching FTIR spectra for other samples containing the pigment.

*** Matched to other samples identified as PR83 or presenting SEM-EDS results consistent with an alumina substrate.

Lake Pigments, Alizarin

Alizarin is one of two magenta colors that appear in Hofmann's late-career work. The *Colour Index* categorizes alizarin as a lake pigment, defined as "broadly similar to toners [see definition below] in type but precipitated in the presence of a substrate such as alumina, alumina blanc-fixe etc. the substrate being a necessary and integral part of the product."[29] FTIR analysis identified materials consistent with IRUG standards for CI Pigment Red 83 (PR83, also known as CI 58000[30])—an anthraquinone-based[31] alizarin substitute for natural madder pigment—in the 1947 painting *The Third Hand*, as well as three later works: *Le Gilotin*, *Morning Mist*, and *The Clash*. Samples of magenta paints from *Delight, Ecstasy, Magnum Opus,* and *Polyhymnia* were too small to definitively identify the synthetic organic pigment used but provided FTIR matches to other samples identified as PR83 or exhibited SEM-EDS results consistent with an appropriate alumina substrate. No examples of PR83 were found in the palettes.

Toners

A second magenta color appears exclusively on Hofmann's late-career palettes. The *Colour Index* categorizes this rhodamine color as a toner, defined as "concentrated colouring matters produced by reaction of a water soluble dye with an

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[29] "Pigments," in vol. 3 of *Colour Index*, 3267.

[30] "Anthraquinone and Related Colouring Matters," in vol. 3 of *Colour Index*, 3469-544. The *Colour Index* lists CI Mordant Red 11 as the parent dye of PR83 and also lists PR83 as a metal lake of CI Mordant Red 11. Pigment charts in *Colour Index*, vol. 3 (3315) and vol. 2 (2754).

[31] Herbst and Hunger, *Industrial Organic Pigments: Production, Properties, Applications*, 9.

appropriate precipitant."[32] The xanthene-based[33] rhodamine pigment known as CI Pigment Red 81 (PR81, also known as CI 45160[34]) does not appear in any of the study group paintings, but FTIR analysis identified materials consistent with IRUG standards for PR81 in all three magenta paint samples available for testing from the Trust palettes. It is worth noting that PR83 was not identified in any of the palettes from which samples were available.

Conservation Materials

FTIR analysis also reveals the presence of materials consistent with conservation records for the study group paintings.[35] Table 4.6 provides a summary of conservation materials identified in the study group samples; the listing is not comprehensive, as sampling was designed to avoid non-original materials. Materials consistent with IRUG standards for waxes appear in samples from four paintings with conservation records of overall or local wax infusion: *The Third Hand* (1947), *Scintillating Space* (1954), *Above Deep Waters* (1959), and *The Clash* (1964). Binding media consistent with IRUG standards for the poly(vinyl acetate) components of consolidation or

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[32] "Pigments," in vol. 3 of *Colour Index*, 3267.

[33] Herbst and Hunger, *Industrial Organic Pigments: Production, Properties, Applications*, 554.

[34] "Xanthene Colouring Matters," in vol. 3 of *Colour Index*, 3381-94. The *Colour Index* lists CI Basic Red 1 as the parent dye of PR81 and also lists PR81 as an acid lake of CI Basic Red 3. Pigment charts in *Colour Index*, vol. 3 (3315) and vol. 2 (2753).

[35] Conservation department archives, Elise S. Haas Conservation Department, San Francisco Museum of Modern Art.

inpainting materials[36] appear in only one paint sample, from an area of compositional white paint in the 1958 painting *Equinox* noted in conservation records as having undergone local consolidation with poly(vinyl acetate). Acrylic media consistent with the IRUG standards for methacrylate varnishes appear in 43 samples comprising in nine paintings with conservation records of local or overall varnishing treatment: *Le Gilotin* (1953), *Scintillating Space* (1954), *Equinox* (1958), *Bald Eagle* (1960), *Combinable Wall I and II* (1961), *Magnum Opus* (1962), and *The Clash*, *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Night*, and *Silent Night* (all 1964).

The information provided by FTIR analysis regarding conservation materials is limited. The methacrylate polymers identified through FTIR analysis, for example, are a primary component of the poly(n-butyl methacrylate) varnish used by conservator Daniel Goldreyer in the early treatment of Hofmann's work, but also a primary component of the ethyl methacrylate methyl acrylate polymer coatings utilized in contemporary conservation treatment. Nominal differences in the FTIR spectra of these materials[37] are difficult to discern when even small amounts of pigment or other material are present in a sample (see figure 4.11). The FTIR identification of conservation materials in samples from the study group paintings is therefore limited to general categorization and cannot provide the level of identifying information necessary to date or differentiate conservation campaigns in the individual artworks.

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[36] Poly(vinyl acetate) formulations commonly used in conservation include AYAA, AYAB, and AYAC. As noted in Chapter Three, conservation records indicate that AYAA appears in conjunction with dry pigments used for inpainting and AYAC is a component of the inpainting material Mowilith 20.

[37] Learner, *Analysis of Modern Paints*, 81.

Table 4.6—Summary of Conservation Materials Present in Study Group Samples

Year	Title	Acc. No.	Sample No.	Result	Method(s)
1947	*Ecstasy*	BAM 1963.2	Esc01	wax	Py-GC-MS
			Esc02	acrylic, wax	Py-GC-MS
			Esc03	acrylic	Py-GC-MS
			Esc06	acrylic varnish	ATR-FTIR
			Esc07	wax	Py-GC-MS
	The Third Hand	BAM 1966.48	C063	acrylics	Py-GC-MS
			C064	acrylic	Py-GC-MS
			C071	wax	Py-GC-MS, ATR-FTIR
1953	*Le Gilotin*	BAM 1965.15	C016	acrylic varnish	ATR-FTIR
1954	*Scintillating Space*	BAM 1966.47	C072	wax	ATR-FTIR
			C074	acrylic varnish	ATR-FTIR
			C076	acrylic varnish	ATR-FTIR
			C077	acrylic varnish	ATR-FTIR
			C078	acrylic varnish	ATR-FTIR
1958	*Equinox*	BAM 1965.12	C050	acrylic varnish	ATR-FTIR
			C052	acrylic varnish	ATR-FTIR
			C053	acrylic varnish	ATR-FTIR
			C057	acrylic media	ATR-FTIR
1959	*Above Deep Waters*	BAM 1965.13	C110	wax	ATR-FTIR
			C111	wax	ATR-FTIR
			C114	wax	ATR-FTIR
			C117	wax	ATR-FTIR
1960	*Bald Eagle*	BAM 1964.3	C027	acrylic varnish	ATR-FTIR
			C030	acrylic varnish	Py-GC-MS, ATR-FTIR
			C033	acrylic	Py-GC-MS
			C036	acrylic varnish	ATR-FTIR
	In the Wake . . .	BAM 1965.6	C175	acrylic varnish	ATR-FTIR
			C176	acrylic	Py-GC-MS
			C178	acrylic	Py-GC-MS
			C180	wax	Py-GC-MS
1961	*Combinable Wall I/II*	BAM 1963.10	C083	acrylic varnish	ATR-FTIR
			C084	acrylic varnish	ATR-FTIR
			C089	acrylic varnish	ATR-FTIR
	Tormented Bull	BAM 1963.6	C061	acrylics	Py-GC-MS
1962	*Magnum Opus*	BAM 1963.7	C154	acrylic varnish	ATR-FTIR
1964	*The Clash*	BAM 1965.8	C004	acrylic, wax	Py-GC-MS, ATR-FTIR
			C005	acrylic varnish	ATR-FTIR
			C006	wax	ATR-FTIR
			C011	acrylic	Py-GC-MS
	And Out of the Caves . . .	BAM 1965.4	C170	acrylic varnish	ATR-FTIR
			C172	acrylic	Py-GC-MS
	Silent Night	BAM 1965.5	C104	acrylic, wax	Py-GC-MS
			C105	acrylic varnish	ATR-FTIR
			C106	acrylic varnish	ATR-FTIR
			C107	acrylic varnish	ATR-FTIR
			C108	acrylic varnish	ATR-FTIR
			C109	acrylic varnish	Py-GC-MS, ATR-FTIR

BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California)
Py-GC-MS: Pyrolysis-Gas Chromatography-Mass Spectrometry
ATR-FTIR: Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy

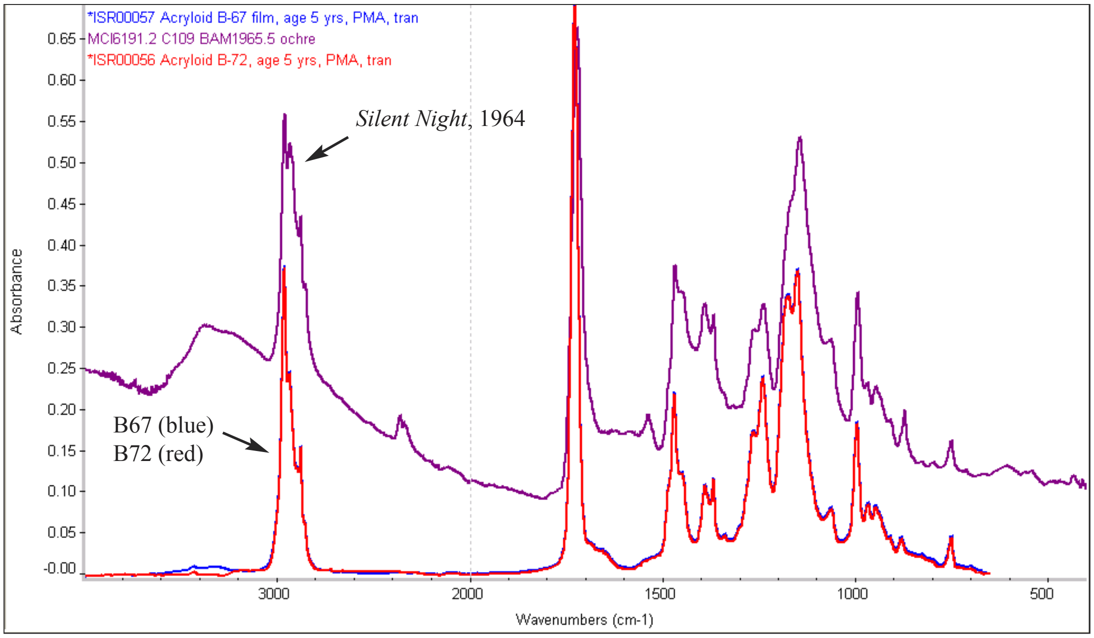

Figure 4.11: Comparison of Infrared & Raman Users Group (IRUG) spectroscopy standards for Paraloid B-67 (poly-iso-butyl methacrylate) and Paraloid B72 (ethyl methacrylate methyl acrylate) with the spectra for sample no. C109, a varnish-containing ochre and cadmium yellow pigment sample from Hans Hofmann's *Silent Night*, 1964.

X-Ray Diffraction

XRD analysis was utilized for a more detailed investigation of Hofmann's cadmium paints. In paint analysis, x-ray diffraction analysis is used to differentiate between pigments with the same elemental composition but different crystalline structures, such as anatase and rutile titanium. The characteristic diffraction of an x-ray beam by crystalline materials can be used to help date paintings executed in traditional artist's paints—rutile predates anatase, for example—but interpretation of such data must proceed with caution when examining modern industrial paints that may continue to incorporate "outdated" artist's materials (rutile titanium creates a more stable exterior paint, but anatase titanium was included in some chalking, "self-cleaning" exterior paint formulations). In paintings conservation, XRD is particularly useful for differentiating between modern synthetic pigments of similar elemental composition, such as cadmium sulfide colors (ranging from yellow to red), chrome-based yellows, and copper-based greens, and help identify these pigments following degradation-related color shifts. In modern paintings, XRD is also used to analyze materials—such as oil paint fatty acids or acrylic paint surfactants—that have crystallized on the surface of a paint sample.

Unlike the complementary materials identification techniques above, my XRD analysis was performed in response to the discovery of calcium sulfate and barium sulfate extenders in secondary shades of yellow, orange, and red cadmium paints in Hofmann's paintings from 1958 onward (see SEM-EDS section above). A material always produces a characteristic diffraction pattern whether that material is present in a pure state or is part of a mixture, and XRD can be employed to determine if the same pigment is present in different colors. The crystalline structure information provided by XRD analysis was sought as a means to determine if primary and secondary shades of any color were prepared using the same pigment. My identification of crystalline phases in the samples analyzed with XRD is based on a qualitative match provided by Jade 8.0 XRD software to reference patterns of known materials in the International Center for Diffraction Data (ICDD) libraries.

A limited amount of pigment sample remained available for XRD analysis as performance of this technique followed all previous analyses. A total of 22 paint samples from the study group paintings were analyzed using XRD. The XRD sample group includes 11 examples of cadmium paint appearing on a total of five paintings produced between 1958 and 1961—*Equinox* (1958), *Indian Summer, Above Deep*

Waters, and *Ruby Gold* (all 1959), and *Combinable Wall I and II* (1961), along with four examples of cadmium paint appearing on three of the Trust palettes. The XRD sample group also includes two samples of paint whose identification through other analytical methods had produced limited or inconsistent results, four samples of pigment containing trace amounts of cobalt violet, and one sample of a modern synthetic organic color. The small number of samples analyzed, the limited number of XRD analyses performed, and the potential for mixed paint materials within each sample precludes the ability to interpret information obtained through this XRD analysis in anything other than a qualitative manner. Table 4.7 is a summary of XRD sampling and results. Diffractograms for individual samples are provided in Appendix B.

Table 4.7—Pigment Polymorphs Identified Using X-Ray Diffraction

Year	Title	Acc. No.	Sample No.	Description	**Cadmium Sulfide Selenide*** **	**Cadmium Selenide Sulfide******	**Cadmium Sulfide, CdS*******	Barite, $BaSO_4$	Calcium Sulfate, $CaSO_4$	Zincite, $(Zn, Mn)O$	Anatase, TiO_2	Lazurite ******	Cobalt Phosphate, $Co_3(PO_4)_2$*******
1958	*Equinox*	BAM 1965.12	C047	dark red	X			X					
			C056	purple				X					X
1959	*Above Deep Waters*	BAM 1965.13	C110	primary red	X			X					
			C111	secondary red	X			X					
	Indian Summer	BAM 1965.11	C128	main orange		X	X						
			C129	purple									X
			C131	bright red	X			X					
	Ruby Gold	MAG 60.37	R03	orange*	X			X					
			R11	orange*	X			X					
1960	*In the Wake . . .*	BAM 1965.6	C174	purple									X
			C175	unknown blue								X	
1961	*Combinable Wall I/II*	BAM 1963.10	C087	main red	X			X	X	X	X		
			C088	secondary red	X			X		X	X		
			C089	pink	X			X		X	X		
			C092	main orange	X			X		X	X		
1963	*Polyhymnia*	BAM 1964.1	C133	yellow			X						
1964	*And Out of the Caves . . .*	BAM 1965.4	C173	purple									X
1966	palette on board	Trust 537-10	S10	red	X			X		X	X		
	palette on board	Trust 536-03	S11	red	X			X					
	palette on board	Trust 536-53	S13	dark red**				X	X				
			S13	dark orange	X			X	X				
			S14	orange		X	X						

BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California)
Trust: Renate, Hans and Maria Hofmann Trust (New York, New York)
MAG: Memorial Art Gallery, University of Rochester (Rochester, New York)
* Samples taken from an area of localized distortion and an area at the edge of the composition that had no visible ground layer
** Identified by Fourier-Transform Infrared Spectrscopy as Colour Index Pigment Red 81
*** Cadmium sulfide selenide polymorph identified in International Center for Diffraction Data (ICDD) libraries as $CdS_{0.54}Se_{0.46}$
**** Cadmium selenide sulfide polymorph identified in ICDD libraries as $CdS_{0.42}Se_{0.58}$
***** Trace levels of manganese in the cadmium sulfide pigment in *Polyhymnia* produced a cadmium manganese sulfide polymorph identified in ICDD libraries as $(Cd_{0.65}Mn_{0.35})S$
******Lazurite polymorph identified in ICDD libraries as $Na_{6.36}Ca_{1.52}(AlSiO_4)_6(SO_4)_{0.84}S_{1.544}$
******* Cobalt phosphate appears in conjunction with dittmarite; in some cases, dittmarite is the only material found in samples identified as cobalt phosphate through other analyses

Cadmium Sulfide Selenide and Cadmium Selenide Sulfide

A limited number of cadmium pigment polymorphs appear in XRD analysis of the study group samples. 13 of the 15 cadmium paint samples exhibited characteristic diffraction patterns consistent with ICDD standards for the same cadmium sulfide selenide crystalline lattice.[38] Pigments identified as the same cadmium sulfide selenide polymorph include all nine samples of red pigment and four of the six samples of orange pigment. For example, samples of both primary and secondary reds from the painting *Above Deep Waters* exhibit the same diffraction patterns, and also match the diffraction patterns of the primary red and orange, secondary red, and pink pigments in *Combinable Wall I and II*. (see figures 4.12 and 4.13). A different cadmium polymorph was found in only two of the pigment samples analyzed using XRD. Diffraction patterns consistent with ICDD standards for the same cadmium selenide sulfide crystalline lattice[39] appeared in conjunction with cadmium sulfate patterns in two orange pigment samples—one sample taken from the painting *Indian Summer* and one sample taken from an Trust palette. No other red or orange pigment polymorphs were identified in the study group samples.

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[38] A match to the International Center for Diffraction Data libraries reference pattern for $CdS_{0.54}Se_{0.46}$

[39] A match to the International Center for Diffraction Data libraries reference pattern for $CdS_{0.42}Se_{0.58}$

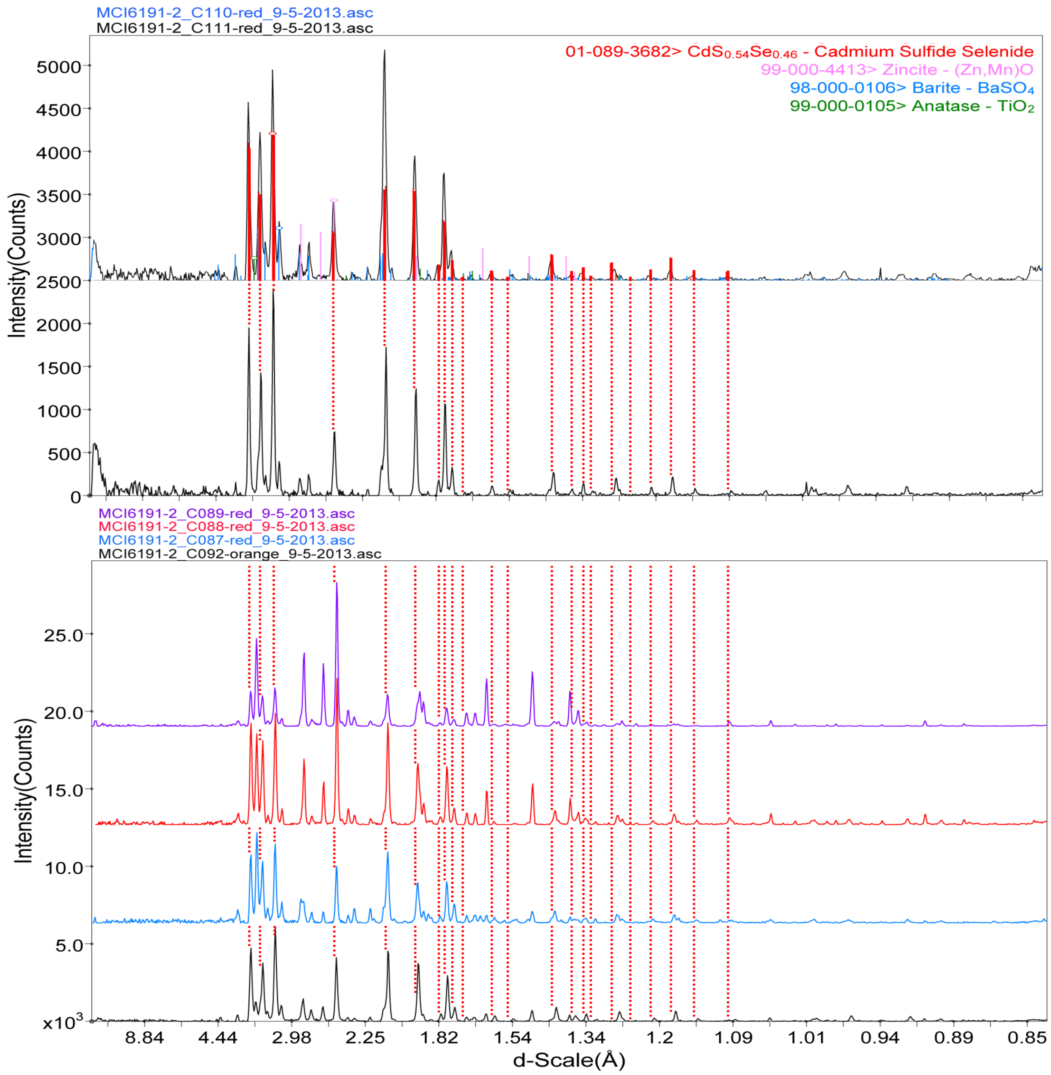

Figure 4.12 (top): Diffractograms for primary and secondary red pigments (samples C110 and C111, respectively) appearing in Hans Hofmann's *Above Deep Waters*, 1959. Figure 4.13 (bottom): Diffractograms for primary red and orange (samples C087 and C092, respectively), secondary red (sample C088), and pink (sample C089) in Hans Hofmann's *Combinable Wall I and II*, 1961. All six paint samples exhibit diffraction patterns characteristic of International Center for Diffraction Data library standards for the same cadmium sulfide selenide crystalline lattice. Please note that the peak heights denoted in the ICDD database represent an ideal sample of pigment unmixed with other materials. The varying peak heights within crystalline phase matches from Hofmann's paintings may have various causes, such as crystal lattice orientation or damaged crystals, or be influenced by other crystalline phases within the pigment mix. The unmatched peaks represent diffraction patterns characteristic of the zinc white, titanium white, and extender components of the paint mixtures.

The appearance of polymorph matches in Hofmann's paints provides interesting but ultimately inconclusive data. While XRD analysis reveals that the same crystalline cadmium pigments were mixed with different extenders to create primary and secondary shades of color in some of Hofmann's paintings (see EDS extender results above), there is no anecdotal or documentary evidence that Hofmann prepared any of his paints from raw pigments[40] and it is likely that the matching crystalline polymorphs identified in Hofmann's paints are an artifact of commercial paint manufacture. XRD analysis provides little insight regarding whether the extenders present in Hofmann's cadmium pigments were added by the paint manufacturer or by the pigment supplier.[41] An economical mixture of barium sulfates and cadmium sulfides—called "cadmopone" in historical sample books[42]—was offered by pigment manufacturers during the 1950s and 1960s, for example, but it is not in the scope of this study to trace the origin or function of the various extenders identified in Hofmann's cadmium colors. Paints with pigment polymorph matches cannot even be tied to a particular brand of artist's paint, because multiple manufacturers may have purchased raw or mixed pigment from the same industrial pigment supplier.

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[40] Colleague Clyfford Still prepared paints from raw pigments. See Susan F. C. Lake and Barbara A. Ramsay, *The Artist's Materials: Clyfford Still* (Los Angeles: The Getty Conservation Institute), in press.

[41] Email correspondence from pigment manufacturer and historian Dr. Georg Kremer to the author dated December 30, 2013 and January 6, 2014.

[42] *Anorganische Pigmente Montecatini* (Milan, Italy: Società Generale per l'Industria Mineraria e Chimica, 1955), 17-18. Industrial pigment catalogue with descriptions and color samples. Translation from the German courtesy Dr. Georg Kremer.

Polymorph matches in paints obtained from paintings produced over several years (in this case, 1958-1964) may reflect an artist's extended use of personal paint stock, the extended distribution of commercial stock (through one store or many stores), or a lengthy run of production from a single raw pigment source, distributed to any number of secondary pigment or paint producers. Any one or any combination of these factors may play a role in the limited number of polymorphs present in Hofmann's late-career cadmium colors.

Other Polymorph Identifications

The identities of two previously unknown pigments were clarified through XRD. XRD analysis of an unknown blue pigment in the painting *In the Wake of the Hurricane* produced a diffractogram characteristic of ICDD standards for the lapis-based pigment Lazurite,[43] and analysis of an unknown yellow pigment in the painting *Polyhymnia* produced a diffractogram characteristic of ICDD standards for cadmium manganese sulfide.[44] Trace levels of manganese in certain crystalline formations of cadmium sulfide yellow pigment may have produced the unique resonance responsible for the latter diffractogram,[45] but the appearance of lazurite in Hofmann's work seems

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[43] A match to the International Center for Diffraction Data libraries reference pattern for $Na_{6.36}Ca_{1.52}(AlSiO_4)_6(SO_4)_{0.84}S_{1.544}$

[44] A match to the International Center for Diffraction Data libraries reference pattern for $(Cd_{0.65}Mn_{0.35})S$

[45] See Paul B. Dorain, "Electron Paramagnetic Resonance of Manganese (II) in Hexagonal Zinc Oxide and Cadmium Sulfide Single Crystals," *Physical Review* 112 (November 1958): 1058–1060. This unique resonance has since been exploited for use in nanotechnology. See M. Ragam et al., "Localized Vibrational Mode in Manganese-Doped Zinc Sulphide and Cadmium Sulphide Nanoparticles," *Defect and Diffusion Forum*, 318 (July 2011): 11-21.

unrelated to any variation of previously identified pigments and is unique to this one study group painting.

XRD analysis was also performed on cobalt violet pigment samples that proved difficult to identify using other analytical techniques. As with previous analytical techniques, not all of samples of pigment previously identified through SEM or FTIR as cobalt violet produced diffractograms identified as cobalt phosphate, although all four samples analyzed using XRD did produce diffractograms consistent with ICDD standards for dittmarite, a crystalline composition of trace elements found in XRD analysis of cobalt violet by scientists at the Canadian Conservation Institute in collaboration with the CANMET Energy Technology Centre.[46]

XRD analysis was also performed to confirm the absence of crystalline coloring materials in samples of organic pigments. XRD analysis of a pigment sample identified by FTIR as Colour Index Pigment Red 81 produced diffractograms solely for the rhodamine-based pigment's inorganic mordant materials.

Discussion of Analyses

Hofmann's most prolific period of creation is distinguished by a limited palette. A timeline compiled from the analytical data reviewed thus far (see figure 4.14) reveals that Hofmann's most recognizable modern paintings were constructed from a small number of colors with only minimal use of mid-twentieth-century paint media. Apart from the artist's adoption of alkyd ground layers, the distinctive visual

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[46] See Marie-Claude Corbeil et al., "The Characterization of Cobalt Violet Pigments," *Studies in Conservation*, 47(4) (2002): 237-49.

vocabulary of Hofmann's later years is fashioned largely from traditional artist's oil paints.

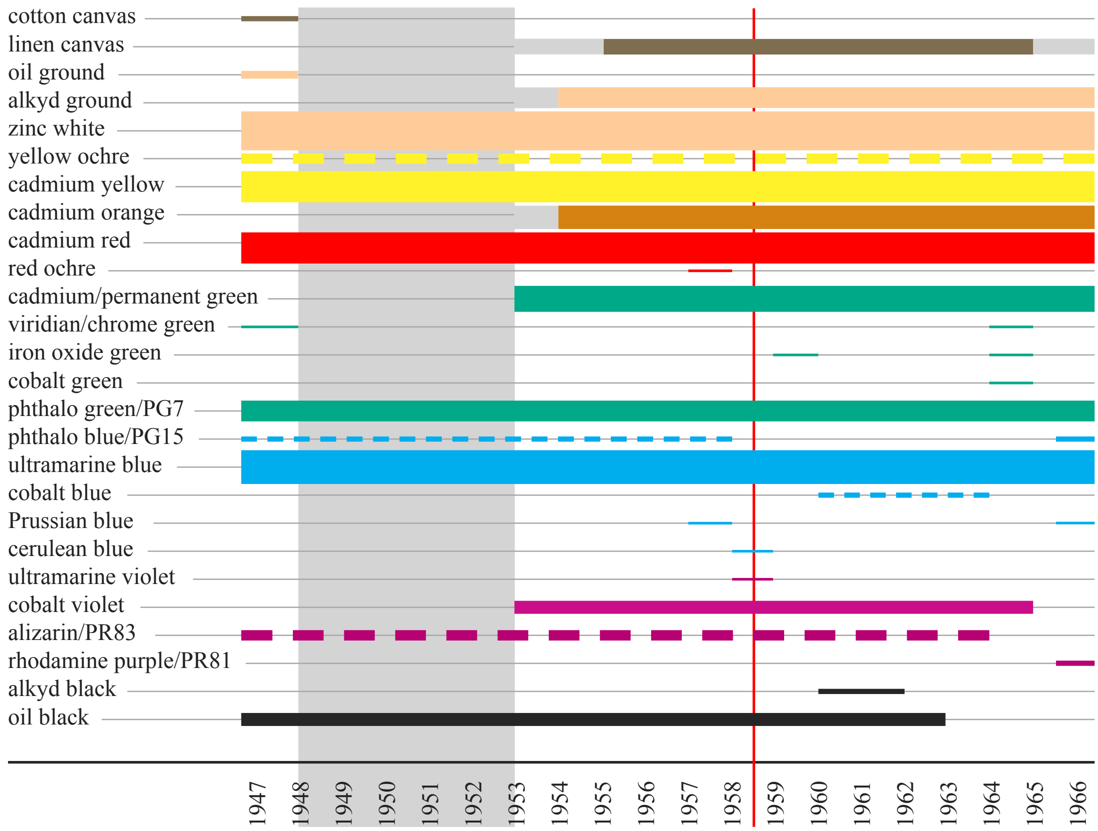

Figure 4.14: Timeline spread of Hofmann's late-career materials. If use of a particular pigment is consistent, a solid line is drawn from beginning to end dates; sporadic use is a dashed line between beginning and end dates; the thickness of the line denotes the relative number of paintings on which the paint is found during this period. Not all colors were sampled from the study group paintings; colors not found in the study group works may exist in other paintings from the same year. Not all materials were sampled from each year in the timeline; the starting and ending dates of common materials are extended with a horizontal gray bar to reflect their likely use. Red line indicates the year Hofmann closed his schools and began to paint full time. No study paintings appear within vertical gray timeframe.

The analytical data presented above confirms anecdotal accounts of linen canvas and alkyd ground or priming layers in Hofmann's work, as well as the artist's preference for a bold but limited selection of colors. The modernist nature of Hofmann's color selection is explored below, along with the relationship between late additions to Hofmann's palette and recurring condition problems in the artist's work.

Preparatory Materials

New paint media appear primarily in Hofmann's preparatory layers. Shifts in Hofmann's materials from the late 1940s to the early 1950s recalled by students and confirmed by analysis include a switch from cotton to linen canvas supports and the introduction of alkyd paints in Hofmann's ground and priming layers.[47] Alkyd paints also appear in Hofmann's sporadic use of splashed black alkyds, but unlike the artist's earlier constructions—which Tony Rockwell described as "several different types of media . . . combined in one painting including oil, casein, duco enamel, gouache, and India ink"[48]—Hofmann's selective compositional applications of alkyd paint are the artist's only late-career deviations from an otherwise conventional oil-based palette.[49]

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[47] See Chapter Three for an overview of published and unpublished accounts of Hofmann's materials.

[48] Tony Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann" (unpublished report with editing marks, S. Haas Conservation Department, San Francisco Museum of Modern Art, 1982), 4.

[49] Alkyds are also oil-based, but distinctly different in appearance and handling than artist's oil paints. A discussion of Hofmann's preference for artist's oil paints follows later in this chapter.

Oil-based Colors

A handful of bright, bold colors is central to Hofmann's palette. Several principal colors in Hofmann's palette appear in the earliest study group paintings and continue in regular use throughout the rest of Hofmann's career. Zinc white is the only compositional white that appears on the study group paintings,[50] in keeping with accounts of Hofmann's disdain for lead white, a hazardous material still employed by colleagues such as Franz Kline.[51] Cadmium red is the only red pigment identified in the paintings, and although not employed in the same exclusive manner, cadmium yellow appears in every painting that includes yellow paint.[52] Ultramarine blue is similarly found in every blue-containing composition, either alone or among a selection of blue pigments. Alizarin crimson and phthalocyanine-based blue and green are among a handful of synthetic organic colors seen regularly throughout Hofmann's late-career work. These principal colors form the bulk of the materials identified through analysis of the study group samples.

Other compositional colors in common use by Hofmann in his later years appear in the study group paintings beginning in the early 1950s. Cadmium-based orange and green pigments appear during this period, and although archival lists and the anecdotal recollections of Hofmann's students allude to its earlier use, cobalt violet does not appear in the study group paintings until 1953. Other colors appear

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[50] Excluding instances of ground layer material incorporated into the composition.

[51] See Dawn Rogala et al., "Condition Problems Related to Zinc Oxide Underlayers: Examination of Selected Abstract Expressionist Paintings from the Collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution," *Journal of the American Institute for Conservation* 49(2) (Fall/Winter 2010): 96-113.

[52] Cadmium yellow paint is visible on *Heraldic Call*, but was not sampled.

sporadically in the last decade of Hofmann's career—of note is the disappearance of alizarin crimson from the study group paintings after 1963 and the appearance shortly thereafter of a rhodamine-based magenta, although it is not clear whether this switch is in fact a substitution of one pigment for another, and if so whether the switch was intentionally made by Hofmann or a formulation change by a paint manufacturer unconsciously implemented by the artist. There is also a period in the early 1960s when cobalt blue temporarily replaced phthalocyanine blue in Hofmann's palette, but there is otherwise no noticeable shift in the artist's materials after 1958, the year Hofmann closed his schools and returned to full-time painting.

Hofmann's Palette and Modern Art History

The bright colors and new pigment formulations that dominate Hofmann's late-career palette are a timeline of the artist's years among the avant-garde communities of Europe and the United States. A chronology of twentieth-century modernism—and the role played by Hofmann's years in Munich, Paris, and New York City—are visible in the artist's distillation of modernist color. The connections between Hofmann's late colors and their associated modernist periods are discussed below and reveal the extent to which Hofmann's seemingly conventional palette was determined by modern art history.

The Colors of Early European Modernism

Modernist colors at the root of Hofmann's palette echo his training in Munich and his time in Paris before World War I. Half of Hofmann's late-career colors are among the pigment formulations identified by science writer Philip Ball and conservators from London's Tate and National Gallery in the work of the

Impressionist painters Hofmann studied as a young artist.[53] Limited extant work from Hofmann's early years as a painter precludes a definitive *terminus post quem* for these pigments, although Impressionist colors make up half of the handwritten pigment list that accompanied Hofmann's early years in the United States.[54] The "push and pull" of color in Hofmann's signature work reflects not only the nineteenth-century color theories of Impressionist favorites Michel-Eugène Chevreul and Ogden Nicholas Rood but also relies on the Impressionist palette of synthetic color formulations Ball called "biased heavily towards . . . new materials."[55] Colors from Hofmann's bold palette that were considered "modern" during his early years as an artist include zinc white, cadmium yellow, cobalt blue, viridian, and cobalt violet—a color featured in Rood's innovative treatise on complementary colors. "I have finally discovered the true color of the atmosphere," Édouard Manet is said to have proclaimed the year that Rood's *Modern Chromatics, with Applications to Art and Industry*, was published in Paris.[56]

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[53] Ball identifies the following colors as materials typically used in Impressionist paintings: zinc white, lead white, lemon yellow (barium chromate), chrome yellow, (lead chromate), cadmium yellow, Naples yellow (lead antimonite), yellow ochre, chrome orange (basic lead chromate), vermilion, red ocher, natural madder lake, crimson (cochineal) lake, Scheele's green (copper arsenite), emerald green (copper-aceto-arsenite), viridian (hydrated chromic oxide), chrome green (a mixture of Prussian blue and chrome yellow), cerulean blue (cobalt stannate), cobalt blue (cobalt aluminate), artificial ultramarine, and ivory black (bone black). Philip Ball, "The Reign of Light: Impressionism's Bright Impact," *Bright Earth: Art and the Invention of Color* (New York: Farrar, Straus and Giroux, 2001), 168-196.

[54] Hofmann Papers.

[55] Ball, *Bright Earth: Art and the Invention of Color,* 181.

[56] Rood's *Modern Chromatics, with Applications to Art and Industry*, was first published in 1879 (New York: D. Appleton and Company), with German and French translations appearing in 1880 (Leipzig: Brockhaus) and 1881 (Paris: G. Baillière et

"It's violet. . . . Three years from now everyone will work in violet."[57] Other principal pigments in Hofmann's palette that entered commercial production during the artist's lifetime include the striking cadmium oranges and reds embraced by modern painters during Hofmann's years in Paris. The "wild" color of experimental artists such as Henri Matisse and André Derain[58] was dominated by newly accessible color formulations. "Once I had discovered that red color," said Matisse, "I put [other] studies in a corner, and that's where they'll stay. . . . I find that all these things—flowers, furniture, the commode—become what they are for me only when I view them together with that red."[59] The colors of Hofmann's Parisian colleagues became central to his later work. "As it now looks to me," professed Clement Greenberg

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cie). Chevreul's *De la loi du Contraste Simultané des couleurs* was first published in 1839 (Paris, Pitois-Levrault et ce.); the first English translation—entitled *The Principles of Harmony and Contrast of Colors and Their Applications to the Arts of Painting, Decoration of Buildings, Mosaic Work, Tapestry and Carpet Weaving, Calico Printing, Dress, Paper Staining, Printing, Illumination, Landscape and Flower Gardening etc.*—appeared in 1854 (London: Longman and Company).

[57] According to playwright and arts critic Jules Arsène Arnaud Claretie, who attributed the quotation to Manet in his May 31, 1881 article "La médaille de M. Manet." Reproduced in Jules Claretie, *La Vie à Paris, 1881* (Paris: Victor-Havard, 1881), 226.

[58] *Gil Blas* critic Louis Vauxcelles is said to have seen a classical sculpture by Albert Marquet surrounded by the new paintings at the 1905 Salon d'automne and exclaimed "Donatello parmi les fauves!"

[59] Matisse, interview with Ernst Goldschmidt, date unknown. Cited in Goldschmidt, "Strejtog I Kunsten: Henri Matisse," *Politiken*, December 24, 1911: page unknown. Reproduced as "Interview with Ernst Goldschmidt, 1911," trans. Desirée Koslin, in *Matisse on Art*, ed. Jack Flam (Berkeley and Los Angeles: University of California Press, 1995), 62.

shortly before Hofmann returned to full-time painting, "you could learn more about Matisse's color from Hofmann than from Matisse himself."[60]

The Materials of Mid-twentieth Century American Modernism

Hofmann's use of modern paint media has origins in both Europe and the United States. Although the alkyd paints of Hofmann's late-career ground and priming layers appeared in the compositions of Parisian colleague Pablo Picasso[61] as Hofmann donned the mantle of modernist art teacher in Germany, the use of alkyd priming layers among Hofmann's neighbors took hold only after the artist was established in New York City. Harriet Standeven noted that the repeated use of house paint among Hofmann's colleagues was often pragmatic:

> Peculiar to the use of commercial paints during this earlier period . . . is that their presence was *implicit*, in that artists did not explore their unique physical capabilities, nor was their inclusion intended to make social commentary. Rather, commercial paints tended to be used for practical reasons: confined to priming layers or applied as though they were traditional artists' oils.[62]

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[60] Clement Greenberg, "New York Painting Only Yesterday" *Art News* 56(4) (Summer 1957): 84.

[61] Jo Crook and Thomas J. S. Learner, *The Impact of Modern Paints* (London: Tate Gallery Publishing Ltd., 2000), 18. Industrial enamel paints have been found in works produced by Picasso and Francis Picabia in the early 1920s. See *Journal of the American Institute for Conservation* 52(3-4) (August and November 2013), postprints from the May 2011 symposium *From Can to Canvas: Early Uses of House Paints by Picasso and His Contemporaries in the First Half of the 20th Century*. For Hofmann's association with Picasso, see Chapter Two, "Hofmann's Years in Paris (1904-1914) and Return to Germany (1914-1931)."

[62] Harriet A.L. Standeven, "The Historical and Technical Development of Gloss House Paints, with Reference to their Use by Twentieth-Century Artists," (PhD diss., Royal College of Art, 2003), 190.

Similarly, the "Permalba" mix of zinc and titanium white pigments that appears throughout Hofmann's late-career paintings likely came to the attention of Hofmann through its ubiquitous use by early American modernists including Thomas Hart Benton and Arthur Dove,[63] and New York City colleagues Richard Pousette-Dart (1916–1992) and Ellsworth Kelly,[64] what Hofmann called "the might of white."[65]

The study group paintings and palettes from the last year of Hofmann's life provide an incomplete picture of the role of modern paints in the artist's late work. Hofmann's late-career paintings incorporate materials embraced by modernists towards the end of his career—such as the phthalocyanine-based blues and greens popular among second-generation Abstract Expressionists including Richard

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[63] Lance Mayer and Gay Myers*, American Painters on Technique: 1860-1945* (Los Angeles: J. Paul Getty Museum, 2013), 202, 219. See also Justine S. Wimsat, "Wax Emulsion, Tempera, or Oil? Arthur Dove's Materials, Techniques, and Surface Effects," in *American Institute for Conservation Preprints of the 10th Annual Meeting, held in , Milwaukee, Wisconsin, May 26-30, 1982* (Washington, DC: AIC, 1982),

183-88, and "AXA Equitable Donates America Today, Thomas Hart Benton's Epic Mural Cycle Celebrating Life in 1920s America, to Metropolitan Museum" Metropolitan Museum of Art press release dated December 11, 2012.

[64] David A. Miller, "Genesis and Metamorphosis: Materials and Techniques." In Robert Hobbs and Joanne Kuebler, *Richard Pousette-Dart* (Bloomington, IN: Indiana University Press, 1990), 168. See also Louise Wijnberg et al., "A Study of the Grounds used by Three Post-War American Artists (1954-1975): Barnett Newman, Ellsworth Kelly and Brice Marden," in *Preprints of the 16th ICOM-Committee for Conservation triennial meeting in Lisbon, Portugal, 19-23 September 2011*, eds. Janet Bridgland and Catherine Antomarchi (London: The International Council of Museums – Committee for Conservation, 2011), CD-ROM. See also Lawrence Campbell, "Blaine Paints a Picture," *Art News* 58(4) (May 1959): 38-41, 61-62. Ellsworth Kelly lived in Paris for six years but moved back to NY by 1954.

[65] Loose notepage, handwritten and undated. Hofmann Papers.

Diebenkorn[66]—but while such contemporary pigments[67] appear regularly in works produced during the last decade of Hofmann's life, it is difficult to ascertain the artist's relationship to the very late additions to his palette. Some colors appear so late in Hofmann's work that it is impossible to determine their impact on the artist. The rhodamine-based magenta paints identified on Hofmann's studio palettes, for example, may reflect popular interest in rose-colored alizarin alternatives shown by colleagues including Stuart Davis and John Ferren,[68] but the absence of rhodamine pigment in any of the study group paintings leaves the question of its overall importance open to debate. The absence of alizarin pigment in study group paintings from the last year of Hofmann's life makes it tempting to associate rhodamine with the "rose-red lake[s]" observed by Lawrence Dinnean in Hofmann's late works,[69] but without definitive

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[66] Herschel B. Chipp, "Diebenkorn Paints a Picture," *Art News* 56(3) (May 1957), 46.

[67] Phthalocyanine-based pigments entered industrial production by E. I. du Pont Nemours & Company, Inc in the United States in 1936. Phthalocyanine blue was introduced in Winsor & Newton's artist's paints in 1937 and phthalocyanine-based green appeared in Winsor & Newton's artist's paints in 1939. Phthalocyanine-based colors appeared in Talens N. V.'s Rembrandt paint series in 1940. Matthijs de Keijzer, "The History of Modern Synthetic Inorganic and Organic Artists' Pigments," in *Contributions to Conservation: Research in Conservation at the Netherlands Institute for Cultural Heritage,* ed. Jaap A. Mosk and Norman H. Tennant (Amsterdam: ICN, 2001), 51-52.

[68] Dorothy G. Seckler, "Stuart Davis Paints a Picture," *Art News* 52(4) (June-August 1953), 74. See also Lawrence Campbell, "Ferren Paints a Picture," *Art News* 52(10) (February 1954), 35. The quinacridone-based rose-colored paints mentioned in the articles—Rembrandt Rose (Davis) and Shiva Rose Red (Ferren)—are among several alizarin alternatives that were introduced in the late 1950s and early 1960s. See de Keijzer, "The History of Modern Synthetic Inorganic and Organic Artists' Pigments," 52. See also Suzanne Quillen Lomax, "Phthalocyanine and Quinacridone Pigments: Their History, Properties and Use," *Reviews in Conservation* 6 (2005): 19-29.

[69] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 16.

identification of this pigment in any study group paintings no hypotheses can be made regarding the future of rhodamine pigments in Hofmann's compositions. The late appearance of such materials suggests their consideration by Hofmann but do not imply a position among the artist's chosen materials.

Hofmann's palette gathered from his personal modernist timeline just as Hofmann's compositions synthesized and advanced formative innovations in late nineteenth- and early twentieth-century painting. Hofmann's materials did not direct his message, but were no less critical to his modernist vision. Hofmann's palette did not guarantee the success of his compositions, but its absence would have ensured failure.

Hofmann's Manipulation of Materials

Hofmann achieved a freedom of expression through a single painting medium and limited range of color that led to unprecedented explorations of abstract composition. "We revere Hofmann," Frank Stella later wrote, "for proving that the straightforward manipulation of pigment can create exalted art."[70] Each component of Hofmann's late-career palette was necessary to his signature style just as the materials used in each painting appear focused on the task at hand. Through a limited palette, Hofmann's mastery of the essential was carried from means to message. "An idea can only be materialized with the help of a medium of expression" Hofmann asserted, "the

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[70] Frank Stella, "The Artist of the Century," *American Heritage* 50(7) (November 1999): 14.

inherent qualities of which must surely be sensed and understood in order to become the carrier of an idea."[71]

Limited Color

The colors identified in the study group paintings advance the exploration of color relationships that defined Hofmann's career. While a wide range of colors were incorporated into early works including *Ecstasy* and *The Third Hand* (both 1947), an equal array of color relationships are explored in later works such as *Combinable Wall I and II* (1961) using only a limited number of pigments (see figures 3.1 and 4.15). As noted above, scientific analysis of primary, secondary, and tertiary shades of the red, yellow, blue, and green paints in *Combinable Wall I and II* reveals a palette built largely on three pigment families—cadmium, phthalocyanine, and ultramarine—modified through the addition of semi-transparent pigment extenders (see SEM-EDS and XRD sections above). The multiple colors perceived by the viewer in *Combinable Wall I and II* are the effect of neighboring colors, much like the tonal effects described two years later by Josef Albers in his teaching manual *The Interaction of Color*.[72] Hofmann's use of color, however, goes beyond the interactions observed and

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[71] Hans Hofmann, "Excerpts from the Teaching of Hans Hofmann," in *Search for the Real and Other Essays*, eds. Sara T. Weeks and Barlett H. Hayes, Jr. (Cambridge and Andover, Massachusetts: The M.I.T. Press and the Addison Gallery of American Art, 1948), 64.

[72] Josef Albers, *The Interaction of Color* (New Haven and London: Yale University Press, 1963). A boxed set of demonstration materials related to Albers's theories was also produced that year.

catalogued in his fellow teacher's "laboratory course."[73] The dimensional appearance of the colored rectangles in *Combinable Wall I and II* is created through Hofmann's manipulation of color interactions to activate and energize the picture plane. "It is not the form that dictates the colour," wrote Hofmann. "It is the colour that makes the form."[74] Another step in Hofmann's exploration of color is apparent in the 1964 painting *Silent Night* (figure 4.16). Scientific analysis of the materials in *Silent Night* identified the largest number of disparate pigments utilized by Hofmann in any of the study group paintings, yet the composition is an exploration of primarily two colors: yellow and blue. In the progression from the shaded colors of *Combinable Wall I and II* to the bold hues of *Silent Night,* Hofmann's study of the relationship between colors advanced to the study of relationships within color:

> [The] continuity of color development is achieved through successful, successive development of the color scales. . . . [and] the rhythmic development of the red scale differs from that of the blue scale, of the yellow scale, etc. . . . Whereas in tonal painting neighborhood relations are achieved through dark-and-light transitions, in pure painting [there is] rhythmic interweaving of the color scale.[75]

The geometric forms of both *Combinable Wall I and II* and *Silent Night* showcase the important role Hofmann's controlled color plays in his exploration of the picture plane. "To create with pure color should be your aim," Hofmann told his

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[73] Josef Albers, "On Teaching Color," in *The Interaction of Color* (New Haven and London: Yale University Press, 1975, rev.), 69.

[74] Loose notepage, handwritten and undated. Hofmann Papers.

[75] Hans Hofmann, "The Color Problem of Pure Painting—Its Creative Origin," in *Hans Hofmann: New Paintings, November 7 - December 3, 1955* (New York: Kootz Gallery, 1955), 2.

students. “The color should not be an ornament. The color should be a creative element of the painting.”[76]

Figure 4.15 (left): Detail of different extenders mixed with similar pigments in Hans Hofmann, *Combinable Wall I and II.* Figure 4.16 (right): Hans Hofmann, *Silent Night*, 1964, oil on canvas, 84.0 x 78.3" (213.4 x 198.9 cm.). Gift of Hans Hofmann, collection of the University of California Berkeley Art Museum and Pacific Film Archive (1965.5). Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These images illustrate the effects Hofmann achieved through the use of the same pigment modified with semi-transparent extenders (left) and a palette exploring primarily two colors through the use of a wide variety of pigments (right).

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[76] “Hofmann Lecture No. VI,” 9. Typescript of Winter 1939-1940 lecture series. Lillian and Frederick Kiesler Papers, [circa 1910]-2003, bulk 1958-2000, Archives of American Art, Smithsonian Institution.

Hofmann limited, but did not discount, the use of mixed color in his late-career paintings. "Pure color means not at all that the color should be used unbroken or unmixed," Hofmann told his students. "Pure color means only that the colors are properly related that they give a power to each other that they have not in themselves."[77] Nonetheless, Hofmann's mixed paints generally display their constituent colors (figure 4.17), as do the muddied streaks of works such as *Memoria in Aeternum* (figure 4.18).


Figure 4.17 (left): Detail of Hans Hofmann, *The Clash.* Image courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Figure 4.18 (right): Detail of mixed/wiped paint in Hans Hofmann, *Memoria in Aeternum*. Image courtesy of the Museum of Modern Art. Images used with permission of the Renate, Hans & Maria Hofmann Trust. Hofmann's mixed paints generally display their constituent colors whether the paint is applied heavily (left) or in thin washes (right).

[77] "Lecture V," 12. Marginal written note ""Winter 1939 Given at Hans Hofmann School of Fine Arts Paid series of lectures open to the public." Lillian and Frederick Kiesler Papers, [circa 1910]-2003, bulk 1958-2000, Archives of American Art, Smithsonian Institution.

This muddied blend of pigments may have occurred when Hofmann dragged a wet, paint-soaked piece of gauze across the canvas, a practice described by Elaine de Kooning in 1950.[78] According to Wolf Kahn, muddied tones were also manufactured from a day's unsuccessful paintings. Kahn recalled that Hofmann often scraped wet paint from discarded compositions and saved it in wax paper for later use. "That's my favorite color," Hofmann told Kahn, "because I use it as a contrast against bright new color. . . . I call that the *Scheisse*."[79]

A less overt use of mixed color appears in a group of paintings Hofmann produced between 1959 and 1964, including *Ruby Gold* and *Indian Summer* (see figures 3.3 and 3.4), *Combinable Wall I/II*, and *Silent Night*. These paintings are distinguished from Hofmann's other works of the same period not only by strongly geometric compositions, but also by what appears to be the related use of localized preparatory layers. In these few works warm colors are painted over a layer of white alkyd paint while cool colors are applied over a layer of mixed black and pthathlocyanine green oil paints. The black and phthalocyanine mix is applied directly onto the canvas, resulting in a support layer that alternates between alkyd- and oil-based materials (figure 4.19). In addition, there is no ground application beneath some orange paints in *Ruby Gold* and *Indian Summer;* this creates localized voids in the

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[78] Elaine de Kooning, "Hofmann Paints a Picture," *Art News* 48(10) (February 1950): 58-59.

[79] Interview with Wolf Kahn conducted October 26, 1998 by Tina Dickey. Cited in Dickey, *Color Creates Light*, 243. Kiesler and others recount Hofmann's fastidious cleaning practices; Dickey notes that Wolfegg would also slip into Hofmann's studio to clean brushes when he was away. Kiesler, interview with Cynthia Goodman, 4-5. Dickey, *Color Creates Light*, 310. *Scheisse* translates roughly as "shit" in English.

patchwork ground application.[80] Like Hofmann's late-career switch to alkyd ground and priming materials, this period of experimental ground layer application has direct correlations to condition issues in the artist's work (discussed later in this chapter in "The Relationship Between Condition Issues and Hofmann's Use of New Materials").

Figure 4.19: Detail of localized black and white ground layers in Hans Hofmann, *Combinable Wall I and II*. Image used with permission of the Renate, Hans & Maria Hofmann Trust. An example of the alternating ground colors in a handful of paintings produced by Hofmann between 1959 and 1964. Warm colors are painted over a layer of white alkyd paint while cool colors are applied over a layer of mixed black and pthathlocyanine green oil paints.

Limited Paint Media

Hofmann's use of new paint media was limited. As noted previously, only alkyd paints appear alongside the oil-based artist's tube colors utilized in Hofmann's late-career paintings. Despite Hofmann's wholesale adoption of alkyd ground layers in the 1950s, the appearance of these industrial paints in Hofmann's compositional layers

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[80] Localized voids were not visible in *Combinable Wall I and II* and *Silent Night*, but may exist.

is restricted to a small number of works produced over a three-year period. Thomas Learner and Jo Crook have suggested that a limited range of artist's alkyd colors played a role in the paint media's relative absence in mid-twentieth century art,[81] yet commercial house paints were commonly used as priming materials by Abstract Expressionist painters such as Jackson Pollock, Franz Kline, and Barnett Newman,[82] and colored industrial alkyds played a prominent role in the drip paintings of contemporary artists including Janet Sobel (1894-1968) and Pollock, who according to Susan Lake was "taking full advantage of the relatively new alkyd-resin paints by 1949."[83] Given the availability and interest in industrial paint media among Hofmann's colleagues and Hofmann's adoption of modernist color, the relative scarcity of alkyd paint in Hofmann's compositions is likely an intentional restriction.

Only three of the study group paintings include alkyd paint in their compositional layers. The alkyd paint appears in the form of a black splash, either in the foreground or background. Four of the study group paintings include areas of splashed black oil paint: *The Vanquished* and *Bald Eagle* (both 1959), *Tormented Bull* (1961) and *Heraldic Call* (1962). Analysis of materials from these paintings shows

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[81] Crook and Learner, *The Impact of Modern Paints*, 21.

[82] See Rogala et al., "Condition Problems Related to Zinc Oxide Underlayers" and Wijnberg et al., "A Study of the Ground used by Three Post-War American Artists (1954-1974): Barnett Newman, Ellsworth Kelly and Brice Marden."

[83] Susan Lake et al., "A Technical Investigation of Paints Used by Jackson Pollock in His Dripped or Poured Paintings," in *Modern Art, New Museums: Contributions to the 20th International Institute of Conservation Congress in Bilbao, 13-18 September 2004*, eds. Ashok Roy and Perry Smith (London: IIC, 2004), 140. There is no documentation regarding whether or not Pollock was aware of DuPont's mid-1930s shift from nitrocellulose- to alkyd-based binders made in their Duco paints.

that the black splash of *The Vanquished* is composed entirely of oil paint, while splashes on the remaining paintings include both oil and alkyd paints. Just as Hofmann's white alkyd grounds do not preclude his use of white oil paint—zinc white oil paint appears in the compositional layers of all the study group paintings except *Heraldic Call*—Hofmann's use of both alkyd and oil black paints is not arbitrary. These mixed-media splashes are artifacts of transition, evidence of Hofmann's attempts to adapt the effects of another paint material to the conditions imposed by his oil-based palette. The black splash of *The Vanquished* (see figure 3.7) is an extension of the splashed ink noted by Rockwell in the artist's earlier work,[84] but the thick, wrinkled surface of the puddled oil paint (figure 3.21) cannot mimic ink's flat, opaque surface. Thinned applications of oil paint in Hofmann's subsequent "splash" paintings are no substitute for the color intensity and the surface characteristics of their alkyd counterparts (figures 4.20 and 4.21).

Black paint—both oil and alkyd—disappears from the background of the study group paintings after 1962, replaced by the alizarin washes and splashes of *Magnum Opus, Polyhymnia,* and *The Clash* (figure 3.8). Black played only a limited role in Hofmann's late-career compositions outside of the splash experiments and disappeared entirely from the artist's palette shortly thereafter. No black pigments appear in any of the study group paintings after 1963 and for the rest of his life Hofmann worked in exclusively oil-based compositional colors. In abandoning both alkyd paints and black pigments from his compositional layers, Hofmann's late paintings regain the vibrant, bold palette at the core of the artist's work.

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[84] Rockwell, "Conservation Problems Present in Paintings by Hans Hofmann," 4.


Figures 4.20 and 4.21: Details of dripped alkyd paint over (left) and next to (right) brushed black paint in Hans Hofmann, *Bald Eagle*, 1960, oil on canvas, 60.3 x 52.3" (153.2 x 132.8 cm.). Gift of Hans Hofmann, collection of the Berkeley Art Museum and Pacific Film Archive (1964.3). Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. Thinned applications of oil paint lack the color intensity and the surface characteristics of their alkyd counterparts.

Handling characteristics may also have played a role in limiting Hofmann's use of new paint media. Hofmann's physical painting style relied on the resistance of a solid material, "address[ing] the picture surface as a responsive rather than inert object," recalled Greenberg, "and painting itself as an affair of prodding and pushing, scoring and marking, rather than simply inscribing or covering."[85] Alkyd paints dried quickly and spread out into thin paint films, characteristics ill-suited to the oil painting technique of Hofmann and colleagues such as Robert Motherwell, who found his traditional painting practices challenged by the new paint media:

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[85] Clement Greenberg, *Hans Hofmann* (Paris: Editions Georges Fall, 1961), 24. Greenberg is talking about Hofmann advancing the physical technique of painters such as Paul Klee and Chaïm Soutine.

> If you are working with a half a dozen buckets of liquid – like house paint on the floor, the options of mixing not only are less seductive, in a way they are more a pain in the neck . . . the liquidity to begin with means that one can't be involved in nuances of thickness or manipulating it with one's hands. . . . It becomes much more artificial to nuance with buckets of paint.[86]

Instead of adapting his practices to accommodate the new paint media, Hofmann stretched the boundaries of his established palette to explore contemporary painting styles. No mere reflection of modern method, Hofmann's adaptation of advancing art practice advanced his own painting technique. The alizarin-splashed backgrounds of *Magnum Opus* and *Polyhymnia* (figures 4.22 and 4.23), for example, show close allegiance with the stained canvases of Mark Rothko and Helen Frankenthaler from the same period, but Hofmann's use of white grounds and saturated oil washes distilled and emboldened the message of his colleagues' unprimed canvases and muted acrylic paints. "When he made those very turpentiney paintings," recalled Frankenthaler, "it was as if he were saying, "I'll fix you, you kid. I'll show you how it's really done.""[87] Hofmann's skilled manipulation of paint allowed him to explore contemporary style while simultaneously advancing his mastery over a dedicated palette of materials.

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[86] Robert Motherwell, interview on July 11, 1988 in Provincetown. Transcript at the William Benton Museum of Art. Cited in Mary Anne Caws, *Robert Motherwell: With Pen and Brush* (London: Reaktion Books Ltd, 2003), 114.

[87] Julia Brown, "A Conversation: Helen Frankenthaler with Julia Brown, Spring-Fall 1997, Connecticut and New York City," in *After Mountains and Sea: Frankenthaler 1956-1959* (New York: Solomon R. Guggenheim Foundation, 1998), 31.

 

Figure 4.22 (left): Hans Hofmann, *Magnum Opus*, 1962, oil on canvas, 84.1 x 78.1" (213.6 x 198.4 cm.). Figure 4.23 (right): Hans Hofmann, *Polyhymnia*, 1963, oil on canvas, 72.1 x 60.3" (183.1 x 153.2 cm.). Gifts of Hans Hofmann, collection of the Berkeley Art Museum and Pacific Film Archive (1963.7 and 1964.1). Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These images illustrate how Hofmann explored the effect of the acrylic-stained unprimed canvases of Mark Rothko and Helen Frankenthaler while retaining his own dedication to bright white ground layers and bold oil-based paints.

Hofmann's late-career palette was the springboard from which the artist achieved his most innovative compositions. By restricting his materials, Hofmann delved deeper into the essential components of painting. "Plastic creation asks for feeling into the essentuality[sic] of nature as well as for feeling into the essentuality of the nature of the medium of expression," wrote Hofmann. "The plastic experience gained by the former must be transformed into the plastic language of the other."[88]

[88] Hans Hofmann, untitled statement dated New York, May 1, 1951. Typescript, Hofmann Papers.

In a 1966 compilation of essays entitled *The Anxious Object*—dedicated to Hofmann shortly after the artist's death—Harold Rosenberg ruminated on the rewards of focused practice:

> Instead of solving his problem—'his' because he has chosen it—the artist lives it through the instrumentality of his materials. By fixing his idea in matter . . . he is led to experiment and refinement. In time, he becomes so adept in materializing his hypotheses, and in manipulating his materials as if they were meanings, that the problem itself is transformed.[89]

Hofmann's art practice melded medium and message and in doing so the artist foreshadowed a dialogue central to subsequent modern art practice. "Hofmann somehow recognized the advanced, process-driven art of the early sixties," Stella noted. "[He] helped make the greatest change in twentieth-century art both possible and successful."[90] It is no coincidence that the first steps towards T. J. Clark's "Defense of Abstract Expressionism" were taken at a lecture in front of the Hofmann collection at the University of California Berkeley. "What matters is Abstract Expressionist paint is once again a medium," Clark told the audience. "What matters is the ability of this painting to retrieve the process of painting, and its bare material condition as a fact worth painting."[91]

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[89] Harold Rosenberg, *The Anxious Object: Art Today and Its Audience* (New York: New American Library, 1966), 22.

[90] Stella, "The Artist of the Century," 16, 17.

[91] T. J. Clark, transcript of lecture to celebrate the reinstallation of the Hofmann paintings at the Berkeley Art Museum and Pacific Film Archive, museum education department files, n.p. This lecture is the starting point for Clark's essay "In Defense of Abstract Expressionism," published in *October* 69 (Summer 1994) and in a revised format in *Farewell to An Idea: Episodes from a History of Modernism* (New Haven and London: Yale University Press, 1999).

The Relationship Between Condition Issues and Hofmann's Use of New Materials[92]

Understanding Hofmann's use of materials is also the key to preserving his legacy. While Hofmann's late-career works exhibit many condition issues common to other oil paintings on canvas, there are a handful of instances where condition issues arise in combination with specific materials in Hofmann's palette. These issues appear in conjunction with Hofmann's use of new, mid-twentieth-century paint media and pigment formulations. An unexpected incompatibility of commonly used material and method is responsible for the recurring examples of lifting paint, canvas distortion, and efflorescing paint layers in Hofmann's late-career paintings.

White Paint and Ground Materials

Hofmann's use of zinc white paints and alkyd ground layers directly impacts the condition of his late-career paintings. The alternating heavy paint layers, underbound washes, and splashed enamels of Hofmann's signature works place unusual stress on the white paint and ground layer materials favored by Hofmann and his colleagues.

Weak pigment matrices and engineered failure mechanisms inherent in the bright zinc-based white paints favored by mid-twentieth century artists made these materials ill suited to use as a fine art material. My previous research in collaboration with conservators and scientists from the Smithsonian Institution and the National Gallery of Art, examined the drying mechanism of zinc oxide oil paints and determined that the stiff and brittle qualities of zinc oxide paints are not suited to the

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[92] Condition issues common to works on canvas were outlined in Chapter Three (see "Condition issues in Hofmann's late-career paintings").

flexible and load-bearing requirements of Abstract Expressionist paintings. This research and the related historical literature search have been described in articles in the *Journal of the American Institute for Conservation* and proceedings from the *Materials Research Society* and the *American Institute for Conservation of Historic and Artistic Works*.[93] Zinc oxide attains a lamellar distribution in oil medium wherein layers of fatty acid chains lie between layers of fatty acid carboxyl groups and the zinc matrix. This layered structure makes the paint very stiff and difficult to oxidize. Consequently, unsaturated fatty acids in zinc oxide paint remain trapped within the paint layer years after oxidation of the paint should have been completed. The paint has prematurely "frozen" into position, without the structural stability afforded by the cross-linking that would accompany the natural drying process. Rather than constituting a well-formed paint layer consisting of a uniform cross-linked network, a zinc oxide-containing paint consists of a collection of plate-like layered "islands" prone to separation and internal (intralayer) cleavage of the paint layer.[94] The problems with this less-toxic replacement for lead white were not unknown. Much of the early literature, such as G. Petit's 1907 treatise *The Manufacture and Comparative*

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[93] Dawn Rogala et al., "Condition Problems Related to Zinc Oxide Underlayers: Examination of Selected Abstract Expressionist Paintings from the Collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution," *Journal of the American Institute for Conservation* 49(2) (Fall/Winter 2010): 96-113. Christopher Maines et al., "Deterioration in Abstract Expressionist Paintings: Analysis of Zinc Oxide Paint Layers in Works from the collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution." Dawn Rogala, "Industrial Literature as a Resource in Modern Materials Conservation: Zinc Oxide House Paint as a Case Study," in American Institute for Conservation Paintings Specialty Group Postprints, Philadelphia, Pennsylvania, May 31-June 3, 2011 (Washington, DC: AIC, in press), 78-90.

[94] Rogala et al., "Condition Problems Related to Zinc Oxide Underlayers."

Merits of White Lead and Zinc White Paints, reflected a marketplace wary of the new material, and warned that "Zinc white covers poorly. It dries poorly. It stands the weather badly."[95] Within two years technical manuals were warning against the use of zinc white paint as a support layer for other paints,[96] a problem later seen in the work of Pre-Raphaelite artists who used zinc paint as a ground layer.[97] Problems inherent in paintings with zinc oxide ground layers were exacerbated in the mid-twentieth century by the appearance of ineffective house paint formulations of zinc oxide marketed during the period when Hofmann and his colleagues experimented with house paint grounds. The shift from lead- to zinc-based white house paint stymied industrial paint manufacturers. At 1949 Oil & Colour Chemists' Association symposium devoted entirely to zinc oxide house paint, representatives of the Zinc Pigment Development Association helpfully noted that while "zinc fails by checking and cracking with flaking . . . and erosion which seems fairly severe," the industry was optimistic that "paints containing zinc pigments have, however, a natural useful life of at least three and a half years."[98] Additionally, engineered paint film behaviors favored by

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[95] G. Petit, *The Manufacture and Comparative Merits of White Lead and Zinc White Paints*, trans. D. Grant (London: Scott, Greenwood & Son., 1907), 84.

[96] E. Täuber, "Cracks in the surfaces of oil paintings," *Chemiker-Zeitung* 33(10) (1909): 85-86, 33(11): 94-95.

[97] See Joyce H. Townsend, Jacqueline Ridge, and Stephen Hackney, *Pre-Raphaelite Painting Techniques*, 1848-56 (London: Tate Publishing, 2004).

[98] R. W. Bailey and A. Pass. 1953. "Comparative Exposure Tests on Typical Exterior Paint Formulations Containing White Zinc Paints," *Journal of the Oil & Colour Chemists' Association* 36: 183, 171. This article is a reprint of the paper presented at the 1949 symposium.

house paint manufacturers did not serve the needs of the modern artists using their materials. In a presentation at the same 1949 conference, for example, paint chemist J. R. Rischbieth, applauded the widespread use of acicular zinc pigment, selected for the resultant micro-fissuring qualities in the paint film that were favorable to the house paint industry but weakened the already fragile film structure of the zinc oxide grounds in Abstract Expressionist paintings.[99] Early house paints such as those used by Hofmann and his colleagues were not formulated for long-term stability. Frequent statements in the contemporaneous literature confirm that while zinc oxide was considered a poor film-former, the industry requirements for durability differed significantly from those of the modern artist. "A white house paint possesses real merit," noted New Jersey Zinc Company representative S. Werthan, "if it maintains a . . . surface free of significant film failure for a period of three years."[100] Early house paint manufacturers were also aware of the problems posed by layering zinc oxide house paint with other paint materials. "In the aim of developing a better primer it is possible that too little thought has been given as to how this primer might work under the different finishing paints," noted F. C. Schmutz in a 1935 article for *Paint, Oil, and Chemical Review*. "In some cases there is a marked increase in checking and cracking of the finishing coats and in others an actual decrease in adherence of the

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[99] J. R. Rischbieth, "Weathering Tests on Zinc Oxide Paints," Postprints from the Zinc Oxide Symposium of the Victorian Branch (Australian Section) of the Oil & Colour Chemists Association in Melbourne on June 6, 1949. Printed in *Paint Notes: A Journal of Paint Technology* 4(7-8): 225-237.

[100] S. Werthan, "Post-war Exterior House Paints," *Paint, Oil & Chemical Review* 110(April 3, 1947): 38.

whole system."[101] This type of historical literature sheds light on the widespread condition problems observed in the zinc oxide paint layers of modern paintings. For example, all 18 of the Abstract Expressionist paintings that exhibited severe paint layer failure in the previously mentioned study were found to have zinc oxide grounds or underlying layers of compositional zinc oxide paint[102] and all of the paintings in the current study group with zinc oxide paint layers have exhibited cracking and cleaving paint (see table 3.2). Historical literature on zinc oxide has entered the conservation research canon as a result of recent publications by conservators including Rogala and Gillian Osmond.[103]

The white alkyd house paint formulations also popular with Hofmann and his Abstract Expressionist colleagues avoid the problems associated with zinc oxide pigment but exhibit other characteristics ill suited to fine art materials. In the mid-1950s, heavily bulked mixes of titanium dioxide pigment replaced zinc oxide in American house paint formulations.[104] The transparency of titanium dioxide in oil binders had previously relegated the inexpensive pigment to use as an extender or filler material in artist's oil paints, but titanium dioxide alkyd formulations provided industrial paint

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101 F. C. Schmutz, "Primers for Exterior House Paints," *Official Digest – Federation of Paint & Varnish Production Clubs* 141(1935): 356. Like Werthan, Schmutz was also a representative for the New Jersey Zinc Company.

102 Rogala et al., "Condition Problems Related to Zinc Oxide Underlayers."

103 Dawn Rogala, "Industrial Literature as a Resource in Modern Materials Conservation," and Gillian Osmond, "Zinc White: A Review of Zinc Oxide Pigment Properties and Implications for Stability in Oil-Based Paintings," *Australian Institute for the Conservation of Cultural Material Bulletin* 33 (2012): 20-29.

104 Rogala, "Industrial Literature as a Resource in Modern Materials Conservation," 80.

manufacturers with economical house paints less vulnerable to the wide-ranging climate of the American market. Zinc oxide-containing house paints continued to be manufactured for milder European climates[105]—Hofmann and his American colleagues may not have known that a new pigment had appeared in their white paints.

Titanium dioxide alkyd paint exhibits failure behaviors similar to those found in zinc oxide oil paints. The high pigment volume concentration endemic to house paint formulations creates a weak paint film[106] exacerbated by the brittle nature of an alkyd paint binder. Studies by conservation scientists including Marion Mecklenburg and Charles Tumosa have shown that alkyd paint films will fail before oil paint films under equal amounts of stress, and in layered structures of oil and alkyd paints, the stress imposed on an alkyd film will transfer to surrounding materials upon failure of the alkyd paint layer. Mechanical stresses on paintings with disparate paint layers can result in widespread failure of the composite structure when the stress of failed paint layers is transferred to equally vulnerable paint films. Recent conservation research—including work by Hagan et al., Moar and Murray, Rogala et al., and Young et al.[107]—noted the

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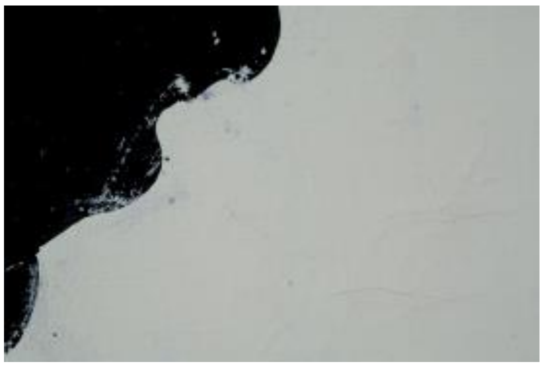
105 Rogala, "Industrial Literature as a Resource in Modern Materials Conservation," 80.

106 Robert Feller, "Critical Pigment Volume Concentration and Chalking in Paints," *Bulletin of the American Group – IIC* 5(4) (1964): 25-26.

107 Eric Hagan et al.,"Factors Affecting the Mechanical Properties of Modern Paints," in *Modern Paints Uncovered*, ed. Thomas J. S. Learner (Los Angeles: Getty Conservation Institute, 2007), 227-35. Yonah Maor and Alison Murray, "Delamination of Oil Paints on Acrylic Grounds," in *Materials Issues in Art and Archaeology VIII: Symposium held November 26-30, 2007, Boston, Massachusetts*, Materials Research Society Symposium Proceedings 1047, eds. Pamela B. Vandiver et al. (Pittsburgh, PA: Materials Research Society, 2008), 127-36. Rogala et al., "Condition Problems Related to Zinc Oxide Underlayers," and Christina Young et al., "The Physical Properties of Modern Commercially Available Primings and their Interaction with Subsequent Paint Layers," in *Modern Art, New Museums*, 244.

media incompatibility problems resulting from the use of disparate binding materials by Hofmann and his Abstract Expressionist colleagues. An example of this phenomenon in the study group paintings is the early and ongoing cracking of layered zinc and alkyd priming materials in Hofmann's 1961 painting *Tormented Bull* (figures 4.24 and 4.25).

Figures 4.24 and 4.25: Detail of cracking priming layer in Hans Hofmann, *Tormented Bull*, photographed in normal (left) and oblique (right) light. Images courtesy of the University of California Berkeley Art Museum and Pacific Film Archive. Images used with permission of the Renate, Hans & Maria Hofmann Trust. Oblique light highlights the widespread cracking of an alkyd priming layer painted over a commercially applied ground; the cracking of alkyd ground layers is usually obscured by compositional paint.

What is significant about problems in the ground layers and compositional white paints used by Hofmann and his colleagues is the unexpected results of combining Abstract Expressionist painting method with the painting materials commonly used by these artists. Zinc oxide paint and alkyd house paint were not engineered for the load-bearing function historically fulfilled by lead white artist's paints, but these new paints were popular choices from among limited alternatives as lead paint left commercial manufacture. The problems inherent in Hofmann's choice of preparatory materials are compounded in those instances where Hofmann used multiple ground layer materials. The different drying and absorption characteristics of Hofmann's oil and alkyd paints directly contribute to the localized distortions present in works such as *Ruby Gold*, *Indian Summer*, *Combinable Wall I and II*, and *Silent Night*. Differences in the expansion-contraction process during oxidative drying of the paints can distort the picture plane and place additional stress on individual paints and bonds among paint layers. Localized binder loss in compositional paints that span both saturated (oil) and absorbent (alkyd) grounds can also physically distort the paint layers through uneven drying (see Chapter Three, Condition Issues in Hofmann's Late-Career Paintings). Localized binder loss may also have been exacerbated by the lack of glue sizing in Hofmann's late paintings, although accounts of this step in Hofmann's practice are inconclusive. While Erle Loran states that Hofmann always sized his canvases and ultraviolet examination by Carolyn Tallent identified fluorescence consistent with glue-based sizing materials on two early study group paintings,[108] accounts by former San Francisco Museum of Modern Art conservator Will Shank state that by the mid-1950s Hofmann's alkyd ground layers replaced earlier glue sizing and gesso preparatory methods.[109] Gaps in alkyd paint left by alternating ground preparation therefore would allow direct contact between oil paint and canvas, leaching binder from the paint layer and exposing the canvas to acidic paint materials. Differences in drying behavior and differences in topography between

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108 According to Erle Loran, Hofmann always sized his canvases. "Notes from one hour interview with Erle Loran, June 1987," courtesy Carolyn Tallent, n.p.

109 J. William Shank's August 1991 condition survey entitled "An Overview of the Structure and Condition of the Hans Hofmann Paintings, University Art Museum, Berkeley, California," 3. Elise S. Haas Conservation Department, San Francisco Museum of Modern Art.

structural oil paint and conforming alkyd paint surfaces place increased stress on the borders where oil and alkyd regions meet and on the canvas and upper paint layers that lay across these borders. The distortions endemic to these paintings are exaggerated as the materials age. The problems of loosening fabric and hardening paint are common to all works on canvas, but the effects of aging are exaggerated in works containing alternating ground layers. The uneven stresses within these paintings increase with the disparate aging of their materials, and with those materials' differing capacities to withstand stress. While many of Hofmann's late-career paintings exhibit canvas distortion, these distortions are particularly pronounced in works with alternating ground layers. Voids in the alternating ground layers in *Ruby Gold* and *Indian Summer* produce the most extreme distortions in the study group (figures 4.26 and 4.27).

Figures 4.26 (left) and 4.27 (right): Detail and overall of Hans Hofmann's *Ruby Gold*, photographed in oblique light. Images courtesy of the Memorial Art Gallery, University of Rochester. Images used with permission of the Renate, Hans & Maria Hofmann Trust. These images illustrate local distortions caused by voids in alternating ground layer materials.

Degradation of Synthetic Colors

Color-specific surface exudates are another notable example of condition problems resulting from a combination of new paint materials and traditional painting technique in Hofmann's work. Unusual drying problems ranging from efflorescing fatty acids to expressed liquid oils have been observed in relation to a specific formulation of alizarin in every study group painting in which that pigment appears. In contrast to dry exudates found in association with other paint colors in Hofmann's late-career work, this particular alizarin paint exudes both dry and liquid exudates decades after the painting's completion. The pigment was identified through analysis (see FTIR section above) as Pigment Red 83, described in *Industrial Organic Pigments: Production, Properties, Applications* as an American-manufactured substitute for natural madder pigment.[110] Recent studies by conservators including Kathleen Martin and Bonnie Rimer have linked chronic efflorescence in alizarin colors with early exposure of paintings to high levels of humidity similar to those found at Hofmann's Provincetown studio,[111] but there may also exist a relationship between Hofmann's use of PR83 and his painting technique. According to *Industrial Organic Pigments* authors Herbst and Hunger, PR83's alkaline-based formulation is overly responsive to "common organic solvents,"[112] a category that may include the benzine (petroleum ether) solvent Hofmann mixed with his paints to speed their

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110 Herbst and Hunger, *Industrial Organic Pigments*, 9.

111 Bonnie Rimer et al., "Investigation of Fatty Acid Migration in Alizarin Crimson Oil Paint in Two Works by Frank Stella," in *American Institute for Conservation Paintings Specialty Group Postprints, St. Louis, Missouri, June 8-13, 1999* (Washington, DC: AIC, 1999), 1-14.

112 Herbst and Hunger, *Industrial Organic Pigments*, 511.

drying in the coastal environs of Provincetown. Traditional painting manuals commonly recommended of benzine as a diluent, particularly when working in situations that slowed the drying of a paint film. "If painting be done in an atmosphere where the humidity is high and the temperature near the dew point," wrote New York City chemist and professor Maximilian Toch in the 1925 manual *The Chemistry and Technology of Paints*, "a great advantage is to be obtained by the moderate use of benzine . . . in brushing on a quick-drying paint containing benzine the evaporation carries with it much of the moisture in the paint."[113] As noted in Chapter Three, there is evidence that Hofmann purchased benzine for his classroom[114] and used the material in his painting practice.[115] "When he uses thin paint," de Kooning noted, "[Hofmann] tilt[s] the canvas one way or another to control the 'runners.'"[116] There is also evidence that Hofmann used benzine when painting outdoors. In a series of letters written to Alice Hodges in the 1940s, Hofmann noted the oppressive weight of his painting supplies. "I can work only in the closest neighborhood," Hofmann complained to Hodges in a letter from Provincetown. "It is the oil painting material

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[113] Maximilian Toch, *The Chemistry and Technology of Paints* (New York: D. Van Nostrand Company, 1925), 269. On the next page Toch notes that "the low price of benzine in America offers a great temptation for its unlimited use."

[114] "SUMMER Course" / Consumable Instructional Supplies for the Period: June 14-September 3, 1948" and "FULL DAY and EVENING Courses / For the Period: January 30-May 28, 1948 (Spring Session) / And October 4-January 28, 1949 (Winter Session) / Consumable Instructional Supplies," Hofmann Papers.

[115] De Kooning, "Hans Hofmann Paints a Picture," 40.

[116] De Kooning, "Hans Hofmann Paints a Picture," 58.

what is so heavy to carry."[117] Hofmann tethered large glass bottles to his easel when painting on the dunes and may have carried solvent in those bottles. It is possible that Hofmann filled empty bottles with seawater to make his ballast, but the burden Hofmann recounts seems unlikely without the large amount of solvents necessary to his practice. "I [have been] only 3 time[s] on the beach," Hofmann wrote near the end of one summer. "The worst is carrying 70-90 pound[s of] material often twice a day over hills up and down."[118] Although conservation and archival accounts of the study group paintings report increased levels of exudation in heavily-thinned applications of PR83 in the study group paintings,[119] a finding that is in keeping with new research on the behavior of modern synthetic pigments. At the 2013 symposium *Issues in Contemporary Oil Paint*, for example, conservation scientist Jaap Boon presented new research that links the presence of exudates in modern oil paints with the separation of binding media and pigment (with attendant polar agglomeration of the pigment particles) in response to added solvents.[120] At the same conference, conservator Diana Blumenroth presented her ongoing study of solvent sensitivity in synthetic organic

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[117] Letter from Hans Hofmann to Alice Hodges regarding war-time gasoline restrictions, dated July 29, 1943. Lillian and Frederick Kiesler Papers, [circa 1910]-2003, bulk 1958-2000, Archives of American Art, Smithsonian Institution.

[118] Letter from Hans Hofmann to Alice Hodges regarding his health after a hernia operation, dated September 13, 1943. Lillian and Frederick Kiesler Papers.

[119] Yohe also conveyed his observation that thinned alizarin paints were more likely to "weep." James Yohe, phone conversation with the author on December 4, 2013.

[120] Jaap Boon and Frank Hoogland, "Toward an Understanding Dripping Oil Paint in Paintings," and Jenny Schultz et al., "Set Back the Race: Treatment Strategies for Running Oil Paint," in *Issues in Contemporary Oil Paint*, ed. Klaas Jan van den Berg (Amsterdam and Amersfoort: Netherlands Cultural Heritage Agency, in press).

pigments, and categorized PR83 as the most reactive and sensitive pigment of her study group.[121] If a connection exists between Hofmann's use of benzine and condition issues with his late-career alizarin paints, the phenomenon may again be the result of incompatibility between traditional painting practices and newly formulated painting materials. As in Hofmann's use of house paint grounds, the problem of exudates in Hofmann's alizarin paint colors may arise from the expected incompatibility of favored material and method. Hazardous overlaps in accepted practice may also arise in the conservation treatment of these alizarin exudates, which were commonly removed by cleaning with benzine, a conservation solvent considered safe for the testing and removal of exudates.[122]

In summary, Hofmann's late-career paintings are constructed from a selected range of modernist paint materials that reflect the artist's connection to centers of art and materials innovation in the late nineteenth and early twentieth centuries. Hofmann continued to incorporate new paint materials into his work throughout his career, but notable shifts in the materials used in Hofmann's late paintings from those employed in the artist's earlier work are primarily found in his preparatory and support layers—in Hofmann's change from cotton to linen fabric supports and his late-career adoption of alkyd ground layers. Analysis of materials from the study group paintings confirms

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[121] Diana Blumenroth et al., "Sensitivity of Modern Oil Paints to Solvents: Effects on Synthetic Organic Pigments," *Issues in Contemporary Oil Paint*, in press.

[122] Elise S. Haas Conservation Department records, San Francisco Museum of Modern Art. Tallent also notes that benzine was commonly used to test the solubility of exudates. "Investigation of the Painting Materials and Techniques of Hans Hofmann—Preliminary Report." Unpublished fellowship report, dated August 1, 1988. Intermuseum Conservation Association.

published and personal accounts of the artist's almost exclusive use of oil-based paints for his boldly colored compositions. Deviations from Hofmann's oil-based palette include the limited use of alkyd compositional paints, which appear for a brief period in works created shortly after Hofmann retired from teaching. Splashed applications of black alkyd paint appear in Hofmann's works from 1959 to 1962, at which time Hofmann replaced the alkyd splashes with brushy applications of alizarin oil color. The period after Hofmann's retirement is also distinguished by a brief period of experimental ground layer preparation, when a handful of geometric works produced between 1959 and 1964 was executed over localized preparatory layers—regional oil grounds underneath cool colors and alkyd grounds underneath warm colors, with occasional voids in ground beneath orange colors—a technique that does not appear at any other time in Hofmann's late work. Condition issues related to paint application—including the above-mentioned experimental ground technique—are seen throughout Hofmann's late-career work, but condition issues related directly to individual materials appear consistently in association with the artist's use of zinc white oil paint, alkyd paint, and alizarin oil paint. All three of these modern materials perform poorly in response to modern painting techniques or to the functions assigned to the materials by the construction of modern paintings. Zinc oxide paint and alkyd house paint, for example, were embraced by modern artists as alternatives to toxic lead white paints, but neither material was engineered for the load-bearing function historically fulfilled by lead white paints or required by heavy Abstract Expressionist paint layers. Similarly, synthetic alternatives to natural alizarin pigments—such as the PR83 pigment that appears throughout Hofmann's late work—were an improvement over natural alizarin pigments prone to fading and discoloration, but respond poorly to the conditions under which the artists painted and to the additives in common use by those same artists. While these materials behaved as they were designed to behave, and addressed Hofmann's needs at the time of their use, their inherent physical properties are at odds with keeping the works looking as the artist intended.

The goal of this dissertation is to illuminate the role played by paint materials in the creation and preservation of Hofmann's signature works and to clarify the relationship between Hofmann's art practice and the conservation treatment of Abstract Expressionist and later works that incorporate both traditional and modern paint media. In the preceding chapters I provided a brief overview of Abstract Expressionism and the role of new materials in the creation, interpretation, and preservation of Abstract Expressionist painting and explained my selection of Hofmann as an exemplar for Abstract Expressionist practice, reviewed Hofmann's relationship with the avant-garde communities of early twentieth-century Europe and the United States and his exposure to new ideas about art making and art materials, presented the paintings chosen for materials analysis as representatives examples of the artist's work, reviewed published and unpublished documentation of Hofmann's materials and their conservation, and presented my scientific analysis of materials from Hofmann's late-career paintings and discussed the resulting relationships between Hofmann's materials, style, and the aging characteristics of his work.
This dissertation will conclude with an overview of my research, an assessment of Hofmann's relationship to new materials as a reflection of Abstract Expressionist art practice, and a re-evaluation of traditional conservation methodology related to the preservation of modern art, and will close with suggestions for additional avenues of research to contribute to our understanding and preservation of Abstract Expressionist art.

Chapter 5

CONCLUSION: THE LESSONS OF HOFMANN'S LATE-CAREER MATERIALS

> We can call the artist's technical procedure a self-fashioning, a making of self, since it produces or defines the artist as artist as much as it produces the artwork.
> —Richard Shiff, "Performing an Appearance: On the Surface of Abstract Expressionism," 1987[1]

The work of renowned Abstract Expressionist painter and teacher Hans Hofmann (1880-1966) shows us why and how we need to alter our thinking about the study and conservation of modern art. The research presented in the preceding chapters aids our efforts to preserve Hofmann's physical legacy and expands our understanding of Hofmann's role in the modernist communities of Europe and the United States. In positioning Hofmann as part of a modernist continuum, I wish to place modernist materials within that same framework and re-direct our approach to modern art scholarship.

Hofmann's participation in the formative modernist communities of Munich and Paris afforded the artist a central position within the American avant-garde when he arrived in the United States in 1930, and placed Hofmann's schools in New York City and Provincetown, Massachusetts at a primary nexus of experimental painting

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[1] Richard Shiff, "Performing an Appearance: On the Surface of Abstract Expressionism," in *Abstract Expressionism: The Critical Developments*, ed. Michael Auping (New York: Harry N. Abrams Inc. in assoc with the Albright-Knox Art Gallery, 1987), 95.

theory and practice. Hofmann's influence with colleagues, critics, and the thousands of students and teachers who flocked to Hofmann's schools—"as a pilgrim comes to Mecca,"[2] recalled student Nell Blaine—made the Abstract Expressionist painter and teacher simultaneously the influencer and the benefactor of the leading edge of modern American art. In writing of modernism's prospects in 1947, Clement Greenberg asserted that

> Most of the young artists [today] have either been students of Hans Hofmann or come in close contact with his students and ideas. . . . Hofmann will in the future, when the accomplishment of American painting in the last five and the next twenty years is properly evaluated, be considered the most important figure in American art of the period since 1935 and one of the most influential forces in its entire history.[3]

The materials and techniques employed in Hofmann's paintings represent a key moment in the evolution of modern art, a paradigm shift from product to process that influenced subsequent generations of artists. The overt materiality of Hofmann's signature compositions can be seen as a direct link between the representative, nature-based abstractions of the late-nineteenth and early-twentieth century modernists and the conceptual, materials-based process art that rose to prominence after the Second World War. The study of Hofmann's late paintings underscores the formative role that materials studies play in interdisciplinary scholarship, and reveals how the study of physical evidence in historical context informs our preservation and understanding of modern art.

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[2] Nell Blaine, Hofmann Student Dossier: Scrapbook of replies to questionnaires on Hofmann as a teacher by his students [in conjunction with the 1963-64 MoMA exhibition "Hans Hofmann and His Students."]. Museum of Modern Art Special Collections.

[3] Clement Greenberg, "Present Prospects of American Painting and Sculpture." *Art on the American Horizon* 93-94 (October 1947): 29.

Hans Hofmann as a Case Study in the Ramifications of Mid-twentieth Century Painting Practice

Hofmann's late works were created at a pivotal moment in the dialogue between artist and art-making, but the idea that twentieth-century modernist innovators such as Hofmann abandoned traditional painting practice is a myth that works against the study and preservation of their artwork. The comprehensive catalogue of Hofmann's materials presented in this dissertation reveals a primarily traditional palette with only limited incorporation of modern materials. Apart from the artist's adoption of alkyd ground layers and synthetic alizarin pigments, the distinctive visual vocabulary of Hofmann's later years is fashioned largely from traditional artist's oil paints. Many prominent Abstract Expressionist artists employed a similar mix of familiar and experimental materials. Willem de Kooning and Franz Kline, for example, continued to work with traditional artist's oil paints while experimenting with commercial house paints or industrial alkyd coatings.[4] Published descriptions of visits to the studios of de Kooning and Richard Diebenkorn recount "tube oil colors in random piles" found next to "a variety of half-pint cans of oil-based house paint,"[5] and

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[4] Susan F. C. Lake et al., "A Technical Investigation of Willem de Kooning's Paintings from the 1960s and 1970s," in *Modern Art, New Museums*, 381-85; Dawn Rogala et al., "Condition Problems Related to Zinc Oxide Underlayers: Examination of Selected Abstract Expressionist Paintings from the Collection of the Hirshhorn Museum and Sculpture Garden, Smithsonian Institution," *Journal of the American Institute for Conservation* 49(2) (Fall/Winter 2010): 96-113. According to Lake, de Kooning was close friends with sculptor David Smith, who co-managed an experimental materials workshop through which his Abstract Expressionist colleagues had access to new art-making materials. See Susan F.C. Lake, "The Relationship Between Style and Technical Procedure: Willem de Kooning's Paintings of the Late 1940s and 1960s," (PhD diss., University of Delaware, 1999), 395-96.

[5] Herschel B. Chipp, "Diebenkorn Paints a Picture," *Art News* 56(3) (May 1957): 46. See also Thomas B. Hess, "De Kooning Paints a Picture," *Art News* 52(1) (March 1953): 65.

traditional oil paints have also been found in combination with alkyd and acrylic paints in works by Barnett Newman and Ellsworth Kelly.[6] Ad Reinhardt reportedly had no interest in modern paint materials,[7] while Jackson Pollock—despite his well-known affinity for industrial paint formulations—continued to incorporate traditional oil paints in his compositions late into his career.[8]

The mix of new paint materials with traditional materials and painting practices that characterizes Abstract Expressionist painting has a direct impact on the material stability and aging characteristics of artworks from this pivotal art movement. Condition issues in Hofmann's late work appear consistently in association with the artist's use of zinc white oil paint, alkyd paint, and alizarin oil paint. In each of these cases, the modern material chosen by Hofmann behaved according to its design but performed poorly in response to commonly used painting techniques or to the structural requirements of paintings that combined new and traditional art materials.

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[6] Louise Wijnberg et al., "A Study of the Grounds used by Three Post-War American Artists (1954-1975): Barnett Newman, Ellsworth Kelly and Brice Marden," in *Preprints of the 16th ICOM-Committee for Conservation triennial meeting in Lisbon, Portugal, 19-23 September 2011*, eds. Janet Bridgland and Catherine Antomarchi (London: The International Council of Museums – Committee for Conservation, 2011), CD-ROM, 10 pages.

[7] Lucy R. Lippard, *Ad Reinhardt Paintings* (New York: The Jewish Museum, 1966), 26. See also Carol Stringari et al., "Reversal Versus Retirement: Study and Treatment of *Black Painting, 1960-66* by Ad Reinhardt," in *Modern Art, New Museums: Contributions to the 20th International Institute of Conservation Congress in Bilbao, 13-18 September 2004*, Ashok Roy and Perry Smith, eds. (London: International Institute for Conservation, 2004), 165-69.

[8] Susan Lake et al., "A Technical Investigation of Paints Used by Jackson Pollock in His Dripped or Poured Paintings," in *Modern Art, New Museums*, 137-41. See also James Coddington, "No Chaos, Damn It," in *Jackson Pollock: New Approaches*, eds. Kirk Varnadoe and Pepe Karmel (New York: Museum of Modern Art, 1999), 101-16.

Condition issues in Hofmann's work appear in relation to the artist's use of zinc oxide white paint—a popular, less toxic alternative to lead white that proved too stiff and brittle for Hofmann's heavy compositions and physical painting technique—and his 1950s embrace of house paint grounds whose weak pigment matrixes and engineered failure mechanisms were ill suited to use as a fine art material and layering with traditional oil paints. Similarly, Hofmann's preferred synthetic alizarin pigment responded poorly to the conditions under which the artist painted and to additives in common use by period artists. This study of Hofmann's late-career paintings sheds light on an unexplored incompatibility between the new materials associated with Abstract Expressionist painting and the conventional art materials and practices still used by many Abstract Expressionist artists.

The condition problems in Hofmann's work related to the mix of material and method endemic to Abstract Expressionist painting practice should cause us to reconsider the role of materials in the aging and degradation of modern paintings. The history of modern painting includes the gradual incorporation of new materials and it is shortsighted to believe that the physical impact of modern paints lies with anomalous failures in paint formulation, or that an artist's use of modern materials warrants study only when those materials play a prominent role in the artist's technique. The works of Hofmann and his Abstract Expressionist contemporaries set as standard art practice a mixture of techniques and materials that directly impacts the physical stability of works by these painters and their modernist descendents. Some modern materials, such as the PR83 pigment mentioned above, may respond poorly to traditional conservation treatment (in this case, the use of benzine to test and remove exudates). In other cases, the localized treatment methodologies commonly applied by conservators in response to site-specific condition issues in paintings do not take into account the systemic condition problems revealed by this dissertation research to exist in such structurally important components as ground layer materials. Traditional, localized treatment strategies are not sufficient to address the widespread failure of such materials in paintings from this era, condition problems that can propagate and become more severe in response to changing environmental or handling conditions. Modern paintings and painting collections exhibiting localized condition problems should be assessed for the presence of mixed materials and the attendant potential for less visible, widespread condition concerns; modified treatment methodologies should be considered that incorporate overall treatment or overall support materials and limitations on travel and exhibition schedules.

The problem of addressing overall condition issues, however, is not as simple as implementing overall treatment strategies, as treatment methodologies intended to address widespread condition issues must be balanced against the increasing role of physical evidence in art historical study. The future study of Hofmann's regional ground layer applications, for example, is directly affected by those early conservation treatments that eliminated the canvas distortion indicative of alternating grounds, applied overall lining fabrics that block access to the original canvas, and utilized overall lining adhesives that compromise the analysis of ground and canvas materials. In removing our ability to recognize the underlying "compositions" in Hofmann's ground layers, we lose material evidence of technique that could enhance our understanding of the artist's physical and metaphysical processes. Abstract Expressionist materials play a pivotal role in modern art history and conservators should be wary of treatments that limit access to or adulterate information related to era-specific product and process. Two years before Hofmann's death, conservator Caroline Keck told an audience of future conservators that "in preserving all art we have two problems: the continuance of its objective, material, structure and the preservation of its integrity of context."[9] When approaching the conservation of works by Hofmann and his Abstract Expressionist colleagues, conservators must prioritize both the physical and art historical impact of the artists' materials and make decisions that carefully balance the preservation of each object with the preservation of that object's role in future scholarship.

Hofmann's Support of the Modernist Continuum

Hofmann recognized that innovative art is built upon a modernist continuum. Through his schools in Europe and the United States, Hofmann distilled the advances of preceding generations of modern painters while supporting the communal dialogue, education, and experimentation that encouraged new forms of modern art. "We are connected with our own age if we recognize ourselves in relation to outside events," Hofmann told his students, "and we have grasped its spirit when we influence the future."[10] When mural projects in the late 1950s sparked Hofmann's signature painting style and his departure from teaching, the bold color and composition of Hofmann's subsequent, signature works provide a physical link between nineteenth- and

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[9] Caroline Keck, "History and Philosophy of Conservation." *Bulletin of the American Group, International Institute for Conservation of Historic and Artistic Works* 5(1) (October 1964): 1.

[10] Hans Hofmann, "Excerpts from the Teaching of Hans Hofmann: On Standards and Values," *The Search for the Real and Other Essays*, eds. Bartlett H. Hayes, Jr. and Sara T. Weeks (Andover, MA: Addison Gallery of American Art, 1948), 60.

twentieth-century modernism, a continuum recognized by artist Frank Stella, who dubbed Hofmann "the artist of the century":

> [We] see Hofmann reach back to the painting of the past with the act of painting, watch as Hofmann pushes his painting to engage with all the painting of his time, and finally, recognize how, by example, Hofmann thrusts painting into the future.[11]

Hofmann is ultimately an exemplar of modernist spirit—the drive to preserve past lessons while supporting future innovation. Hofmann recognized that modernist ideology does not escape eventual historicism. "Art is for me the glorification of the human spirit," Hofmann noted, "and as such it is the cultural documentation of the time in which it is produced."[12] In a telling gesture of his belief in the value of modernist community, when Hofmann donated forty-seven of his paintings and a quarter of a million dollars to help establish an art museum at the University of California Berkeley, he inserted a unique proviso into the agreement that allowed the university to sell any work from his donated collection in order to purchase art "considered to be avant-garde at the time of such purchase."[13] In this manner, Hofmann ensured his ability to bring avant-garde art to the public long after his own

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[11] Frank Stella, "The Artist of the Century," *American Heritage* 50(7) (November 1999): 16.

[12] Hans Hofmann, in Sam Feinstein, *Hans Hofmann: A Film by Sam Feinstein*, 1950 documentary film (New York: Samuel L. Feinstein Trust, 2008).

[13] Article 8d, "AGREEMENT made and entered into, in duplicate, as of the 27th day of December, 1963, by and between HANS HOFMANN (hereinafter referred to as "Hofmann"), party of the first part, and THE REGENTS OF THE UNIVERSTIY OF CALIFORNIA, a California corporation, (hereinafter referred to as the "University"), part of the second part," 8-9. Hans Hofmann Papers, Bancroft Library, University of California Berkeley.

era was no longer considered avant-garde. While helping to choose works for donation to the university, Samuel Kootz insisted that the collection include the very latest paintings created by Hofmann, but perhaps the artist's valuation of community over ego is a better example of what Kootz called Hofmann's "brilliant present and promising future."[14] Hofmann's last lesson is to restore our understanding of the continuum inherent in modern art—in the community, in the individual artist, in his work, and in his materials. The physical evidence of Hofmann and his modernist colleagues is best appreciated and preserved through our recognition of this continuum.

Overlooked Areas of Modernist Scholarship

The legacy of Hofmann and his colleagues would be well served by the continued study of their materials and practices. The extensive analytical data catalogue developed for this dissertation offers the largest and most comprehensive technical study to date on a single Abstract Expressionist artist and can be mined for more detailed examination of Hofmann's individual materials, or compiled with other technical studies to answer questions regarding changing twentieth-century paint formulations—the post-World War II shift from long-oil to short-oil alkyd paint media or the appearance of substitute materials in response to war-era shortage or surplus, for example[15]—or to contribute to the long-term study of aging behaviors in modern materials. The data provided in this dissertation can also be used to assess other

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[14] Letter, Samuel M. Kootz to Erle Loran, June 8, 1965. Curatorial archives, University of California Berkeley Art Museum and Pacific Film Archive.

[15] See Thomas J. S. Learner, *Analysis of Modern Paints* (Los Angeles: Getty Conservation Institute, 2004). Additives that also function as oil-length markers are discussed on page 18; other period additives are listed on page 19.

patterns of materials usage within the mid-twentieth century New York arts community, particularly patterns that address larger questions about the making and meaning of modern art. One area that has thus far been neglected in technical scholarship is the role of color in the Abstract Expressionist palette.

The innovative use of color is a formative thread throughout modern art. Each of the modernist periods synthesized in Hofmann's late-career paintings is accompanied by artists' embrace—often with concomitant public and critical rejection—of newly developed paint colors. Hofmann's early art lessons, for example, focused on the style of Impressionist painters whose lavish use of new blue and purple pigment formulations caused critics to question whether painting *en plein air* had damaged the artists' perception of color.[16] More innovative, bold paint colors became available during Hofmann's years in Paris as the "restitution" of symbolic color lauded by Matisse in the work of avant-garde Fauvist painters and members of Der Blaue Reiter was greeted with shock and dismay by critics.[17] At the same time, color gained a primary creative function with the emergence of such movements as Orphism and Synchromism. "From its once-secondary position, 'color,'" Guillaume Apollinaire

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[16] See Alfred de Lostalot, "Exposition des oeuvres de M. Claude Monet," *Gazette des Beaux-Arts*, April 1, 1883; reprinted in *La Promenade du critique influent: Anthologie de la critique d`art en France, 1850-1900*, Jean Paul Bouillon et al., ed.s (Paris: Fernand Hazan, 1990), 246-47.

[17] Henri Matisse, "Rôle et modalités de la couleur," in Gaston Diehl, *Les problèmes de la peinture sous la direction de Gaston Diehl* (Paris: Éditions Confluences, 1945), 237. Reproduced as "The Role and Modalities of Colour, 1945," in *Matisse on Art*, ed. Jack Flam (Berkeley and Los Angeles: University of California Press, 1995), 98-100. *Gil Blas* critic Louis Vauxcelles is said to have seen a classical sculpture by Albert Marquet surrounded by the new paintings at the 1905 Salon d'automne and exclaimed "Donatello parmi les fauves!"

wrote at the time, "is no longer used for just coloring . . . color is now itself the form. . . . Color no longer depends on the three dimensions, for it is color that creates them."[18] Color maintained its creative and visual force in the mid-twentieth century in the work of Hofmann and his modernist colleagues. The ability of new color palettes to shock continued unabated. Hofmann's use of color, for example, was compared to military explosions[19] as critics and commentators such as T. J. Clark, Tom Wolfe, and even Greenberg explored what they claimed to be a purposefully ugly use of color that both defined and defended Abstract Expressionism.[20] Yet the primacy of color is rarely discussed in technical scholarship on Abstract Expressionism.

The surge in mid-twentieth century innovation in paint binding media has shifted the focus of art history and conservation scholarship. Technical studies of early modernist movements acknowledge the formative role played by new color formulations, but the industrial and synthetic paint binders that captured popular and

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[18] Guillaume Apollinaire, *The Cubist Painters*, trans. Peter Read (Berkeley: University of California Press, 2004), 69. In this instance, Apollinaire—who coined the term Orphism in 1912—is discussing the work of Hofmann's friend and Orphist painter Robert Delaunay.

[19] Frank Stella, "The Artist of the Century," *American Heritage* 50(7) (November 1999): 14-17.

[20] Greenberg and Wolfe primarily associate Abstract Expressionism's vulgar colors with references to the bourgeoisie, while Clark saw the "vulgarity" of the artists' bourgeois colors as insistently modern. See Clement Greenberg, "Avant Garde and Kitsch," *Partisan Review* 6(5) (Fall 1939): 34-49, and Tom Wolfe, *The Painted Word* (New York: Farrar, Straus & Giroux, Inc., 1975). Clark's October 15, 1992 lecture to celebrate the reinstallation of the Hofmann paintings at the Berkeley Art Museum and Pacific Film Archive was the starting point for the subsequent essay "In Defense of Abstract Expressionism," published in *October* 69 (Summer 1994) and in a revised format in *Farewell to An Idea: Episodes from a History of Modernism* (New Haven and London: Yale University Press, 1999).

critical attention in the mid-twentieth century has all but pushed aside the artists' own emphasis on color. "The color itself is a plastic medium," Hofmann proclaimed. "Color is a complete medium in itself."[21] While new binding media inarguably played a formative role in the work of some Abstract Expressionist artists, it is now clear that many contemporaneous painters relied heavily on traditional materials while creating their work. Conservation and technical analysis focused solely on new paint binders overlooks the parallel advances in color formulation and modernist color that link Hofmann and his colleagues to the rest of art history. By defining modern art history as the appearance of industrial binding media, we break the connections between contemporary art and its influences and replace pivotal movements in modern art history with the myth of the spontaneous genius-artist whose potential contributions fade with his transient fame. The growing compendium of modern art technical studies contains a wealth of information that can be used to look for trends, gaps, and patterns in the use of color by mid-twentieth century modern painters. It would be particularly interesting to see what patterns of color use emerge among the Abstract Expressionist painters and track the evolution of modernist color through Hofmann and his Abstract Expressionist colleagues. Re-building the Abstract Expressionist link in modernist color would be a step towards re-establishing the modernist community Hofmann embodied.

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[21] "Hofmann Lecture No. VII," typsescript, Lillian and Frederick Kiesler Papers, [circa 1910]-2003, bulk 1958-2000. Archives of American Art, Smithsonian Institution. Part of the Winter 1938-39 lecture series attended by Greenberg. Transcript of this lecture also appears as "Lectures on Plastic Painting, Berkely [*sic*] 1931," typescript, n.p. MoMA Archives Special Collections, The Museum of Modern Art, New York.

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Appendix B

EXPERIMENTAL DATA

This appendix contains representative data for all analyses performed on samples from the study group paintings. Information regarding instrumental set up for the analyses is provided below, followed by an overview of the data page organization and layout.

Experimental Conditions

Cross-section Preparation

Samples were positioned on pre-cast epoxy half-tablets and adhered using a small droplet of cyanoacrylate adhesive. The sample and half-tablet are then transferred into a silicon rubber mold for embedding. The epoxy resin, Tra-bond 2113 two-part system, was mixed and poured over the adhered sample and half-tablet. The liquid resin was held at room temperature for one hour, then cured at approximately 45°C for 3 hours. Once de-molded, the tablets were trimmed with a mill to expose the sample. Aluminum oxide abrasive was used to polish the face edge the surfaces using an aliphatic hydrocarbon as a lubricant. (Some samples were dry polished later for FTIR analysis.) 83 of the 284 paint samples presented multilayered stratigraphy and were selected for mounting and analysis as cross-sections.

Microscopy

Samples were viewed on Leica models DMLM and DMRX research microscopes. Both share some components such as objectives and filters. The range of magnification for the reflected light techniques is 50x to 500x, measured at the eyepieces. Objectives are 5, 10, 20, 40, and 50x. Through the use of a prism system, brightfield and darkfield illumination conditions can be alternated. The tungsten halogen lamp is the primary source of reflected light and it is corrected for daylight color temperature using a dichroic mirror. The fluorescence illuminator is either a 100W mercury or a 150W xenon lamp. The filters span the range from ultraviolet to the violet. The Leitz (Leica) filter sets characteristics are provided in Table B.2.

A purpose-built digital camera is used for image acquisition (camera chip dimensions, as well as pixel count, determine ultimate magnification of image). The camera system is a Nikon DMX 1200 24-bit color system. The camera uses the Sony ICX085AK color CCD and Nikon's proprietary Inter Pixel Stepping (IPS) high-density imaging technology. Images are normally captured as 24-bit 1.4Mp tif images, approximately 3.8 Mp each.

Table B.1—Leitz Filters for Fluorescence Microscopy (DMR and DMLM)

Filter System	Excitation	Excitation Filter	Split Mirror	Suppression Filter	Part No.
A	UV	BP 340-380	RKP 400	LP 430	513 804
D	Violet	BP 355-425	RKP 455	LP 460	513 805

BP = band pass filter; RKP = reflection short pass filter; LP = long pass filter

All 284 paint material samples and 28 fiber samples were examined and photographed using both normal and ultraviolet illumination sources. Multilayered paint samples were embedded as cross-sections prior to photography. The remaining paint samples were photographed in their storage vials and subsequently analyzed in their loose form.

Pyrolysis-Gas Chromatography-Mass Spectrometry

Samples were analyzed using a Varian Saturn 2000 GC/MS equipped with a CDS Pyroprobe 2000. Each sample was derivatized using two microliters of tetramethylammonium hydroxide (TMAH) put onto the sample in a quartz boat. The boat was placed into the coiled platinum probe of a CDS Pyroprobe 2000 filament pyrolysis unit, and the probe was then placed into a helium-purged CDS 1500 Valved Interface attached to the Varian GC. The interface was held at a constant 310°C and purged with helium for 10 seconds before opening the valve to the GC column. The sample was then heated with the pyroprobe to a temperature of approx. 600°C for 10 seconds. The pyrolysis products were transferred directly to a capillary column (ZB-5ms; 30 m x 0.25 mm i.d.; 0.25 micron film thickness; He flow of 1.2 ml/min; splitless.) in a Varian 3800 gas chromatograph (GC) equipped with electronic flow control. The GC oven was programmed with an initial temperature of 30°C, which was held for 5 minutes. The temperature was increased at a rate of 10°C per minute to 300°C and held for 10 minutes. The Varian 3800 GC was interfaced to a Varian Saturn 2000 ion trap, the transfer line being held at 270°C. Operating conditions for the trap were: trap 150°C, manifold at 80°C; electron multiplier 1500 V; scan range 45-650 amu; scan time 1 second; data analysis Saturn GC/MS Workstation 6.5 software and the NIST 2005 spectral libraries.

GC-MS binding media analysis was performed on a total of 106 discrete paint samples. Samples of Hofmann's materials selected for Py-GC-MS analysis included those materials expected to contain modern polymer formulations—ground layer materials reported by others to contain house paints—and those paints exhibiting the flow characteristics or surface sheen associated with industrial paints. All white and black paints were analyzed using Py-GC-MS in order to differentiate suspected industrial paints in Hofmann's palette from traditional materials of similar color.

Scanning Electron Microscopy-Energy Dispersive Spectroscopy

Samples were imaged and analyzed using a Hitachi S3700-N scanning electron microscope and a Bruker XFlash energy dispersive spectrometer with Quantax 400 software. The samples were received after they had been prepared for and imaged by polarized light microscopy. They were carbon coated before analysis. The SEM was operated at 15 kV at variable pressure (40 pascal). The system was calibrated to the 130K counts per second setting, as improper peak shift was detected at the 275K setting. Elemental maps were generated over 180 seconds real time (with 0–18% dead time). Analyses were conducted at a working distance between 9.8 and 10.2 mm.

Backscatter electron images were taken of all 284 loose and mounted paint samples, and EDS inorganic materials analysis was performed on each of the 519 discernable paint layers within those samples. EDS analysis was performed on at least three disparate points within each paint layer. EDS analysis was also performed on visible inclusions such as mordant materials for dye-based pigments.

Fourier-Transform Infrared Spectroscopy

ATR-FTIR (Attenuated Total Reflectance) analysis of loose samples was performed using a Thermo Nicolet 6700 Fourier transform infrared (FTIR) spectrometer with a Golden Gate ATR with diamond crystal, single bounce (45º) sampling accessory and DTGS detector. Spectra were obtained from 64 scans taken at a resolution of 4 cm-1. Samples for ATR-FTIR were placed directly on the diamond crystal of the ATR accessory. For small samples a piece of aluminum foil was used to back the sapphire anvil to eliminate any sapphire absorption in the IR spectrum. μFTIR (Infrared Microscope) analysis of embedded cross-sections was performed using a Thermo Nicolet 6700 Fourier transform infrared spectrometer with a Continuum microscope, MCT/A detector and a single bounce diamond crystal μATR objective. Spectra were obtained from 128 scans taken at a resolution of 4 cm-1 between 4000-625 cm-1. Samples for μFTIR were examined directly using a variable aperture to choose the area of interest. All spectra were ATR corrected and examined using OMNIC v 7.2 and compared to IRUG 2000 and local spectral libraries.

A total of 248 paint samples from the study group paintings were analyzed using FTIR. Embedded cross-section samples were re-polished to remove the carbon coating from previous SEM-EDS analysis and were then examined using an FTIR microscope attachment (micro-FTIR). Useful FTIR data was acquired from 76 re-polished cross-sections. Loose paint samples were examined using an attenuated total reflectance (FTIR-ATR) platform. FTIR analysis of loose samples was performed on excess sample from 167 loose paints, as well as excess sample of the same materials appearing in the five cross-sections deemed too small for micro-FTIR.

X-ray Diffraction

Samples were analyzed using a Rigaku D/Max Rapid Micro X-ray Diffractometer and Rigaku AreaMax 2.0 software. Samples for XRD analysis were mounted on glass fiber with Elmer's glue on a sample holder. The copper Kα collimator tube with a 0.8 mm aperture was operated at 50 kV and 40 mA to achieve 2.00 kW. The goniometer was set with an omega angle at 45 º while the sample could be adjusted on two different axes, a chi fixed at 0º and a phi determined by the position and orientation of the desired analysis site in order to randomize orientation of the crystals with respect to the beam as much as possible. The phi axis could remain at a fixed position, oscillate between a degree range, or fully rotate at a speed of 1º per second. XRD patterns were produced of sample areas between 100-800 microns in diameter and with a penetration depth of 20-100 micrometers, depending on the density and mass of elements, as well as the angle of incidence. After background subtraction, diffraction patterns produced for the samples were qualitatively matched using Jade 8.0 software to reference patterns of known materials in the ICDD libraries and/or user libraries developed from reference materials.

A total of 22 paint samples from the study group paintings were analyzed using XRD. The XRD sample group includes 11 examples of cadmium paint appearing on a total of five paintings produced between 1958 and 1961, four examples of cadmium paint appearing on three of the Estate palettes, and seven samples of paint whose identification through other analytical methods had produced limited or inconsistent results.

Representative Data

Each of the following data pages includes identification information for the painting and sample and basic instrumental set-up information for each analytical technique, along with representative visual data, results, and interpretation. In cases of multiple paint layers or analytical techniques, the data provided for individual samples encompasses several pages. Each sample is presented individually and grouped by painting. Each sample group is organized according to the date of the painting's creation (see table B.1).

Table B.2—Organization of Representative Data

Year	Title	Acc. No.	Sample Nos.	Fibers	Paints	Pages
1947	*Delight*	MoMA 2.1956	N14-24	X	X	378-396
	Ecstasy	BAM 1963.2	Ecs01-10	X	X	397-412
	The Third Hand	BAM 1966.48	C062-071		X	413-431
1953	*Le Gilotin*	BAM 1965.15	C012-022		X	432-459
1954	*Scintillating Space*	BAM 1966.47	C072-080		X	460-475
1955	*Exuberance*	AKAG 1955:8	B01-13	X	X	476-497
1957	*Sommernachtstraum*	AKAG 1958:4	B14-25	X	X	498-517
1958	*Equinox*	BAM 1965.12	C047-057		X	518-535
	Morning Mist	BAM 1966.45	C037-046		X	536-550
1959	*Above Deep Waters*	BAM 1965.13	C110-122	X	X	551-574
	Indian Summer	BAM 1965.11	C123-132	X	X	575-591
	Ruby Gold	MAG 60.37	R01-13	X	X	592-617
	The Vanquished	BAM 1966.49	C158-167		X	618-641
1960	*Bald Eagle*	BAM 1964.3	C023-036	X	X	642-665
	In the Wake of the Hurricane	BAM 1965.6	C174-183	X	X	666-689
1961	*Combinable Wall I and II*	BAM 1963.10	C081-093		X	690-712
	Tormented Bull	BAM 1963.6	C058-061		X	713-720
1962	*Heraldic Call*	BAM 1965.17	Hera1-6	X	X	721-727
	Magnum Opus	BAM 1963.7	C151-157	X	X	728-739
	Memoria in Aeternum	MoMA 399.1963	N01-13	X	X	740-761
1963	*Polyhymnia*	BAM 1964.1	C133-138, Poly1	X	X	762-775
1964	*The Clash*	BAM 1965.8	C001-011	X	X	776-792
	Imperium in Imperio	BAM 1966.43	Imp04-15	X	X	793-807
	And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light	BAM 1965.4	C168-173		X	808-819
	Silent Night	BAM 1965.5	C094-109	X	X	820-846
1965	*Struwel Peter*	BAM 1966.5	C139-150	X	X	847-869
1966	palette on plywood	Trust M536-12	S01		X	870-871
	palette on board	Trust M593-12	S02		X	872-874
	palette on board	Trust M537-10	S03-10		X	875-887
	palette on board	Trust M536-53	S11-15		X	888-897
	palette on glass	Trust (no #)	S16-20		X	898-906
	palette on paint can lid	Trust M536-49	S21-23		X	907-913
	palette on board	Trust M536-45	S24-26		X	914-919
	palette on board	Trust M536-03	S27-30		X	920-926

AKAG: Albright-Knox Art Gallery (Buffalo, New York); BAM: University of California Berkeley Art Museum and Pacific Film Archive (Berkeley, California); MAG: Memorial Art Gallery, University of Rochester (Rochester, New York); MoMA: Museum of Modern Art (New York, New York); Trust: Renate, Hans and Maria Hofmann Trust (New York, New York).
Note: Gaps in numbering are the result of rejected or missing samples.

The individual data pages begin on the next page and run for a total of 549 pages. A sample data page layout is provided (see figure B.1), and locations of the various types of information are indicated.

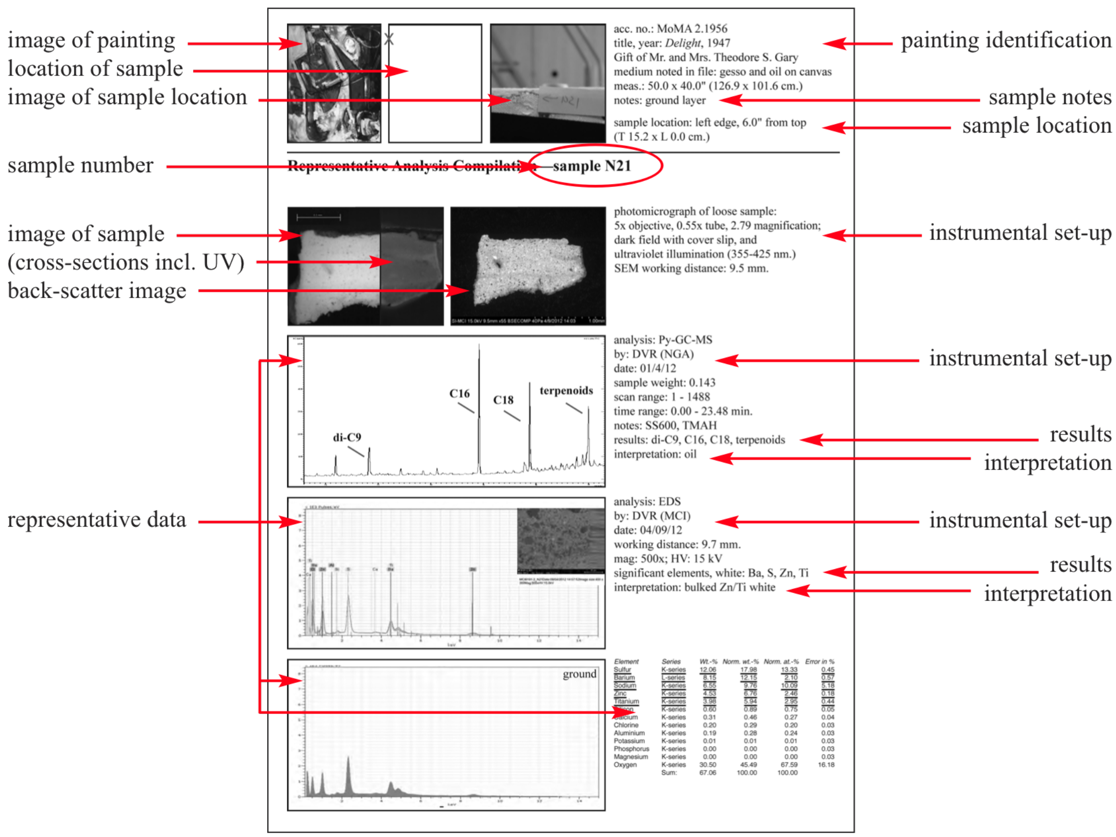
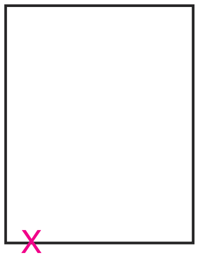
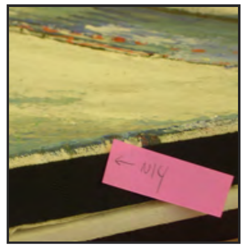


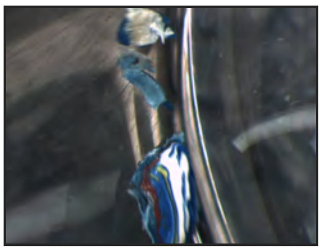
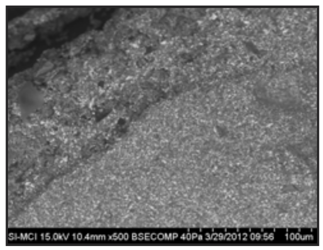
Figure B.1: Page layout for representative data presented in Appendix B.

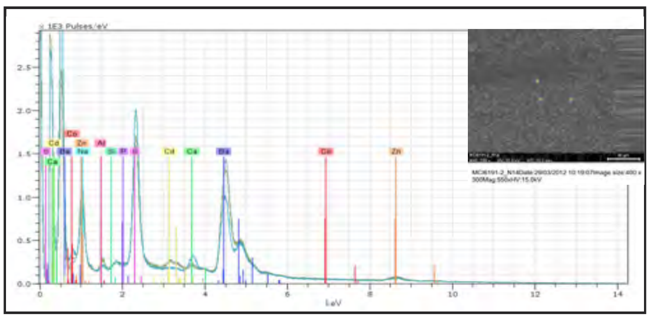
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: dark and light blues

sample location: bottom edge, 3.0" from left
(B 0.0 x L 7.6 cm.)

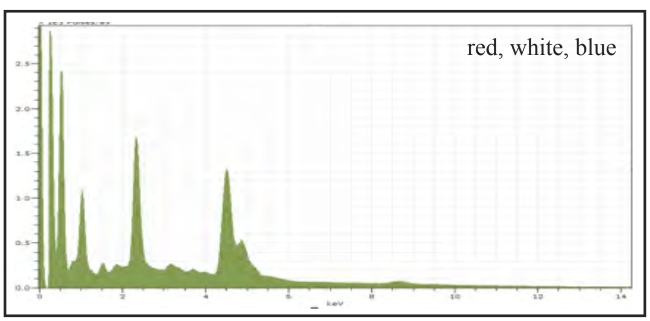
Representative Analysis Compilation—sample N14

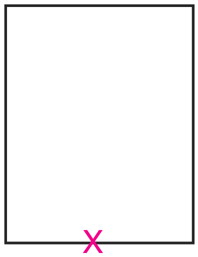
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.4 mm.



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 10.3 mm.
mag: 550x; HV: 15 kV
significant elements: Cd, S, Zn, Ti, Na
interpretation: cadmium red, Zn/Ti white, ultramarine blue



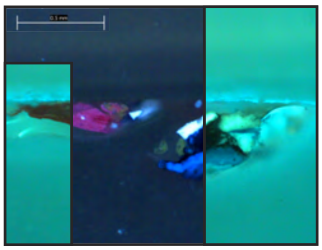
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	22.11	23.39	4.94	1.50
Zinc	K-series	12.61	13.34	5.92	0.45
Titanium	K-series	9.54	10.09	6.12	0.98
Sulfur	K-series	8.96	9.47	8.57	0.34
Sodium	K-series	1.90	2.01	2.54	1.52
Cadmium	L-series	1.27	1.34	0.35	0.34
Aluminium	K-series	0.58	0.61	0.66	0.47
Chlorine	K-series	0.37	0.39	0.32	0.04
Phosphorus	K-series	0.28	0.29	0.27	0.04
Calcium	K-series	0.20	0.21	0.15	0.05
Silicon	K-series	0.18	0.19	0.20	0.03
Potassium	K-series	0.11	0.12	0.09	0.10
Magnesium	K-series	0.07	0.07	0.08	0.06
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	36.38	38.47	69.79	14.92
	Sum:	94.56	100.00	100.00	

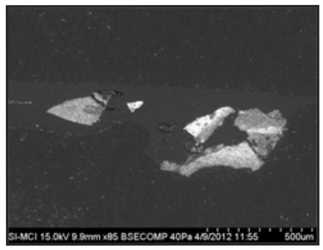


acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: green, purple, pink, white

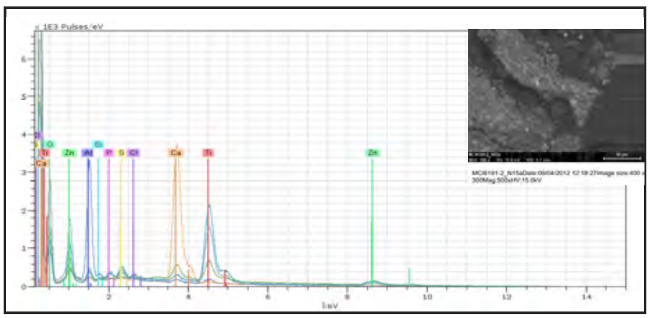
sample location: bottom edge, 22.5" from left
(B 0.0 x L 57.2 cm.)

Representative Analysis Compilation—sample N15

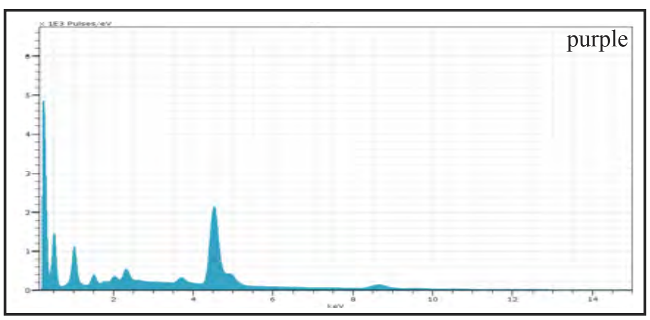




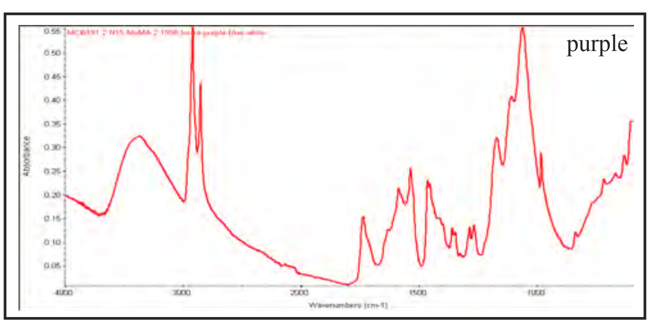
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.9 mm.



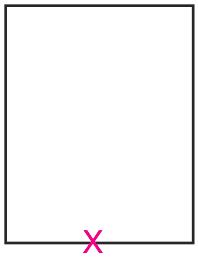
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Ti, Zn, Al
interpretation: Ti/Zn white, possible synthetic alizarin



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	30.14	38.69	23.78	0.89
Zinc	K-series	14.30	18.35	8.26	0.50
Sulfur	K-series	2.53	3.24	2.98	0.11
Calcium	K-series	2.10	2.70	1.98	0.09
Aluminium	K-series	1.75	2.25	2.45	0.11
Chlorine	K-series	1.39	1.78	1.48	0.07
Phosphorus	K-series	1.22	1.57	1.49	0.07
Silicon	K-series	0.21	0.26	0.28	0.03
Oxygen	K-series	24.27	31.15	57.30	11.87
	Sum:	77.91	100.00	100.00	



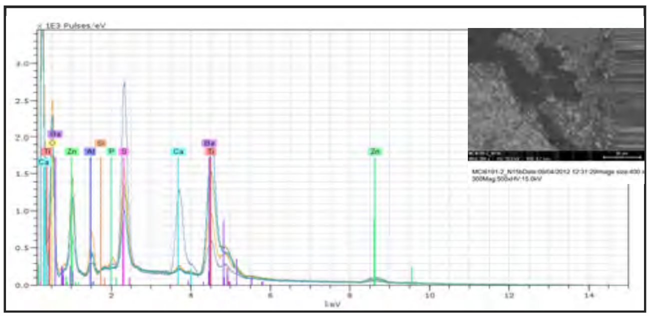
analysis: ATR-FTIR
by: DVR (MCI)
date: 03/14/13
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR83



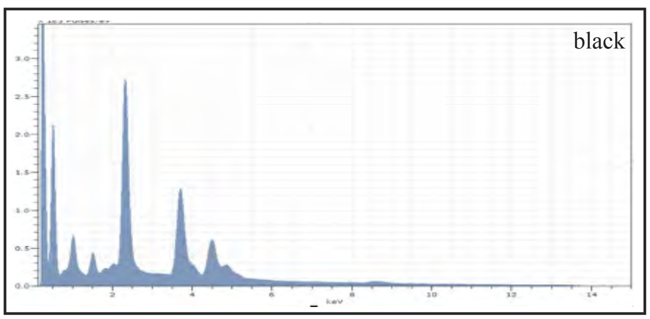
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: green, purple, pink, white

sample location: bottom edge, 22.5" from left (B 0.0 x L 57.2 cm.)

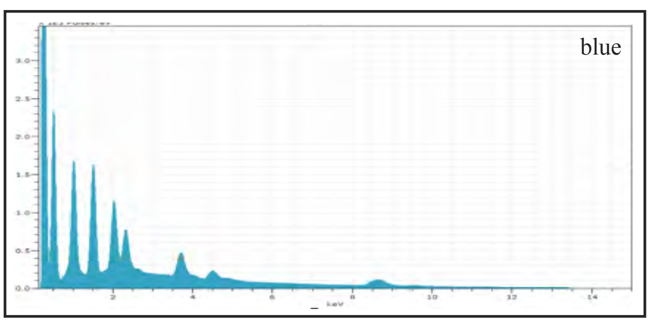
Representative Analysis Compilation—sample N15, continued



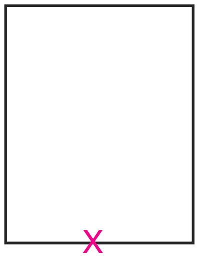
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, black: none
significant elements, blue: Na, Al
interpretation: ultramarine blue, possible carbon black



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	26.92	28.00	9.40	1.71
Sulfur	K-series	23.98	24.94	35.87	0.87
Calcium	K-series	20.63	21.46	24.69	0.64
Zinc	K-series	9.88	10.27	7.24	0.36
Titanium	K-series	4.24	4.41	4.25	0.63
Sodium	K-series	3.95	4.10	8.23	3.13
Chlorine	K-series	2.61	2.72	3.54	0.11
Aluminium	K-series	2.23	2.32	3.97	0.13
Phosphorus	K-series	1.13	1.17	1.75	0.07
Silicon	K-series	0.37	0.39	0.64	0.04
Magnesium	K-series	0.21	0.22	0.41	0.04
	Sum:	96.15	100.00	100.00	



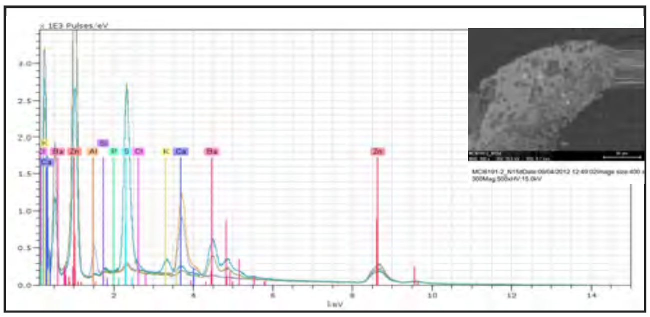
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	25.67	28.71	19.07	1.22
Barium	L-series	13.64	15.26	3.53	1.39
Zinc	K-series	13.62	15.23	7.41	0.48
Sulfur	K-series	6.92	7.75	7.68	0.27
Aluminium	K-series	1.51	1.69	2.00	0.10
Phosphorus	K-series	0.70	0.79	0.81	0.05
Calcium	K-series	0.60	0.67	0.53	0.05
Silicon	K-series	0.51	0.57	0.64	0.05
Oxygen	K-series	26.23	29.34	58.32	10.91
	Sum:	89.39	100.00	100.00	



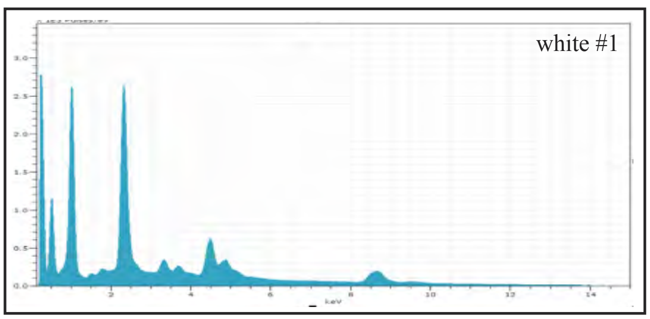
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: green, purple, pink, white

sample location: bottom edge, 22.5" from left
(B 0.0 x L 57.2 cm.)

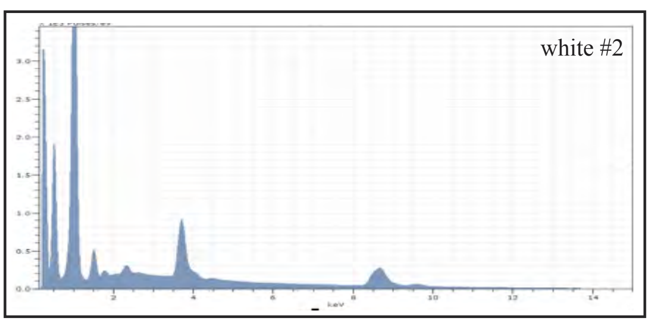
Representative Analysis Compilation—sample N15, continued



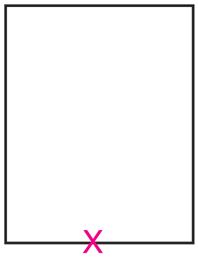
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, white #1: Zn, Ba
significant elements, white #2: Zn, Ca
interpretation: zinc white, bulked zinc white ground



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	39.52	37.20	25.42	1.33
Barium	L-series	22.82	21.49	6.99	1.40
Sodium	K-series	21.39	20.14	39.13	16.86
Sulfur	K-series	17.21	16.20	22.58	0.63
Potassium	K-series	1.71	1.61	1.84	0.08
Calcium	K-series	1.28	1.21	1.34	0.07
Titanium	K-series	0.98	0.92	0.86	0.41
Silicon	K-series	0.54	0.51	0.81	0.05
Chlorine	K-series	0.42	0.39	0.49	0.04
Aluminium	K-series	0.25	0.23	0.38	0.04
Phosphorus	K-series	0.11	0.10	0.14	0.03
	Sum:	106.22	100.00	100.00	



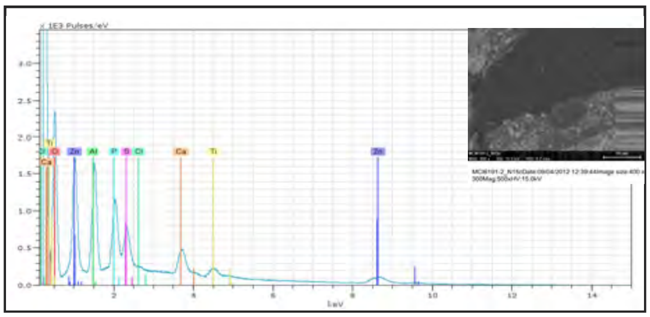
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	59.76	51.17	27.70	1.99
Sodium	K-series	26.17	22.41	34.51	20.62
Calcium	K-series	9.51	8.14	7.19	0.31
Barium	L-series	3.45	2.95	0.76	0.27
Aluminium	K-series	2.89	2.48	3.25	0.16
Sulfur	K-series	0.82	0.70	0.77	0.05
Chlorine	K-series	0.49	0.42	0.42	0.04
Potassium	K-series	0.30	0.26	0.23	0.05
Silicon	K-series	0.26	0.22	0.28	0.04
Phosphorus	K-series	0.02	0.02	0.02	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	13.12	11.23	24.85	5.74
	Sum:	116.79	100.00	100.00	

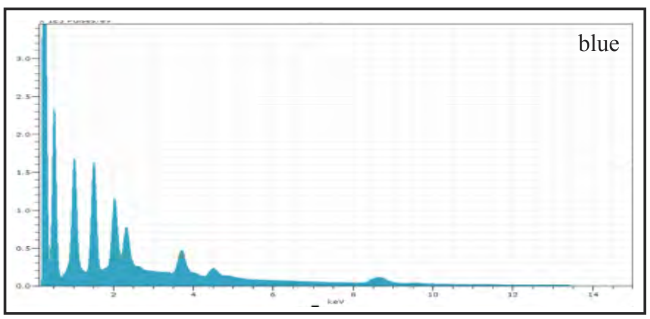

acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: green, purple, pink, white

sample location: bottom edge, 22.5" from left (B 0.0 x L 57.2 cm.)

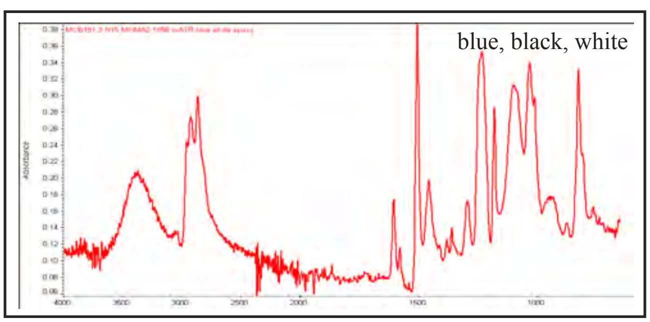
Representative Analysis Compilation—sample N15, continued



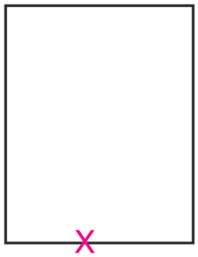
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Al, Na
interpretation: ultramarine blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	11.20	16.11	5.75	0.40
Aluminium	K-series	7.53	10.83	9.38	0.37
Sodium	K-series	6.33	9.10	9.25	1.78
Phosphorus	K-series	5.26	7.56	5.70	0.22
Sulfur	K-series	3.68	5.29	3.85	0.16
Calcium	K-series	3.10	4.46	2.60	0.12
Titanium	K-series	1.92	2.76	1.35	0.08
Chlorine	K-series	1.14	1.64	1.08	0.06
Potassium	K-series	0.53	0.76	0.46	0.06
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	28.84	41.49	60.58	11.49
	Sum:	69.52	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 12/20/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: carbon interference

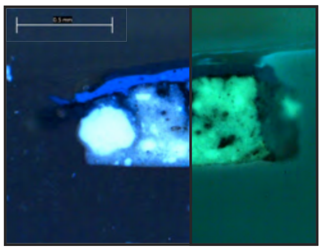


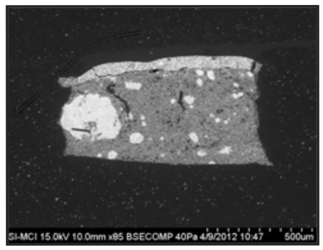
no image available

acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: blue

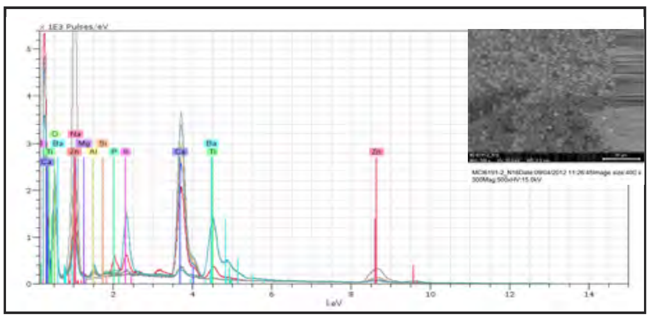
sample location: bottom edge, 22.0" from left
(B 0.0 x L 55.9 cm.)

Representative Analysis Compilation—sample N16

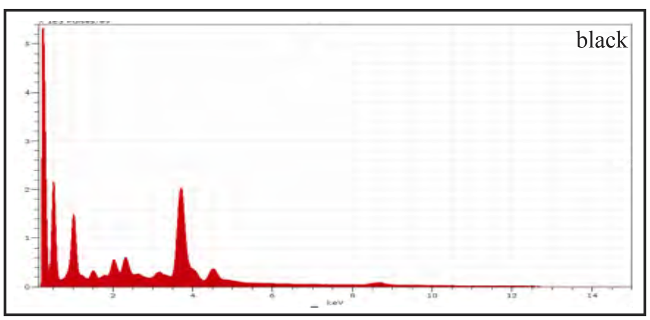




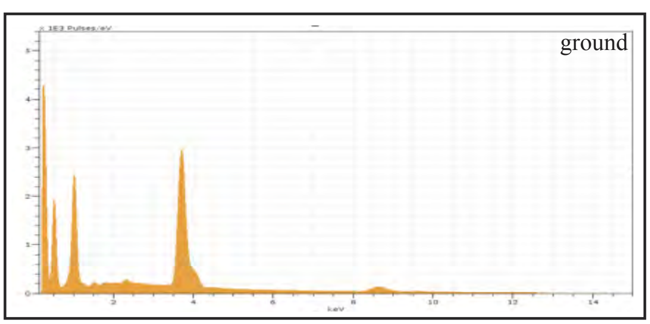
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



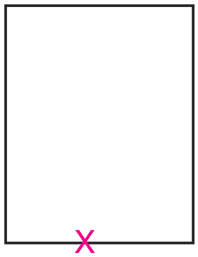
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, black: none
significant elements, ground: Ca, Zn
significant elements, blue: Na, Al
interpretation: ultramarine blue, possible carbon black, bulked zinc white ground



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	22.04	38.75	38.36	0.73
Zinc	K-series	10.12	17.80	10.80	0.37
Sodium	K-series	7.55	13.28	22.92	5.97
Titanium	K-series	5.40	9.50	7.87	0.44
Sulfur	K-series	3.07	5.39	6.67	0.13
Phosphorus	K-series	2.62	4.60	5.89	0.13
Cadmium	L-series	2.22	3.90	1.38	0.54
Barium	L-series	1.62	2.85	0.82	0.50
Aluminium	K-series	0.91	1.59	2.34	0.07
Chlorine	K-series	0.69	1.20	1.35	0.05
Magnesium	K-series	0.28	0.50	0.81	0.04
Silicon	K-series	0.22	0.38	0.54	0.03
Potassium	K-series	0.14	0.25	0.25	0.12
	Sum:	56.87	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	30.72	47.12	43.57	0.94
Zinc	K-series	16.70	25.61	14.51	0.58
Sodium	K-series	14.69	22.53	36.32	11.59
Sulfur	K-series	0.88	1.35	1.56	0.06
Chlorine	K-series	0.69	1.06	1.11	0.05
Aluminium	K-series	0.54	0.83	1.14	0.05
Phosphorus	K-series	0.49	0.76	0.91	0.04
Silicon	K-series	0.37	0.57	0.76	0.04
Titanium	K-series	0.11	0.16	0.13	0.04
Barium	L-series	0.00	0.00	0.00	0.03
	Sum:	65.20	100.00	100.00	

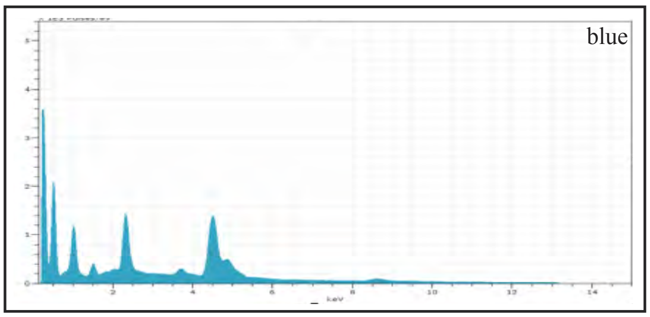


no image available

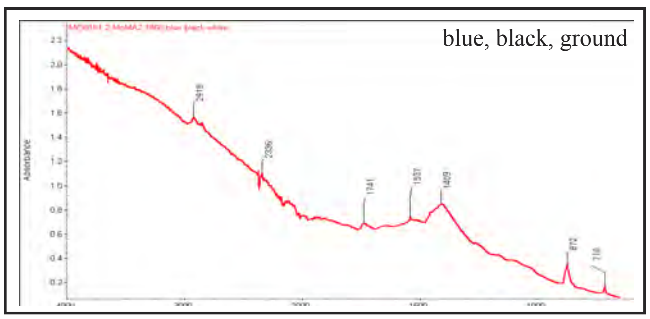
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: blue

sample location: bottom edge, 22.0" from left
(B 0.0 x L 55.9 cm.)

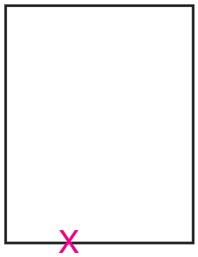
Representative Analysis Compilation—sample N16, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	29.01	27.50	6.57	1.86
Zinc	K-series	16.60	15.74	7.90	0.58
Titanium	K-series	12.56	11.91	8.16	1.24
Sulfur	K-series	8.33	7.90	8.08	0.32
Sodium	K-series	4.19	3.97	5.67	3.32
Calcium	K-series	1.65	1.56	1.28	0.08
Aluminium	K-series	1.57	1.49	1.81	0.10
Phosphorus	K-series	0.65	0.62	0.66	0.05
Silicon	K-series	0.16	0.16	0.18	0.03
Magnesium	K-series	0.14	0.14	0.19	0.04
Oxygen	K-series	30.61	29.02	59.51	13.50
	Sum:	105.48	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: carbon interference

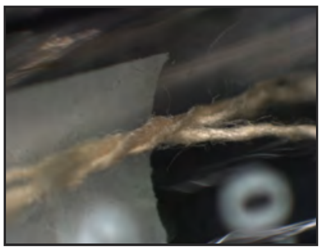


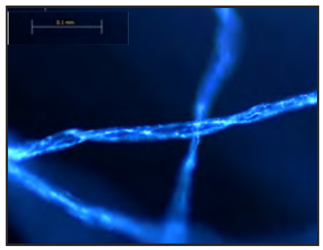
no image available

acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: threads, possibly warp

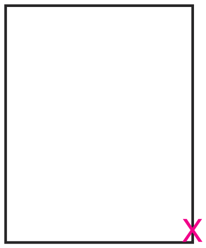
sample location: bottom edge, 14.0" from left
(B 0.0 x L 35.6 cm.)

Representative Analysis Compilation—sample N17





photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification; cross polars
interpretation: cotton

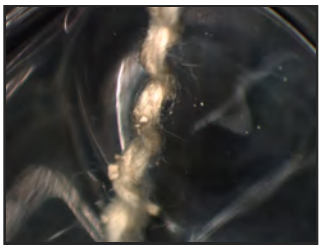


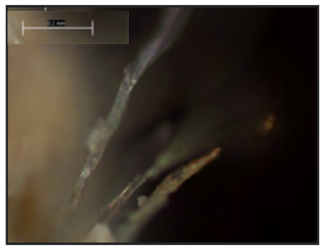
no image available

acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: threads, possibly weft

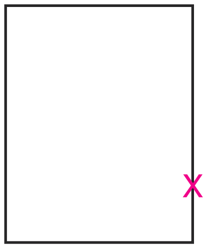
sample location: right edge, 1.0" from bottom
(B 2.5 x R 0.0 cm.)

Representative Analysis Compilation—sample N18





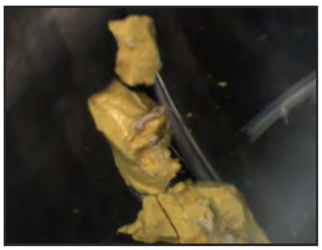
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification
interpretation: cotton

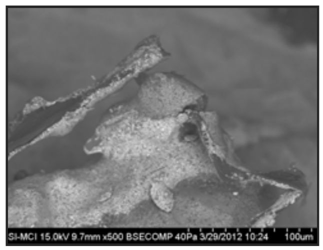


acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: yellow

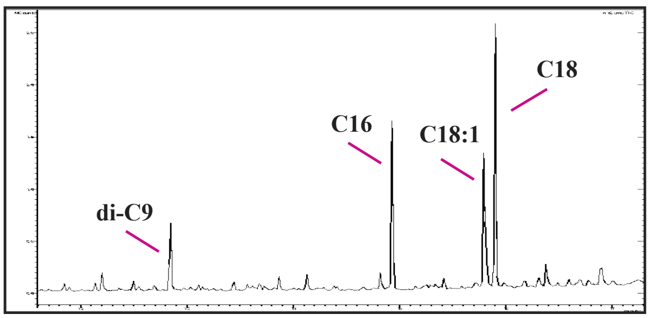
sample location: right edge, 9" from bottom
(B 22.86 x R 0.00 cm.)

Representative Analysis Compilation—sample N19

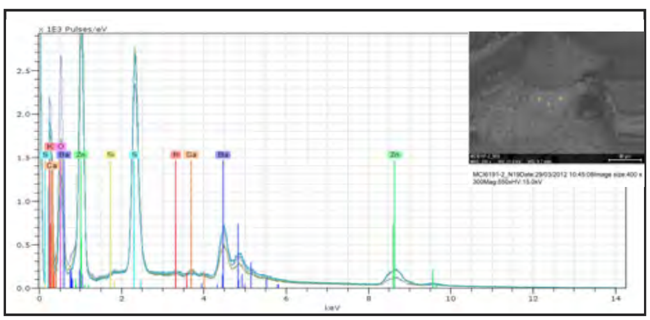




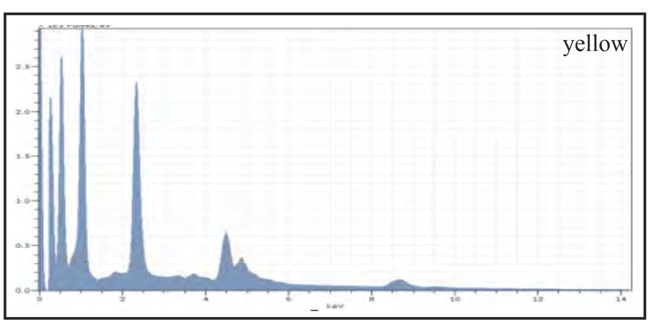
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.223
scan range: 1 - 1485
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.7 mm.
mag: 550x; HV: 15 kV
significant elements, yellow: Fe
interpretation: yellow ochre



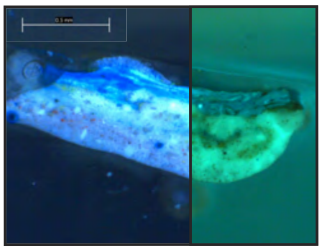
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	30.75	28.26	15.69	1.04
Barium	L-series	25.86	23.76	6.28	1.67
Sulfur	K-series	19.42	17.84	20.20	0.71
Sodium	K-series	6.98	6.42	10.13	5.52
Iron	K-series	1.37	1.26	0.82	0.07
Titanium	K-series	0.63	0.58	0.44	0.37
Chlorine	K-series	0.60	0.55	0.56	0.05
Calcium	K-series	0.59	0.54	0.49	0.08
Silicon	K-series	0.51	0.47	0.60	0.05
Phosphorus	K-series	0.39	0.36	0.42	0.04
Cadmium	L-series	0.29	0.27	0.09	0.10
Potassium	K-series	0.23	0.22	0.20	0.13
Magnesium	K-series	0.10	0.09	0.13	0.07
Aluminium	K-series	0.01	0.01	0.02	0.04
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	21.07	19.37	43.93	8.42
	Sum:	108.81	100.00	100.00	

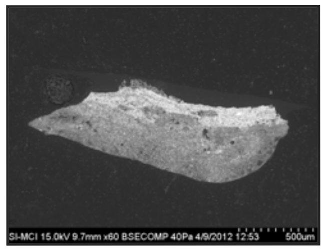
no image available

acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: stratigraphy

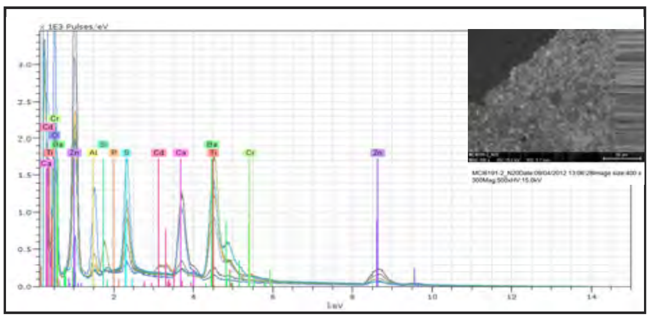
sample location: left edge, 5" from top
(T 12.7 x L 0.0 cm.)

Representative Analysis Compilation—sample N20

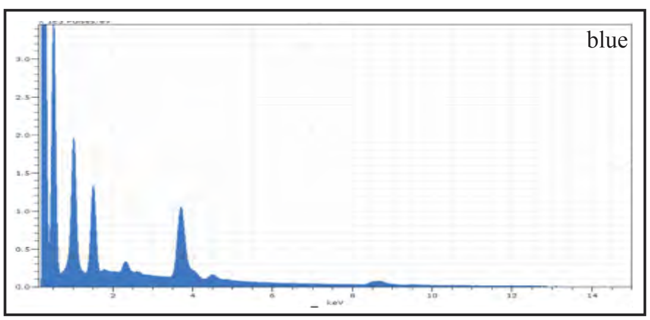




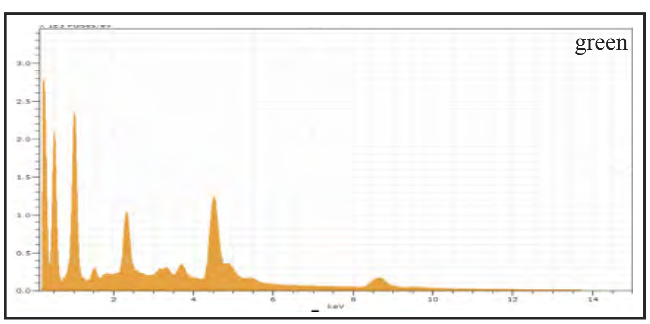
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
signifcant elements, blue: Na, Al
major elements, green: Na, Al, Cd, S
major elements, white: Ti, Zn
interpretation: ultramarine blue, cadmium yellow, Ti/Zn white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	9.99	12.99	4.23	0.36
Calcium	K-series	8.85	11.51	6.12	0.29
Sodium	K-series	7.48	9.72	9.00	5.91
Aluminium	K-series	5.03	6.53	5.16	0.26
Titanium	K-series	0.94	1.22	0.54	0.14
Barium	L-series	0.85	1.10	0.17	0.18
Sulfur	K-series	0.75	0.98	0.65	0.05
Chlorine	K-series	0.21	0.28	0.17	0.03
Silicon	K-series	0.16	0.21	0.16	0.03
Phosphorus	K-series	0.05	0.06	0.04	0.03
Potassium	K-series	0.03	0.04	0.02	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	42.60	55.38	73.74	14.96
	Sum:	76.93	100.00	100.00	



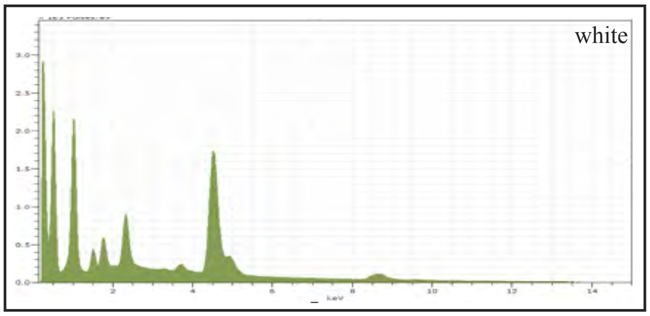
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	23.34	25.08	13.00	0.80
Barium	L-series	15.85	17.03	4.20	1.19
Titanium	K-series	11.77	12.65	8.95	0.95
Sodium	K-series	10.62	11.41	16.83	8.38
Sulfur	K-series	5.78	6.21	6.56	0.23
Calcium	K-series	1.68	1.81	1.53	0.11
Cadmium	L-series	1.15	1.24	0.37	0.31
Aluminium	K-series	1.12	1.20	1.51	0.08
Potassium	K-series	0.90	0.96	0.84	0.21
Chlorine	K-series	0.39	0.42	0.40	0.04
Phosphorus	K-series	0.34	0.37	0.40	0.04
Silicon	K-series	0.33	0.36	0.43	0.04
Magnesium	K-series	0.11	0.12	0.16	0.03
Oxygen	K-series	19.68	21.15	44.81	8.39
	Sum:	93.06	100.00	100.00	

no image available

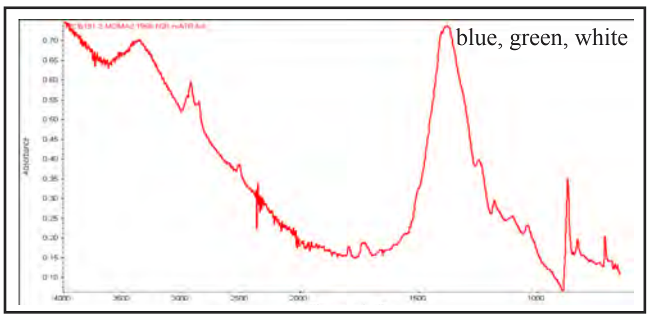
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: stratigraphy

sample location: left edge, 5" from top
(T 12.7 x L 0.0 cm.)

Representative Analysis Compilation—sample N20, continued

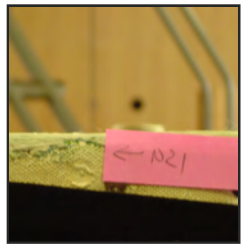


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Titanium	K-series	21.27	27.00	14.63	0.82
Zinc	K-series	10.60	13.46	5.34	0.38
Sodium	K-series	7.59	9.63	10.87	6.00
Sulfur	K-series	4.27	5.42	4.39	0.18
Silicon	K-series	2.62	3.33	3.08	0.13
Aluminium	K-series	1.46	1.85	1.78	0.09
Barium	L-series	1.11	1.41	0.27	0.57
Calcium	K-series	0.60	0.76	0.49	0.04
Chlorine	K-series	0.52	0.66	0.48	0.04
Phosphorus	K-series	0.26	0.34	0.28	0.04
Potassium	K-series	0.16	0.20	0.13	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	28.30	35.93	58.25	11.37
	Sum:	78.77	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 12/20/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference, fillers

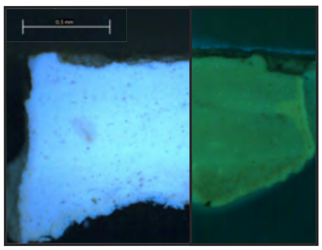
analysis: µFTIR
by: DVR (MCI)
date: 12/20/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

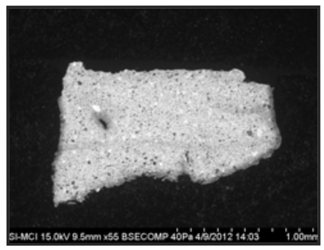


acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: ground layer

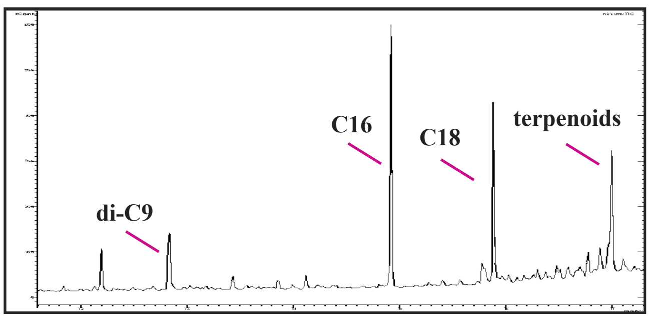
sample location: left edge, 6.0" from top
(T 15.2 x L 0.0 cm.)

Representative Analysis Compilation—sample N21

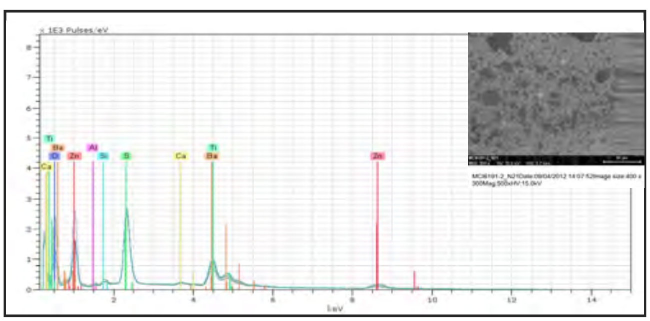




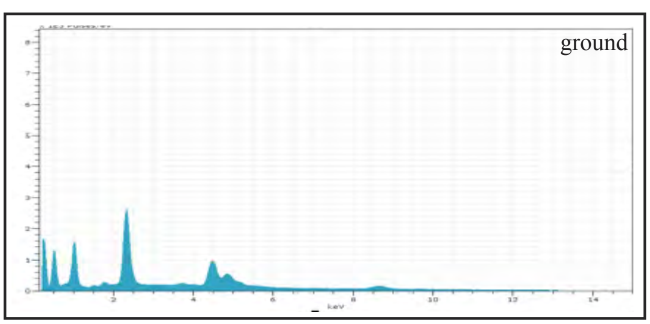
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



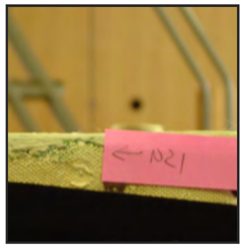
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/4/12
sample weight: 0.143
scan range: 1 - 1488
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, white: Ba, S, Zn, Ti
interpretation: bulked Zn/Ti white



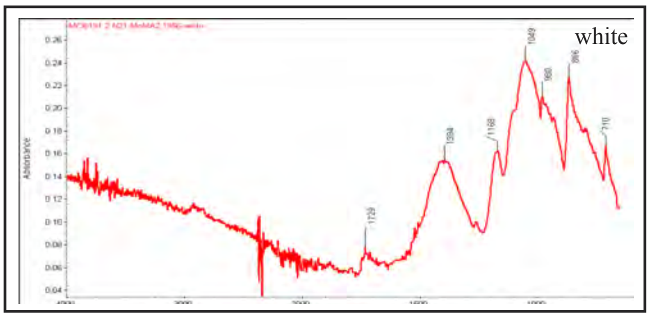
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Sulfur	K-series	12.06	17.98	13.33	0.45
Barium	L-series	8.15	12.15	2.10	0.57
Sodium	K-series	6.55	9.76	10.09	5.18
Zinc	K-series	4.53	6.76	2.46	0.18
Titanium	K-series	3.98	5.94	2.95	0.44
Silicon	K-series	0.60	0.89	0.75	0.05
Calcium	K-series	0.31	0.46	0.27	0.04
Chlorine	K-series	0.20	0.29	0.20	0.03
Aluminium	K-series	0.19	0.28	0.24	0.03
Potassium	K-series	0.01	0.01	0.01	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	30.50	45.49	67.59	16.18
	Sum:	67.06	100.00	100.00	

 X 

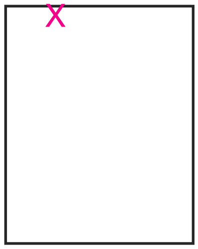
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: ground layer

sample location: left edge, 6.0" from top
(T 15.2 x L 0.0 cm.)

Representative Analysis Compilation—sample N21, continued



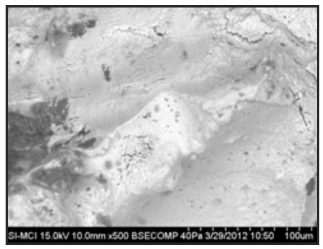
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

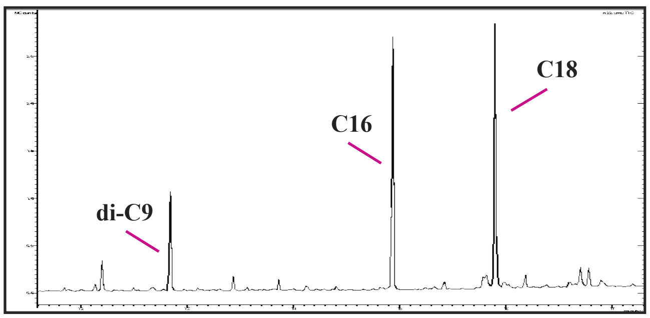
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: red

sample location: 1.5" from top, 9.5" from left
(T 3.8 x L 24.1 cm.)

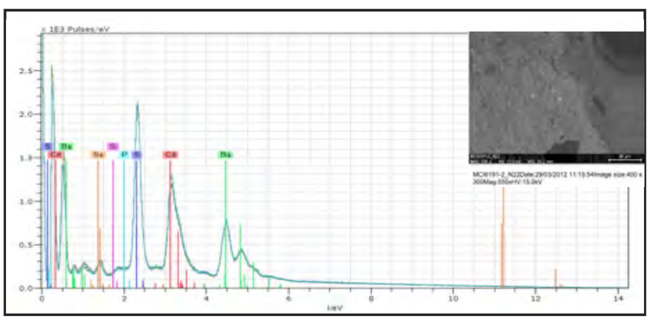
Representative Analysis Compilation—sample N22

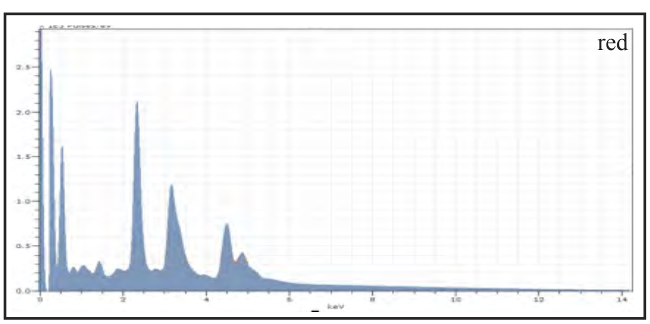
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



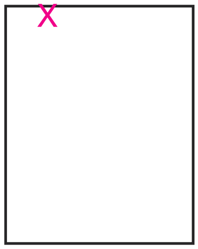
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.323
scan range: 1 - 1486
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil

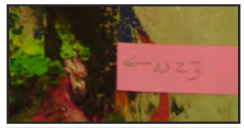


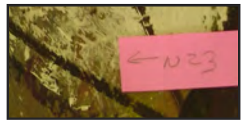
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 10.2 mm.
mag: 550x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	18.85	21.91	6.67	1.83
Barium	L-series	16.00	18.59	4.63	1.08
Sulfur	K-series	14.49	16.84	17.96	0.54
Zinc	K-series	4.06	4.71	2.47	0.17
Titanium	K-series	3.47	4.04	2.88	0.45
Potassium	K-series	1.92	2.24	1.96	0.67
Selenium	L-series	1.14	1.32	0.57	0.11
Phosphorus	K-series	0.53	0.61	0.68	0.05
Sodium	K-series	0.47	0.54	0.80	0.39
Chlorine	K-series	0.42	0.49	0.47	0.05
Silicon	K-series	0.29	0.34	0.42	0.04
Aluminium	K-series	0.15	0.17	0.22	0.14
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	24.26	28.19	60.27	12.05
	Sum:	86.04	100.00	100.00	

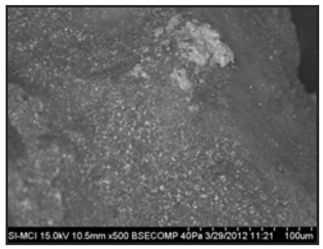




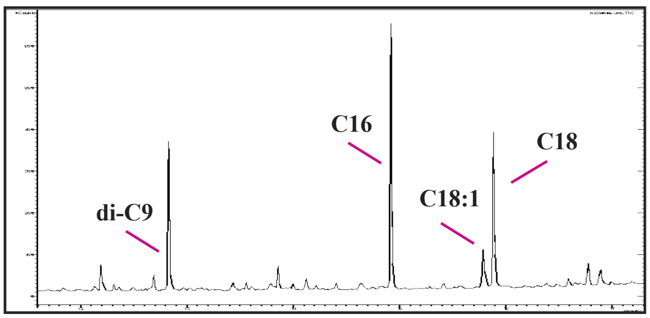
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: white, black, others

sample location: 1.8" from top, 8.0" from left
(T 4.6 x L 20.3 cm.)

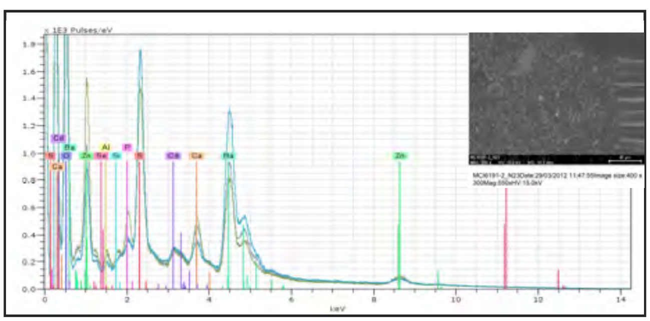
Representative Analysis Compilation—sample N23

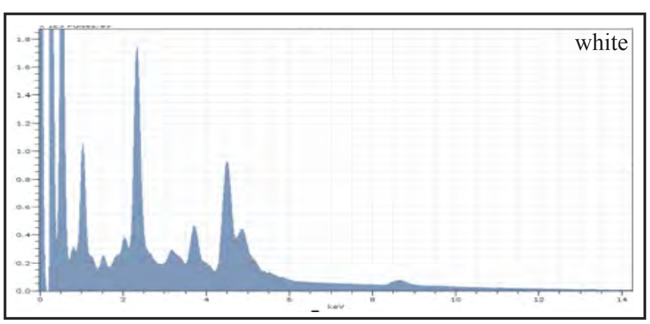
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.5 mm.



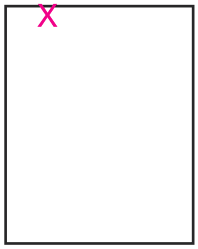
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.265
scan range: 1 - 1480
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil

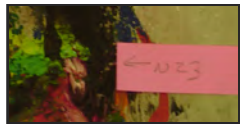


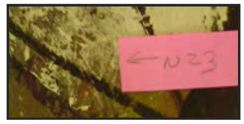
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 10.2 mm.
mag: 550x; HV: 15 kV
signifcant elements, white: Ba, S, Zn, Ti
interpretation: bulked Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	18.80	20.01	3.88	1.25
Sulfur	K-series	9.66	10.28	8.54	0.37
Zinc	K-series	9.23	9.82	4.00	0.34
Sodium	K-series	5.32	5.66	6.56	4.21
Titanium	K-series	4.18	4.45	2.48	0.52
Calcium	K-series	2.54	2.71	1.80	0.14
Cadmium	L-series	1.88	2.00	0.47	0.48
Phosphorus	K-series	1.23	1.31	1.13	0.07
Chlorine	K-series	0.66	0.71	0.53	0.05
Magnesium	K-series	0.54	0.57	0.63	0.11
Aluminium	K-series	0.37	0.40	0.39	0.31
Potassium	K-series	0.26	0.28	0.19	0.18
Silicon	K-series	0.18	0.19	0.18	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	39.08	41.60	69.22	15.30
	Sum:	93.95	100.00	100.00	



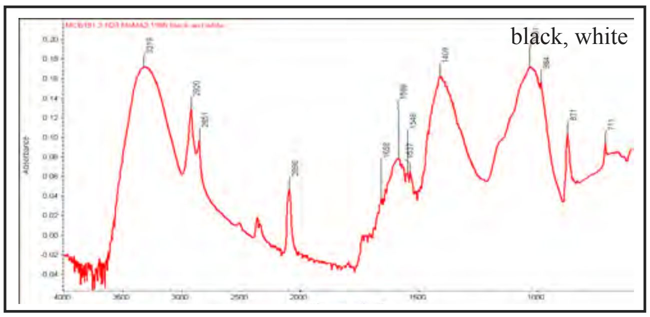




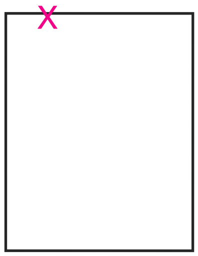
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: white, black, others

sample location: 1.8" from top, 8.0" from left (T 4.6 x L 20.3 cm.)

Representative Analysis Compilation—sample N23, continued



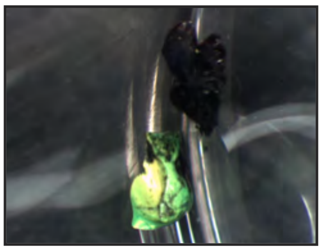
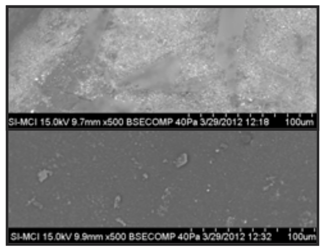
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil, fillers

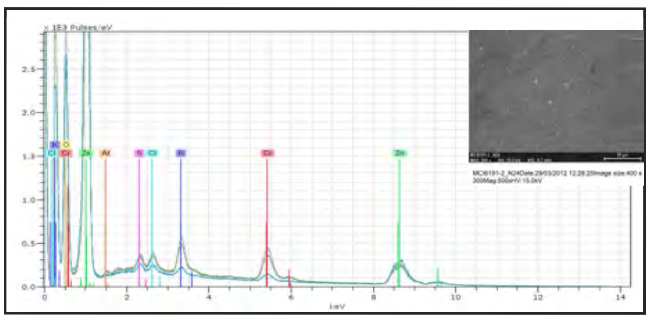
acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: black, green

sample location: top edge, 8.0" from left
(T 0.0 x L 20.3 cm.)

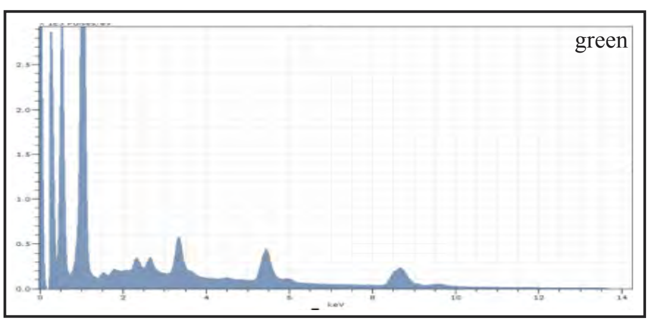
Representative Analysis Compilation—sample N24

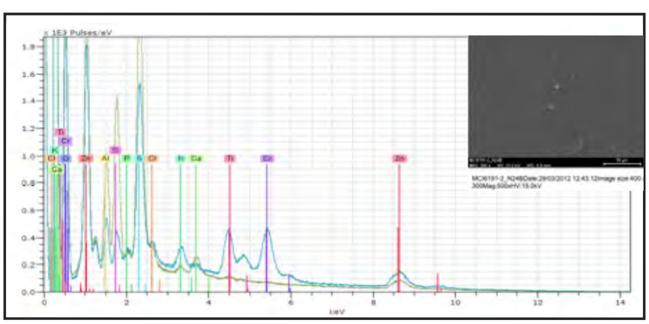
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distances: 9.9 and 9.7 mm.



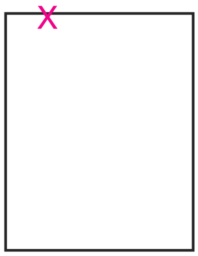
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cr
interpretation: viridian green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	38.89	40.01	18.78	1.31
Sodium	K-series	18.79	19.33	25.80	14.81
Chromium	K-series	9.54	9.81	5.79	0.30
Potassium	K-series	3.81	3.92	3.07	0.14
Chlorine	K-series	1.50	1.54	1.33	0.08
Sulfur	K-series	1.31	1.35	1.29	0.07
Silicon	K-series	0.57	0.58	0.64	0.05
Phosphorus	K-series	0.47	0.49	0.48	0.04
Calcium	K-series	0.37	0.39	0.30	0.04
Aluminium	K-series	0.34	0.35	0.39	0.04
Barium	L-series	0.20	0.21	0.05	0.07
Magnesium	K-series	0.11	0.12	0.15	0.03
Titanium	K-series	0.07	0.07	0.05	0.05
Oxygen	K-series	21.23	21.84	41.88	33.84
	Sum:	97.20	100.00	100.00	



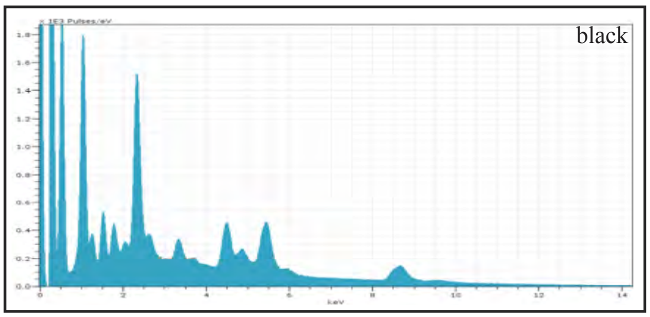
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
major elements, black: none
interpretation: possible carbon black


acc. no.: MoMA 2.1956
title, year: *Delight*, 1947
Gift of Mr. and Mrs. Theodore S. Gary
medium noted in file: gesso and oil on canvas
meas.: 50.0 x 40.0" (126.9 x 101.6 cm.)
notes: black, green

sample location: top edge, 8.0" from left
(T 0.0 x L 20.3 cm.)

Representative Analysis Compilation—sample N24, continued



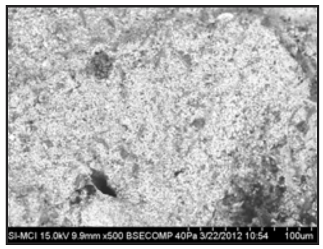
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	24.48	30.72	14.20	0.83
Chromium	K-series	11.42	14.33	8.33	0.35
Titanium	K-series	7.26	9.11	5.75	0.24
Sulfur	K-series	6.84	8.58	8.09	0.27
Aluminium	K-series	1.65	2.07	2.31	0.10
Potassium	K-series	1.18	1.48	1.15	0.06
Chlorine	K-series	1.09	1.36	1.16	0.06
Silicon	K-series	1.00	1.25	1.35	0.07
Calcium	K-series	0.48	0.60	0.45	0.04
Phosphorus	K-series	0.35	0.44	0.43	0.04
Oxygen	K-series	23.96	30.06	56.78	38.22
	Sum:	79.70	100.00	100.00	

no image available

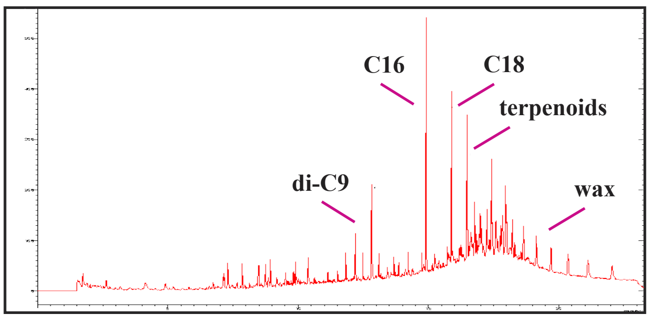
acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: ground layer

sample location: left edge, 34.3" from top
(T 87.1 x L 0.0 cm.)

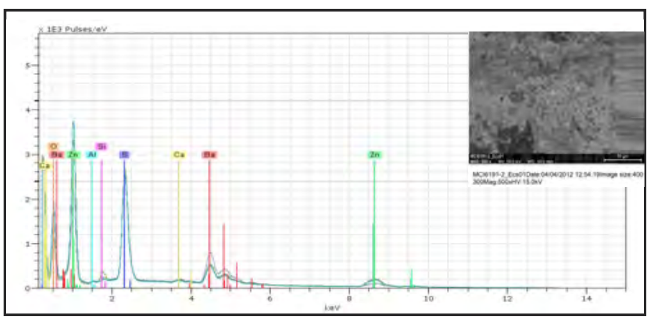
Representative Analysis Compilation—sample Ecs01



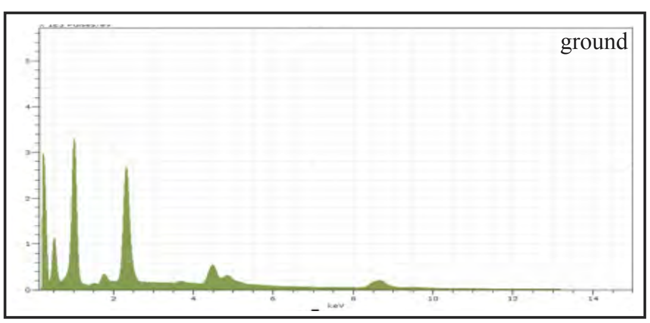
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 03/16/12
sample weight: 0.371
scan range: 1 - 1473
time range: 0.00 - 23.31 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids, wax
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
signifcant elements, ground: Zn, Ba
interpretation: bulked zinc white



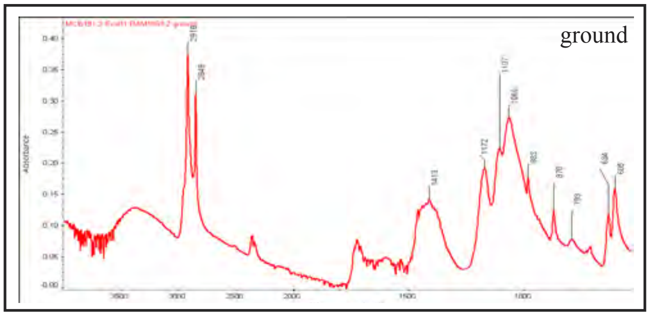
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Sulfur	K-series	17.73	22.23	19.35	0.65
Zinc	K-series	17.60	22.07	9.42	0.61
Sodium	K-series	9.48	11.89	14.43	7.49
Barium	L-series	6.49	8.13	1.65	0.50
Titanium	K-series	2.99	3.74	2.18	0.36
Silicon	K-series	1.58	1.98	1.96	0.09
Calcium	K-series	0.29	0.36	0.25	0.04
Aluminium	K-series	0.20	0.25	0.26	0.04
Phosphorus	K-series	0.13	0.17	0.15	0.03
Potassium	K-series	0.06	0.07	0.05	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	22.81	28.60	49.89	12.75
	Sum:	79.77	100.00	100.00	

no image available

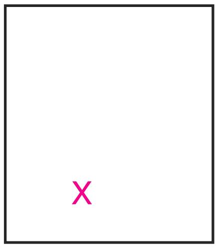
acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: ground layer

sample location: left edge, 34.3" from top
(T 87.1 x L 0.0 cm.)

Representative Analysis Compilation—sample Ecs01, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil, fillers

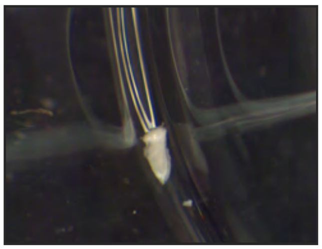


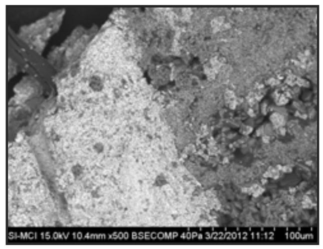
no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: compositional white

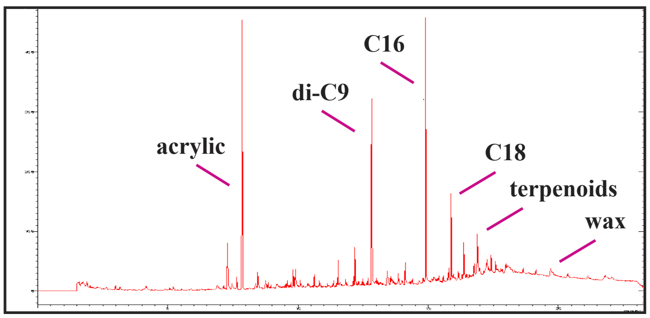
sample location: 19.3" from left, 15.4" from bottom
(B 39.1 x L 49.0 cm.)

Representative Analysis Compilation—sample Ecs02

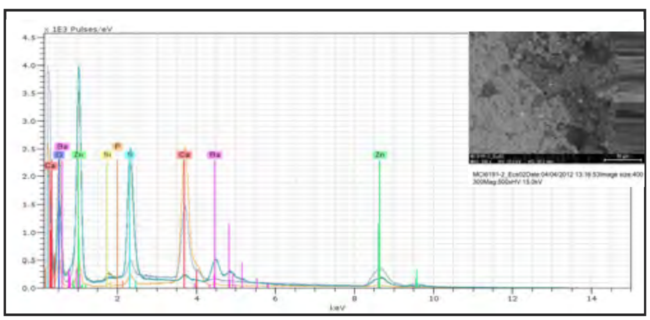




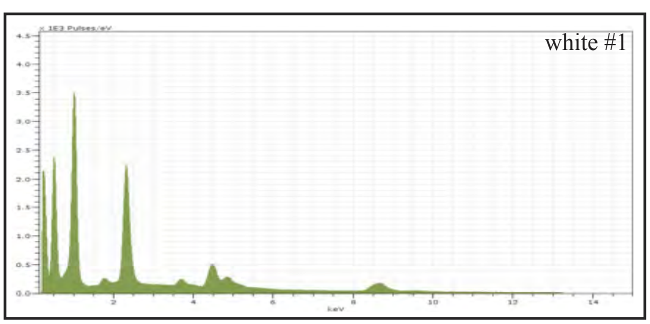
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.4 mm.



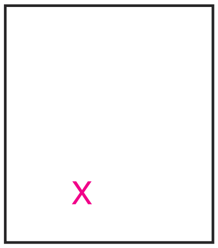
analysis: Py-GC-MS
by: DVR (NGA)
date: 03/16/12
sample weight: 0.117
scan range: 1 - 1478
time range: 0.00 - 23.33 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids, wax, acrylic
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 10.2 mm.
mag: 500x; HV: 15 kV
significant elements, white #1: Zn, Ba
significant elements, white #2: Zn, Ca
interpretation: bulked zinc whites



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	25.71	28.70	13.22	0.87
Sulfur	K-series	16.38	18.28	17.18	0.60
Sodium	K-series	13.17	14.70	19.26	10.39
Barium	L-series	7.46	8.33	1.83	0.54
Titanium	K-series	2.52	2.81	1.77	0.32
Calcium	K-series	1.21	1.35	1.02	0.06
Silicon	K-series	1.12	1.25	1.34	0.07
Chlorine	K-series	0.79	0.89	0.75	0.05
Magnesium	K-series	0.52	0.58	0.72	0.06
Phosphorus	K-series	0.36	0.40	0.39	0.04
Potassium	K-series	0.19	0.22	0.17	0.04
Aluminium	K-series	0.03	0.04	0.04	0.03
Oxygen	K-series	20.13	22.47	42.31	8.41
	Sum:	89.61	100.00	100.00	

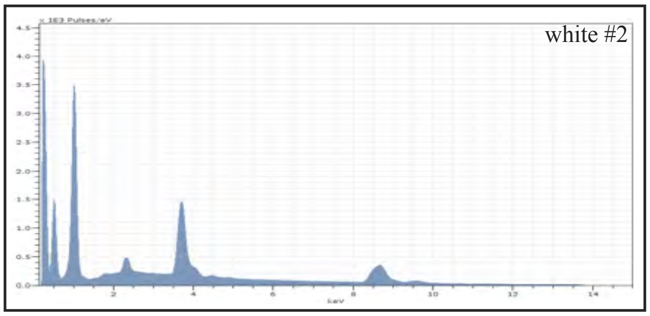


no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: compositional white

sample location: 19.3" from left, 15.4" from bottom
(B 39.1 x L 49.0 cm.)

Representative Analysis Compilation—sample Ecs02, continued



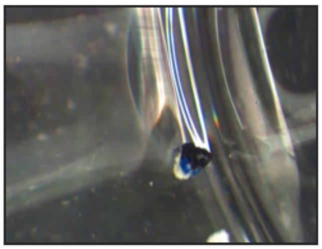
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	55.80	50.40	28.63	1.86
Sodium	K-series	19.94	18.01	29.10	15.72
Calcium	K-series	15.30	13.82	12.81	0.48
Sulfur	K-series	3.35	3.03	3.50	0.14
Barium	L-series	1.76	1.59	0.43	0.16
Chlorine	K-series	1.70	1.54	1.61	0.08
Potassium	K-series	0.86	0.78	0.74	0.11
Phosphorus	K-series	0.85	0.77	0.92	0.06
Silicon	K-series	0.70	0.64	0.84	0.06
Magnesium	K-series	0.57	0.52	0.79	0.06
Titanium	K-series	0.03	0.02	0.02	0.04
Aluminium	K-series	0.02	0.02	0.03	0.03
Oxygen	K-series	9.82	8.87	20.58	4.75
	Sum:	110.72	100.00	100.00	

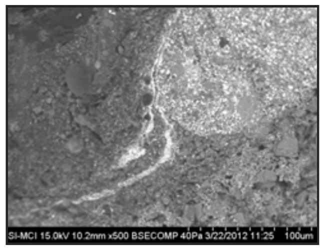
no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: black outline

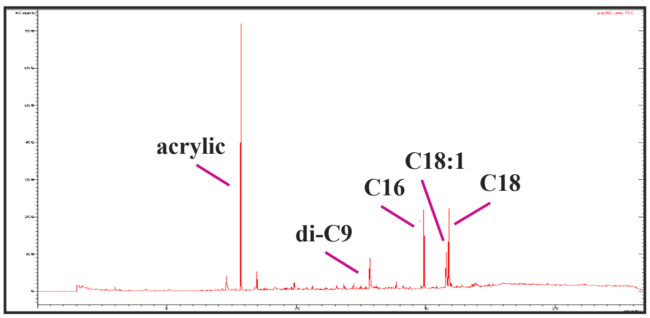
sample location: 8.5" from top, 14.6" from left
(T 21.6 x L 37.1 cm.)

Representative Analysis Compilation—sample Ecs03

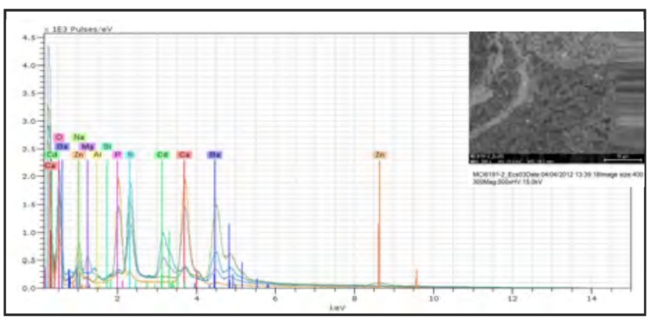




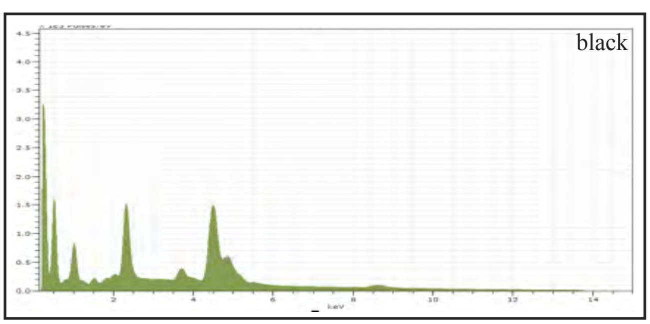
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.2 mm.



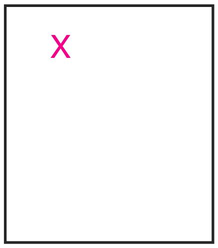
analysis: Py-GC-MS
by: DVR (NGA)
date: 03/16/12
sample weight: 0.148
scan range: 1 - 1500
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, acrylic
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, black: Ca, P
major elements, blue: Cd, S, Se
major elements, white: Ca, Ba, Zn
interpretation: bone black, possible cadmium red spot, bulked zinc white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	10.90	16.48	9.82	0.73
Barium	L-series	10.83	16.38	3.40	0.85
Sulfur	K-series	8.75	13.22	11.77	0.33
Zinc	K-series	6.79	10.27	4.48	0.25
Sodium	K-series	2.01	3.04	3.77	1.61
Calcium	K-series	1.38	2.09	1.49	0.07
Phosphorus	K-series	0.91	1.38	1.27	0.06
Aluminium	K-series	0.69	1.04	1.10	0.06
Chlorine	K-series	0.53	0.81	0.65	0.04
Silicon	K-series	0.25	0.39	0.39	0.04
Magnesium	K-series	0.18	0.27	0.32	0.04
Potassium	K-series	0.13	0.20	0.15	0.04
Oxygen	K-series	22.77	34.43	61.39	10.77
	Sum:	66.13	100.00	100.00	

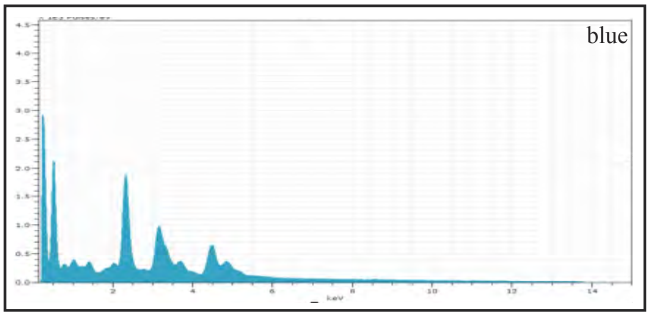


no image available

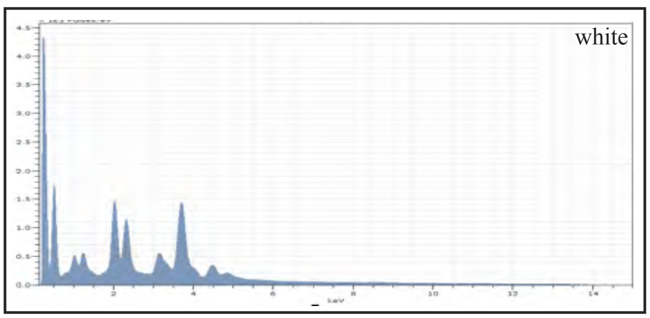
acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: black outline

sample location: 8.5" from top, 14.6" from left
(T 21.6 x L 37.1 cm.)

Representative Analysis Compilation—sample Ecs03, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	14.28	15.86	3.12	0.96
Cadmium	L-series	12.73	14.14	3.39	1.43
Sulfur	K-series	11.13	12.36	10.40	0.42
Zinc	K-series	3.46	3.84	1.58	0.15
Titanium	K-series	2.23	2.48	1.40	0.35
Calcium	K-series	1.52	1.69	1.14	0.13
Potassium	K-series	1.45	1.61	1.11	0.52
Selenium	L-series	1.07	1.19	0.41	0.10
Phosphorus	K-series	1.03	1.15	1.00	0.07
Sodium	K-series	0.35	0.39	0.46	0.30
Chlorine	K-series	0.25	0.28	0.21	0.04
Silicon	K-series	0.17	0.19	0.18	0.03
Aluminium	K-series	0.01	0.02	0.02	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	40.34	44.81	75.58	17.80
	Sum:	90.03	100.00	100.00	



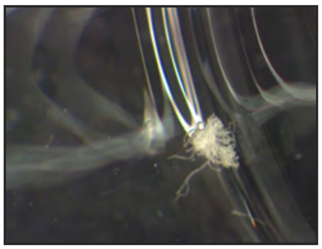
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	22.48	18.49	16.19	0.76
Barium	L-series	22.07	18.16	4.64	1.44
Zinc	K-series	14.80	12.17	6.53	0.52
Cadmium	L-series	11.55	9.50	2.96	1.49
Phosphorus	K-series	9.54	7.85	8.89	0.39
Sulfur	K-series	8.71	7.17	7.84	0.33
Magnesium	K-series	3.75	3.08	4.45	0.36
Sodium	K-series	0.90	0.74	1.14	0.74
Chlorine	K-series	0.85	0.70	0.69	0.06
Selenium	L-series	0.81	0.67	0.30	0.09
Potassium	K-series	0.62	0.51	0.46	0.45
Titanium	K-series	0.04	0.03	0.02	0.05
Aluminium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.44	20.93	45.89	11.98
	Sum:	121.56	100.00	100.00	

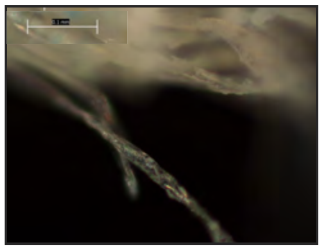
no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: warp and weft fibers

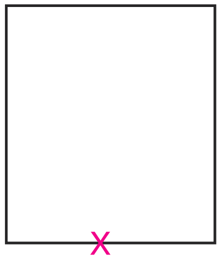
sample location: left edge, 22.3" from top
(T 56.6 x L 0.0 cm.)

Representative Analysis Compilation—sample Ecs04





photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification
interpretation: cotton

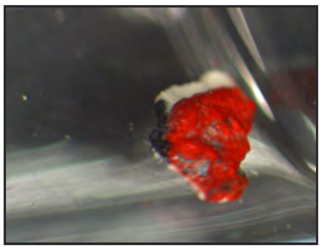


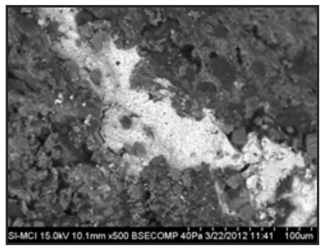
no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: red, possible white underlayer

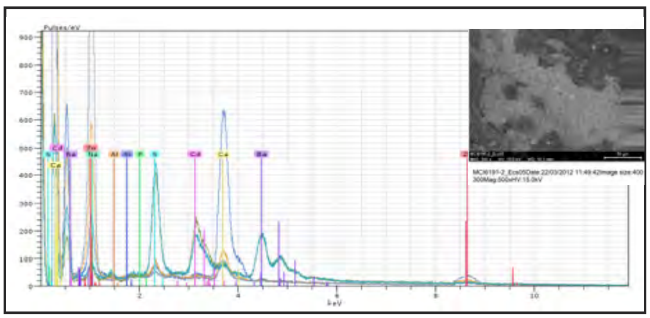
sample location: bottom edge, 27.5" from left
(B 0.0 x L 69.9 cm.)

Representative Analysis Compilation—sample Ecs05

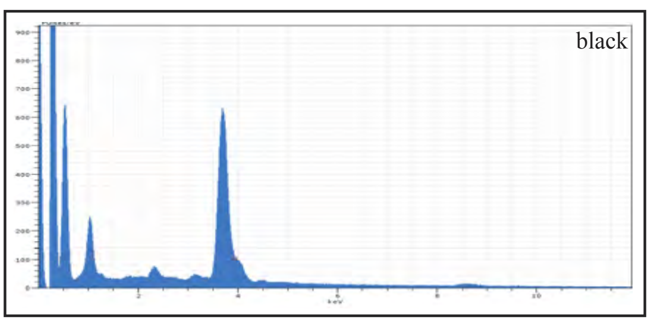




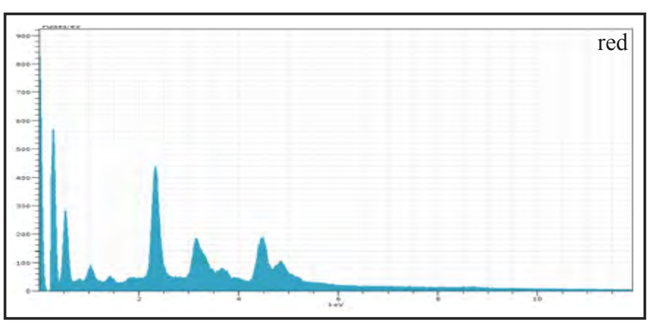
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, black: Ca, P
significant elements, red: Cd, S, Se
interpretation: bone black, cadmium red



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	14.28	15.86	3.12	0.96
Calcium	K-series	52.44	37.75	27.19	1.95
Zinc	K-series	21.50	15.48	6.83	0.80
Barium	L-series	8.76	6.31	1.33	0.83
Sodium	K-series	3.83	2.76	3.46	3.04
Cadmium	L-series	3.63	2.62	0.67	0.93
Sulfur	K-series	2.03	1.46	1.31	0.10
Magnesium	K-series	0.95	0.68	0.81	0.09
Chlorine	K-series	0.84	0.61	0.49	0.06
Phosphorus	K-series	0.42	0.31	0.28	0.05
Silicon	K-series	0.27	0.19	0.20	0.04
Aluminium	K-series	0.05	0.04	0.04	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	44.18	31.80	57.37	31.28
	Sum:	138.92	100.00	100.00	



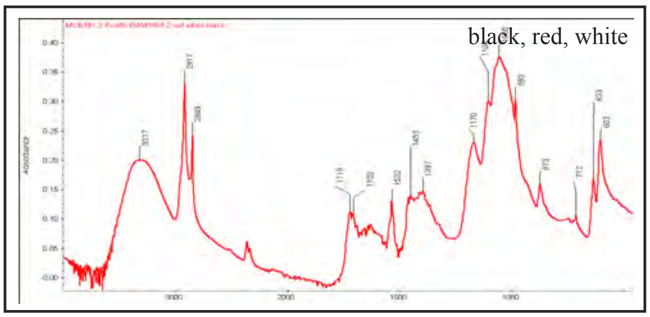
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	18.22	20.17	4.75	1.46
Sulfur	K-series	15.25	16.89	17.04	0.57
Cadmium	L-series	14.07	15.58	4.48	3.09
Zinc	K-series	4.65	5.15	2.55	0.21
Titanium	K-series	4.03	4.46	3.01	0.75
Calcium	K-series	1.90	2.10	1.70	0.26
Sodium	K-series	1.31	1.45	2.04	1.06
Potassium	K-series	1.20	1.33	1.10	0.84
Selenium	L-series	0.63	0.70	0.29	0.08
Chlorine	K-series	0.61	0.68	0.62	0.06
Phosphorus	K-series	0.57	0.63	0.66	0.05
Silicon	K-series	0.47	0.52	0.60	0.05
Aluminium	K-series	0.13	0.15	0.17	0.13
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	27.24	30.17	60.99	28.89
	Sum:	90.30	100.00	100.00	

no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: red, possible white underlayer

sample location: bottom edge, 27.5" from left
(B 0.0 x L 69.9 cm.)

Representative Analysis Compilation—sample Ecs05, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil, fillers

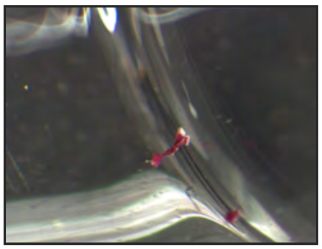
X

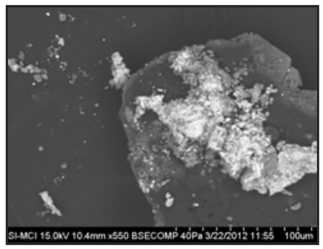
no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: magenta

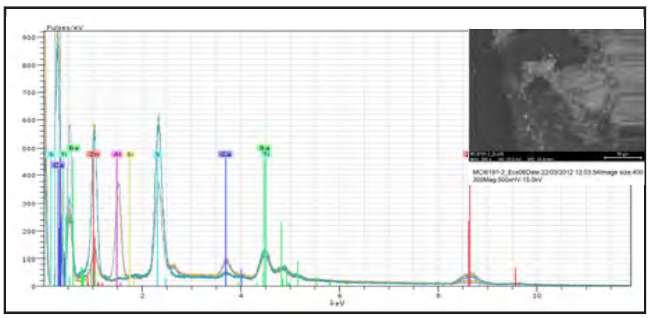
sample location: 15.4" from top, 20.4" from right (T 39.1 x R 51.8 cm.)

Representative Analysis Compilation—sample Ecs06

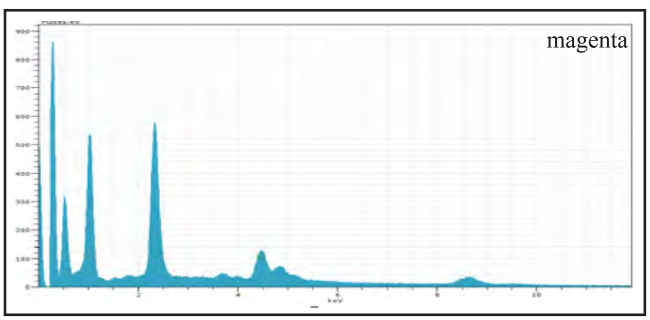




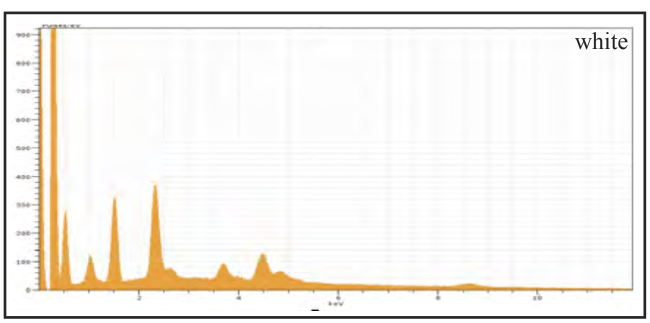
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.4 mm.



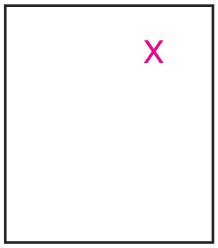
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.4 mm.
mag: 500x; HV: 15 kV
significant elements, magenta: Ba
significant elements, white: Zn
interpretation: possible synthetic alizarin, zinc white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	24.71	28.95	15.27	0.88
Sulfur	K-series	21.75	25.49	27.41	0.80
Barium	L-series	12.35	14.47	3.63	1.09
Sodium	K-series	5.96	6.98	10.48	4.72
Titanium	K-series	3.00	3.52	2.53	0.62
Calcium	K-series	0.77	0.90	0.78	0.06
Chlorine	K-series	0.75	0.87	0.85	0.06
Silicon	K-series	0.52	0.60	0.74	0.05
Aluminium	K-series	0.25	0.29	0.37	0.04
Potassium	K-series	0.22	0.26	0.23	0.05
Phosphorus	K-series	0.21	0.24	0.27	0.04
Magnesium	K-series	0.12	0.14	0.19	0.04
Oxygen	K-series	14.75	17.28	37.24	14.66
	Sum:	85.36	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Sulfur	K-series	8.37	12.71	8.95	0.32
Aluminium	K-series	7.93	12.05	10.08	0.40
Zinc	K-series	6.11	9.27	3.20	0.25
Barium	L-series	3.60	5.46	0.90	0.52
Sodium	K-series	2.74	4.16	4.09	2.18
Titanium	K-series	2.48	3.77	1.78	0.36
Calcium	K-series	1.29	1.97	1.11	0.07
Chlorine	K-series	1.10	1.67	1.06	0.06
Phosphorus	K-series	0.09	0.14	0.10	0.03
Potassium	K-series	0.07	0.11	0.06	0.03
Silicon	K-series	0.06	0.09	0.08	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	31.99	48.60	68.59	33.52
	Sum:	65.83	100.00	100.00	

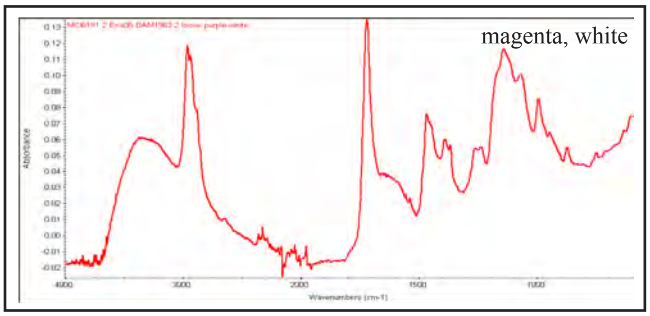


no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: magenta

sample location: 15.4" from top, 20.4" from right
(T 39.1 x R 51.8 cm.)

Representative Analysis Compilation—sample Ecs06, continued



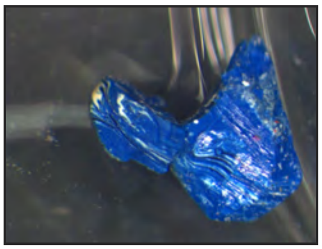
analysis: ATR-FTIR
by: DVR (MCI)
date: 03/14/13
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

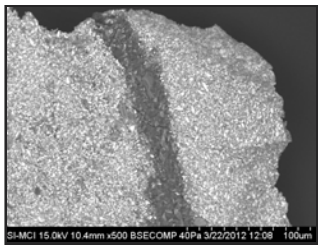
no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: blue

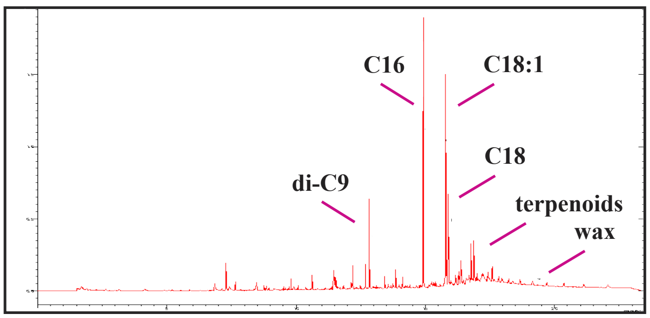
sample location: left edge, 17.0" from top
(T 43.2 x L 0.0 cm.)

Representative Analysis Compilation—sample Ecs07

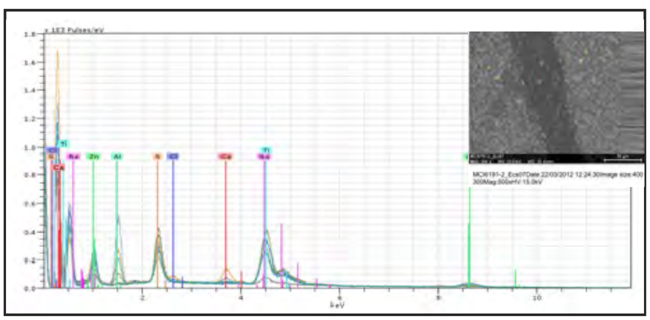




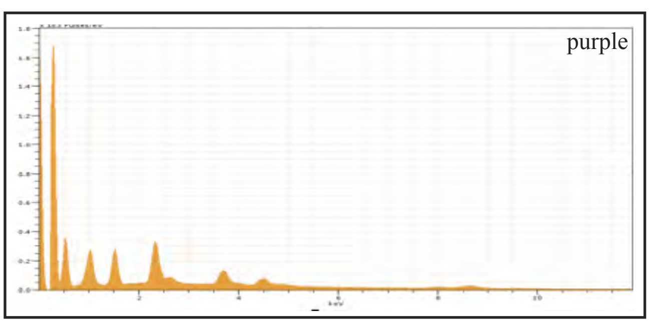
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.4 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 03/16/12
sample weight: 0.300
scan range: 1 - 1477
time range: 0.00 - 23.33 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, terpenoids, wax
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.4 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Al, Cu, Cl
significant elements, blue: Na
significant elements, white: Zn, Ti
interpretation: possible synthetic alizarin, phthalo blue, ultramarine blue, Zn/Ti white



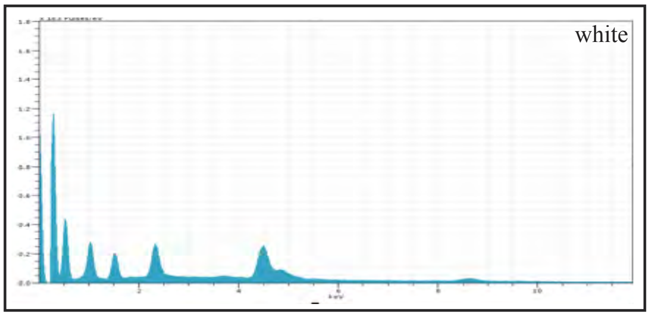
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	15.40	19.58	8.87	0.57
Aluminium	K-series	9.74	12.38	13.59	0.48
Sulfur	K-series	9.26	11.77	10.87	0.36
Copper	K-series	5.74	7.30	3.40	0.24
Sodium	K-series	4.97	6.31	8.13	3.93
Barium	L-series	4.84	6.15	1.33	0.66
Calcium	K-series	4.41	5.60	4.14	0.17
Chlorine	K-series	2.27	2.89	2.41	0.11
Titanium	K-series	1.97	2.51	1.55	0.40
Silicon	K-series	0.51	0.64	0.68	0.05
Phosphorus	K-series	0.46	0.58	0.56	0.05
Potassium	K-series	0.21	0.27	0.20	0.05
Magnesium	K-series	0.20	0.26	0.31	0.04
Oxygen	K-series	18.69	23.76	43.97	17.25
	Sum:	78.67	100.00	100.00	

no image available

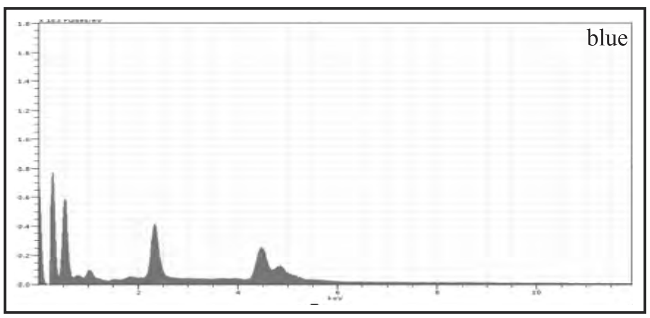
acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: blue

sample location: left edge, 17.0" from top
(T 43.2 x L 0.0 cm.)

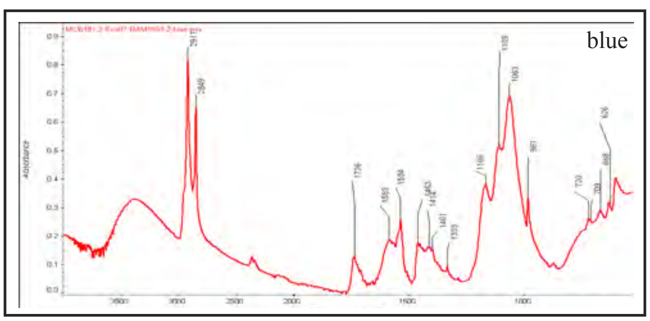
Representative Analysis Compilation—sample Ecs07, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	17.63	21.17	10.12	0.64
Barium	L-series	13.67	16.41	3.74	1.56
Titanium	K-series	10.93	13.12	8.56	1.26
Aluminium	K-series	7.49	8.99	10.42	0.38
Sodium	K-series	7.21	8.65	11.76	5.70
Sulfur	K-series	4.59	5.51	5.37	0.19
Calcium	K-series	0.43	0.51	0.40	0.05
Silicon	K-series	0.13	0.15	0.17	0.03
Chlorine	K-series	0.12	0.15	0.13	0.03
Potassium	K-series	0.09	0.11	0.09	0.03
Phosphorus	K-series	0.03	0.03	0.03	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	20.98	25.19	49.21	17.33
	Sum:	83.28	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	19.99	23.28	4.43	1.49
Sulfur	K-series	12.78	14.88	12.12	0.48
Titanium	K-series	5.20	6.06	3.30	0.80
Sodium	K-series	4.26	4.96	5.63	3.38
Zinc	K-series	3.56	4.15	1.66	0.17
Magnesium	K-series	1.17	1.37	1.47	0.10
Silicon	K-series	0.93	1.08	1.01	0.07
Chlorine	K-series	0.71	0.83	0.61	0.05
Phosphorus	K-series	0.62	0.72	0.61	0.05
Aluminium	K-series	0.45	0.52	0.50	0.05
Potassium	K-series	0.07	0.08	0.05	0.03
Calcium	K-series	0.05	0.05	0.04	0.03
Oxygen	K-series	36.09	42.02	68.58	26.92
	Sum:	85.88	100.00	100.00	



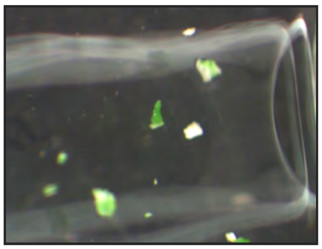
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PB15

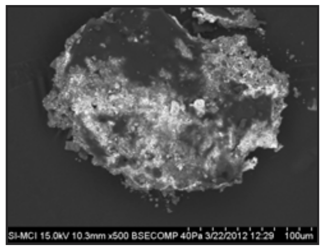
no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: green

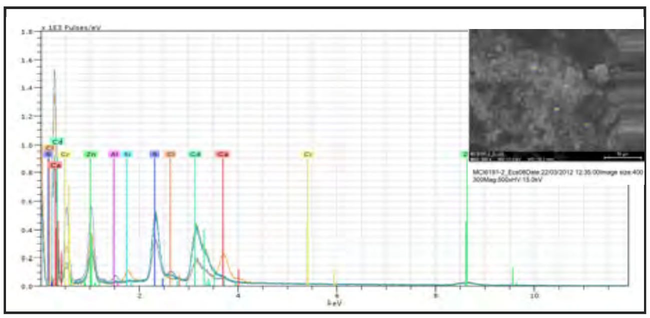
sample location: 6.5" from top, 22.1" from left
(T 16.5 x L 56.1 cm.)

Representative Analysis Compilation—sample Ecs08

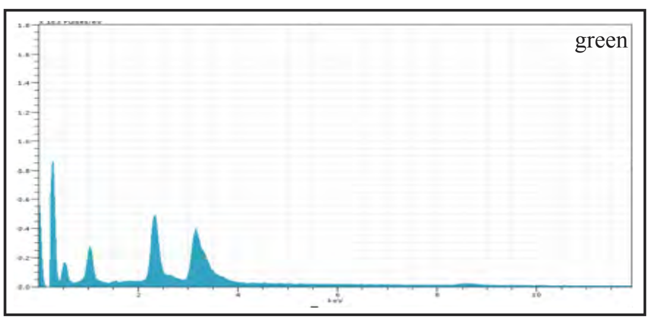




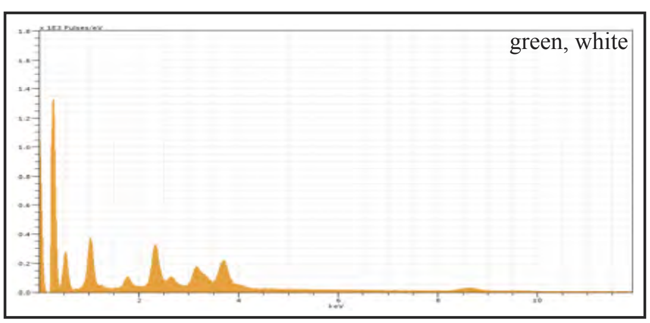
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.3 mm.



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.3 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cd, S, Cl Cu
significant elements, white: Zn
interpretation: cadmium red, phthalo green, zinc white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	45.83	37.58	13.86	7.02
Sulfur	K-series	22.80	18.70	24.17	0.83
Zinc	K-series	16.88	13.85	8.78	0.63
Sodium	K-series	7.62	6.25	11.27	6.02
Potassium	K-series	4.99	4.09	4.33	2.62
Chlorine	K-series	2.87	2.35	2.75	0.15
Copper	K-series	2.37	1.95	1.27	0.14
Calcium	K-series	1.76	1.44	1.49	0.41
Silicon	K-series	0.71	0.59	0.86	0.06
Aluminium	K-series	0.61	0.50	0.77	0.06
Chromium	K-series	0.59	0.49	0.39	0.06
Magnesium	K-series	0.46	0.38	0.65	0.06
Barium	L-series	0.46	0.38	0.11	0.16
Phosphorus	K-series	0.34	0.28	0.38	0.05
Titanium	K-series	0.04	0.03	0.03	0.05
Oxygen	K-series	13.60	11.15	28.90	21.86
	Sum:	121.94	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	19.20	20.23	10.07	0.70
Cadmium	L-series	15.23	16.05	4.65	3.36
Calcium	K-series	11.58	12.21	9.91	0.60
Sulfur	K-series	11.27	11.88	12.06	0.43
Sodium	K-series	10.87	11.45	16.21	8.58
Chlorine	K-series	3.54	3.73	3.42	0.15
Silicon	K-series	3.03	3.19	3.70	0.16
Potassium	K-series	1.29	1.36	1.13	0.90
Magnesium	K-series	0.99	1.04	1.39	0.33
Barium	L-series	0.34	0.36	0.08	0.11
Phosphorus	K-series	0.26	0.28	0.29	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	17.30	18.24	37.09	17.86
	Sum:	94.89	100.00	100.00	

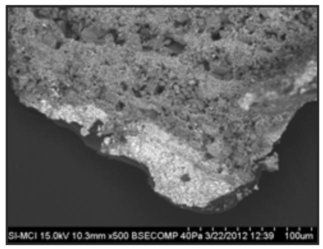
X

no image available

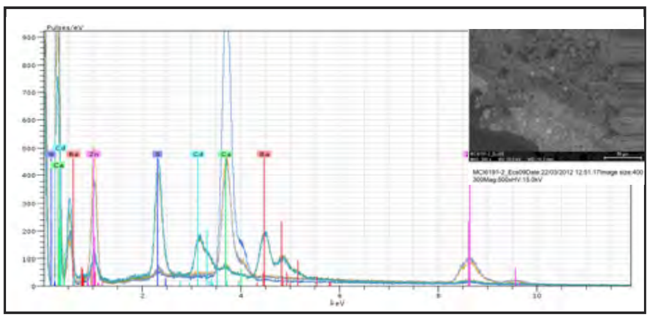
acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: yellow wash, possible white underlayer

sample location: 29.1" from top, 25.9" from left
(T 73.9 x L 65.8 cm.)

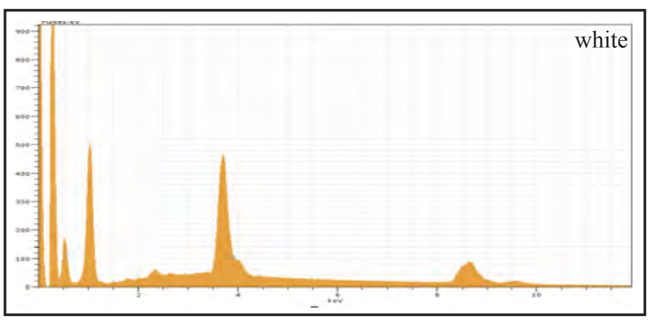
Representative Analysis Compilation—sample Ecs09



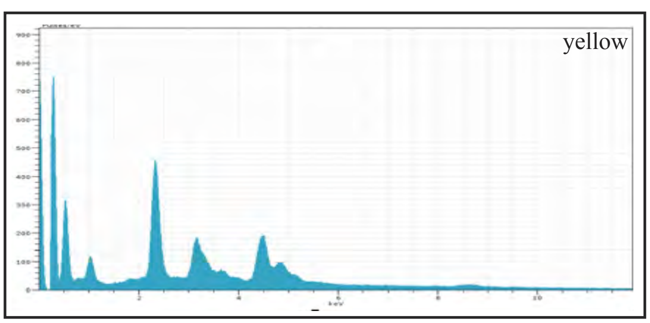
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.3 mm.



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.3 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn
significant elements, yellow: Cd, S
interpretation: cadmium yellow, zinc white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	42.95	52.17	30.08	1.46
Calcium	K-series	15.39	18.69	17.58	0.49
Sodium	K-series	14.54	17.66	28.97	11.47
Sulfur	K-series	1.11	1.35	1.59	0.07
Chlorine	K-series	0.47	0.57	0.61	0.04
Silicon	K-series	0.31	0.38	0.51	0.04
Potassium	K-series	0.28	0.33	0.32	0.05
Phosphorus	K-series	0.10	0.12	0.15	0.03
Barium	L-series	0.09	0.11	0.03	0.06
Aluminium	K-series	0.06	0.08	0.11	0.03
Magnesium	K-series	0.05	0.06	0.09	0.04
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	6.98	8.47	19.97	8.88
	Sum:	82.34	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	20.64	21.46	5.23	1.58
Sulfur	K-series	16.30	16.94	17.67	0.60
Cadmium	L-series	13.10	13.62	4.05	3.02
Zinc	K-series	10.17	10.57	5.41	0.40
Titanium	K-series	3.59	3.73	2.60	0.78
Sodium	K-series	2.16	2.25	3.27	1.73
Potassium	K-series	1.25	1.30	1.11	0.88
Calcium	K-series	1.07	1.12	0.93	0.20
Silicon	K-series	0.30	0.31	0.37	0.04
Phosphorus	K-series	0.29	0.30	0.32	0.04
Chlorine	K-series	0.27	0.29	0.27	0.05
Aluminium	K-series	0.02	0.02	0.02	0.04
Magnesium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	27.04	28.10	58.74	26.78
	Sum:	96.20	100.00	100.00	

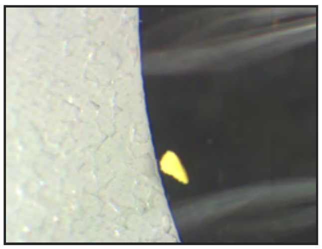
X

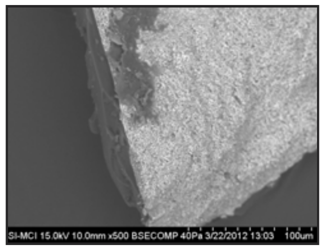
no image available

acc. no.: BAM 1963.2
title, year: *Ecstasy*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 68.0 x 60.0" (172.7 x 152.4 cm.)
notes: green yellow

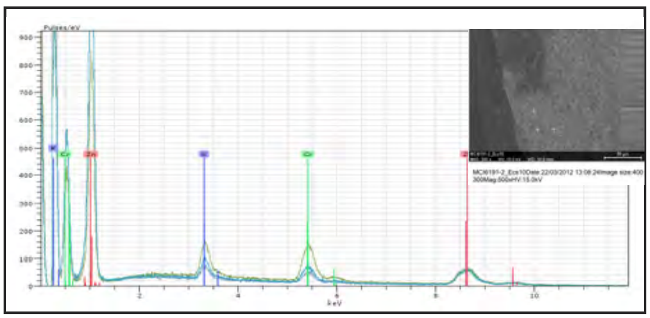
sample location: 32.1" from top, 29.8" from left
(T 81.5 x L 75.7 cm.)

Representative Analysis Compilation—sample Ecs10

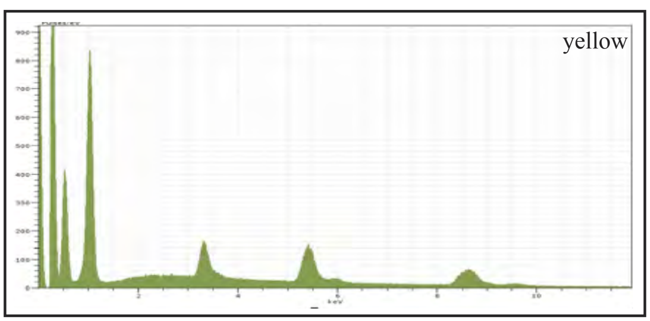




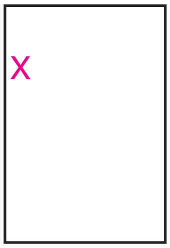
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.

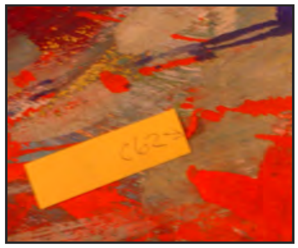


analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Zn, Cr
interpretation: zinc yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	47.80	47.46	26.20	1.63
Sodium	K-series	21.57	21.42	33.64	17.00
Chromium	K-series	14.57	14.46	10.04	0.45
Potassium	K-series	4.36	4.33	4.00	0.16
Sulfur	K-series	0.30	0.30	0.34	0.04
Phosphorus	K-series	0.29	0.28	0.33	0.04
Barium	L-series	0.20	0.20	0.05	0.09
Chlorine	K-series	0.19	0.19	0.19	0.03
Silicon	K-series	0.17	0.17	0.22	0.04
Calcium	K-series	0.17	0.17	0.15	0.05
Aluminium	K-series	0.03	0.03	0.04	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	11.06	10.99	24.79	17.72
	Sum:	100.71	100.00	100.00	

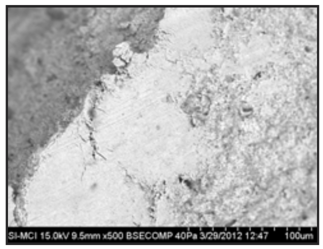





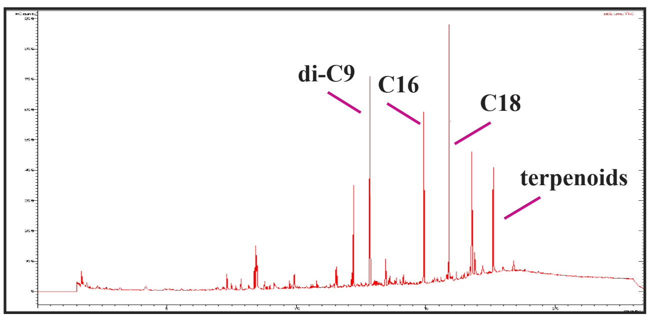
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: bright red

sample location: 16.5" from top, 4.0" from left
(T 41.9 x L 10.2 cm.)

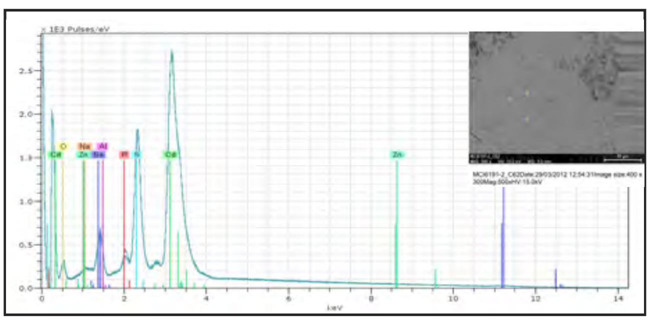
Representative Analysis Compilation—sample C062

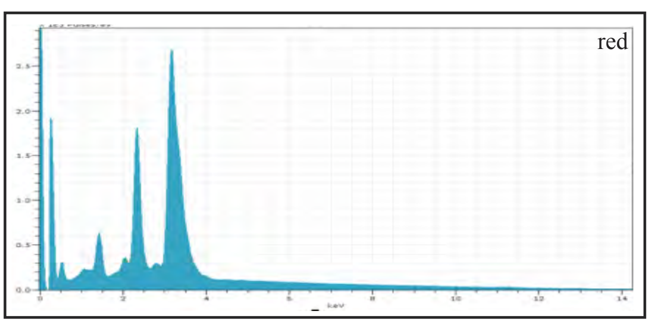
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



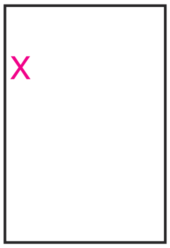
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.223
scan range: 1 - 1485
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil

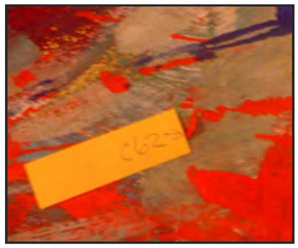


analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	29.83	37.72	16.49	2.37
Zinc	K-series	15.29	19.33	14.53	0.54
Sulfur	K-series	10.88	13.76	21.08	0.41
Potassium	K-series	6.13	7.75	9.75	0.81
Selenium	L-series	4.31	5.45	3.39	0.30
Barium	L-series	3.37	4.26	1.53	0.27
Phosphorus	K-series	1.00	1.26	2.01	0.06
Sodium	K-series	0.36	0.46	0.98	0.31
Aluminium	K-series	0.31	0.39	0.71	0.26
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
Chlorine	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	7.61	9.62	29.54	7.64
	Sum:	79.09	100.00	100.00	

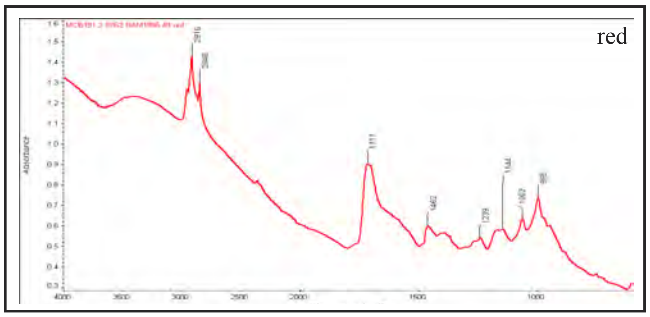




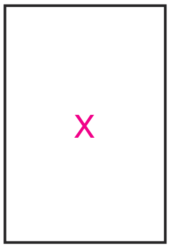
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: bright red

sample location: 16.5" from top, 4.0" from left
(T 41.9 x L 10.2 cm.)

Representative Analysis Compilation—sample C062, continued



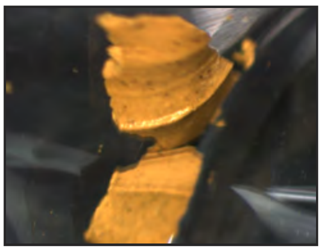
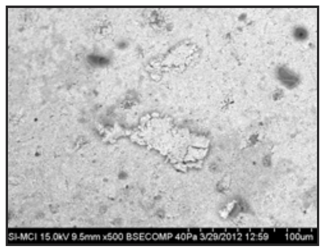
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

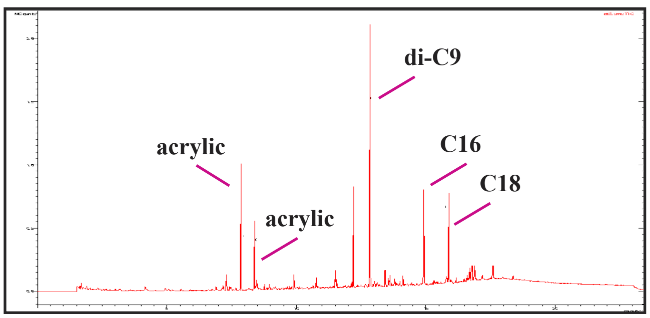
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: dark yellow

sample location: 31.0" from top, 20.0" from left
(T 78.7 x L 50.8 cm.)

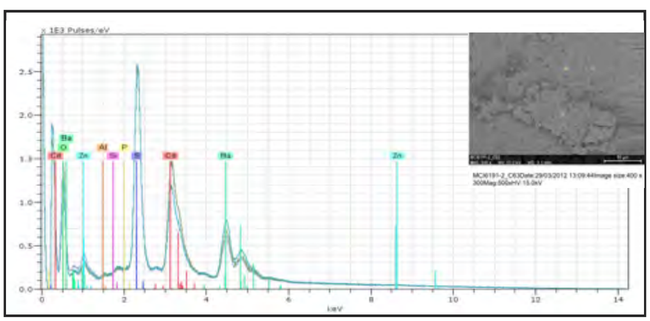
Representative Analysis Compilation—sample C063

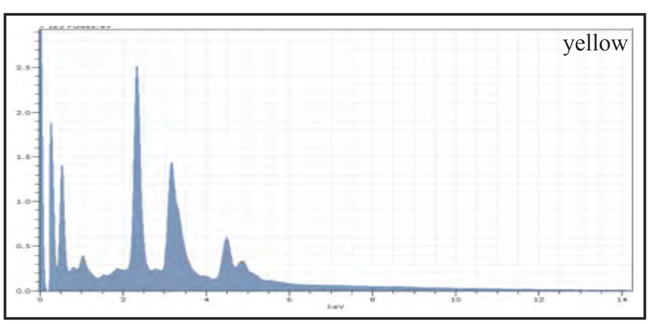
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



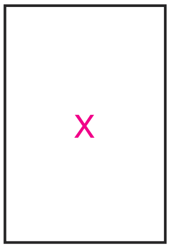
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.399
scan range: 1 - 1488
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, acrylics
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
interpretation: cadmium yellow



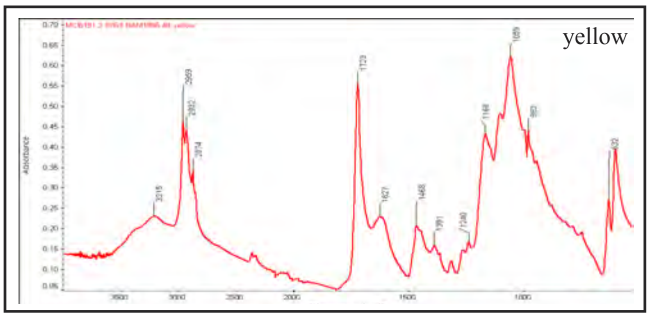
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	19.30	20.17	4.68	1.26
Cadmium	L-series	17.65	18.44	5.22	1.75
Sulfur	K-series	14.30	14.94	14.83	0.53
Zinc	K-series	7.11	7.43	3.62	0.27
Potassium	K-series	2.80	2.93	2.38	0.61
Sodium	K-series	1.10	1.15	1.59	0.89
Titanium	K-series	0.89	0.93	0.62	0.37
Silicon	K-series	0.31	0.32	0.36	0.04
Phosphorus	K-series	0.25	0.27	0.27	0.04
Magnesium	K-series	0.06	0.06	0.08	0.05
Aluminium	K-series	0.06	0.06	0.07	0.07
Calcium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	31.87	33.30	66.26	16.50
	Sum:	95.71	100.00	100.00	



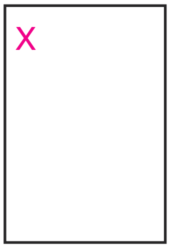
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: dark yellow

sample location: 31.0" from top, 20.0" from left
(T 78.7 x L 50.8 cm.)

Representative Analysis Compilation—sample C063, continued



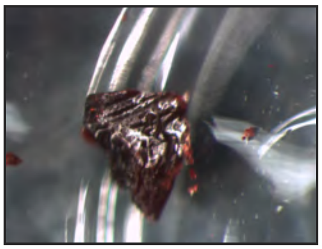
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil, fillers

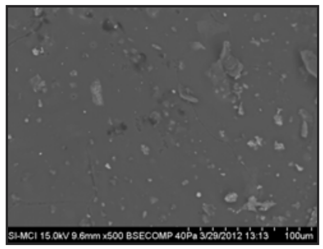


acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: magenta

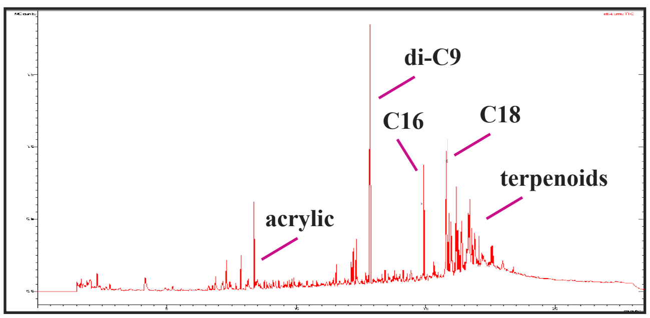
sample location: 6.0" from top, 2.5" from left
(T 15.2 x L 6.4 cm.)

Representative Analysis Compilation—sample C064

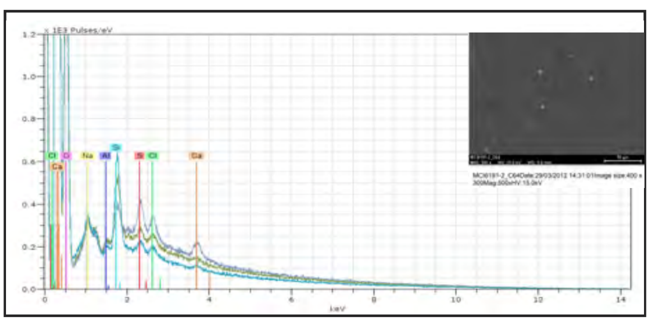




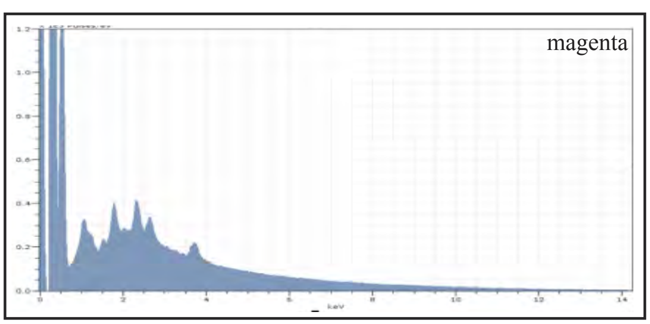
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



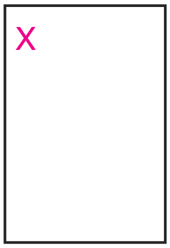
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.322
scan range: 1 - 1482
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18, acrylic, terpenoids
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, magenta: none
interpretation: possible synthetic color



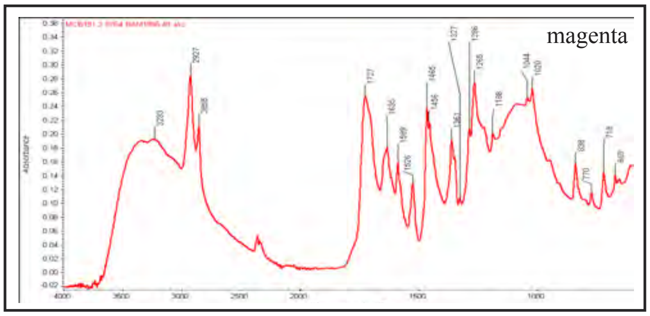
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	0.67	0.67	0.17	0.05
Sodium	K-series	0.60	0.60	0.43	0.50
Calcium	K-series	0.42	0.42	0.17	0.04
Silicon	K-series	0.36	0.36	0.21	0.04
Chlorine	K-series	0.35	0.35	0.16	0.04
Sulfur	K-series	0.33	0.33	0.17	0.04
Barium	L-series	0.26	0.26	0.03	0.05
Magnesium	K-series	0.20	0.20	0.13	0.04
Potassium	K-series	0.05	0.05	0.02	0.03
Aluminium	K-series	0.04	0.04	0.02	0.03
Phosphorus	K-series	0.02	0.02	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	96.71	96.71	98.48	39.56
	Sum:	100.00	100.00	100.00	



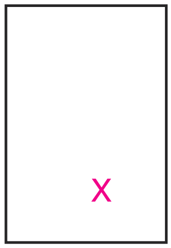
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: magenta

sample location: 6.0" from top, 2.5" from left
(T 15.2 x L 6.4 cm.)

Representative Analysis Compilation—sample C064, continued



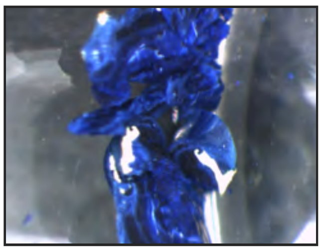
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR83

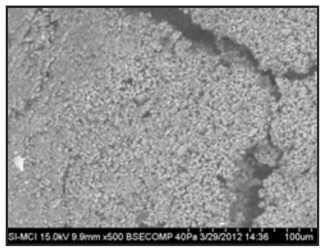


acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: blue

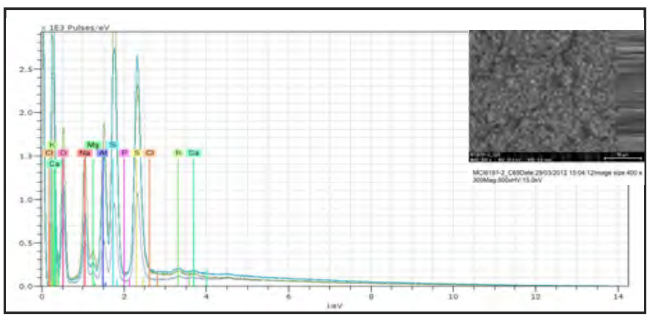
sample location: 15.0" from bottom, 21.0" from left
(B 38.1 x L 53.3 cm.)

Representative Analysis Compilation—sample C065

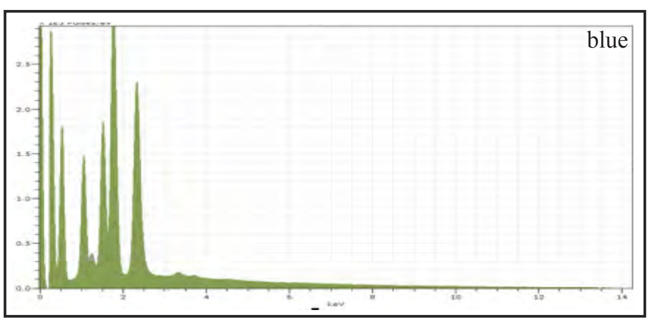




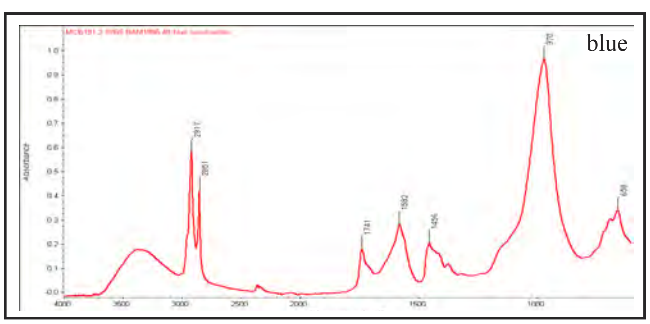
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



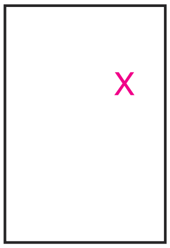
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Al
interpretation: ultramarine blue



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Silicon	K-series	13.33	17.90	13.67	0.58
Sulfur	K-series	12.16	16.32	10.92	0.45
Sodium	K-series	6.24	8.37	7.81	4.93
Aluminium	K-series	5.05	6.78	5.39	0.26
Zinc	K-series	2.56	3.44	1.13	0.12
Barium	L-series	0.75	1.01	0.16	0.09
Magnesium	K-series	0.45	0.61	0.54	0.05
Potassium	K-series	0.32	0.43	0.24	0.04
Calcium	K-series	0.20	0.27	0.15	0.03
Chlorine	K-series	0.13	0.18	0.11	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	33.29	44.68	59.90	14.90
	Sum:	74.50	100.00	100.00	



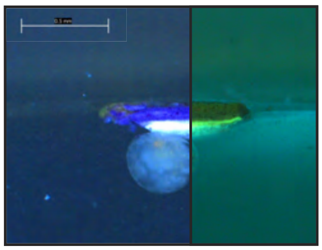
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

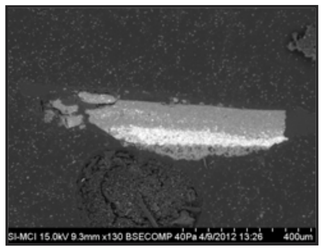


acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: purple, likely varnish

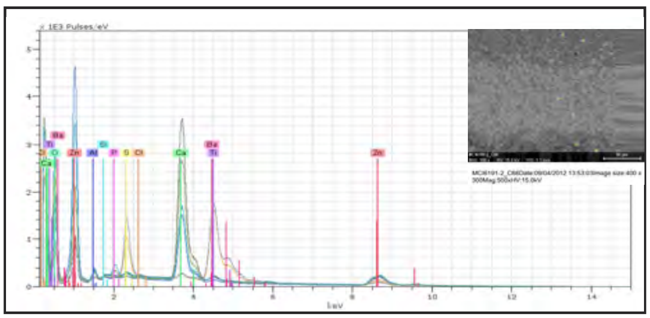
sample location: 16.0" from top, 8.0" from right
(T 40.6 x R 20.3 cm.)

Representative Analysis Compilation—sample C066

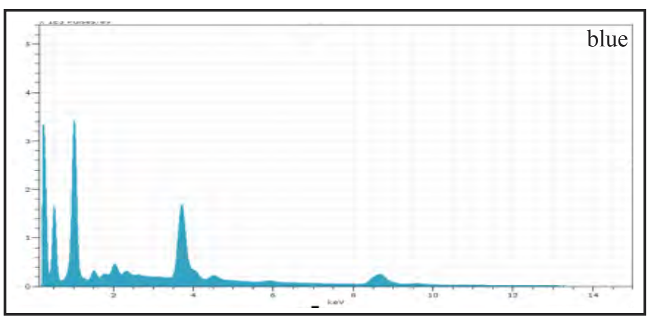




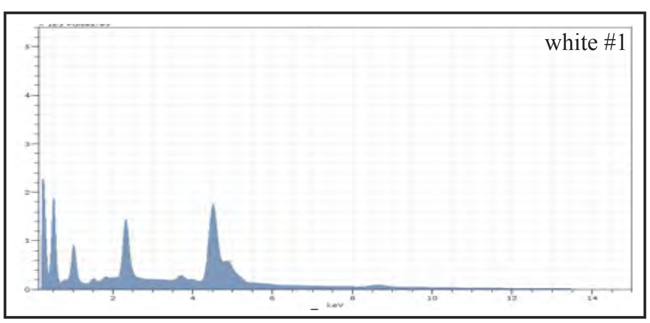
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.3 mm.



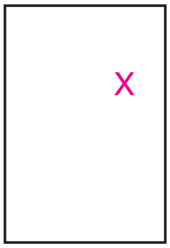
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.1 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na
significant elements, white #1: Ti
significant elements, white #2: Zn
interpretation: ultramarine blue, Ti/Zn white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	35.58	40.22	19.46	1.20
Sodium	K-series	16.71	18.89	26.00	13.18
Calcium	K-series	14.54	16.44	12.98	0.46
Titanium	K-series	1.67	1.89	1.25	0.18
Phosphorus	K-series	1.01	1.14	1.16	0.06
Aluminium	K-series	0.93	1.05	1.23	0.07
Manganese	K-series	0.68	0.77	0.45	0.05
Sulfur	K-series	0.25	0.28	0.28	0.03
Barium	L-series	0.22	0.25	0.06	0.13
Silicon	K-series	0.19	0.22	0.24	0.03
Chlorine	K-series	0.13	0.15	0.13	0.03
Magnesium	K-series	0.12	0.13	0.17	0.03
Potassium	K-series	0.11	0.13	0.11	0.04
Oxygen	K-series	16.31	18.44	36.47	17.27
	Sum:	88.47	100.00	100.00	



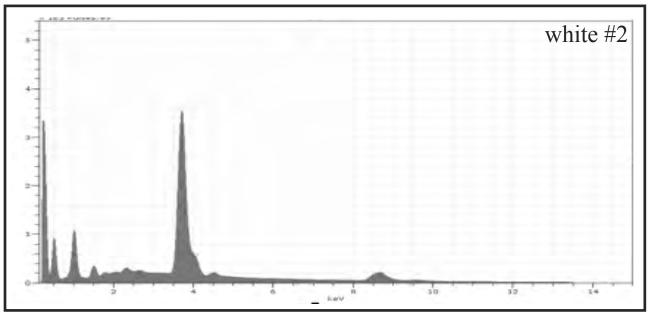
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	27.28	35.23	12.97	1.82
Titanium	K-series	18.64	24.07	25.43	1.39
Sulfur	K-series	10.58	13.66	21.55	0.40
Zinc	K-series	8.63	11.14	8.62	0.32
Sodium	K-series	7.95	10.27	22.60	6.29
Calcium	K-series	1.04	1.35	1.70	0.06
Chlorine	K-series	0.99	1.28	1.83	0.06
Phosphorus	K-series	0.79	1.02	1.66	0.06
Silicon	K-series	0.77	1.00	1.80	0.06
Aluminium	K-series	0.70	0.90	1.69	0.06
Magnesium	K-series	0.06	0.07	0.16	0.03
	Sum:	77.45	100.00	100.00	



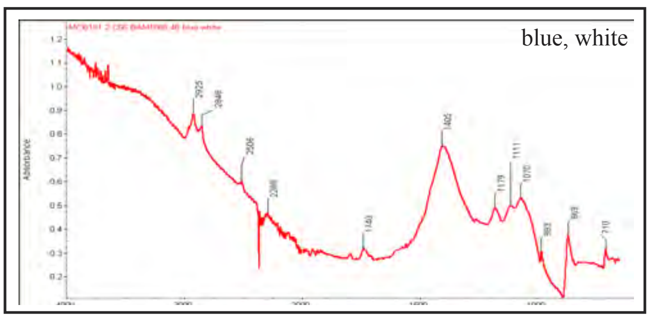
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: purple, likely varnish

sample location: 16.0" from top, 8.0" from right (T 40.6 x R 20.3 cm.)

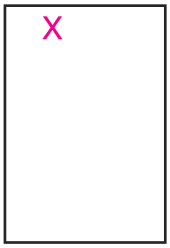
Representative Analysis Compilation—sample C066, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	34.12	42.89	43.02	1.04
Zinc	K-series	27.56	34.65	21.30	0.93
Sodium	K-series	12.46	15.66	27.38	9.83
Aluminium	K-series	2.13	2.68	4.00	0.13
Titanium	K-series	1.38	1.73	1.46	0.16
Sulfur	K-series	0.67	0.84	1.06	0.05
Chlorine	K-series	0.64	0.81	0.91	0.05
Potassium	K-series	0.27	0.34	0.35	0.05
Magnesium	K-series	0.14	0.18	0.29	0.04
Phosphorus	K-series	0.07	0.09	0.11	0.03
Silicon	K-series	0.06	0.08	0.11	0.03
Barium	L-series	0.04	0.05	0.01	0.05
	Sum:	79.55	100.00	100.00	



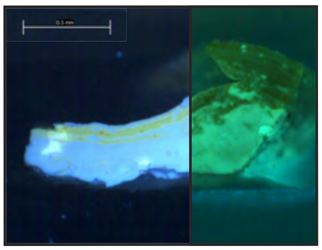
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: fillers, interference

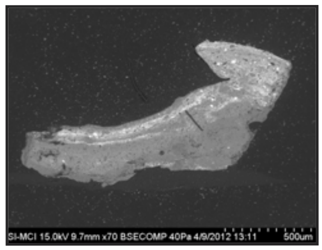


acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: lemon yellow

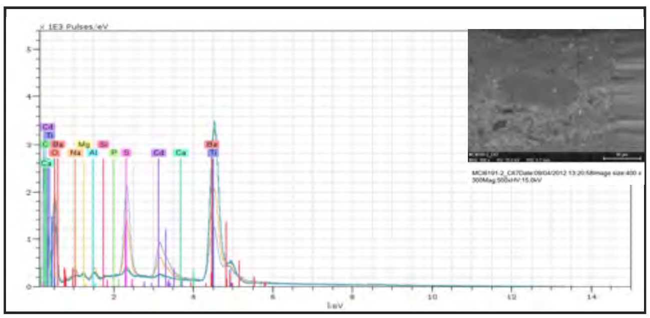
sample location: 4.0" from top, 11.5" from left
(T 10.2 x L 29.2 cm.)

Representative Analysis Compilation—sample C067

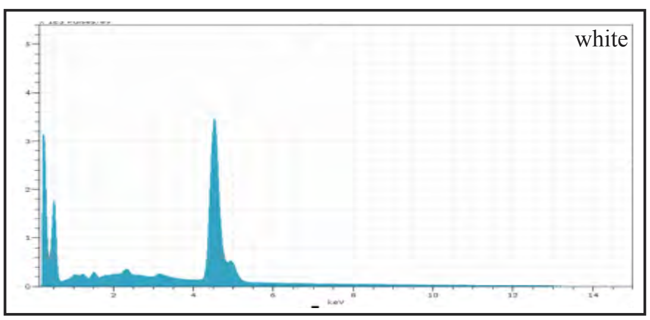




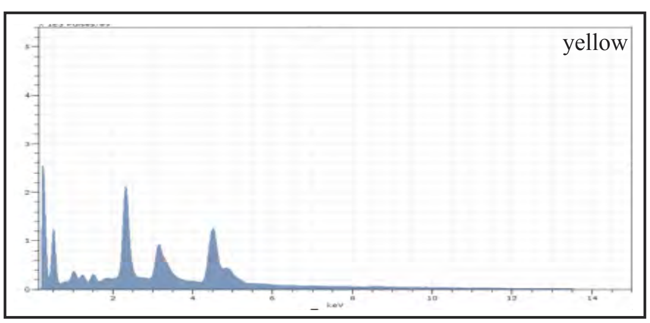
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



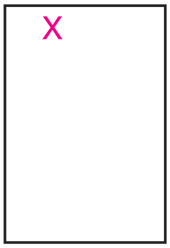
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, white: Ti, Zn
significant elements, yellow: Cd, S
interpretation: cadmium yellow, Ti/Zn white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Titanium	K-series	53.59	51.60	28.41	1.80
Carbon	K-series	7.88	7.58	16.65	12.58
Cadmium	L-series	2.38	2.29	0.54	0.53
Barium	L-series	2.26	2.17	0.42	1.13
Zinc	K-series	2.16	2.08	0.84	0.10
Sulfur	K-series	1.34	1.29	1.06	0.07
Chlorine	K-series	0.72	0.69	0.51	0.05
Phosphorus	K-series	0.60	0.58	0.50	0.05
Sodium	K-series	0.51	0.49	0.56	0.42
Aluminium	K-series	0.43	0.41	0.40	0.35
Magnesium	K-series	0.36	0.35	0.38	0.09
Calcium	K-series	0.23	0.22	0.15	0.06
Silicon	K-series	0.18	0.18	0.17	0.03
Potassium	K-series	0.12	0.11	0.08	0.10
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	31.11	29.95	49.36	14.07
	Sum:	103.86	100.00	100.00	



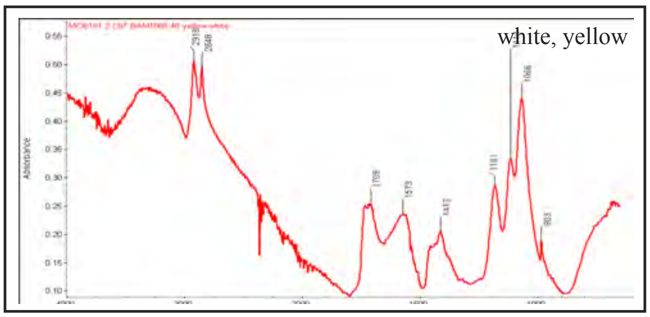
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	18.60	18.23	4.45	1.34
Sulfur	K-series	15.23	14.93	15.60	0.56
Cadmium	L-series	14.17	13.89	4.14	1.61
Titanium	K-series	11.87	11.64	8.14	1.00
Zinc	K-series	7.98	7.82	4.01	0.29
Potassium	K-series	1.78	1.74	1.50	0.57
Sodium	K-series	1.31	1.28	1.87	1.05
Magnesium	K-series	0.98	0.96	1.33	0.16
Aluminium	K-series	0.96	0.94	1.17	0.75
Chlorine	K-series	0.85	0.83	0.79	0.06
Phosphorus	K-series	0.57	0.56	0.60	0.05
Silicon	K-series	0.46	0.45	0.54	0.05
Calcium	K-series	0.09	0.08	0.07	0.08
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	27.19	26.65	55.81	14.44
	Sum:	102.04	100.00	100.00	



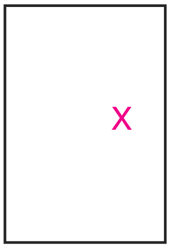
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: lemon yellow

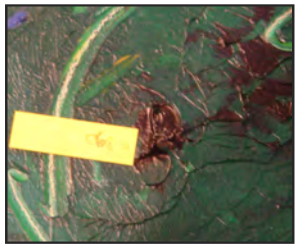
sample location: 4.0" from top, 11.5" from left
(T 10.2 x L 29.2 cm.)

Representative Analysis Compilation—sample C067, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

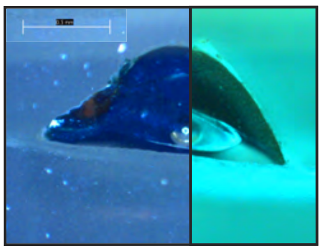
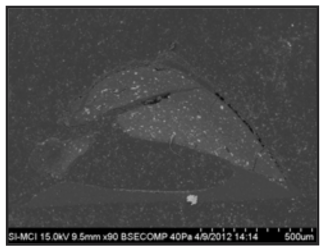





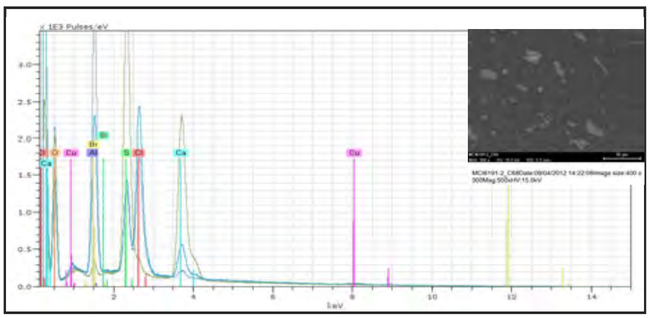
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: deep green

sample location: 30.0" from top, 11.0" from right
(T 76.2 x R 27.9 cm.)

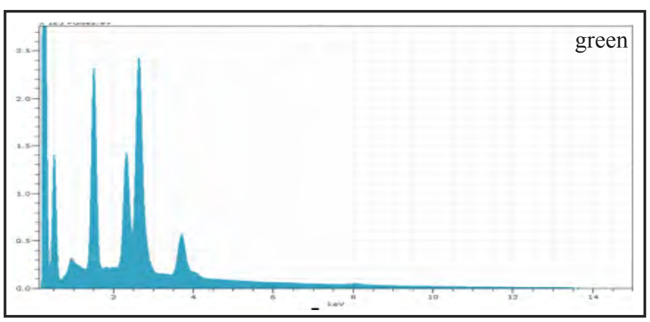
Representative Analysis Compilation—sample C068

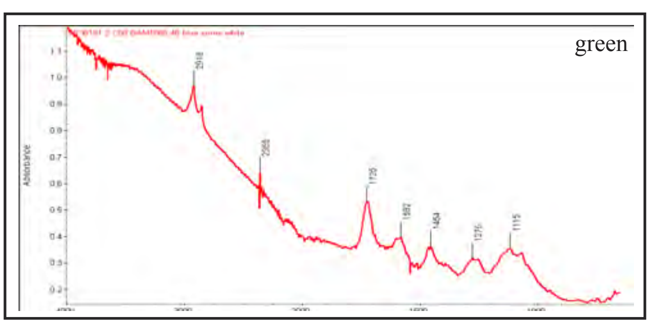
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



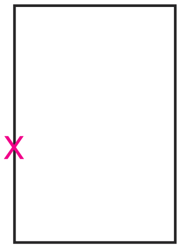
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cl, Cu, Br with chunks of Ca, S
interpretation: phthalo green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Chlorine	K-series	12.63	17.87	12.25	0.44
Bromine	L-series	12.56	17.78	5.41	2.48
Sulfur	K-series	5.11	7.23	5.48	0.21
Calcium	K-series	3.81	5.39	3.27	0.14
Aluminium	K-series	2.57	3.64	3.28	1.98
Copper	K-series	1.24	1.75	0.67	0.07
Sodium	K-series	0.99	1.40	1.47	0.18
Silicon	K-series	0.04	0.05	0.05	0.04
Phosphorus	K-series	0.03	0.04	0.03	0.03
Potassium	K-series	0.01	0.01	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	31.69	44.85	68.10	3.52
	Sum:	70.66	100.00	100.00	



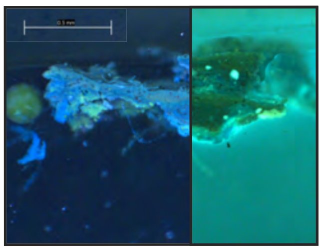
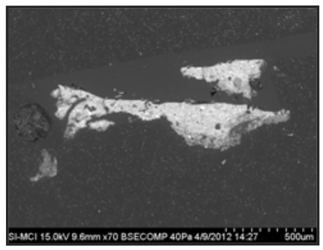
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: carbon interference

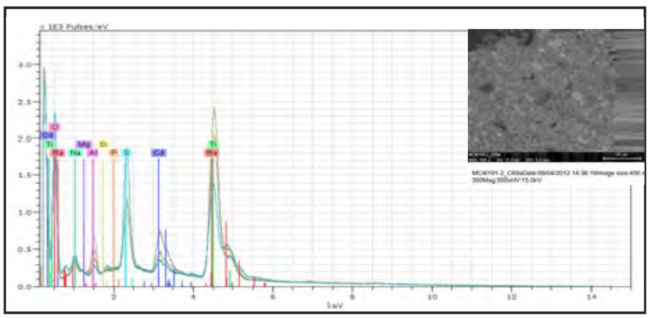
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: teal, likely adhesive

sample location: left edge, 23.5" from bottom
(T 41.9 x L 10.2 cm.)

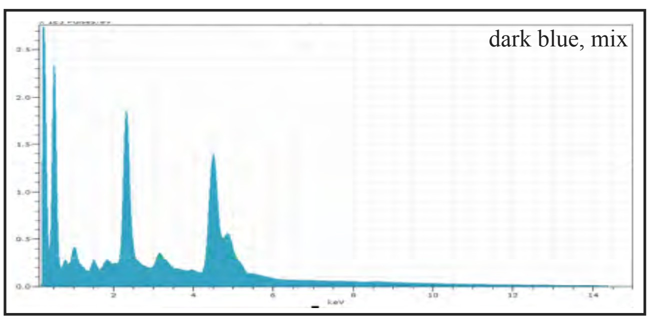
Representative Analysis Compilation—sample C069

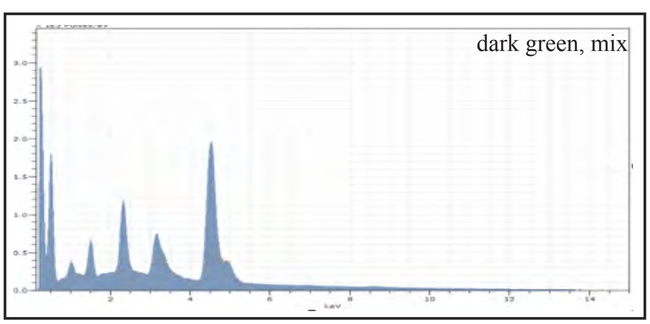
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.6 mm.



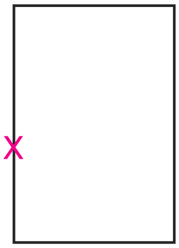
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, blue mix: Na, Al
significant elements, green mix: Cd, S
interpretation: ultramarine blue, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	21.36	24.49	4.73	1.46
Titanium	K-series	10.26	11.77	6.52	0.96
Sulfur	K-series	7.11	8.16	6.75	0.28
Zinc	K-series	3.57	4.10	1.66	0.15
Cadmium	L-series	2.01	2.30	0.54	0.51
Sodium	K-series	0.93	1.07	1.23	0.76
Aluminium	K-series	0.51	0.58	0.57	0.05
Silicon	K-series	0.31	0.35	0.33	0.04
Potassium	K-series	0.26	0.30	0.20	0.18
Chlorine	K-series	0.17	0.20	0.15	0.03
Magnesium	K-series	0.06	0.07	0.08	0.03
Phosphorus	K-series	0.05	0.06	0.05	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	40.60	46.55	77.18	17.03
	Sum:	87.21	100.00	100.00	



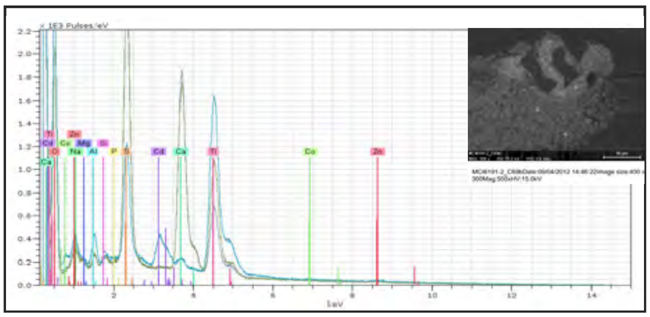
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	35.02	49.18	51.77	1.44
Barium	L-series	8.85	12.42	4.56	1.45
Cadmium	L-series	8.12	11.40	5.11	1.24
Sulfur	K-series	6.76	9.49	14.91	0.26
Zinc	K-series	4.35	6.11	4.71	0.18
Aluminium	K-series	3.25	4.57	8.53	0.18
Potassium	K-series	1.60	2.25	2.90	0.42
Sodium	K-series	1.31	1.84	4.03	1.06
Cobalt	K-series	0.93	1.30	1.11	0.06
Phosphorus	K-series	0.34	0.48	0.79	0.04
Chlorine	K-series	0.27	0.37	0.53	0.04
Silicon	K-series	0.23	0.32	0.57	0.04
Magnesium	K-series	0.11	0.15	0.31	0.03
Calcium	K-series	0.09	0.12	0.16	0.08
	Sum:	71.22	100.00	100.00	



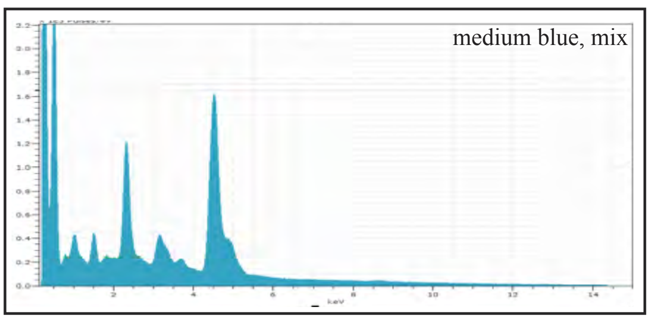
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: teal, likely adhesive

sample location: left edge, 23.5" from bottom
(T 41.9 x L 10.2 cm.)

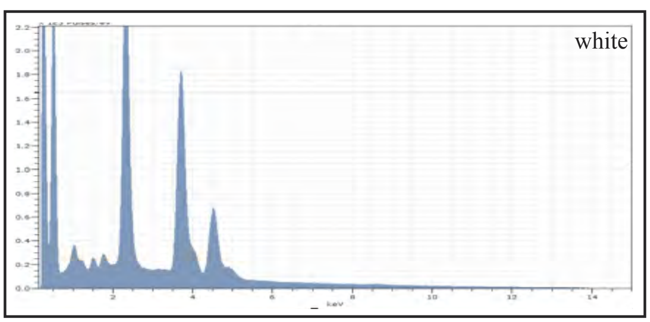
Representative Analysis Compilation—sample C069, continued



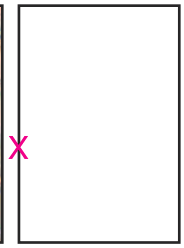
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, medium blue mix: Cd, Na
significant elements, white: Ti
interpretation: Ti white, cadmium yellow, ultramarine blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	22.39	25.97	15.27	1.09
Barium	L-series	10.70	12.42	2.55	1.20
Sulfur	K-series	5.80	6.72	5.90	0.23
Zinc	K-series	5.42	6.28	2.70	0.21
Cadmium	L-series	4.30	4.99	1.25	0.21
Sodium	K-series	1.19	1.37	1.68	0.96
Aluminium	K-series	1.12	1.30	1.35	0.08
Cobalt	K-series	0.81	0.94	0.45	0.05
Calcium	K-series	0.61	0.71	0.50	0.08
Chlorine	K-series	0.31	0.35	0.28	0.04
Silicon	K-series	0.21	0.25	0.25	0.03
Phosphorus	K-series	0.20	0.24	0.21	0.03
Magnesium	K-series	0.10	0.12	0.14	0.03
Oxygen	K-series	33.04	38.33	67.46	13.20
	Sum:	86.20	100.00	100.00	



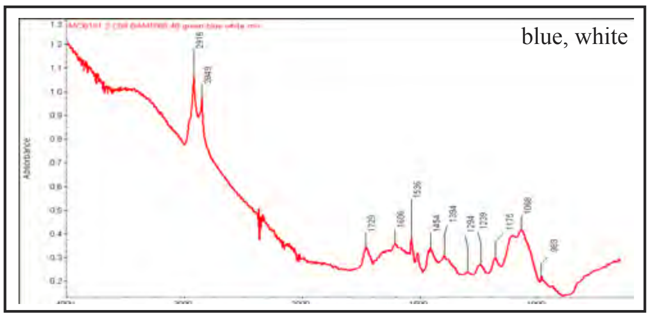
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	23.62	36.24	36.78	0.78
Sulfur	K-series	18.18	27.89	35.38	0.67
Titanium	K-series	12.84	19.70	16.73	0.85
Barium	L-series	5.50	8.44	2.50	0.87
Zinc	K-series	1.51	2.32	1.44	0.08
Sodium	K-series	0.94	1.44	2.54	0.76
Cadmium	L-series	0.61	0.93	0.34	0.18
Chlorine	K-series	0.57	0.88	1.01	0.05
Silicon	K-series	0.56	0.86	1.25	0.05
Aluminium	K-series	0.43	0.66	0.99	0.05
Magnesium	K-series	0.38	0.58	0.97	0.05
Potassium	K-series	0.04	0.06	0.06	0.05
Phosphorus	K-series	0.01	0.01	0.02	0.03
	Sum:	65.17	100.00	100.00	

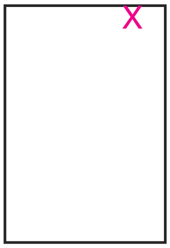
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: teal, likely adhesive

sample location: left edge, 23.5" from bottom
(T 41.9 x L 10.2 cm.)

Representative Analysis Compilation—sample C069, continued



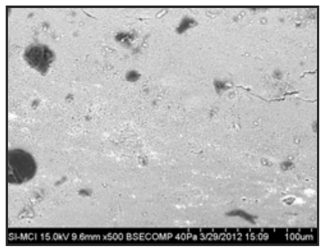
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



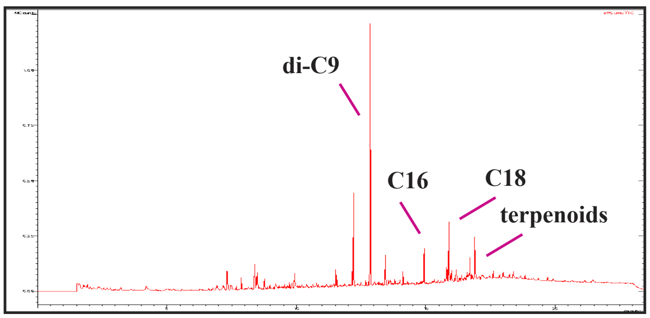
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: compositional white

sample location: 2.0" from top, 9.0" from right
(T 5.1 x R 22.9 cm.)

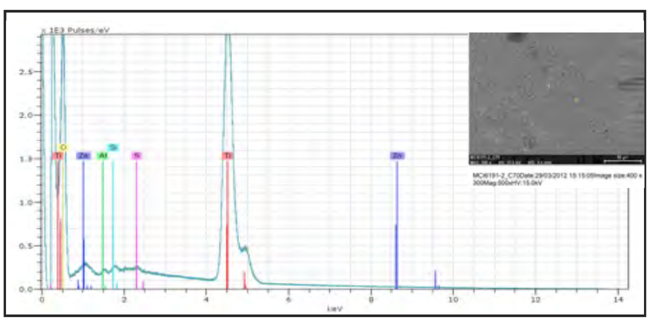
Representative Analysis Compilation—sample C070



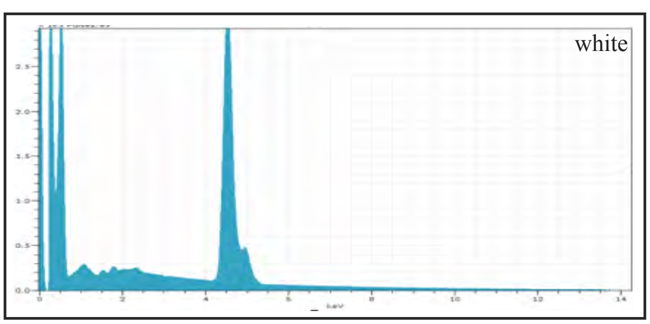
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



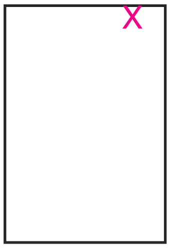
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.211
scan range: 1 - 1483
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, white: Ti, Zn
interpretation: Ti/Zn white



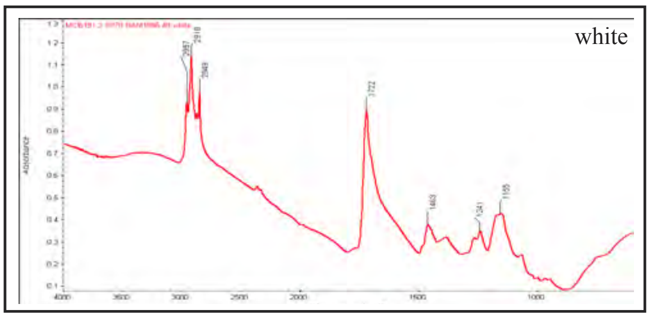
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	64.13	50.92	31.19	2.28
Barium	L-series	9.97	7.91	1.69	2.16
Zinc	K-series	5.72	4.54	2.04	0.22
Sulfur	K-series	0.63	0.50	0.46	0.05
Sodium	K-series	0.54	0.43	0.55	0.45
Chlorine	K-series	0.43	0.34	0.28	0.04
Potassium	K-series	0.36	0.28	0.21	0.04
Phosphorus	K-series	0.35	0.28	0.27	0.04
Silicon	K-series	0.30	0.24	0.25	0.04
Calcium	K-series	0.19	0.15	0.11	0.04
Magnesium	K-series	0.10	0.08	0.09	0.03
Aluminium	K-series	0.09	0.07	0.08	0.03
Oxygen	K-series	43.13	34.25	62.78	15.10
	Sum:	125.94	100.00	100.00	



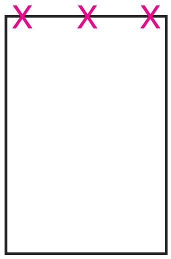
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: compositional white

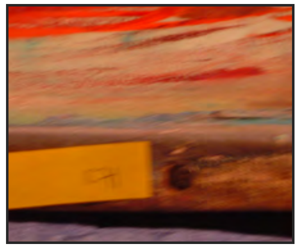
sample location: 2.0" from top, 9.0" from right
(T 5.1 x R 22.9 cm.)

Representative Analysis Compilation—sample C070, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

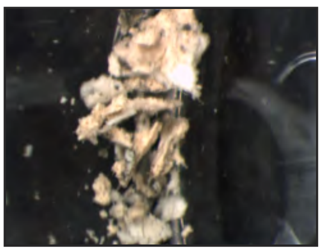


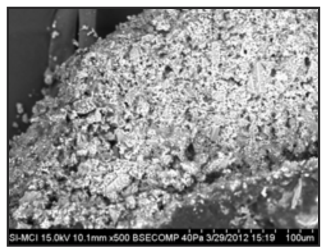


acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: possible ground layer

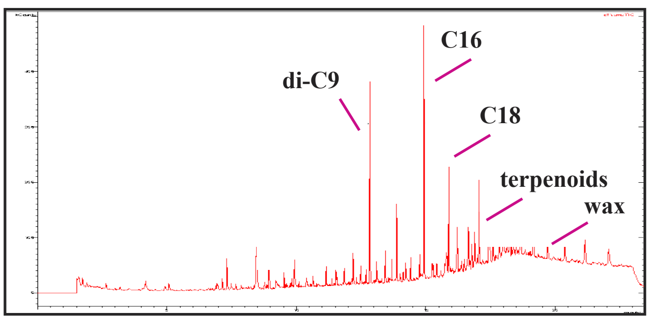
sample location: along top edge
(T 0.0 x L 0.0-40.0 cm.)

Representative Analysis Compilation—sample C071

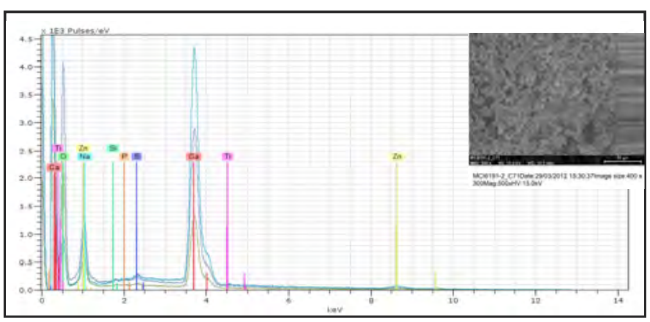




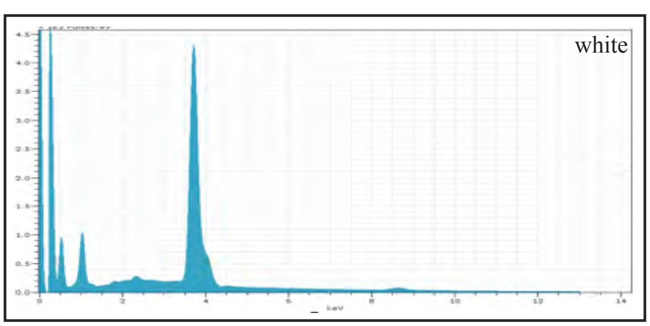
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



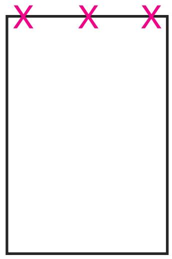
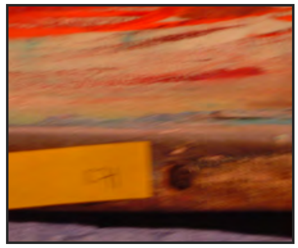
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.113
scan range: 1 - 1492
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids, wax
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, white: Ca, Zn
interpretation: bulked zinc white



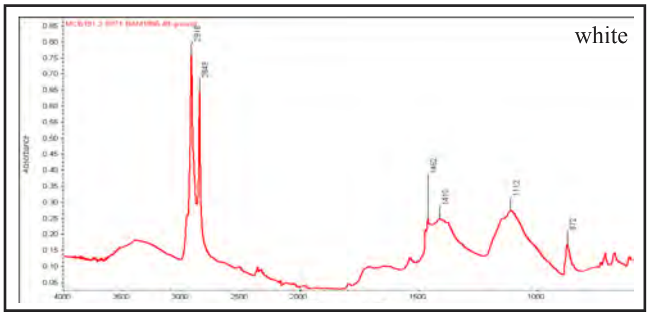
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	31.15	43.07	28.43	0.95
Zinc	K-series	9.67	13.37	5.41	0.35
Sodium	K-series	4.73	6.54	7.53	3.75
Sulfur	K-series	0.66	0.91	0.75	0.05
Magnesium	K-series	0.48	0.67	0.73	0.05
Barium	L-series	0.38	0.52	0.10	0.07
Phosphorus	K-series	0.30	0.42	0.36	0.04
Silicon	K-series	0.19	0.26	0.25	0.03
Chlorine	K-series	0.13	0.18	0.14	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	24.63	34.06	56.31	14.57
	Sum:	72.32	100.00	100.00	

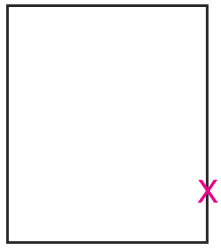
acc. no.: BAM 1966.48
title, year: *The Third Hand*, 1947
Gift of Hans Hofmann
medium noted in file: oil on canvas on plywood
meas.: 60.1 x 40.0" (152.7 x 101.6 cm.)
notes: possible ground layer

sample location: along top edge
(T 0.0 x L 0.0-40.0 cm.)

Representative Analysis Compilation—sample C071, continued



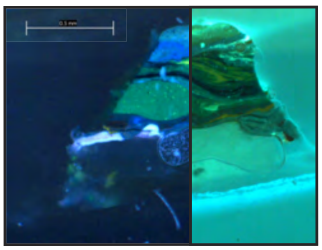
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for wax

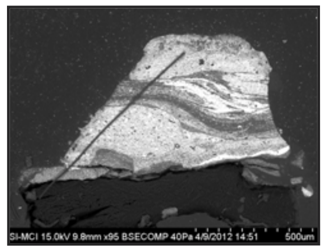


acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: red, others, consolidant

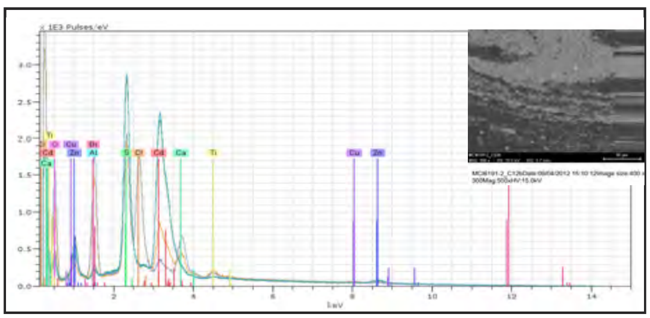
sample location: right edge, 13.0" from bottom
(B 33.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C012

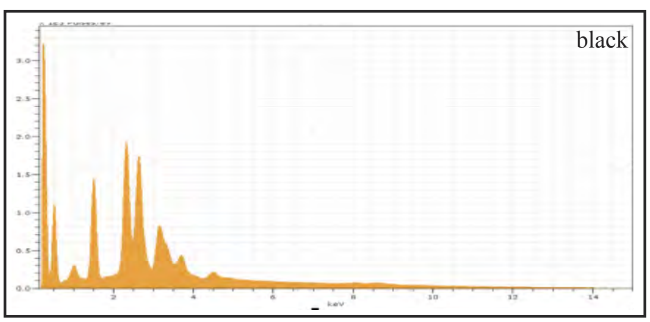




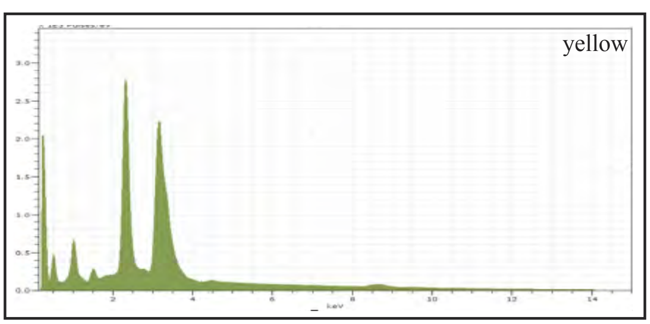
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.8 mm.



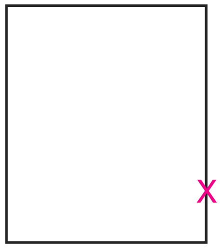
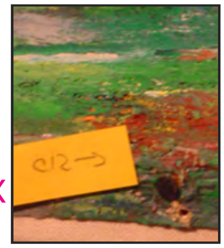
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, black: Cu, Cl
significant elements, yellow: Cd, S
interpretation: phthalo green, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	11.71	18.79	29.10	0.57
Zinc	K-series	9.63	15.46	9.88	0.35
Sulfur	K-series	9.36	15.02	19.57	0.36
Chlorine	K-series	9.26	14.86	17.52	0.33
Cadmium	L-series	6.52	10.47	3.89	1.03
Copper	K-series	5.86	9.40	6.18	0.22
Barium	L-series	4.70	7.53	2.29	0.35
Sodium	K-series	2.14	3.44	6.25	1.71
Calcium	K-series	1.68	2.70	2.82	0.12
Potassium	K-series	1.45	2.33	2.49	0.35
Phosphorus	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
	Sum:	62.32	100.00	100.00	



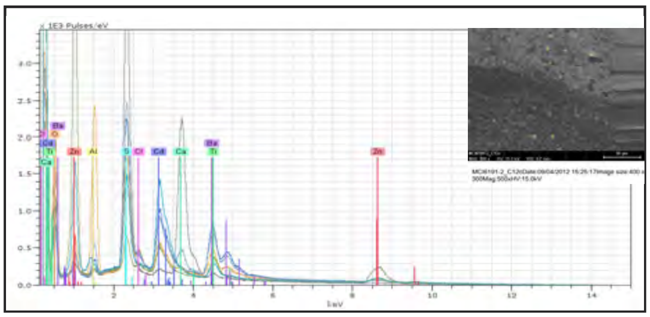
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	44.84	44.62	21.46	3.51
Sulfur	K-series	19.65	19.55	32.96	0.72
Zinc	K-series	16.48	16.40	13.56	0.58
Potassium	K-series	7.01	6.98	9.65	1.16
Sodium	K-series	6.42	6.39	15.02	5.08
Barium	L-series	2.57	2.56	1.01	0.22
Aluminium	K-series	1.67	1.66	3.33	0.10
Chlorine	K-series	0.92	0.92	1.40	0.07
Calcium	K-series	0.47	0.47	0.63	0.22
Magnesium	K-series	0.36	0.36	0.79	0.05
Silicon	K-series	0.09	0.09	0.17	0.03
Phosphorus	K-series	0.02	0.02	0.03	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
	Sum:	100.50	100.00	100.00	

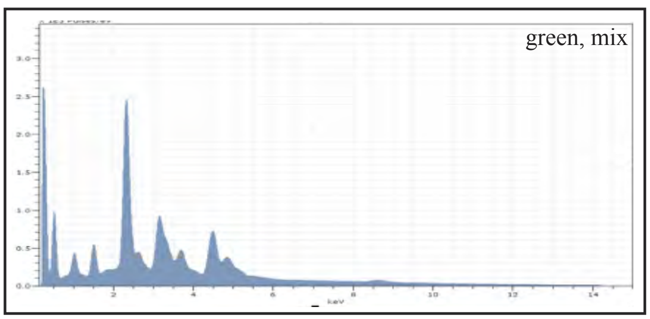
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: red, others, consolidant

sample location: right edge, 13.0" from bottom
(B 33.0 x R 0.0 cm.)

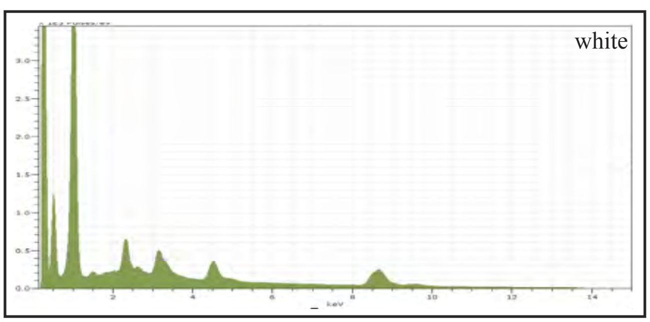
Representative Analysis Compilation—sample C012, continued



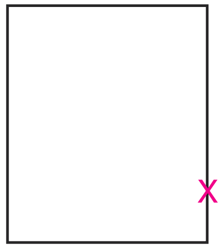
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, green mix: Na, Al
significant elements, white: Zn
interpretation: cadmium green, zinc white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	18.11	27.96	10.16	1.21
Sulfur	K-series	14.13	21.82	33.96	0.52
Cadmium	L-series	8.87	13.69	6.08	1.26
Zinc	K-series	6.66	10.29	7.85	0.25
Sodium	K-series	4.38	6.76	14.67	3.47
Aluminium	K-series	3.56	5.50	10.18	0.19
Titanium	K-series	3.22	4.97	5.18	0.45
Calcium	K-series	2.50	3.86	4.81	0.15
Potassium	K-series	1.74	2.69	3.43	0.43
Chlorine	K-series	1.30	2.00	2.82	0.07
Magnesium	K-series	0.14	0.22	0.46	0.04
Phosphorus	K-series	0.08	0.13	0.21	0.03
Silicon	K-series	0.07	0.11	0.19	0.03
	Sum:	64.76	100.00	100.00	



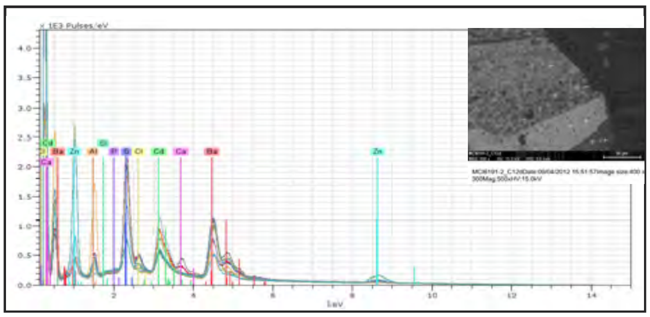
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	57.33	57.38	38.00	1.91
Sodium	K-series	25.93	25.95	48.89	20.43
Cadmium	L-series	4.45	4.45	1.71	0.90
Titanium	K-series	3.69	3.69	3.34	0.42
Barium	L-series	3.21	3.21	1.01	0.43
Sulfur	K-series	3.10	3.11	4.20	0.14
Potassium	K-series	0.90	0.90	1.00	0.32
Chlorine	K-series	0.54	0.54	0.66	0.05
Aluminium	K-series	0.37	0.37	0.59	0.04
Phosphorus	K-series	0.26	0.26	0.36	0.04
Silicon	K-series	0.11	0.11	0.16	0.03
Magnesium	K-series	0.03	0.03	0.06	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	99.92	100.00	100.00	

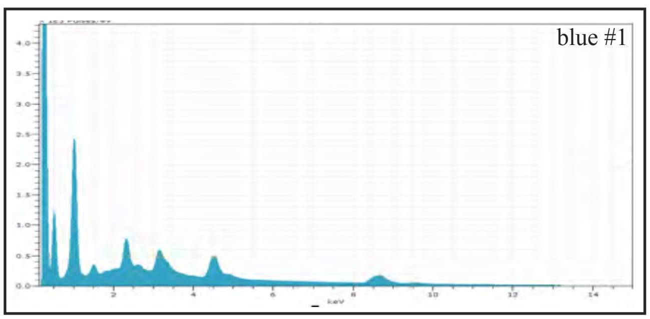

acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: red, others, consolidant

sample location: right edge, 13.0" from bottom (B 33.0 x R 0.0 cm.)

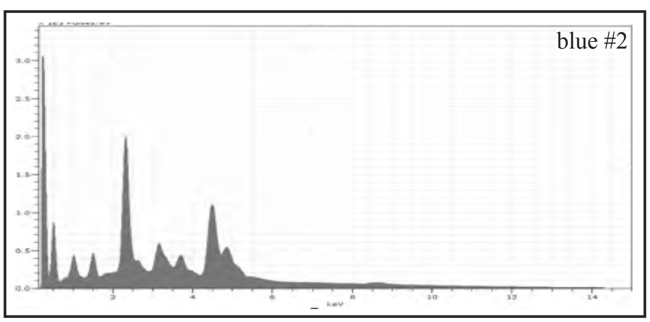
Representative Analysis Compilation—sample C012, continued



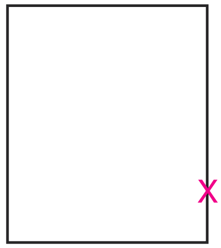
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, blue #1: Na
significant elements, blue #2: Cu
significant elements, yellow: Cd, S
interpretation: ultramarine blue, phthalo blue, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	24.05	43.07	27.76	0.82
Sodium	K-series	14.18	25.39	46.55	11.18
Titanium	K-series	5.58	9.98	8.79	0.44
Cadmium	L-series	4.37	7.83	2.94	0.79
Sulfur	K-series	2.82	5.05	6.63	0.13
Barium	L-series	2.25	4.03	1.24	0.46
Aluminium	K-series	0.97	1.74	2.71	0.07
Potassium	K-series	0.82	1.47	1.58	0.29
Chlorine	K-series	0.53	0.96	1.14	0.04
Phosphorus	K-series	0.23	0.40	0.55	0.03
Calcium	K-series	0.02	0.04	0.04	0.04
Silicon	K-series	0.02	0.04	0.06	0.03
Magnesium	K-series	0.00	0.00	0.01	0.03
	Sum:	55.85	100.00	100.00	



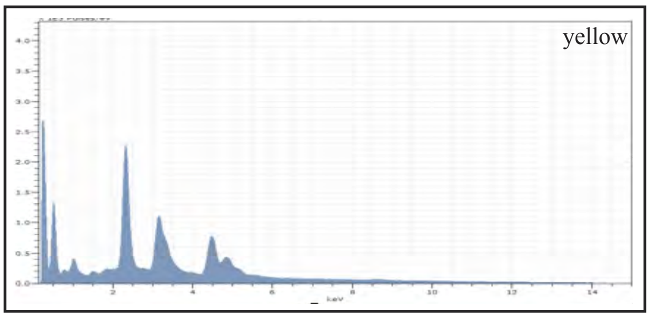
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	30.77	37.03	15.04	2.00
Sulfur	K-series	12.74	15.34	26.68	0.47
Zinc	K-series	10.88	13.09	11.17	0.39
Titanium	K-series	6.00	7.22	8.41	0.73
Cadmium	L-series	5.65	6.80	3.37	1.00
Sodium	K-series	4.67	5.62	13.65	3.70
Aluminium	K-series	3.38	4.07	8.42	0.18
Calcium	K-series	2.59	3.12	4.35	0.16
Copper	K-series	2.34	2.81	2.47	0.11
Cobalt	K-series	1.71	2.06	1.95	0.08
Chlorine	K-series	1.10	1.32	2.07	0.06
Potassium	K-series	0.92	1.11	1.58	0.36
Silicon	K-series	0.18	0.22	0.44	0.03
Magnesium	K-series	0.11	0.14	0.31	0.03
Phosphorus	K-series	0.04	0.04	0.08	0.03
	Sum:	83.09	100.00	100.00	



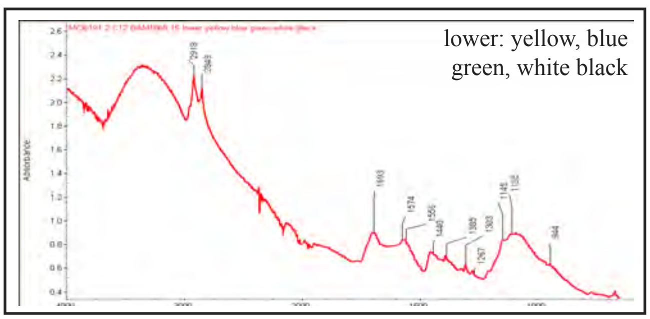
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: red, others, consolidant

sample location: right edge, 13.0" from bottom
(B 33.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C012, continued

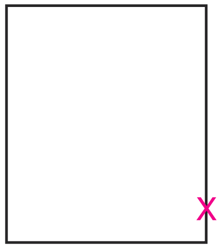


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	29.66	44.14	21.34	1.91
Sulfur	K-series	12.18	18.13	37.53	0.45
Cadmium	L-series	11.80	17.57	10.38	1.53
Zinc	K-series	6.39	9.50	9.65	0.24
Potassium	K-series	2.34	3.49	5.93	0.50
Titanium	K-series	2.30	3.42	4.75	0.52
Sodium	K-series	1.90	2.83	8.16	1.52
Aluminium	K-series	0.40	0.60	1.47	0.33
Silicon	K-series	0.18	0.26	0.62	0.03
Magnesium	K-series	0.05	0.07	0.18	0.05
Phosphorus	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	67.19	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

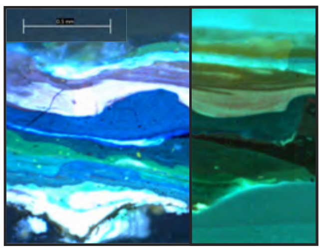
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standards for PG7 and PB15

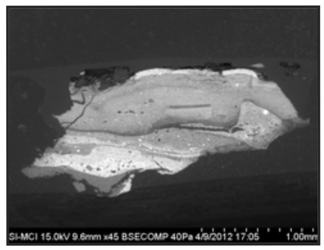


acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: greens, others

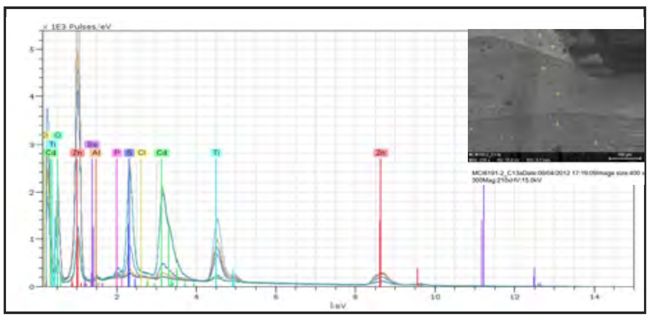
sample location: right edge, 9.3" from bottom
(B 23.6 x R 0.0 cm.)

Representative Analysis Compilation—sample C013

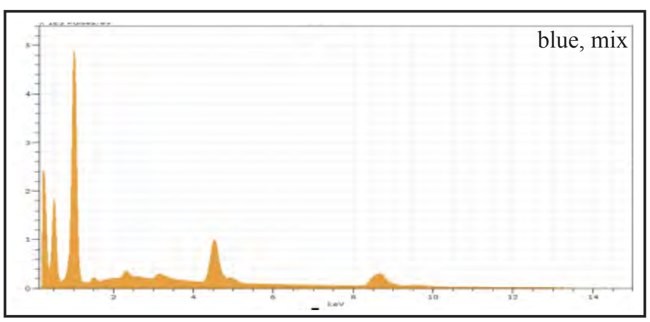




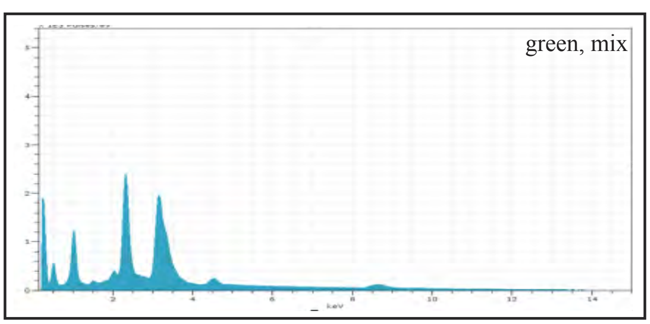
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.6 mm.



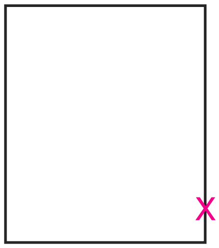
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, blue mix: Na
significant elements, green mix: Zn, Cd, S, Na
interpretation: ultramarine blue, cadmium green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	57.69	53.55	34.74	1.92
Sodium	K-series	28.42	26.37	48.67	22.39
Titanium	K-series	14.59	13.54	12.00	0.74
Barium	L-series	3.18	2.95	0.91	0.84
Cadmium	L-series	1.36	1.26	0.48	0.36
Sulfur	K-series	1.01	0.94	1.24	0.06
Aluminium	K-series	0.78	0.73	1.14	0.62
Potassium	K-series	0.30	0.28	0.30	0.17
Phosphorus	K-series	0.21	0.20	0.27	0.03
Chlorine	K-series	0.11	0.10	0.12	0.03
Silicon	K-series	0.09	0.08	0.12	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	107.74	100.00	100.00	



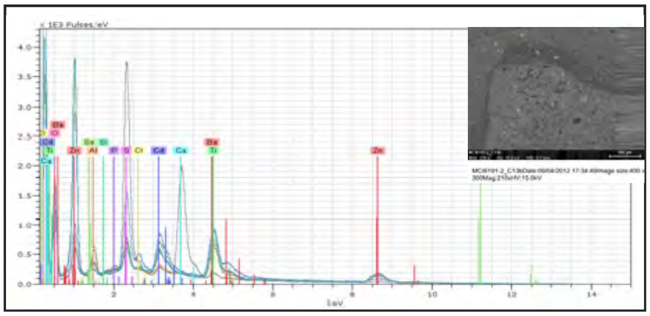
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	32.53	30.90	20.84	1.10
Cadmium	L-series	24.14	22.93	9.00	2.20
Sulfur	K-series	14.31	13.59	18.69	0.53
Sodium	K-series	10.51	9.98	19.15	8.30
Barium	L-series	8.41	7.99	2.56	0.59
Potassium	K-series	5.11	4.86	5.48	0.74
Phosphorus	K-series	1.14	1.09	1.55	0.07
Chlorine	K-series	0.35	0.33	0.41	0.05
Aluminium	K-series	0.23	0.21	0.35	0.20
Titanium	K-series	0.12	0.11	0.10	0.10
Magnesium	K-series	0.10	0.09	0.17	0.07
Calcium	K-series	0.07	0.06	0.07	0.07
Silicon	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	8.26	7.85	21.63	6.26
	Sum:	105.28	100.00	100.00	

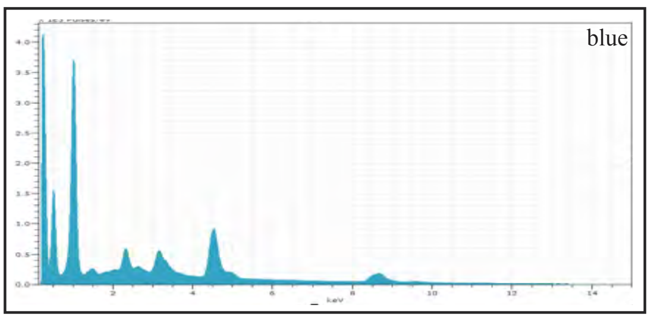

acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: greens, others

sample location: right edge, 9.3" from bottom
(B 23.6 x R 0.0 cm.)

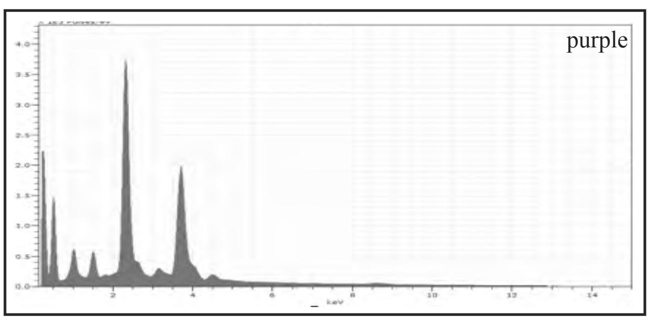
Representative Analysis Compilation—sample C013, continued



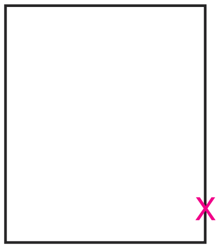
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na
significant elements, purple: Ca, S
significant elements, red: Cd, S, Se
interpretation: ultramarine blue, cadmium red, possible synthetic purple



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	31.31	35.90	17.63	1.06
Titanium	K-series	12.88	14.77	9.90	0.65
Sodium	K-series	10.44	11.97	16.72	8.24
Cadmium	L-series	4.62	5.30	1.51	0.86
Sulfur	K-series	2.37	2.72	2.72	0.11
Barium	L-series	2.22	2.54	0.59	0.79
Potassium	K-series	0.94	1.08	0.89	0.30
Aluminium	K-series	0.56	0.64	0.76	0.45
Chlorine	K-series	0.55	0.63	0.57	0.05
Phosphorus	K-series	0.30	0.34	0.35	0.04
Silicon	K-series	0.05	0.06	0.07	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	20.98	24.05	48.27	10.13
	Sum:	87.22	100.00	100.00	



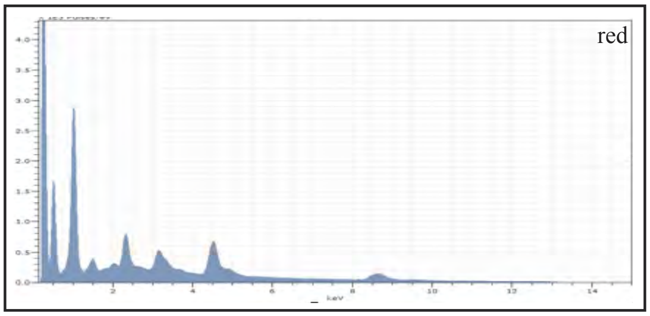
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Sulfur	K-series	21.06	42.40	46.34	0.77
Calcium	K-series	14.39	28.97	25.33	0.49
Sodium	K-series	3.44	6.92	10.55	2.73
Zinc	K-series	2.95	5.95	3.19	0.13
Aluminium	K-series	2.79	5.62	7.30	1.51
Chlorine	K-series	1.99	4.01	3.96	0.09
Titanium	K-series	1.55	3.12	2.28	0.17
Cadmium	L-series	1.38	2.77	0.86	0.36
Barium	L-series	0.06	0.12	0.03	0.06
Silicon	K-series	0.06	0.12	0.15	0.03
Phosphorus	K-series	0.00	0.01	0.01	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	49.68	100.00	100.00	

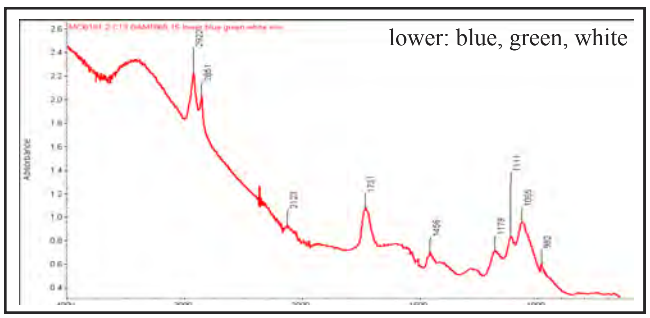

acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: greens, others

sample location: right edge, 9.3" from bottom
(B 23.6 x R 0.0 cm.)

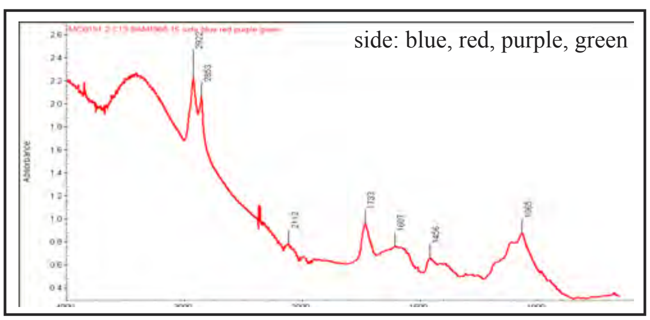
Representative Analysis Compilation—sample C013, continued



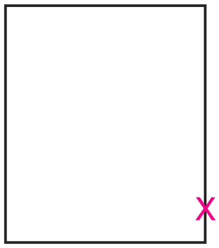
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	21.92	37.09	24.60	0.75
Sodium	K-series	13.88	23.48	44.29	10.95
Titanium	K-series	8.69	14.70	13.32	0.65
Barium	L-series	4.97	8.40	2.65	0.66
Cadmium	L-series	4.31	7.30	2.81	0.87
Sulfur	K-series	2.54	4.30	5.82	0.12
Aluminium	K-series	1.37	2.31	3.72	0.97
Potassium	K-series	0.90	1.53	1.70	0.30
Calcium	K-series	0.24	0.41	0.45	0.07
Phosphorus	K-series	0.22	0.37	0.51	0.03
Chlorine	K-series	0.06	0.09	0.12	0.03
Silicon	K-series	0.01	0.01	0.02	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	59.11	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7



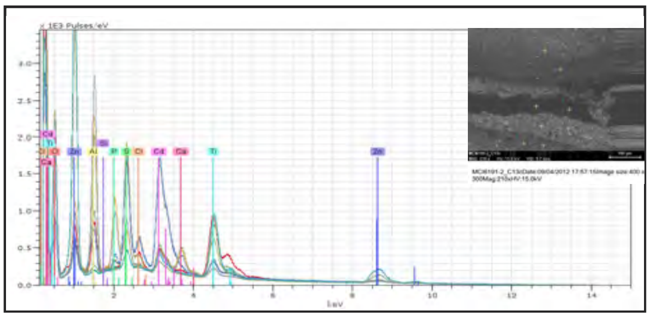
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7



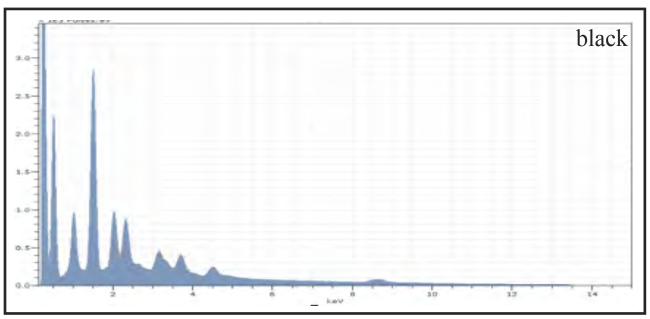
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: greens, others

sample location: right edge, 9.3" from bottom
(B 23.6 x R 0.0 cm.)

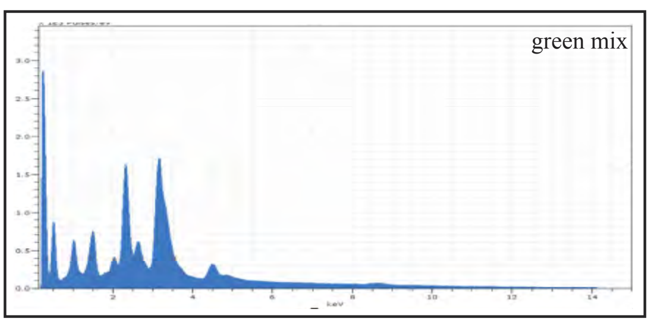
Representative Analysis Compilation—sample C013, continued



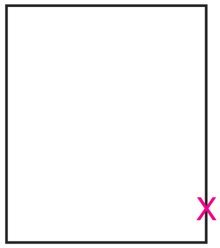
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, black: Ca, P
significant elements, green: Cl
interpretation: bone black, phthalo green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	12.80	31.64	40.16	0.62
Zinc	K-series	7.38	18.25	9.56	0.27
Sodium	K-series	5.09	12.59	18.75	1.48
Phosphorus	K-series	3.56	8.81	9.74	0.16
Sulfur	K-series	3.56	8.80	9.40	0.15
Cadmium	L-series	2.91	7.19	2.19	0.62
Titanium	K-series	2.28	5.63	4.02	0.09
Calcium	K-series	2.02	5.00	4.28	0.11
Potassium	K-series	0.48	1.19	1.04	0.24
Chlorine	K-series	0.37	0.90	0.87	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
	Sum:	40.45	100.00	100.00	



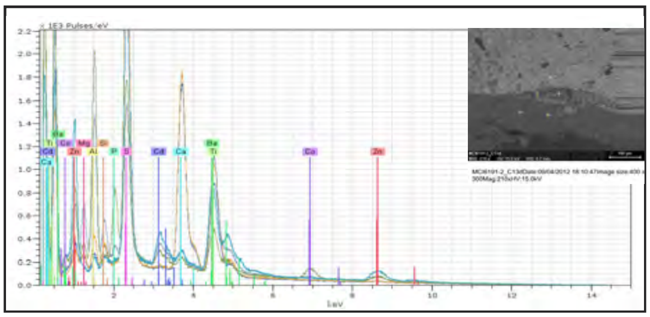
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	33.53	42.61	19.39	2.91
Sulfur	K-series	12.20	15.50	24.72	0.46
Zinc	K-series	5.54	7.04	5.50	0.22
Aluminium	K-series	5.13	6.52	12.36	2.16
Potassium	K-series	4.83	6.14	8.03	0.96
Chlorine	K-series	4.70	5.97	8.61	0.18
Sodium	K-series	3.83	4.87	10.83	3.04
Barium	L-series	3.41	4.34	1.62	0.44
Titanium	K-series	3.21	4.09	4.36	0.38
Phosphorus	K-series	1.74	2.21	3.65	0.09
Calcium	K-series	0.56	0.71	0.90	0.18
Silicon	K-series	0.01	0.01	0.03	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	78.70	100.00	100.00	

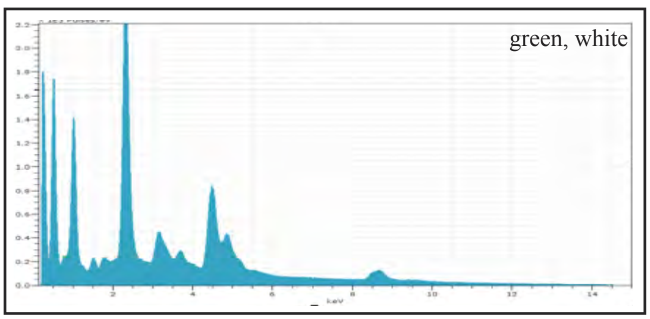

acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: greens, others

sample location: right edge, 9.3" from bottom
(B 23.6 x R 0.0 cm.)

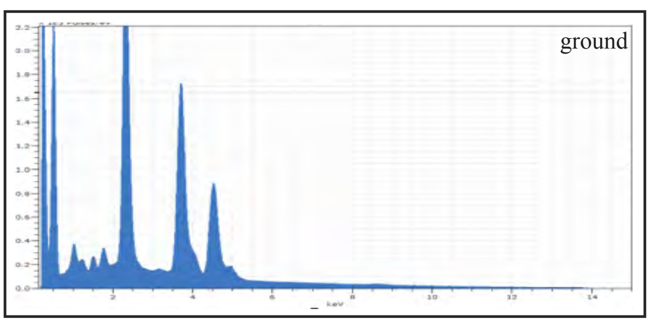
Representative Analysis Compilation—sample C013, continued



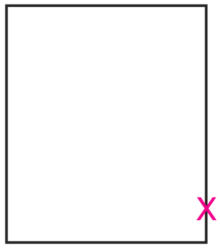
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, green: Cd, S, Na
significant elements, ground: Ti, Ca
significant elements, purple: Co, P
interpretation: cadmium green, bulked titanium white, cobalt violet



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	28.34	30.71	11.53	1.84
Zinc	K-series	23.04	24.96	19.68	0.79
Sulfur	K-series	18.30	19.83	31.87	0.67
Sodium	K-series	9.31	10.09	22.61	7.35
Cadmium	L-series	4.49	4.87	2.23	0.93
Titanium	K-series	3.63	3.93	4.23	0.56
Calcium	K-series	1.43	1.55	2.00	0.13
Cobalt	K-series	1.08	1.17	1.02	0.06
Potassium	K-series	0.77	0.83	1.09	0.34
Aluminium	K-series	0.63	0.68	1.29	0.50
Silicon	K-series	0.57	0.61	1.13	0.05
Chlorine	K-series	0.31	0.34	0.50	0.04
Magnesium	K-series	0.23	0.25	0.54	0.09
Phosphorus	K-series	0.16	0.18	0.29	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	92.28	100.00	100.00	



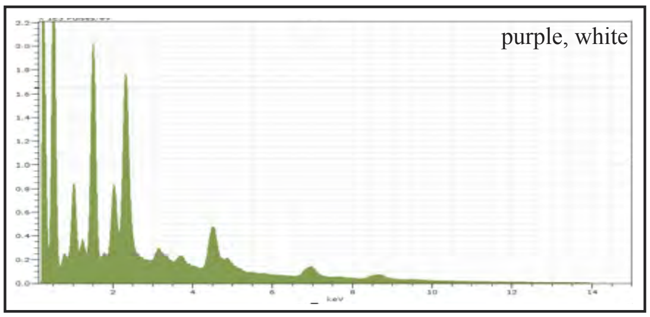
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	20.28	30.56	29.93	0.68
Sulfur	K-series	19.01	28.65	35.07	0.70
Titanium	K-series	17.98	27.10	22.22	0.85
Zinc	K-series	2.30	3.46	2.08	0.11
Barium	L-series	2.01	3.03	0.87	1.01
Sodium	K-series	1.41	2.12	3.62	1.13
Silicon	K-series	1.03	1.55	2.16	0.07
Aluminium	K-series	0.60	0.91	1.32	0.05
Magnesium	K-series	0.53	0.80	1.29	0.06
Chlorine	K-series	0.51	0.78	0.86	0.04
Cadmium	L-series	0.35	0.52	0.18	0.11
Iron	K-series	0.30	0.45	0.32	0.05
Manganese	K-series	0.03	0.04	0.03	0.04
Phosphorus	K-series	0.02	0.04	0.05	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
	Sum:	66.36	100.00	100.00	



acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: greens, others

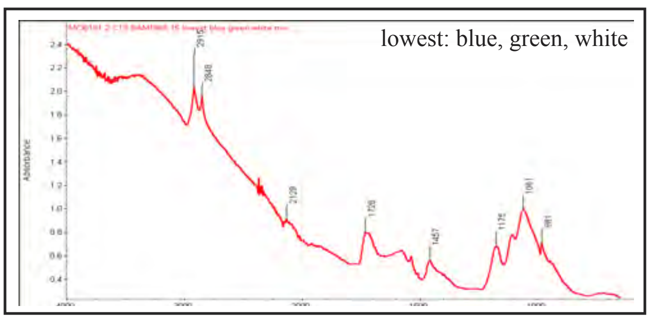
sample location: right edge, 9.3" from bottom
(B 23.6 x R 0.0 cm.)

Representative Analysis Compilation—sample C013, continued



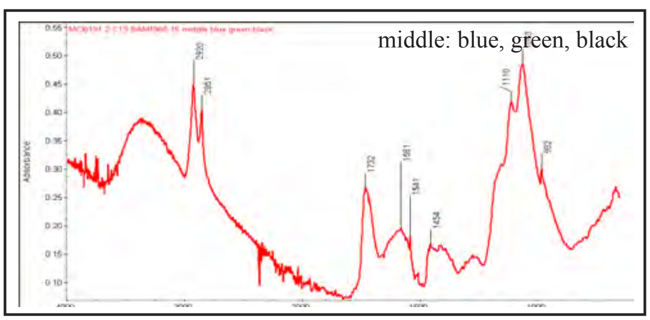
purple, white

Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	10.16	18.75	27.21	2.69
Sulfur	K-series	9.37	17.29	21.12	0.36
Zinc	K-series	8.26	15.25	9.14	0.30
Cobalt	K-series	5.76	10.62	7.06	0.20
Barium	L-series	5.71	10.54	3.00	0.56
Titanium	K-series	4.40	8.12	6.64	0.50
Sodium	K-series	4.12	7.61	12.96	3.27
Phosphorus	K-series	3.09	5.71	7.22	0.14
Cadmium	L-series	1.23	2.27	0.79	0.33
Magnesium	K-series	0.86	1.58	2.55	0.14
Calcium	K-series	0.73	1.35	1.32	0.08
Potassium	K-series	0.26	0.49	0.49	0.16
Chlorine	K-series	0.18	0.33	0.36	0.03
Silicon	K-series	0.05	0.09	0.13	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	54.18	100.00	100.00	



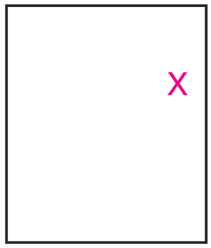
lowest: blue, green, white

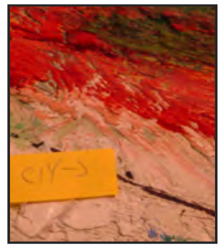
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7



middle: blue, green, black

analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

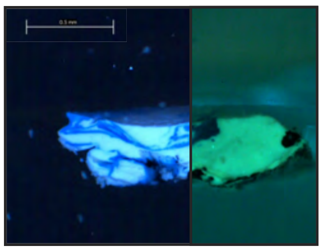
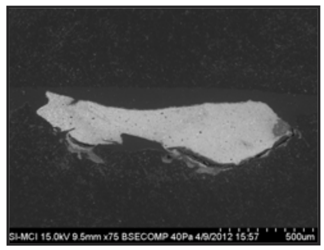





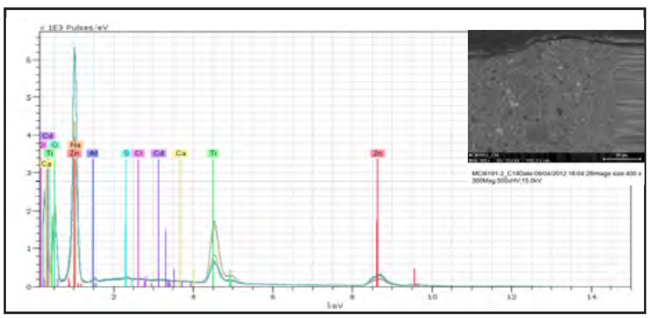
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: black outline, compositional white

sample location: 20.0" from top, 8.0" from right
(T 50.8 x R 20.3 cm.)

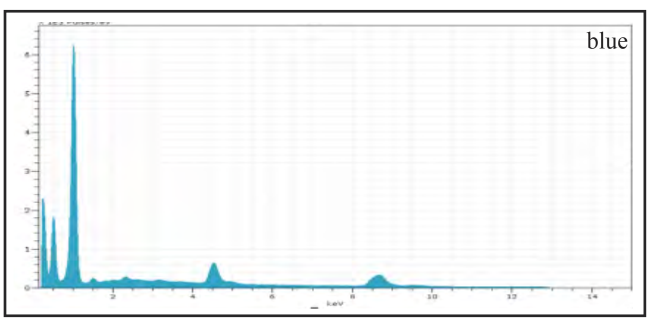
Representative Analysis Compilation—sample C014

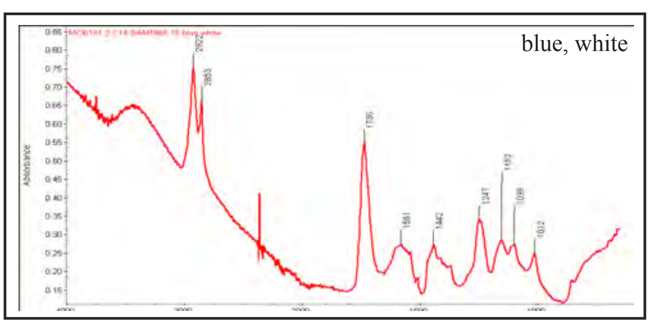
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



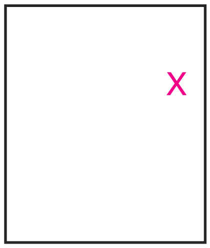
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.3 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na
interpretation: ultramarine blue

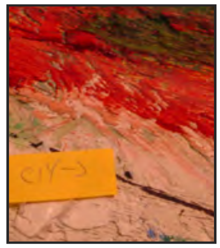


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	111.34	59.76	41.91	3.68
Sodium	K-series	26.77	14.37	28.67	21.10
Barium	L-series	18.22	9.78	3.27	1.37
Titanium	K-series	9.09	4.88	4.67	1.01
Cadmium	L-series	3.87	2.08	0.85	0.85
Sulfur	K-series	1.79	0.96	1.37	0.09
Chlorine	K-series	1.49	0.80	1.04	0.08
Calcium	K-series	1.40	0.75	0.86	0.13
Aluminium	K-series	1.22	0.65	1.11	0.95
Phosphorus	K-series	0.78	0.42	0.62	0.06
Silicon	K-series	0.31	0.17	0.27	0.04
Potassium	K-series	0.09	0.05	0.06	0.09
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	9.94	5.34	15.30	4.46
	Sum:	186.32	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil, cadmium interference

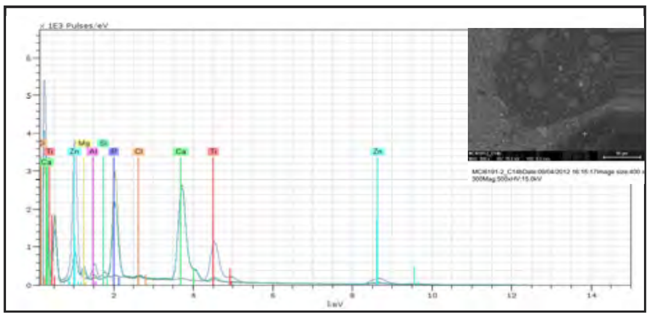





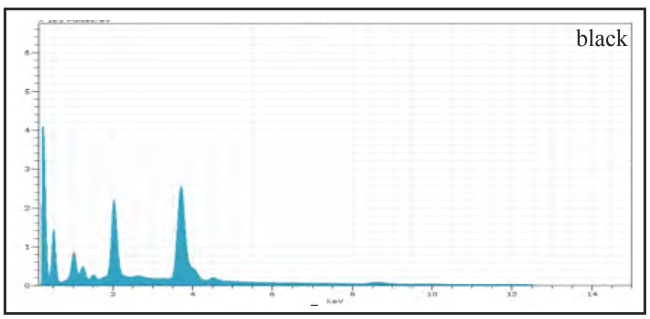
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: black outline, compositional white

sample location: 20.0" from top, 8.0" from right
(T 50.8 x R 20.3 cm.)

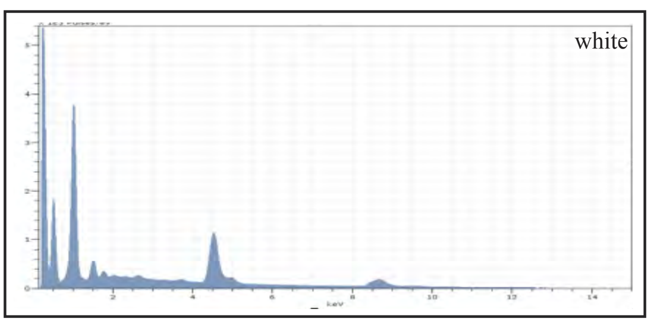
Representative Analysis Compilation—sample C014, continued



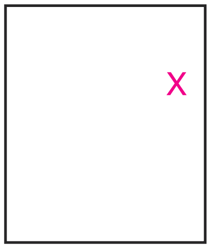
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.3 mm.
mag: 500x; HV: 15 kV
significant elements, black: Ca, P
significant elements, white: Zn, Ti
interpretation: bone black, Zn/Ti white

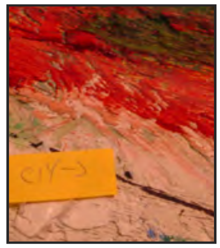


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	22.91	44.43	39.69	0.71
Phosphorus	K-series	12.28	23.82	27.53	0.49
Zinc	K-series	6.61	12.82	7.02	0.25
Sodium	K-series	5.00	9.70	15.10	3.96
Magnesium	K-series	1.95	3.78	5.56	0.13
Titanium	K-series	1.33	2.58	1.93	0.15
Chlorine	K-series	0.65	1.27	1.28	0.05
Sulfur	K-series	0.47	0.90	1.01	0.04
Aluminium	K-series	0.31	0.61	0.81	0.04
Potassium	K-series	0.04	0.08	0.07	0.03
Barium	L-series	0.01	0.02	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
	Sum:	51.55	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	34.95	40.52	25.07	1.18
Sodium	K-series	21.95	25.45	44.78	17.30
Titanium	K-series	19.37	22.46	18.97	0.90
Barium	L-series	3.57	4.14	1.22	1.05
Aluminium	K-series	2.47	2.87	4.30	0.14
Silicon	K-series	1.03	1.19	1.71	0.07
Chlorine	K-series	0.90	1.05	1.19	0.06
Calcium	K-series	0.60	0.70	0.70	0.05
Phosphorus	K-series	0.58	0.67	0.87	0.05
Sulfur	K-series	0.43	0.50	0.63	0.04
Potassium	K-series	0.29	0.34	0.35	0.04
Magnesium	K-series	0.10	0.12	0.19	0.03
	Sum:	86.26	100.00	100.00	

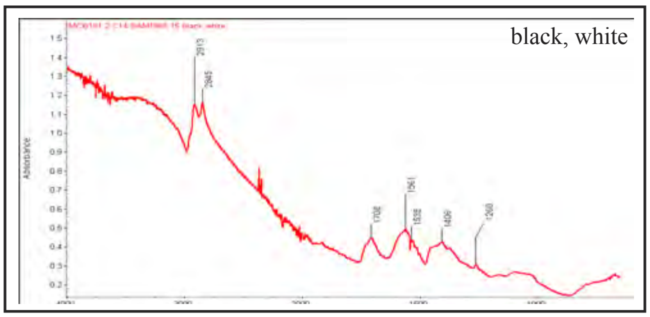




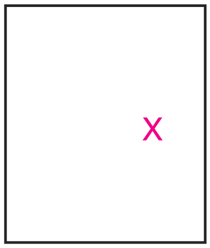
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: black outline, compositional white

sample location: 20.0" from top, 8.0" from right
(T 50.8 x R 20.3 cm.)

Representative Analysis Compilation—sample C014, continued



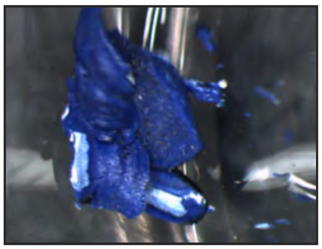
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: carbon interference

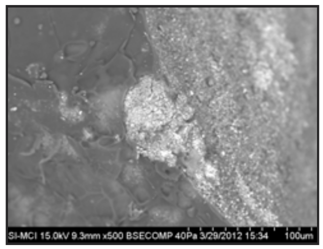


acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: purple-blue, likely varnish and consolidant

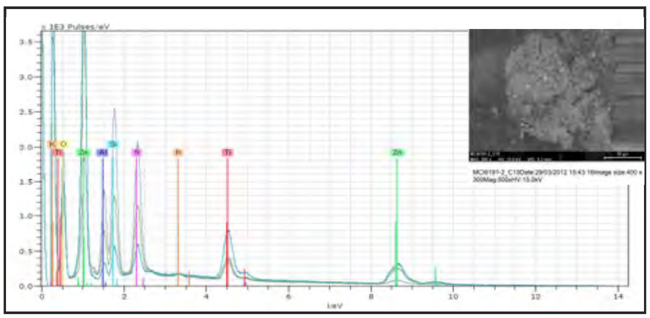
sample location: 26.5" from bottom, 12.0" from right
(B 67.3 x R 30.5 cm.)

Representative Analysis Compilation—sample C015

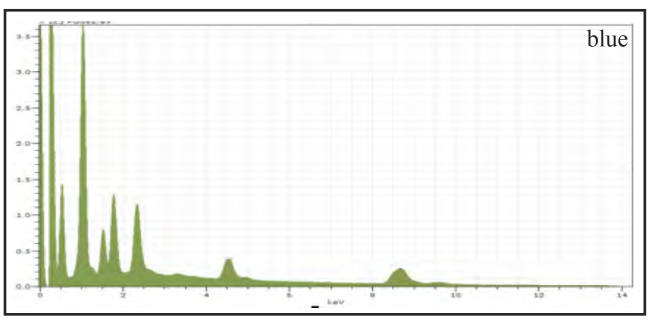




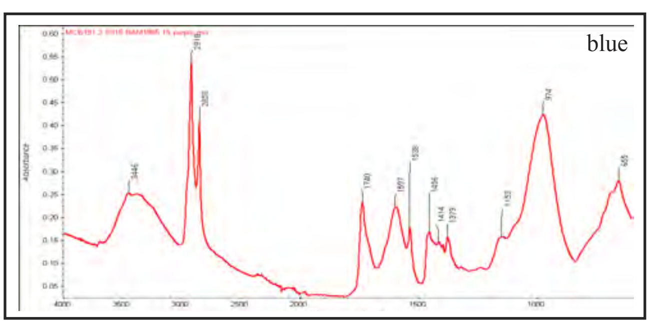
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.3 mm.



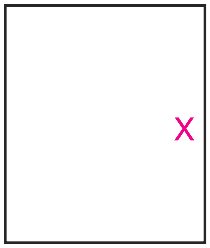
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.3 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Si
interpretation: ultramarine blue

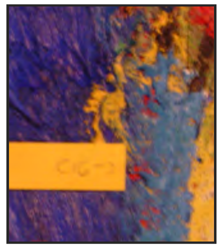


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	52.25	47.12	24.95	1.75
Sodium	K-series	23.80	21.46	32.32	18.75
Silicon	K-series	6.84	6.17	7.61	0.31
Sulfur	K-series	6.38	5.75	6.21	0.25
Titanium	K-series	5.37	4.84	3.50	0.42
Aluminium	K-series	3.21	2.90	3.72	0.17
Barium	L-series	1.32	1.19	0.30	0.50
Chlorine	K-series	0.54	0.49	0.47	0.04
Magnesium	K-series	0.47	0.42	0.60	0.05
Potassium	K-series	0.37	0.34	0.30	0.04
Calcium	K-series	0.12	0.11	0.09	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	10.22	9.21	19.94	5.08
	Sum:	110.87	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil, epoxy mount medium

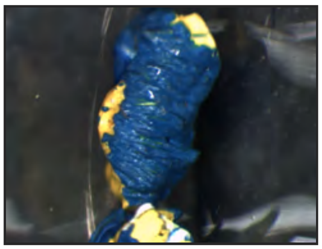
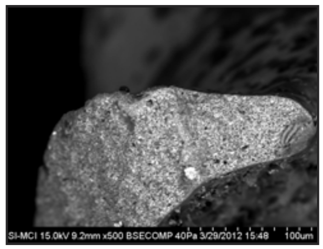





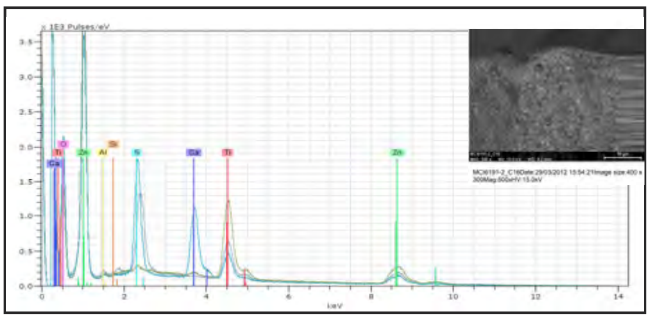
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: teal

sample location: 28.5" from bottom, 9.5" from right (B 72.4 x R 24.1 cm.)

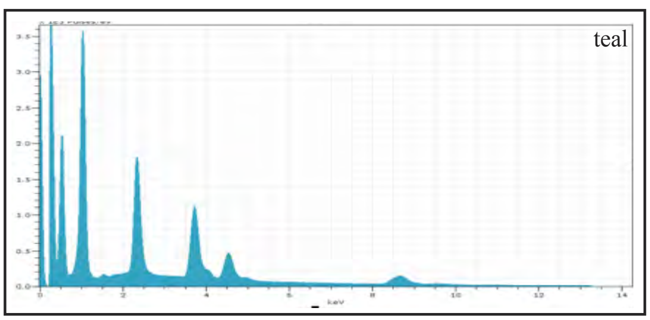
Representative Analysis Compilation—sample C016

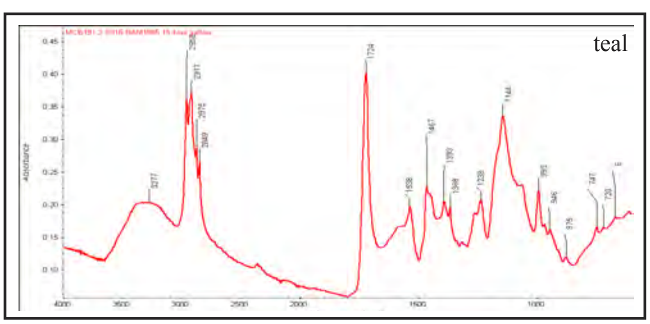
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.2 mm.



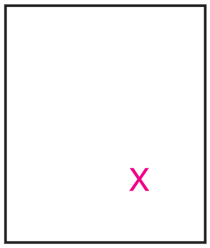
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, teal: Na
interpretation: ultramarine blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	25.77	27.26	11.82	0.88
Sodium	K-series	13.81	14.61	18.03	10.90
Sulfur	K-series	11.83	12.52	11.07	0.44
Calcium	K-series	10.47	11.08	7.84	0.34
Titanium	K-series	6.83	7.22	4.28	0.41
Chlorine	K-series	0.43	0.46	0.36	0.04
Barium	L-series	0.29	0.30	0.06	0.17
Aluminium	K-series	0.21	0.22	0.23	0.04
Phosphorus	K-series	0.20	0.21	0.19	0.03
Silicon	K-series	0.11	0.11	0.11	0.03
Magnesium	K-series	0.09	0.10	0.11	0.03
Potassium	K-series	0.03	0.03	0.02	0.03
Oxygen	K-series	24.46	25.87	45.86	10.34
	Sum:	94.52	100.00	100.00	



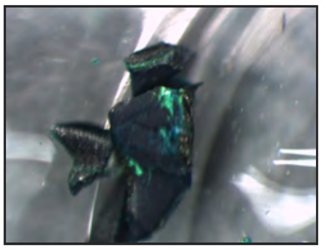
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

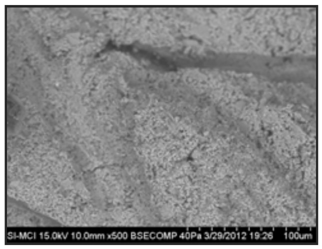


acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: black, maybe green

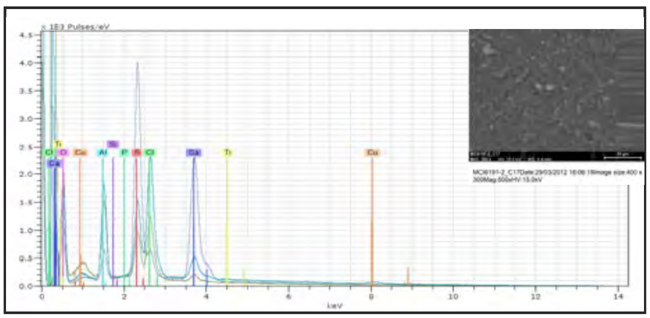
sample location: 20.0" from bottom, 19.0" from right
(B 50.8 x R 48.3 cm.)

Representative Analysis Compilation—sample C017

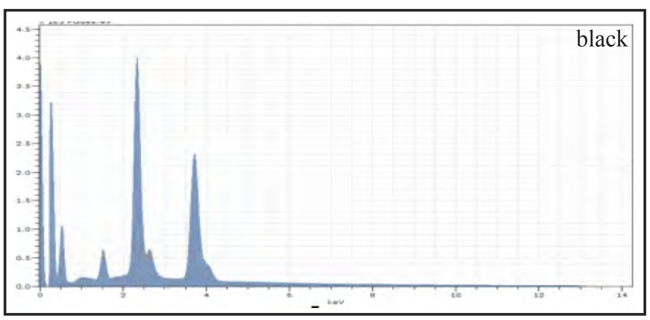




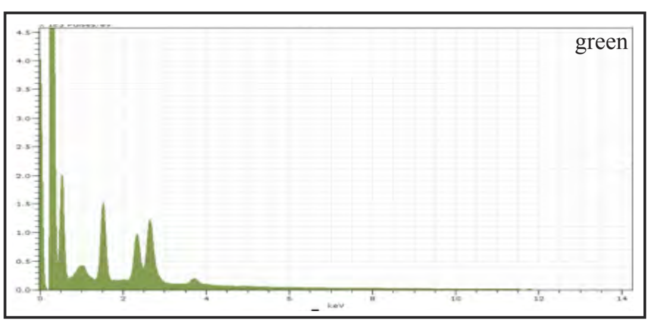
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



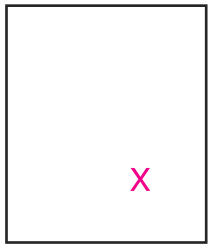
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, black: none
significant elements, green: Cl, Cu
interpretation: phthalo green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Sulfur	K-series	24.97	27.71	22.61	0.91
Calcium	K-series	21.90	24.31	15.87	0.68
Chlorine	K-series	4.56	5.06	3.74	0.18
Aluminium	K-series	3.67	4.07	3.95	0.20
Zinc	K-series	3.03	3.37	1.35	0.13
Copper	K-series	2.33	2.59	1.07	0.11
Barium	L-series	1.07	1.19	0.23	0.12
Sodium	K-series	0.53	0.59	0.67	0.44
Phosphorus	K-series	0.23	0.26	0.22	0.03
Magnesium	K-series	0.11	0.12	0.13	0.03
Silicon	K-series	0.07	0.07	0.07	0.03
Potassium	K-series	0.02	0.02	0.02	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	27.60	30.63	50.09	15.27
	Sum:	90.09	100.00	100.00	



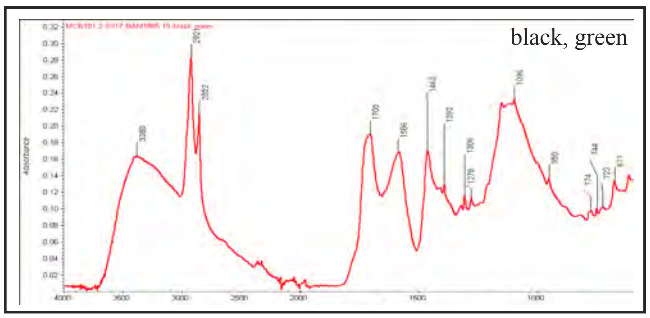
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Chlorine	K-series	7.92	11.35	6.53	0.29
Aluminium	K-series	5.98	8.56	6.48	0.30
Sulfur	K-series	4.03	5.78	3.68	0.17
Zinc	K-series	1.83	2.62	0.82	0.10
Copper	K-series	1.83	2.62	0.84	0.09
Calcium	K-series	1.60	2.30	1.17	0.08
Barium	L-series	1.48	2.11	0.31	0.15
Sodium	K-series	1.47	2.11	1.87	1.18
Iron	K-series	1.00	1.44	0.53	0.06
Magnesium	K-series	0.09	0.13	0.11	0.03
Potassium	K-series	0.08	0.12	0.06	0.03
Phosphorus	K-series	0.02	0.03	0.02	0.03
Silicon	K-series	0.01	0.02	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	42.45	60.82	77.57	19.33
	Sum:	69.79	100.00	100.00	



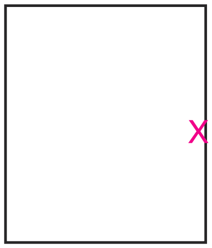
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: black, maybe green

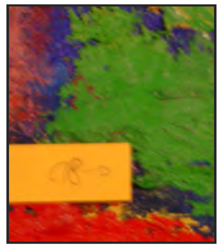
sample location: 20.0" from bottom, 19.0" from right
(B 50.8 x R 48.3 cm.)

Representative Analysis Compilation—sample C017, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

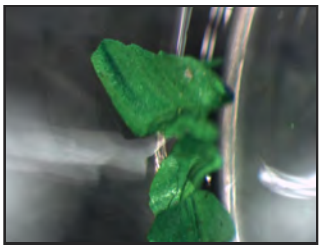
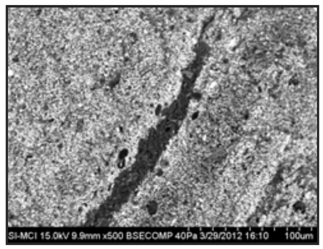





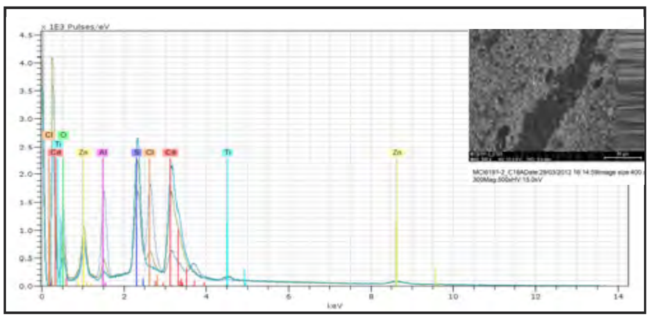
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: bright green

sample location: 28.0" from bottom, 2.5" from right
(B 71.1 x R 6.4 cm.)

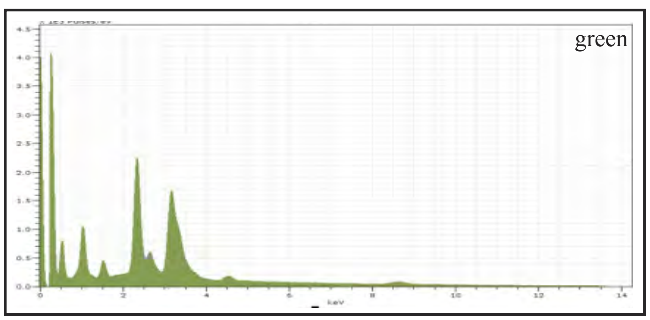
Representative Analysis Compilation—sample C018

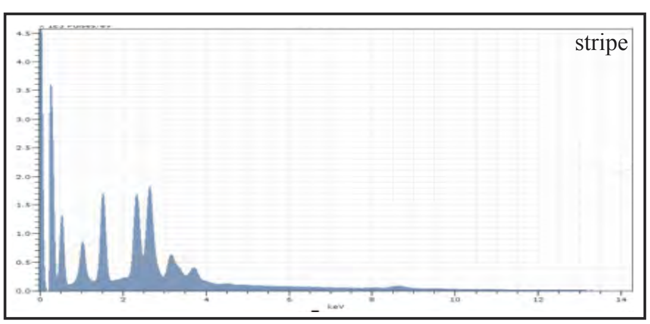
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



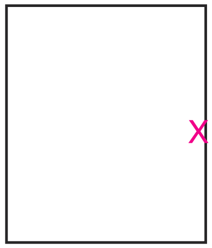
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cd, S, Na
significant elements, stripe: Cu, Cl
interpretation: cadmium green, phthalo green

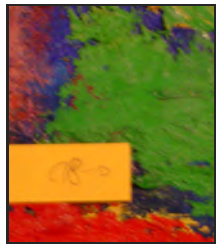


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	18.81	24.70	7.92	1.73
Zinc	K-series	16.52	21.69	11.96	0.58
Sulfur	K-series	10.95	14.37	16.17	0.41
Sodium	K-series	3.61	4.74	7.44	2.87
Barium	L-series	3.19	4.19	1.10	0.30
Potassium	K-series	3.03	3.98	3.68	0.63
Aluminium	K-series	2.33	3.06	4.08	1.45
Chlorine	K-series	1.93	2.54	2.58	0.09
Titanium	K-series	0.62	0.82	0.62	0.17
Magnesium	K-series	0.16	0.21	0.32	0.08
Calcium	K-series	0.12	0.15	0.14	0.10
Silicon	K-series	0.04	0.05	0.07	0.03
Phosphorus	K-series	0.02	0.03	0.03	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	14.83	19.47	43.89	9.86
	Sum:	76.16	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	10.29	15.15	5.88	0.37
Aluminium	K-series	7.71	11.35	10.68	2.24
Chlorine	K-series	6.58	9.68	6.93	0.24
Sulfur	K-series	5.85	8.61	6.81	0.23
Sodium	K-series	3.20	4.71	5.20	2.54
Cadmium	L-series	2.93	4.32	0.98	0.52
Copper	K-series	2.74	4.03	1.61	0.12
Calcium	K-series	1.57	2.32	1.47	0.10
Barium	L-series	0.93	1.36	0.25	0.11
Potassium	K-series	0.45	0.67	0.43	0.22
Phosphorus	K-series	0.14	0.21	0.17	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	25.52	37.58	59.59	13.24
	Sum:	67.90	100.00	100.00	

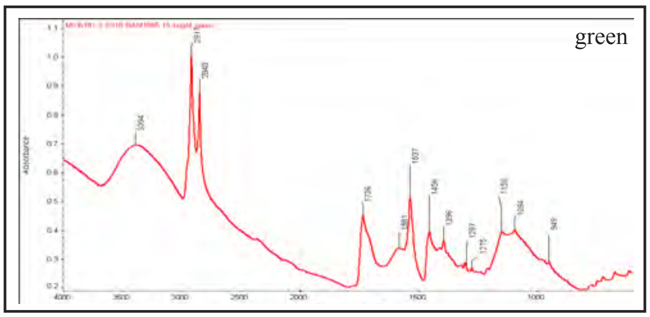




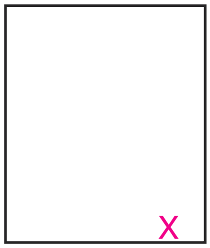
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: bright green

sample location: 28.0" from bottom, 2.5" from right
(B 71.1 x R 6.4 cm.)

Representative Analysis Compilation—sample C018, continued



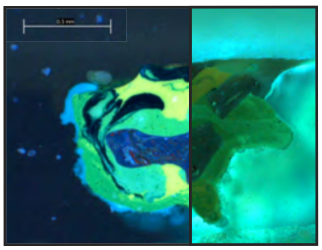
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

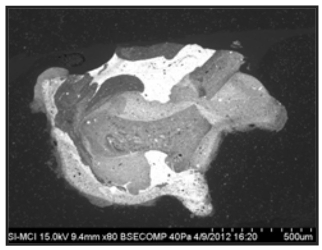


acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: green, stratigraphy

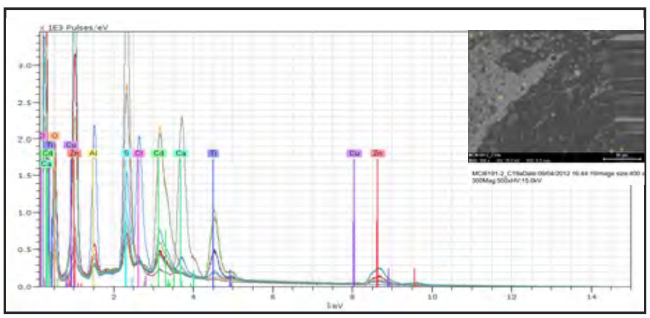
sample location: 4.0" from bottom, 10.0" from right
(B 10.2 x R 25.4 cm.)

Representative Analysis Compilation—sample C019

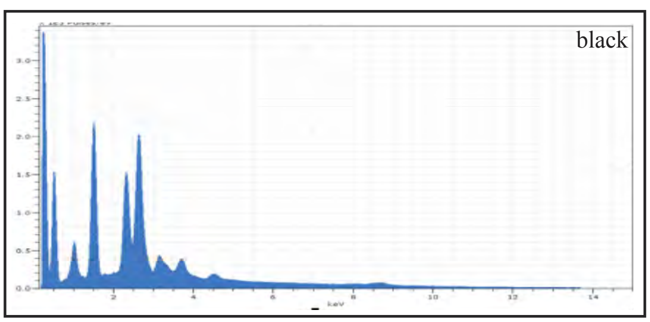




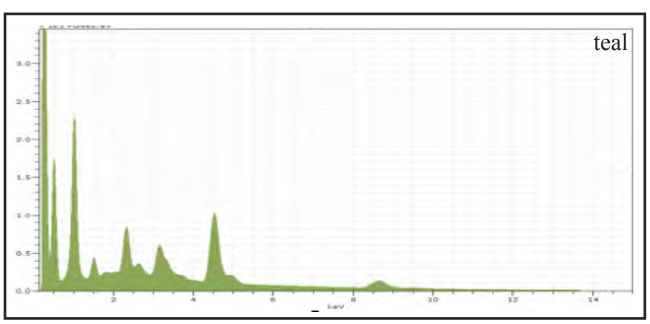
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.4 mm.



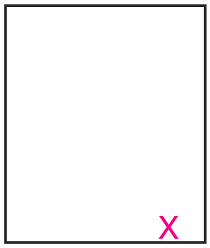
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, black: Cl, Cu
significant elements, teal: Na, Cd, S
significant elements, green: Cd, S, Na
significant elements, light blue: Na
interpretation: phthalo green, cadmium green, ultramarine blue, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	10.92	24.36	32.18	0.53
Chlorine	K-series	10.50	23.43	23.56	0.37
Sulfur	K-series	6.38	14.24	15.83	0.25
Zinc	K-series	5.98	13.34	7.27	0.23
Sodium	K-series	3.05	6.80	10.54	2.42
Cadmium	L-series	2.27	5.06	1.61	0.54
Copper	K-series	1.98	4.41	2.47	0.09
Calcium	K-series	1.85	4.13	3.68	0.11
Titanium	K-series	0.84	1.88	1.40	0.13
Barium	L-series	0.53	1.18	0.31	0.17
Potassium	K-series	0.37	0.83	0.75	0.20
Silicon	K-series	0.09	0.21	0.27	0.03
Phosphorus	K-series	0.05	0.12	0.14	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	44.83	100.00	100.00	



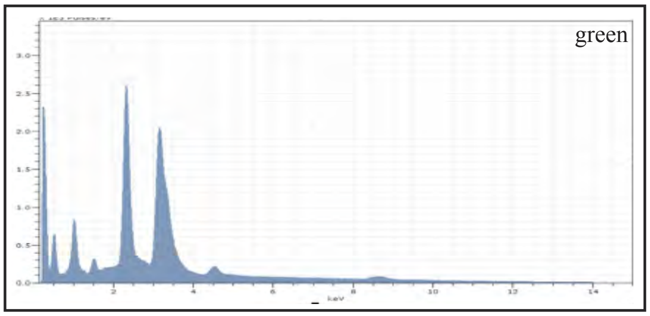
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	22.27	32.45	21.27	0.76
Titanium	K-series	17.21	25.08	22.45	0.81
Sodium	K-series	13.77	20.07	37.41	10.86
Cadmium	L-series	5.34	7.77	2.96	0.95
Sulfur	K-series	3.54	5.15	6.88	0.15
Barium	L-series	2.44	3.55	1.11	1.04
Aluminium	K-series	1.53	2.23	3.54	1.05
Potassium	K-series	1.05	1.53	1.68	0.34
Chlorine	K-series	0.84	1.22	1.47	0.05
Calcium	K-series	0.31	0.45	0.49	0.08
Silicon	K-series	0.16	0.23	0.36	0.03
Phosphorus	K-series	0.14	0.20	0.27	0.03
Magnesium	K-series	0.04	0.06	0.10	0.05
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	68.63	100.00	100.00	



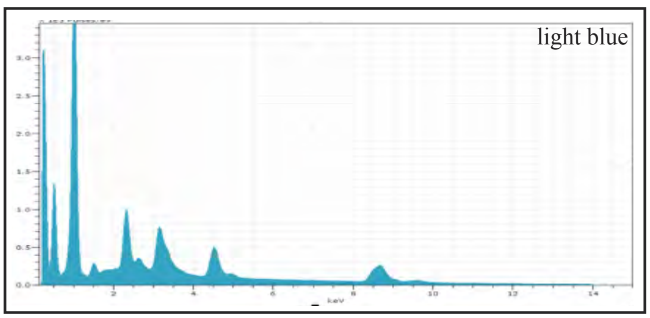
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: green, stratigraphy

sample location: 4.0" from bottom, 10.0" from right
(B 10.2 x R 25.4 cm.)

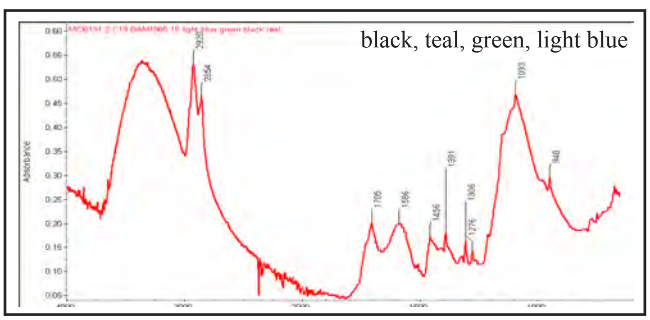
Representative Analysis Compilation—sample C019, continued



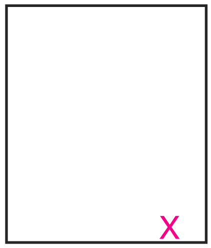
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	27.32	32.43	14.60	2.45
Zinc	K-series	19.53	23.19	17.94	0.68
Sulfur	K-series	16.38	19.44	30.67	0.60
Sodium	K-series	7.36	8.74	19.23	5.82
Potassium	K-series	5.81	6.89	8.92	0.82
Barium	L-series	4.21	5.00	1.84	0.37
Aluminium	K-series	1.47	1.74	3.27	0.09
Titanium	K-series	0.96	1.14	1.20	0.21
Chlorine	K-series	0.54	0.64	0.92	0.05
Silicon	K-series	0.24	0.28	0.51	0.04
Magnesium	K-series	0.21	0.25	0.51	0.04
Phosphorus	K-series	0.12	0.14	0.22	0.03
Calcium	K-series	0.11	0.13	0.17	0.10
	Sum:	84.25	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	58.82	49.60	30.10	1.96
Sodium	K-series	20.63	17.40	30.03	16.26
Cadmium	L-series	9.11	7.68	2.71	1.32
Titanium	K-series	6.41	5.41	4.48	0.56
Barium	L-series	4.16	3.51	1.01	0.58
Sulfur	K-series	4.08	3.44	4.26	0.17
Potassium	K-series	1.74	1.47	1.49	0.46
Aluminium	K-series	1.37	1.16	1.70	0.09
Chlorine	K-series	0.93	0.79	0.88	0.06
Calcium	K-series	0.20	0.17	0.17	0.10
Silicon	K-series	0.12	0.10	0.14	0.03
Magnesium	K-series	0.01	0.01	0.02	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	11.00	9.28	23.01	5.72
	Sum:	118.58	100.00	100.00	



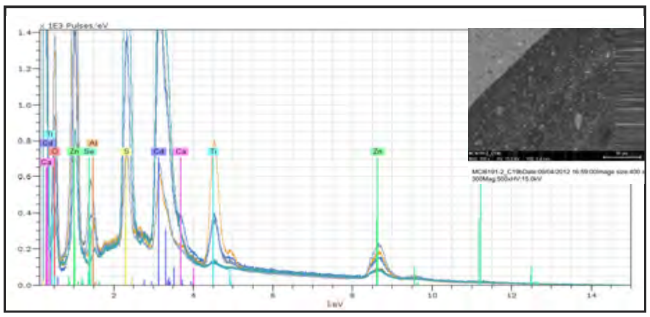
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7



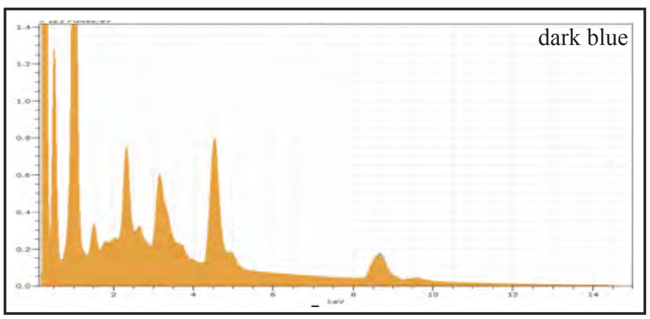
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: green, stratigraphy

sample location: 4.0" from bottom, 10.0" from right
(B 10.2 x R 25.4 cm.)

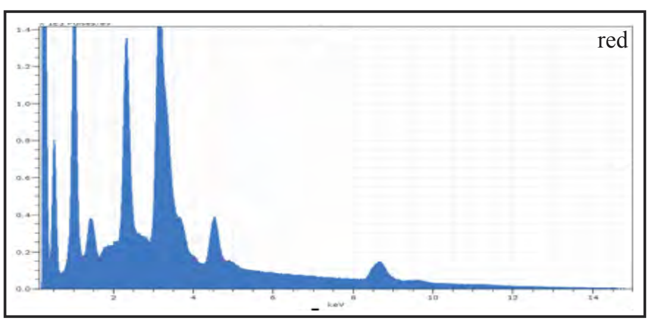
Representative Analysis Compilation—sample C019, continued



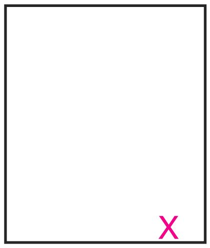
analysis: EDS
by: DVR (MCI)
date: 04/09/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, dark blue: Na
significant elements, red: Cd, S, Se
significant elements, yellow: Cd, S
interpretation: ultramarine blue, cadmium red, cadmium yellow



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	27.17	40.45	25.56	0.92
Sodium	K-series	16.60	24.72	44.43	13.09
Titanium	K-series	11.86	17.66	15.24	0.56
Cadmium	L-series	5.03	7.49	2.75	0.92
Sulfur	K-series	3.04	4.52	5.83	0.13
Potassium	K-series	1.05	1.57	1.66	0.32
Aluminium	K-series	0.92	1.38	2.11	0.73
Chlorine	K-series	0.60	0.89	1.04	0.05
Calcium	K-series	0.33	0.49	0.51	0.07
Phosphorus	K-series	0.21	0.31	0.42	0.03
Barium	L-series	0.18	0.27	0.08	0.12
Silicon	K-series	0.09	0.14	0.21	0.03
Magnesium	K-series	0.07	0.11	0.18	0.06
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	67.17	100.00	100.00	



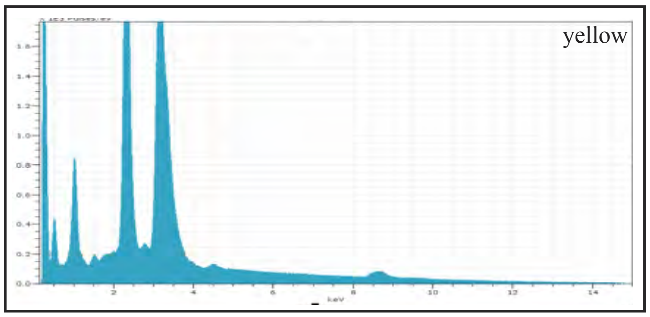
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	23.89	30.75	21.41	0.82
Cadmium	L-series	16.48	21.22	8.59	1.75
Sodium	K-series	14.95	19.25	38.12	11.79
Sulfur	K-series	6.88	8.86	12.58	0.27
Titanium	K-series	3.68	4.74	4.51	0.36
Potassium	K-series	3.65	4.70	5.47	0.58
Selenium	L-series	2.81	3.62	2.09	0.23
Barium	L-series	1.90	2.44	0.81	0.38
Aluminium	K-series	1.48	1.91	3.22	1.16
Calcium	K-series	1.25	1.61	1.83	0.13
Silicon	K-series	0.29	0.37	0.60	0.04
Phosphorus	K-series	0.24	0.31	0.46	0.04
Chlorine	K-series	0.10	0.13	0.17	0.03
Magnesium	K-series	0.06	0.07	0.14	0.07
	Sum:	77.68	100.00	100.00	



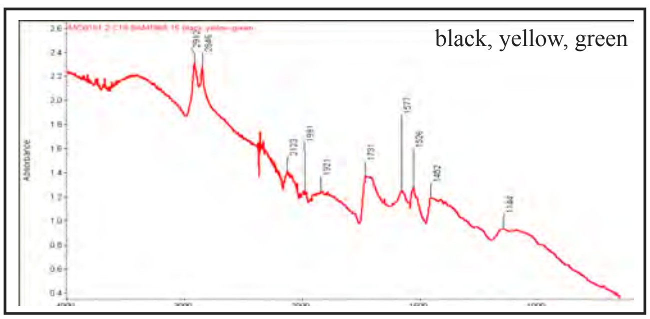
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: green, stratigraphy

sample location: 4.0" from bottom, 10.0" from right
(B 10.2 x R 25.4 cm.)

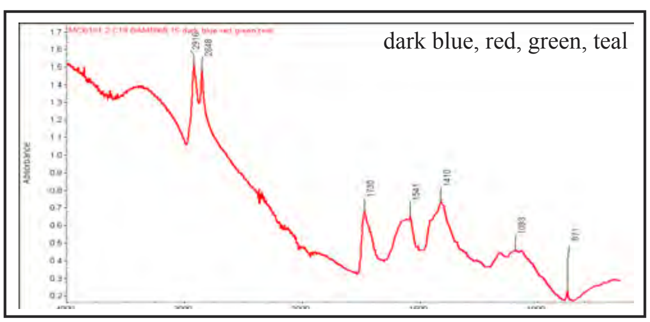
Representative Analysis Compilation—sample C019, continued



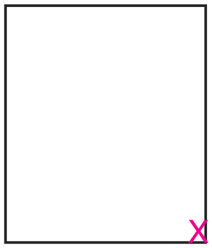
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	25.03	29.41	11.26	2.32
Zinc	K-series	21.47	25.22	16.60	0.74
Sulfur	K-series	14.02	16.47	22.11	0.52
Sodium	K-series	6.83	8.02	15.02	5.40
Potassium	K-series	6.36	7.47	8.23	0.76
Barium	L-series	2.94	3.45	1.08	0.25
Magnesium	K-series	0.40	0.47	0.83	0.12
Aluminium	K-series	0.39	0.46	0.74	0.33
Silicon	K-series	0.06	0.07	0.11	0.03
Calcium	K-series	0.02	0.03	0.03	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	7.59	8.92	24.00	6.56
	Sum:	85.12	100.00	100.00	

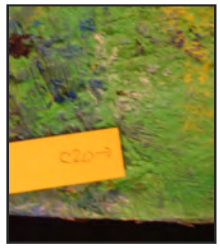


analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

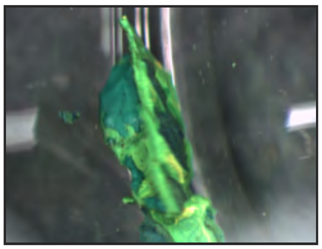




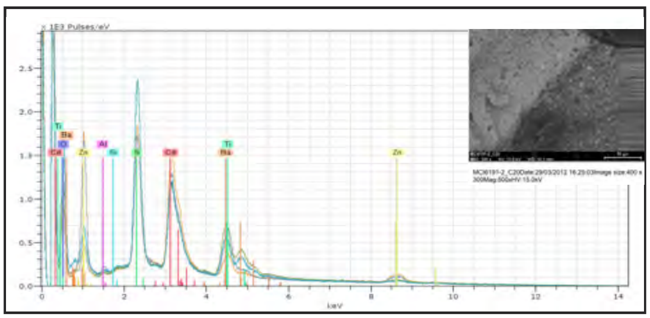
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: yellow, green

sample location: 3.0" from bottom, 1.0" from right (B 7.6 x R 2.54 cm.)

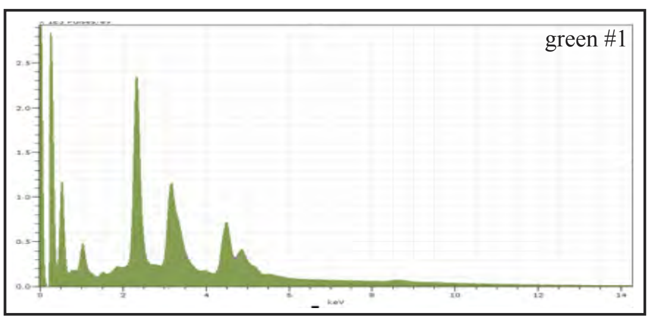
Representative Analysis Compilation—sample C020



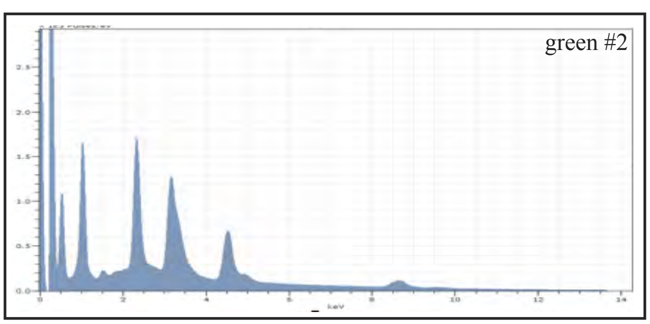
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



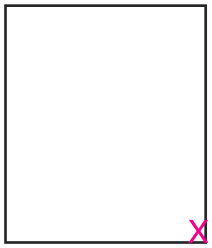
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, green #1: Ba, Cd, S, Na
significant elements, green #2: Zn, Cd, S, Na
interpretation: cadmium green

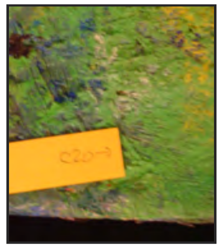


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	24.29	25.14	6.63	1.57
Sulfur	K-series	14.47	14.98	16.92	0.54
Cadmium	L-series	13.89	14.37	4.63	1.53
Zinc	K-series	13.67	14.14	7.84	0.48
Sodium	K-series	2.38	2.46	3.88	1.90
Potassium	K-series	2.16	2.23	2.07	0.54
Titanium	K-series	0.94	0.97	0.73	0.40
Magnesium	K-series	0.32	0.33	0.49	0.11
Phosphorus	K-series	0.25	0.25	0.30	0.04
Silicon	K-series	0.21	0.22	0.28	0.04
Aluminium	K-series	0.14	0.14	0.19	0.13
Chlorine	K-series	0.02	0.02	0.02	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	23.91	24.75	56.03	13.34
	Sum:	96.62	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	20.48	23.18	12.38	0.71
Cadmium	L-series	15.08	17.06	5.30	1.54
Titanium	K-series	8.93	10.11	7.37	0.70
Sulfur	K-series	8.79	9.94	10.83	0.34
Sodium	K-series	7.22	8.17	12.41	5.71
Barium	L-series	5.70	6.45	1.64	0.71
Potassium	K-series	2.27	2.56	2.29	0.57
Aluminium	K-series	0.46	0.52	0.68	0.38
Chlorine	K-series	0.26	0.30	0.29	0.04
Magnesium	K-series	0.19	0.22	0.32	0.08
Phosphorus	K-series	0.18	0.21	0.23	0.03
Silicon	K-series	0.10	0.11	0.14	0.03
Calcium	K-series	0.07	0.08	0.07	0.07
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	18.64	21.09	46.05	10.75
	Sum:	88.38	100.00	100.00	

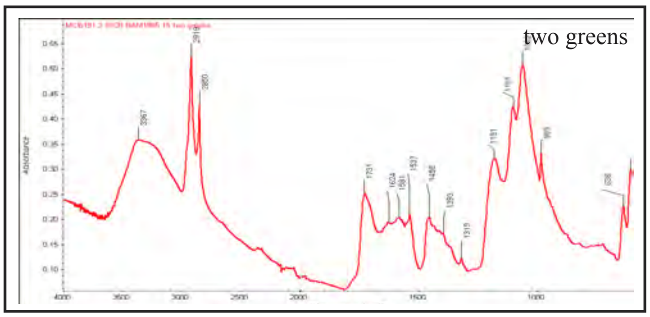




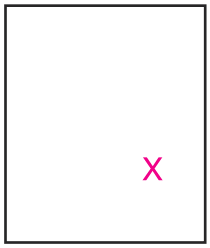
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: yellow, green

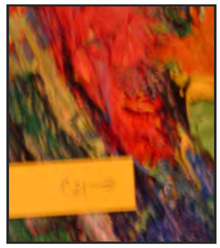
sample location: 3.0" from bottom, 1.0" from right
(B 7.6 x R 2.54 cm.)

Representative Analysis Compilation—sample C020, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

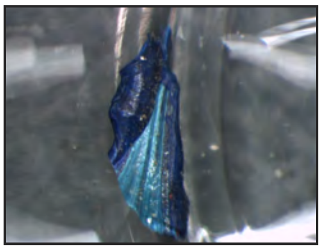


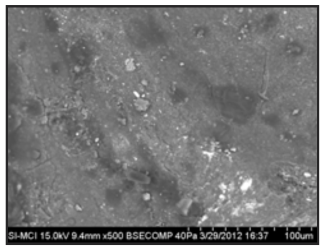


acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: deep blue

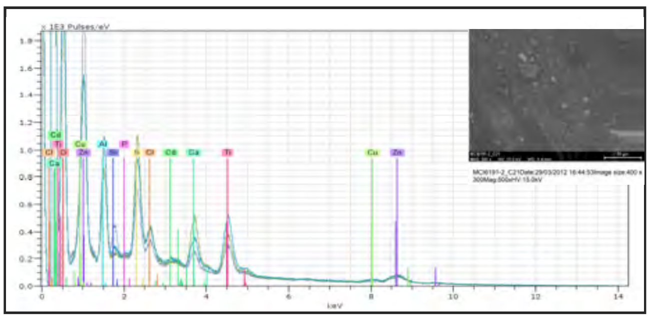
sample location: 22.0" from bottom, 20.5" from right (B 55.9 x R 52.1 cm.)

Representative Analysis Compilation—sample C021

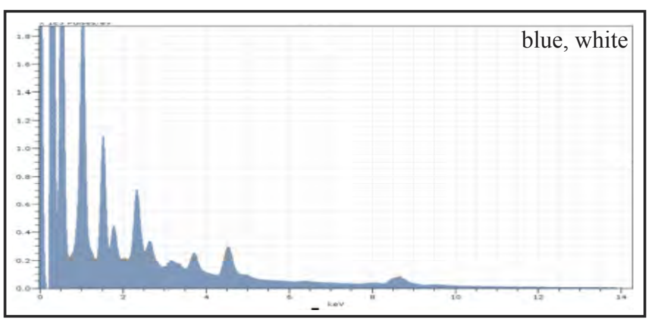




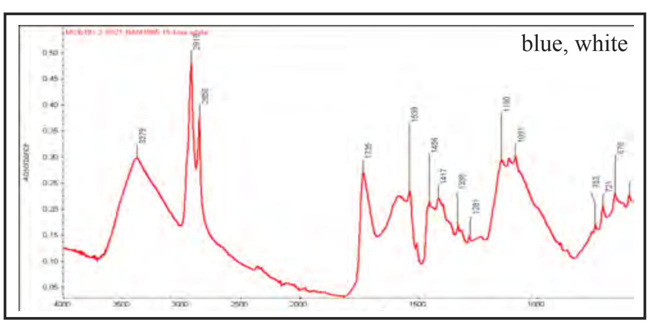
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



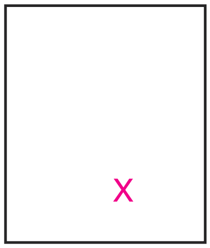
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Cu, Cl
significant elements, white: Zn
interpretation: phthalo blue, zinc white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	13.97	17.21	6.05	0.49
Sodium	K-series	8.52	10.49	10.49	6.73
Aluminium	K-series	4.17	5.14	4.38	1.56
Titanium	K-series	3.74	4.61	2.21	0.32
Sulfur	K-series	2.96	3.64	2.61	0.13
Copper	K-series	1.96	2.42	0.87	0.09
Calcium	K-series	1.51	1.86	1.07	0.10
Silicon	K-series	1.35	1.67	1.36	0.08
Chlorine	K-series	1.32	1.63	1.06	0.07
Cadmium	L-series	1.16	1.43	0.29	0.31
Barium	L-series	0.60	0.74	0.12	0.32
Iron	K-series	0.55	0.68	0.28	0.04
Magnesium	K-series	0.24	0.30	0.28	0.08
Potassium	K-series	0.21	0.26	0.15	0.15
Phosphorus	K-series	0.12	0.15	0.11	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	38.76	47.76	68.63	14.49
	Sum:	81.17	100.00	100.00	



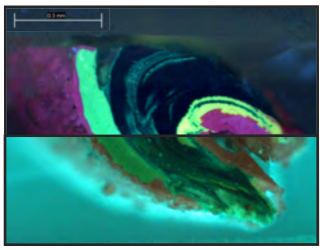
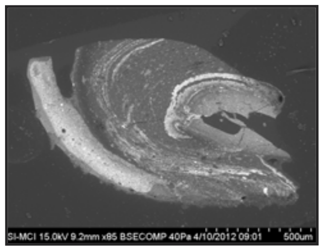
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PB15

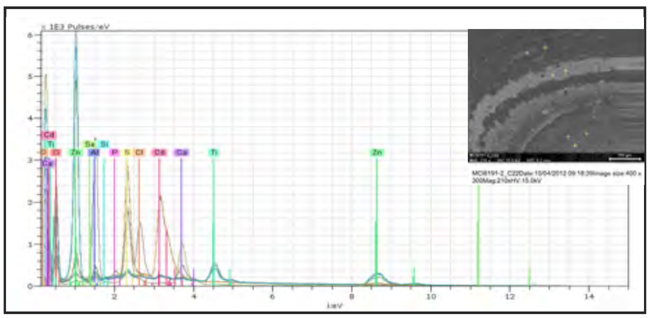
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: pink

sample location: 21.0" from bottom, 22.0" from right
(B 53.3 x R 55.9 cm.)

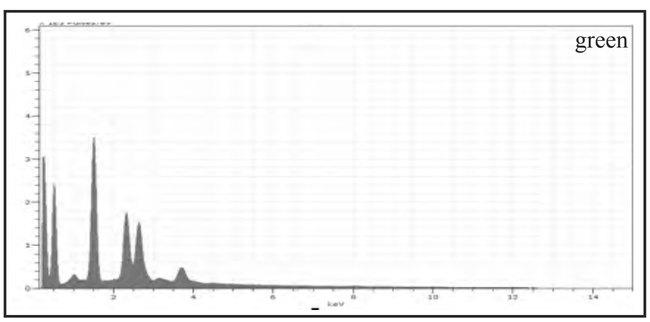
Representative Analysis Compilation—sample C022

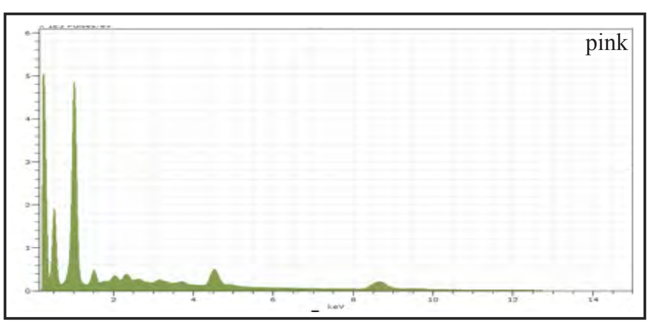
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.2 mm.



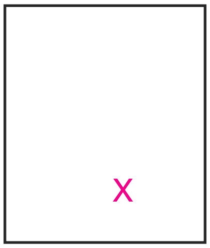
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.2 mm.
mag: 210x; HV: 15 kV
significant elements, green: Cl, Cu
significant elements, pink: Al
significant elements, yellow: Cd, S
interpretation: synthetic color, phthalo green, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	17.18	38.22	46.42	0.82
Chlorine	K-series	10.39	23.11	21.36	0.37
Sulfur	K-series	8.94	19.88	20.32	0.34
Calcium	K-series	3.38	7.53	6.16	0.15
Zinc	K-series	1.49	3.32	1.66	0.08
Cadmium	L-series	1.29	2.88	0.84	0.09
Copper	K-series	1.26	2.79	1.44	0.07
Barium	L-series	0.47	1.05	0.25	0.09
Sodium	K-series	0.38	0.85	1.21	0.33
Titanium	K-series	0.09	0.21	0.14	0.06
Silicon	K-series	0.08	0.17	0.20	0.03
	Sum:	44.95	100.00	100.00	



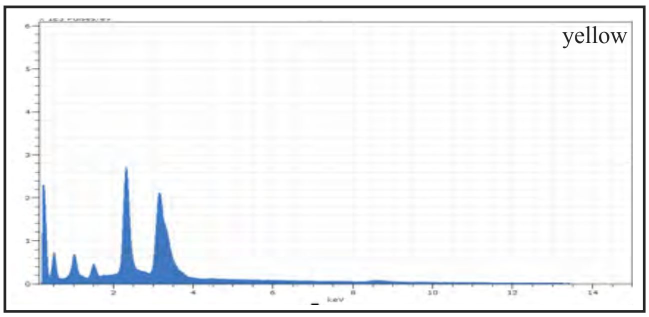
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	40.60	46.24	26.14	1.36
Sodium	K-series	33.22	37.83	60.82	26.17
Titanium	K-series	6.69	7.62	5.88	0.46
Aluminium	K-series	1.93	2.20	3.01	1.22
Barium	L-series	1.63	1.85	0.50	0.55
Cadmium	L-series	1.06	1.20	0.40	0.28
Calcium	K-series	0.79	0.90	0.83	0.08
Sulfur	K-series	0.78	0.88	1.02	0.05
Phosphorus	K-series	0.58	0.66	0.78	0.05
Chlorine	K-series	0.33	0.38	0.40	0.04
Potassium	K-series	0.20	0.23	0.22	0.15
Silicon	K-series	0.01	0.01	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	87.81	100.00	100.00	



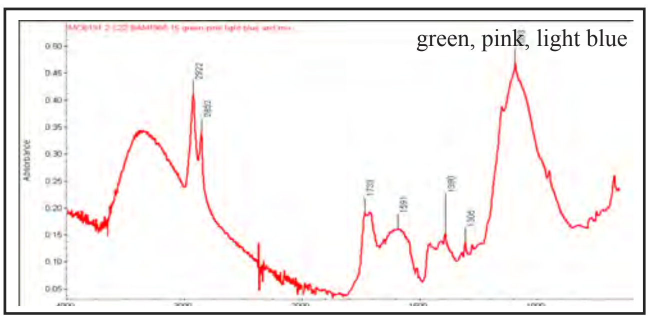
acc. no.: BAM 1965.15
title, year: *Le Gilotin*, 1953
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 58.0 x 48.0" (147.3 x 121.9 cm.)
notes: pink

sample location: 21.0" from bottom, 22.0" from right
(B 53.3 x R 55.9 cm.)

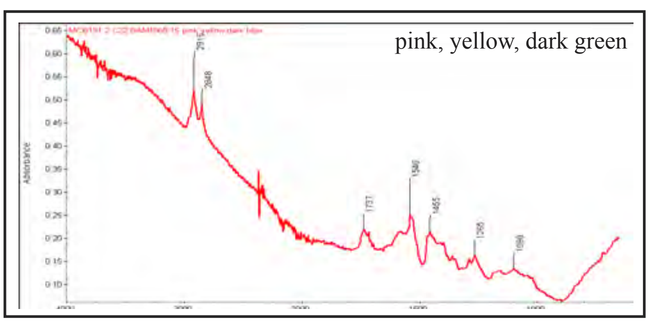
Representative Analysis Compilation—sample C022, continued



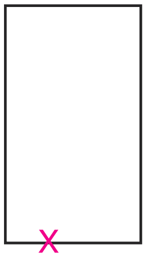
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	26.00	38.73	16.63	2.36
Sulfur	K-series	15.33	22.82	34.37	0.57
Zinc	K-series	10.97	16.34	12.07	0.39
Sodium	K-series	5.92	8.82	18.53	4.69
Potassium	K-series	5.82	8.66	10.70	0.77
Aluminium	K-series	2.26	3.37	6.03	0.13
Chlorine	K-series	0.37	0.55	0.75	0.05
Magnesium	K-series	0.20	0.30	0.59	0.04
Barium	L-series	0.14	0.21	0.07	0.03
Calcium	K-series	0.10	0.14	0.17	0.09
Silicon	K-series	0.04	0.05	0.09	0.03
	Sum:	67.15	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7



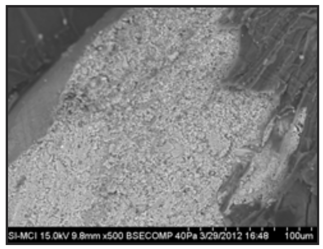
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR83



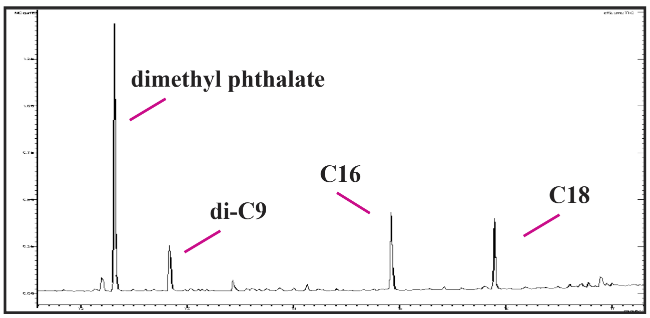
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: ground layer

sample location: bottom edge, 17.0" from left (B 0.0 x L 43.2 cm.)

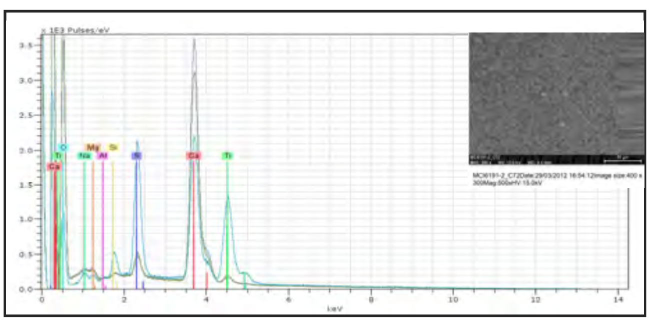
Representative Analysis Compilation—sample C072



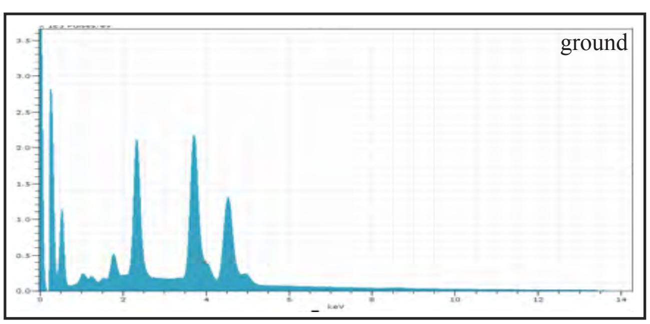
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



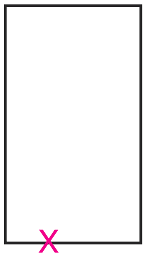
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/04/12
sample weight: 0.086
scan range: 1 - 1495
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti
interpretation: titanium white



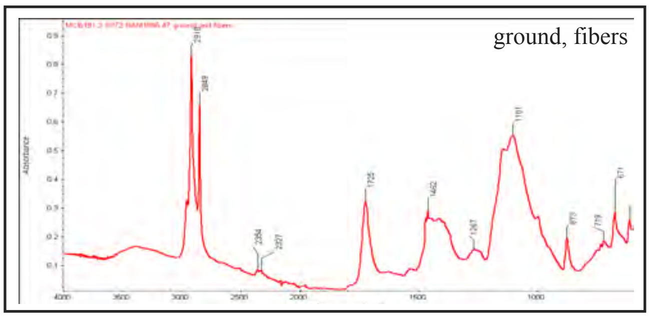
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	17.64	23.21	13.12	0.71
Calcium	K-series	17.29	22.74	15.37	0.54
Sulfur	K-series	12.26	16.13	13.62	0.46
Silicon	K-series	2.66	3.49	3.37	0.14
Sodium	K-series	1.09	1.43	1.69	0.88
Zinc	K-series	0.81	1.07	0.44	0.06
Magnesium	K-series	0.46	0.60	0.67	0.05
Chlorine	K-series	0.42	0.56	0.43	0.04
Phosphorus	K-series	0.38	0.50	0.44	0.04
Aluminium	K-series	0.15	0.19	0.19	0.03
Potassium	K-series	0.10	0.13	0.09	0.03
Barium	L-series	0.05	0.07	0.01	0.05
Oxygen	K-series	22.71	29.88	50.56	12.25
	Sum:	76.03	100.00	100.00	

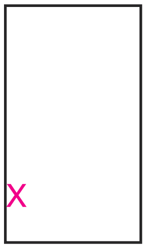

acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: ground layer

sample location: bottom edge, 17.0" from left
(B 0.0 x L 43.2 cm.)

Representative Analysis Compilation—sample C072, continued



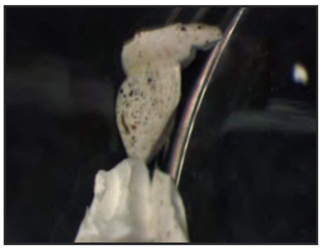
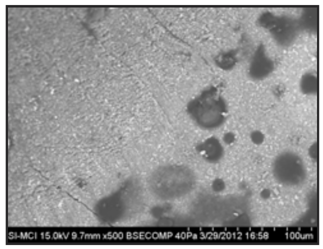
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for wax

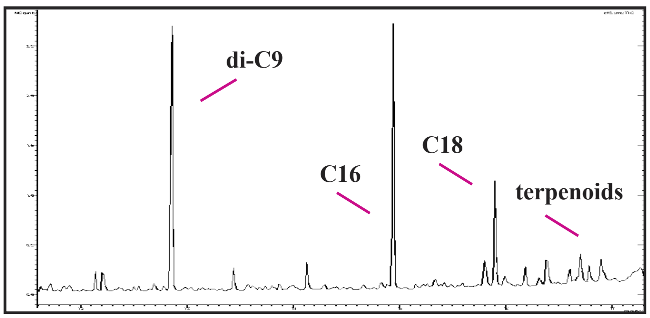
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: compositional white

sample location: 14.0" from bottom, 4.0" from left
(B 35.6 x L 10.2 cm.)

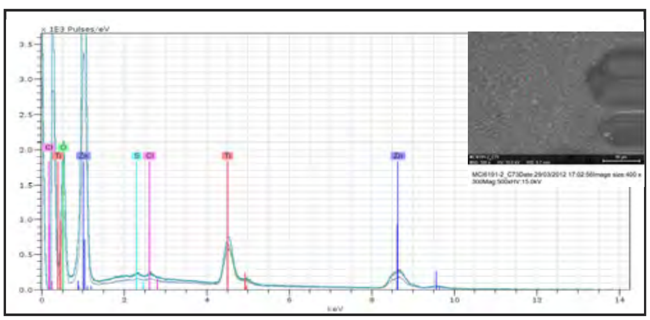
Representative Analysis Compilation—sample C073

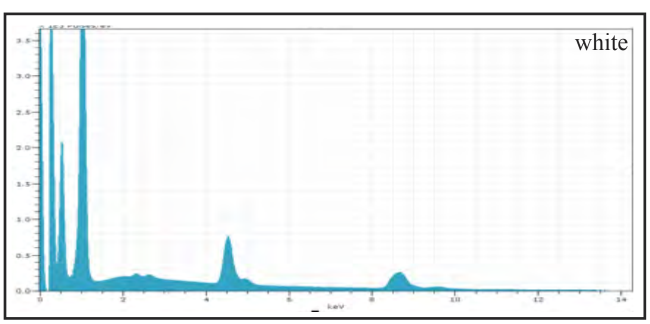
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



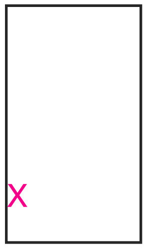
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.164
scan range: 1 - 1485
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



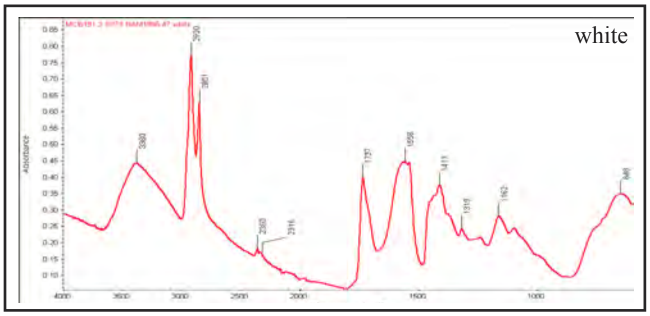
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	51.52	48.88	24.95	1.72
Sodium	K-series	21.66	20.55	29.84	17.07
Titanium	K-series	12.09	11.47	8.00	0.57
Chlorine	K-series	0.82	0.78	0.74	0.05
Sulfur	K-series	0.72	0.68	0.71	0.05
Phosphorus	K-series	0.47	0.45	0.48	0.04
Silicon	K-series	0.20	0.19	0.22	0.03
Barium	L-series	0.14	0.13	0.03	0.10
Potassium	K-series	0.10	0.09	0.08	0.03
Magnesium	K-series	0.03	0.03	0.04	0.03
Aluminium	K-series	0.01	0.01	0.02	0.03
Calcium	K-series	0.01	0.01	0.01	0.03
Oxygen	K-series	17.63	16.72	34.89	7.50
	Sum:	105.40	100.00	100.00	



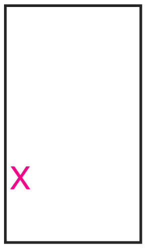
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: compositional white

sample location: 14.0" from bottom, 4.0" from left
(B 35.6 x L 10.2 cm.)

Representative Analysis Compilation—sample C073, continued



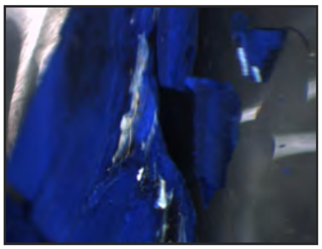
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

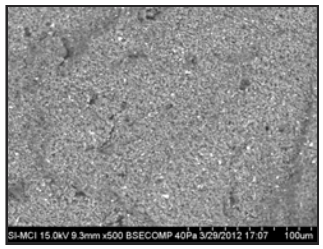


acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: deep blue

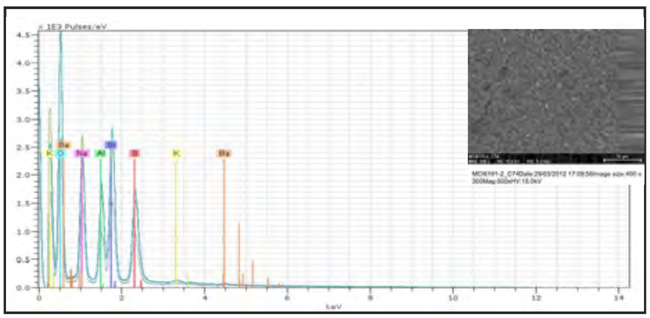
sample location: 26.0" from bottom, 5.0" from left
(B 66.0 x L 12.7 cm.)

Representative Analysis Compilation—sample C074

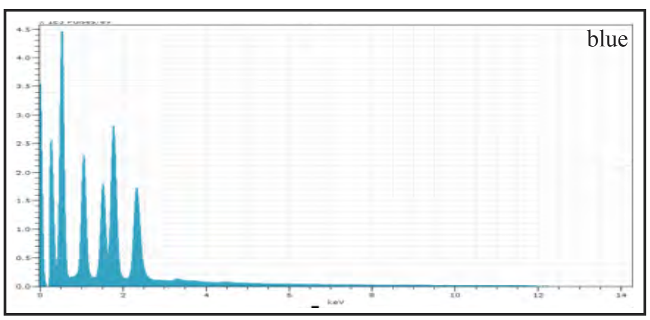




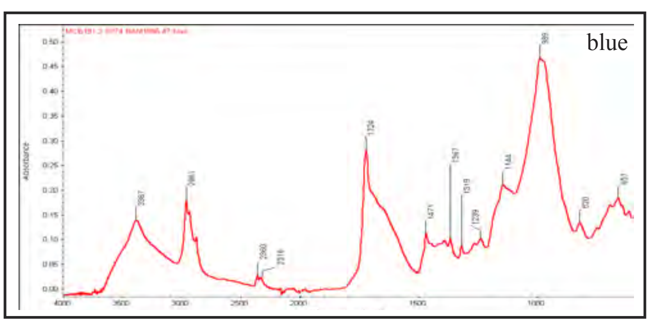
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.3 mm.



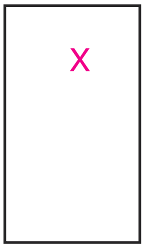
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.3 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Al
interpretation: ultramarine blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	13.61	14.52	10.42	0.59
Sodium	K-series	11.92	12.71	11.14	9.40
Sulfur	K-series	10.18	10.86	6.82	0.38
Aluminium	K-series	6.30	6.72	5.02	0.32
Zinc	K-series	1.37	1.46	0.45	0.08
Barium	L-series	0.67	0.71	0.10	0.09
Potassium	K-series	0.49	0.53	0.27	0.04
Chlorine	K-series	0.22	0.23	0.13	0.03
Calcium	K-series	0.21	0.22	0.11	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	48.77	52.03	65.53	15.48
	Sum:	93.74	100.00	100.00	



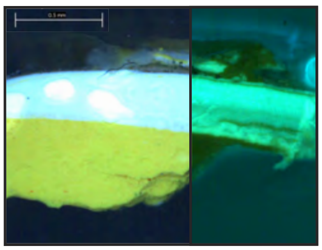
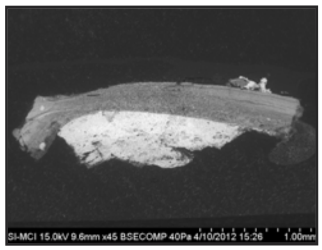
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard
for F10/B67/72 varnish

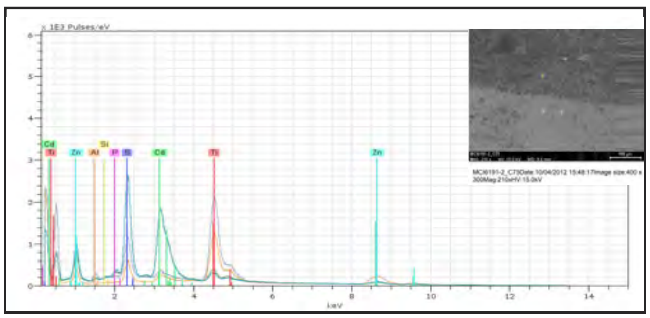
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: lemon yellow

sample location: 19.0" from top, 19.5" from right
(T 48.3 x R 49.5 cm.)

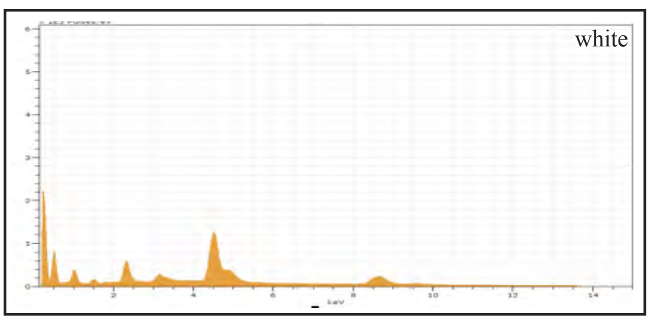
Representative Analysis Compilation—sample C075

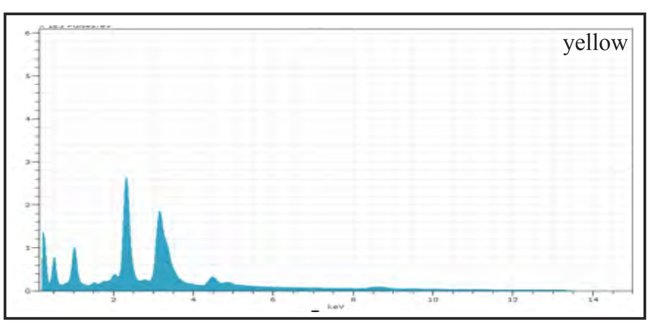
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.6 mm.



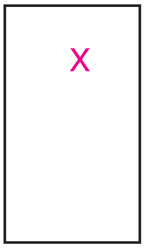
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.6 mm.
mag: 210x; HV: 15 kV
significant elements, white: Zn, Ti
significant elements, yellow: Cd, S
interpretation: Zn/Ti white, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	120.77	51.20	49.69	4.00
Barium	L-series	62.23	26.38	12.19	4.10
Titanium	K-series	22.40	9.50	12.59	2.40
Sodium	K-series	9.58	4.06	11.21	7.56
Sulfur	K-series	9.15	3.88	7.68	0.35
Cadmium	L-series	5.84	2.48	1.40	1.44
Aluminium	K-series	2.71	1.15	2.70	0.15
Potassium	K-series	1.83	0.78	1.26	0.52
Silicon	K-series	0.55	0.23	0.52	0.05
Phosphorus	K-series	0.37	0.16	0.32	0.04
Magnesium	K-series	0.32	0.13	0.35	0.05
Chlorine	K-series	0.12	0.05	0.09	0.04
	Sum:	235.86	100.00	100.00	



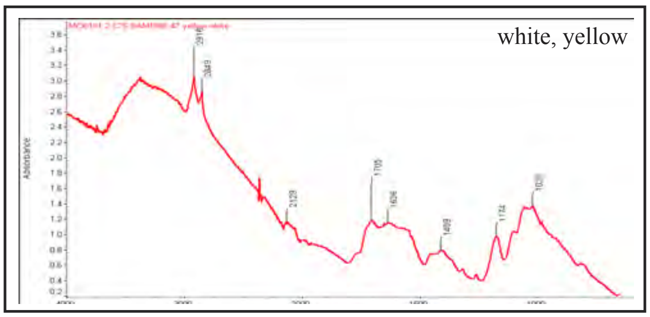
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	21.81	31.59	12.96	2.15
Sulfur	K-series	15.31	22.17	31.89	0.56
Zinc	K-series	9.88	14.31	10.09	0.36
Sodium	K-series	8.90	12.90	25.87	7.03
Potassium	K-series	4.93	7.14	8.42	0.69
Barium	L-series	3.60	5.21	1.75	0.38
Titanium	K-series	2.01	2.91	2.80	0.26
Phosphorus	K-series	1.08	1.56	2.33	0.07
Aluminium	K-series	0.59	0.85	1.45	0.05
Magnesium	K-series	0.56	0.80	1.53	0.06
Silicon	K-series	0.39	0.56	0.92	0.04
	Sum:	69.03	100.00	100.00	



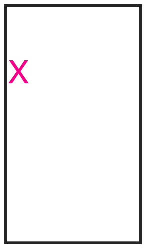
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: lemon yellow

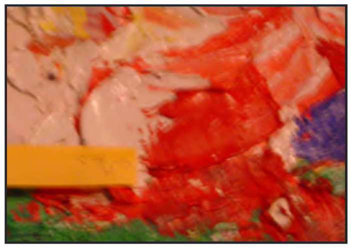
sample location: 19.0" from top, 19.5" from right
(T 48.3 x R 49.5 cm.)

Representative Analysis Compilation—sample C075, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

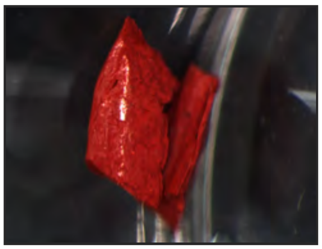


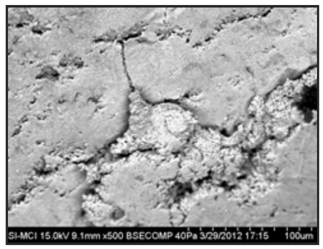


acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: red

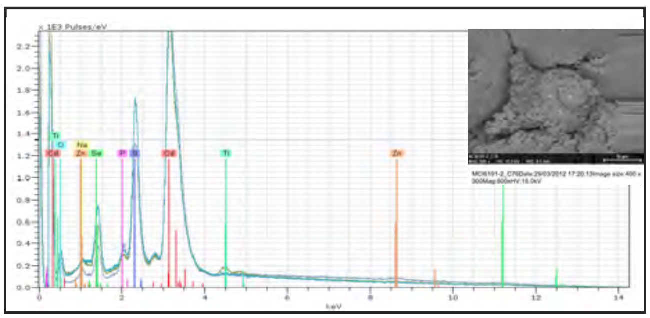
sample location: 22.5" from top, 5.0" from left
(T 57.2 x L 12.7 cm.)

Representative Analysis Compilation—sample C076

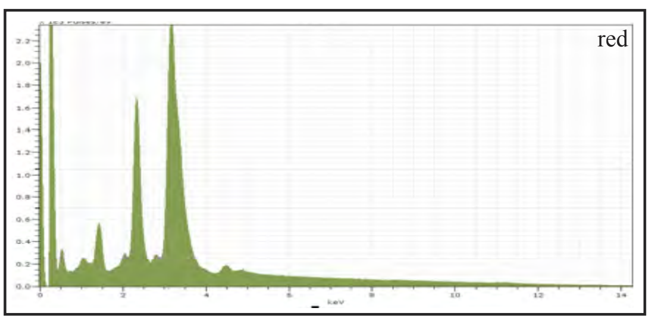




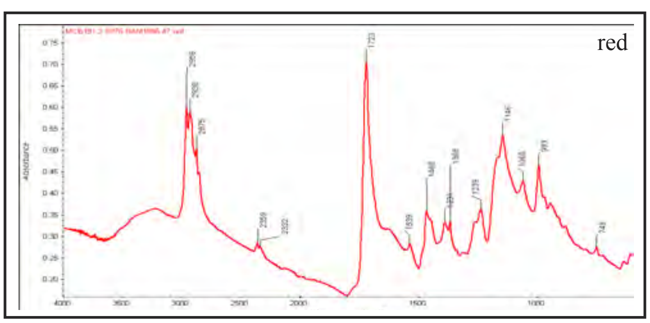
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.1 mm.



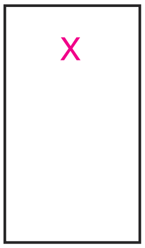
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.1 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	43.40	47.72	21.43	3.27
Sulfur	K-series	12.36	13.59	21.39	0.46
Zinc	K-series	8.26	9.08	7.01	0.30
Potassium	K-series	6.61	7.27	9.39	1.08
Selenium	L-series	6.47	7.12	4.55	0.44
Barium	L-series	2.59	2.85	1.05	0.25
Sodium	K-series	1.07	1.18	2.59	0.87
Phosphorus	K-series	0.89	0.98	1.60	0.06
Titanium	K-series	0.38	0.42	0.44	0.15
Aluminium	K-series	0.22	0.24	0.45	0.19
Silicon	K-series	0.02	0.02	0.03	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	8.67	9.53	30.07	9.22
	Sum:	90.94	100.00	100.00	



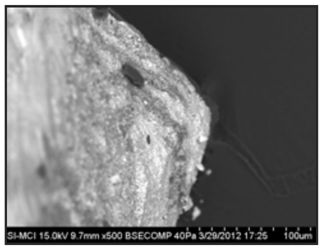
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish



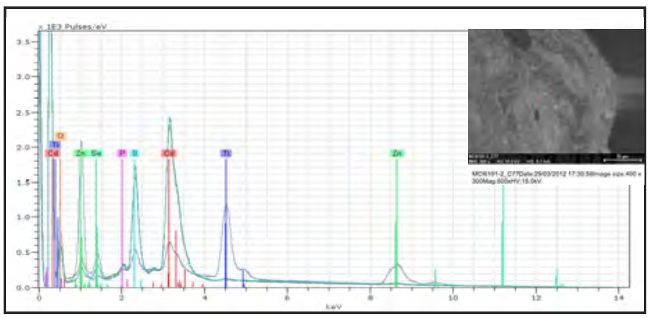
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: orange

sample location: 14.0" from top, 21.5" from left
(T 35.6 x L 54.6 cm.)

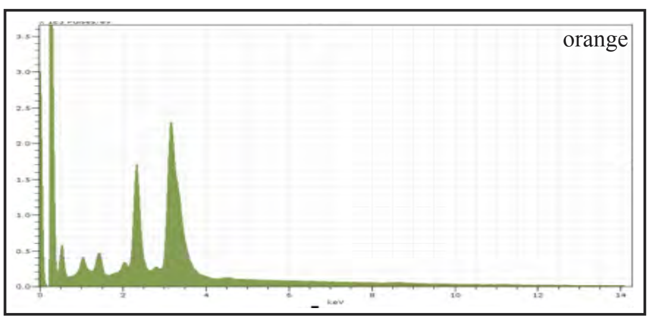
Representative Analysis Compilation—sample C077



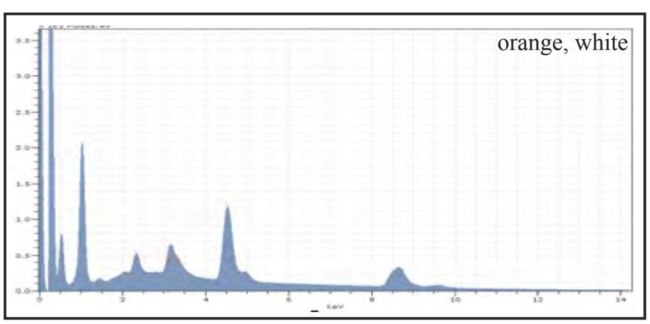
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



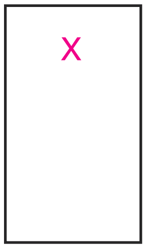
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
significant elements, white: Zn, Ti
interpretation: cadmium orange, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	120.77	51.20	49.69	4.00
Cadmium	L-series	51.30	48.17	19.43	3.69
Sulfur	K-series	13.88	13.03	18.42	0.51
Zinc	K-series	11.12	10.44	7.24	0.40
Potassium	K-series	5.77	5.42	6.29	1.28
Selenium	L-series	4.14	3.89	2.23	0.29
Sodium	K-series	2.05	1.93	3.80	1.64
Barium	L-series	1.47	1.38	0.45	0.15
Phosphorus	K-series	1.30	1.22	1.79	0.08
Chlorine	K-series	0.45	0.42	0.54	0.05
Aluminium	K-series	0.05	0.05	0.09	0.07
Calcium	K-series	0.05	0.05	0.06	0.06
Magnesium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	14.91	14.00	39.66	11.44
	Sum:	106.49	100.00	100.00	



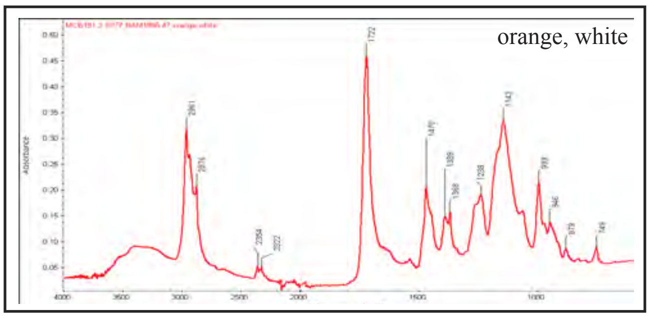
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	60.72	52.84	37.31	2.02
Titanium	K-series	14.10	12.27	11.84	0.85
Sodium	K-series	13.92	12.12	24.34	10.98
Barium	L-series	8.13	7.07	2.38	0.93
Cadmium	L-series	5.68	4.94	2.03	0.93
Sulfur	K-series	2.41	2.09	3.01	0.11
Selenium	L-series	1.26	1.10	0.64	0.12
Potassium	K-series	1.01	0.88	1.04	0.34
Phosphorus	K-series	0.89	0.77	1.15	0.06
Silicon	K-series	0.29	0.26	0.42	0.04
Aluminium	K-series	0.24	0.21	0.36	0.21
Magnesium	K-series	0.11	0.10	0.19	0.11
Chlorine	K-series	0.10	0.09	0.11	0.03
Calcium	K-series	0.02	0.01	0.02	0.04
Oxygen	K-series	6.03	5.25	15.16	3.93
	Sum:	114.92	100.00	100.00	



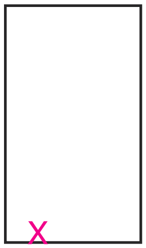
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: orange

sample location: 14.0" from top, 21.5" from left (T 35.6 x L 54.6 cm.)

Representative Analysis Compilation—sample C077, continued



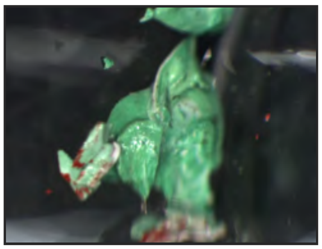
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

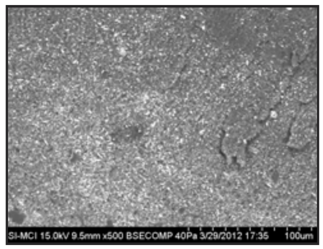


acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: mint green

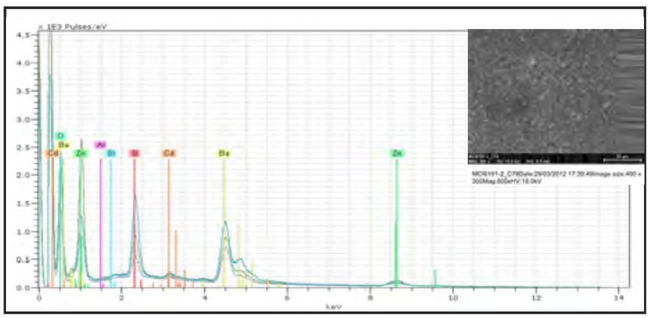
sample location: 2.5" from bottom, 10.0" from left
(B 6.4 x L 25.4 cm.)

Representative Analysis Compilation—sample C078

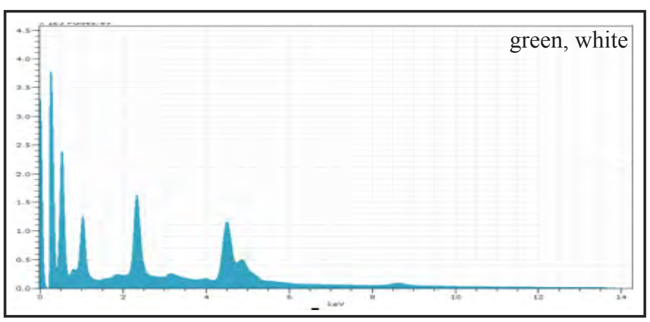




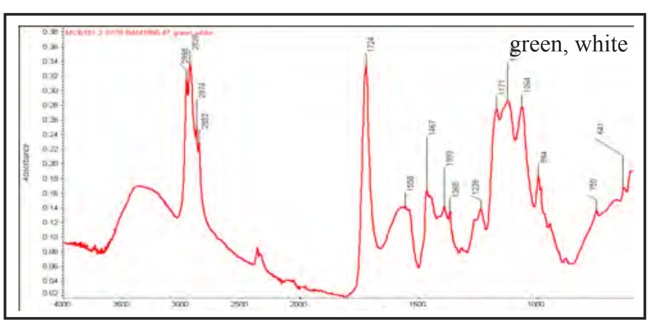
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



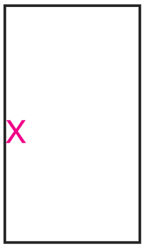
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cd, S, Na
significant elements, white: Zn, Ti
interpretation: cadmium green, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	32.45	30.76	7.27	2.11
Zinc	K-series	17.96	17.03	8.45	0.62
Sulfur	K-series	8.06	7.64	7.73	0.31
Titanium	K-series	7.34	6.96	4.72	0.86
Sodium	K-series	3.43	3.25	4.58	2.72
Cadmium	L-series	1.14	1.08	0.31	0.30
Silicon	K-series	0.29	0.28	0.32	0.04
Magnesium	K-series	0.20	0.19	0.26	0.08
Potassium	K-series	0.10	0.09	0.08	0.09
Phosphorus	K-series	0.07	0.07	0.07	0.03
Aluminium	K-series	0.01	0.01	0.02	0.04
Chlorine	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	34.43	32.63	66.19	14.60
	Sum:	105.51	100.00	100.00	



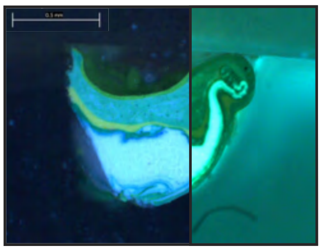
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

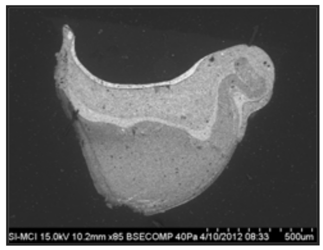


acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: yellow green

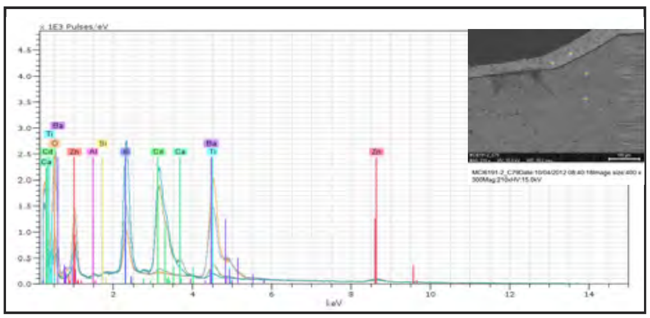
sample location: 42.0" from bottom, 3.0" from left
(B 106.7 x L 7.6 cm.)

Representative Analysis Compilation—sample C079

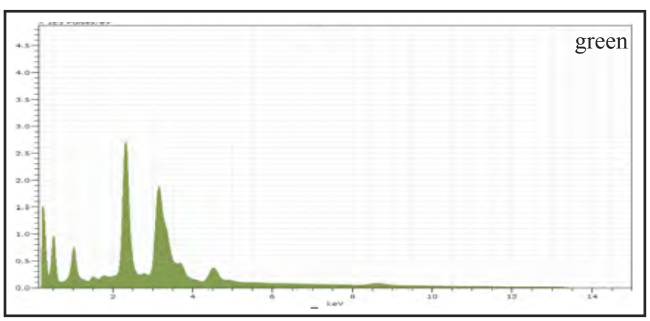




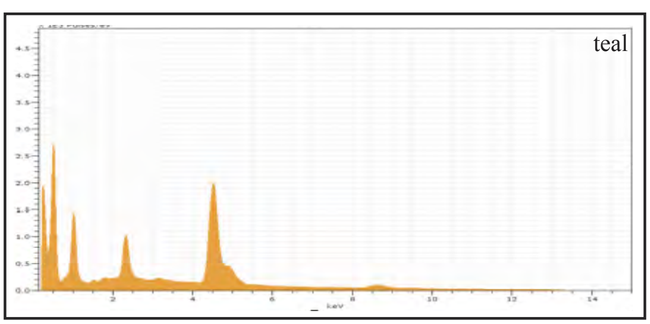
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.2 mm.



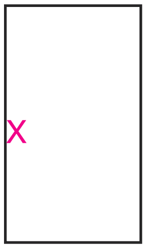
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 10.2 mm.
mag: 210x; HV: 15 kV
significant elements, green: Cd, S, Na
significant elements, teal: Cd, S, Na
interpretation: cadmium green, ultramarine blue, cadmium yellow



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	24.17	29.98	13.38	2.33
Sulfur	K-series	15.56	19.29	30.19	0.57
Zinc	K-series	15.35	19.04	14.61	0.54
Sodium	K-series	7.56	9.37	20.46	5.97
Barium	L-series	5.90	7.31	2.67	0.59
Potassium	K-series	4.98	6.17	7.92	0.75
Titanium	K-series	3.85	4.77	5.00	0.46
Calcium	K-series	2.44	3.03	3.79	0.18
Silicon	K-series	0.37	0.45	0.81	0.04
Magnesium	K-series	0.25	0.31	0.63	0.04
Aluminium	K-series	0.23	0.28	0.52	0.04
	Sum:	80.65	100.00	100.00	



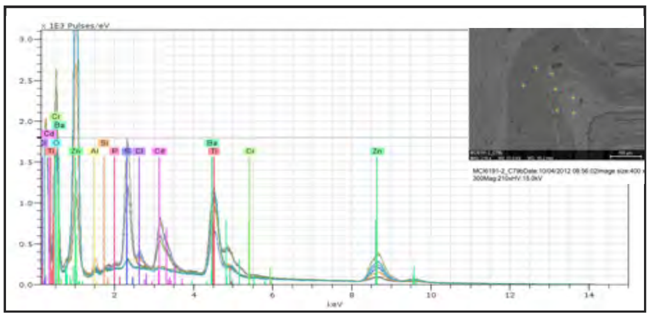
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Titanium	K-series	28.22	45.56	43.01	1.17
Zinc	K-series	8.73	14.10	9.74	0.32
Barium	L-series	7.95	12.83	4.22	1.18
Sulfur	K-series	6.70	10.82	15.25	0.26
Sodium	K-series	6.64	10.71	21.07	5.25
Cadmium	L-series	1.29	2.08	0.84	0.08
Chlorine	K-series	0.70	1.14	1.45	0.05
Silicon	K-series	0.63	1.01	1.63	0.05
Phosphorus	K-series	0.58	0.93	1.36	0.05
Aluminium	K-series	0.30	0.48	0.81	0.04
Magnesium	K-series	0.21	0.34	0.63	0.04
	Sum:	61.94	100.00	100.00	

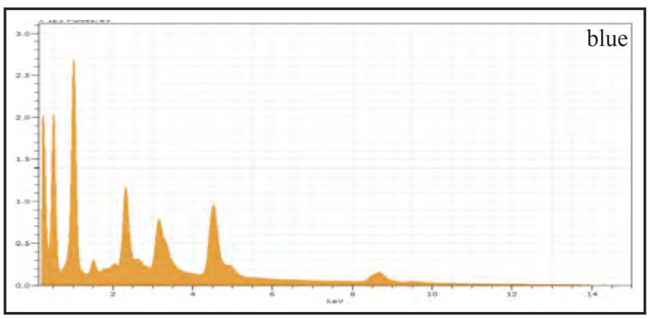
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: yellow green

sample location: 42.0" from bottom, 3.0" from left
(B 106.7 x L 7.6 cm.)

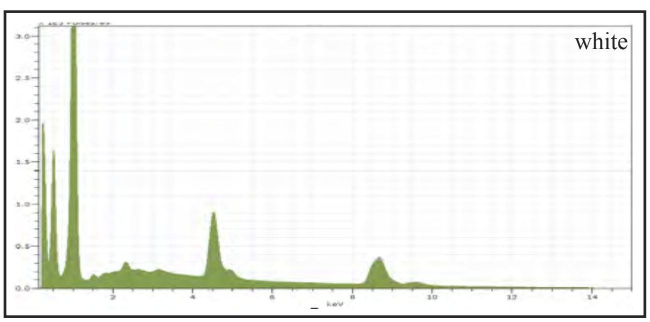
Representative Analysis Compilation—sample C079, continued



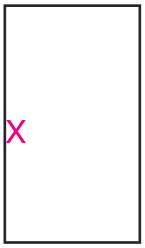
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 10.2 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na
significant elements, white: Zn, Ti
significant elements, yellow: Cd, S
interpretation: ultramarine blue, Zn/Ti white, cadmium yellow



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	25.61	31.20	20.10	0.87
Sodium	K-series	19.79	24.10	44.17	15.60
Titanium	K-series	14.20	17.29	15.22	0.78
Cadmium	L-series	8.18	9.96	3.73	1.19
Sulfur	K-series	6.08	7.40	9.72	0.24
Barium	L-series	4.80	5.84	1.79	0.82
Potassium	K-series	1.55	1.89	2.03	0.41
Aluminium	K-series	0.88	1.08	1.68	0.70
Chlorine	K-series	0.71	0.87	1.03	0.05
Phosphorus	K-series	0.27	0.33	0.45	0.04
Silicon	K-series	0.03	0.04	0.05	0.03
Magnesium	K-series	0.00	0.01	0.01	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	82.11	100.00	100.00	



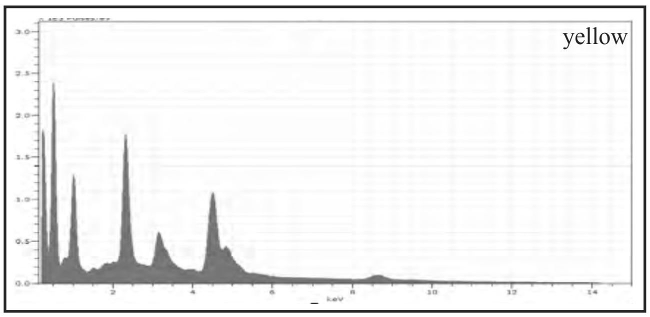
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	76.87	51.77	32.28	2.55
Sodium	K-series	47.77	32.17	57.06	37.62
Titanium	K-series	11.25	7.57	6.45	0.84
Barium	L-series	8.94	6.02	1.79	0.93
Cadmium	L-series	1.27	0.85	0.31	0.33
Sulfur	K-series	0.68	0.45	0.58	0.05
Aluminium	K-series	0.56	0.38	0.57	0.45
Silicon	K-series	0.39	0.26	0.38	0.04
Chlorine	K-series	0.29	0.20	0.23	0.04
Calcium	K-series	0.26	0.18	0.18	0.06
Phosphorus	K-series	0.13	0.09	0.11	0.03
Potassium	K-series	0.09	0.06	0.06	0.08
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	148.48	100.00	100.00	



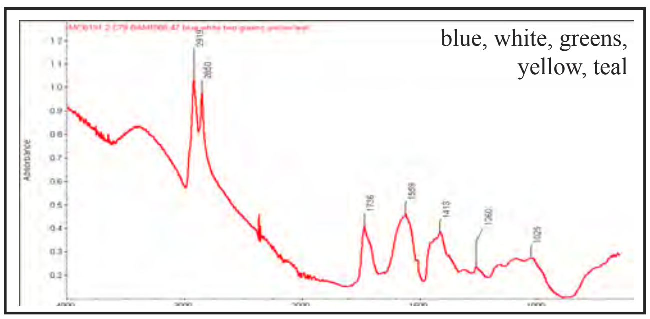
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: yellow green

sample location: 42.0" from bottom, 3.0" from left
(B 106.7 x L 7.6 cm.)

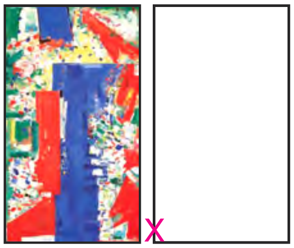
Representative Analysis Compilation—sample C079, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	43.95	47.22	20.73	1.61
Zinc	K-series	15.22	16.35	15.08	0.53
Sulfur	K-series	13.55	14.56	27.37	0.50
Sodium	K-series	9.00	9.67	25.36	7.11
Cadmium	L-series	7.95	8.54	4.58	1.29
Potassium	K-series	1.28	1.37	2.12	0.46
Phosphorus	K-series	0.68	0.73	1.41	0.05
Silicon	K-series	0.49	0.53	1.14	0.05
Magnesium	K-series	0.40	0.43	1.06	0.12
Chlorine	K-series	0.35	0.37	0.63	0.04
Aluminium	K-series	0.22	0.23	0.52	0.19
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	93.06	100.00	100.00	



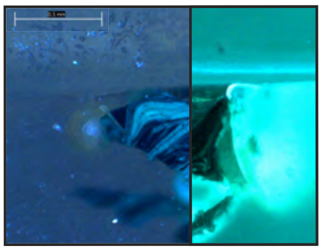
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

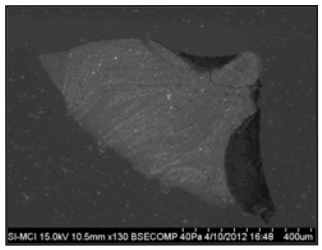


acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: dark green

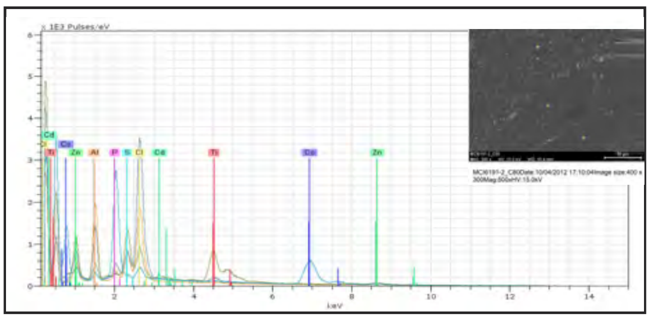
sample location: left edge, 3.5" from bottom
(B 8.9 x L 0.0 cm.)

Representative Analysis Compilation—sample C080

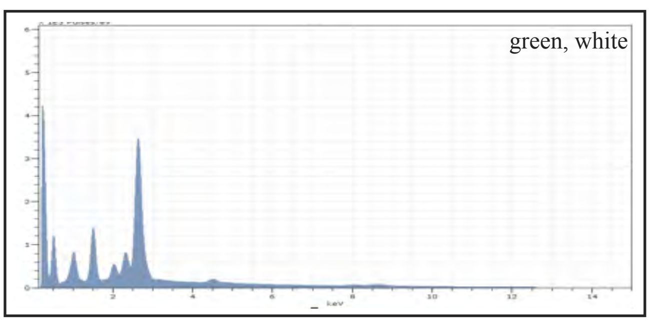




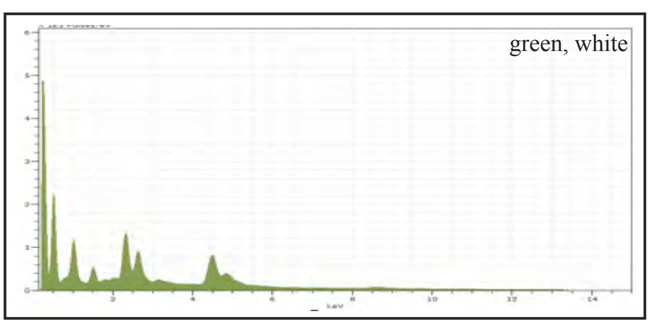
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.5 mm.



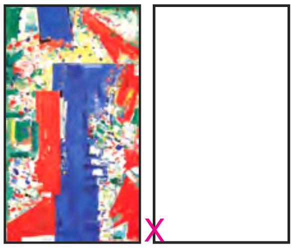
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 10.4 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cu, Cl
significant elements, white: Zn, Ti
interpretation: phthalo green, Zn/Ti white

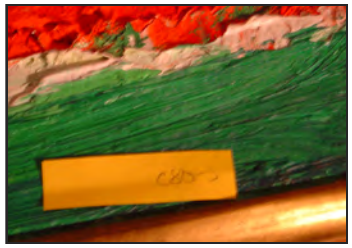


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Chlorine	K-series	20.51	37.29	38.66	0.71
Zinc	K-series	8.30	15.09	8.48	0.31
Aluminium	K-series	7.95	14.46	19.70	0.39
Sodium	K-series	5.28	9.59	15.34	4.18
Copper	K-series	4.01	7.29	4.22	0.16
Sulfur	K-series	3.03	5.50	6.31	0.13
Barium	L-series	2.44	4.44	1.19	0.26
Phosphorus	K-series	1.89	3.43	4.07	0.10
Titanium	K-series	0.84	1.53	1.17	0.16
Cobalt	K-series	0.69	1.25	0.78	0.05
Cadmium	L-series	0.04	0.07	0.02	0.04
Magnesium	K-series	0.02	0.03	0.05	0.03
Calcium	K-series	0.00	0.01	0.01	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
	Sum:	54.99	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	28.59	40.10	15.33	1.88
Zinc	K-series	11.21	15.73	12.63	0.40
Sodium	K-series	7.93	11.13	25.41	6.27
Sulfur	K-series	6.97	9.78	16.01	0.27
Titanium	K-series	5.59	7.84	8.59	0.71
Chlorine	K-series	5.13	7.20	10.66	0.20
Aluminium	K-series	2.48	3.48	6.78	1.50
Copper	K-series	1.57	2.20	1.82	0.08
Cadmium	L-series	0.57	0.80	0.38	0.17
Cobalt	K-series	0.52	0.74	0.65	0.05
Phosphorus	K-series	0.35	0.49	0.82	0.04
Potassium	K-series	0.15	0.21	0.28	0.12
Magnesium	K-series	0.11	0.16	0.35	0.07
Silicon	K-series	0.11	0.16	0.29	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	71.29	100.00	100.00	

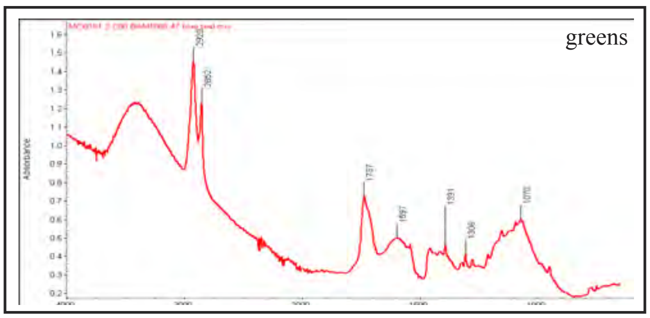




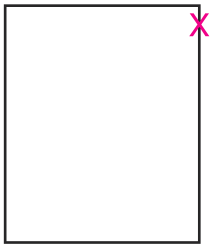
acc. no.: BAM 1966.47
title, year: *Scintillating Space*, 1954
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 48.4" (213.6 x 122.9 cm.)
notes: dark green

sample location: left edge, 3.5" from bottom
(B 8.9 x L 0.0 cm.)

Representative Analysis Compilation—sample C080, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

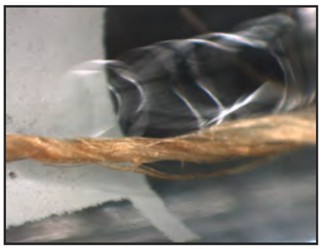


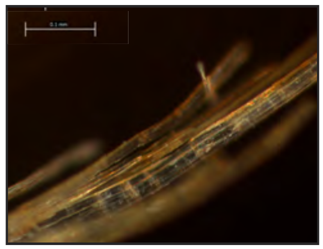
no image available

acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: fibers, possibly warp

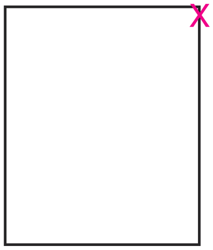
sample location: right edge, 4.0" from top
(T 10.2 x R 0.0 cm.)

Representative Analysis Compilation—sample B01





photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification
interpretation: linen

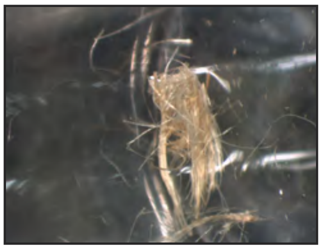


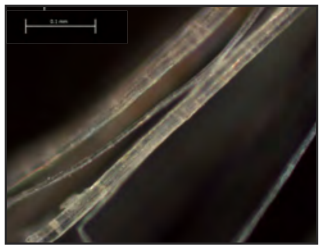
no image available

acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: fibers, possibly weft

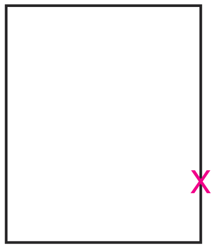
sample location: right edge, 1.0" from top
(T 2.5 x R 0.0 cm.)

Representative Analysis Compilation—sample B02





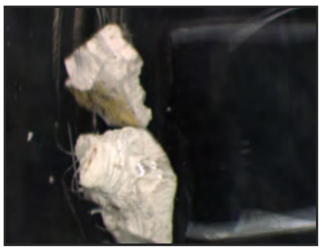
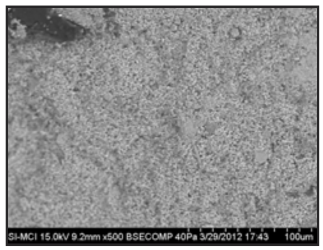
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification
interpretation: linen

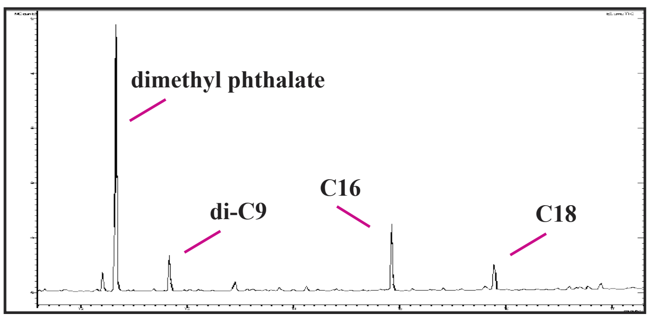

acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: ground layer

sample location: right edge, 12.5" from bottom
(B 31.8 x R 0.0 cm.)

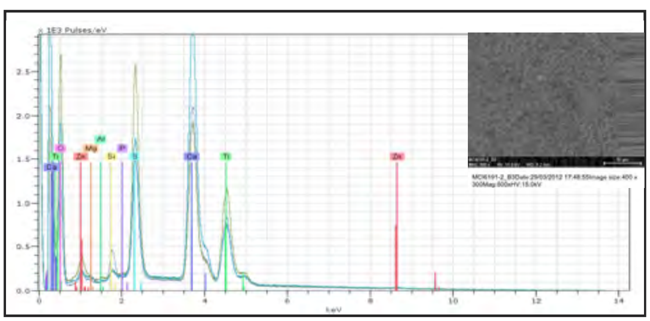
Representative Analysis Compilation—sample B03

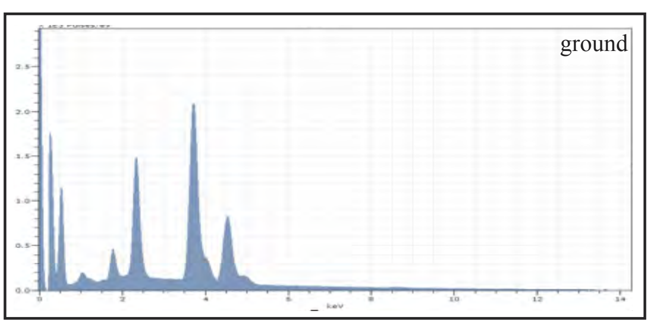
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.2 mm.



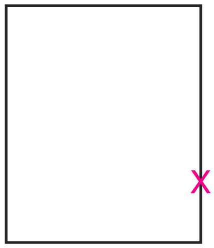
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.143
scan range: 1 - 1490
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, white: Ca, Ti
interpretation: bulked titanium white



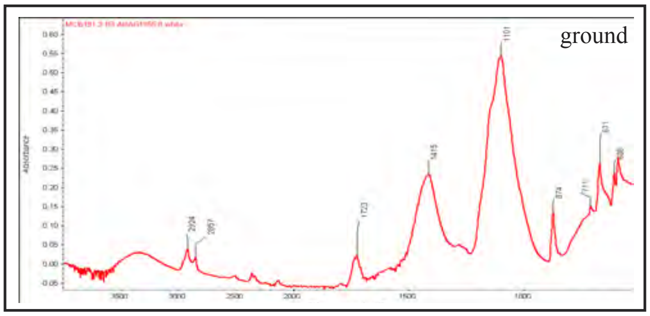
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	23.27	25.89	17.15	0.72
Titanium	K-series	15.58	17.33	9.61	0.74
Sulfur	K-series	10.93	12.15	10.06	0.41
Zinc	K-series	3.81	4.24	1.72	0.16
Silicon	K-series	2.91	3.24	3.06	0.15
Sodium	K-series	1.24	1.37	1.59	1.00
Barium	L-series	1.23	1.37	0.27	0.63
Phosphorus	K-series	0.26	0.28	0.24	0.04
Chlorine	K-series	0.20	0.22	0.17	0.03
Magnesium	K-series	0.19	0.21	0.23	0.04
Potassium	K-series	0.00	0.00	0.00	0.03
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	30.28	33.69	55.90	15.85
	Sum:	89.90	100.00	100.00	

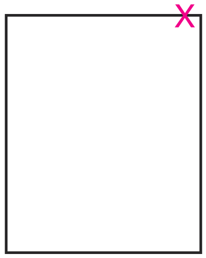

acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: ground layer

sample location: right edge, 12.5" from bottom
(B 31.8 x R 0.0 cm.)

Representative Analysis Compilation—sample B03, continued



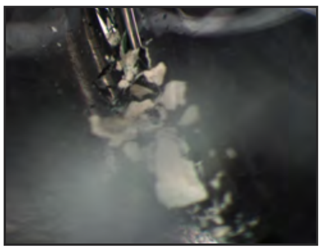
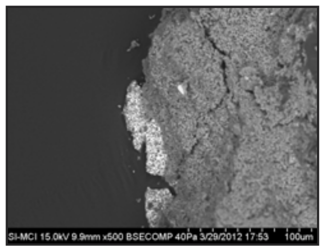
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

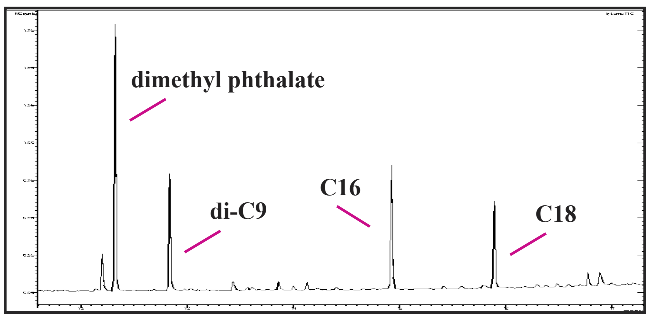

acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: brown and ground layer

sample location: top edge, 3.5" from right
(T 0.0 x R 8.9 cm.)

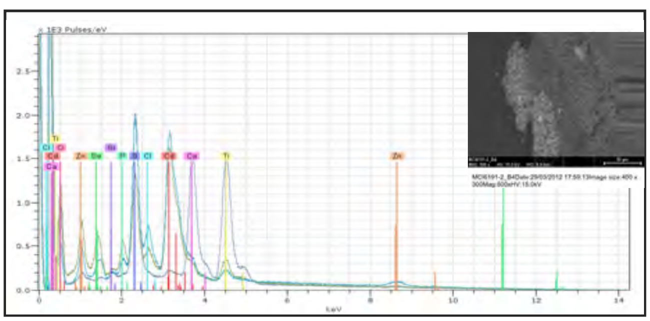
Representative Analysis Compilation—sample B04

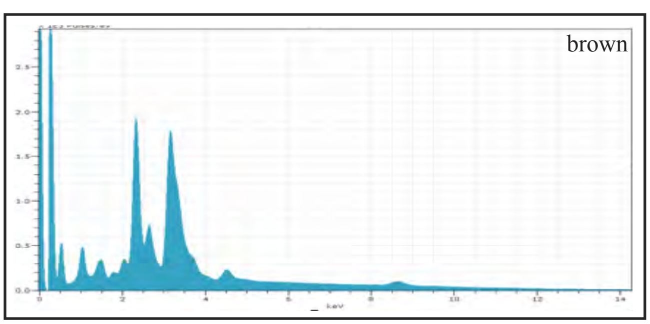
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.148
scan range: 1 - 1485
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: oil, alkyd



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, brown: none
significant elements, white: Ti
interpretation: titanium white, mixed colors

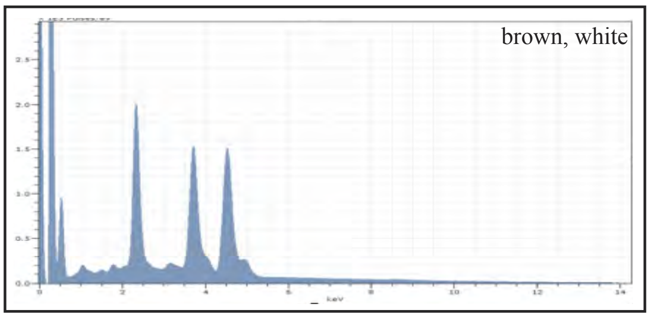


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	24.24	28.57	17.91	0.83
Cadmium	L-series	18.36	21.64	7.89	1.74
Sulfur	K-series	9.59	11.30	14.44	0.36
Barium	L-series	5.00	5.89	1.76	0.38
Sodium	K-series	4.36	5.14	9.16	3.46
Potassium	K-series	3.57	4.21	4.42	0.61
Chlorine	K-series	2.36	2.78	3.22	0.11
Aluminium	K-series	2.14	2.52	3.83	1.65
Selenium	L-series	1.86	2.19	1.14	0.17
Calcium	K-series	1.02	1.20	1.22	0.14
Phosphorus	K-series	0.74	0.87	1.15	0.05
Magnesium	K-series	0.55	0.65	1.10	0.16
Titanium	K-series	0.21	0.25	0.21	0.15
Silicon	K-series	0.18	0.21	0.31	0.03
Oxygen	K-series	10.68	12.59	32.25	8.26
	Sum:	84.84	100.00	100.00	

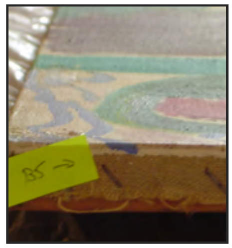
acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: brown and ground layer

sample location: top edge, 3.5" from right
(T 0.0 x R 8.9 cm.)

Representative Analysis Compilation—sample B04, continued



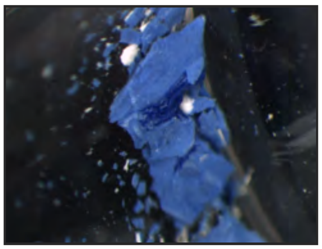
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	28.07	29.37	20.51	1.21
Calcium	K-series	16.74	17.52	14.61	0.57
Sulfur	K-series	13.98	14.62	15.25	0.52
Zinc	K-series	9.01	9.43	4.82	0.33
Barium	L-series	5.57	5.82	1.42	1.30
Sodium	K-series	1.31	1.37	2.00	1.06
Cadmium	L-series	1.28	1.34	0.40	0.34
Silicon	K-series	0.58	0.61	0.73	0.05
Chlorine	K-series	0.41	0.43	0.40	0.04
Magnesium	K-series	0.30	0.32	0.44	0.10
Aluminium	K-series	0.25	0.26	0.32	0.21
Phosphorus	K-series	0.20	0.21	0.22	0.03
Potassium	K-series	0.14	0.15	0.12	0.12
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	17.73	18.55	38.77	10.51
	Sum:	95.57	100.00	100.00	

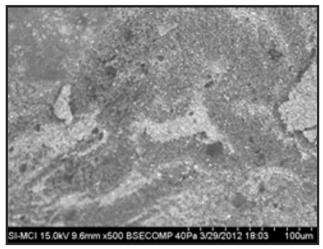


acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: light blue

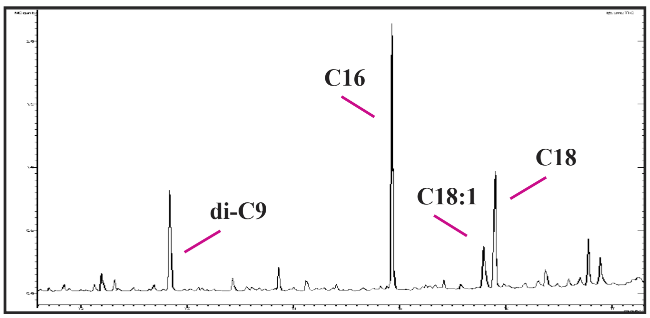
sample location: left edge, 1.5" from top
(T 3.8 x L 0.0 cm.)

Representative Analysis Compilation—sample B05

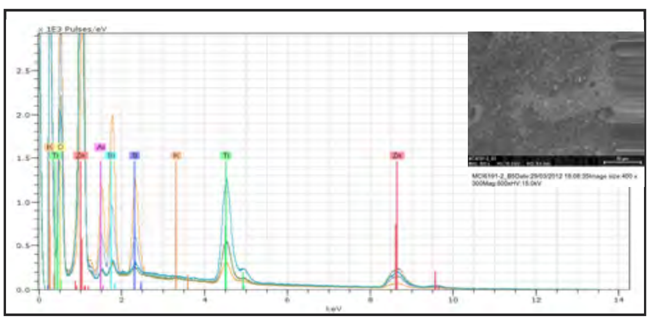




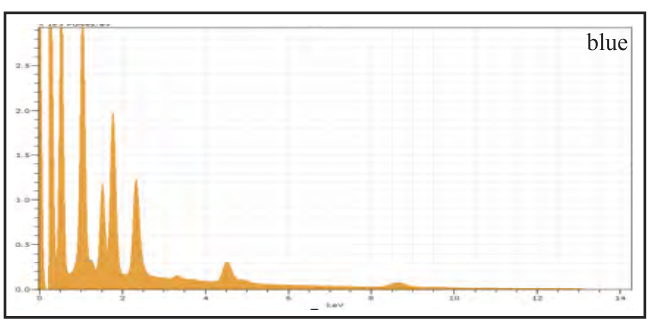
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



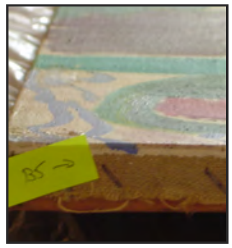
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.226
scan range: 1 - 1482
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na
significant elements, white: Zn, Ti
interpretation: ultramarine blue, Zn/Ti white



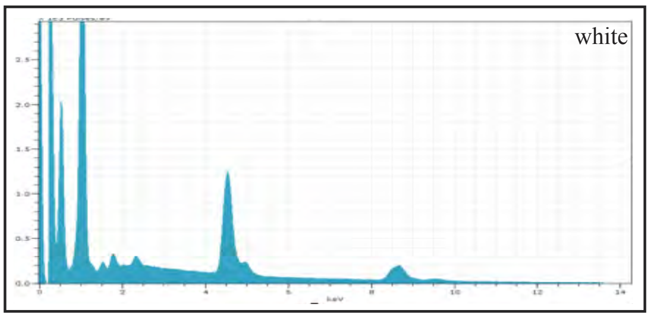
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Sodium	K-series	13.76	14.17	13.52	10.86
Zinc	K-series	12.87	13.25	4.45	0.46
Silicon	K-series	8.66	8.91	6.96	0.38
Sulfur	K-series	5.92	6.09	4.17	0.23
Titanium	K-series	3.88	3.99	1.83	0.35
Aluminium	K-series	3.85	3.96	3.22	0.20
Barium	L-series	1.25	1.29	0.21	0.39
Magnesium	K-series	0.50	0.51	0.46	0.05
Potassium	K-series	0.31	0.32	0.18	0.04
Chlorine	K-series	0.11	0.11	0.07	0.03
Calcium	K-series	0.07	0.07	0.04	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	45.95	47.32	64.89	16.38
	Sum:	97.12	100.00	100.00	



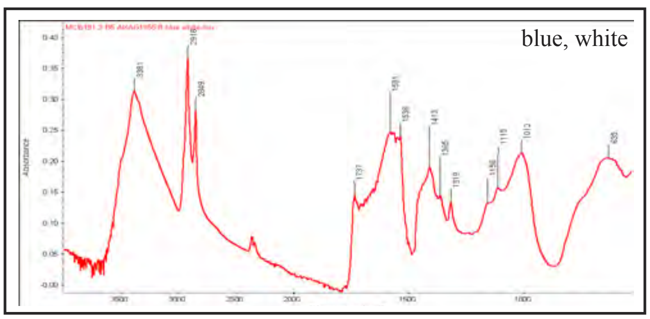
acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: light blue

sample location: left edge, 1.5" from top
(T 3.8 x L 0.0 cm.)

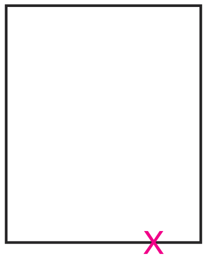
Representative Analysis Compilation—sample B05, continued

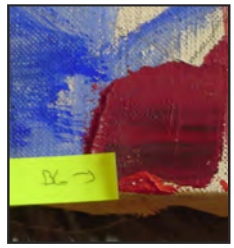


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	37.30	36.69	17.86	1.26
Titanium	K-series	19.82	19.49	12.96	0.86
Sodium	K-series	17.14	16.85	23.34	13.51
Barium	L-series	2.17	2.13	0.49	1.08
Silicon	K-series	1.25	1.23	1.39	0.08
Sulfur	K-series	1.11	1.10	1.09	0.07
Chlorine	K-series	0.55	0.55	0.49	0.04
Aluminium	K-series	0.50	0.49	0.58	0.05
Magnesium	K-series	0.35	0.35	0.46	0.05
Phosphorus	K-series	0.33	0.33	0.34	0.04
Potassium	K-series	0.27	0.27	0.22	0.03
Calcium	K-series	0.05	0.05	0.04	0.03
Oxygen	K-series	20.83	20.48	40.75	8.84
	Sum:	101.68	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

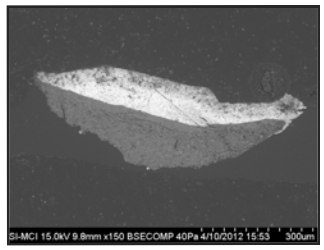




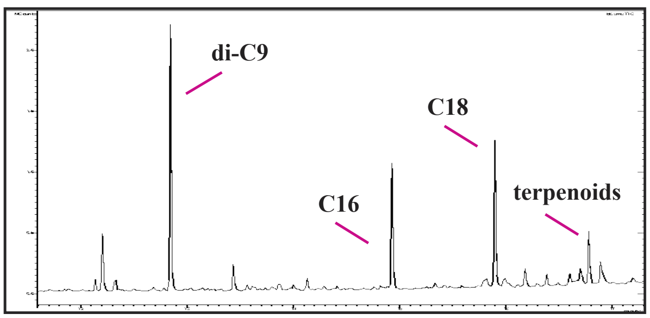
acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: light red

sample location: bottom edge, 14.0" from right
(B 0.0 x R 35.6 cm.)

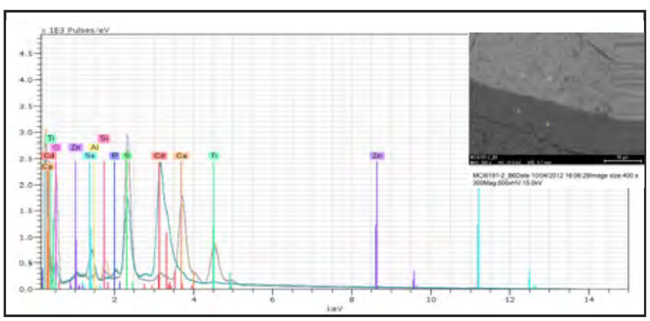
Representative Analysis Compilation—sample B06



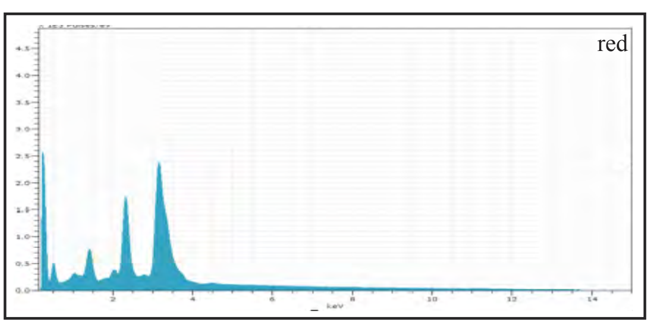
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.8 mm.



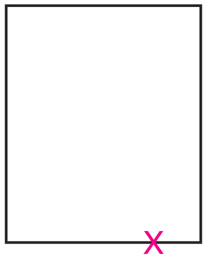
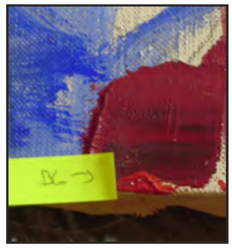
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.276
scan range: 1 - 1482
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, white: Ti
interpretation: cadmium red, titanium white



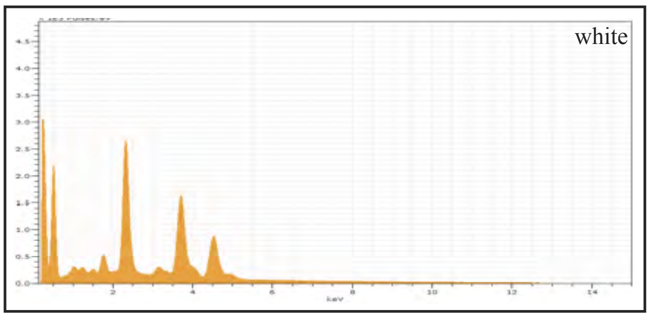
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	28.19	39.30	13.20	2.36
Sulfur	K-series	8.54	11.91	14.02	0.33
Zinc	K-series	7.27	10.13	5.85	0.27
Potassium	K-series	5.69	7.93	7.66	0.78
Selenium	L-series	2.53	3.53	1.69	0.19
Barium	L-series	1.25	1.74	0.48	0.13
Phosphorus	K-series	0.70	0.97	1.18	0.05
Calcium	K-series	0.57	0.80	0.75	0.18
Sodium	K-series	0.38	0.53	0.87	0.32
Aluminium	K-series	0.20	0.28	0.39	0.18
Silicon	K-series	0.02	0.03	0.03	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	16.38	22.84	53.88	13.54
	Sum:	71.72	100.00	100.00	

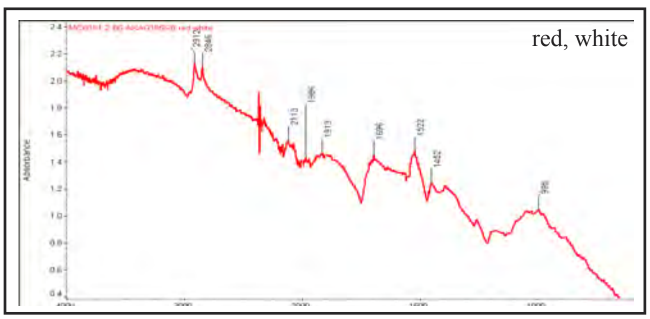
acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: light red

sample location: bottom edge, 14.0" from right
(B 0.0 x R 35.6 cm.)

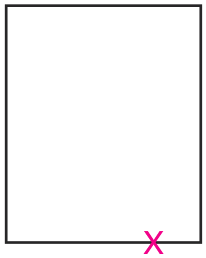
Representative Analysis Compilation—sample B06, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	21.42	31.65	32.85	0.72
Titanium	K-series	19.10	28.23	24.52	0.93
Sulfur	K-series	16.20	23.94	31.06	0.60
Cadmium	L-series	3.69	5.45	2.02	0.75
Barium	L-series	2.66	3.93	1.19	1.22
Silicon	K-series	1.61	2.38	3.52	0.09
Zinc	K-series	1.46	2.16	1.38	0.08
Magnesium	K-series	0.49	0.72	1.24	0.10
Sodium	K-series	0.44	0.65	1.17	0.37
Chlorine	K-series	0.36	0.53	0.63	0.04
Potassium	K-series	0.17	0.25	0.26	0.14
Aluminium	K-series	0.07	0.11	0.17	0.08
Phosphorus	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	67.68	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

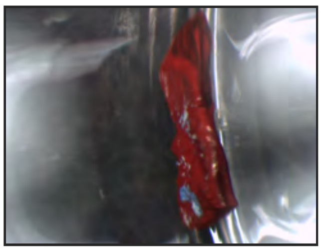


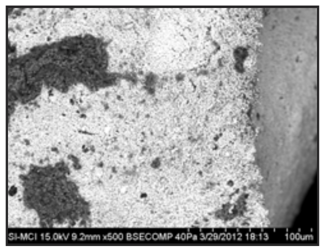
no image available

acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: dark red

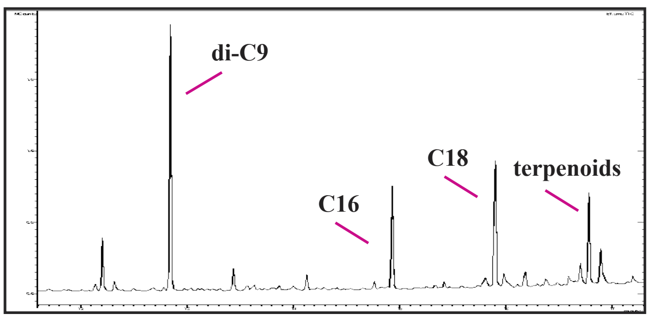
sample location: bottom edge, 14.0" from right
(B 0.0 x R 35.6 cm.)

Representative Analysis Compilation—sample B07

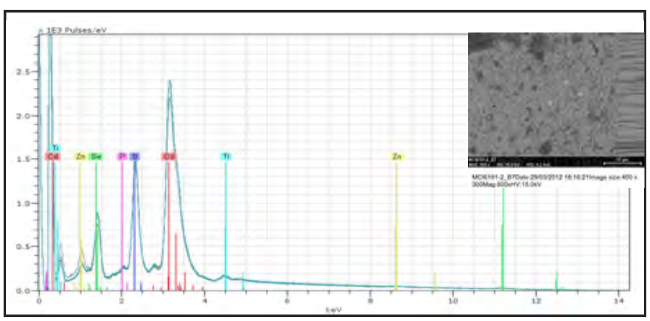




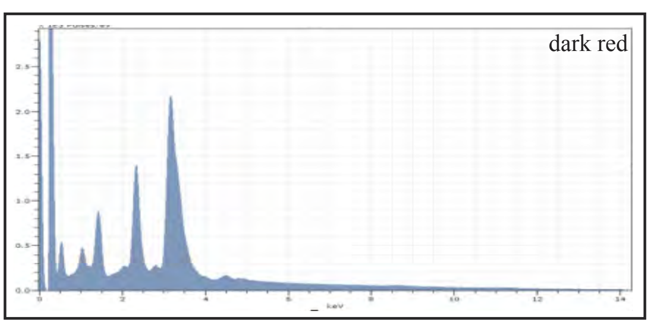
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.2 mm.



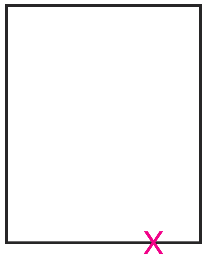
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.245
scan range: 1 - 1481
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	46.10	46.40	19.67	3.46
Sulfur	K-series	10.70	10.77	16.00	0.40
Zinc	K-series	10.51	10.57	7.71	0.38
Selenium	L-series	5.88	5.92	3.57	0.40
Potassium	K-series	5.72	5.76	7.02	1.18
Barium	L-series	4.42	4.45	1.54	0.34
Sodium	K-series	0.83	0.84	1.74	0.68
Phosphorus	K-series	0.69	0.70	1.07	0.05
Aluminium	K-series	0.64	0.64	1.13	0.51
Chlorine	K-series	0.34	0.35	0.47	0.05
Calcium	K-series	0.25	0.25	0.30	0.19
Titanium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	13.27	13.36	39.78	10.94
	Sum:	99.37	100.00	100.00	

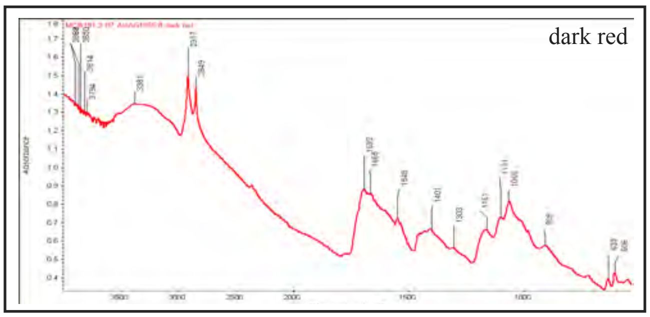


no image available

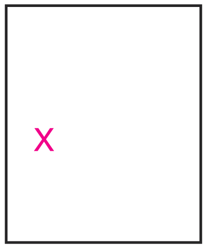
acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: dark red

sample location: bottom edge, 14.0" from right
(B 0.0 x R 35.6 cm.)

Representative Analysis Compilation—sample B07, continued



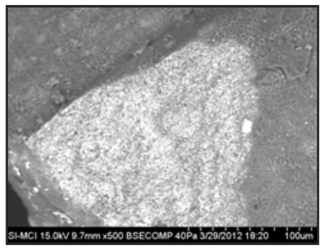
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



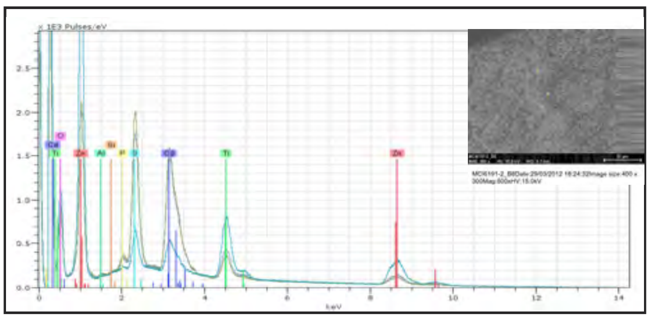
acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: light yellow

sample location: 22.5" from bottom, 6.0" from left (B 56.4 x L 15.2 cm.)

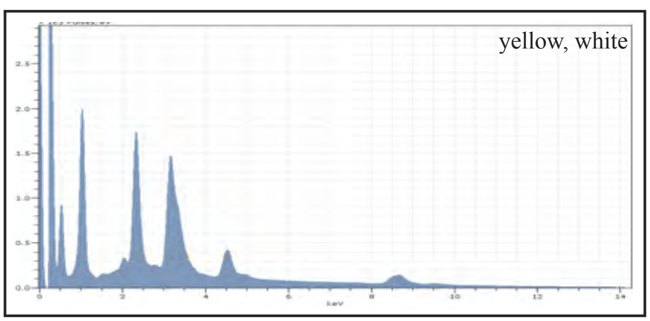
Representative Analysis Compilation—sample B08



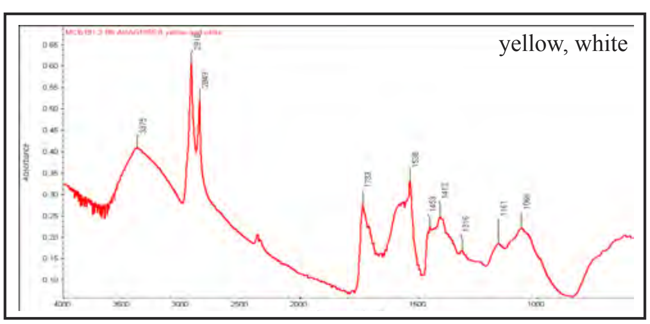
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



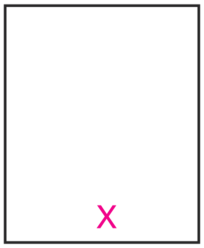
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
significant elements, white: Zn, Ti
interpretation: cadmium yellow, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	26.24	29.13	16.19	0.89
Cadmium	L-series	17.19	19.09	6.17	1.69
Sodium	K-series	10.32	11.46	18.12	8.15
Sulfur	K-series	9.95	11.04	12.52	0.38
Titanium	K-series	4.84	5.37	4.08	0.43
Potassium	K-series	2.82	3.13	2.91	0.60
Barium	L-series	2.50	2.77	0.73	0.45
Phosphorus	K-series	0.85	0.94	1.11	0.06
Magnesium	K-series	0.32	0.35	0.52	0.11
Aluminium	K-series	0.14	0.15	0.21	0.13
Chlorine	K-series	0.08	0.09	0.09	0.03
Silicon	K-series	0.02	0.02	0.03	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	14.80	16.43	37.32	8.96
	Sum:	90.06	100.00	100.00	



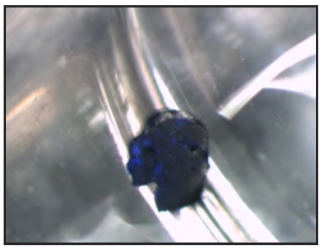
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

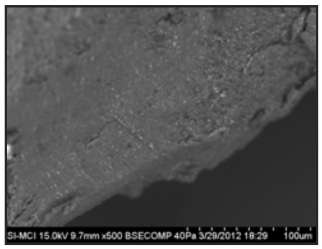


acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: dark blue, shiny

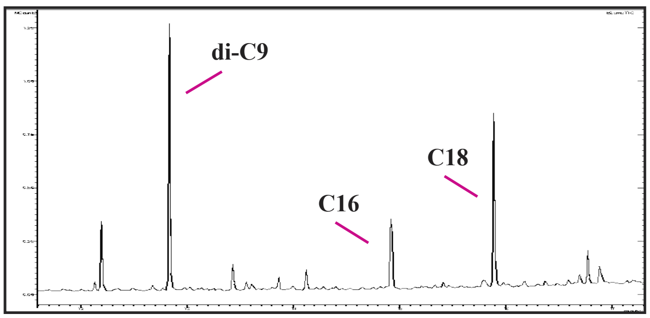
sample location: 7.0" from bottom, 20.5" from left
(B 17.8 x L 52.1 cm.)

Representative Analysis Compilation—sample B09

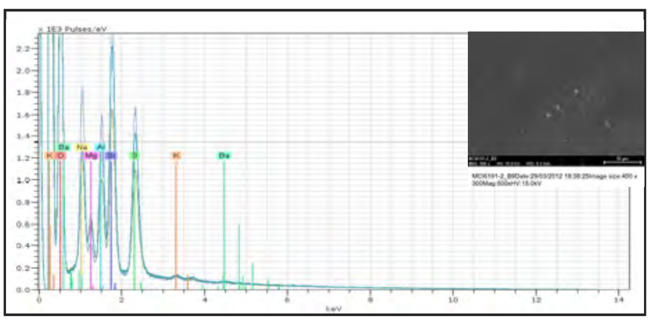




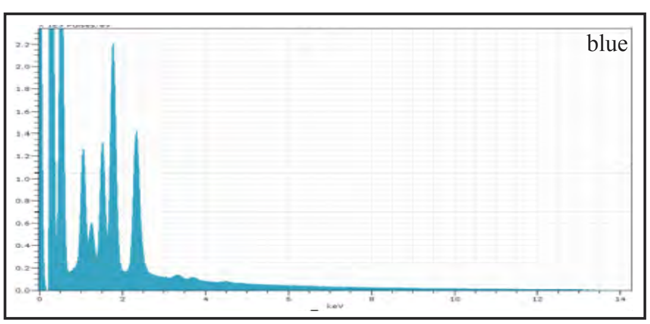
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



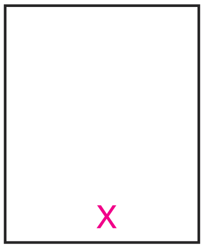
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/10/12
sample weight: 0.090
scan range: 1 - 1482
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.3 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na
interpretation: ultramarine blue



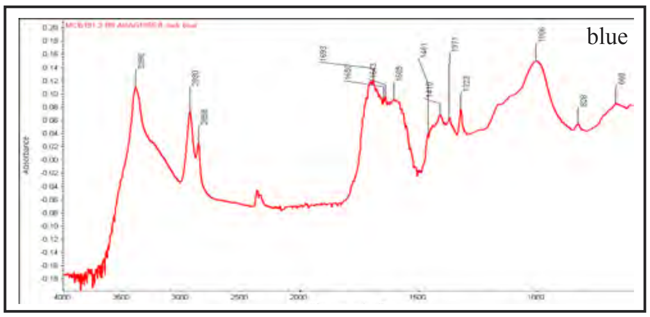
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	8.18	10.92	7.36	0.36
Sulfur	K-series	6.23	8.32	4.91	0.25
Sodium	K-series	5.11	6.82	5.62	4.05
Aluminium	K-series	3.60	4.81	3.37	0.19
Magnesium	K-series	1.57	2.09	1.63	0.11
Zinc	K-series	0.94	1.26	0.36	0.06
Barium	L-series	0.36	0.48	0.07	0.07
Potassium	K-series	0.25	0.34	0.16	0.03
Calcium	K-series	0.19	0.25	0.12	0.03
Chlorine	K-series	0.16	0.22	0.12	0.03
Titanium	K-series	0.01	0.02	0.01	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	48.30	64.48	76.28	17.00
	Sum:	74.90	100.00	100.00	



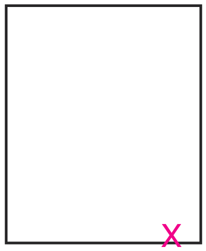
acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: dark blue, shiny

sample location: 7.0" from bottom, 20.5" from left
(B 17.8 x L 52.1 cm.)

Representative Analysis Compilation—sample B09, continued



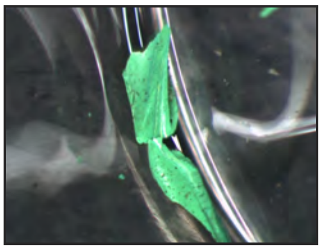
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

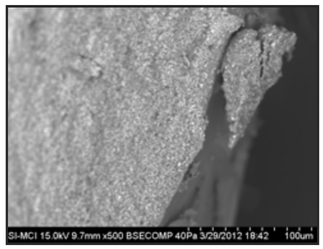


acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: light green

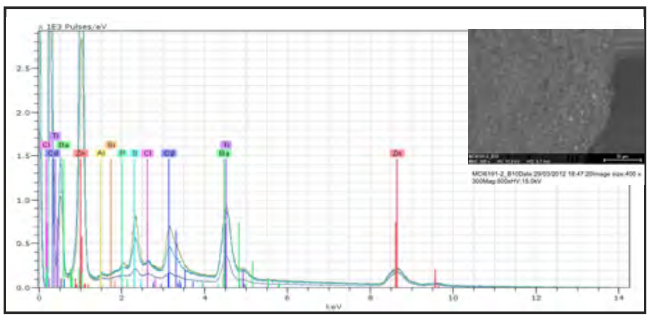
sample location: 1.0" from bottom, 8.0" from right
(B 2.5 x R 20.3 cm.)

Representative Analysis Compilation—sample B10

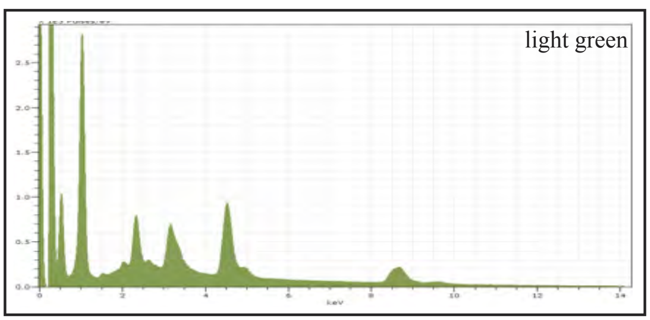




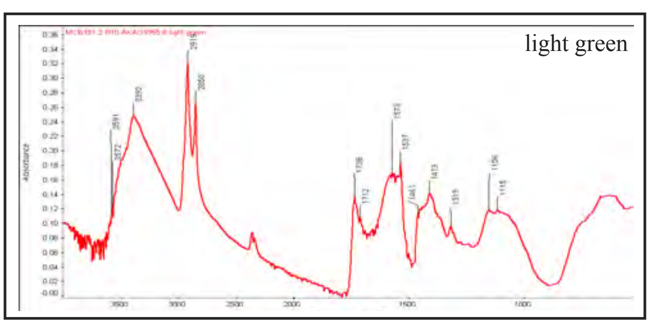
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



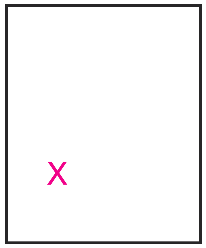
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, green: Na, Cd, S
interpretation: cadmium green

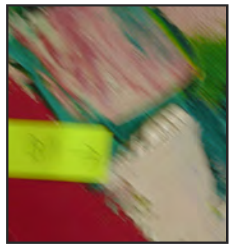


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	38.57	41.33	23.32	1.30
Sodium	K-series	14.25	15.26	24.50	11.24
Titanium	K-series	12.75	13.66	10.53	0.65
Cadmium	L-series	6.47	6.94	2.28	1.01
Sulfur	K-series	3.77	4.03	4.64	0.16
Barium	L-series	2.43	2.60	0.70	0.77
Potassium	K-series	1.16	1.24	1.17	0.36
Phosphorus	K-series	0.68	0.73	0.87	0.05
Chlorine	K-series	0.37	0.40	0.41	0.04
Aluminium	K-series	0.13	0.14	0.19	0.13
Magnesium	K-series	0.11	0.12	0.18	0.08
Silicon	K-series	0.04	0.04	0.05	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	12.61	13.51	31.15	7.21
	Sum:	93.33	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

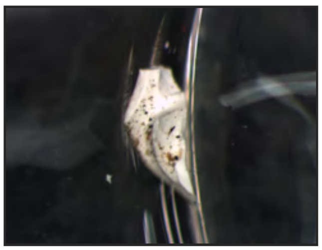


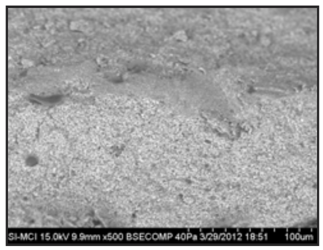


acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: compositional white

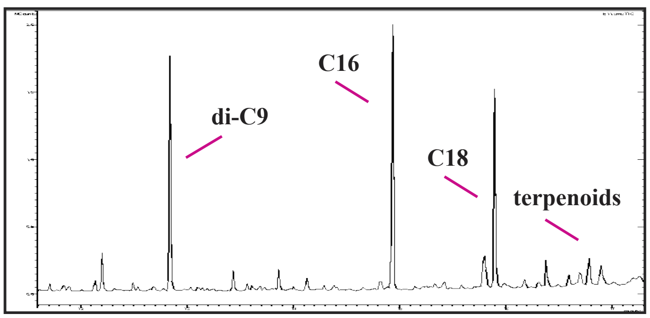
sample location: 14.0" from bottom, 10.0" from left
(B 35.6 x L 25.4 cm.)

Representative Analysis Compilation—sample B11

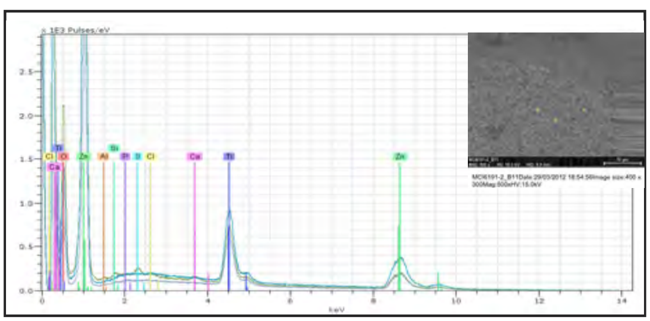




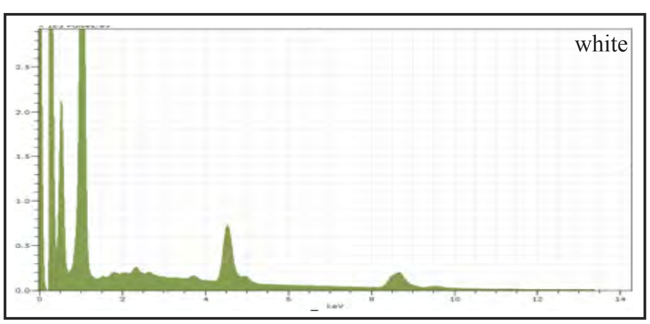
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



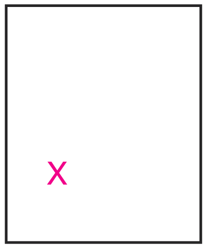
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.171
scan range: 1 - 1481
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil

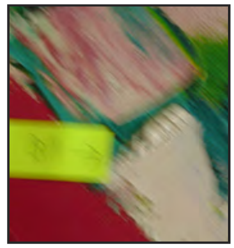


analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	48.77	46.87	23.17	1.63
Sodium	K-series	17.69	17.00	23.90	13.95
Titanium	K-series	11.27	10.83	7.31	0.62
Barium	L-series	1.77	1.70	0.40	0.81
Sulfur	K-series	0.84	0.81	0.82	0.06
Chlorine	K-series	0.54	0.52	0.47	0.04
Phosphorus	K-series	0.38	0.36	0.38	0.04
Calcium	K-series	0.32	0.31	0.25	0.04
Silicon	K-series	0.31	0.29	0.34	0.04
Potassium	K-series	0.05	0.05	0.04	0.03
Aluminium	K-series	0.03	0.03	0.03	0.03
Magnesium	K-series	0.02	0.02	0.02	0.03
Oxygen	K-series	22.08	21.22	42.87	9.37
	Sum:	104.07	100.00	100.00	

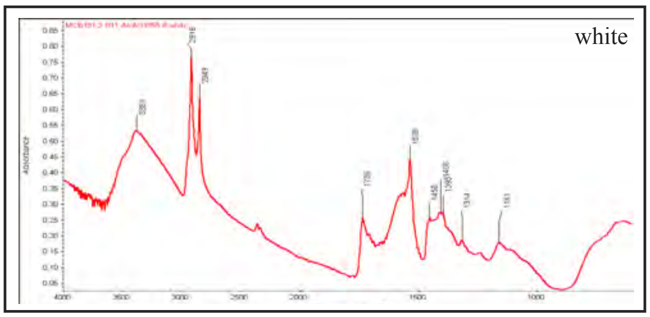




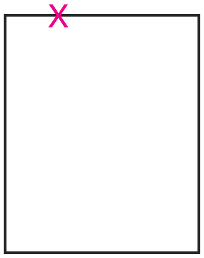
acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: compositional white

sample location: 14.0" from bottom, 10.0" from left (B 35.6 x L 25.4 cm.)

Representative Analysis Compilation—sample B11, continued



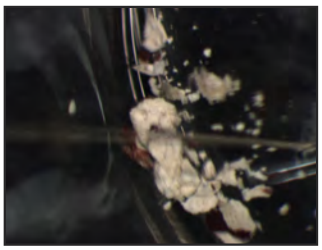
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

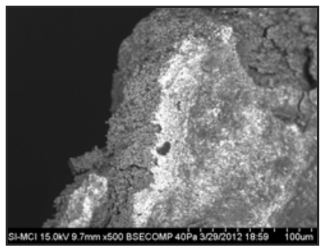


acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: brown and white underlayer

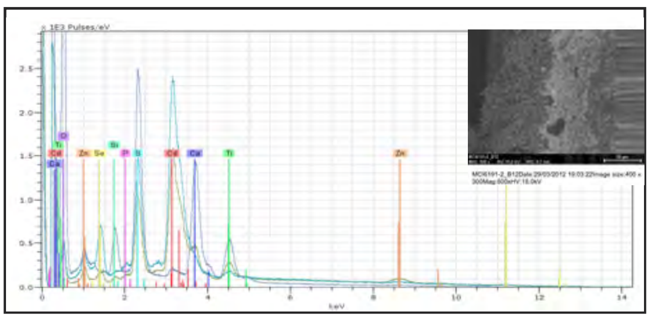
sample location: top edge, 12.0" from left
(T 0.0 x L 30.5 cm.)

Representative Analysis Compilation—sample B12

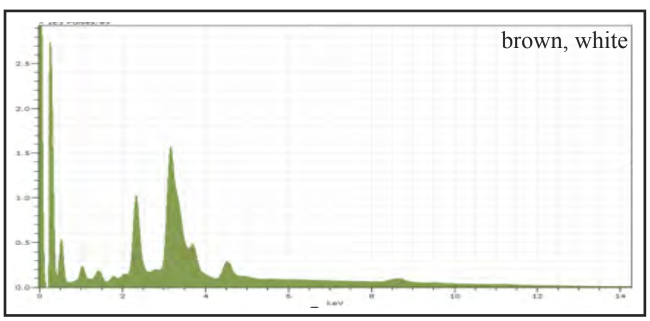




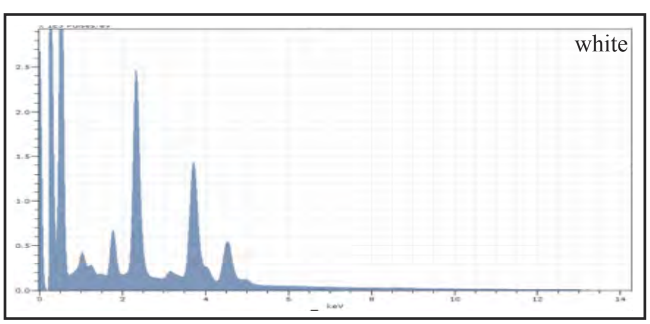
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



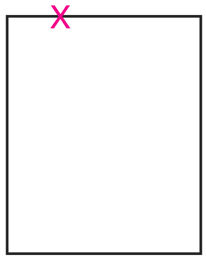
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, brown: none
significant elements, white: Ti, Zn
interpretation: Ti/Zn white, mixed colors



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	14.69	22.58	6.47	1.63
Sulfur	K-series	7.13	10.96	11.01	0.28
Zinc	K-series	6.26	9.61	4.74	0.24
Potassium	K-series	3.64	5.59	4.61	0.56
Selenium	L-series	3.48	5.35	2.18	0.27
Titanium	K-series	3.41	5.24	3.53	0.38
Calcium	K-series	2.65	4.08	3.28	0.17
Sodium	K-series	2.61	4.01	5.63	2.08
Barium	L-series	2.24	3.45	0.81	0.40
Silicon	K-series	0.35	0.54	0.62	0.04
Aluminium	K-series	0.24	0.37	0.44	0.21
Phosphorus	K-series	0.10	0.15	0.16	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	18.27	28.07	56.53	14.02
	Sum:	65.08	100.00	100.00	



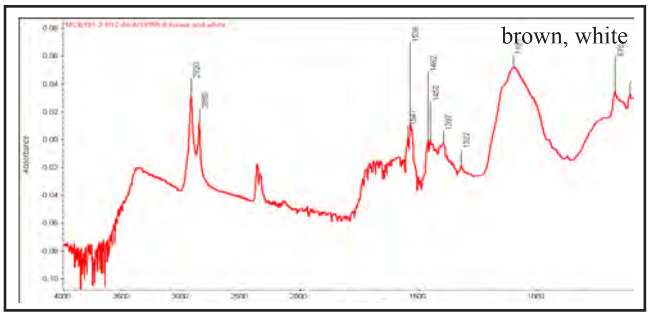
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	16.84	15.56	8.90	0.57
Sulfur	K-series	15.21	14.05	10.05	0.56
Titanium	K-series	9.54	8.81	4.22	0.62
Zinc	K-series	3.64	3.37	1.18	0.16
Silicon	K-series	3.04	2.81	2.29	0.15
Barium	L-series	2.58	2.38	0.40	0.70
Cadmium	L-series	1.90	1.76	0.36	0.49
Magnesium	K-series	0.89	0.83	0.78	0.14
Sodium	K-series	0.40	0.37	0.37	0.34
Chlorine	K-series	0.22	0.21	0.13	0.04
Phosphorus	K-series	0.09	0.09	0.06	0.03
Potassium	K-series	0.07	0.06	0.04	0.07
Aluminium	K-series	0.02	0.02	0.02	0.04
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	53.79	49.69	71.20	17.96
	Sum:	108.25	100.00	100.00	



acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: brown and white underlayer

sample location: top edge, 12.0" from left
(T 0.0 x L 30.5 cm.)

Representative Analysis Compilation—sample B12, continued



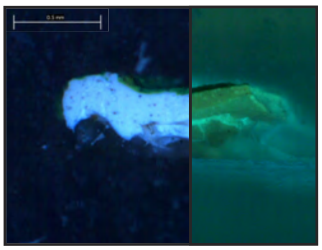
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: filler

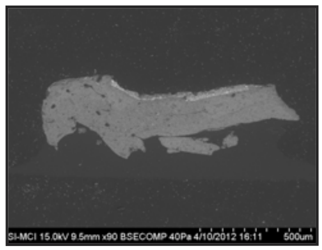
no image available

acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: green and white underlayer

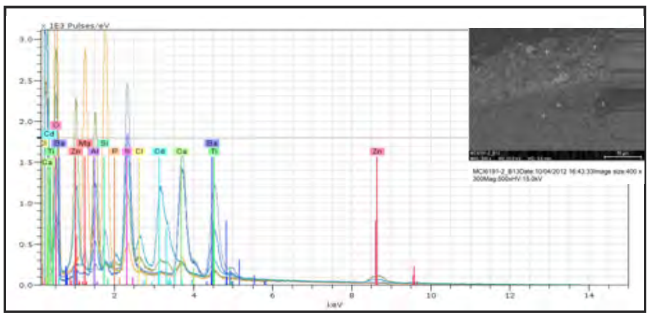
sample location: top edge, 13.0" from left
(T 0.0 x L 33.0 cm.)

Representative Analysis Compilation—sample B13

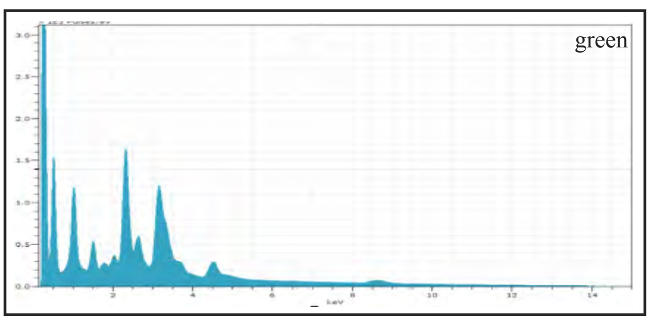




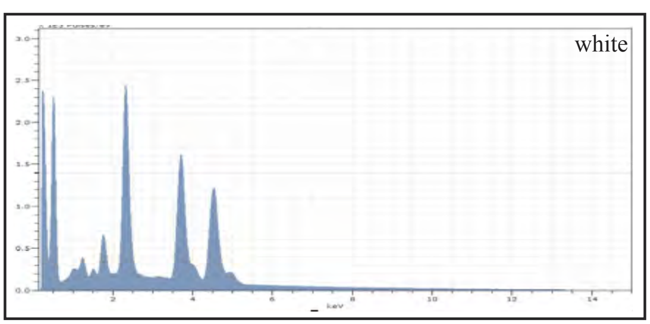
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



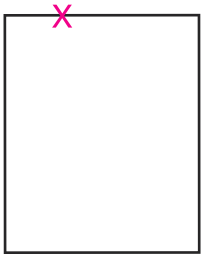
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, green: Zn, Cd, S, Na
significant elements, white: Ti
interpretation: cadmium green, titanium white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	12.38	16.69	6.81	0.44
Cadmium	L-series	9.77	13.17	3.13	1.22
Sulfur	K-series	6.10	8.23	6.85	0.24
Sodium	K-series	3.26	4.39	5.10	2.59
Barium	L-series	3.23	4.35	0.85	0.37
Potassium	K-series	2.26	3.05	2.08	0.42
Titanium	K-series	2.25	3.04	1.69	0.28
Chlorine	K-series	1.59	2.14	1.61	0.08
Aluminium	K-series	1.46	1.97	1.94	0.92
Calcium	K-series	0.68	0.92	0.61	0.10
Phosphorus	K-series	0.49	0.66	0.57	0.04
Silicon	K-series	0.25	0.34	0.33	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	30.42	41.04	68.44	15.08
	Sum:	74.13	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	25.23	36.38	29.94	1.05
Calcium	K-series	18.39	26.53	26.08	0.62
Sulfur	K-series	15.62	22.52	27.68	0.58
Silicon	K-series	3.23	4.66	6.54	0.16
Magnesium	K-series	2.11	3.04	4.93	0.14
Barium	L-series	1.74	2.51	0.72	0.87
Zinc	K-series	1.33	1.92	1.16	0.08
Sodium	K-series	0.56	0.81	1.40	0.47
Cadmium	L-series	0.38	0.55	0.19	0.12
Chlorine	K-series	0.35	0.50	0.56	0.04
Aluminium	K-series	0.32	0.47	0.68	0.04
Phosphorus	K-series	0.07	0.10	0.13	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
	Sum:	69.35	100.00	100.00	

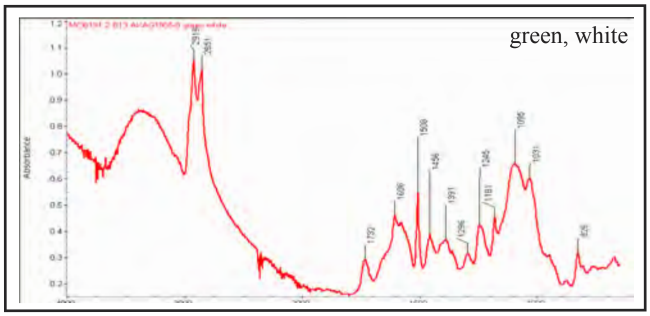


no image available

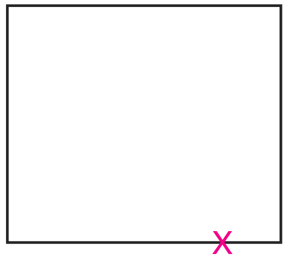
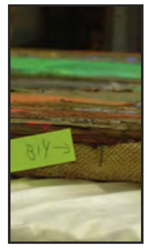
acc. no.: AKAG 1955:8
title, year: *Exuberance*, 1955
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 50.0 x 40.0" (127.0 x 101.6 cm.)
notes: green and white underlayer

sample location: top edge, 13.0" from left
(T 0.0 x L 33.0 cm.)

Representative Analysis Compilation—sample B13, continued



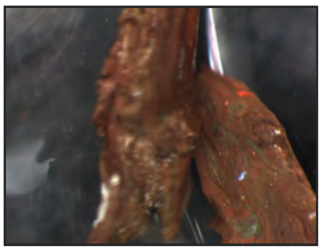
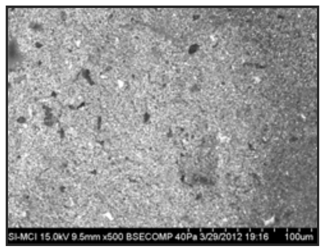
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil, epoxy mount medium

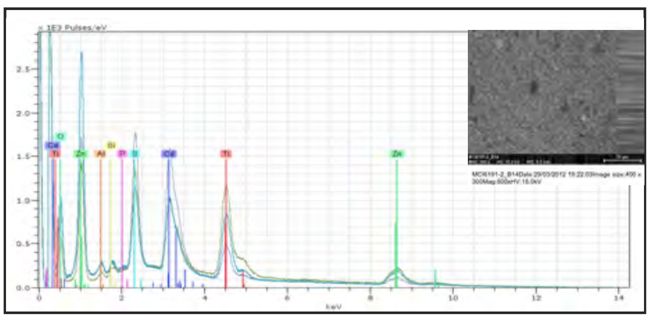
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: brown

sample location: bottom edge,
14.0" from right (B 0.0 x R 35.6 cm.)

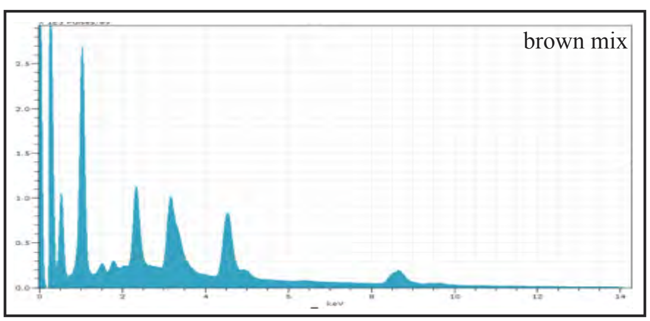
Representative Analysis Compilation—sample B14

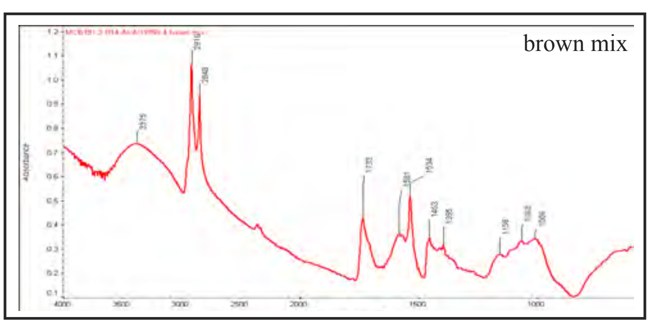
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



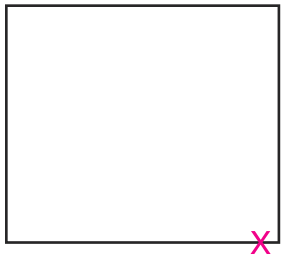
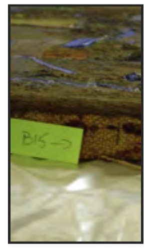
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, brown: none
interpretation: mixed colors



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	34.18	35.71	20.14	1.15
Sodium	K-series	14.15	14.78	23.71	11.16
Titanium	K-series	12.18	12.73	9.80	0.63
Cadmium	L-series	10.39	10.86	3.56	1.29
Sulfur	K-series	5.27	5.51	6.33	0.21
Potassium	K-series	1.91	2.00	1.88	0.46
Barium	L-series	1.91	1.99	0.53	0.80
Iron	K-series	1.42	1.49	0.98	0.07
Aluminium	K-series	0.68	0.71	0.96	0.54
Silicon	K-series	0.54	0.56	0.74	0.05
Phosphorus	K-series	0.09	0.10	0.12	0.03
Chlorine	K-series	0.03	0.03	0.03	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	12.97	13.55	31.22	7.61
	Sum:	95.71	100.00	100.00	



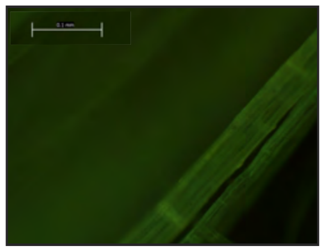
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

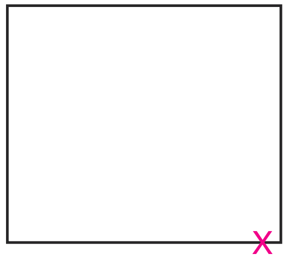
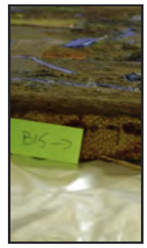
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: threads, possibly weft

sample location: bottom edge,
3.5" from right (B 0.0 x R 8.9 cm.)

Representative Analysis Compilation—sample B15

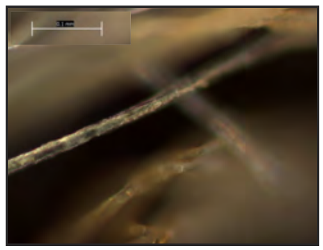
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification;
ultraviolet illumination (355-425 nm.)
interpretation: linen

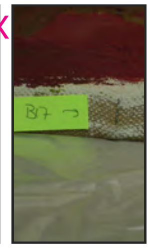
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: threads, possibly warp

sample location: bottom edge,
3.5" from right (B 0.0 x R 8.9 cm.)

Representative Analysis Compilation—sample B16

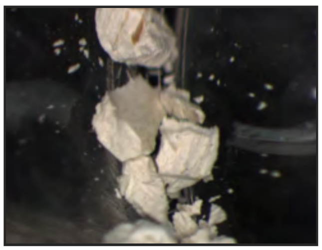
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification
interpretation: linen

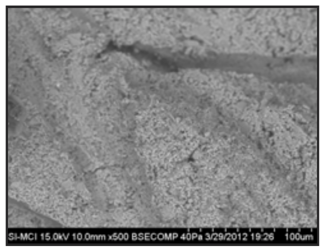


acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: ground layer

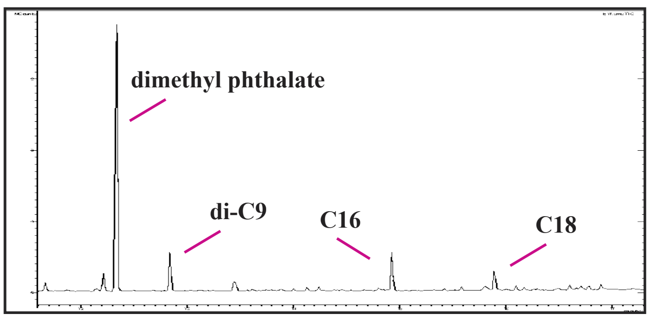
sample location: right edge,
5.0" from top (T 12.7 x R 0.0 cm.)

Representative Analysis Compilation—sample B17

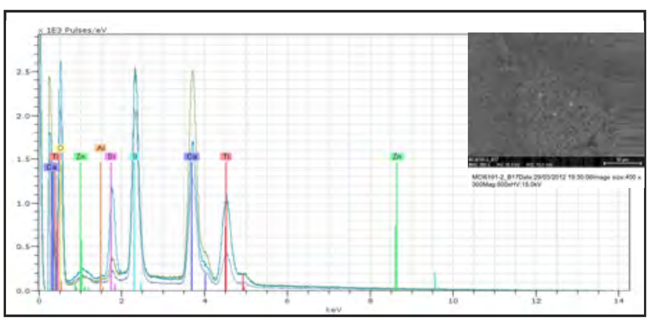




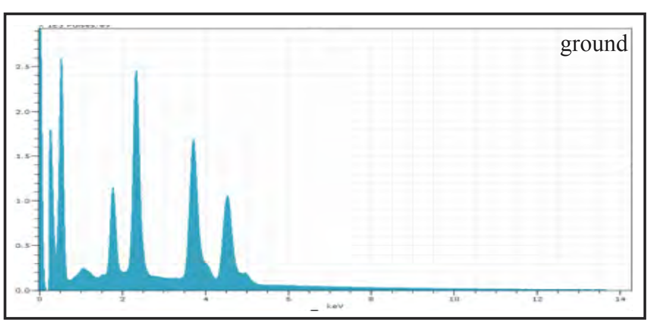
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.292
scan range: 1 - 1479
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd

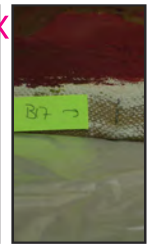


analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti, Ca
interpretation: titanium white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	19.06	19.17	10.49	0.87
Calcium	K-series	17.73	17.83	11.65	0.55
Sulfur	K-series	16.08	16.17	13.21	0.59
Silicon	K-series	6.49	6.52	6.09	0.29
Barium	L-series	2.43	2.45	0.47	1.13
Zinc	K-series	1.99	2.00	0.80	0.10
Sodium	K-series	0.80	0.81	0.92	0.66
Chlorine	K-series	0.51	0.51	0.38	0.04
Magnesium	K-series	0.50	0.50	0.54	0.05
Phosphorus	K-series	0.25	0.25	0.21	0.04
Potassium	K-series	0.11	0.11	0.07	0.04
Aluminium	K-series	0.01	0.01	0.01	0.03
Oxygen	K-series	33.50	33.68	55.16	12.89
	Sum:	99.47	100.00	100.00	



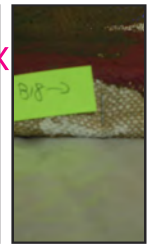


acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: ground layer

sample location: right edge,
5.0" from top (T 12.7 x R 0.0 cm.)

Representative Analysis Compilation—sample B17, continued

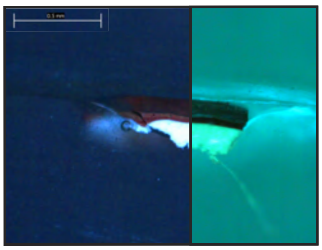
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

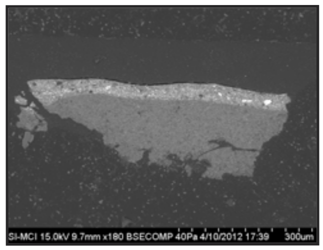


acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
conservation notes: reddish brown

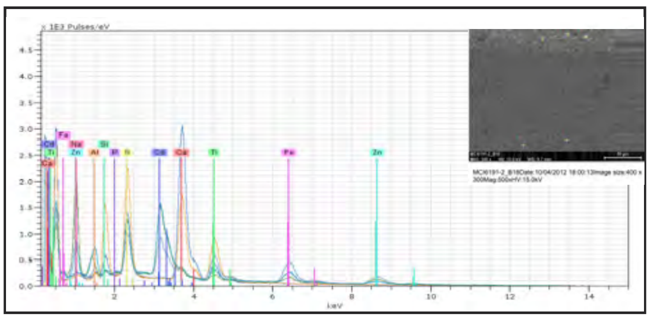
sample location: right edge,
10.0" from top (T 25.4 x R 0.0 cm.)

Representative Analysis Compilation—sample B18

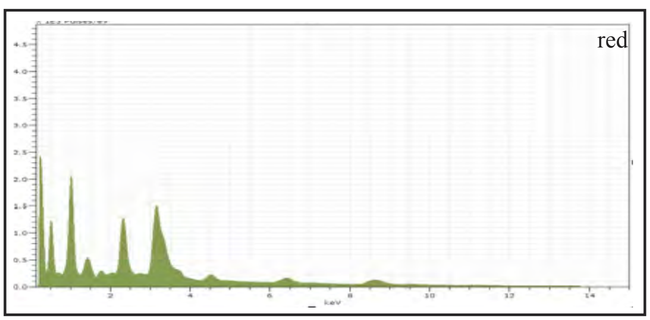




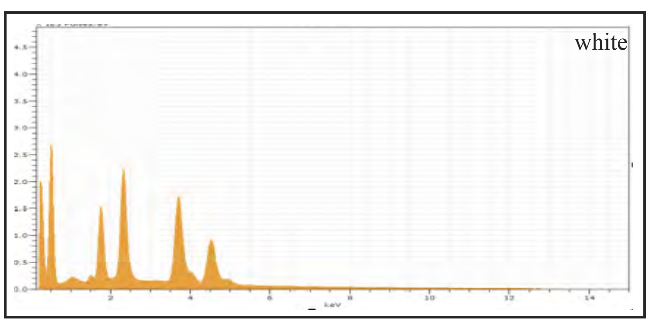
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se, Fe
significant elements, white: Ti
interpretation: cadmium red, possibly red ochre, titanium white

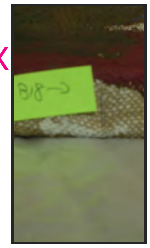


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	26.38	32.53	26.18	0.90
Cadmium	L-series	21.31	26.28	12.30	2.16
Sodium	K-series	8.29	10.22	23.40	6.55
Iron	K-series	6.98	8.61	8.11	0.23
Sulfur	K-series	5.76	7.10	11.66	0.23
Potassium	K-series	3.87	4.77	6.42	0.73
Titanium	K-series	1.94	2.39	2.63	0.25
Aluminium	K-series	1.66	2.05	3.99	1.26
Selenium	L-series	1.59	1.96	1.31	0.14
Barium	L-series	1.46	1.81	0.69	0.30
Calcium	K-series	1.40	1.73	2.27	0.16
Silicon	K-series	0.45	0.56	1.05	0.05
Phosphorus	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	81.11	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	21.13	31.23	30.36	0.65
Titanium	K-series	18.64	27.54	22.41	0.91
Sulfur	K-series	13.12	19.38	23.55	0.49
Silicon	K-series	8.82	13.03	18.07	0.39
Barium	L-series	3.01	4.45	1.26	1.13
Zinc	K-series	1.44	2.12	1.26	0.08
Aluminium	K-series	0.43	0.63	0.91	0.05
Magnesium	K-series	0.34	0.50	0.81	0.05
Chlorine	K-series	0.29	0.43	0.47	0.04
Potassium	K-series	0.26	0.39	0.39	0.05
Sodium	K-series	0.20	0.30	0.51	0.18
Phosphorus	K-series	0.00	0.00	0.00	0.03
	Sum:	67.67	100.00	100.00	

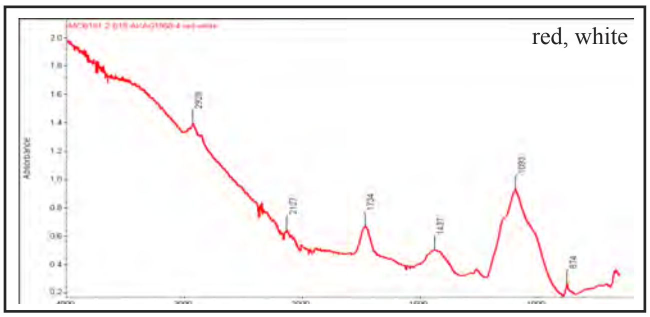




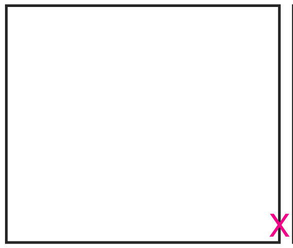
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
conservation notes: reddish brown

sample location: right edge,
10.0" from top (T 25.4 x R 0.0 cm.)

Representative Analysis Compilation—sample B18, continued



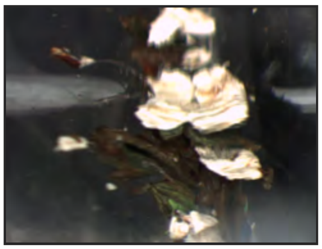
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

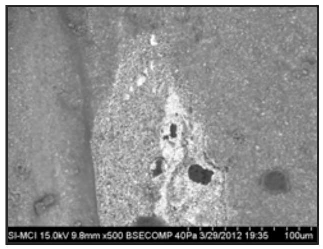


acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: stratigraphy

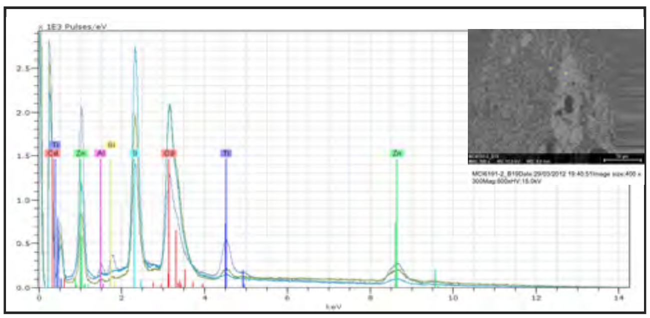
sample location: right edge,
4.5" from bottom (B 11.4 x R 0.0 cm.)

Representative Analysis Compilation—sample B19

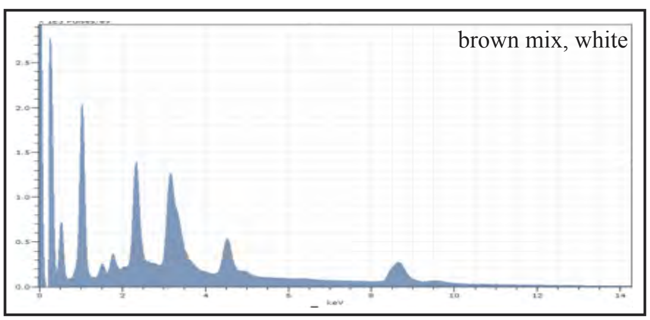




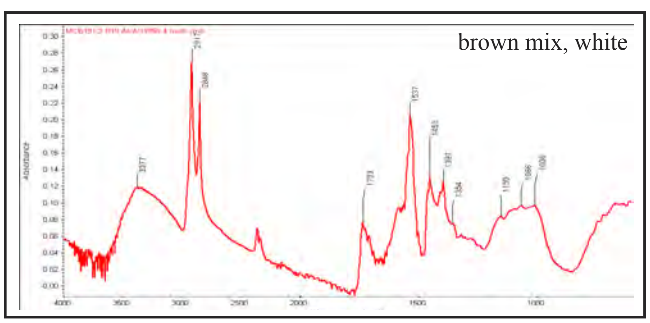
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



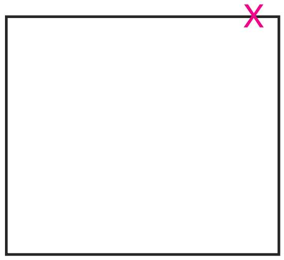
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, brown: none
significant elements, white: Zn, Ti
interpretation: mixed colors, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	44.52	43.50	27.20	1.49
Sodium	K-series	17.02	16.63	29.58	13.42
Cadmium	L-series	13.81	13.50	4.91	1.48
Sulfur	K-series	7.39	7.22	9.20	0.29
Titanium	K-series	5.83	5.69	4.86	0.38
Potassium	K-series	2.35	2.30	2.40	0.52
Silicon	K-series	1.39	1.36	1.98	0.08
Iron	K-series	1.05	1.02	0.75	0.06
Barium	L-series	0.94	0.92	0.27	0.48
Aluminium	K-series	0.89	0.87	1.33	0.71
Chlorine	K-series	0.14	0.13	0.15	0.04
Phosphorus	K-series	0.07	0.06	0.08	0.03
Calcium	K-series	0.06	0.06	0.06	0.07
Magnesium	K-series	0.00	0.00	0.00	0.02
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	6.89	6.73	17.21	4.67
	Sum:	102.36	100.00	100.00	



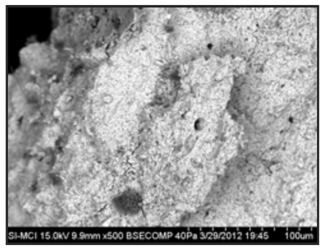
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil



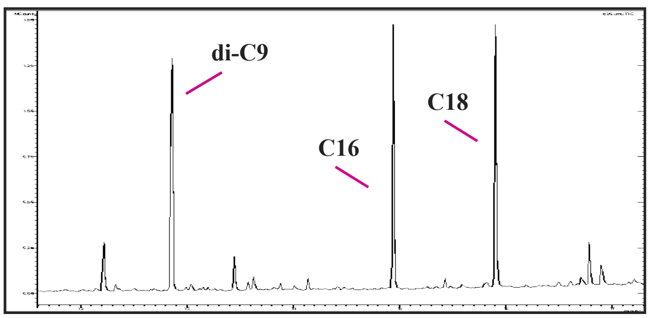
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: yellow

sample location: top edge,
6.0" from right (T 0.0 x R 15.2 cm.)

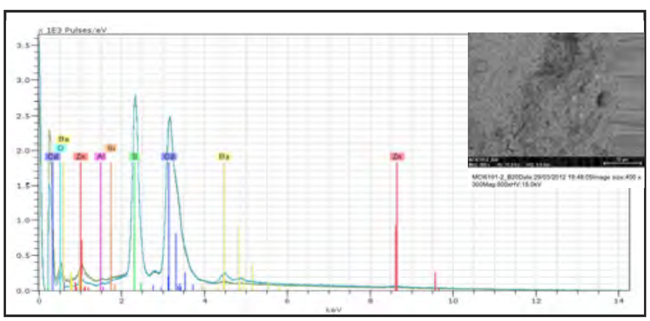
Representative Analysis Compilation—sample B20



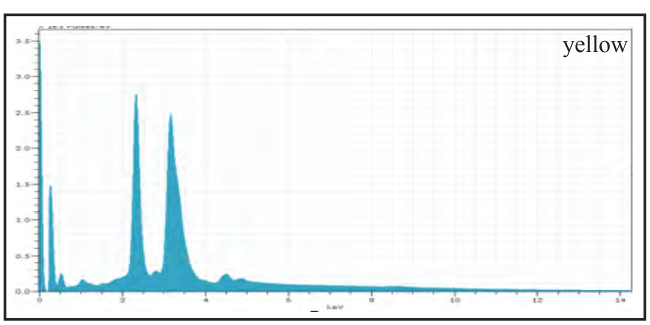
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



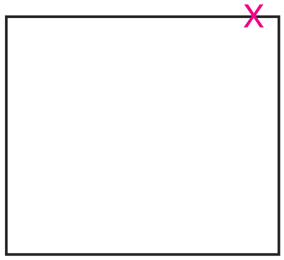
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.198
scan range: 1 - 1482
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
interpretation: cadmium yellow



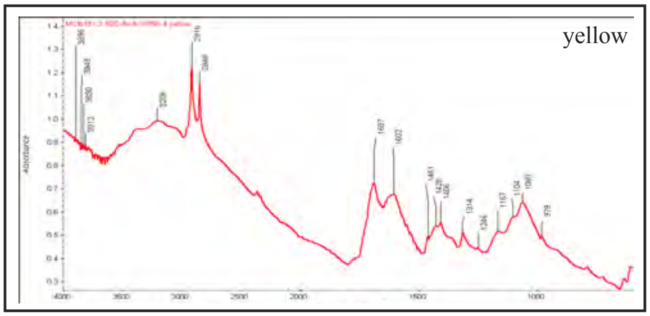
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	33.64	33.80	15.81	2.69
Zinc	K-series	21.09	21.19	17.05	0.73
Sulfur	K-series	19.34	19.43	31.88	0.71
Barium	L-series	10.67	10.72	4.11	0.73
Potassium	K-series	6.43	6.46	8.69	0.91
Sodium	K-series	2.96	2.98	6.81	2.36
Magnesium	K-series	0.99	1.00	2.16	0.23
Silicon	K-series	0.26	0.27	0.50	0.04
Phosphorus	K-series	0.25	0.25	0.43	0.04
Aluminium	K-series	0.21	0.21	0.42	0.19
Calcium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	3.68	3.70	12.15	4.12
	Sum:	99.54	100.00	100.00	

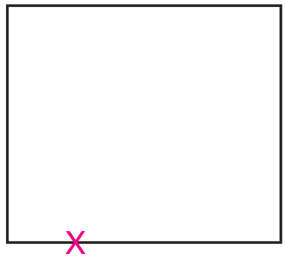

acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: yellow

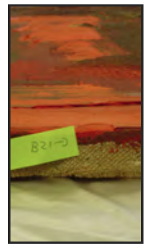
sample location: top edge,
6.0" from right (T 0.0 x R 15.2 cm.)

Representative Analysis Compilation—sample B20, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

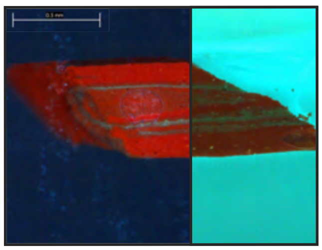


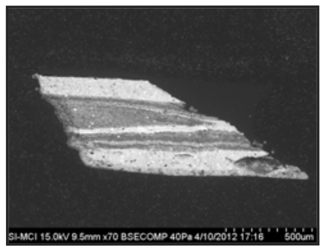


acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: orange

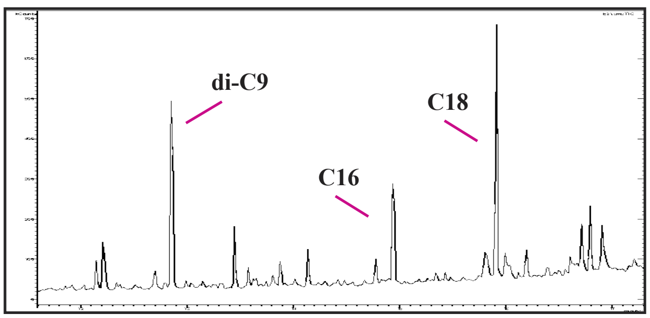
sample location: bottom edge,
14.5" from left (B 0.0 x L 36.8 cm.)

Representative Analysis Compilation—sample B21

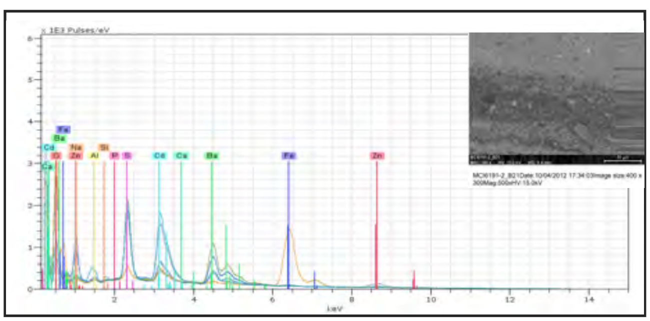




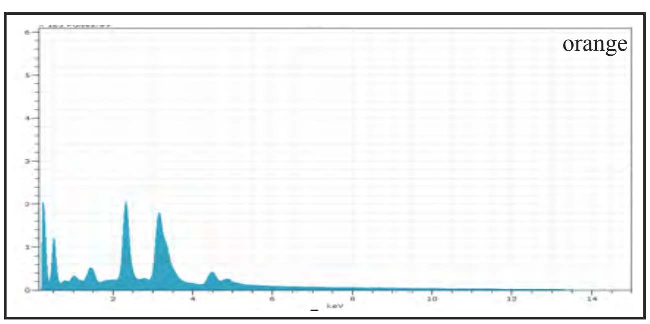
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



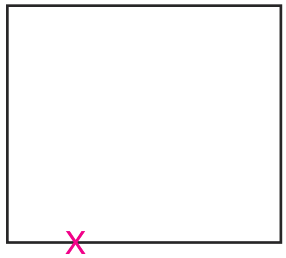
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.400
scan range: 1 - 1482
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil

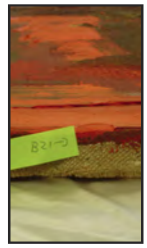


analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
significant elements, tan mix: Fe
interpretation: cadmium orange, yellow ochre



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	21.71	25.18	8.84	2.12
Barium	L-series	15.49	17.97	5.16	1.03
Sulfur	K-series	10.41	12.07	14.86	0.39
Zinc	K-series	9.65	11.20	6.76	0.35
Potassium	K-series	4.78	5.54	5.59	0.70
Iron	K-series	2.19	2.54	1.80	0.09
Aluminium	K-series	1.68	1.95	2.85	1.14
Selenium	L-series	0.89	1.03	0.52	0.09
Sodium	K-series	0.78	0.91	1.55	0.64
Titanium	K-series	0.41	0.48	0.40	0.28
Silicon	K-series	0.19	0.22	0.31	0.03
Phosphorus	K-series	0.17	0.19	0.25	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	17.86	20.72	51.11	10.06
	Sum:	86.20	100.00	100.00	

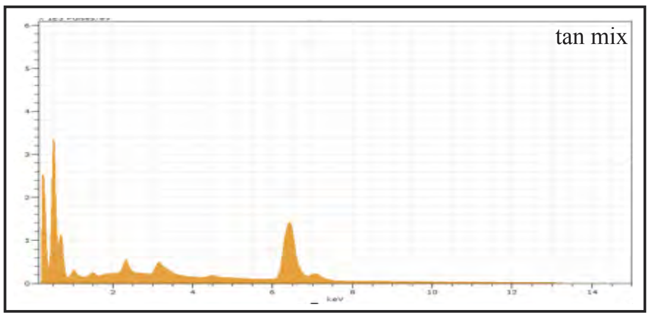




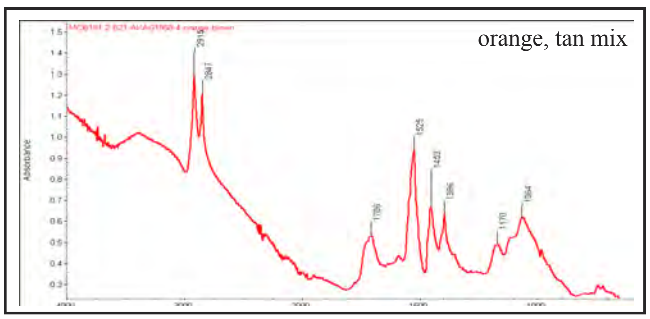
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: orange

sample location: bottom edge,
14.5" from left (B 0.0 x L 36.8 cm.)

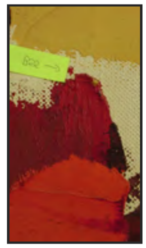
Representative Analysis Compilation—sample B21, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Iron	K-series	105.06	71.52	75.05	3.09
Zinc	K-series	14.37	9.78	8.76	0.51
Cadmium	L-series	10.22	6.96	3.63	1.41
Barium	L-series	8.91	6.07	2.59	0.62
Sulfur	K-series	3.55	2.42	4.42	0.15
Calcium	K-series	1.27	0.87	1.27	0.13
Chlorine	K-series	1.26	0.86	1.42	0.07
Potassium	K-series	0.70	0.48	0.72	0.50
Phosphorus	K-series	0.68	0.46	0.87	0.05
Aluminium	K-series	0.67	0.45	0.99	0.53
Silicon	K-series	0.20	0.14	0.28	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Sodium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	146.89	100.00	100.00	



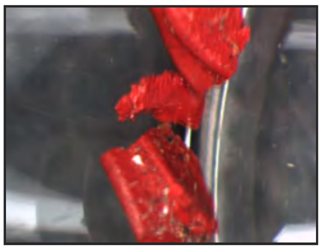
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

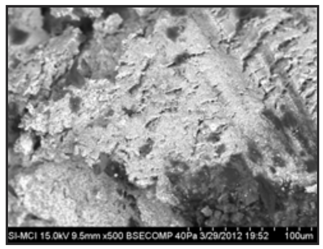


acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: red

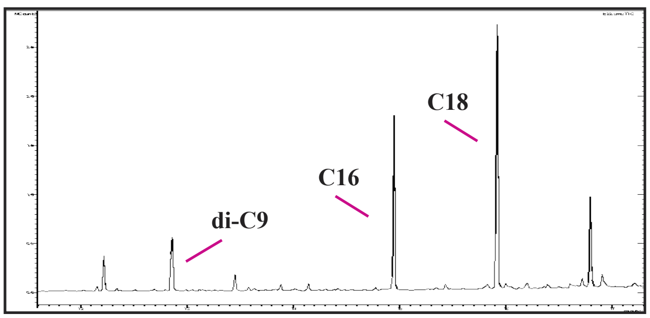
sample location: 18.0" from bottom, 2.5" from left (B 45.7 x L 6.4 cm.)

Representative Analysis Compilation—sample B22

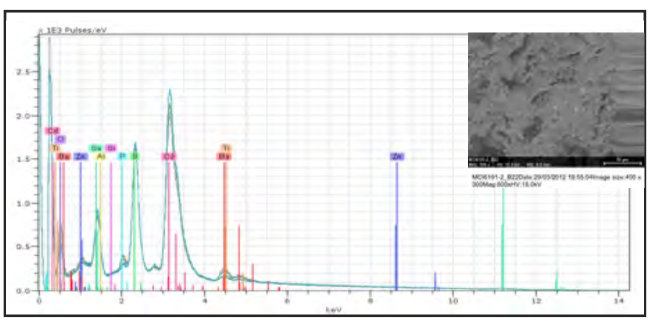




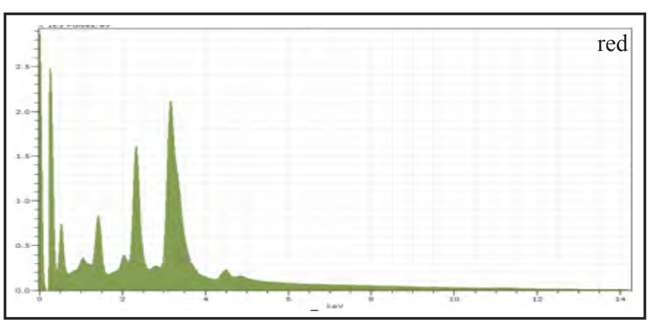
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



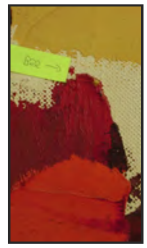
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.229
scan range: 1 - 1482
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red



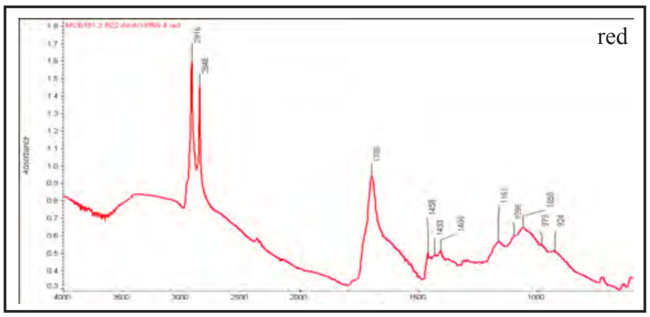
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	29.97	37.11	12.80	2.46
Sulfur	K-series	8.75	10.83	13.10	0.33
Selenium	L-series	6.53	8.08	3.97	0.44
Barium	L-series	5.05	6.25	1.77	0.38
Zinc	K-series	4.97	6.15	3.65	0.20
Potassium	K-series	4.85	6.00	5.95	0.84
Phosphorus	K-series	0.99	1.22	1.53	0.06
Sodium	K-series	0.95	1.18	1.99	0.77
Aluminium	K-series	0.36	0.44	0.64	0.30
Titanium	K-series	0.21	0.26	0.21	0.15
Calcium	K-series	0.03	0.04	0.04	0.05
Magnesium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Silicon	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	18.11	22.43	54.36	12.78
	Sum:	80.76	100.00	100.00	



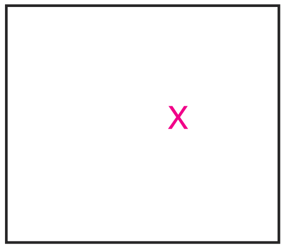
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: red

sample location: 18.0" from bottom, 2.5" from left (B 45.7 x L 6.4 cm.)

Representative Analysis Compilation—sample B22, continued



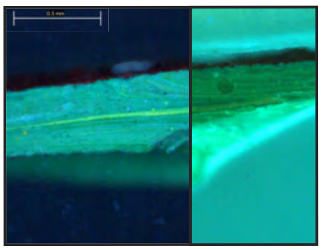
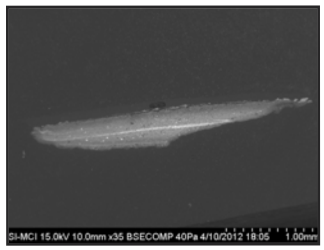
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

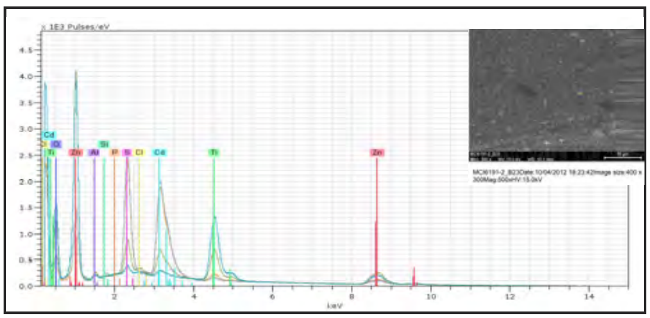
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: green mix

sample location: 21.0" from top,
33.0" from left (T 53.3 x L 83.8 cm.)

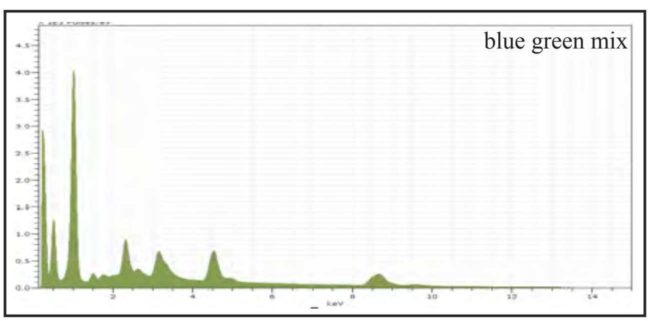
Representative Analysis Compilation—sample B23

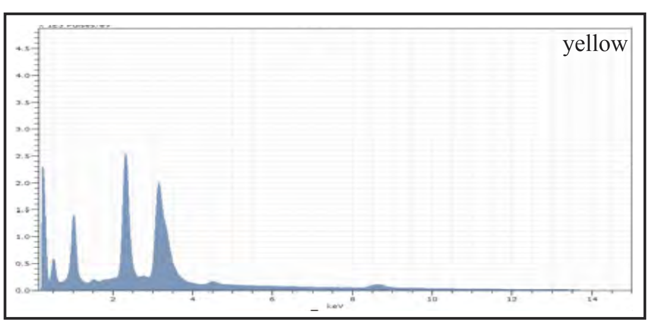
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



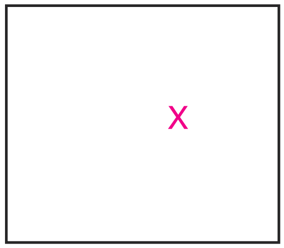
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na
significant elements, green: Zn, Na, Cd, S
significant elements, yellow: Cd, S
interpretation: ultramarine blue, cadmium green, cadmium yellow



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	55.75	47.24	33.09	1.86
Sodium	K-series	24.73	20.96	41.74	19.49
Cadmium	L-series	10.92	9.25	3.77	1.43
Titanium	K-series	9.55	8.09	7.74	0.77
Barium	L-series	7.23	6.13	2.04	0.83
Sulfur	K-series	4.99	4.23	6.04	0.20
Chlorine	K-series	1.61	1.37	1.77	0.08
Potassium	K-series	1.29	1.09	1.28	0.55
Aluminium	K-series	0.95	0.80	1.36	0.74
Silicon	K-series	0.43	0.37	0.60	0.04
Calcium	K-series	0.42	0.36	0.41	0.10
Phosphorus	K-series	0.14	0.12	0.18	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	118.00	100.00	100.00	



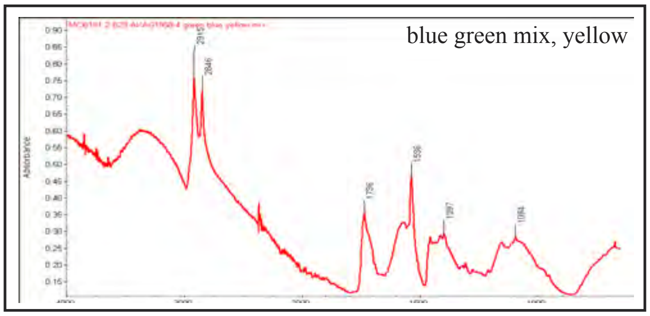
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	41.90	42.41	19.08	3.31
Sulfur	K-series	20.95	21.20	33.45	0.76
Zinc	K-series	17.23	17.44	13.49	0.60
Sodium	K-series	9.98	10.10	22.22	7.88
Potassium	K-series	5.68	5.75	7.43	1.11
Titanium	K-series	0.99	1.01	1.06	0.14
Chlorine	K-series	0.91	0.92	1.32	0.07
Phosphorus	K-series	0.40	0.41	0.67	0.04
Aluminium	K-series	0.30	0.30	0.57	0.25
Silicon	K-series	0.17	0.18	0.32	0.03
Magnesium	K-series	0.16	0.16	0.33	0.08
Barium	L-series	0.12	0.12	0.05	0.08
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	98.80	100.00	100.00	

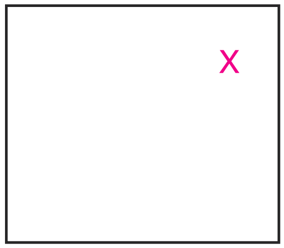

acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: green mix

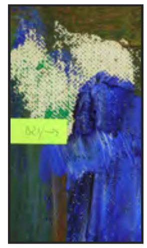
sample location: 21.0" from top,
33.0" from left (T 53.3 x L 83.8 cm.)

Representative Analysis Compilation—sample B23, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

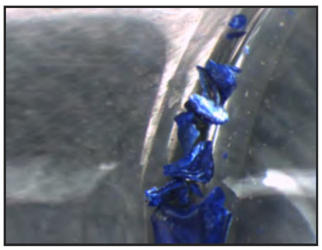
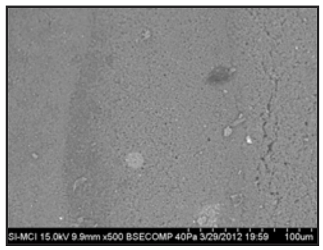





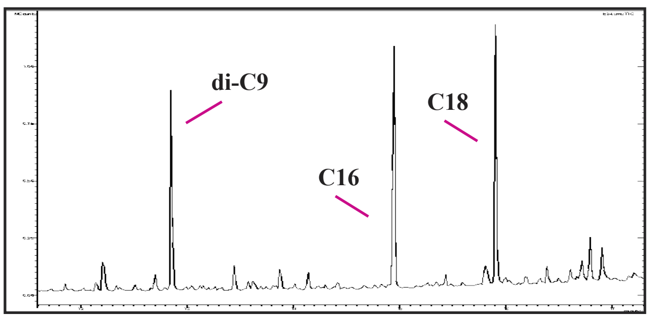
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: blue mix

sample location: 12.5" from top,
10.5" from right (T 31.8 x R 26.7 cm.)

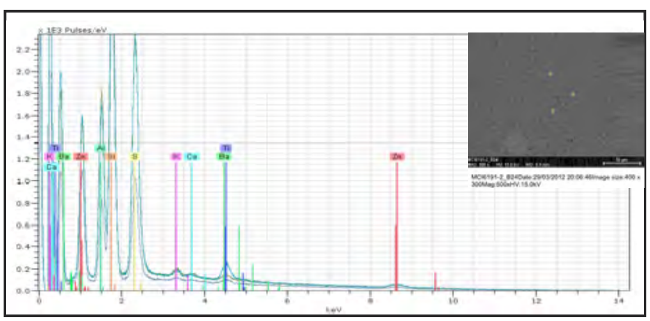
Representative Analysis Compilation—sample B24

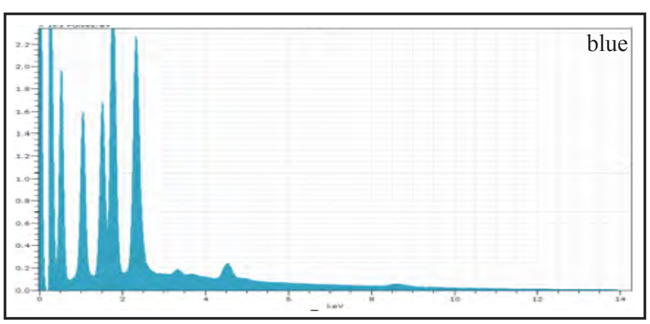
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



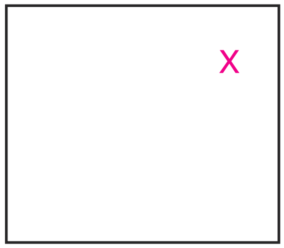
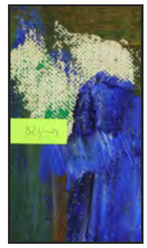
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.177
scan range: 1 - 1485
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Si, Na
interpretation: ultramarine blue



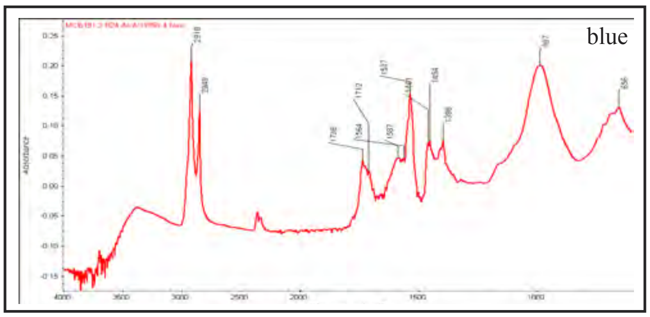
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	15.64	23.48	25.57	0.67
Sulfur	K-series	14.74	22.12	21.10	0.54
Sodium	K-series	13.64	20.47	27.24	10.76
Aluminium	K-series	9.06	13.59	15.41	0.44
Zinc	K-series	6.54	9.82	4.60	0.25
Titanium	K-series	2.03	3.05	1.95	0.25
Barium	L-series	1.22	1.82	0.41	0.27
Copper	K-series	0.75	1.12	0.54	0.06
Potassium	K-series	0.75	1.12	0.87	0.05
Chlorine	K-series	0.72	1.08	0.93	0.05
Cobalt	K-series	0.60	0.90	0.47	0.05
Calcium	K-series	0.40	0.60	0.46	0.04
Iron	K-series	0.32	0.48	0.27	0.05
Manganese	K-series	0.23	0.34	0.19	0.05
Magnesium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
	Sum:	66.63	100.00	100.00	

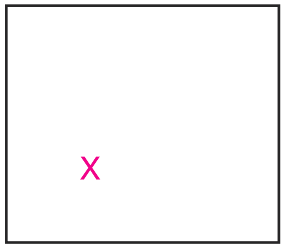
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: blue mix

sample location: 12.5" from top,
10.5" from right (T 31.8 x R 26.7 cm.)

Representative Analysis Compilation—sample B24, continued



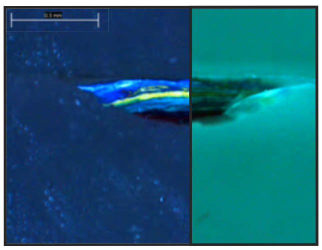
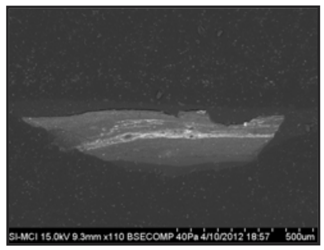
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

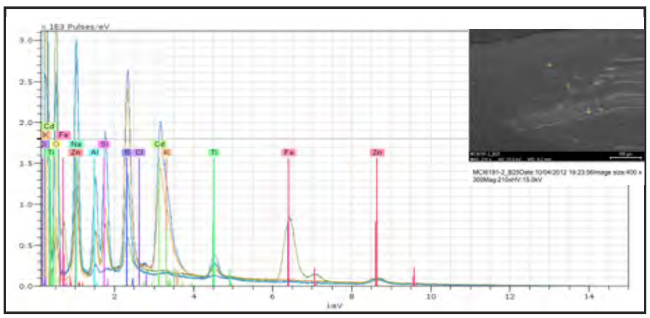
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: black

sample location: 16.5" from bottom, 20.0" from left (B 41.9 x L 50.8 cm.)

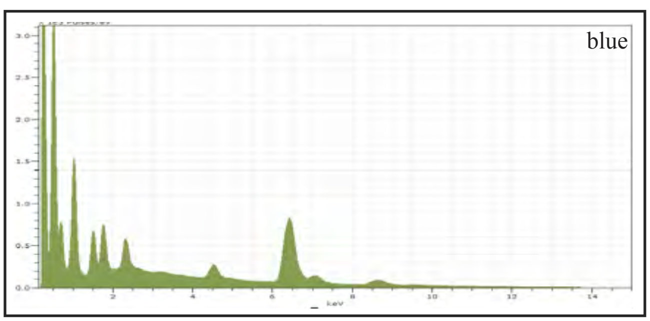
Representative Analysis Compilation—sample B25

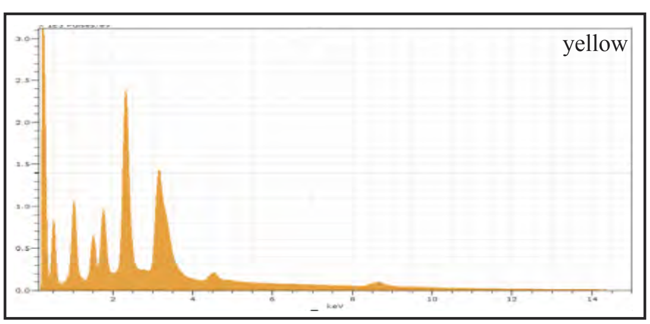
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.3 mm.



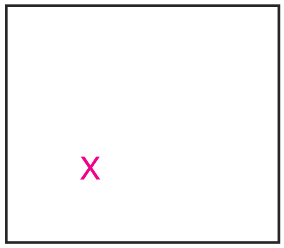
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.2 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Fe, Na
significant elements, yellow: Cd, S
interpretation: Prussian blue, ultramarine blue, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Iron	K-series	40.20	55.26	43.69	1.20
Zinc	K-series	11.70	16.08	10.86	0.42
Sodium	K-series	7.81	10.74	20.63	6.17
Silicon	K-series	3.93	5.40	8.49	0.19
Aluminium	K-series	3.43	4.71	7.71	0.18
Titanium	K-series	2.59	3.56	3.28	0.22
Sulfur	K-series	2.31	3.18	4.38	0.11
Chlorine	K-series	0.33	0.45	0.56	0.04
Cadmium	L-series	0.23	0.31	0.12	0.08
Potassium	K-series	0.11	0.15	0.17	0.09
Barium	L-series	0.06	0.09	0.03	0.06
Calcium	K-series	0.03	0.04	0.05	0.04
Phosphorus	K-series	0.02	0.02	0.03	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	72.75	100.00	100.00	



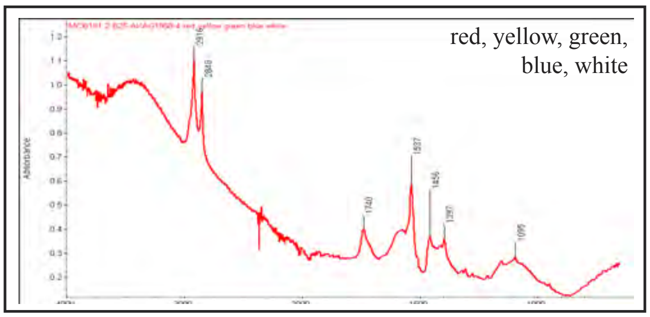
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	24.48	27.45	18.54	0.84
Cadmium	L-series	17.03	19.10	7.50	1.94
Sulfur	K-series	13.12	14.71	20.25	0.49
Sodium	K-series	12.73	14.28	27.43	10.05
Barium	L-series	7.28	8.17	2.63	0.52
Silicon	K-series	5.95	6.67	10.49	0.27
Potassium	K-series	4.36	4.89	5.52	0.64
Aluminium	K-series	4.01	4.50	7.36	2.08
Calcium	K-series	0.15	0.17	0.18	0.12
Magnesium	K-series	0.05	0.05	0.10	0.05
Titanium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
	Sum:	89.15	100.00	100.00	



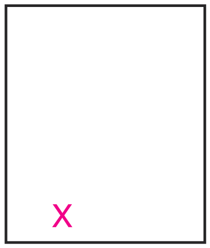
acc. no.: AKAG 1958:4
title, year: *Sommernachtstraum*, 1957
Gift of Seymour H. Knox, Jr.
medium noted in file: oil on canvas
meas.: 52.0 x 60.0" (132.1 x 152.4 cm.)
notes: black

sample location: 16.5" from bottom, 20.0" from left (B 41.9 x L 50.8 cm.)

Representative Analysis Compilation—sample B25, continued



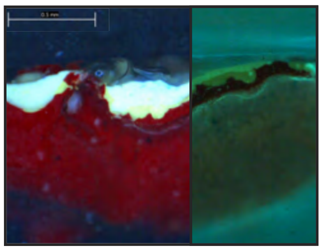
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

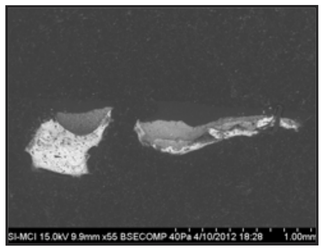


acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: brick red, some yellow

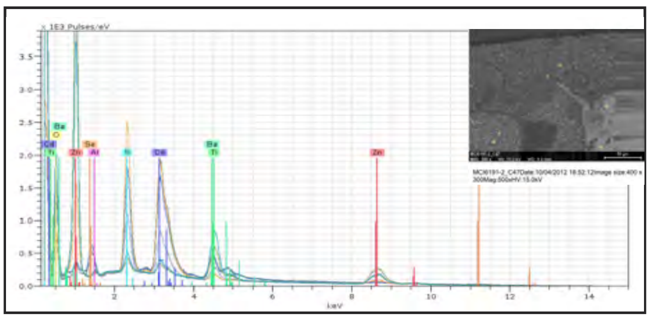
sample location: 8.0" from bottom, 14.0" from left
(B 20.3 x L 35.6 cm.)

Representative Analysis Compilation—sample C047

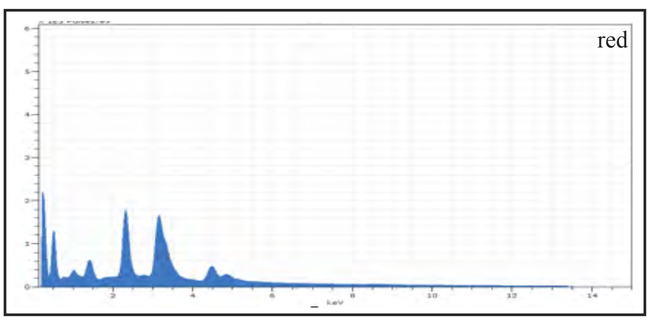




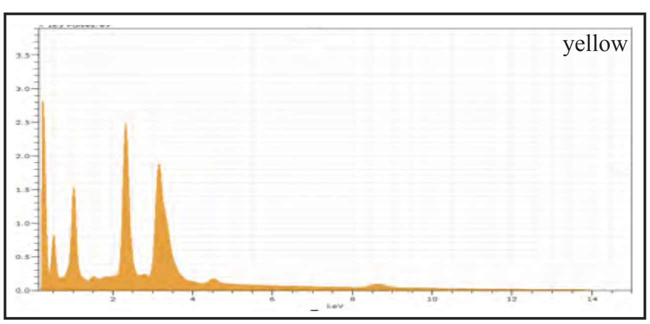
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.9 mm.



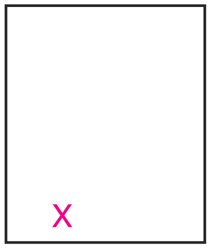
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, yellow: Cd, S
significant elements, white: Zn, Ti
interpretation: cadmium red, cadmium yellow, Zn/Ti white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	22.77	30.52	18.43	2.28
Barium	L-series	21.57	28.92	14.30	1.41
Sulfur	K-series	11.15	14.95	31.65	0.42
Zinc	K-series	8.07	10.82	11.24	0.30
Potassium	K-series	4.77	6.39	11.09	0.76
Selenium	L-series	3.42	4.58	3.94	0.25
Aluminium	K-series	1.41	1.89	4.75	1.10
Sodium	K-series	0.80	1.07	3.17	0.66
Titanium	K-series	0.45	0.61	0.86	0.33
Silicon	K-series	0.09	0.13	0.31	0.03
Phosphorus	K-series	0.08	0.11	0.25	0.03
Calcium	K-series	0.01	0.01	0.02	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	74.60	100.00	100.00	



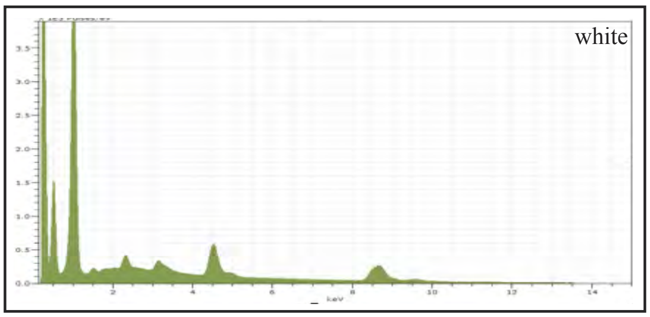
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	27.88	33.30	15.07	2.57
Zinc	K-series	22.00	26.27	20.44	0.76
Sulfur	K-series	14.56	17.39	27.58	0.54
Sodium	K-series	9.15	10.93	24.19	7.23
Potassium	K-series	5.66	6.76	8.80	0.87
Barium	L-series	2.84	3.39	1.25	0.32
Titanium	K-series	1.00	1.20	1.27	0.19
Aluminium	K-series	0.25	0.30	0.57	0.22
Silicon	K-series	0.20	0.24	0.43	0.03
Magnesium	K-series	0.09	0.11	0.23	0.06
Calcium	K-series	0.08	0.09	0.11	0.08
Phosphorus	K-series	0.03	0.04	0.06	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
	Sum:	83.72	100.00	100.00	



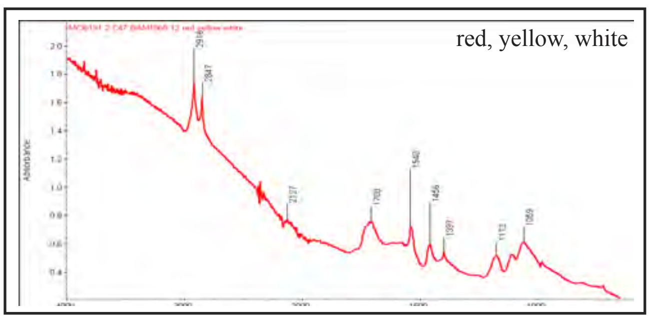
acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: brick red, some yellow

sample location: 8.0" from bottom, 14.0" from left (B 20.3 x L 35.6 cm.)

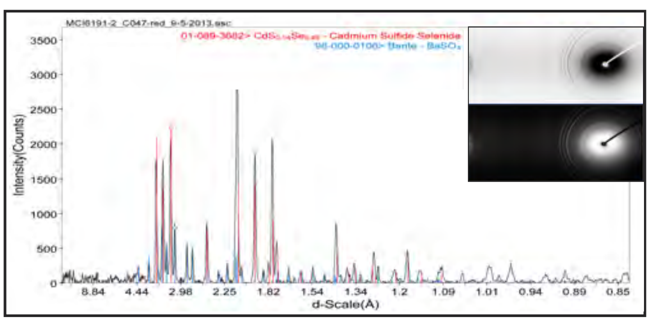
Representative Analysis Compilation—sample C047, continued



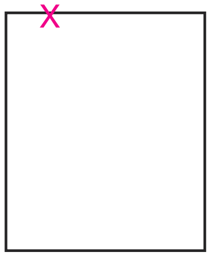
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	49.36	53.30	33.03	1.65
Sodium	K-series	27.92	30.14	53.12	22.00
Titanium	K-series	8.54	9.22	7.81	0.50
Cadmium	L-series	2.22	2.40	0.87	0.57
Sulfur	K-series	1.52	1.64	2.08	0.08
Barium	L-series	1.16	1.25	0.37	0.59
Aluminium	K-series	0.55	0.60	0.90	0.45
Potassium	K-series	0.40	0.43	0.45	0.22
Phosphorus	K-series	0.31	0.34	0.44	0.04
Silicon	K-series	0.23	0.24	0.35	0.04
Chlorine	K-series	0.21	0.23	0.26	0.03
Magnesium	K-series	0.18	0.20	0.33	0.09
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	92.61	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



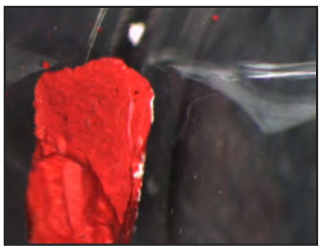
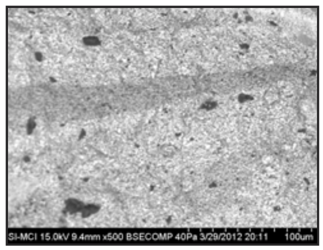
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, spin 360º; omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, barite
interpretation: cadmium red

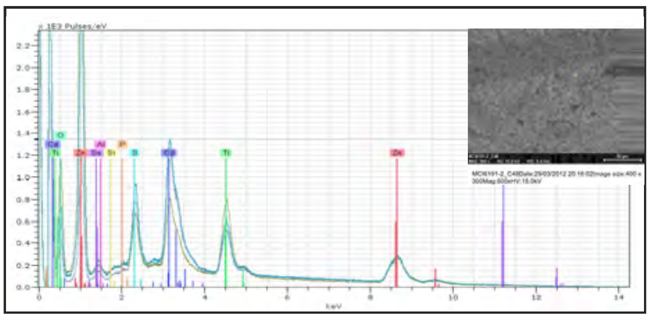

acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: pinkish red

sample location: 0.5" from top, 13.0" from left
(T 1.3 x L 33.0 cm.)

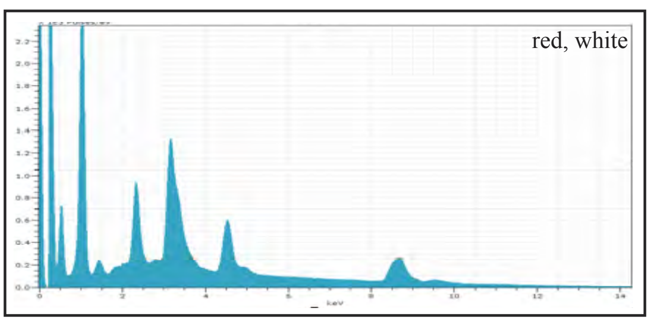
Representative Analysis Compilation—sample C048

photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.

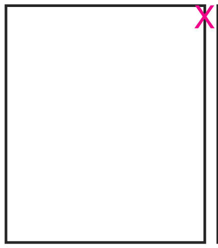
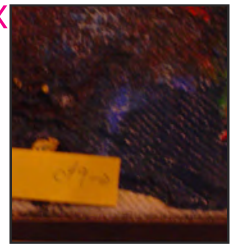


analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, white: Zn, Ti
interpretation: cadmium red, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	46.43	46.66	30.83	1.55
Cadmium	L-series	13.50	13.57	5.21	1.55
Sodium	K-series	12.57	12.63	23.74	9.92
Titanium	K-series	6.22	6.25	5.64	0.48
Sulfur	K-series	5.20	5.23	7.04	0.21
Potassium	K-series	2.93	2.94	3.25	0.51
Barium	L-series	2.70	2.71	0.85	0.49
Selenium	L-series	0.91	0.91	0.50	0.10
Aluminium	K-series	0.63	0.63	1.02	0.51
Phosphorus	K-series	0.44	0.45	0.62	0.04
Silicon	K-series	0.27	0.27	0.42	0.04
Calcium	K-series	0.01	0.01	0.01	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	7.69	7.73	20.87	5.16
	Sum:	99.49	100.00	100.00	

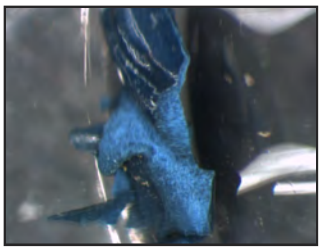
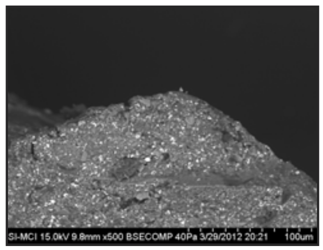
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

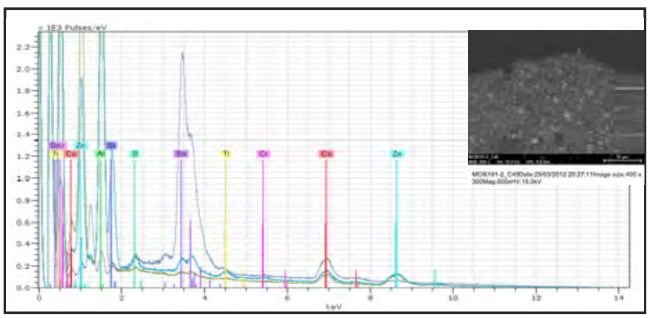
acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: dark greenish blue (seen in other ptgs)

sample location: right edge, 2.0" from top
(T 5.1 x R 0.0 cm.)

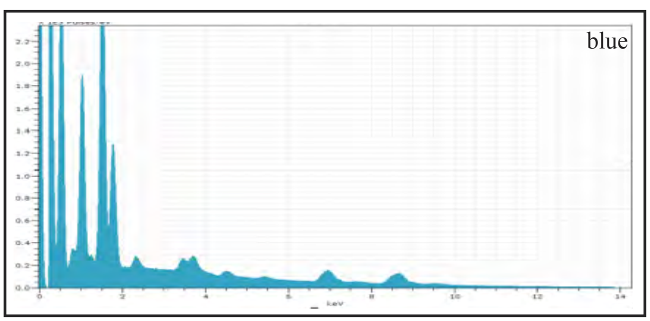
Representative Analysis Compilation—sample C049

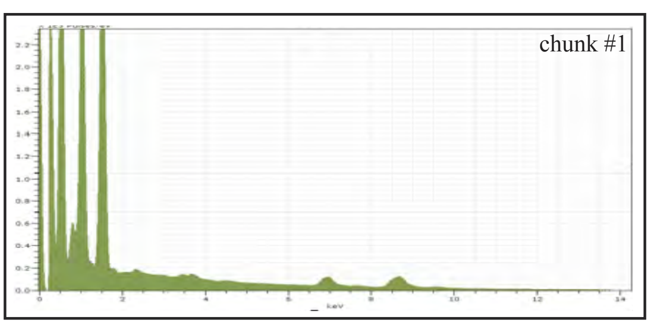
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



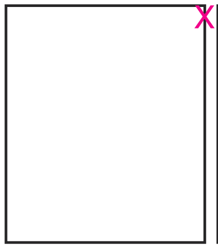
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
major elements, blue: Co, Sn
interpretation: cerulean blue

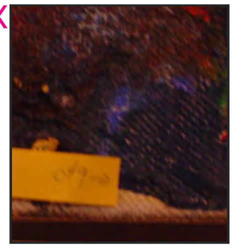


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	22.96	26.03	10.91	0.79
Aluminium	K-series	11.35	12.87	13.07	0.55
Cobalt	K-series	7.86	8.92	4.15	0.26
Silicon	K-series	6.20	7.03	6.86	0.28
Tin	L-series	3.63	4.12	0.95	0.68
Calcium	K-series	1.22	1.38	0.94	0.79
Sulfur	K-series	0.93	1.05	0.90	0.06
Titanium	K-series	0.89	1.01	0.58	0.14
Chromium	K-series	0.82	0.93	0.49	0.05
Sodium	K-series	0.81	0.92	1.10	0.66
Chlorine	K-series	0.33	0.38	0.29	0.04
Barium	L-series	0.26	0.30	0.06	0.15
Potassium	K-series	0.22	0.25	0.17	0.05
Phosphorus	K-series	0.10	0.11	0.10	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	30.61	34.71	59.44	48.80
	Sum:	88.20	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	29.43	29.74	11.75	1.00
Aluminium	K-series	14.11	14.26	13.66	0.68
Cobalt	K-series	7.65	7.72	3.39	0.26
Sodium	K-series	6.37	6.44	7.24	5.04
Tin	L-series	1.15	1.17	0.25	0.32
Barium	L-series	0.93	0.94	0.18	0.18
Calcium	K-series	0.31	0.31	0.20	0.23
Sulfur	K-series	0.29	0.29	0.24	0.04
Chlorine	K-series	0.10	0.10	0.07	0.03
Phosphorus	K-series	0.02	0.02	0.02	0.03
Silicon	K-series	0.02	0.02	0.01	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	38.59	38.99	62.99	12.33
	Sum:	98.97	100.00	100.00	

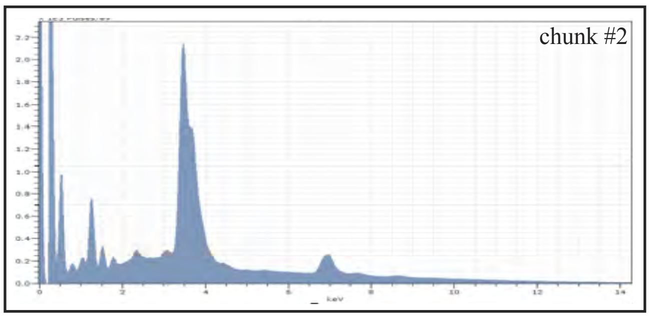




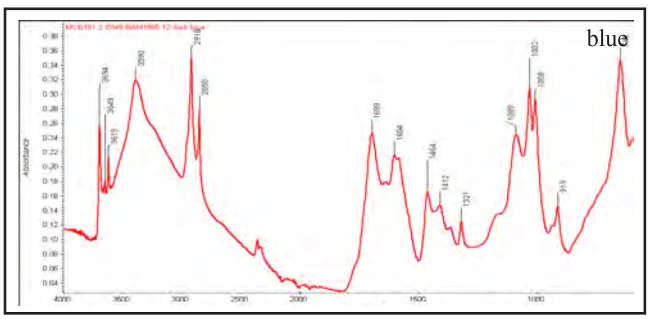
acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: dark greenish blue (seen in other ptgs)

sample location: right edge, 2.0" from top
(T 5.1 x R 0.0 cm.)

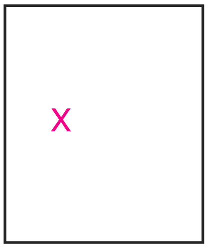
Representative Analysis Compilation—sample C049, continued

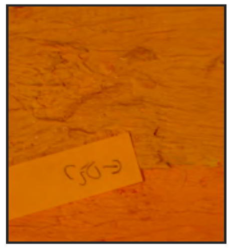


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Tin	L-series	44.69	40.67	14.97	2.18
Cobalt	K-series	17.58	16.00	11.87	0.55
Zinc	K-series	13.90	12.65	8.45	0.49
Magnesium	K-series	6.75	6.14	11.04	0.38
Calcium	K-series	3.18	2.89	3.15	2.14
Barium	L-series	2.27	2.07	0.66	0.40
Aluminium	K-series	1.50	1.36	2.20	0.10
Sodium	K-series	0.92	0.83	1.58	0.75
Sulfur	K-series	0.67	0.61	0.83	0.05
Silicon	K-series	0.50	0.45	0.70	0.05
Chlorine	K-series	0.04	0.04	0.05	0.03
Phosphorus	K-series	0.01	0.01	0.01	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	17.89	16.28	44.48	10.81
	Sum:	109.89	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

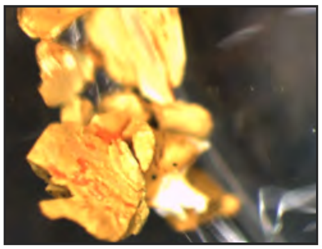


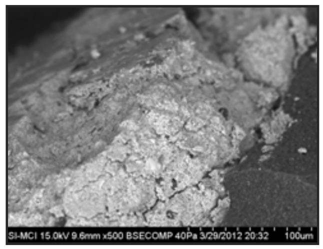


acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: two yellows

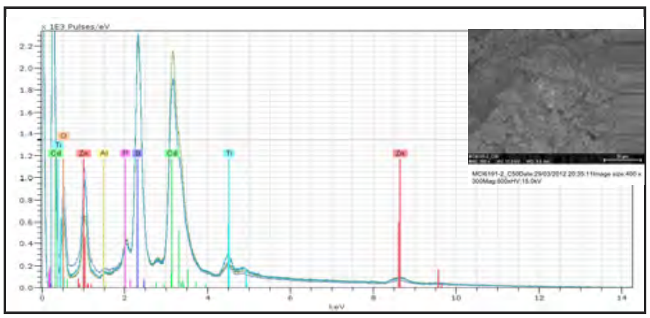
sample location: 38.0" from bottom, 14.0" from left
(B 96.5 x L 35.6 cm.)

Representative Analysis Compilation—sample C050

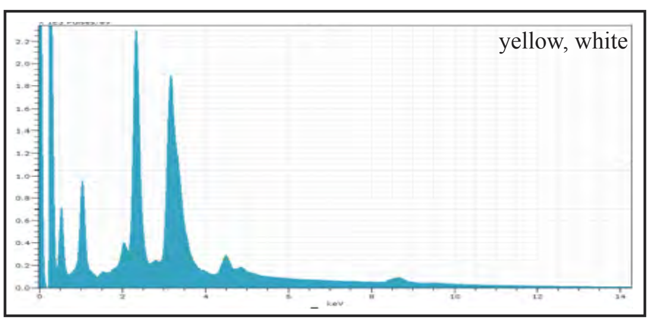




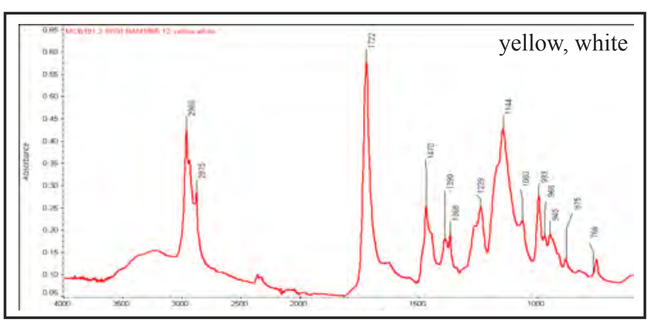
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



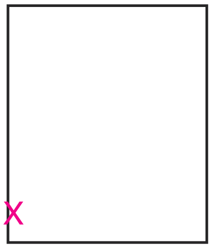
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
significant elements, white: Zn
interpretation: cadmium yellow, zinc yellow

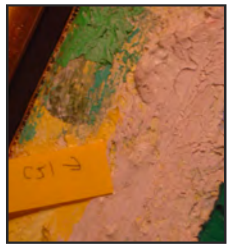


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	23.57	24.80	9.53	2.15
Zinc	K-series	21.70	22.84	15.09	0.75
Sulfur	K-series	15.47	16.28	21.94	0.57
Barium	L-series	10.62	11.18	3.52	0.72
Sodium	K-series	8.02	8.44	15.86	6.34
Potassium	K-series	4.56	4.80	5.31	0.74
Phosphorus	K-series	1.50	1.58	2.21	0.08
Magnesium	K-series	0.49	0.52	0.93	0.14
Aluminium	K-series	0.13	0.13	0.21	0.12
Silicon	K-series	0.02	0.03	0.04	0.03
Titanium	K-series	0.02	0.02	0.02	0.04
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	8.92	9.38	25.35	6.10
	Sum:	95.04	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

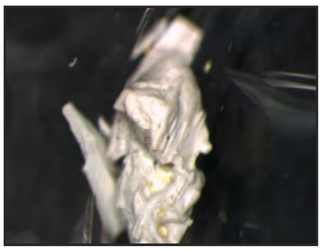


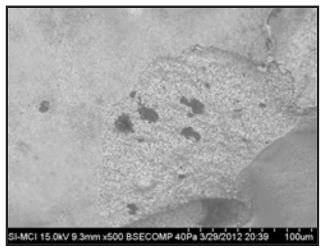


acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: compositional white

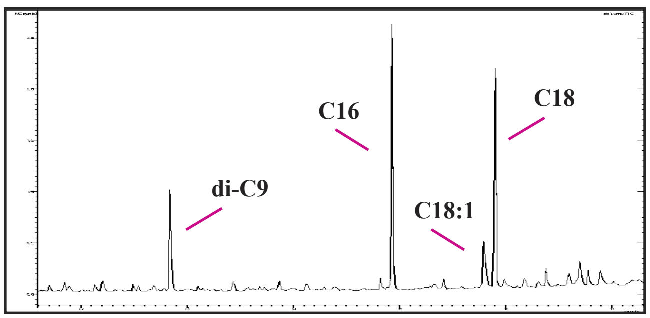
sample location: 5.5" from bottom, 1.0" from left (B 14.0 x L 2.5 cm.)

Representative Analysis Compilation—sample C051

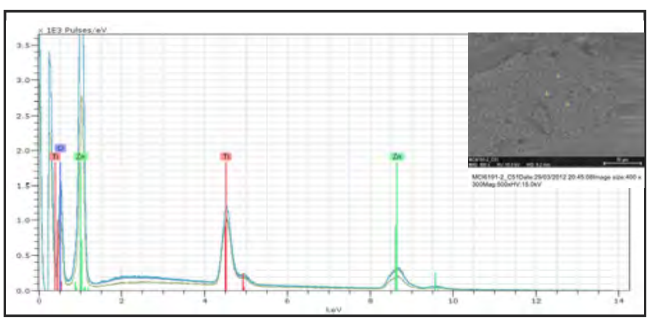




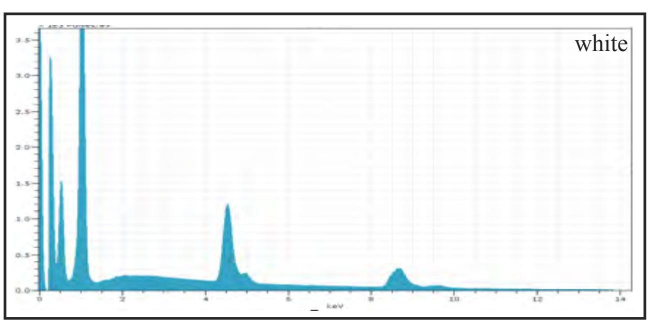
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.3 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.256
scan range: 1 - 1488
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white

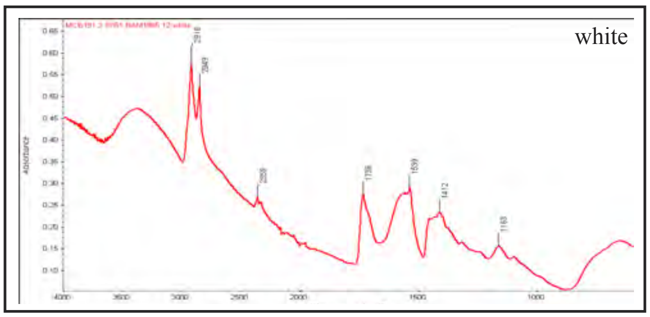


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	66.46	52.87	32.28	2.21
Sodium	K-series	22.25	17.70	30.73	17.54
Titanium	K-series	19.10	15.20	12.67	0.95
Barium	L-series	5.95	4.73	1.38	1.00
Chlorine	K-series	0.23	0.18	0.20	0.03
Potassium	K-series	0.21	0.17	0.17	0.03
Calcium	K-series	0.09	0.07	0.07	0.03
Phosphorus	K-series	0.09	0.07	0.09	0.03
Sulfur	K-series	0.04	0.04	0.04	0.03
Aluminium	K-series	0.02	0.02	0.03	0.03
Silicon	K-series	0.02	0.02	0.02	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	11.24	8.94	22.31	5.34
	Sum:	125.71	100.00	100.00	

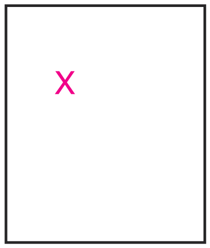
acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: compositional white

sample location: 5.5" from bottom, 1.0" from left (B 14.0 x L 2.5 cm.)

Representative Analysis Compilation—sample C051, continued



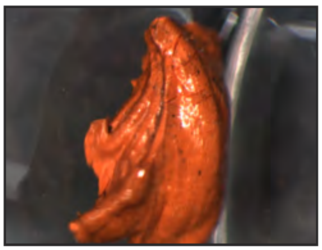
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

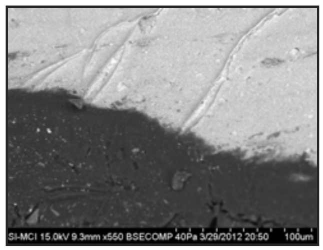


acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: lighter orange

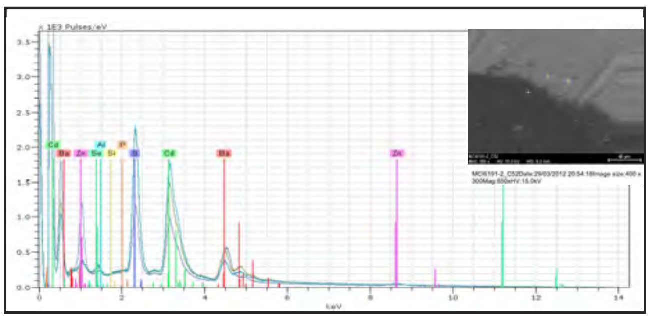
sample location: 45.0" from bottom, 17.0" from right
(B 114.3 x R 43.2 cm.)

Representative Analysis Compilation—sample C052

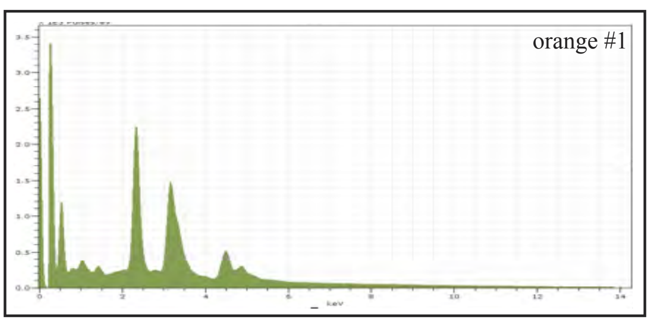




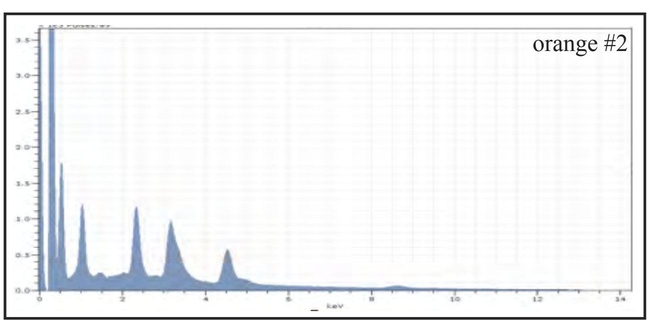
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.3 mm.



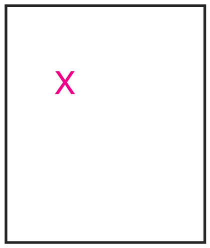
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.3 mm.
mag: 550x; HV: 15 kV
significant elements, orange #1: Cd, S, Se
significant elements, orange #2: Cd, S, Se
interpretation: cadmium orange



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	19.48	20.95	5.01	1.27
Cadmium	L-series	17.77	19.11	5.58	1.80
Sulfur	K-series	12.04	12.95	13.26	0.45
Zinc	K-series	7.76	8.35	4.19	0.29
Potassium	K-series	3.19	3.43	2.88	0.63
Selenium	L-series	0.81	0.88	0.36	0.09
Sodium	K-series	0.67	0.72	1.03	0.55
Titanium	K-series	0.59	0.63	0.43	0.32
Phosphorus	K-series	0.18	0.20	0.21	0.03
Aluminium	K-series	0.10	0.11	0.13	0.10
Silicon	K-series	0.10	0.11	0.12	0.03
Magnesium	K-series	0.05	0.05	0.07	0.06
Calcium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	30.24	32.53	66.73	18.10
	Sum:	92.98	100.00	100.00	



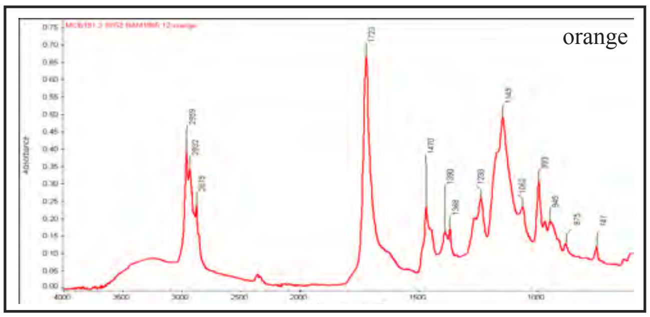
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	19.68	20.20	5.86	2.06
Zinc	K-series	12.96	13.31	6.63	0.46
Barium	L-series	10.70	10.99	2.61	1.00
Titanium	K-series	8.89	9.13	6.21	0.88
Sulfur	K-series	7.76	7.97	8.10	0.30
Sodium	K-series	3.77	3.87	5.48	2.99
Potassium	K-series	2.11	2.16	1.80	0.81
Selenium	L-series	0.44	0.45	0.19	0.06
Calcium	K-series	0.44	0.45	0.37	0.13
Phosphorus	K-series	0.43	0.44	0.46	0.04
Chlorine	K-series	0.41	0.43	0.39	0.05
Magnesium	K-series	0.24	0.25	0.34	0.09
Aluminium	K-series	0.24	0.25	0.30	0.21
Silicon	K-series	0.03	0.04	0.04	0.03
Oxygen	K-series	29.29	30.07	61.23	13.91
	Sum:	97.40	100.00	100.00	



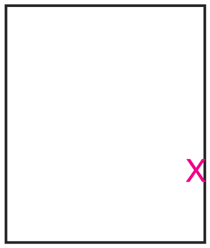
acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: lighter orange

sample location: 45.0" from bottom, 17.0" from right
(B 114.3 x R 43.2 cm.)

Representative Analysis Compilation—sample C052, continued



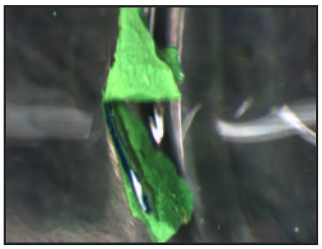
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

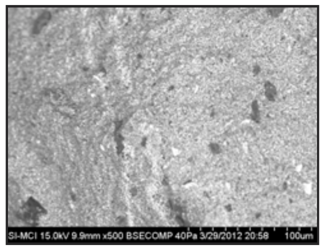


acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: bright green

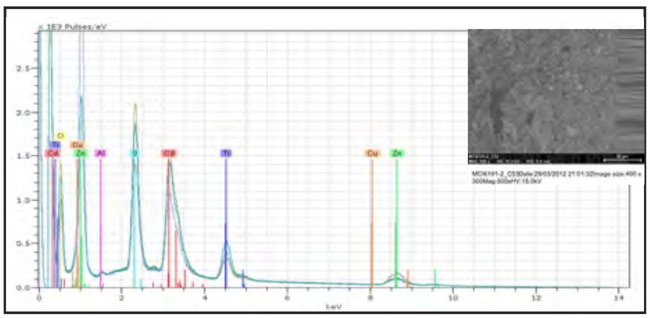
sample location: 22.5" from bottom, 2.5" from right
(B 57.2 x R 6.4 cm.)

Representative Analysis Compilation—sample C053

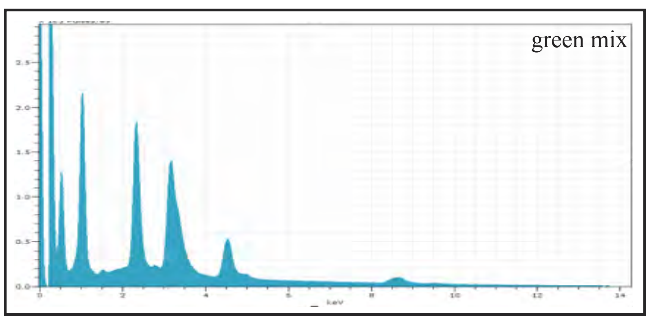




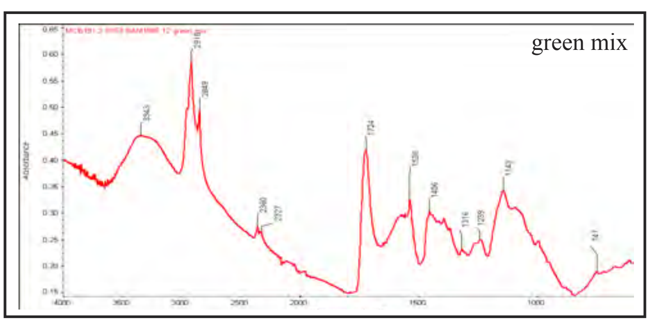
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



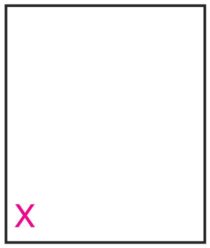
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, green: Zn, Cd, S, Na
interpretation: cadmium green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	23.21	24.03	12.50	0.80
Cadmium	L-series	17.44	18.06	5.46	1.76
Sulfur	K-series	9.81	10.15	10.77	0.37
Sodium	K-series	8.08	8.36	12.37	6.38
Titanium	K-series	7.87	8.14	5.78	0.65
Barium	L-series	4.43	4.59	1.14	0.66
Potassium	K-series	3.02	3.13	2.72	0.63
Magnesium	K-series	0.61	0.63	0.88	0.14
Aluminium	K-series	0.29	0.30	0.38	0.25
Phosphorus	K-series	0.05	0.05	0.06	0.03
Silicon	K-series	0.02	0.02	0.02	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	21.78	22.55	47.93	11.84
	Sum:	96.61	100.00	100.00	



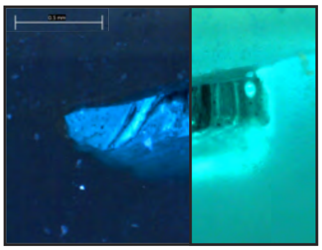
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard
for F10/B67/72 varnish

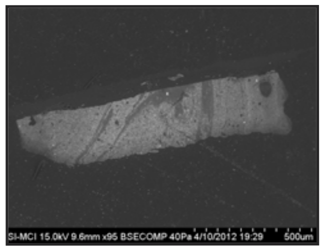


acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: dark teal, likely varnish

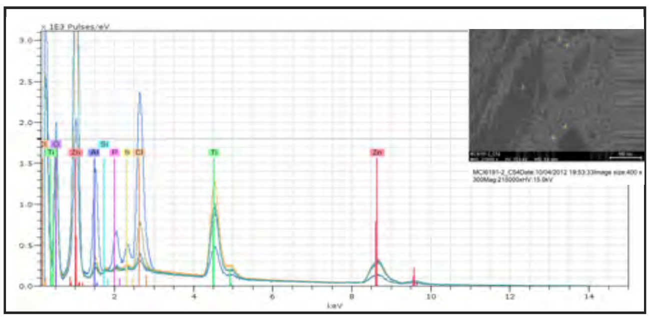
sample location: 6.0" from bottom, 3.3" from left
(B 15.2 x L 8.4 cm.)

Representative Analysis Compilation—sample C054

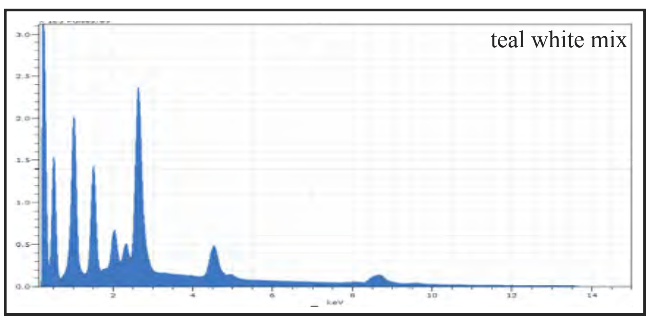




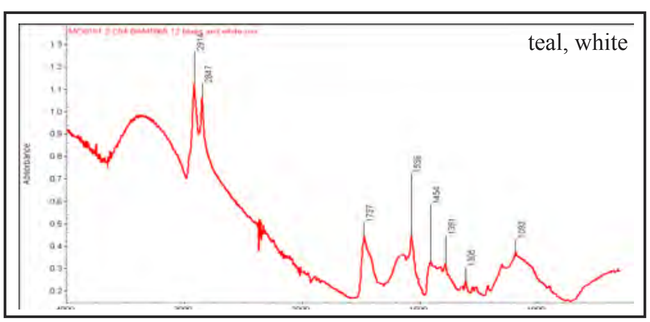
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.6 mm.



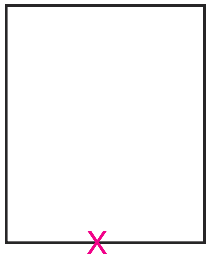
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.6 mm.
mag: 215x; HV: 15 kV
significant elements, teal: Cl, Cu, Na
significant elements, white: Zn, Ti
interpretation: phthalo green, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	21.03	27.36	15.52	0.72
Chlorine	K-series	18.81	24.48	25.62	0.65
Sodium	K-series	11.33	14.74	23.80	8.94
Aluminium	K-series	9.15	11.91	16.38	0.45
Titanium	K-series	6.09	7.92	6.14	0.42
Phosphorus	K-series	3.76	4.89	5.86	0.17
Copper	K-series	2.28	2.96	1.73	0.10
Sulfur	K-series	2.24	2.91	3.37	0.11
Barium	L-series	1.35	1.76	0.48	0.52
Potassium	K-series	0.45	0.59	0.56	0.04
Silicon	K-series	0.21	0.27	0.36	0.03
Calcium	K-series	0.16	0.20	0.19	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	76.86	100.00	100.00	



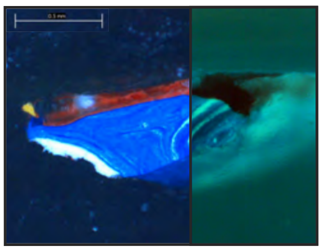
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

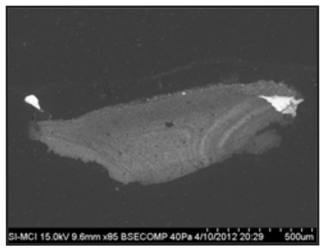


acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: deep orange, likely consolidant

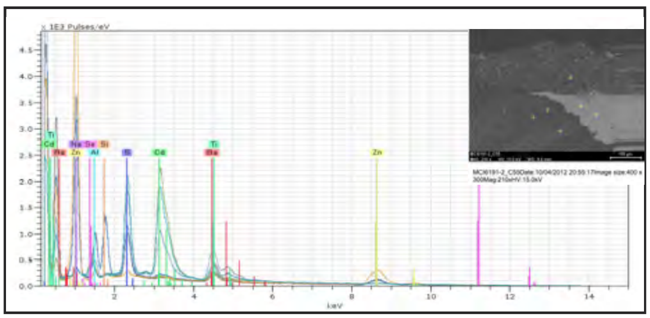
sample location: bottom edge, 27.0" from right
(B 0.0 x R 68.6 cm.)

Representative Analysis Compilation—sample C055

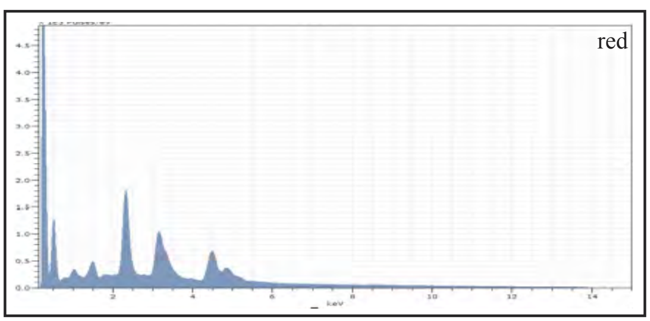




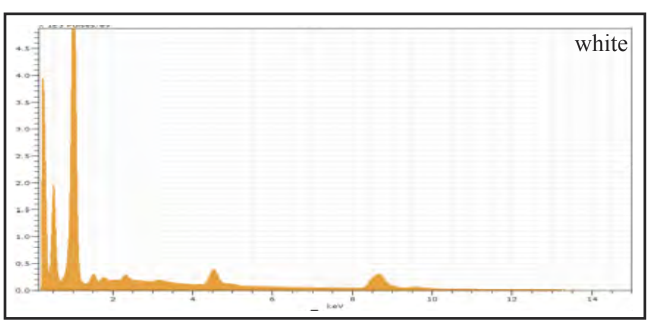
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.6 mm.



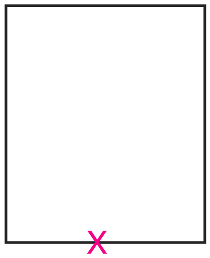
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.6 mm.
mag: 210x; HV: 15 kV
significant elements, red: Cd, S
(Se peaks in other spectra of this red)
significant elements, white: Zn, Ti
significant elements, blue: Na
interpretation: cadmium red, Zn/Ti white,
ultramarine blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	24.78	38.05	16.73	1.63
Cadmium	L-series	12.06	18.51	9.94	1.57
Sulfur	K-series	11.91	18.29	34.44	0.45
Zinc	K-series	5.49	8.44	7.79	0.22
Titanium	K-series	3.09	4.74	5.98	0.52
Aluminium	K-series	2.75	4.21	9.43	1.60
Potassium	K-series	2.49	3.83	5.92	0.53
Sodium	K-series	1.89	2.90	7.62	1.51
Silicon	K-series	0.32	0.50	1.07	0.04
Phosphorus	K-series	0.19	0.29	0.56	0.03
Magnesium	K-series	0.09	0.13	0.33	0.06
Chlorine	K-series	0.07	0.11	0.18	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	65.13	100.00	100.00	



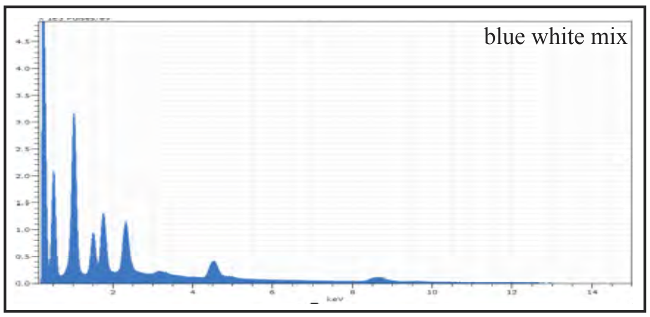
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	67.24	60.95	38.49	2.24
Sodium	K-series	32.20	29.19	52.43	25.37
Titanium	K-series	5.74	5.20	4.49	0.43
Aluminium	K-series	1.27	1.15	1.76	0.99
Barium	L-series	1.03	0.93	0.28	0.53
Cadmium	L-series	0.98	0.89	0.33	0.26
Sulfur	K-series	0.90	0.81	1.05	0.06
Silicon	K-series	0.58	0.52	0.77	0.05
Chlorine	K-series	0.22	0.20	0.23	0.03
Phosphorus	K-series	0.09	0.08	0.11	0.03
Potassium	K-series	0.06	0.06	0.06	0.07
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	110.32	100.00	100.00	



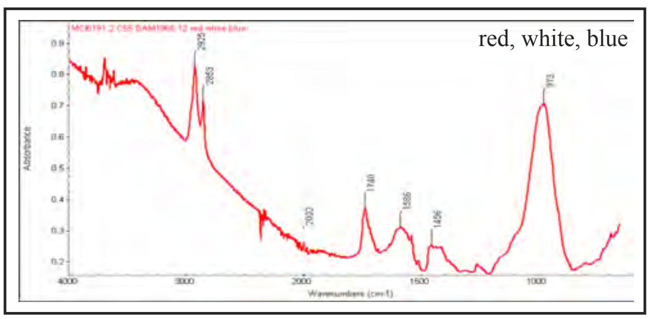
acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: deep orange, likely consolidant

sample location: bottom edge, 27.0" from right
(B 0.0 x R 68.6 cm.)

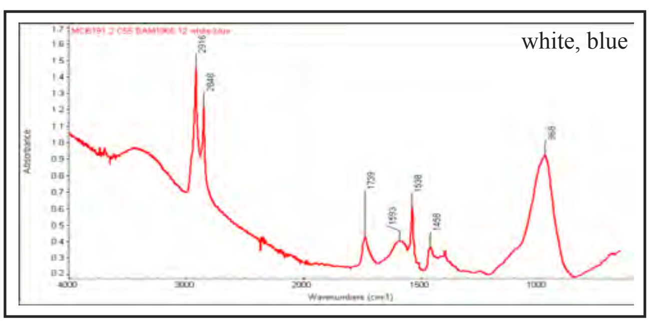
Representative Analysis Compilation—sample C055, continued



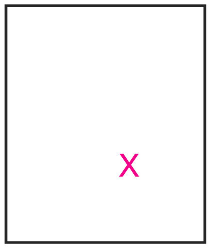
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Sodium	K-series	20.58	28.58	42.74	16.22
Zinc	K-series	20.26	28.14	14.79	0.70
Silicon	K-series	8.42	11.69	14.30	0.38
Sulfur	K-series	6.91	9.60	10.29	0.27
Titanium	K-series	5.67	7.88	5.66	0.48
Aluminium	K-series	5.11	7.10	9.04	2.08
Barium	L-series	2.46	3.41	0.85	0.50
Cadmium	L-series	1.31	1.82	0.56	0.35
Chlorine	K-series	0.46	0.64	0.62	0.04
Potassium	K-series	0.33	0.46	0.41	0.19
Phosphorus	K-series	0.26	0.36	0.40	0.04
Calcium	K-series	0.14	0.20	0.17	0.05
Magnesium	K-series	0.09	0.13	0.18	0.06
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	72.01	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: fillers



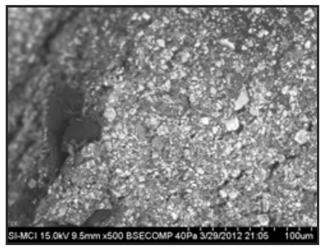
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: fillers



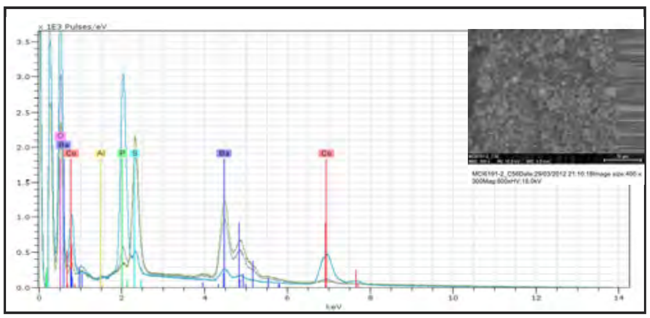
acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: purple

sample location: 28.5" from bottom, 18.0" from right
(B 72.4 x R 45.7 cm.)

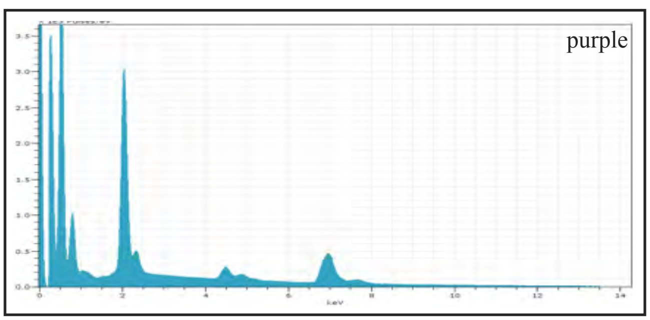
Representative Analysis Compilation—sample C056



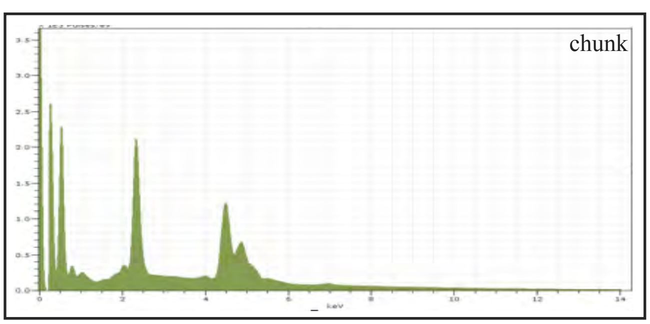
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



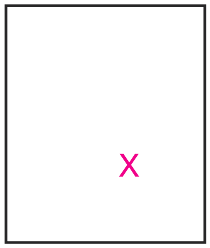
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Co, P
interpretation: cobalt violet



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	30.55	34.37	16.90	0.94
Phosphorus	K-series	18.36	20.66	19.32	0.72
Barium	L-series	5.45	6.13	1.29	0.39
Sulfur	K-series	2.33	2.63	2.37	0.11
Zinc	K-series	2.12	2.38	1.06	0.10
Sodium	K-series	1.36	1.53	1.92	1.09
Titanium	K-series	0.67	0.76	0.46	0.19
Magnesium	K-series	0.57	0.64	0.76	0.06
Aluminium	K-series	0.03	0.03	0.04	0.03
Silicon	K-series	0.02	0.02	0.02	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	27.43	30.86	55.87	8.93
	Sum:	88.88	100.00	100.00	



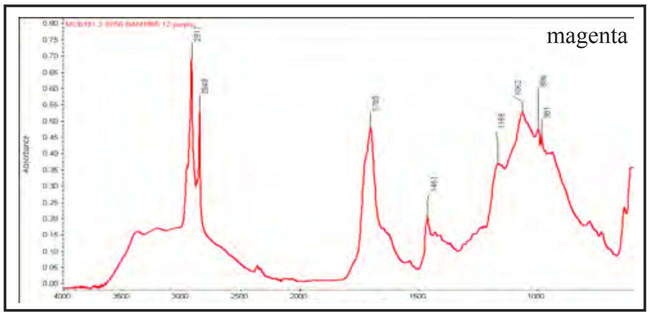
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	43.72	41.06	10.56	2.62
Sulfur	K-series	16.09	15.11	16.64	0.59
Zinc	K-series	6.79	6.37	3.44	0.26
Cobalt	K-series	3.79	3.56	2.13	0.14
Titanium	K-series	2.10	1.98	1.46	0.60
Phosphorus	K-series	1.66	1.56	1.77	0.09
Sodium	K-series	1.34	1.26	1.94	1.08
Chlorine	K-series	0.98	0.92	0.92	0.06
Magnesium	K-series	0.51	0.48	0.70	0.06
Silicon	K-series	0.45	0.42	0.53	0.04
Potassium	K-series	0.23	0.22	0.19	0.03
Aluminium	K-series	0.03	0.03	0.04	0.03
Calcium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	28.79	27.03	59.67	11.57
	Sum:	106.49	100.00	100.00	

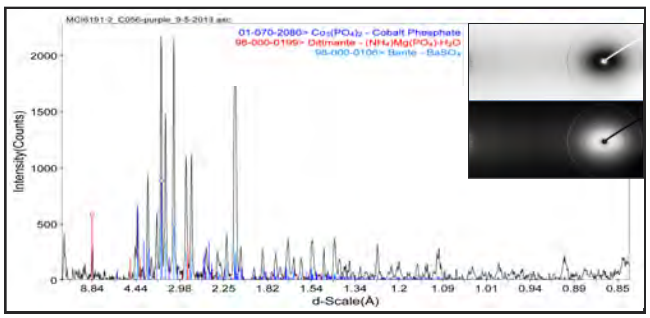

acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: magenta

sample location: 28.5" from bottom, 18.0" from right
(B 72.4 x R 45.7 cm.)

Representative Analysis Compilation—sample C056, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

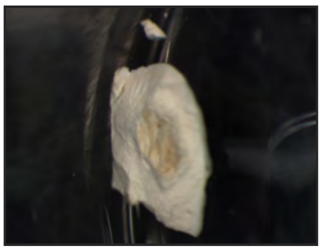
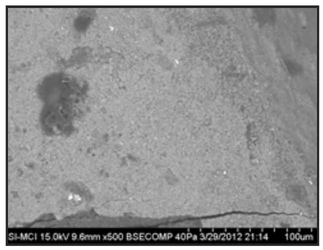


analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, spin 360º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cobalt phosphate, dittmarite, barite
interpretation: cobalt violet

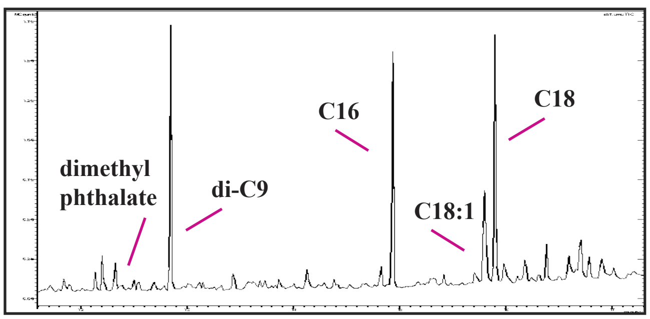

acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: possible ground layer

sample location: left edge, 0.5" from top
(T 1.3 x L 0.0 cm.)

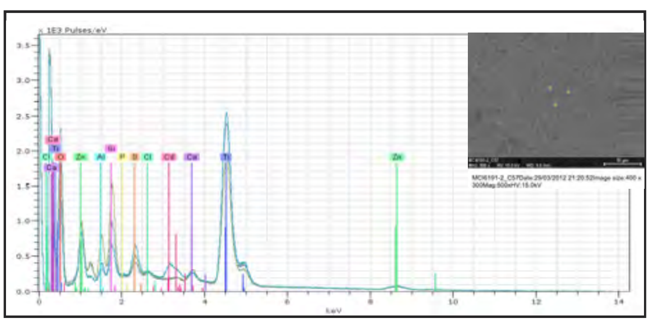
Representative Analysis Compilation—sample C057

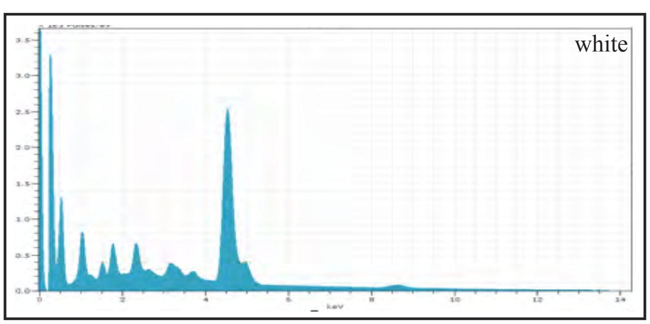
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.275
scan range: 1 - 1484
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: small amount of alkyd ground; mostly upper layer of oil paint



analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, white: Ti, Zn
interpretation: Ti/Zn white

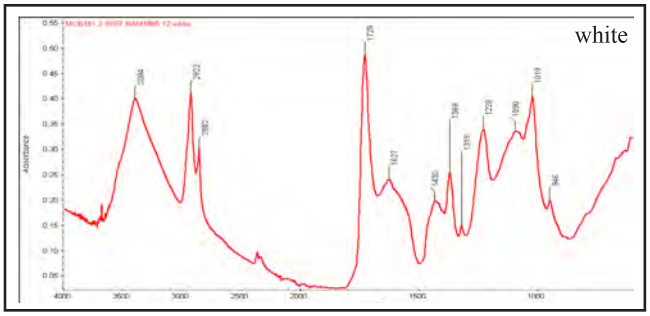


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	34.14	42.89	25.66	1.19
Zinc	K-series	8.19	10.29	4.51	0.30
Sodium	K-series	3.04	3.82	4.76	2.42
Cadmium	L-series	2.40	3.02	0.77	0.61
Sulfur	K-series	2.09	2.62	2.34	0.10
Silicon	K-series	1.79	2.25	2.29	0.10
Calcium	K-series	0.67	0.84	0.60	0.07
Potassium	K-series	0.58	0.72	0.53	0.21
Chlorine	K-series	0.53	0.67	0.54	0.04
Aluminium	K-series	0.52	0.65	0.69	0.42
Barium	L-series	0.19	0.24	0.05	0.13
Magnesium	K-series	0.04	0.05	0.06	0.04
Phosphorus	K-series	0.00	0.01	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.42	31.94	57.20	13.17
	Sum:	79.59	100.00	100.00	

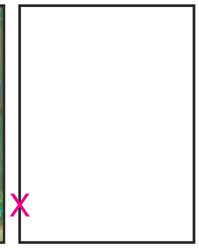
acc. no.: BAM 1965.12
title, year: *Equinox*, 1958
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (127.0 x 101.6 cm.)
notes: possible ground layer

sample location: left edge, 0.5" from top
(T 1.3 x L 0.0 cm.)

Representative Analysis Compilation—sample C057, continued



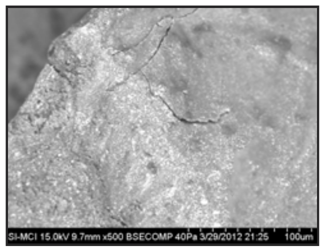
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish; consistent with IRUG standard for AYAA and Mowilith DM912PVAc inpainting media; upper layer white may not be original

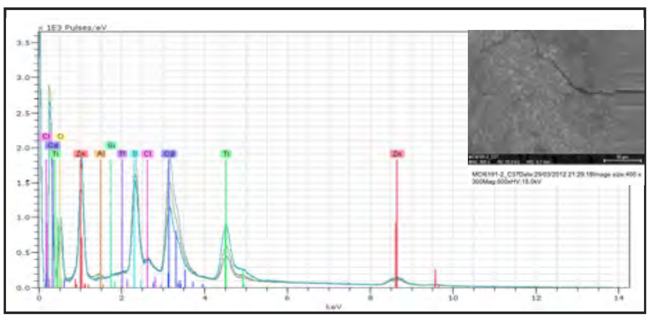

acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: orange

sample location: left edge, 8.0" from bottom
(B 20.3 x L 0.0 cm.)

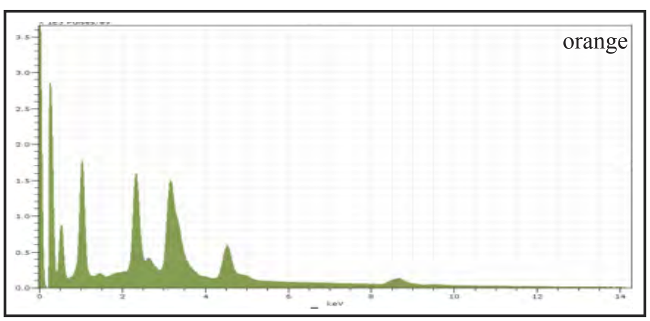
Representative Analysis Compilation—sample C037

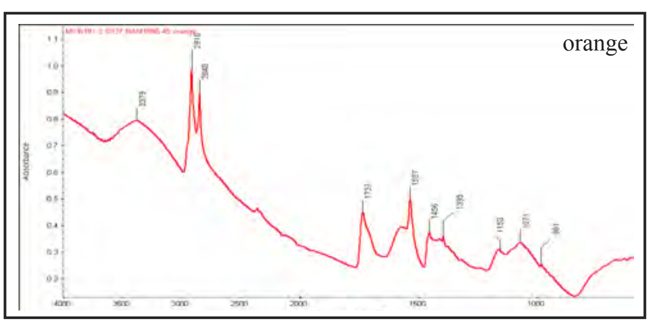
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



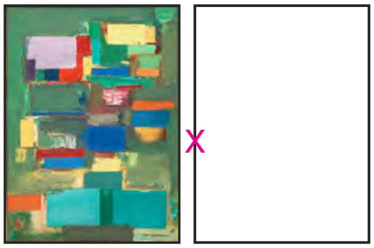
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
interpretation: cadmium orange



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	26.35	28.52	16.88	0.90
Cadmium	L-series	17.06	18.46	6.36	1.67
Sulfur	K-series	8.27	8.95	10.80	0.32
Sodium	K-series	7.85	8.49	14.30	6.20
Titanium	K-series	7.01	7.59	6.13	0.64
Barium	L-series	6.33	6.86	1.93	0.71
Potassium	K-series	2.92	3.16	3.13	0.60
Chlorine	K-series	0.99	1.07	1.17	0.06
Selenium	L-series	0.52	0.56	0.27	0.07
Phosphorus	K-series	0.12	0.13	0.17	0.03
Aluminium	K-series	0.11	0.12	0.17	0.11
Calcium	K-series	0.09	0.09	0.09	0.08
Silicon	K-series	0.07	0.08	0.11	0.03
Magnesium	K-series	0.00	0.00	0.01	0.03
Oxygen	K-series	14.70	15.91	38.48	9.18
	Sum:	92.38	100.00	100.00	



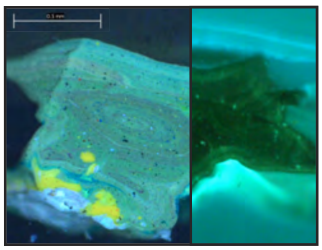
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

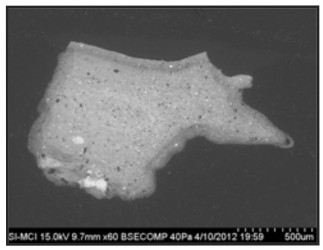


acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: blue green

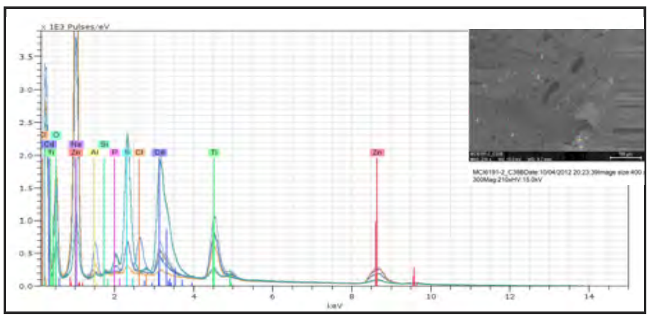
sample location: left edge, 23.5" from bottom
(B 59.7 x L 0.0 cm.)

Representative Analysis Compilation—sample C038

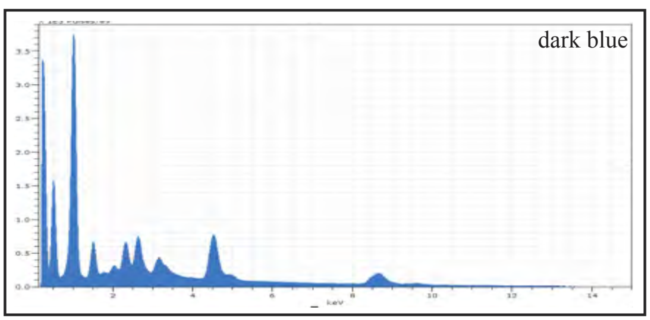




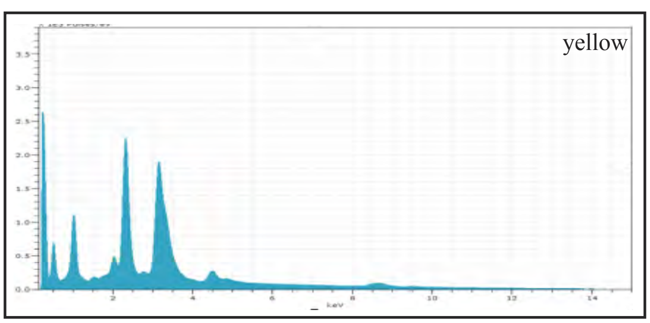
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na
significant elements, green: Zn, Cd, S, Na
significant elements, yellow: Cd, S
interpretation: ultramarine blue, cadmium green, cadmium yellow



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	35.96	41.39	24.29	1.21
Sodium	K-series	26.21	30.17	50.35	20.65
Titanium	K-series	11.52	13.26	10.63	0.60
Aluminium	K-series	3.50	4.02	5.72	0.19
Chlorine	K-series	2.67	3.07	3.32	0.11
Cadmium	L-series	2.21	2.54	0.87	0.56
Sulfur	K-series	2.12	2.44	2.93	0.10
Barium	L-series	1.64	1.89	0.53	0.81
Potassium	K-series	0.52	0.60	0.59	0.21
Phosphorus	K-series	0.47	0.54	0.66	0.04
Silicon	K-series	0.07	0.08	0.10	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	86.89	100.00	100.00	

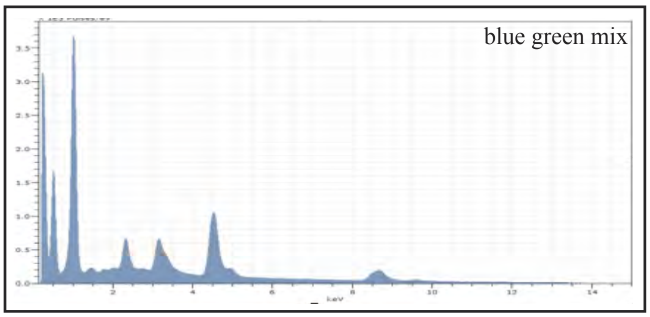


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	21.87	24.98	9.40	2.12
Zinc	K-series	20.66	23.60	15.27	0.71
Sulfur	K-series	12.41	14.17	18.70	0.46
Barium	L-series	8.61	9.84	3.03	0.61
Sodium	K-series	7.08	8.09	14.88	5.60
Potassium	K-series	5.05	5.77	6.24	0.71
Phosphorus	K-series	1.53	1.75	2.38	0.08
Titanium	K-series	0.38	0.44	0.39	0.22
Aluminium	K-series	0.19	0.21	0.33	0.17
Magnesium	K-series	0.05	0.05	0.09	0.05
Silicon	K-series	0.01	0.01	0.02	0.03
Calcium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	9.69	11.07	29.26	6.89
	Sum:	87.53	100.00	100.00	

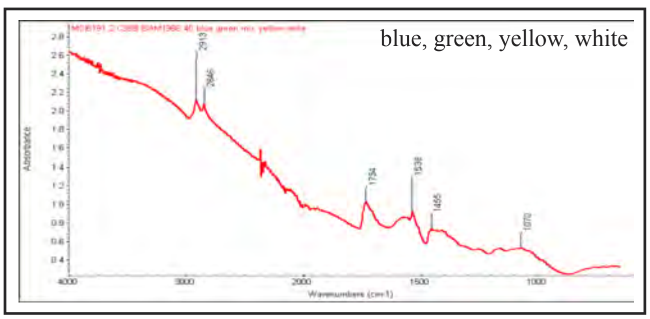
acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: blue green

sample location: left edge, 23.5" from bottom (B 59.7 x L 0.0 cm.)

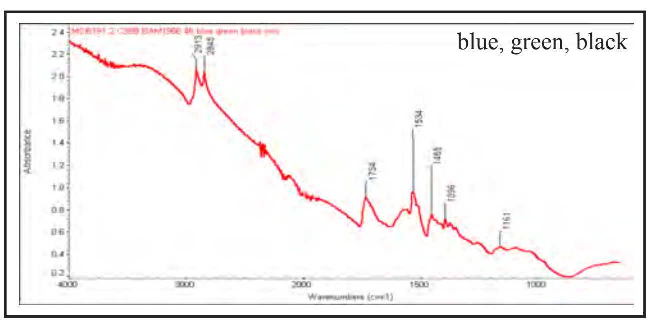
Representative Analysis Compilation—sample C038, continued



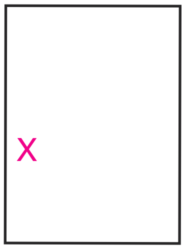
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	54.08	48.94	31.76	1.81
Sodium	K-series	28.23	25.55	47.17	22.25
Titanium	K-series	12.29	11.12	9.86	0.72
Cadmium	L-series	5.22	4.72	1.78	0.98
Barium	L-series	3.79	3.43	1.06	0.78
Sulfur	K-series	3.55	3.21	4.26	0.15
Potassium	K-series	1.07	0.97	1.05	0.34
Aluminium	K-series	0.76	0.69	1.09	0.61
Silicon	K-series	0.76	0.69	1.04	0.06
Phosphorus	K-series	0.42	0.38	0.52	0.04
Chlorine	K-series	0.22	0.20	0.24	0.04
Magnesium	K-series	0.11	0.10	0.17	0.09
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	110.50	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



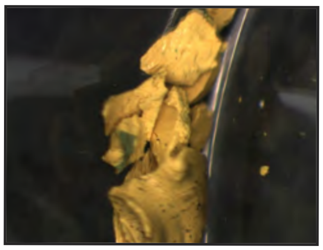
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

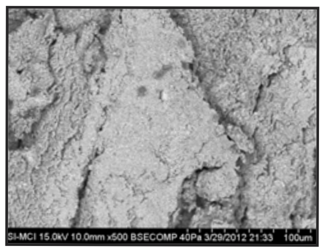


acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: lemon yellow

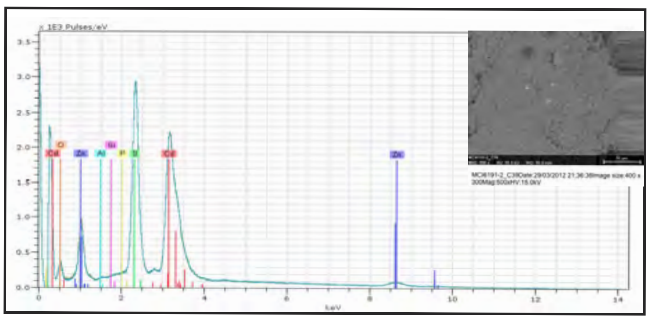
sample location: 22.5" from bottom, 6.0" from left
(B 57.2 x L 15.2 cm.)

Representative Analysis Compilation—sample C039

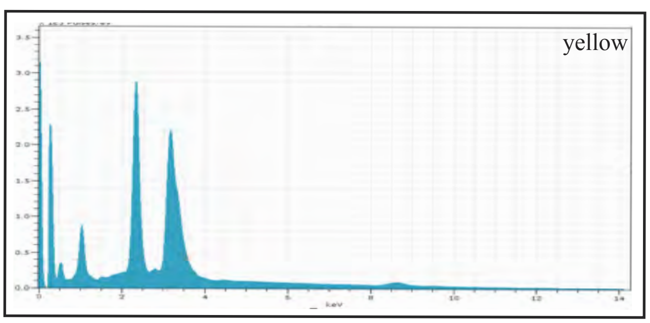




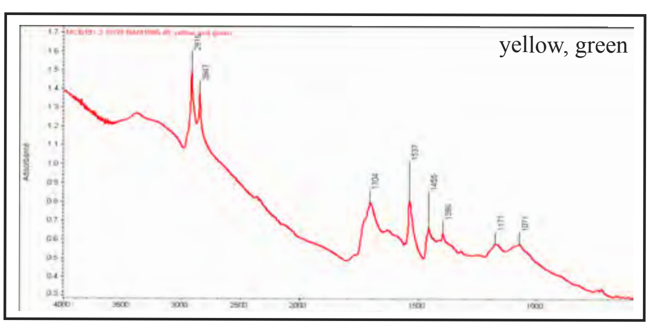
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



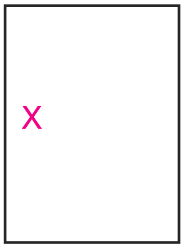
analysis: EDS
by: DVR (MCI)
date: 03/29/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
interpretation: cadmium yellow



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	31.74	36.84	14.17	2.56
Sulfur	K-series	17.42	20.22	27.27	0.64
Zinc	K-series	16.60	19.26	12.74	0.58
Sodium	K-series	5.84	6.78	12.75	4.62
Potassium	K-series	5.22	6.06	6.70	0.88
Barium	L-series	0.64	0.74	0.23	0.09
Magnesium	K-series	0.54	0.63	1.12	0.14
Phosphorus	K-series	0.15	0.17	0.24	0.03
Aluminium	K-series	0.14	0.16	0.26	0.13
Silicon	K-series	0.11	0.13	0.20	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	7.75	9.00	24.32	7.60
	Sum:	86.15	100.00	100.00	



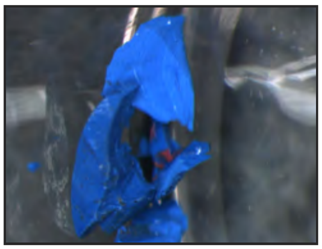
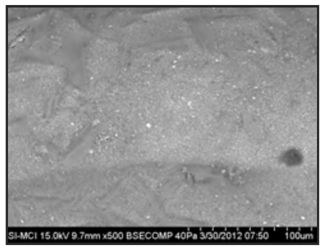
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

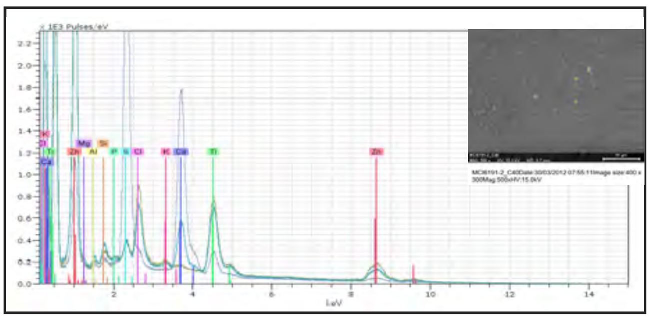
acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: medium blue

sample location: 25.0" from top, 6.5" from left
(T 63.5 x L 16.5 cm.)

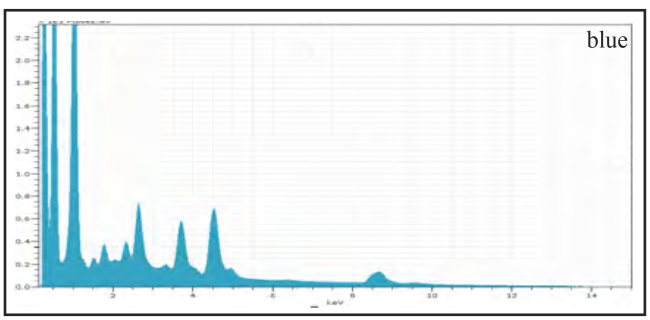
Representative Analysis Compilation—sample C040

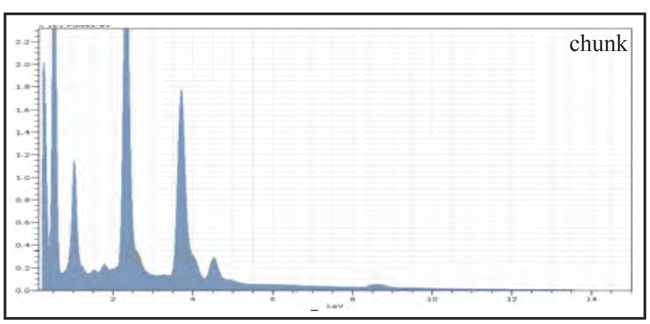
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



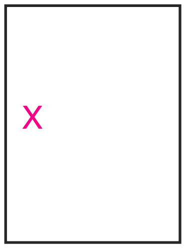
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Cl
interpretation: phthalo blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	21.29	25.40	9.47	0.73
Titanium	K-series	9.55	11.40	5.80	0.47
Calcium	K-series	4.32	5.16	3.14	0.16
Chlorine	K-series	3.59	4.28	2.94	0.14
Sulfur	K-series	0.99	1.18	0.89	0.06
Silicon	K-series	0.72	0.86	0.74	0.06
Iron	K-series	0.44	0.53	0.23	0.04
Potassium	K-series	0.43	0.51	0.32	0.06
Phosphorus	K-series	0.21	0.25	0.20	0.03
Barium	L-series	0.19	0.23	0.04	0.12
Magnesium	K-series	0.19	0.22	0.23	0.04
Aluminium	K-series	0.15	0.18	0.16	0.03
Oxygen	K-series	41.73	49.80	75.84	14.83
	Sum:	83.80	100.00	100.00	



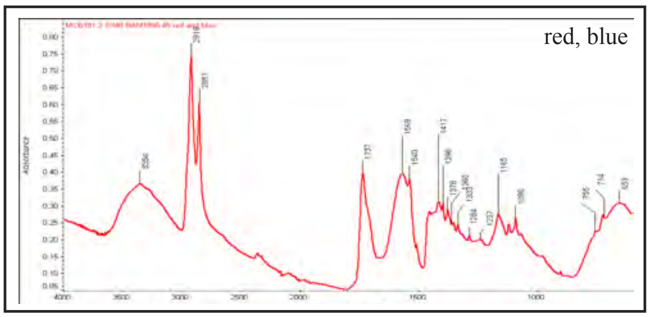
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	20.13	19.33	11.65	0.62
Sulfur	K-series	18.29	17.56	13.23	0.67
Zinc	K-series	9.48	9.10	3.36	0.35
Titanium	K-series	3.98	3.82	1.93	0.38
Sodium	K-series	3.19	3.07	3.22	2.54
Chlorine	K-series	1.61	1.55	1.06	0.08
Barium	L-series	1.53	1.47	0.26	0.42
Iron	K-series	0.68	0.65	0.28	0.05
Silicon	K-series	0.33	0.31	0.27	0.04
Magnesium	K-series	0.27	0.26	0.26	0.04
Potassium	K-series	0.19	0.18	0.11	0.04
Phosphorus	K-series	0.10	0.10	0.08	0.03
Aluminium	K-series	0.05	0.05	0.05	0.03
Oxygen	K-series	44.32	42.55	64.25	15.58
	Sum:	104.15	100.00	100.00	

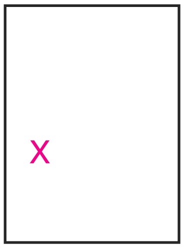
acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: medium blue

sample location: 25.0" from top, 6.5" from left
(T 63.5 x L 16.5 cm.)

Representative Analysis Compilation—sample C040, continued



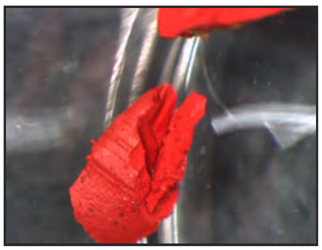
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PB15

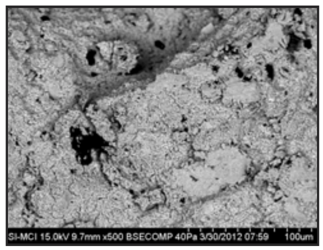


acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: red

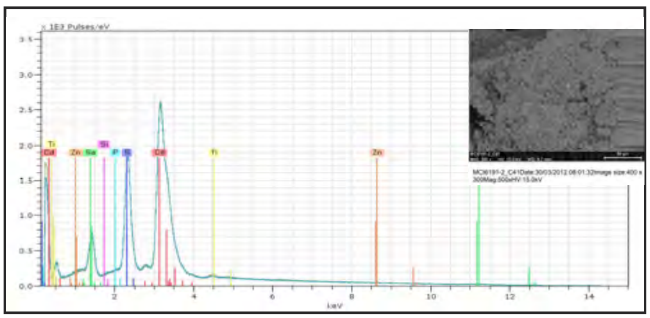
sample location: 21.5" from bottom, 7.5" from left (B 54.6 x L 19.1 cm.)

Representative Analysis Compilation—sample C041

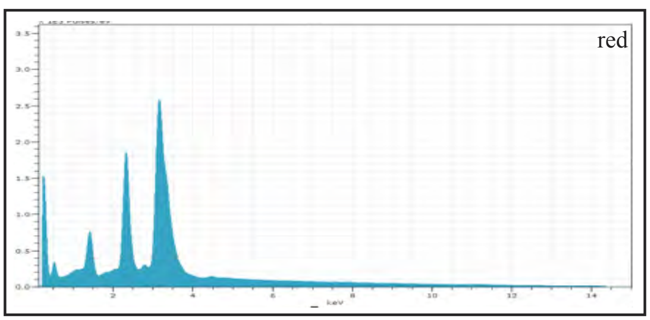




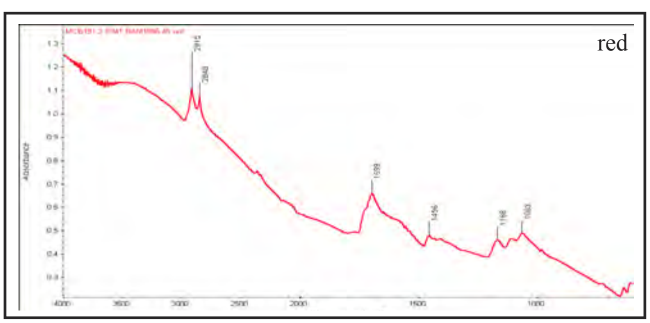
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



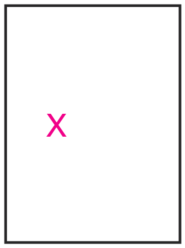
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	55.82	54.17	24.96	3.89
Sulfur	K-series	15.19	14.74	23.82	0.56
Zinc	K-series	7.14	6.93	5.49	0.27
Potassium	K-series	6.71	6.51	8.63	1.30
Selenium	L-series	4.90	4.75	3.12	0.30
Barium	L-series	2.04	1.98	0.75	0.19
Chlorine	K-series	0.55	0.53	0.78	0.06
Phosphorus	K-series	0.52	0.50	0.84	0.05
Calcium	K-series	0.11	0.11	0.14	0.10
Sodium	K-series	0.10	0.09	0.21	0.10
Silicon	K-series	0.06	0.06	0.10	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	9.92	9.63	31.17	9.96
	Sum:	103.05	100.00	100.00	



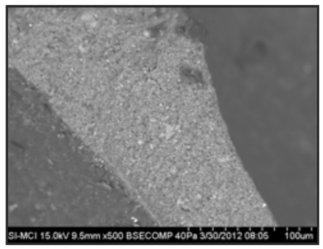
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



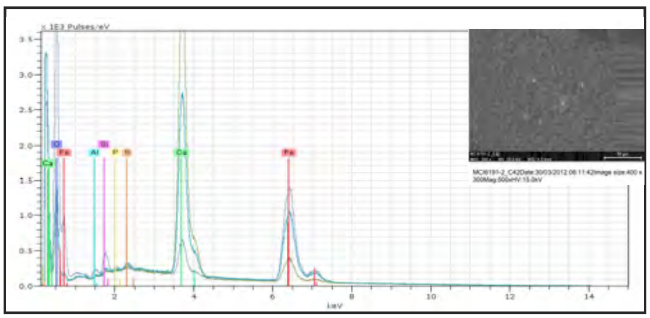
acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: ochre

sample location: 26.0" from top, 15.0" from left
(T 66.0 x L 38.1 cm.)

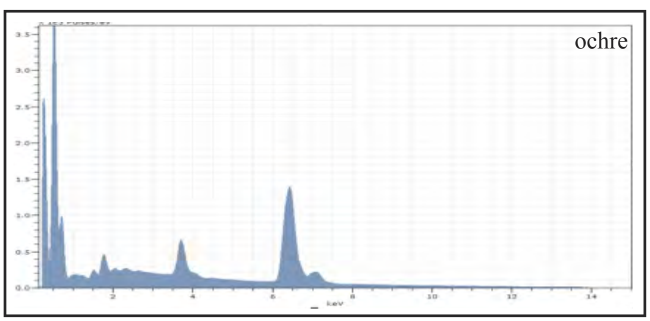
Representative Analysis Compilation—sample C042



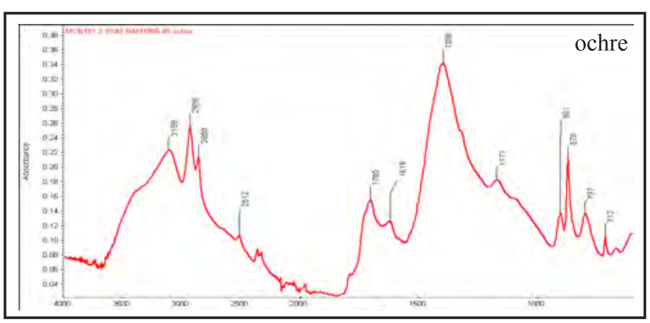
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



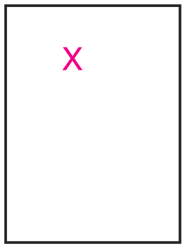
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, ochre: Fe
interpretation: yellow ochre



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Iron	K-series	61.15	64.17	39.43	1.81
Calcium	K-series	3.90	4.10	3.51	0.14
Zinc	K-series	2.97	3.12	1.64	0.13
Silicon	K-series	1.99	2.09	2.56	0.11
Sodium	K-series	0.84	0.88	1.32	0.69
Phosphorus	K-series	0.69	0.72	0.80	0.05
Sulfur	K-series	0.64	0.67	0.71	0.05
Chlorine	K-series	0.54	0.57	0.55	0.04
Aluminium	K-series	0.47	0.49	0.62	0.38
Magnesium	K-series	0.41	0.43	0.61	0.11
Barium	L-series	0.24	0.25	0.06	0.06
Potassium	K-series	0.07	0.07	0.07	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	21.38	22.44	48.13	7.21
	Sum:	95.30	100.00	100.00	



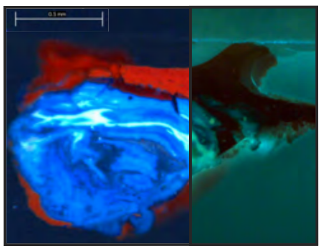
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

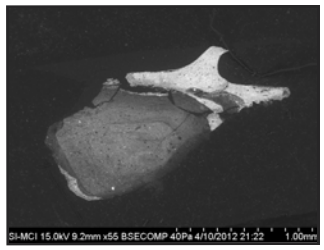


acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: orange red

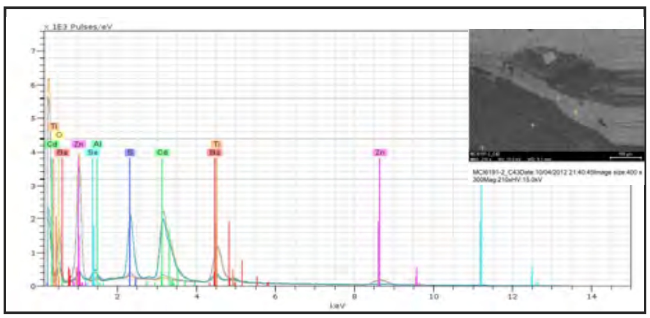
sample location: 15.0" from top, 17.0" from left
(T 38.1 x L 43.2 cm.)

Representative Analysis Compilation—sample C043

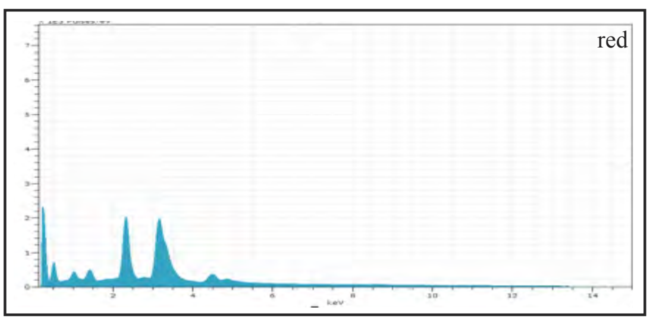




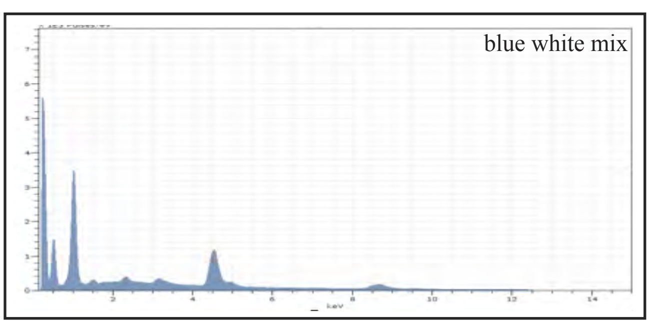
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.2 mm.



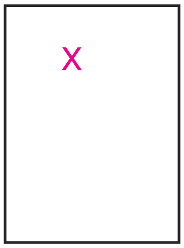
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.1 mm.
mag: 210x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, blue: Na
significant elements, white: Zn, Ti
interpretation: cadmium red, ultramarine blue, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	21.54	26.82	9.98	2.12
Sulfur	K-series	11.54	14.36	18.73	0.43
Barium	L-series	11.16	13.90	4.23	0.76
Zinc	K-series	11.11	13.83	8.84	0.40
Potassium	K-series	5.37	6.68	7.15	0.69
Selenium	L-series	3.14	3.90	2.07	0.23
Sodium	K-series	1.89	2.35	4.27	1.51
Aluminium	K-series	0.65	0.81	1.25	0.52
Titanium	K-series	0.60	0.75	0.66	0.27
Phosphorus	K-series	0.19	0.24	0.32	0.03
Silicon	K-series	0.16	0.20	0.30	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	12.97	16.15	42.21	9.02
	Sum:	80.32	100.00	100.00	



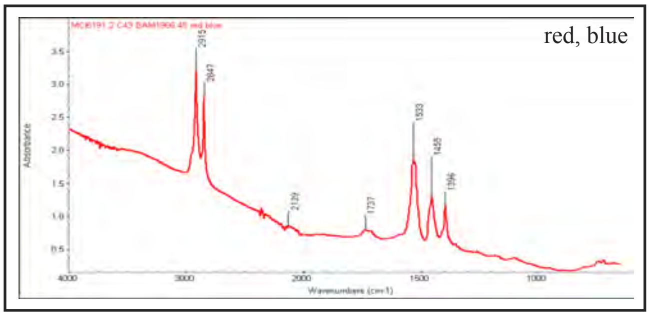
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	26.65	34.88	21.65	0.91
Sodium	K-series	19.53	25.57	45.13	15.40
Titanium	K-series	18.63	24.39	20.67	0.82
Cadmium	L-series	3.80	4.97	1.80	0.72
Barium	L-series	2.12	2.78	0.82	1.06
Sulfur	K-series	1.75	2.30	2.91	0.09
Aluminium	K-series	1.25	1.64	2.47	0.97
Chlorine	K-series	0.76	1.00	1.14	0.05
Phosphorus	K-series	0.72	0.95	1.24	0.05
Silicon	K-series	0.50	0.65	0.94	0.05
Magnesium	K-series	0.39	0.51	0.86	0.11
Potassium	K-series	0.23	0.30	0.32	0.18
Calcium	K-series	0.05	0.06	0.06	0.05
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	76.40	100.00	100.00	

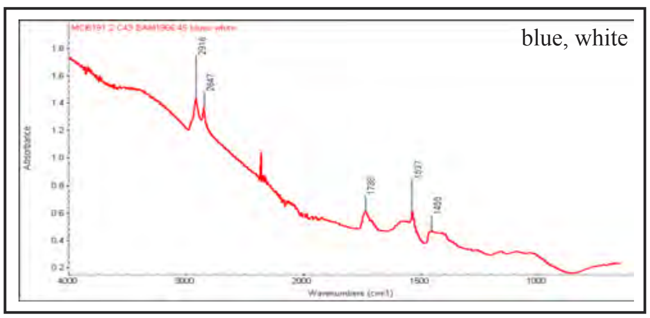
acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: orange red

sample location: 15.0" from top, 17.0" from left
(T 38.1 x L 43.2 cm.)

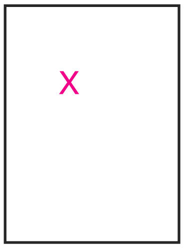
Representative Analysis Compilation—sample C043, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: zinc soaps



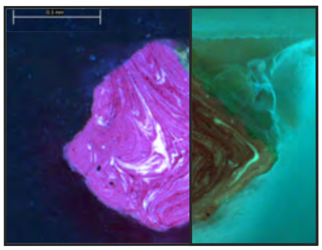
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

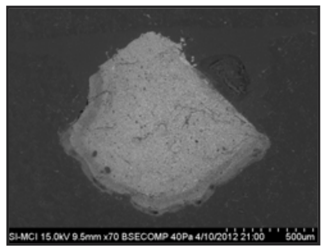


acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: pink stripe

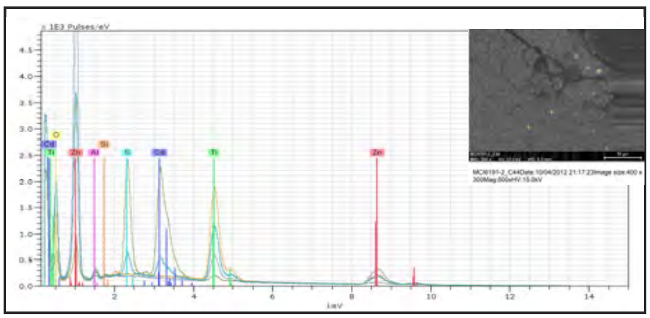
sample location: 18.0" from top, 15.0" from left
(T 45.7 x L 38.1 cm.)

Representative Analysis Compilation—sample C044

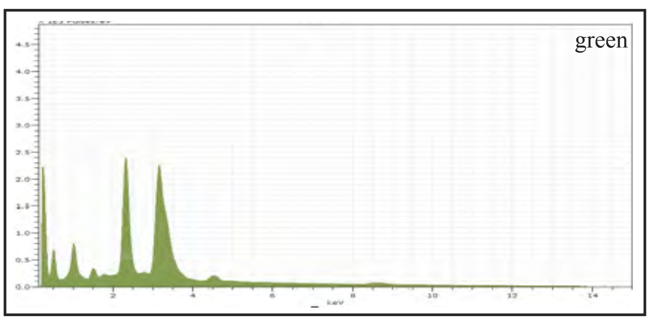




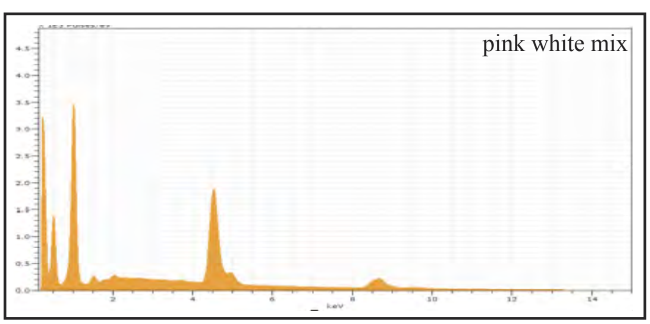
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



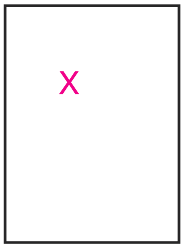
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cd, S, Na
significant elements, pink: Al
significant elements, white: Zn, Ti
interpretation: ultramarine blue, cadmium
yellow, synthetic color, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	27.78	41.78	18.57	2.48
Sulfur	K-series	13.70	20.61	32.12	0.51
Zinc	K-series	9.45	14.21	10.85	0.34
Potassium	K-series	6.28	9.44	12.07	0.81
Sodium	K-series	5.68	8.55	18.58	4.50
Titanium	K-series	1.75	2.64	2.75	0.20
Aluminium	K-series	1.32	1.98	3.67	1.03
Magnesium	K-series	0.26	0.40	0.81	0.09
Silicon	K-series	0.21	0.31	0.55	0.04
Barium	L-series	0.05	0.08	0.03	0.05
Calcium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	66.48	100.00	100.00	



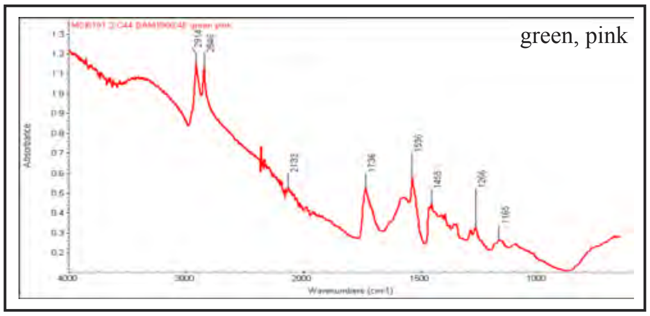
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	28.60	36.11	22.29	0.97
Titanium	K-series	26.73	33.75	28.46	0.98
Sodium	K-series	19.50	24.62	43.22	15.37
Phosphorus	K-series	0.98	1.23	1.61	0.06
Aluminium	K-series	0.83	1.04	1.56	0.06
Cadmium	L-series	0.76	0.96	0.34	0.21
Chlorine	K-series	0.67	0.84	0.96	0.05
Sulfur	K-series	0.56	0.71	0.89	0.05
Calcium	K-series	0.25	0.31	0.32	0.05
Barium	L-series	0.18	0.23	0.07	0.12
Silicon	K-series	0.15	0.19	0.28	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	79.20	100.00	100.00	



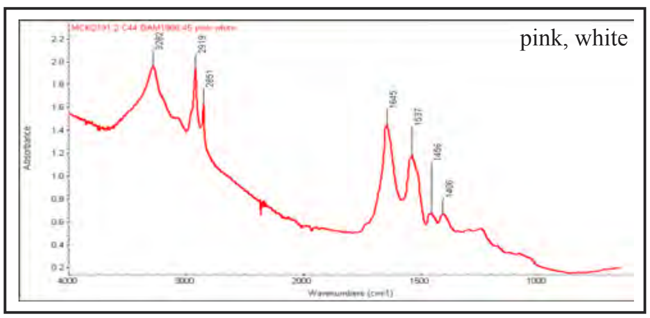
acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: pink stripe

sample location: 18.0" from top, 15.0" from left
(T 45.7 x L 38.1 cm.)

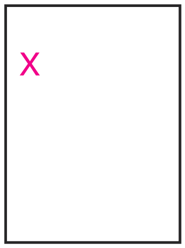
Representative Analysis Compilation—sample C044, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



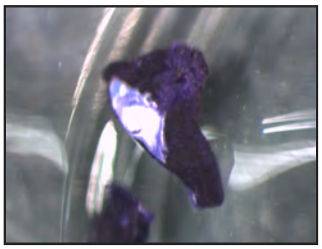
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR83

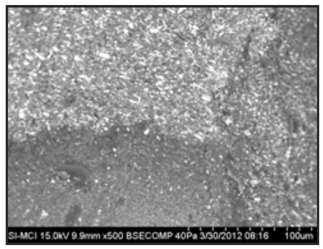


acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: purple

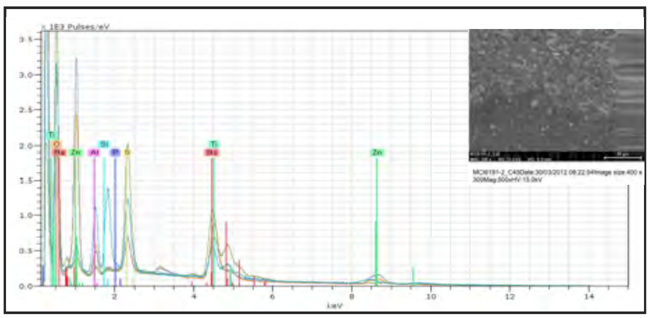
sample location: 12.5" from top, 6.0" from left
(T 31.8 x L 15.2 cm.)

Representative Analysis Compilation—sample C045

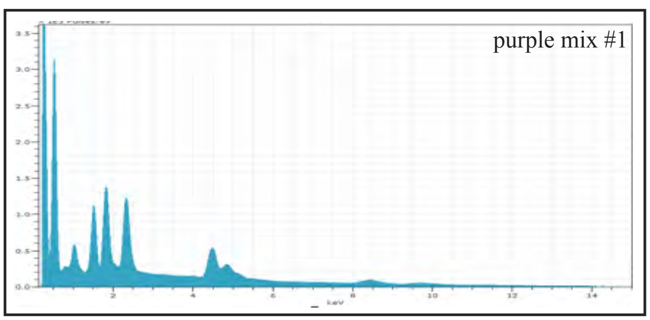




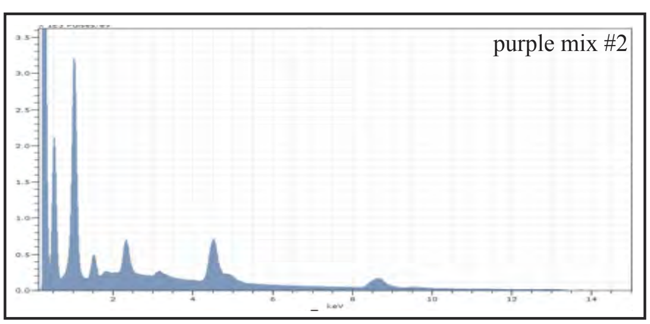
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



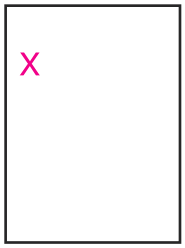
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Na, Al, S
significant elements, white: Zn, Ti
interpretation: ultramarine violet, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	22.33	23.14	11.68	0.77
Barium	L-series	21.89	22.69	5.46	1.35
Sulfur	K-series	6.54	6.77	6.97	0.26
Silicon	K-series	6.22	6.45	7.58	0.28
Copper	K-series	5.57	5.77	3.00	0.21
Aluminium	K-series	4.34	4.49	5.50	1.69
Sodium	K-series	1.97	2.04	2.93	1.57
Phosphorus	K-series	1.25	1.29	1.38	0.07
Titanium	K-series	0.36	0.37	0.26	0.27
Chlorine	K-series	0.13	0.13	0.12	0.03
Calcium	K-series	0.11	0.11	0.09	0.03
Potassium	K-series	0.10	0.10	0.09	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.69	26.63	54.95	9.39
	Sum:	96.47	100.00	100.00	



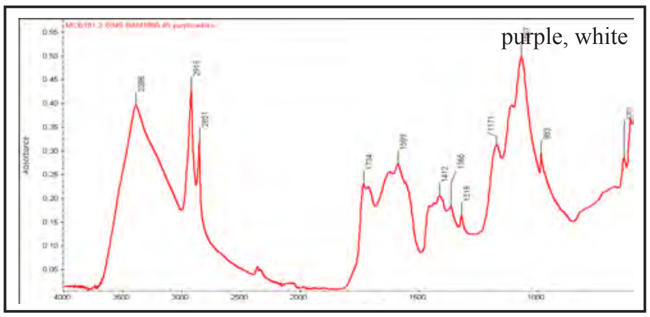
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	25.07	31.60	13.68	0.85
Sodium	K-series	8.62	10.87	13.38	6.81
Titanium	K-series	7.71	9.72	5.75	0.57
Barium	L-series	4.33	5.46	1.13	0.58
Sulfur	K-series	2.89	3.64	3.22	0.13
Cadmium	L-series	1.71	2.15	0.54	0.42
Aluminium	K-series	1.56	1.97	2.07	1.00
Phosphorus	K-series	0.31	0.39	0.36	0.04
Chlorine	K-series	0.29	0.37	0.29	0.04
Silicon	K-series	0.24	0.30	0.31	0.04
Potassium	K-series	0.03	0.04	0.03	0.05
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	26.58	33.49	59.26	11.44
	Sum:	79.35	100.00	100.00	



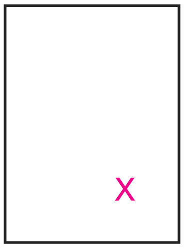
acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: purple

sample location: 12.5" from top, 6.0" from left
(T 31.8 x L 15.2 cm.)

Representative Analysis Compilation—sample C045, continued



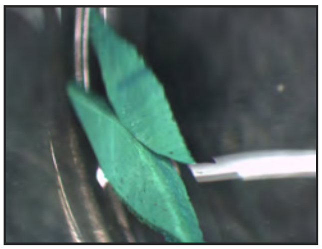
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation:fillers

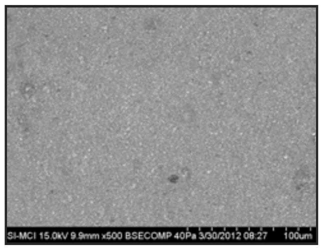


acc. no.: BAM 1966.45
title, year: *Morning Mist*, 1958
Bequest of the artist
medium noted in file: oil on canvas
meas.: 55.1 x 40.4" (140.0 x 102.6 cm.)
notes: dark teal

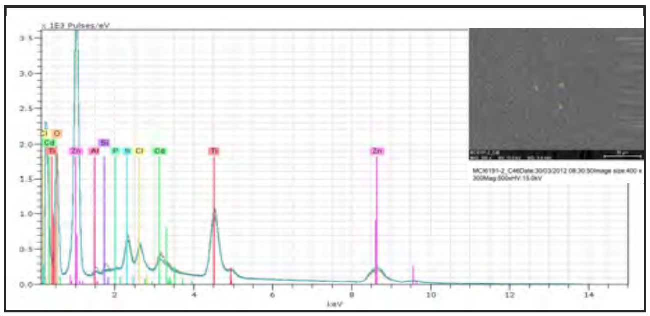
sample location: 14.5" from bottom, 13.5" from right
(B 36.8 x R 34.3 cm.)

Representative Analysis Compilation—sample C046

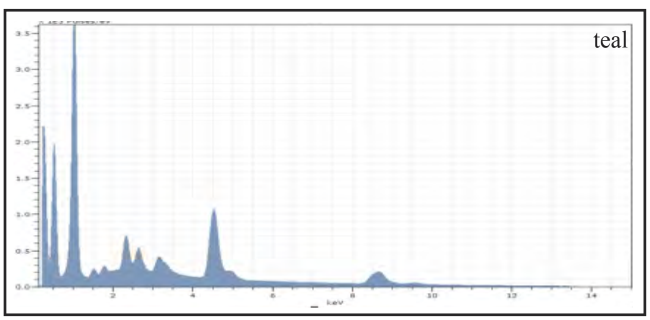




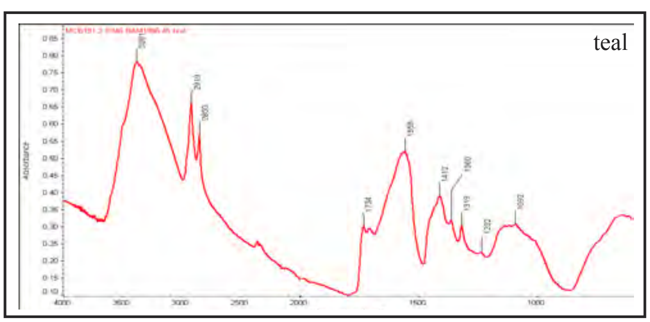
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



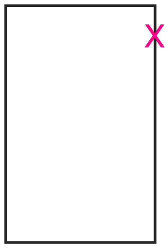
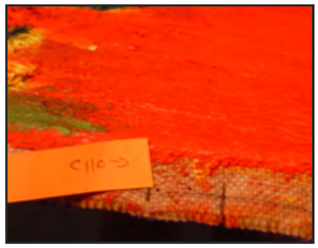
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, teal: Zn, Cd, S, Na
interpretation: cadmium green



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	35.02	35.59	17.72	1.18
Titanium	K-series	15.52	15.77	10.72	0.71
Sodium	K-series	12.33	12.53	17.74	9.73
Cadmium	L-series	4.70	4.77	1.38	0.82
Sulfur	K-series	3.34	3.40	3.45	0.14
Chlorine	K-series	2.92	2.96	2.72	0.12
Barium	L-series	1.59	1.62	0.38	0.80
Silicon	K-series	0.56	0.57	0.66	0.05
Potassium	K-series	0.47	0.47	0.39	0.29
Aluminium	K-series	0.33	0.34	0.41	0.28
Phosphorus	K-series	0.24	0.25	0.26	0.04
Calcium	K-series	0.03	0.03	0.02	0.05
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	21.35	21.70	44.14	9.32
	Sum:	98.40	100.00	100.00	



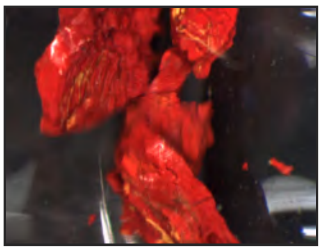
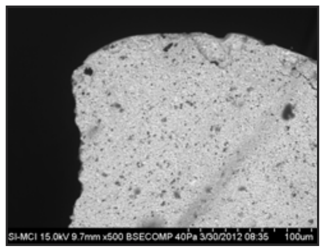
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

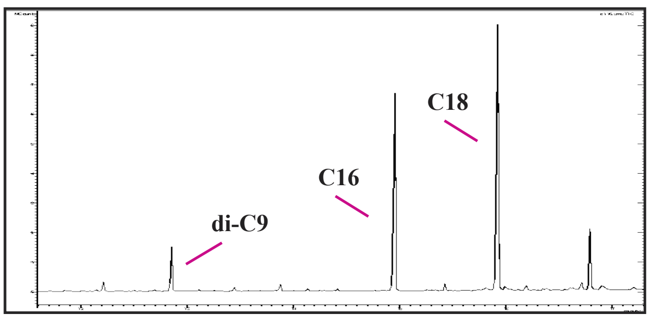
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: red

sample location: right edge, 16.0" from top
(T 40.6 x R 0.0 cm.)

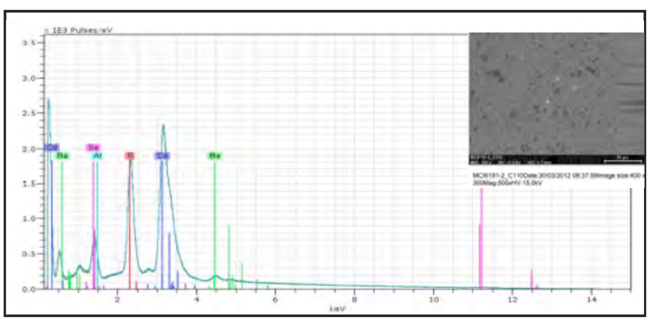
Representative Analysis Compilation—sample C110

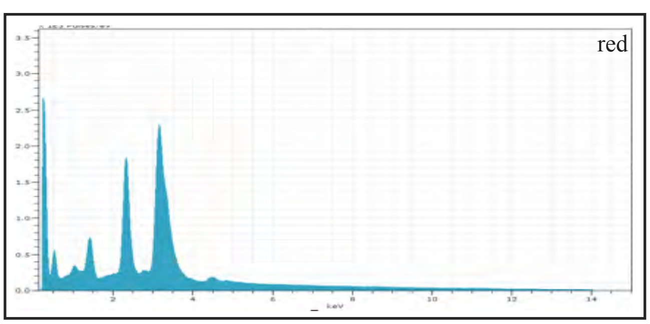
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



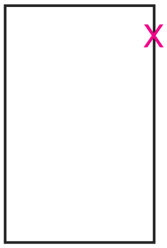
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.335
scan range: 1 - 1481
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil

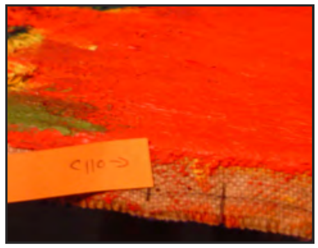


analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se, Zn
interpretation: cadmium red mixed with zinc white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	44.25	57.13	34.89	3.33
Sulfur	K-series	11.25	14.53	31.09	0.42
Potassium	K-series	5.86	7.57	13.29	1.15
Selenium	L-series	5.43	7.02	6.10	0.37
Zinc	K-series	4.60	5.94	6.23	0.19
Barium	L-series	4.41	5.69	2.84	0.35
Aluminium	K-series	0.74	0.96	2.44	0.59
Sodium	K-series	0.67	0.86	2.58	0.55
Calcium	K-series	0.12	0.15	0.26	0.10
Titanium	K-series	0.08	0.10	0.14	0.08
Phosphorus	K-series	0.02	0.03	0.06	0.03
Silicon	K-series	0.02	0.03	0.06	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	77.45	100.00	100.00	

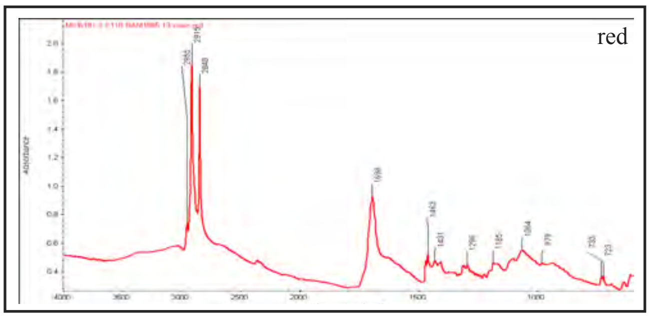




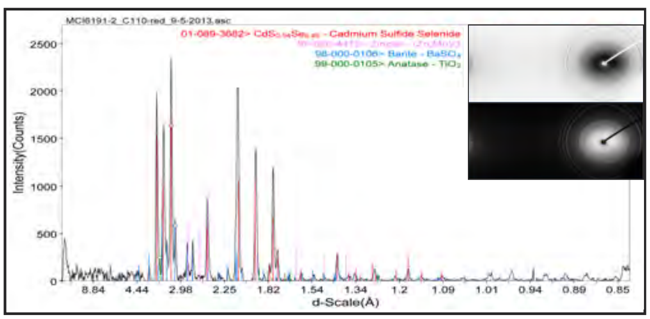
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: red

sample location: right edge, 16.0" from top
(T 40.6 x R 0.0 cm.)

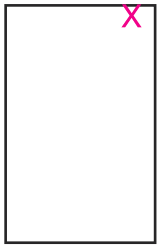
Representative Analysis Compilation—sample C110, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for wax



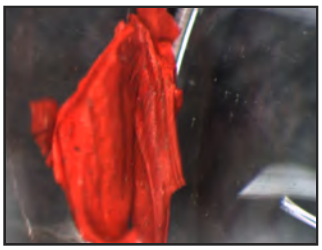
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-90º; omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, zincite, barite, anatase titanium
interpretation: cadmium red

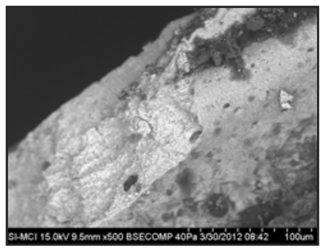


acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: secondary red

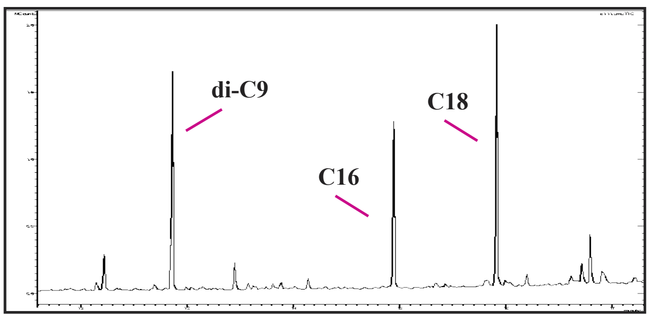
sample location: 4.0" from top, 7.0" from right
(T 10.2 x R 17.8 cm.)

Representative Analysis Compilation—sample C111

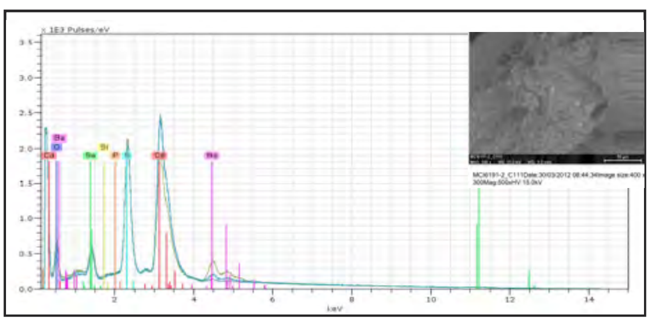




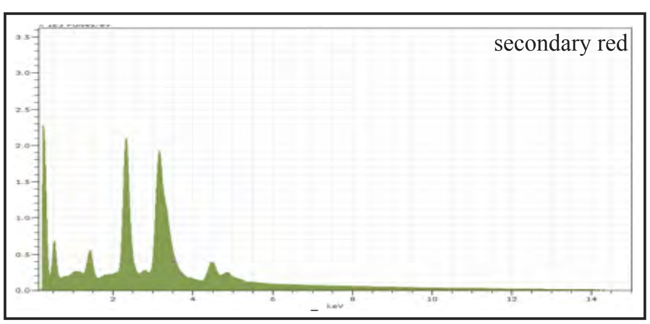
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



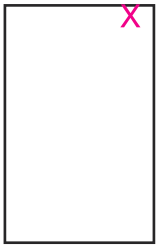
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.373
scan range: 1 - 1482
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se, Ba
interpretation: cadmium red mixed with barium sulfate



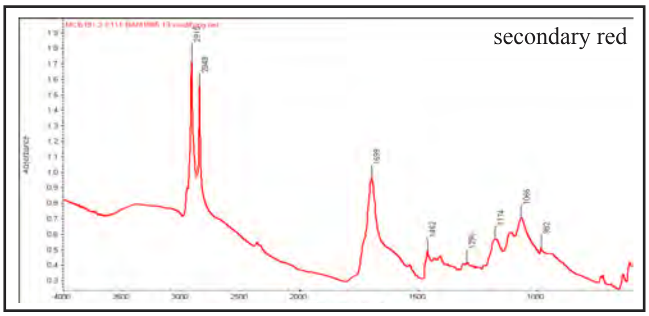
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	23.31	30.18	11.10	2.13
Barium	L-series	12.42	16.08	4.84	0.83
Sulfur	K-series	11.86	15.35	19.81	0.44
Zinc	K-series	6.36	8.23	5.21	0.24
Potassium	K-series	4.39	5.68	6.01	0.71
Selenium	L-series	3.12	4.04	2.12	0.23
Titanium	K-series	0.40	0.52	0.45	0.25
Sodium	K-series	0.37	0.47	0.85	0.31
Aluminium	K-series	0.31	0.40	0.62	0.26
Phosphorus	K-series	0.09	0.12	0.16	0.03
Silicon	K-series	0.07	0.09	0.13	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	14.55	18.84	48.71	10.51
	Sum:	77.25	100.00	100.00	

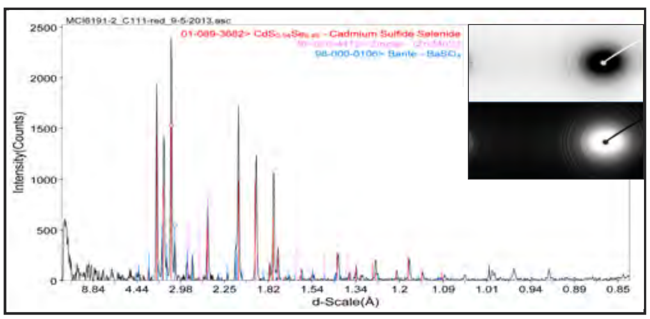

acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: secondary red

sample location: 4.0" from top, 7.0" from right (T 10.2 x R 17.8 cm.)

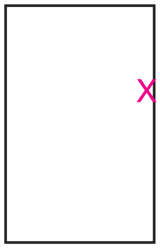
Representative Analysis Compilation—sample C111, continued

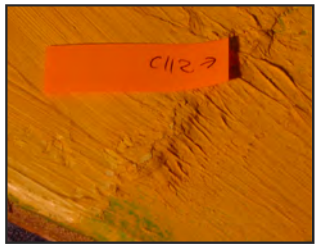


analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for wax



analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 100-200º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, zincite, barite
interpretation: cadmium red

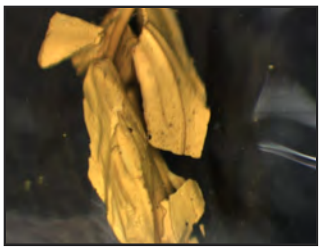


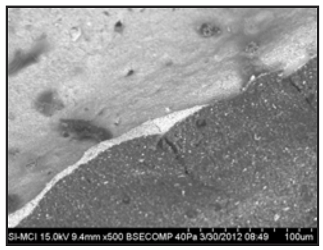


acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: lemon yellow

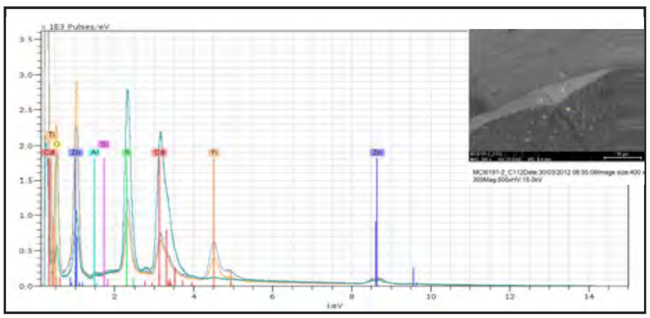
sample location: 25.0" from top, 2.0" from right
(T 63.5 x R 5.1 cm.)

Representative Analysis Compilation—sample C112

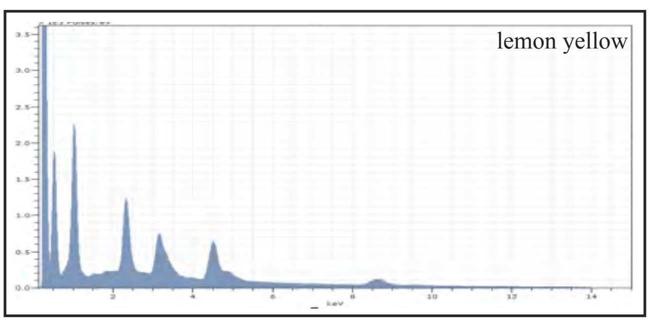




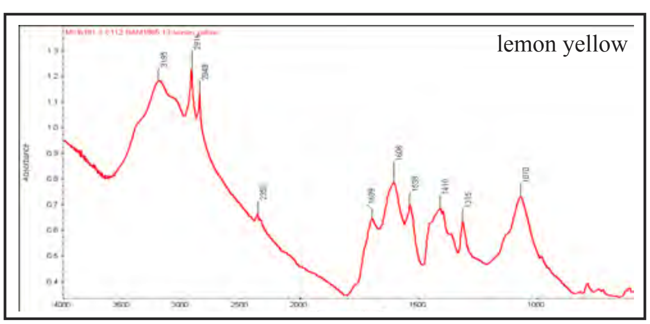
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



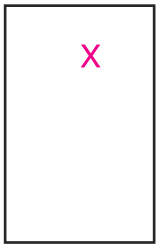
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S, Zn
interpretation: cadmium lemon yellow

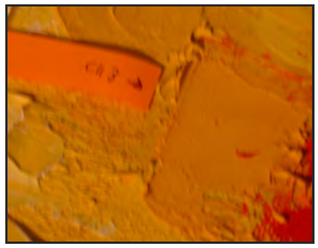


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	27.29	28.60	14.77	0.93
Barium	L-series	12.53	13.13	3.23	0.98
Cadmium	L-series	8.27	8.67	2.60	1.19
Sodium	K-series	7.86	8.24	12.10	6.21
Titanium	K-series	6.91	7.24	5.11	0.77
Sulfur	K-series	6.47	6.79	7.14	0.25
Potassium	K-series	1.39	1.45	1.26	0.44
Magnesium	K-series	0.36	0.38	0.52	0.11
Phosphorus	K-series	0.22	0.23	0.25	0.03
Silicon	K-series	0.18	0.19	0.22	0.03
Aluminium	K-series	0.13	0.13	0.17	0.12
Calcium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	23.79	24.94	52.62	10.99
	Sum:	95.40	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

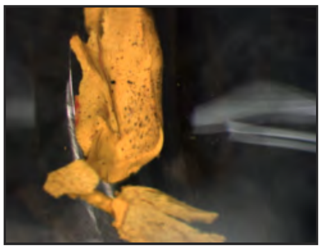


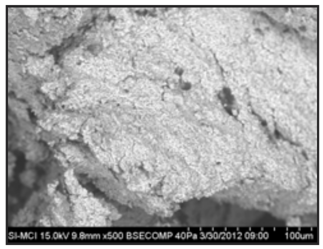


acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: light yellow

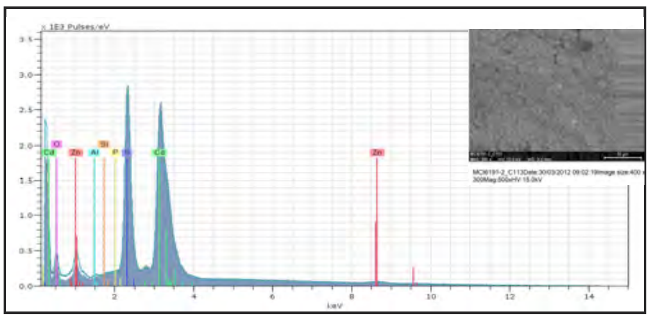
sample location: 26.0" from top, 17.0" from right
(T 66.0 x R 43.2 cm.)

Representative Analysis Compilation—sample C113

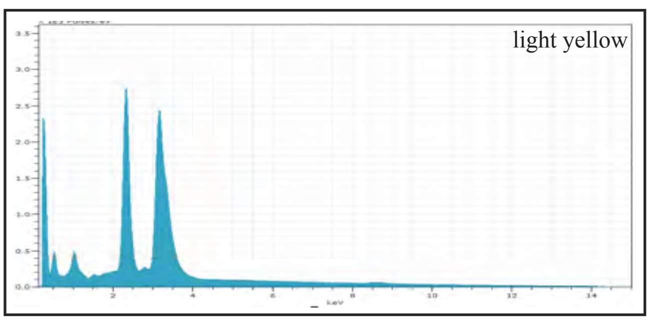




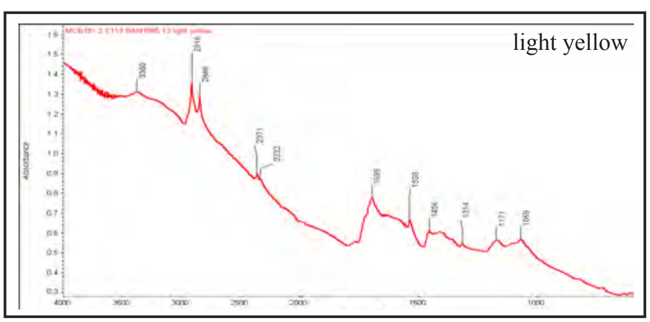
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



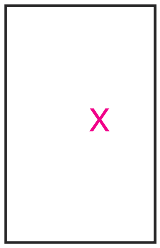
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
interpretation: cadmium yellow



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	53.11	47.21	19.43	3.78
Sulfur	K-series	24.02	21.35	30.81	0.87
Zinc	K-series	12.71	11.30	8.00	0.45
Potassium	K-series	6.21	5.52	6.53	1.27
Sodium	K-series	2.74	2.43	4.90	2.18
Barium	L-series	1.23	1.09	0.37	0.14
Chlorine	K-series	0.48	0.43	0.56	0.06
Magnesium	K-series	0.47	0.41	0.79	0.12
Phosphorus	K-series	0.46	0.41	0.62	0.04
Silicon	K-series	0.26	0.23	0.39	0.04
Aluminium	K-series	0.17	0.16	0.27	0.16
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	10.64	9.45	27.35	9.03
	Sum:	112.50	100.00	100.00	



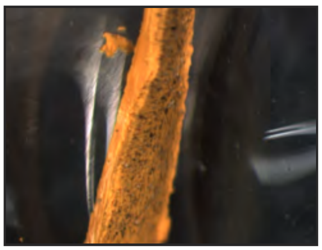
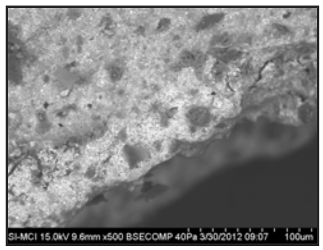
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

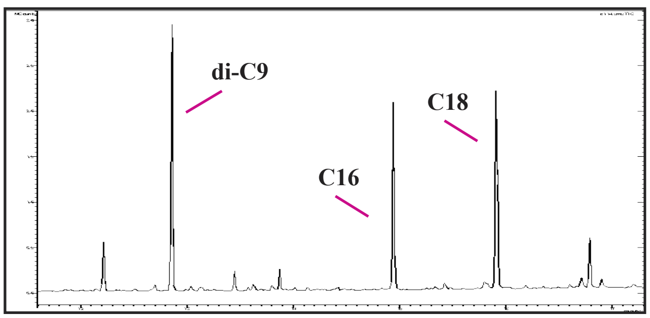
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: secondary yellow

sample location: 43.0" from top, 23.0" from right
(T 109.2 x R 58.4 cm.)

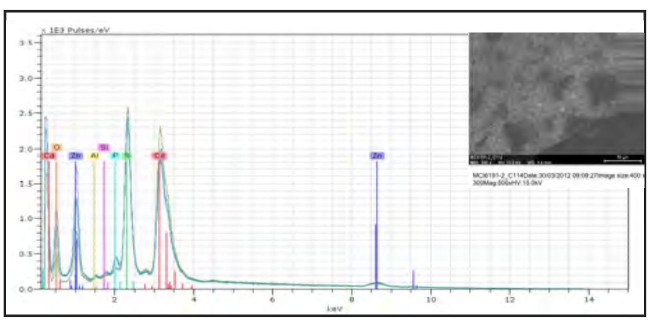
Representative Analysis Compilation—sample C114

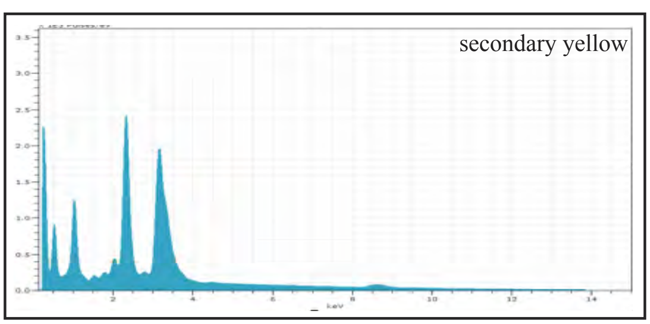
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



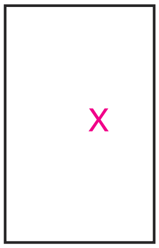
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.274
scan range: 1 - 1481
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
major elements, yellow: Cd, S
interpretation: cadmium yellow deep



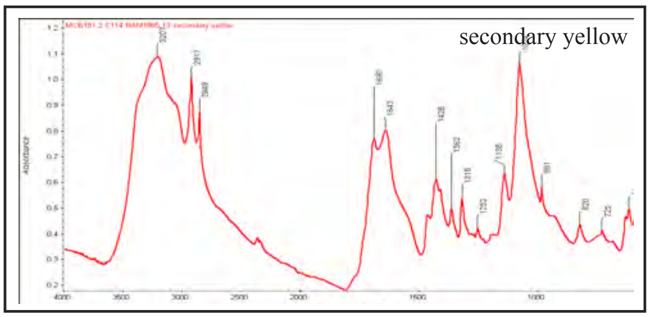
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	27.76	30.02	10.27	2.35
Zinc	K-series	19.73	21.34	12.55	0.68
Sulfur	K-series	15.05	16.27	19.52	0.56
Sodium	K-series	5.98	6.47	10.83	4.73
Potassium	K-series	4.49	4.85	4.77	0.81
Barium	L-series	2.46	2.66	0.74	0.22
Phosphorus	K-series	1.49	1.61	2.00	0.08
Silicon	K-series	0.40	0.43	0.59	0.04
Magnesium	K-series	0.34	0.37	0.59	0.10
Aluminium	K-series	0.27	0.29	0.42	0.23
Calcium	K-series	0.02	0.03	0.02	0.04
Chlorine	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	14.49	15.67	37.68	9.24
	Sum:	92.49	100.00	100.00	



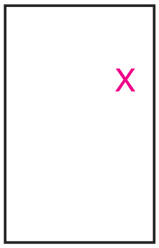
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: secondary yellow

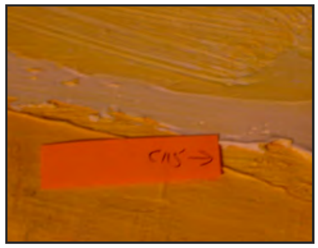
sample location: 43.0" from top, 23.0" from right
(T 109.2 x R 58.4 cm.)

Representative Analysis Compilation—sample C114, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for wax

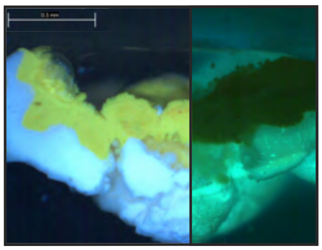
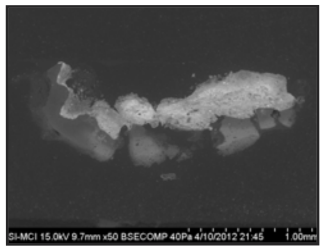
 



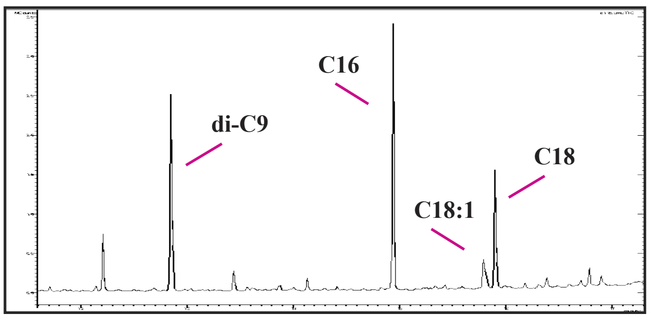
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: compositional white

sample location: 28.0" from top, 13.0" from right
(T 71.1 x R 33.0 cm.)

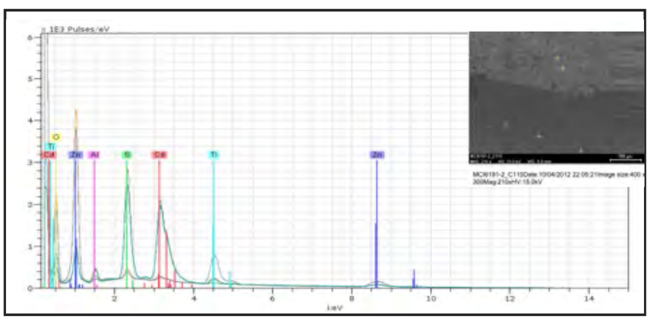
Representative Analysis Compilation—sample C115

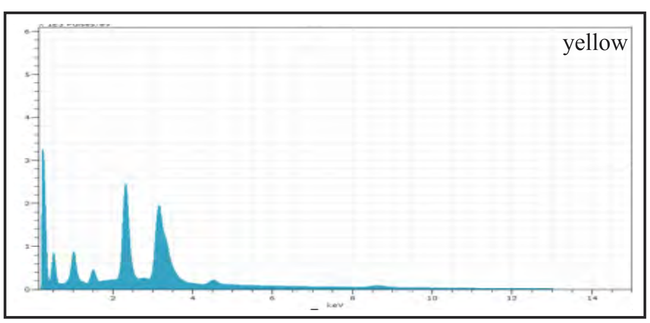
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



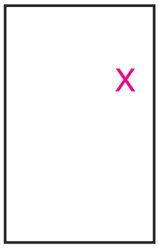
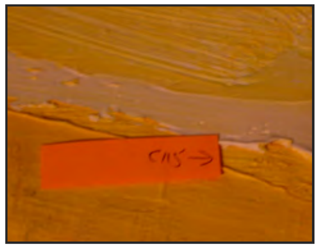
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.194
scan range: 1 - 1482
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.9 mm.
mag: 210x; HV: 15 kV
major elements, yellow: Cd, S
major elements, white: Zn, Ti
interpretation: cadmium yellow, Zn/Ti white



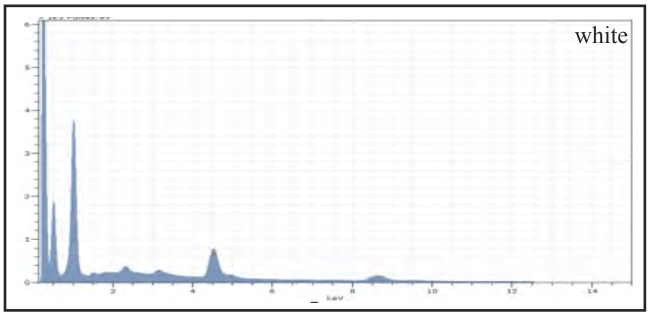
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	23.13	28.01	8.95	2.10
Zinc	K-series	15.27	18.50	10.16	0.54
Sulfur	K-series	13.09	15.85	17.75	0.49
Sodium	K-series	5.29	6.40	10.00	4.19
Potassium	K-series	4.62	5.60	5.14	0.71
Aluminium	K-series	2.11	2.56	3.40	1.36
Barium	L-series	1.88	2.28	0.60	0.27
Titanium	K-series	1.34	1.62	1.22	0.19
Magnesium	K-series	0.14	0.17	0.24	0.07
Silicon	K-series	0.07	0.09	0.12	0.03
Phosphorus	K-series	0.04	0.05	0.06	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	15.58	18.87	42.36	9.97
	Sum:	82.56	100.00	100.00	

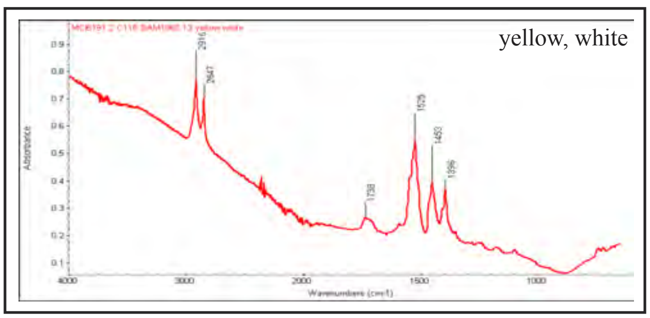
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: compositional white

sample location: 28.0" from top, 13.0" from right
(T 71.1 x R 33.0 cm.)

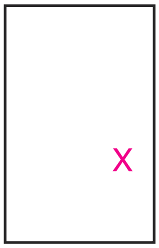
Representative Analysis Compilation—sample C115, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	24.81	39.47	23.77	0.85
Sodium	K-series	17.95	28.57	48.94	14.16
Titanium	K-series	12.67	20.16	16.58	0.59
Cadmium	L-series	2.87	4.57	1.60	0.61
Sulfur	K-series	1.76	2.80	3.44	0.09
Chlorine	K-series	0.68	1.09	1.21	0.05
Phosphorus	K-series	0.65	1.03	1.31	0.05
Silicon	K-series	0.55	0.88	1.23	0.05
Aluminium	K-series	0.51	0.80	1.17	0.41
Magnesium	K-series	0.22	0.35	0.57	0.09
Barium	L-series	0.09	0.15	0.04	0.07
Potassium	K-series	0.08	0.13	0.13	0.08
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	62.84	100.00	100.00	



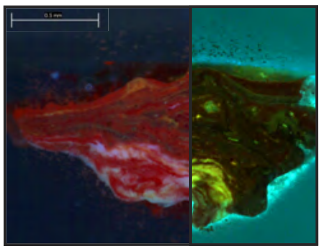
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference, zinc soaps

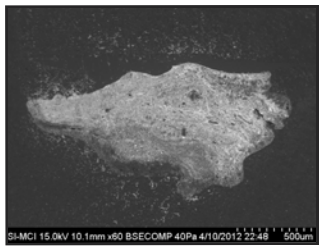


acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: orange

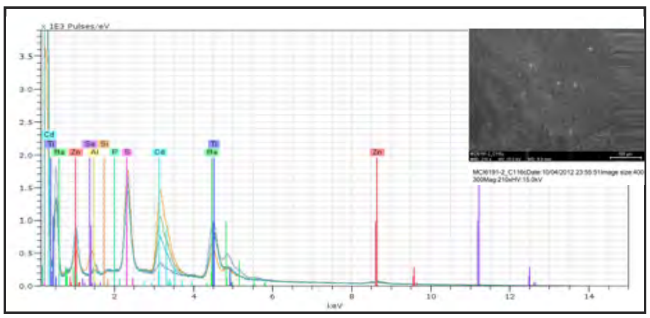
sample location: 31.5" from bottom, 13.0" from right
(B 80.0 x R 33.0 cm.)

Representative Analysis Compilation—sample C116

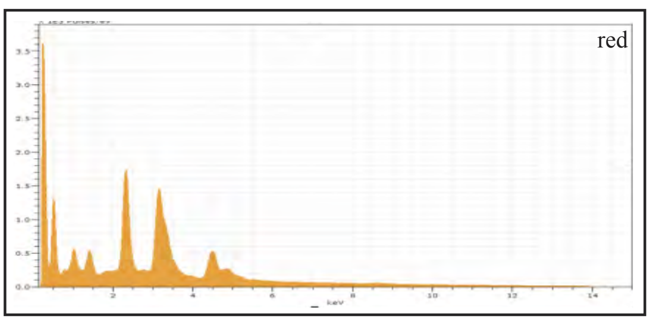




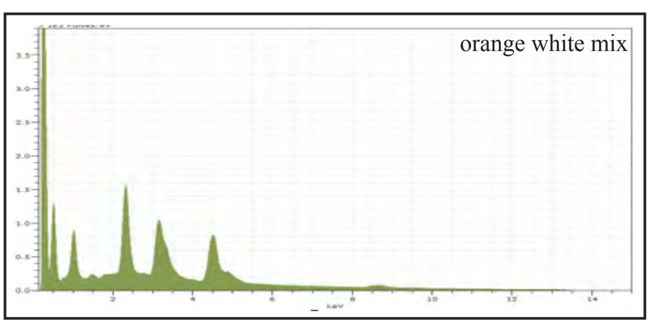
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.1 mm.



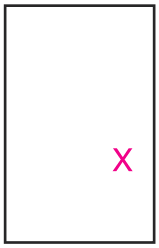
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.9 mm.
mag: 210x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, orange: Cd, S
significant elements, white: Ti, Zn
interpretation: cadmium red, cadmium orange, Ti/Zn white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	19.40	33.52	17.28	2.00
Sulfur	K-series	11.09	19.17	34.65	0.42
Barium	L-series	10.16	17.56	7.41	0.81
Titanium	K-series	5.00	8.63	10.45	0.58
Potassium	K-series	3.51	6.06	8.98	0.67
Selenium	L-series	3.10	5.36	3.93	0.23
Zinc	K-series	2.20	3.81	3.38	0.11
Sodium	K-series	2.15	3.71	9.36	1.72
Aluminium	K-series	0.79	1.36	2.92	0.62
Phosphorus	K-series	0.25	0.44	0.82	0.04
Silicon	K-series	0.22	0.39	0.80	0.04
Chlorine	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	57.88	100.00	100.00	



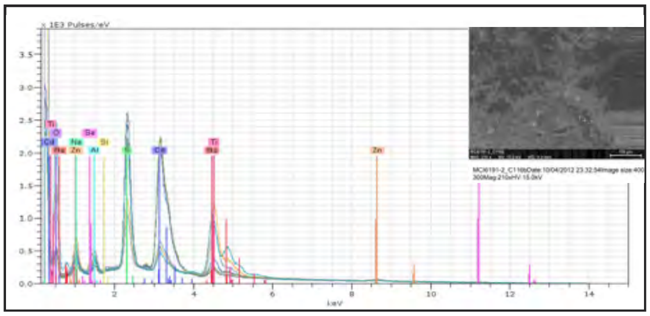
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	11.58	20.20	9.12	1.45
Titanium	K-series	10.98	19.17	20.32	0.88
Barium	L-series	10.05	17.54	6.48	0.98
Sulfur	K-series	8.57	14.96	23.68	0.33
Zinc	K-series	7.00	12.21	9.48	0.26
Sodium	K-series	5.79	10.10	22.30	4.58
Potassium	K-series	2.22	3.88	5.03	0.50
Aluminium	K-series	0.48	0.84	1.58	0.39
Silicon	K-series	0.24	0.42	0.76	0.04
Phosphorus	K-series	0.23	0.40	0.65	0.03
Magnesium	K-series	0.16	0.29	0.60	0.08
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
	Sum:	57.31	100.00	100.00	

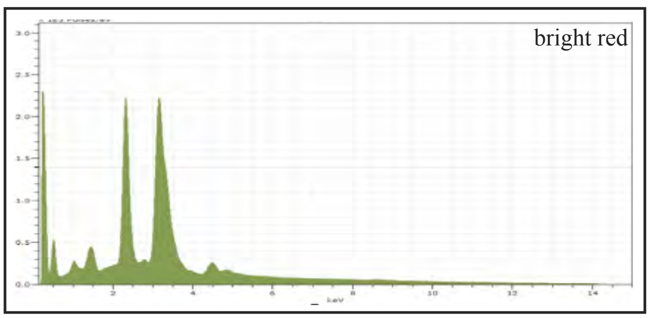
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: orange

sample location: 31.5" from bottom, 13.0" from right
(B 80.0 x R 33.0 cm.)

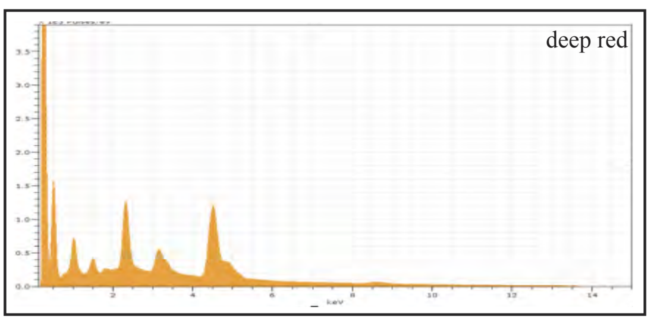
Representative Analysis Compilation—sample C116, continued



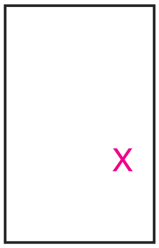
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 9.9 mm.
mag: 210x; HV: 15 kV
significant elements, red #1: Cd, S, Se, Zn
significant elements, red #2: Cd, S, Se, Ti
significant elements, yellow: Cd, S
interpretation: cadmium red mix with zinc or titanium white, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	29.37	44.10	24.28	2.56
Sulfur	K-series	11.53	17.32	33.43	0.43
Barium	L-series	8.15	12.23	5.51	0.57
Zinc	K-series	7.56	11.35	10.74	0.28
Potassium	K-series	6.20	9.31	14.74	0.85
Sodium	K-series	1.30	1.96	5.27	1.05
Aluminium	K-series	1.26	1.90	4.35	0.99
Selenium	L-series	1.03	1.55	1.22	0.10
Titanium	K-series	0.12	0.17	0.22	0.10
Silicon	K-series	0.05	0.07	0.16	0.03
Phosphorus	K-series	0.02	0.03	0.07	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
	Sum:	66.60	100.00	100.00	



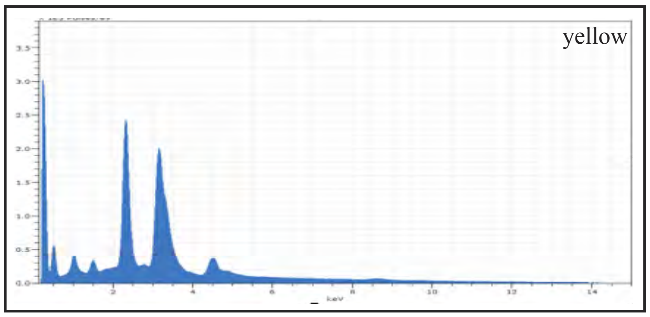
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	15.70	33.87	34.32	0.94
Barium	L-series	9.92	21.40	7.56	1.06
Sulfur	K-series	6.49	14.00	21.19	0.25
Cadmium	L-series	4.46	9.62	4.15	0.84
Sodium	K-series	3.88	8.37	17.66	3.08
Zinc	K-series	2.83	6.10	4.53	0.13
Aluminium	K-series	1.52	3.29	5.91	1.05
Potassium	K-series	0.76	1.64	2.04	0.30
Chlorine	K-series	0.29	0.63	0.86	0.04
Phosphorus	K-series	0.26	0.57	0.89	0.04
Silicon	K-series	0.24	0.51	0.89	0.04
Magnesium	K-series	0.00	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	46.36	100.00	100.00	

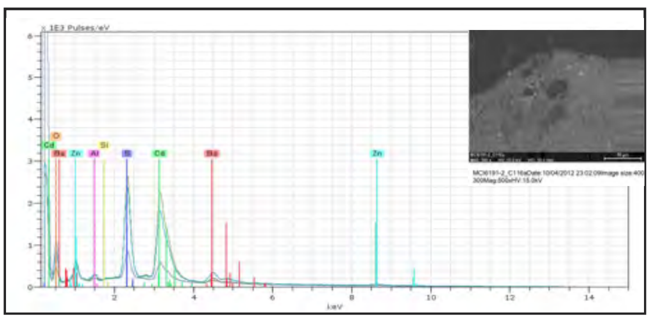
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: orange

sample location: 31.5" from bottom, 13.0" from right
(B 80.0 x R 33.0 cm.)

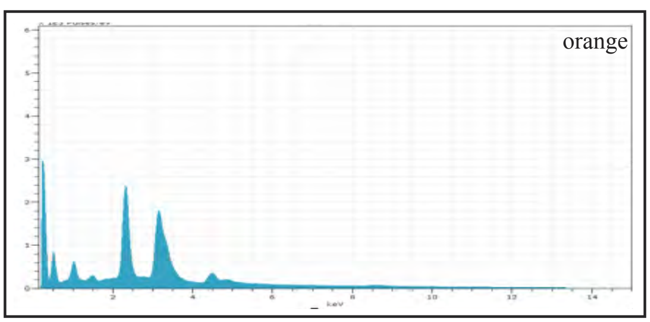
Representative Analysis Compilation—sample C116, continued



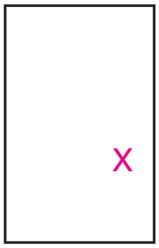
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	27.70	31.56	16.13	2.48
Zinc	K-series	16.01	18.24	16.03	0.56
Sulfur	K-series	15.78	17.98	32.21	0.58
Barium	L-series	14.69	16.74	7.00	1.01
Potassium	K-series	5.58	6.36	9.35	0.84
Sodium	K-series	3.91	4.45	11.13	3.10
Aluminium	K-series	1.80	2.05	4.37	1.33
Titanium	K-series	1.60	1.82	2.19	0.39
Silicon	K-series	0.30	0.34	0.70	0.04
Phosphorus	K-series	0.21	0.24	0.44	0.03
Magnesium	K-series	0.14	0.16	0.38	0.07
Calcium	K-series	0.04	0.05	0.07	0.05
Chlorine	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	87.76	100.00	100.00	



analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S
interpretation: cadmium orange



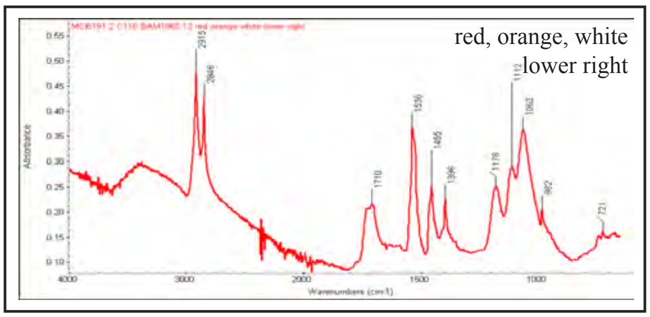
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	20.97	26.11	9.05	2.00
Zinc	K-series	12.76	15.88	9.46	0.45
Sulfur	K-series	12.72	15.84	19.23	0.47
Barium	L-series	10.33	12.87	3.65	0.71
Potassium	K-series	4.25	5.29	5.27	0.67
Sodium	K-series	2.74	3.41	5.77	2.18
Aluminium	K-series	0.80	1.00	1.44	0.64
Titanium	K-series	0.75	0.94	0.76	0.30
Silicon	K-series	0.02	0.03	0.04	0.03
Magnesium	K-series	0.02	0.03	0.04	0.04
Phosphorus	K-series	0.01	0.01	0.02	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	14.94	18.60	45.27	9.62
	Sum:	80.32	100.00	100.00	



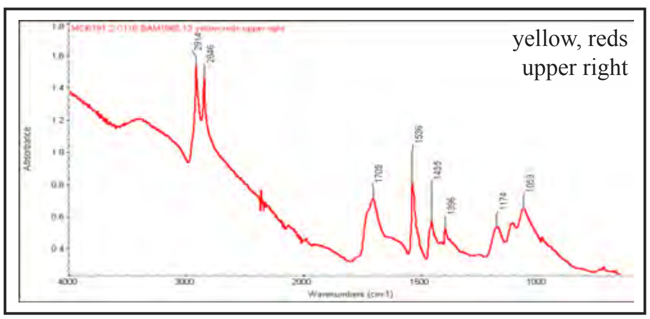
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: orange

sample location: 31.5" from bottom, 13.0" from right
(B 80.0 x R 33.0 cm.)

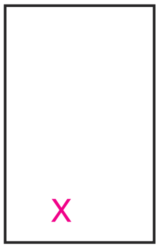
Representative Analysis Compilation—sample C116, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: fillers, zinc soaps



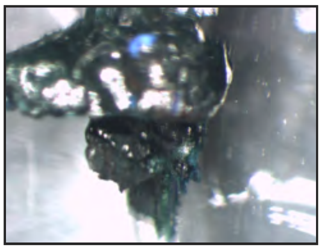
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

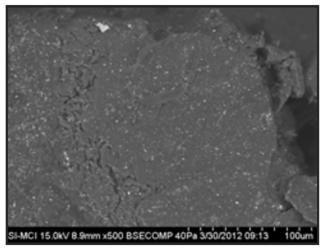


acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: black, gooey, possible varnish

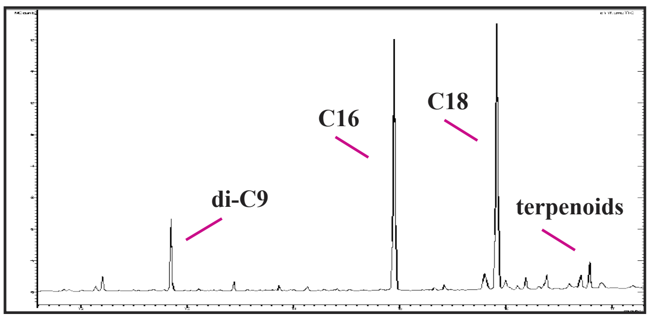
sample location: 7.0" from bottom, 16.0" from left
(B 17.8 x L 40.6 cm.)

Representative Analysis Compilation—sample C117

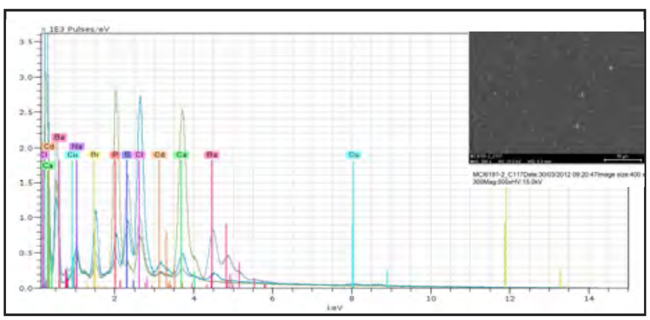




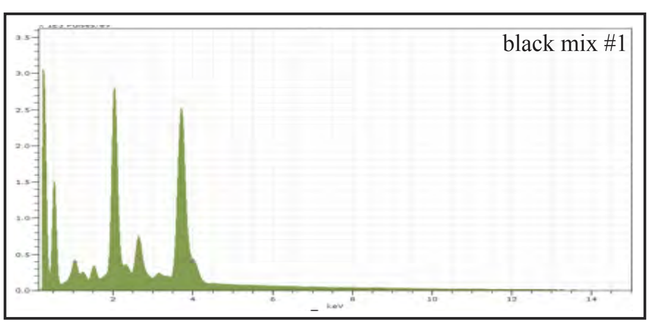
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 8.9 mm.



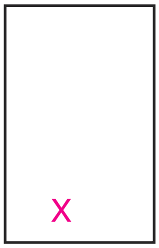
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.235
scan range: 1 - 1475
time range: 0.00 - 23.37 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 8.9 mm.
mag: 500x; HV: 15 kV
significant elements, black #1: Ca, P
significant elements, black #2: Cl, Cu
interpretation: bone black, phthalo green



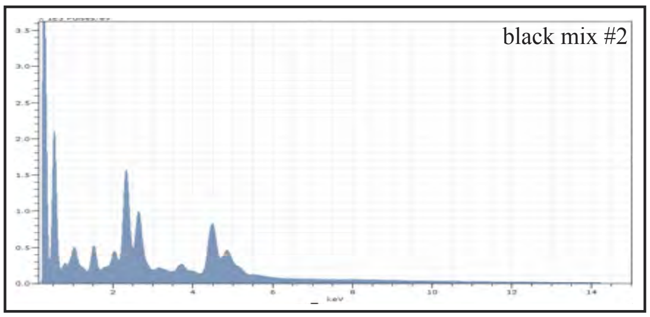
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	44.89	33.89	26.99	1.36
Phosphorus	K-series	20.85	15.74	16.22	0.82
Zinc	K-series	10.22	7.72	3.77	0.38
Barium	L-series	8.43	6.36	1.48	0.60
Chlorine	K-series	7.90	5.97	5.37	0.29
Copper	K-series	7.43	5.61	2.82	0.27
Potassium	K-series	2.77	2.09	1.71	0.22
Sodium	K-series	2.23	1.68	2.34	1.78
Sulfur	K-series	2.08	1.57	1.56	0.10
Aluminium	K-series	0.83	0.63	0.74	0.06
Magnesium	K-series	0.70	0.53	0.70	0.06
Titanium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	24.11	18.20	36.31	11.63
	Sum:	132.45	100.00	100.00	



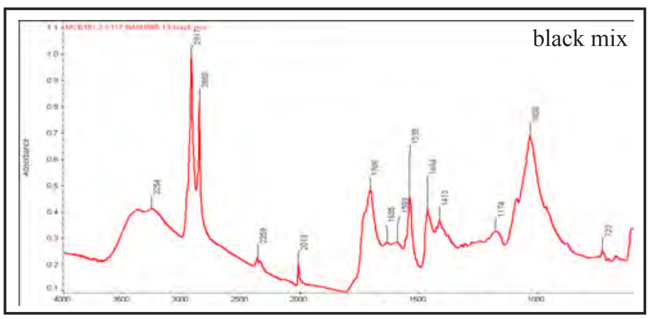
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: black, gooey, possible varnish

sample location: 7.0" from bottom, 16.0" from left (B 17.8 x L 40.6 cm.)

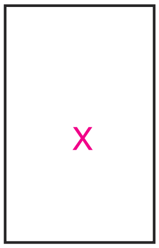
Representative Analysis Compilation—sample C117, continued

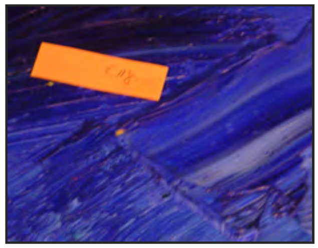


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	26.38	28.65	6.10	1.61
Sulfur	K-series	8.31	9.03	8.24	0.32
Chlorine	K-series	6.29	6.83	5.64	0.23
Zinc	K-series	5.95	6.47	2.89	0.23
Copper	K-series	2.46	2.67	1.23	0.11
Sodium	K-series	2.19	2.38	3.03	1.75
Aluminium	K-series	1.99	2.16	2.34	0.12
Titanium	K-series	1.97	2.14	1.31	0.45
Phosphorus	K-series	1.38	1.50	1.42	0.08
Calcium	K-series	1.08	1.17	0.85	0.06
Potassium	K-series	0.41	0.45	0.34	0.05
Magnesium	K-series	0.35	0.38	0.46	0.05
Silicon	K-series	0.03	0.03	0.03	0.03
Oxygen	K-series	33.30	36.15	66.12	14.49
	Sum:	92.10	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standards for PG7 and wax

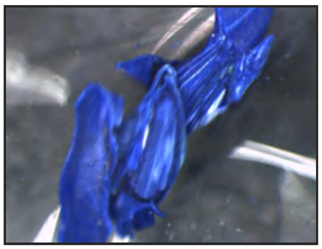


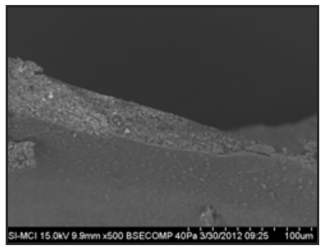


acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: main blue

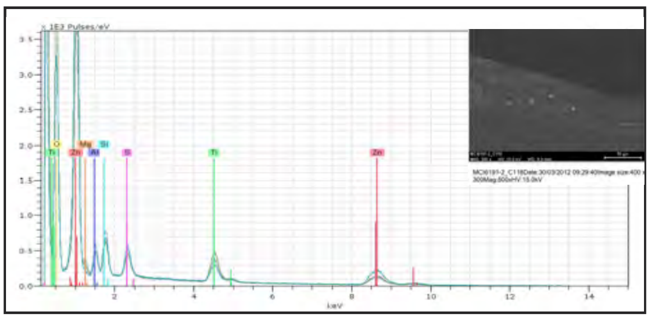
sample location: 36.0" from bottom, 24.5" from right
(B 91.4 x R 62.2 cm.)

Representative Analysis Compilation—sample C118

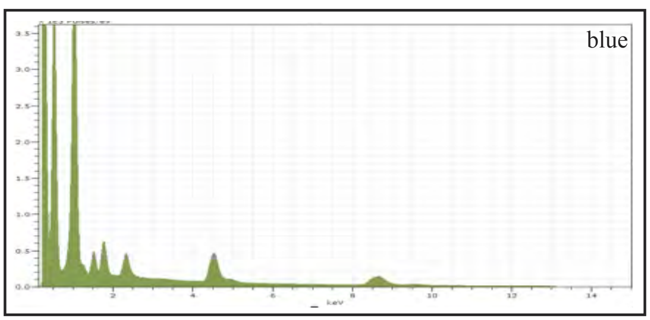




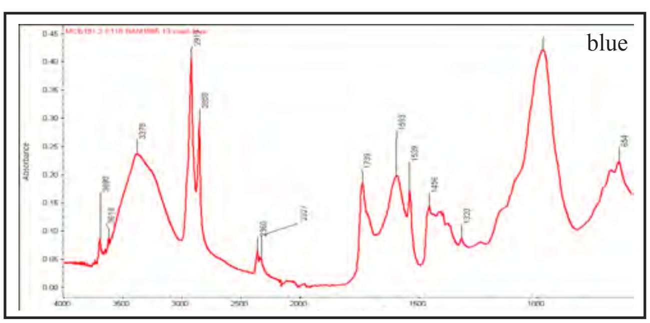
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



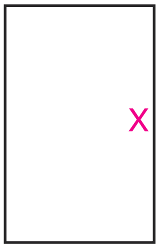
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Zn, Na
interpretation: ultramarine blue mixed with zinc white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	50.07	40.61	18.14	1.68
Sodium	K-series	12.05	9.77	12.41	9.51
Titanium	K-series	10.50	8.52	5.19	0.81
Barium	L-series	4.35	3.53	0.75	0.84
Silicon	K-series	2.97	2.41	2.51	0.15
Sulfur	K-series	2.45	1.98	1.81	0.11
Aluminium	K-series	1.54	1.25	1.35	1.03
Cadmium	L-series	0.15	0.12	0.03	0.06
Magnesium	K-series	0.14	0.12	0.14	0.07
Potassium	K-series	0.09	0.07	0.05	0.09
Chlorine	K-series	0.07	0.06	0.05	0.03
Calcium	K-series	0.06	0.05	0.04	0.04
Selenium	L-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	38.85	31.51	57.52	13.19
	Sum:	123.31	100.00	100.00	



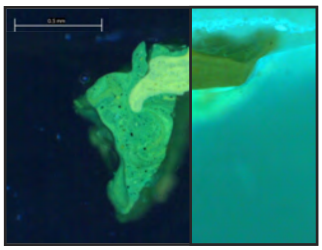
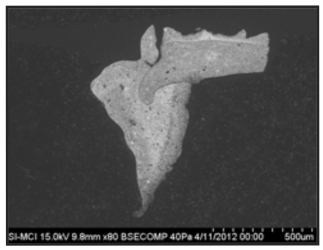
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

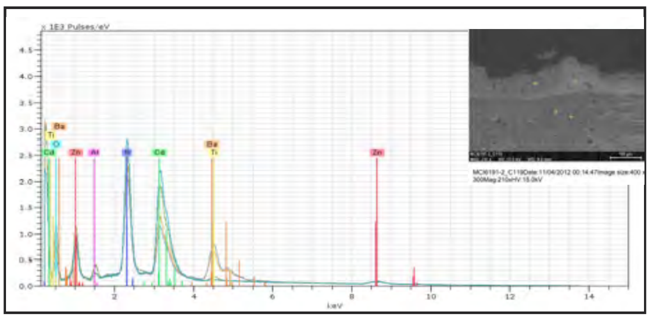
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: medium green

sample location: 39.0" from top, 6.0" from right
(T 99.1 x R 15.2 cm.)

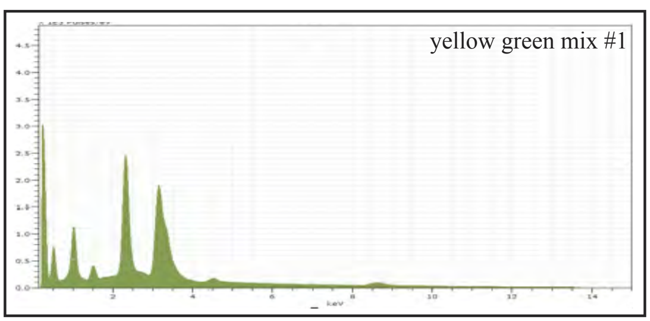
Representative Analysis Compilation—sample C119

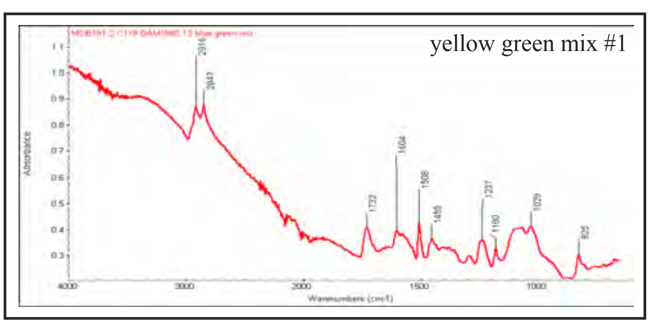
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.8 mm.



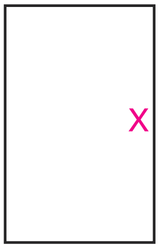
analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.8 mm.
mag: 210x; HV: 15 kV
significant elements, yellow: Cd, S
significant elements, green: Zn, Cd, S, Na
interpretation: ultramarine blue, cadmium green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	23.50	34.43	14.60	2.18
Zinc	K-series	14.43	21.15	15.41	0.51
Sulfur	K-series	14.03	20.55	30.55	0.52
Sodium	K-series	7.72	11.31	23.45	6.10
Potassium	K-series	4.77	6.98	8.51	0.74
Aluminium	K-series	1.80	2.64	4.67	1.24
Titanium	K-series	1.18	1.73	1.72	0.16
Barium	L-series	0.43	0.62	0.22	0.23
Chlorine	K-series	0.26	0.38	0.52	0.04
Magnesium	K-series	0.09	0.13	0.26	0.06
Silicon	K-series	0.03	0.04	0.07	0.03
Phosphorus	K-series	0.02	0.03	0.04	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	68.25	100.00	100.00	



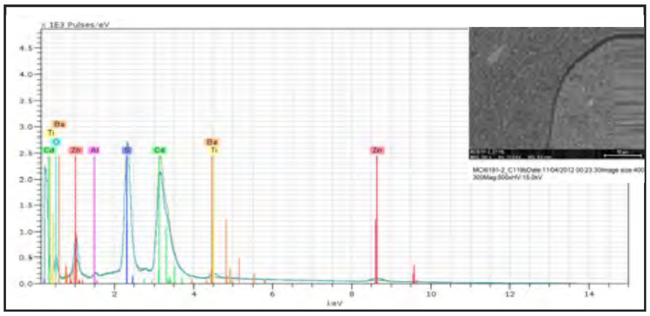
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

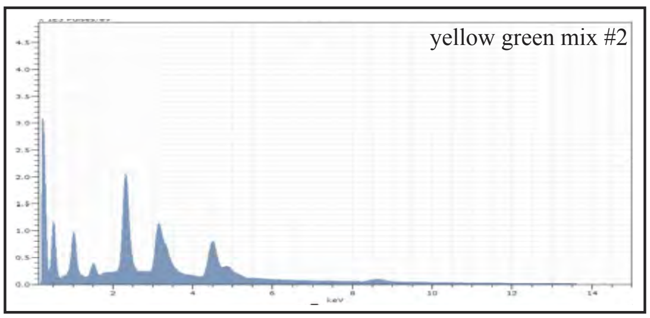
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: medium green

sample location: 39.0" from top, 6.0" from right
(T 99.1 x R 15.2 cm.)

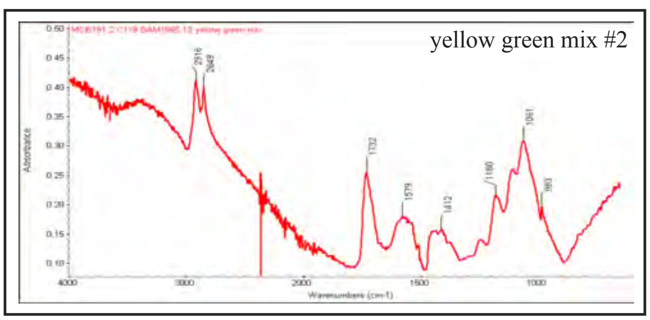
Representative Analysis Compilation—sample C119, continued



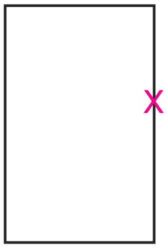
analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, green: Ba, Cd, S, Zn, Na
interpretation: cadmium green bulked with barium sulfate



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	14.03	19.91	7.16	1.05
Cadmium	L-series	12.44	17.65	7.75	1.53
Sulfur	K-series	11.99	17.02	26.22	0.45
Zinc	K-series	11.34	16.09	12.15	0.41
Sodium	K-series	8.08	11.47	24.64	6.39
Titanium	K-series	7.58	10.75	11.09	0.83
Potassium	K-series	2.51	3.57	4.50	0.51
Aluminium	K-series	1.99	2.83	5.18	1.38
Magnesium	K-series	0.23	0.33	0.66	0.09
Silicon	K-series	0.14	0.20	0.36	0.03
Phosphorus	K-series	0.13	0.18	0.28	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	70.46	100.00	100.00	



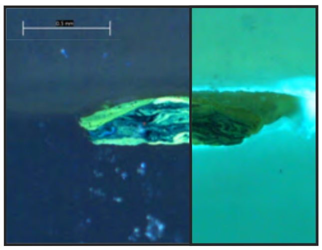
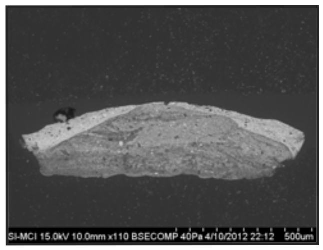
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference, epoxy mount medium

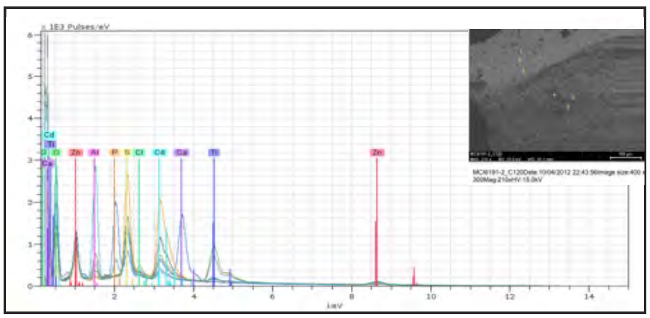

acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: yellow green

sample location: right edge, 38.0" from top
(T 96.5 x R 0.0 cm.)

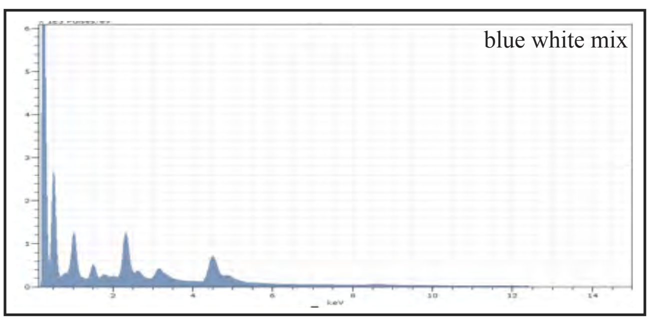
Representative Analysis Compilation—sample C120

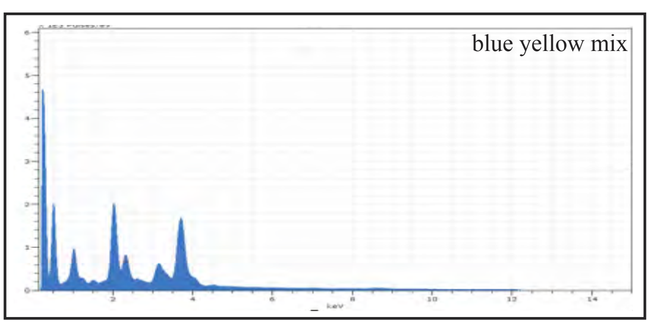
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



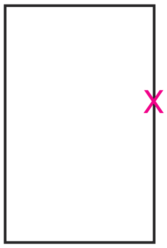
analysis: EDS
by: DVR (MCI)
date: 04/10/12
working distance: 10.1 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Al
significant elements, yellow: Cd, S
interpretation: ultramarine blue, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	14.72	25.63	9.11	1.20
Titanium	K-series	10.34	18.01	18.35	1.00
Sulfur	K-series	7.96	13.86	21.09	0.31
Sodium	K-series	6.46	11.25	23.87	5.11
Zinc	K-series	6.41	11.16	8.33	0.25
Cadmium	L-series	6.14	10.69	4.64	1.11
Chlorine	K-series	2.03	3.53	4.85	0.09
Aluminium	K-series	1.94	3.38	6.10	1.23
Potassium	K-series	0.71	1.24	1.55	0.39
Silicon	K-series	0.47	0.82	1.43	0.05
Phosphorus	K-series	0.24	0.41	0.65	0.03
Magnesium	K-series	0.01	0.02	0.04	0.03
Calcium	K-series	0.00	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	57.43	100.00	100.00	



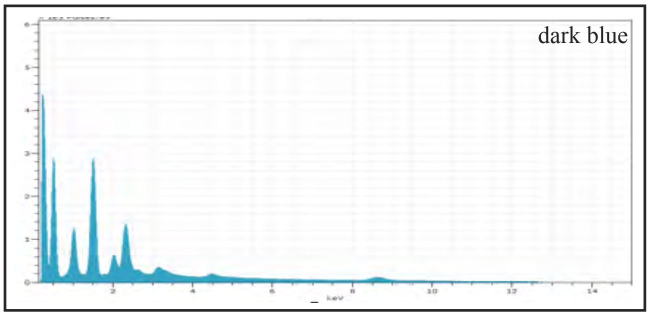
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	32.13	31.58	33.84	1.06
Cadmium	L-series	15.95	15.68	5.99	1.92
Phosphorus	K-series	15.82	15.55	21.56	0.63
Zinc	K-series	12.77	12.55	8.25	0.46
Sulfur	K-series	7.37	7.24	9.70	0.29
Sodium	K-series	6.90	6.78	12.67	5.45
Barium	L-series	6.34	6.23	1.95	0.47
Chlorine	K-series	1.93	1.90	2.30	0.09
Magnesium	K-series	1.20	1.18	2.09	0.18
Potassium	K-series	0.85	0.83	0.92	0.60
Aluminium	K-series	0.41	0.41	0.65	0.34
Silicon	K-series	0.06	0.06	0.09	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	101.72	100.00	100.00	



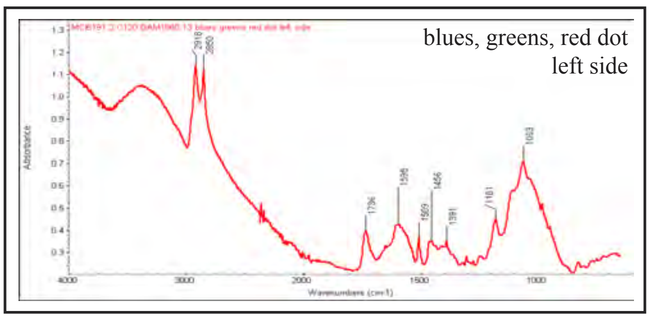
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: yellow green

sample location: right edge, 38.0" from top
(T 96.5 x R 0.0 cm.)

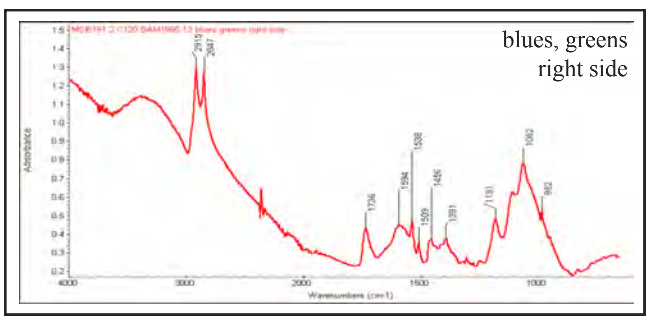
Representative Analysis Compilation—sample C120, continued



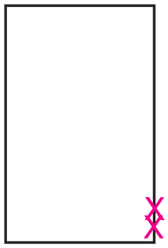
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	10.51	13.97	11.14	2.36
Zinc	K-series	10.39	13.81	4.54	0.37
Sulfur	K-series	5.06	6.73	4.52	0.20
Sodium	K-series	4.03	5.35	5.01	3.19
Cadmium	L-series	1.83	2.43	0.47	0.47
Phosphorus	K-series	1.48	1.97	1.37	0.08
Titanium	K-series	0.71	0.95	0.42	0.11
Chlorine	K-series	0.43	0.57	0.35	0.04
Potassium	K-series	0.40	0.54	0.30	0.18
Barium	L-series	0.18	0.23	0.04	0.11
Calcium	K-series	0.02	0.03	0.02	0.04
Selenium	L-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	40.19	53.41	71.83	16.98
	Sum:	75.23	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

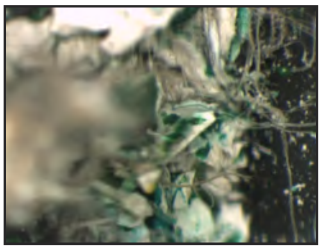


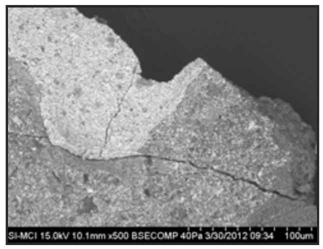
no image available

acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: ground layer and green

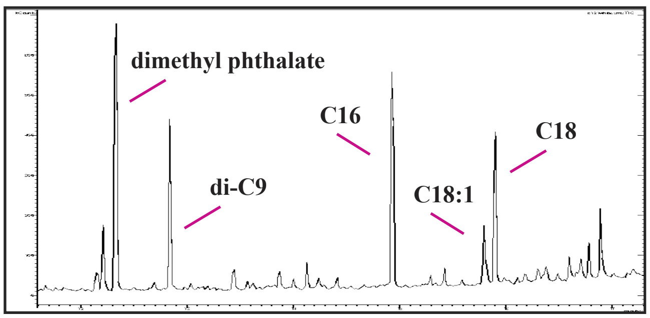
sample location: right edge, 3.0-8.0" from bottom
(B 7.6-20.3 x R 0.0 cm.)

Representative Analysis Compilation—sample C121

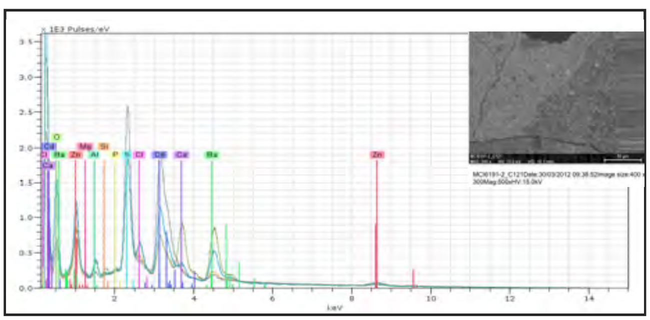




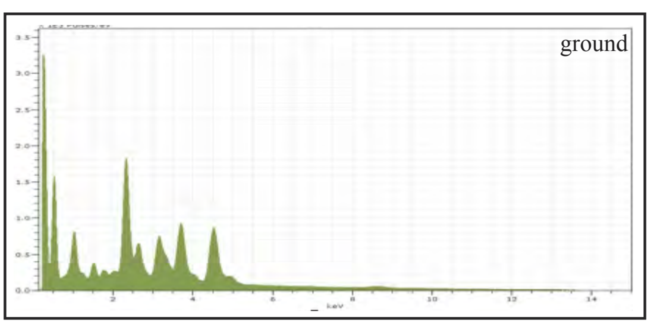
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



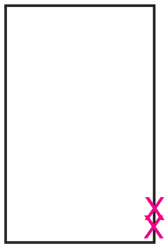
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.262
scan range: 1 - 1482
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18:1, C18
interpretation: alkyd, oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti
significant elements, green: Cd, S, Na, Zn
interpretation: titanium white, cadmium green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	14.68	15.46	10.14	0.88
Cadmium	L-series	11.25	11.85	3.31	1.35
Zinc	K-series	10.04	10.57	5.08	0.36
Calcium	K-series	10.04	10.57	8.28	0.38
Sulfur	K-series	9.43	9.93	9.72	0.36
Barium	L-series	5.96	6.28	1.44	0.91
Chlorine	K-series	3.62	3.81	3.38	0.15
Sodium	K-series	1.21	1.27	1.74	0.97
Aluminium	K-series	0.88	0.93	1.08	0.70
Potassium	K-series	0.84	0.88	0.71	0.50
Magnesium	K-series	0.44	0.47	0.60	0.11
Silicon	K-series	0.24	0.25	0.28	0.04
Phosphorus	K-series	0.14	0.15	0.15	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	26.18	27.57	54.11	12.77
	Sum:	94.93	100.00	100.00	

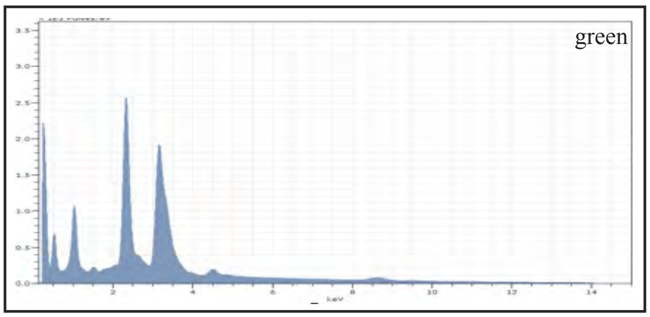


no image available

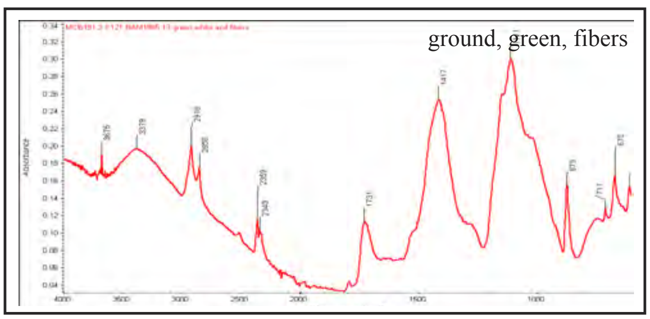
acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: ground layer

sample location: right edge, 3.0-8.0" from bottom (B 7.6-20.3 x R 0.0 cm.)

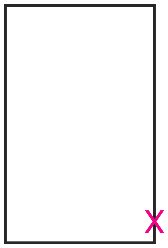
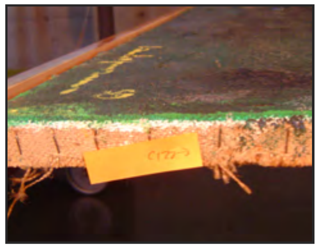
Representative Analysis Compilation—sample C121, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	42.72	40.63	14.75	3.26
Sulfur	K-series	20.22	19.23	24.47	0.74
Zinc	K-series	12.75	12.13	7.57	0.45
Potassium	K-series	4.32	4.10	4.28	1.18
Sodium	K-series	3.94	3.75	6.65	3.12
Chlorine	K-series	2.51	2.38	2.74	0.11
Titanium	K-series	1.06	1.01	0.86	0.16
Barium	L-series	0.98	0.94	0.28	0.22
Phosphorus	K-series	0.55	0.52	0.69	0.05
Calcium	K-series	0.55	0.52	0.53	0.20
Aluminium	K-series	0.28	0.26	0.40	0.23
Magnesium	K-series	0.16	0.15	0.25	0.07
Silicon	K-series	0.12	0.11	0.16	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	15.00	14.26	36.37	11.01
	Sum:	105.14	100.00	100.00	



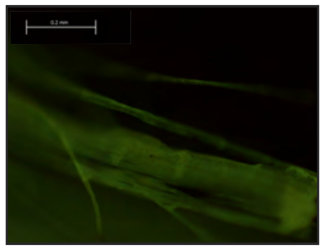
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers, cadmium interference

acc. no.: BAM 1965.13
title, year: *Above Deep Waters*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.2 x 52.0" (213.9 x 132.1 cm.)
notes: warp and weft threads

sample location: right edge, 4.0" from bottom
(B 10.2 x R 0.0 cm.)

Representative Analysis Compilation—sample C122

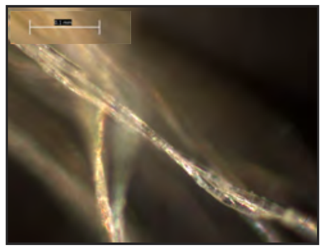
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

no image available

acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: fibers, some lining fabric included

sample location: right edge,
4.0" from bottom (B 10.2 x R 0.0 cm.)

Representative Analysis Compilation—sample C123

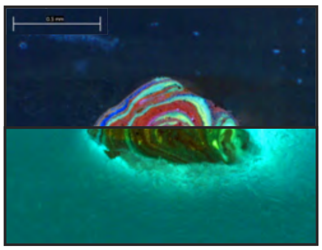


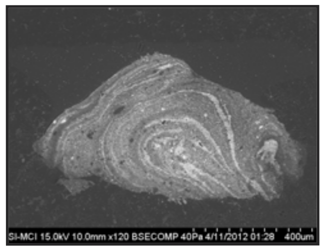
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification
interpretation: linen

acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: brown, possible stratigraphy

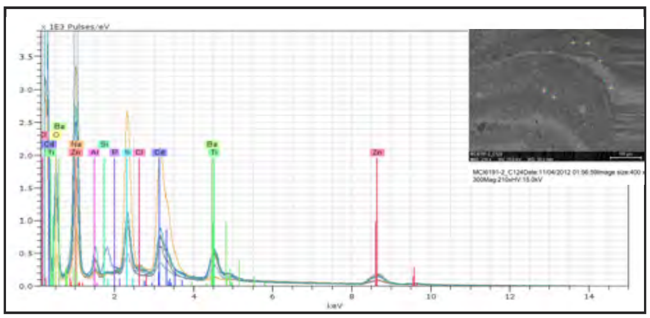
sample location: left edge,
22.0" from top (T 55.9 x L 0.0 cm.)

Representative Analysis Compilation—sample C124

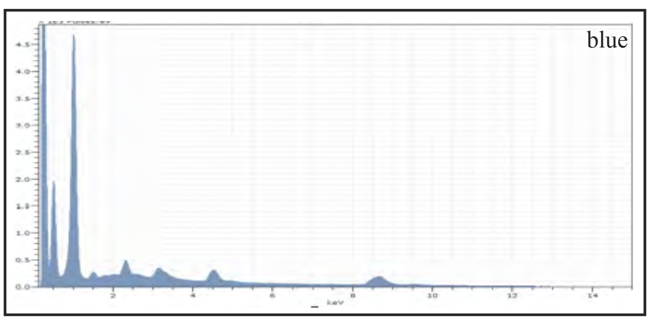




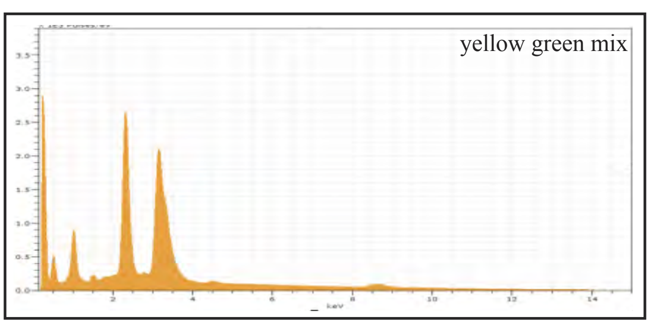
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 10.0 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Al
significant elements, green: Cd, S, Na, Zn
significant elements, red: Cd, S
interpretation: ultramarine blue, cadmium green, cadmium red



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	35.63	51.07	31.00	1.20
Sodium	K-series	22.30	31.96	55.17	17.57
Titanium	K-series	4.09	5.86	4.86	0.30
Cadmium	L-series	3.72	5.33	1.88	0.78
Sulfur	K-series	2.13	3.06	3.79	0.10
Aluminium	K-series	0.56	0.81	1.19	0.05
Chlorine	K-series	0.48	0.69	0.77	0.04
Potassium	K-series	0.44	0.63	0.64	0.28
Phosphorus	K-series	0.30	0.42	0.54	0.04
Silicon	K-series	0.04	0.06	0.09	0.03
Copper	K-series	0.04	0.05	0.03	0.03
Iron	K-series	0.02	0.04	0.03	0.03
Barium	L-series	0.01	0.02	0.00	0.03
Magnesium	K-series	0.00	0.00	0.01	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	69.77	100.00	100.00	

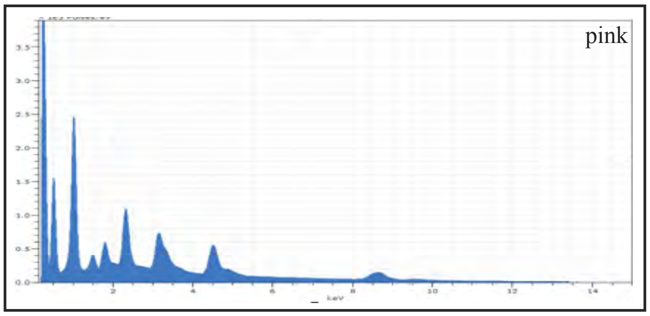


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	26.44	34.38	15.24	2.36
Zinc	K-series	18.24	23.72	18.07	0.63
Sulfur	K-series	16.35	21.26	33.03	0.60
Sodium	K-series	7.01	9.12	19.75	5.54
Potassium	K-series	5.57	7.24	9.23	0.79
Barium	L-series	1.72	2.24	0.81	0.17
Aluminium	K-series	0.82	1.06	1.96	0.65
Magnesium	K-series	0.56	0.72	1.48	0.14
Silicon	K-series	0.10	0.13	0.23	0.03
Phosphorus	K-series	0.09	0.12	0.20	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Vanadium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
	Sum:	76.91	100.00	100.00	

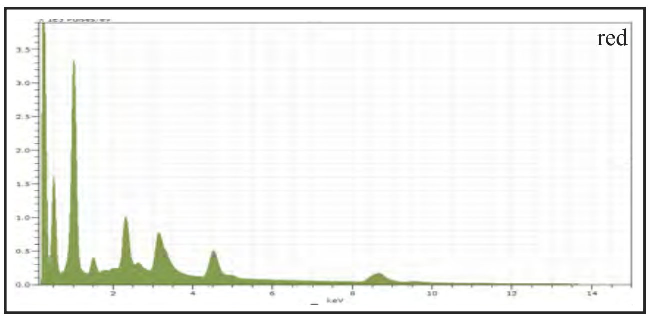
acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: brown, possible stratigraphy

sample location: left edge,
22.0" from top (T 55.9 x L 0.0 cm.)

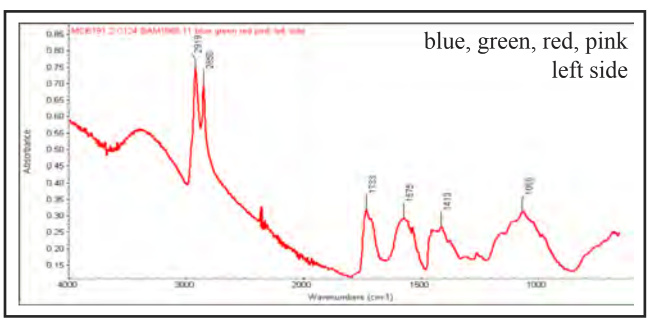
Representative Analysis Compilation—sample C124, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	25.65	32.80	21.34	0.87
Sodium	K-series	15.32	19.59	36.25	12.08
Cadmium	L-series	11.15	14.26	5.40	1.40
Titanium	K-series	7.38	9.43	8.38	0.55
Sulfur	K-series	6.95	8.88	11.79	0.27
Barium	L-series	3.10	3.97	1.23	0.56
Silicon	K-series	2.99	3.82	5.79	0.15
Aluminium	K-series	1.97	2.52	3.97	1.28
Potassium	K-series	1.25	1.60	1.75	0.53
Phosphorus	K-series	1.14	1.46	2.00	0.07
Chlorine	K-series	0.71	0.90	1.08	0.05
Calcium	K-series	0.32	0.41	0.44	0.09
Magnesium	K-series	0.26	0.33	0.57	0.09
Selenium	L-series	0.03	0.03	0.02	0.04
	Sum:	78.22	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	28.75	39.30	26.03	0.98
Sodium	K-series	15.94	21.79	41.04	12.57
Cadmium	L-series	10.99	15.02	5.79	1.42
Titanium	K-series	7.84	10.71	9.69	0.44
Sulfur	K-series	5.55	7.58	10.24	0.22
Potassium	K-series	1.51	2.07	2.29	0.52
Aluminium	K-series	1.21	1.65	2.66	0.08
Chlorine	K-series	1.12	1.54	1.88	0.07
Phosphorus	K-series	0.17	0.23	0.33	0.03
Barium	L-series	0.05	0.07	0.02	0.05
Silicon	K-series	0.02	0.02	0.03	0.03
Calcium	K-series	0.01	0.01	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	73.15	100.00	100.00	

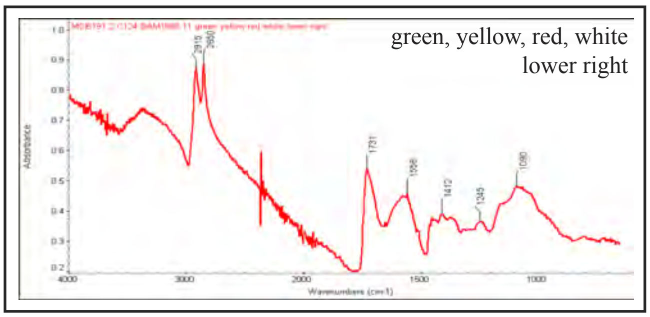


analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

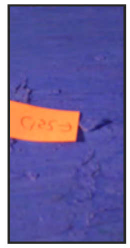
acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: brown, possible stratigraphy

sample location: left edge,
22.0" from top (T 55.9 x L 0.0 cm.)

Representative Analysis Compilation—sample C124, continued



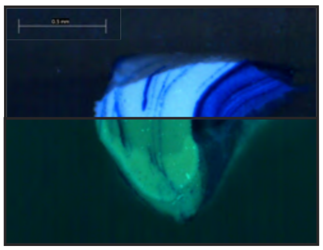
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

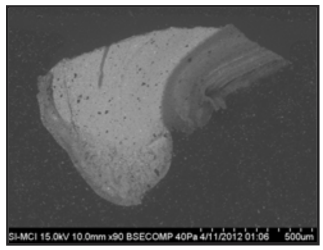


acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: blue

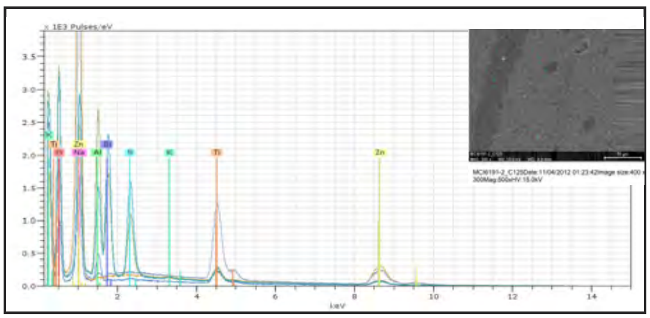
sample location: 23.0" from top,
5.0" from left (T 58.4 x L 12.7 cm.)

Representative Analysis Compilation—sample C125

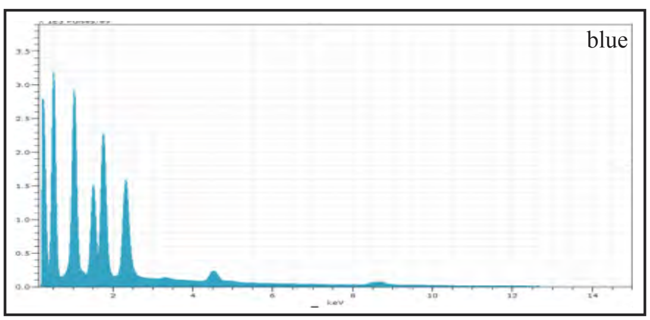




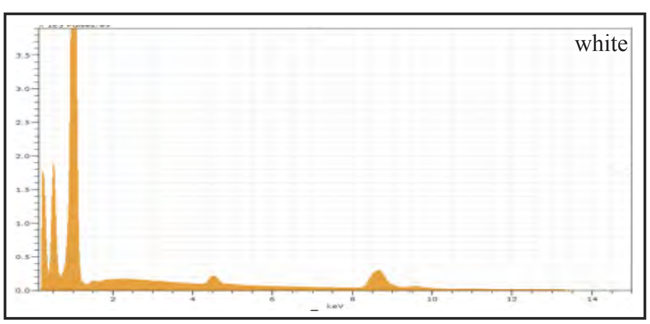
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



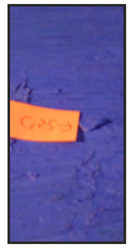
analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Si, Sl
significant elements, white: Zn, Ti
interpretation: ultramarine blue, Zn/Ti white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Sodium	K-series	12.78	13.59	12.72	10.08
Zinc	K-series	10.44	11.10	3.65	0.38
Silicon	K-series	9.49	10.10	7.74	0.42
Sulfur	K-series	7.61	8.09	5.43	0.29
Aluminium	K-series	4.75	5.06	4.03	0.25
Titanium	K-series	2.59	2.75	1.24	0.25
Copper	K-series	0.41	0.43	0.15	0.05
Barium	L-series	0.40	0.43	0.07	0.22
Potassium	K-series	0.17	0.18	0.10	0.03
Chlorine	K-series	0.04	0.05	0.03	0.03
Calcium	K-series	0.01	0.01	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	45.32	48.21	64.84	16.38
	Sum:	94.00	100.00	100.00	



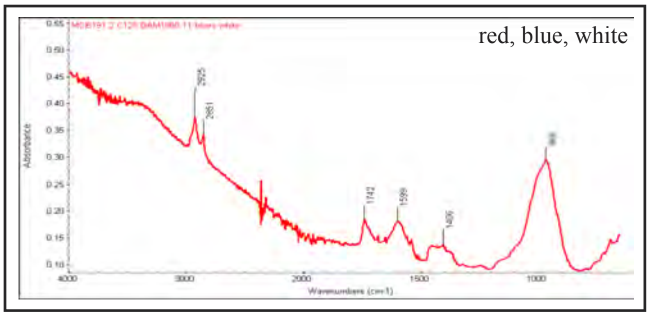
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	74.56	62.20	37.88	2.48
Sodium	K-series	39.20	32.70	56.65	30.88
Titanium	K-series	1.32	1.11	0.92	0.17
Chlorine	K-series	1.06	0.88	0.99	0.06
Phosphorus	K-series	0.78	0.65	0.83	0.06
Sulfur	K-series	0.76	0.63	0.79	0.05
Potassium	K-series	0.61	0.51	0.51	0.05
Silicon	K-series	0.54	0.45	0.64	0.05
Barium	L-series	0.42	0.35	0.10	0.23
Aluminium	K-series	0.40	0.34	0.49	0.05
Calcium	K-series	0.22	0.19	0.18	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	119.87	100.00	100.00	



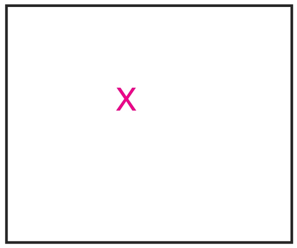
acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: blue

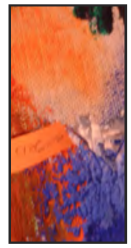
sample location: 23.0" from top,
5.0" from left (T 58.4 x L 12.7 cm.)

Representative Analysis Compilation—sample C125, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference, fillers

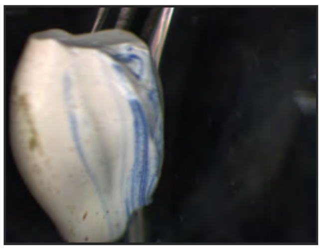


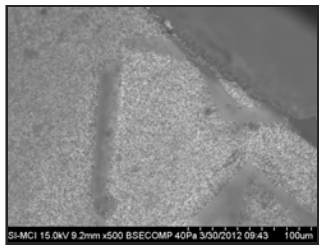


acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: compositional white

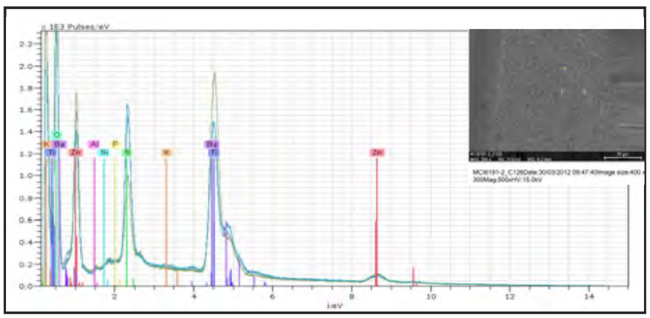
sample location: 21.0" from top,
29.0" from left (T 53.3 x L 73.7 cm.)

Representative Analysis Compilation—sample C126

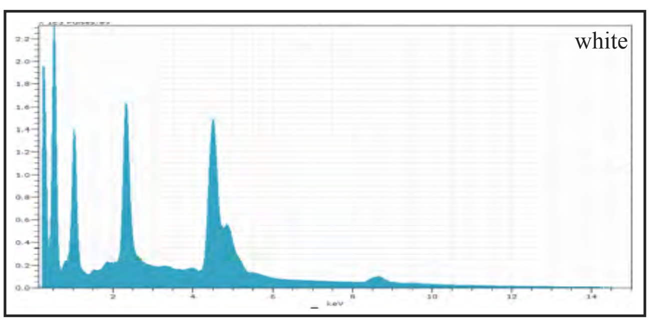




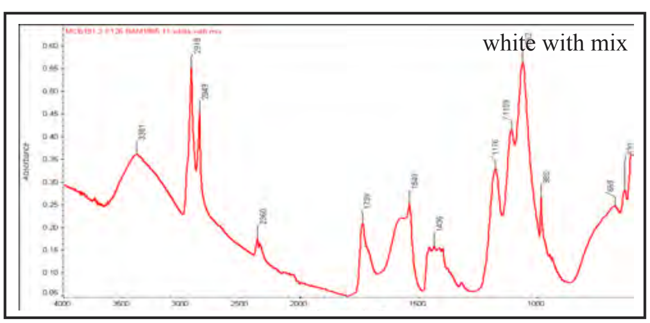
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.2 mm.



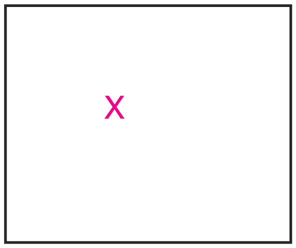
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/ti white

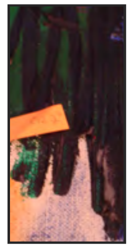


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	31.10	26.27	6.31	1.98
Zinc	K-series	17.04	14.39	7.27	0.59
Titanium	K-series	13.84	11.70	8.06	1.31
Sulfur	K-series	13.45	11.36	11.69	0.50
Sodium	K-series	5.10	4.31	6.19	4.04
Chlorine	K-series	2.38	2.01	1.87	0.11
Potassium	K-series	1.18	1.00	0.84	0.06
Phosphorus	K-series	0.93	0.78	0.84	0.06
Silicon	K-series	0.78	0.66	0.77	0.06
Calcium	K-series	0.44	0.37	0.30	0.04
Aluminium	K-series	0.21	0.18	0.22	0.04
Magnesium	K-series	0.03	0.02	0.03	0.03
Oxygen	K-series	31.90	26.95	55.60	13.11
	Sum:	118.37	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

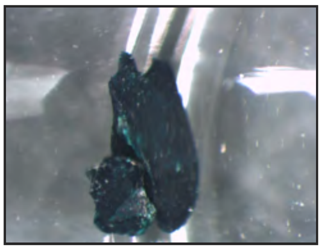


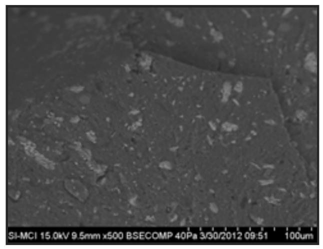


acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: black or maybe deep green

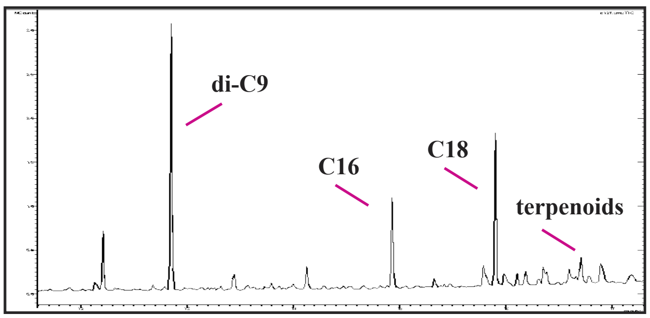
sample location: 22.0" from top,
27.0" from left (T 55.9 x L 68.6 cm.)

Representative Analysis Compilation—sample C127

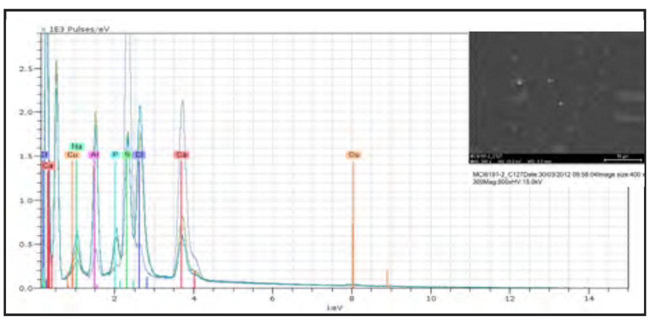




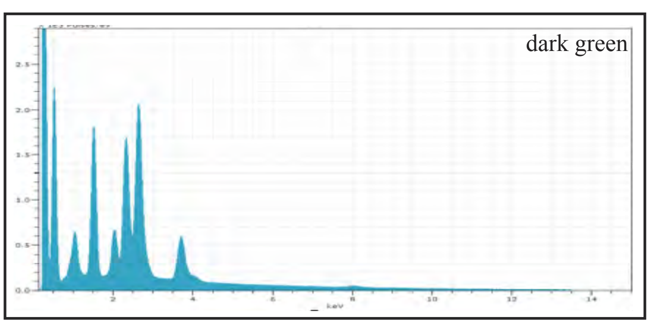
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



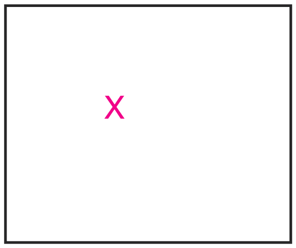
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.308
scan range: 1 - 1478
time range: 0.00 - 23.37 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil

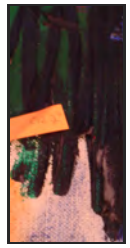


analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cl, Cu
interpretation: phthalo green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Chlorine	K-series	19.05	18.46	13.61	0.66
Sulfur	K-series	10.66	10.34	8.43	0.40
Copper	K-series	10.02	9.71	3.99	0.35
Calcium	K-series	8.40	8.14	5.31	0.28
Aluminium	K-series	8.29	8.04	7.79	5.12
Barium	L-series	4.81	4.66	0.89	0.37
Sodium	K-series	4.26	4.13	4.70	2.39
Phosphorus	K-series	3.03	2.93	2.48	0.14
Bromine	L-series	1.06	1.03	0.34	0.74
Potassium	K-series	0.75	0.72	0.48	0.09
Magnesium	K-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	32.84	31.83	51.99	13.62
	Sum:	103.16	100.00	100.00	

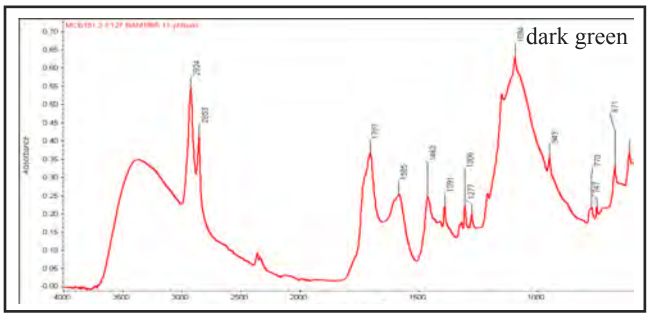




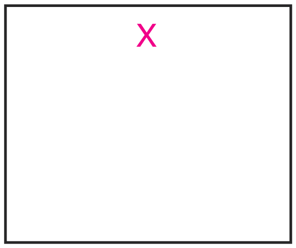
acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: black or maybe deep green

sample location: 22.0" from top,
27.0" from left (T 55.9 x L 68.6 cm.)

Representative Analysis Compilation—sample C127, continued



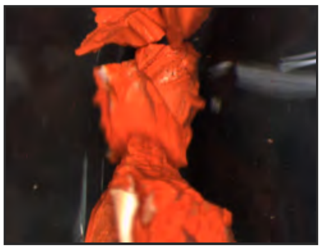
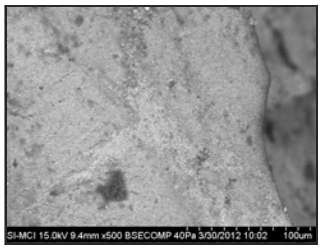
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

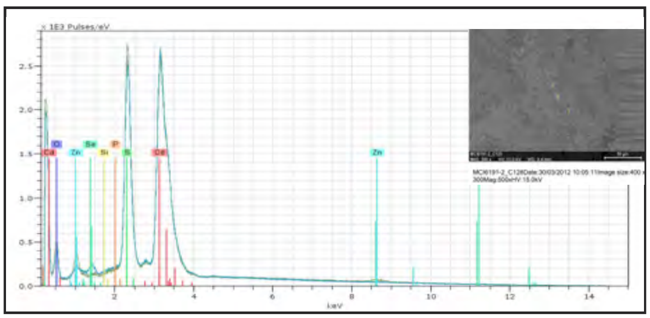
acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: orange

sample location: 8.0" from top,
33.0" from left (T 20.3 x L 83.8 cm.)

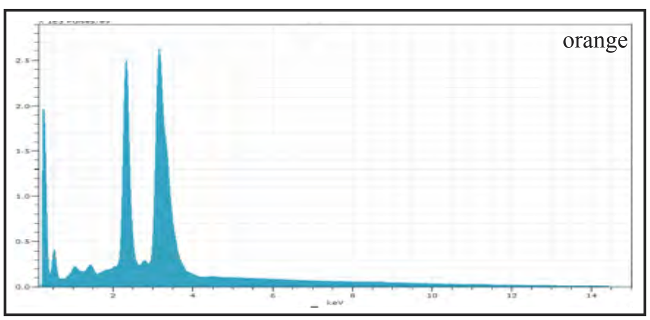
Representative Analysis Compilation—sample C128

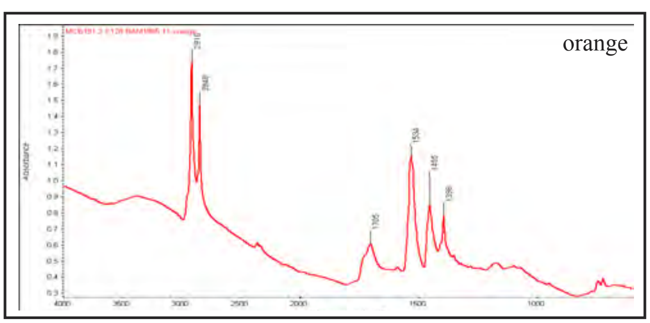
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



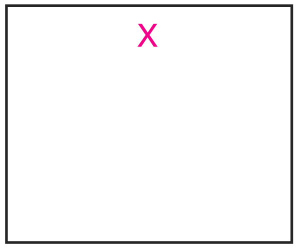
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
interpretation: cadmium orange



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	60.80	50.91	22.82	4.25
Sulfur	K-series	22.98	19.24	30.22	0.84
Zinc	K-series	11.49	9.62	7.41	0.41
Potassium	K-series	7.81	6.54	8.42	1.40
Selenium	L-series	2.10	1.76	1.12	0.18
Barium	L-series	1.73	1.45	0.53	0.17
Sodium	K-series	1.32	1.11	2.42	1.06
Chlorine	K-series	0.88	0.74	1.05	0.07
Phosphorus	K-series	0.56	0.47	0.76	0.05
Magnesium	K-series	0.27	0.23	0.47	0.13
Silicon	K-series	0.20	0.17	0.30	0.04
Calcium	K-series	0.02	0.02	0.02	0.04
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	9.28	7.77	24.46	8.58
	Sum:	119.43	100.00	100.00	



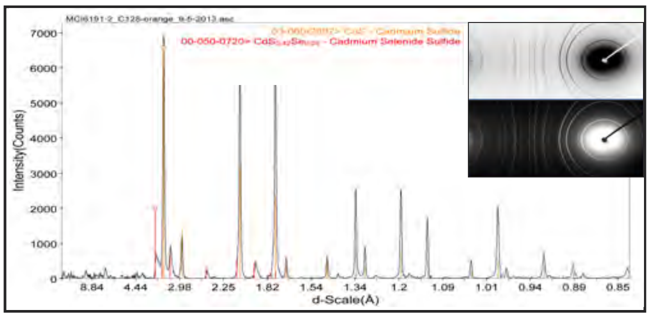
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: zinc soaps



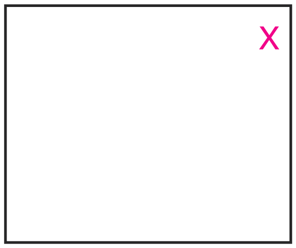
acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: orange

sample location: 8.0" from top,
33.0" from left (T 20.3 x L 83.8 cm.)

Representative Analysis Compilation—sample C128, continued



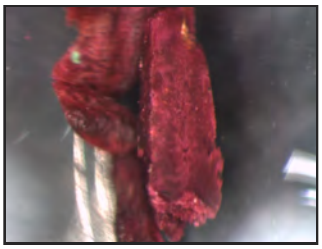
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, spin 360º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide,
cadmium selenide sulfide
interpretation: cadmium orange

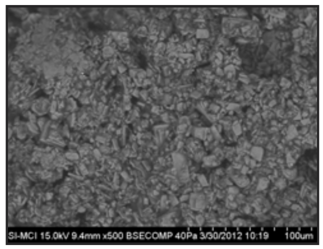


acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: purple

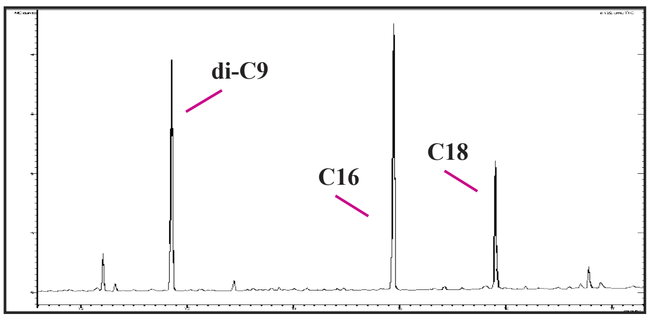
sample location: 8.5" from top,
8.0" from right (T 21.6 x R 20.3 cm.)

Representative Analysis Compilation—sample C129

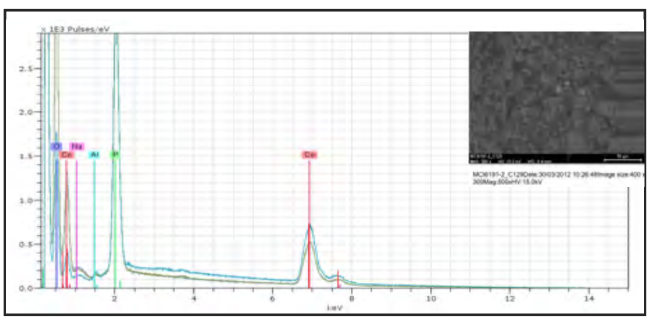




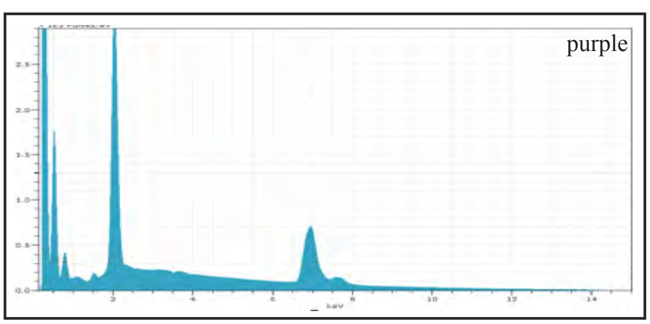
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



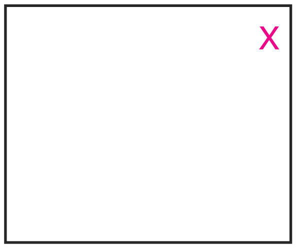
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.317
scan range: 1 - 1477
time range: 0.00 - 23.34 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Co, P
interpretation: cobalt violet



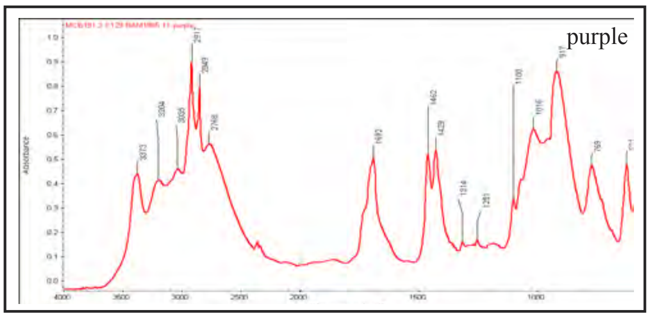
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cobalt	K-series	28.76	36.66	21.20	0.88
Phosphorus	K-series	26.10	33.27	36.60	1.01
Barium	L-series	3.18	4.05	1.00	0.24
Chlorine	K-series	2.74	3.49	3.36	0.12
Potassium	K-series	2.08	2.66	2.31	0.09
Sulfur	K-series	1.85	2.35	2.50	0.09
Calcium	K-series	1.74	2.22	1.89	0.08
Aluminium	K-series	0.48	0.61	0.77	0.05
Sodium	K-series	0.27	0.34	0.51	0.24
Zinc	K-series	0.22	0.29	0.15	0.04
Silicon	K-series	0.17	0.22	0.26	0.03
Magnesium	K-series	0.04	0.05	0.07	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	10.81	13.79	29.36	5.10
	Sum:	78.44	100.00	100.00	



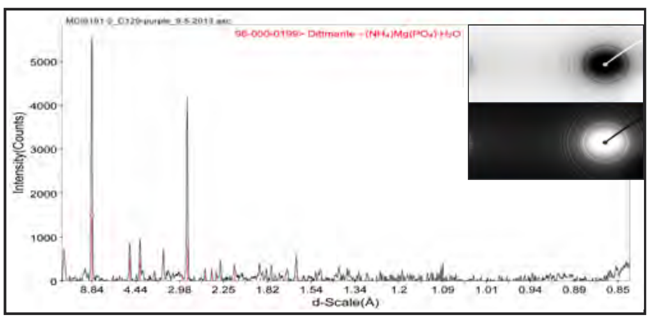
acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: purple

sample location: 8.5" from top,
8.0" from right (T 21.6 x R 20.3 cm.)

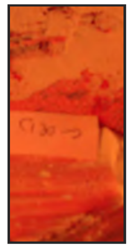
Representative Analysis Compilation—sample C129, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: inconclusive; consistent with three other spectra



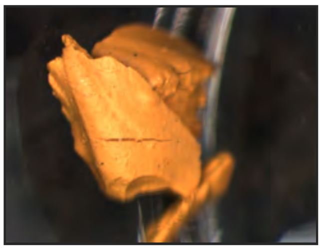
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, spin 360º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: dittmarite
interpretation: cobalt violet

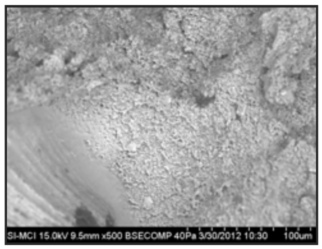


acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: yellow orange

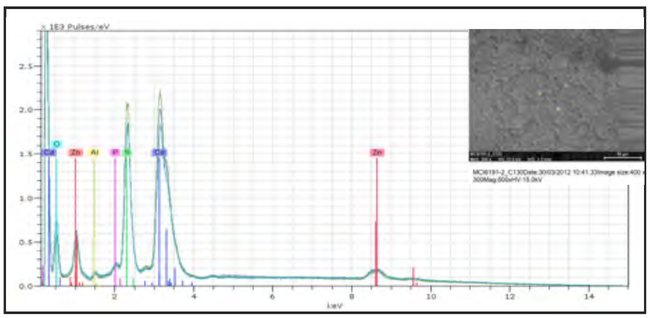
sample location: 33.5" from top,
6.0" from left (T 85.1 x L 15.2 cm.)

Representative Analysis Compilation—sample C130

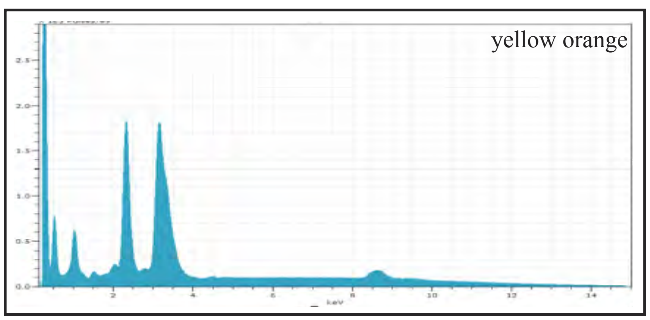




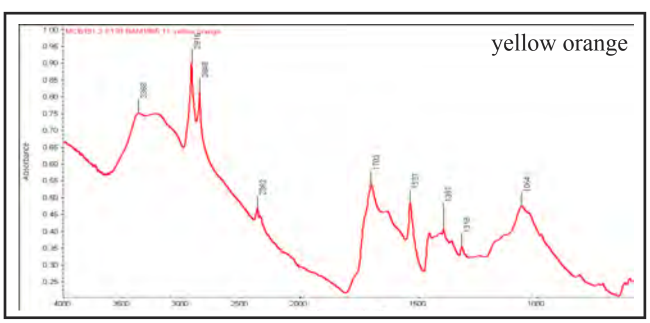
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
interpretation: cadmium yellow deep



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	123.11	52.18	45.85	4.07
Cadmium	L-series	54.75	23.21	11.86	4.51
Sulfur	K-series	22.59	9.57	17.15	0.82
Barium	L-series	11.61	4.92	2.06	0.80
Potassium	K-series	8.36	3.54	5.20	1.48
Sodium	K-series	6.79	2.88	7.19	5.37
Phosphorus	K-series	1.55	0.66	1.22	0.09
Aluminium	K-series	0.84	0.36	0.76	0.66
Magnesium	K-series	0.78	0.33	0.78	0.19
Chlorine	K-series	0.45	0.19	0.31	0.06
Silicon	K-series	0.20	0.08	0.17	0.04
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	4.89	2.07	7.45	3.27
	Sum:	235.91	100.00	100.00	

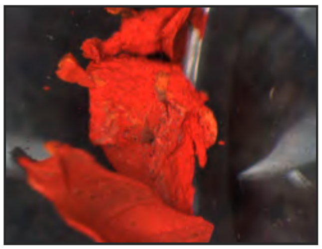


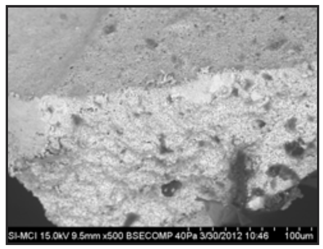
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: pinkish red used in brick red mix

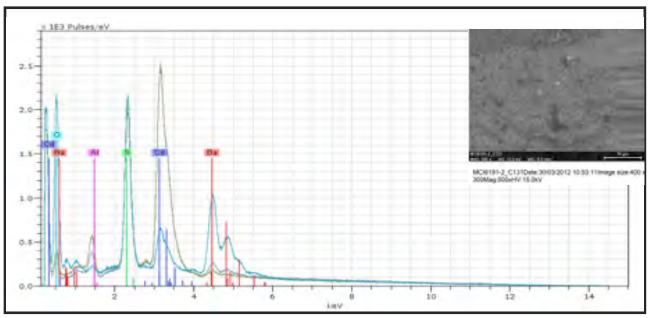
sample location: 31.5" from top,
8.5" from left (T 80.0 x L 21.6 cm.)

Representative Analysis Compilation—sample C131

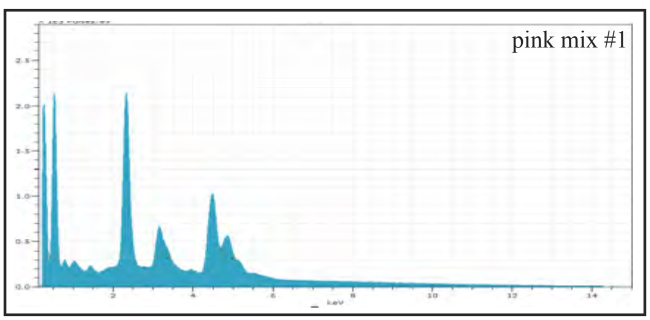




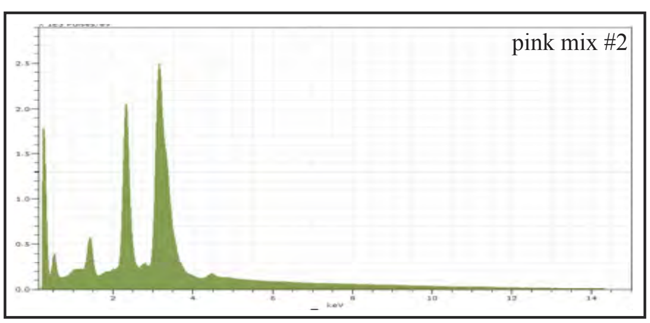
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, pink mix #1: Ba, Cd, S, Se
significant elements, pink mix #2: Zn, Cd, S, Se
interpretation: cadmium red mixed with zinc white or barium sulfate



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	46.85	37.99	10.41	2.97
Sulfur	K-series	18.27	14.82	17.39	0.67
Cadmium	L-series	13.92	11.29	3.78	1.65
Zinc	K-series	5.35	4.34	2.50	0.21
Titanium	K-series	1.91	1.55	1.21	0.71
Chlorine	K-series	1.01	0.82	0.87	0.06
Selenium	L-series	1.01	0.82	0.39	0.10
Potassium	K-series	0.90	0.73	0.71	0.59
Sodium	K-series	0.69	0.56	0.91	0.57
Phosphorus	K-series	0.58	0.47	0.57	0.05
Calcium	K-series	0.54	0.44	0.41	0.11
Magnesium	K-series	0.52	0.43	0.66	0.14
Aluminium	K-series	0.24	0.20	0.28	0.21
Silicon	K-series	0.24	0.20	0.26	0.04
Oxygen	K-series	31.28	25.36	59.65	14.03
	Sum:	123.31	100.00	100.00	

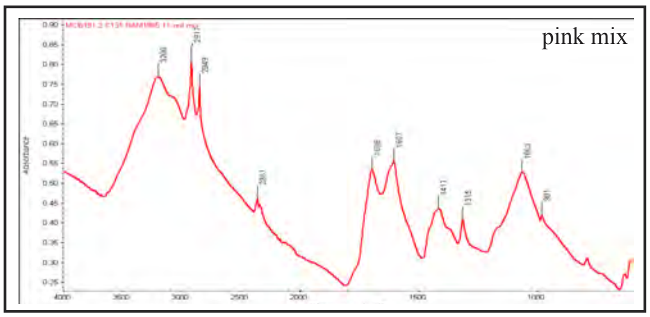


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	60.49	49.17	23.56	4.21
Sulfur	K-series	19.16	15.57	26.16	0.70
Zinc	K-series	11.57	9.41	7.75	0.42
Potassium	K-series	6.81	5.54	7.63	1.43
Selenium	L-series	6.69	5.44	3.71	0.47
Barium	L-series	6.03	4.90	1.92	0.44
Sodium	K-series	0.97	0.79	1.84	0.79
Chlorine	K-series	0.92	0.75	1.14	0.07
Phosphorus	K-series	0.64	0.52	0.90	0.05
Calcium	K-series	0.36	0.29	0.39	0.23
Silicon	K-series	0.26	0.21	0.41	0.04
Aluminium	K-series	0.26	0.21	0.41	0.22
Magnesium	K-series	0.13	0.10	0.23	0.12
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	8.74	7.11	23.93	8.22
	Sum:	123.03	100.00	100.00	

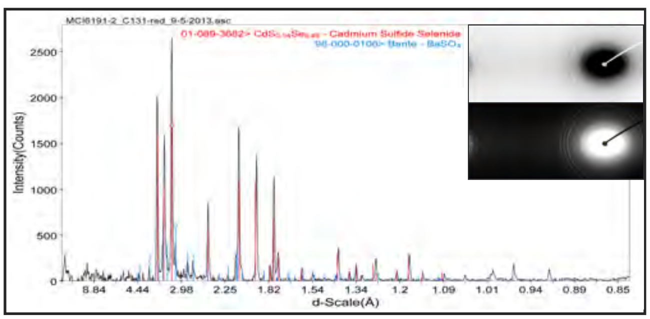
acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: pinkish red used in brick red mix

sample location: 31.5" from top,
8.5" from left (T 80.0 x L 21.6 cm.)

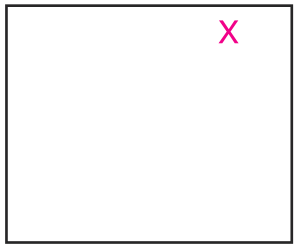
Representative Analysis Compilation—sample C131, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers



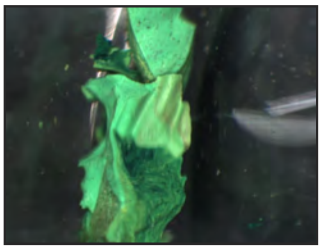
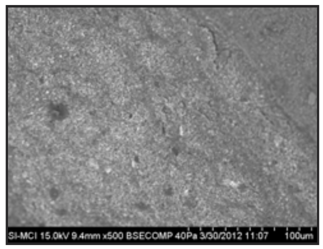
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-120º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, barite
interpretation: cadmium red

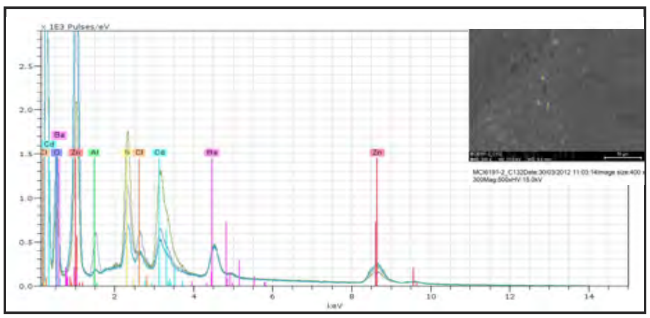
acc. no.: BAM 1965.11
title, year: *Indian Summer*, 1959
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 72.2" (152.7 x 183.4 cm.)
notes: bright green

sample location: 8.5" from top,
19.0" from right (T 21.6 x R 48.3 cm.)

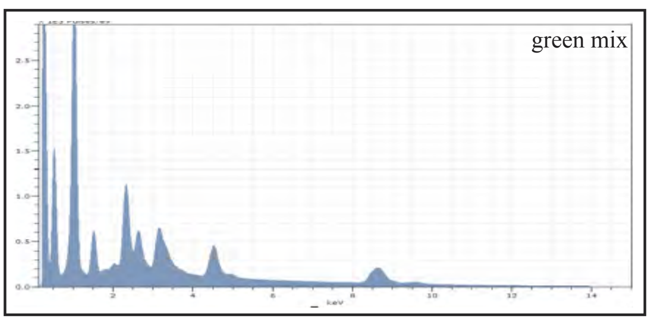
Representative Analysis Compilation—sample C132

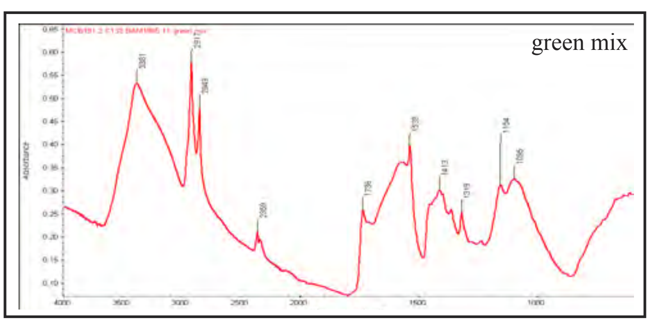
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



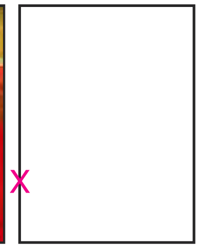
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, green: Zn, Na, Cd, S
interpretation: cadmium green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	43.67	38.06	21.92	1.47
Sodium	K-series	13.31	11.60	19.00	10.50
Cadmium	L-series	12.91	11.25	3.77	1.58
Sulfur	K-series	8.11	7.07	8.30	0.31
Titanium	K-series	5.72	4.98	3.92	0.56
Chlorine	K-series	4.98	4.34	4.61	0.19
Barium	L-series	4.75	4.14	1.13	0.59
Aluminium	K-series	3.81	3.32	4.64	1.96
Potassium	K-series	1.00	0.87	0.84	0.58
Calcium	K-series	0.86	0.75	0.71	0.12
Phosphorus	K-series	0.75	0.65	0.79	0.05
Silicon	K-series	0.17	0.15	0.20	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	14.71	12.82	30.18	7.22
	Sum:	114.75	100.00	100.00	



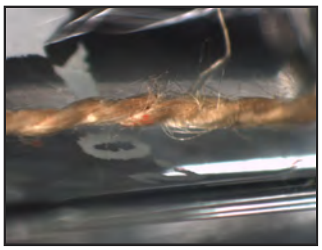
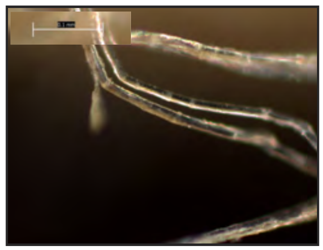
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

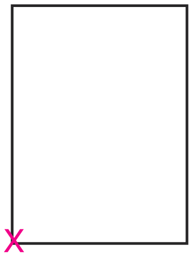
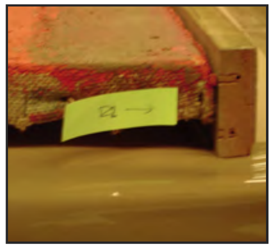

acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: threads, possibly warp

sample location: left edge, 15.8" from bottom
(B 40.0 x L 0.0 cm.)

Representative Analysis Compilation—sample R01

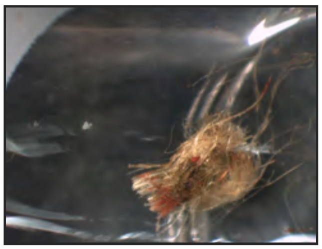
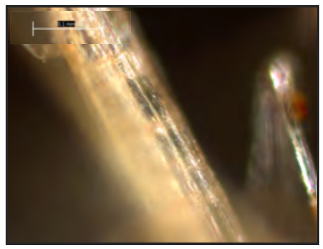
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification
interpretation: linen

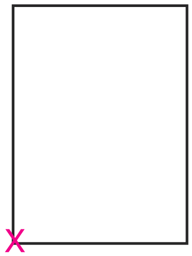
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: threads, possibly weft

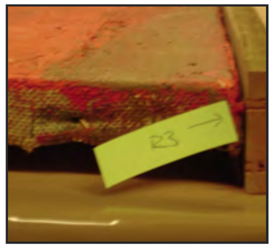
sample location: lower left corner
(B 0.0 x L 0.0 cm.)

Representative Analysis Compilation—sample R02

photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification
interpretation: linen

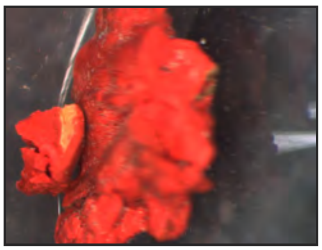


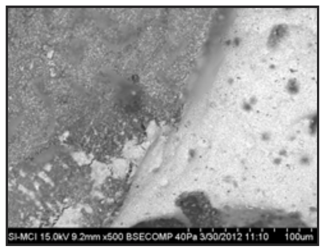


acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: orange, right-side, warping canvas

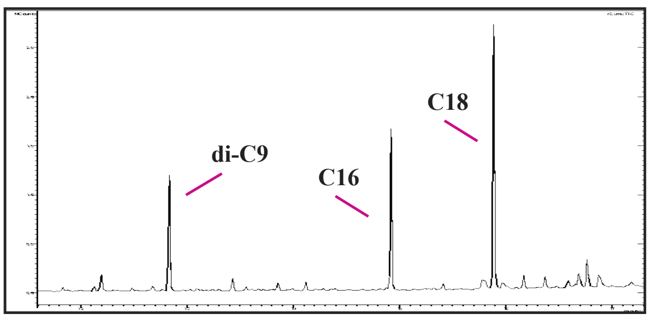
sample location: lower left corner
(B 0.0 x L 0.0 cm.)

Representative Analysis Compilation—sample R03

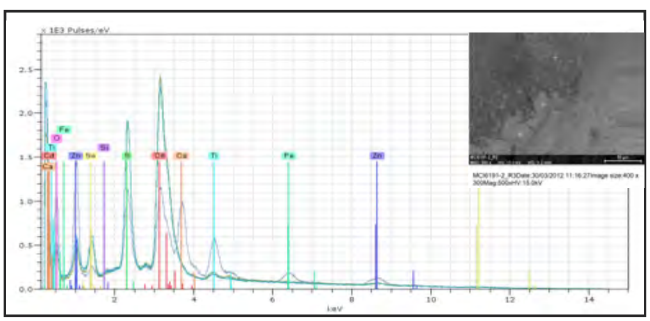




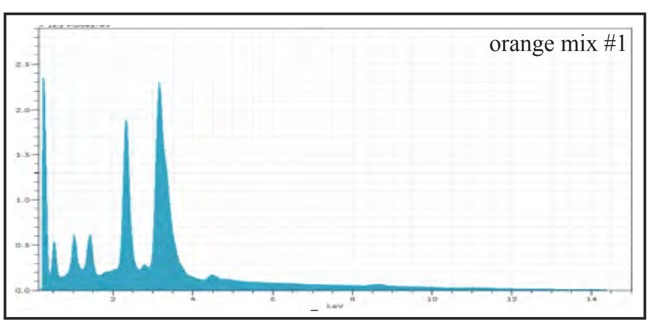
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.2 mm.



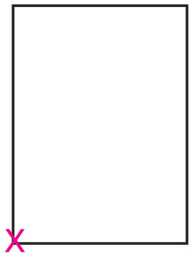
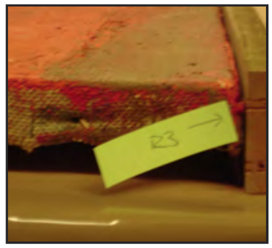
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.163
scan range: 1 - 1487
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, orange #1: Cd, S, Se, Zn
significant elements, orange #2: Cd, S, Se, Ca
interpretation: cadmium orange mixed with zinc white or calcium sulfate



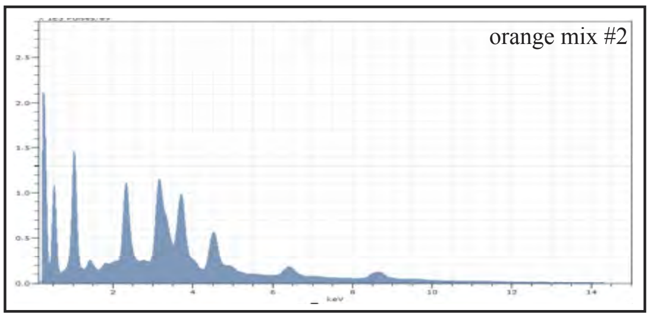
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	54.23	47.46	19.79	3.92
Sulfur	K-series	16.88	14.78	21.60	0.62
Zinc	K-series	10.93	9.57	6.86	0.39
Potassium	K-series	6.19	5.42	6.50	1.35
Selenium	L-series	3.97	3.47	2.06	0.26
Sodium	K-series	2.27	1.99	4.05	1.81
Barium	L-series	2.01	1.76	0.60	0.26
Iron	K-series	1.07	0.94	0.79	0.06
Chlorine	K-series	0.85	0.75	0.99	0.07
Titanium	K-series	0.84	0.74	0.72	0.16
Calcium	K-series	0.79	0.69	0.81	0.23
Phosphorus	K-series	0.69	0.61	0.92	0.05
Silicon	K-series	0.29	0.25	0.42	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	13.22	11.57	33.90	10.69
	Sum:	114.25	100.00	100.00	

acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: orange, right-side, warping canvas

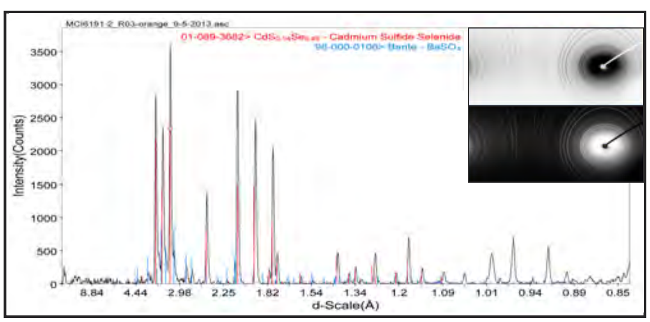
sample location: lower left corner
(B 0.0 x L 0.0 cm.)

Representative Analysis Compilation—sample R03, continued

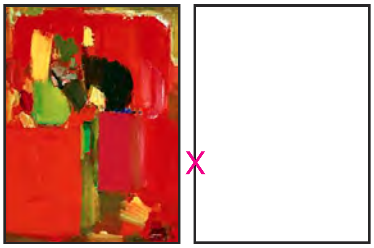


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	22.72	22.33	6.95	2.15
Calcium	K-series	11.33	11.14	9.72	0.42
Zinc	K-series	10.18	10.01	5.35	0.36
Sulfur	K-series	8.64	8.50	9.27	0.33
Titanium	K-series	7.58	7.45	5.44	0.60
Sodium	K-series	7.39	7.27	11.05	5.84
Barium	L-series	4.10	4.03	1.03	0.60
Iron	K-series	2.70	2.65	1.66	0.11
Selenium	L-series	1.76	1.73	0.77	0.16
Potassium	K-series	1.70	1.67	1.49	0.81
Chlorine	K-series	1.28	1.26	1.24	0.07
Phosphorus	K-series	1.00	0.99	1.11	0.06
Silicon	K-series	0.65	0.64	0.79	0.05
Aluminium	K-series	0.37	0.36	0.47	0.31
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	20.33	19.98	43.66	11.71
	Sum:	101.73	100.00	100.00	

analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference, fillers



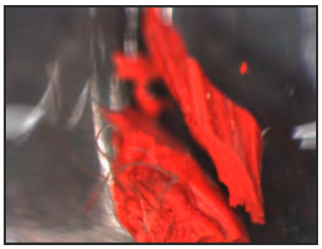
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-90º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, barite
note: a polymorph match to other cadmium red pigments

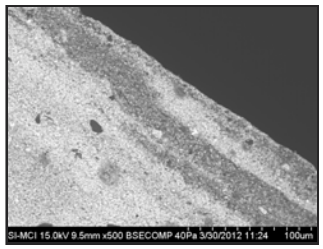


acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: orange

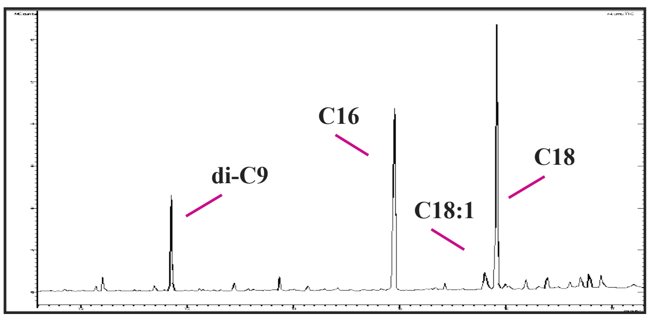
sample location: left edge, 18.9" from bottom
(B 48.0 x L 0.0 cm.)

Representative Analysis Compilation—sample R04

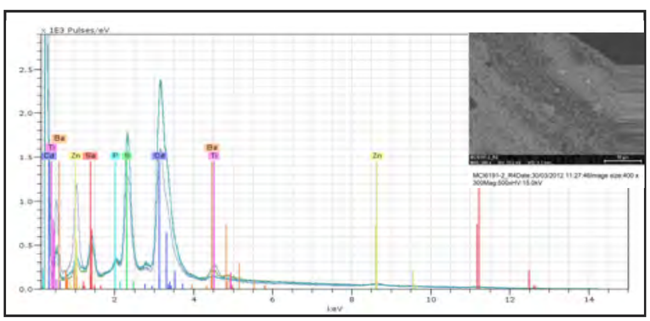




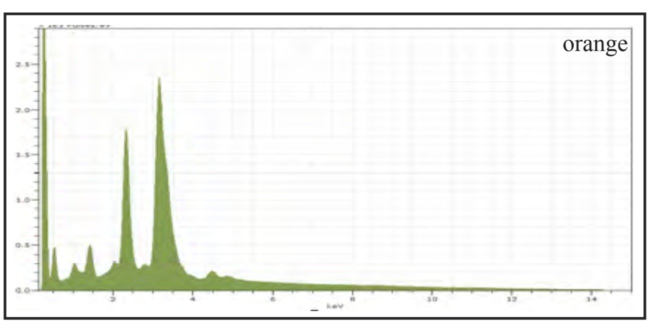
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



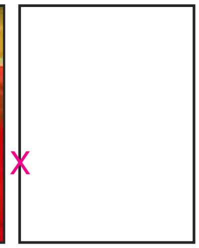
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.373
scan range: 1 - 1482
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
interpretation: cadmium orange



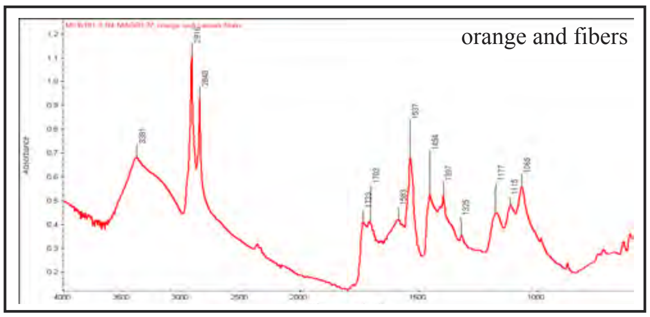
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	49.53	51.16	20.63	3.55
Sulfur	K-series	14.81	15.29	21.62	0.55
Potassium	K-series	5.54	5.72	6.64	1.21
Selenium	L-series	4.61	4.76	2.73	0.32
Zinc	K-series	2.60	2.69	1.86	0.12
Sodium	K-series	1.57	1.62	3.19	1.26
Titanium	K-series	1.45	1.49	1.41	0.20
Phosphorus	K-series	1.33	1.38	2.02	0.08
Barium	L-series	1.26	1.31	0.43	0.25
Chlorine	K-series	0.66	0.68	0.87	0.06
Calcium	K-series	0.25	0.26	0.30	0.19
Aluminium	K-series	0.22	0.22	0.38	0.19
Silicon	K-series	0.08	0.08	0.13	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	12.91	13.34	37.79	11.67
	Sum:	96.82	100.00	100.00	

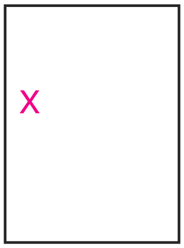
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: orange

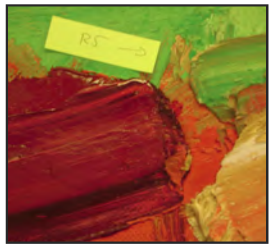
sample location: left edge, 18.9" from bottom
(B 48.0 x L 0.0 cm.)

Representative Analysis Compilation—sample R04, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

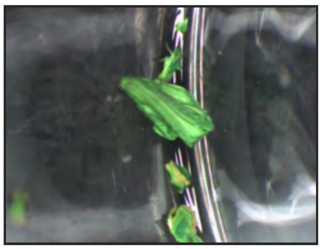


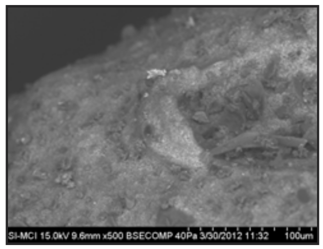


acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: bright green

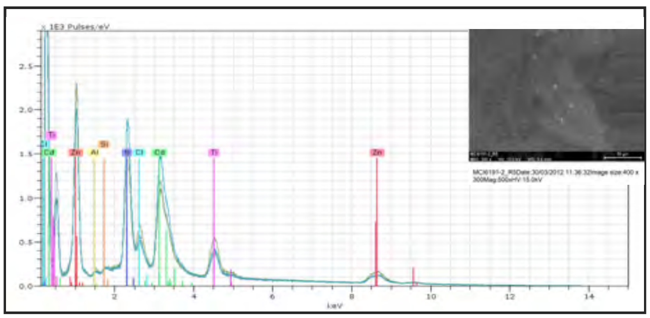
sample location: 31.5" from bottom, 7.1" from left
(B 80.0 x L 18.0 cm.)

Representative Analysis Compilation—sample R05

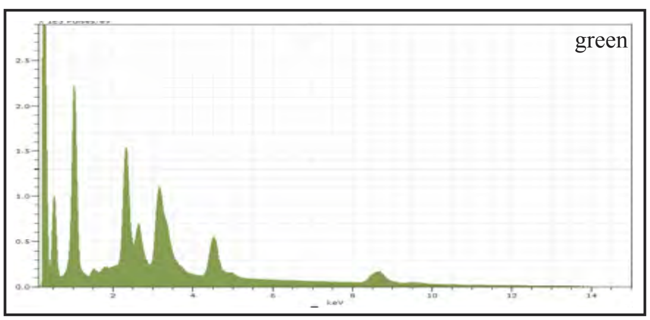




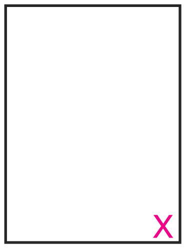
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.

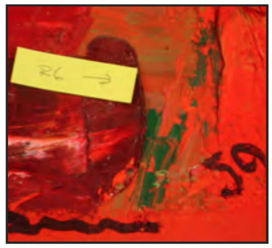


analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, green: Zn, Cd, S, Na
interpretation: cadmium green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	31.62	26.61	16.12	1.07
Cadmium	L-series	24.15	20.32	7.16	2.37
Sodium	K-series	14.78	12.44	21.44	11.66
Sulfur	K-series	12.26	10.32	12.75	0.46
Titanium	K-series	8.88	7.47	6.18	0.61
Chlorine	K-series	6.20	5.22	5.83	0.23
Barium	L-series	2.86	2.41	0.69	0.67
Potassium	K-series	2.67	2.24	2.27	0.87
Iron	K-series	1.08	0.91	0.65	0.06
Calcium	K-series	0.96	0.81	0.80	0.15
Phosphorus	K-series	0.73	0.61	0.78	0.05
Silicon	K-series	0.59	0.50	0.71	0.05
Aluminium	K-series	0.41	0.34	0.50	0.33
Magnesium	K-series	0.21	0.17	0.28	0.09
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	11.44	9.62	23.83	6.81
	Sum:	118.83	100.00	100.00	

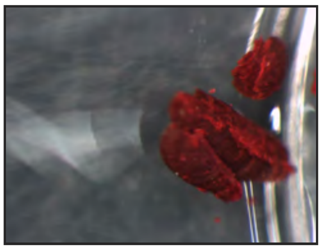
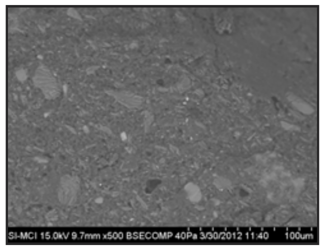





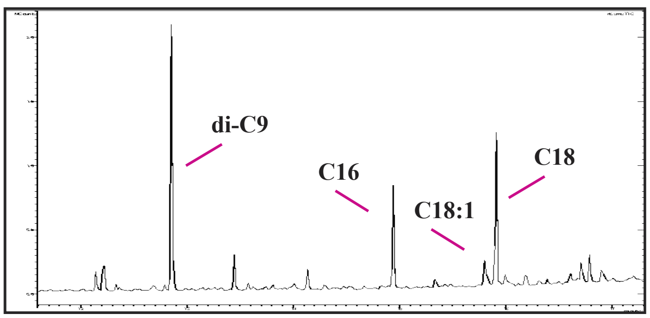
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: magenta, shiny

sample location: 3.5" from bottom, 3.2" from right (B 9.0 x R 8.0 cm.)

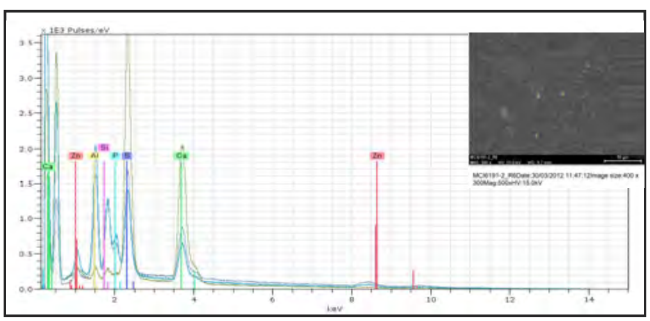
Representative Analysis Compilation—sample R06

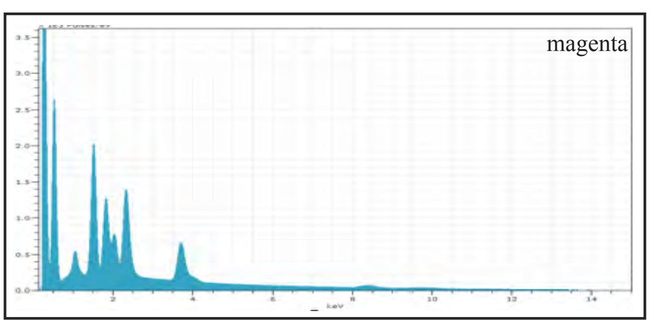
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



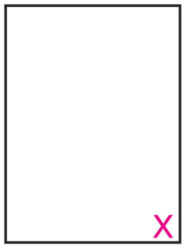
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.176
scan range: 1 - 1483
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil

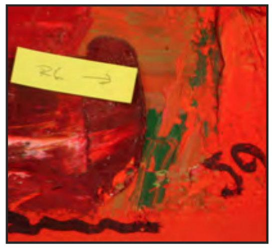


analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, magenta: Al
interpretation: possible synthetic alizarin



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	8.63	11.91	4.12	0.32
Aluminium	K-series	7.06	9.74	8.17	0.35
Sulfur	K-series	6.22	8.58	6.06	0.24
Calcium	K-series	4.53	6.25	3.53	0.16
Silicon	K-series	4.13	5.70	4.59	0.20
Phosphorus	K-series	3.62	4.99	3.65	0.16
Copper	K-series	2.01	2.77	0.99	0.09
Sodium	K-series	1.88	2.59	2.55	1.50
Barium	L-series	0.37	0.50	0.08	0.07
Chlorine	K-series	0.20	0.27	0.17	0.03
Magnesium	K-series	0.03	0.04	0.04	0.03
Potassium	K-series	0.02	0.03	0.02	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	33.80	46.63	66.01	13.25
	Sum:	72.49	100.00	100.00	

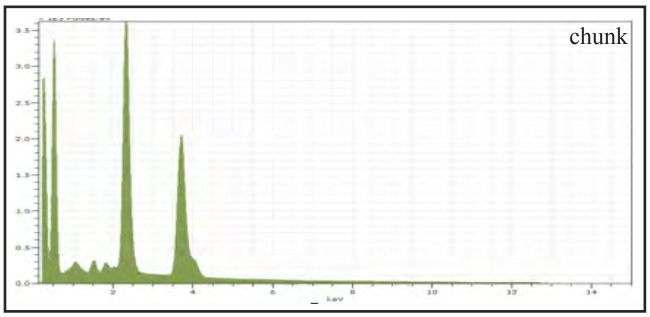




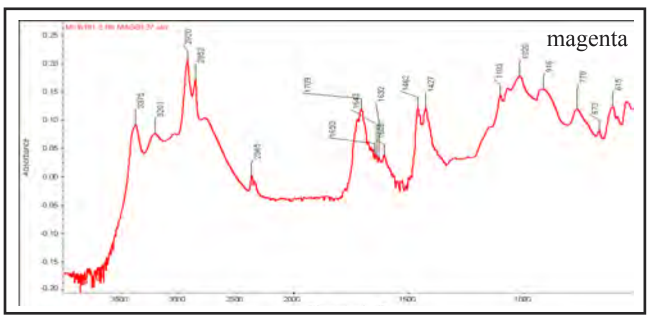
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: magenta, shiny

sample location: 3.5" from bottom, 3.2" from right
(B 9.0 x R 8.0 cm.)

Representative Analysis Compilation—sample R06, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	34.69	27.21	17.27	1.06
Sulfur	K-series	28.12	22.06	17.50	1.02
Zinc	K-series	8.47	6.64	2.58	0.32
Barium	L-series	4.09	3.20	0.59	0.33
Chlorine	K-series	1.09	0.86	0.61	0.06
Sodium	K-series	1.09	0.85	0.95	0.88
Aluminium	K-series	0.86	0.67	0.63	0.07
Silicon	K-series	0.69	0.54	0.49	0.05
Potassium	K-series	0.66	0.52	0.34	0.09
Phosphorus	K-series	0.63	0.50	0.41	0.05
Magnesium	K-series	0.28	0.22	0.23	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	46.84	36.73	58.40	16.73
	Sum:	127.52	100.00	100.00	



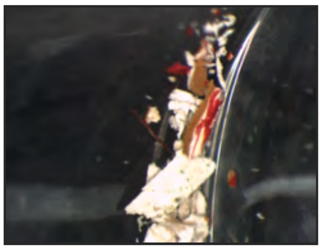
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: inconclusive; consistent with three other spectra containing coblat violet

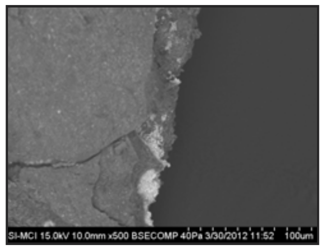
no image available

acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: ground layer

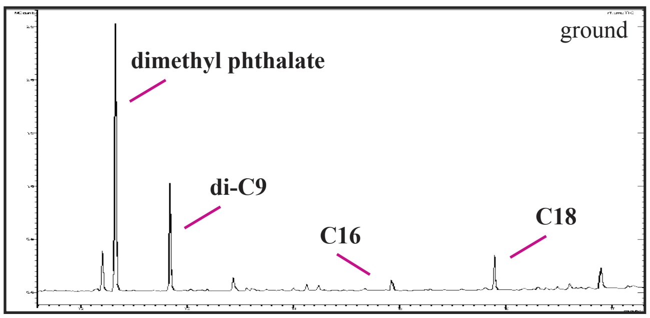
sample location: right edge, 15.0" from bottom
(B 38.0 x R 0.0 cm.)

Representative Analysis Compilation—sample R07

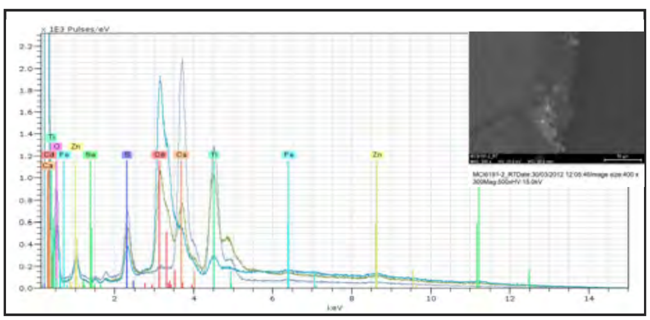




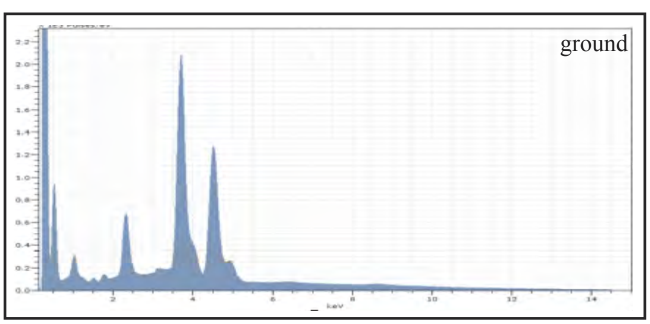
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.126
scan range: 1 - 1483
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd, oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti
interpretation: titanium white



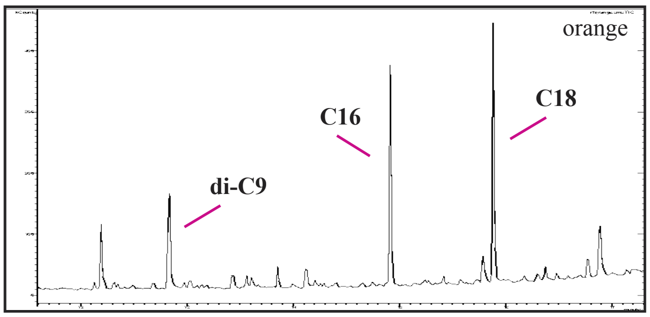
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	29.79	26.71	21.72	0.97
Titanium	K-series	25.62	22.97	15.64	1.04
Zinc	K-series	13.33	11.96	5.96	0.47
Sulfur	K-series	7.67	6.88	6.99	0.30
Cadmium	L-series	3.70	3.31	0.96	0.79
Iron	K-series	2.64	2.36	1.38	0.11
Sodium	K-series	1.57	1.41	2.00	1.26
Barium	L-series	1.23	1.11	0.26	0.63
Chlorine	K-series	0.93	0.84	0.77	0.06
Silicon	K-series	0.91	0.81	0.95	0.07
Phosphorus	K-series	0.33	0.29	0.31	0.04
Aluminium	K-series	0.30	0.27	0.32	0.25
Magnesium	K-series	0.24	0.22	0.29	0.10
Potassium	K-series	0.05	0.05	0.04	0.06
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	23.21	20.81	42.41	14.72
	Sum:	111.53	100.00	100.00	

no image available

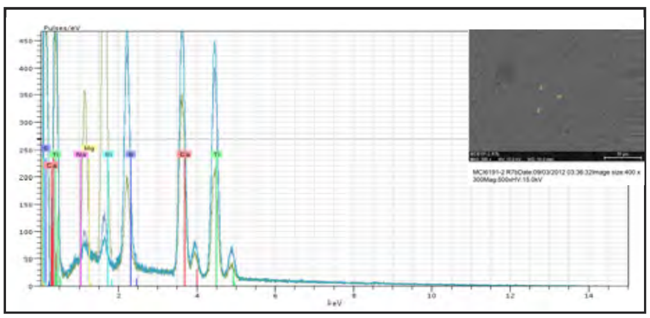
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: orange from nonwarping canvas area

sample location: right edge, 15.0" from bottom
(B 38.0 x R 0.0 cm.)

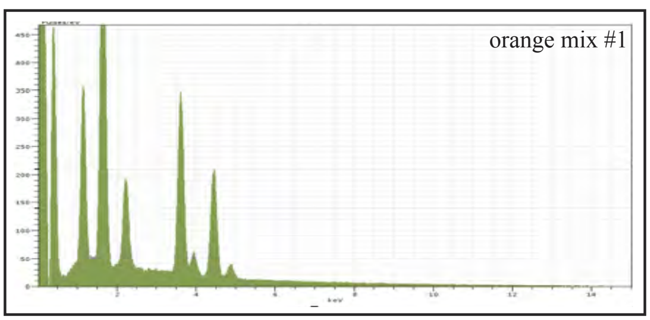
Representative Analysis Compilation—sample R07orange, continued



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.109
scan range: 1 - 1483
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/09/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, orange #1: Cd, S, Ti
significant elements, orange #2: Cd, S, Zn
interpretation: cadmium orange mixed with titanium white ground or zinc white



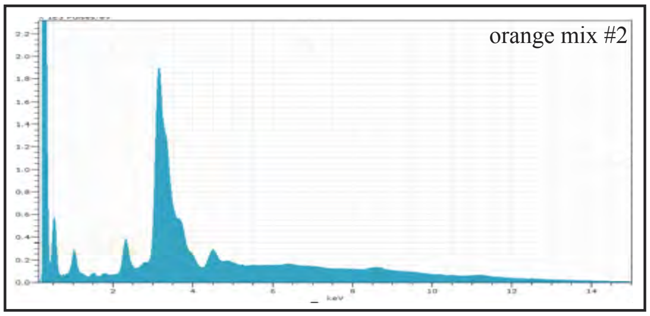
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	15.92	20.69	24.49	0.69
Calcium	K-series	15.78	20.50	17.01	0.85
Titanium	K-series	14.02	18.23	12.65	1.61
Sodium	K-series	8.79	11.42	16.52	6.94
Magnesium	K-series	6.30	8.19	11.20	0.78
Aluminium	K-series	5.17	6.72	8.28	3.96
Sulfur	K-series	5.01	6.51	6.75	0.21
Barium	L-series	2.70	3.50	0.85	1.34
Zinc	K-series	2.53	3.29	1.67	0.15
Cadmium	L-series	0.42	0.54	0.16	0.13
Phosphorus	K-series	0.28	0.37	0.39	0.04
Chlorine	K-series	0.03	0.03	0.03	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	0.00	0.00	0.00	0.03
	Sum:	76.95	100.00	100.00	

no image available

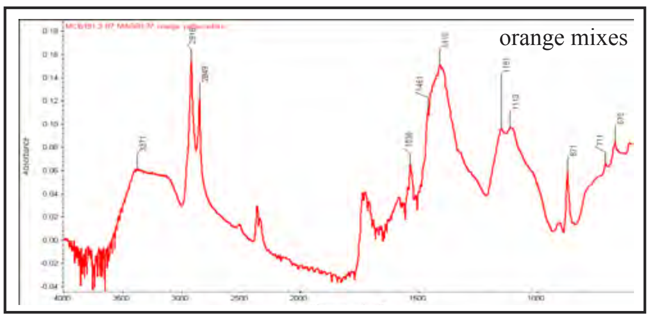
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: orange from nonwarping canvas area

sample location: right edge, 15.0" from bottom
(B 38.0 x R 0.0 cm.)

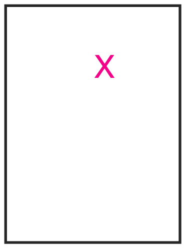
Representative Analysis Compilation—sample R07, continued

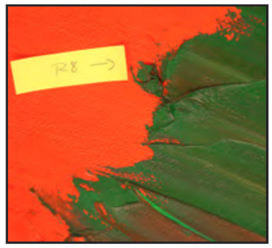


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	44.69	46.24	16.37	3.81
Potassium	K-series	6.46	6.68	6.80	1.13
Calcium	K-series	5.40	5.59	5.54	0.27
Zinc	K-series	5.29	5.48	3.33	0.20
Sulfur	K-series	3.58	3.71	4.60	0.15
Barium	L-series	3.35	3.47	1.00	0.32
Sodium	K-series	3.32	3.44	5.95	2.64
Iron	K-series	1.33	1.37	0.98	0.07
Titanium	K-series	1.13	1.17	0.98	0.19
Silicon	K-series	0.94	0.97	1.38	0.07
Aluminium	K-series	0.72	0.74	1.10	0.57
Magnesium	K-series	0.65	0.68	1.11	0.21
Phosphorus	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	19.77	20.45	50.86	15.53
	Sum:	96.65	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

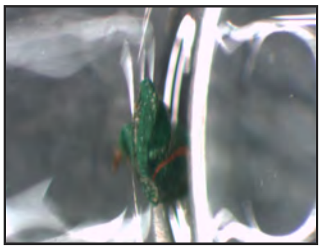
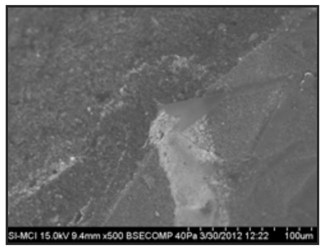





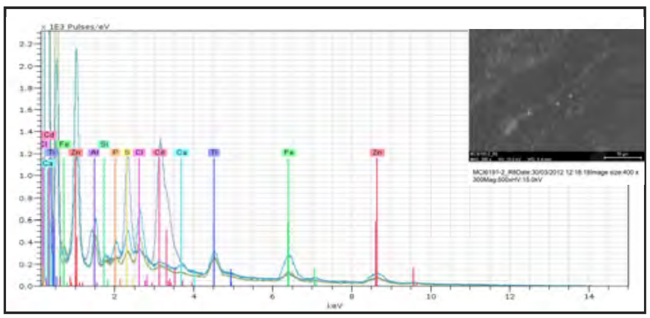
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: deep green, red line

sample location: 13.4" from top, 15.0" from right
(T 34.0 x R 38.0 cm.)

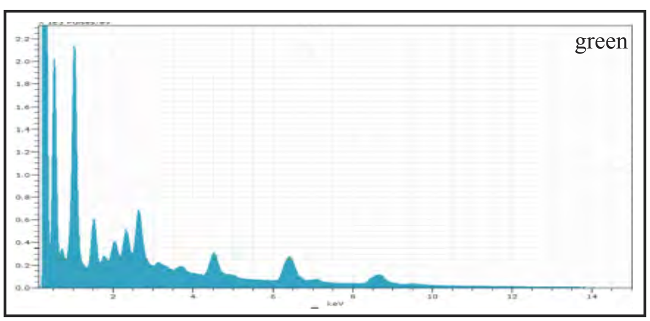
Representative Analysis Compilation—sample R08

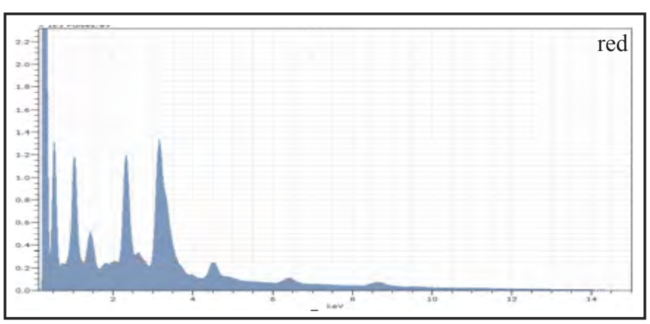
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



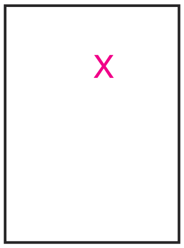
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, green: Fe, Na
significant elements, red: Cd, S, Se
interpretation: iron oxide green, cadmium red

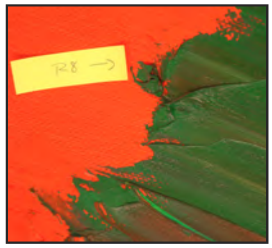


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	46.85	37.99	10.41	2.97
Zinc	K-series	17.02	22.28	9.30	0.59
Iron	K-series	10.15	13.30	6.50	0.32
Sodium	K-series	8.00	10.48	12.45	6.32
Chlorine	K-series	3.80	4.98	3.83	0.15
Titanium	K-series	3.46	4.53	2.58	0.27
Aluminium	K-series	2.21	2.89	2.93	1.20
Sulfur	K-series	1.89	2.47	2.10	0.09
Cadmium	L-series	1.60	2.09	0.51	0.42
Phosphorus	K-series	1.27	1.66	1.47	0.07
Calcium	K-series	0.71	0.93	0.63	0.07
Silicon	K-series	0.38	0.50	0.48	0.04
Barium	L-series	0.26	0.35	0.07	0.15
Magnesium	K-series	0.05	0.07	0.07	0.05
Potassium	K-series	0.04	0.05	0.03	0.05
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.52	33.42	57.03	11.67
	Sum:	76.37	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	26.22	27.86	8.45	2.40
Zinc	K-series	11.92	12.66	6.60	0.43
Sulfur	K-series	7.95	8.44	8.97	0.31
Sodium	K-series	4.97	5.28	7.82	3.93
Iron	K-series	3.26	3.46	2.11	0.12
Selenium	L-series	3.22	3.43	1.48	0.27
Potassium	K-series	2.92	3.10	2.70	0.90
Titanium	K-series	2.90	3.08	2.19	0.35
Barium	L-series	2.59	2.75	0.68	0.39
Chlorine	K-series	1.68	1.78	1.71	0.09
Aluminium	K-series	0.85	0.90	1.14	0.67
Phosphorus	K-series	0.67	0.71	0.78	0.05
Calcium	K-series	0.59	0.62	0.53	0.15
Silicon	K-series	0.30	0.32	0.39	0.04
Magnesium	K-series	0.14	0.15	0.21	0.11
Oxygen	K-series	23.96	25.46	54.23	13.55
	Sum:	94.12	100.00	100.00	

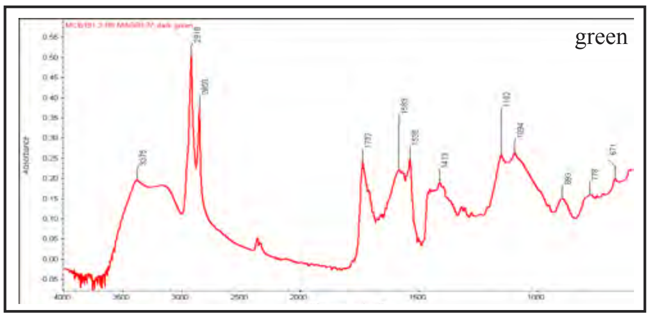




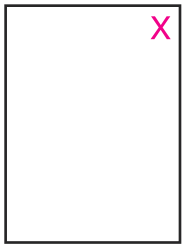
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: deep green, red line

sample location: 13.4" from top, 15.0" from right
(T 34.0 x R 38.0 cm.)

Representative Analysis Compilation—sample R08, continued



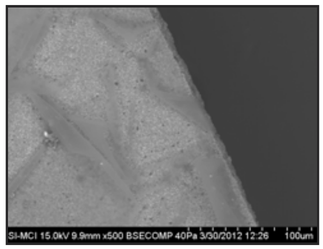
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil



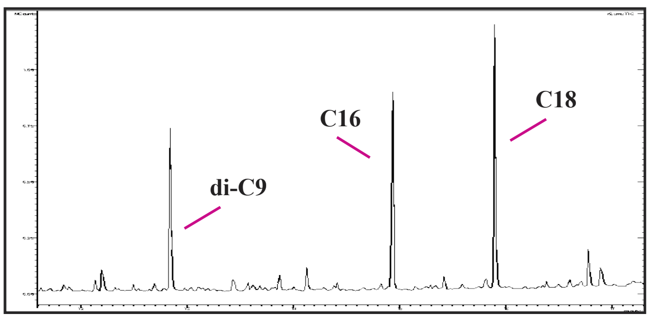
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: compositional white

sample location: 4.7" from top, 3.5" from right
(T 12.0 x R 9.0 cm.)

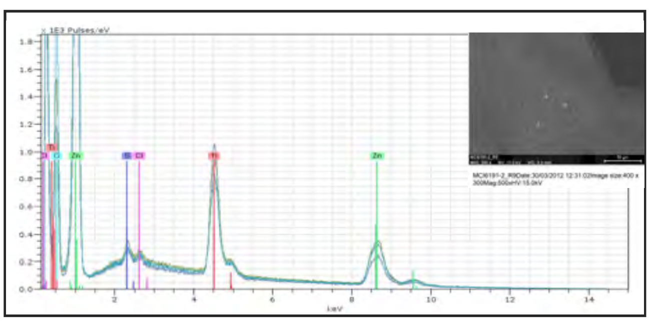
Representative Analysis Compilation—sample R09



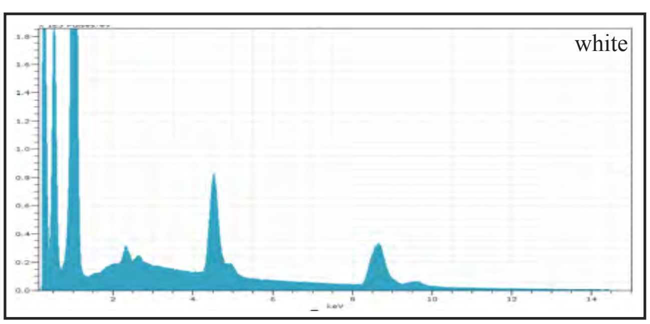
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.140
scan range: 1 - 1478
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white

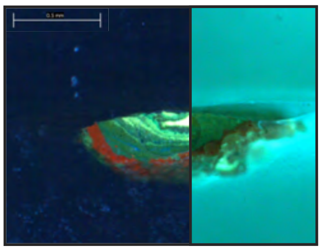


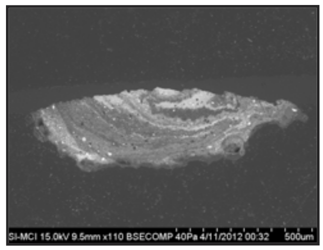
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	64.76	53.82	30.64	2.15
Sodium	K-series	22.88	19.02	30.80	18.03
Titanium	K-series	12.01	9.98	7.76	0.66
Barium	L-series	2.65	2.20	0.60	0.76
Sulfur	K-series	1.59	1.32	1.54	0.08
Chlorine	K-series	1.57	1.30	1.37	0.08
Phosphorus	K-series	0.65	0.54	0.65	0.05
Potassium	K-series	0.53	0.44	0.42	0.04
Silicon	K-series	0.15	0.12	0.17	0.03
Calcium	K-series	0.09	0.07	0.07	0.03
Aluminium	K-series	0.02	0.01	0.02	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	13.43	11.16	25.98	5.83
	Sum:	120.33	100.00	100.00	

acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: different green

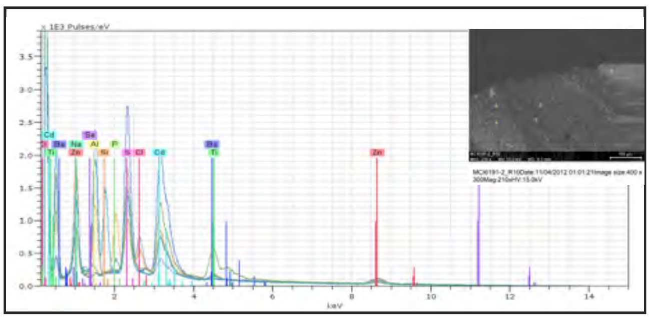
sample location: left edge, 15.0" from top
(T 38.0 x L 0.0 cm.)

Representative Analysis Compilation—sample R10

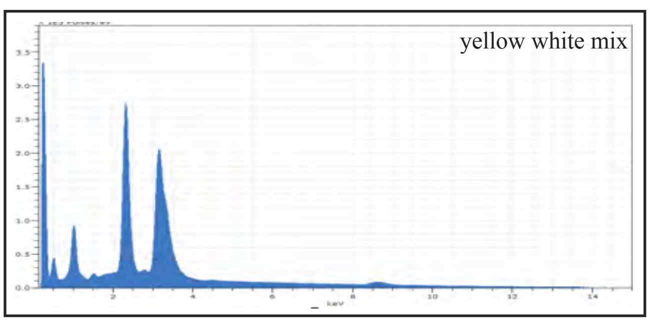




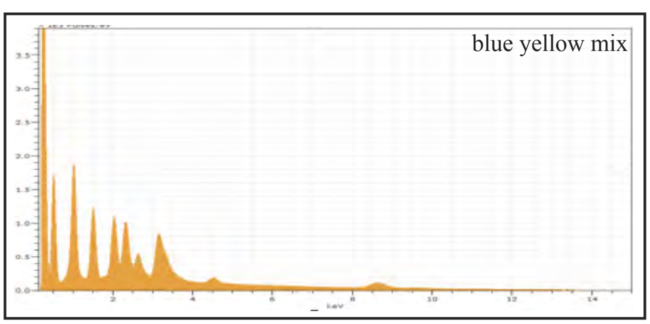
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.5 mm.
mag: 210x; HV: 15 kV
significant elements, yellow: Cd, S
significant elements, blue: Na, Al
significant elements, orange: Cd, S, Se
interpretation: cadmium yellow, ultramarine blue, cadmium orange



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	25.86	36.46	16.00	2.42
Zinc	K-series	15.78	22.24	16.78	0.55
Sulfur	K-series	13.76	19.40	29.84	0.51
Sodium	K-series	8.00	11.27	24.19	6.32
Potassium	K-series	6.09	8.58	10.83	0.79
Barium	L-series	0.72	1.01	0.36	0.10
Magnesium	K-series	0.44	0.62	1.25	0.12
Aluminium	K-series	0.29	0.40	0.74	0.24
Silicon	K-series	0.00	0.00	0.01	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
	Sum:	70.93	100.00	100.00	

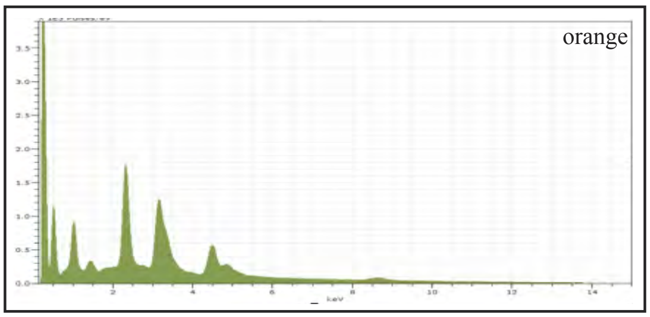


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	18.37	31.98	19.15	0.64
Sodium	K-series	12.01	20.90	35.60	9.47
Cadmium	L-series	8.03	13.98	4.87	1.20
Aluminium	K-series	6.22	10.83	15.73	2.18
Phosphorus	K-series	3.99	6.95	8.79	0.18
Sulfur	K-series	3.80	6.61	8.07	0.16
Potassium	K-series	1.83	3.19	3.20	0.42
Chlorine	K-series	1.27	2.22	2.45	0.07
Titanium	K-series	1.26	2.20	1.80	0.17
Barium	L-series	0.65	1.13	0.32	0.22
Calcium	K-series	0.00	0.01	0.00	0.03
Magnesium	K-series	0.00	0.00	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
	Sum:	57.45	100.00	100.00	

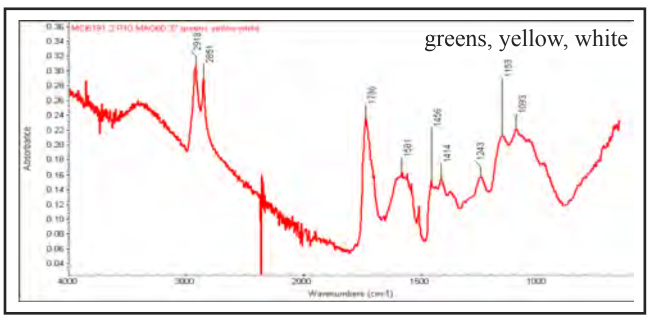
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: different green

sample location: left edge, 15.0" from top
(T 38.0 x L 0.0 cm.)

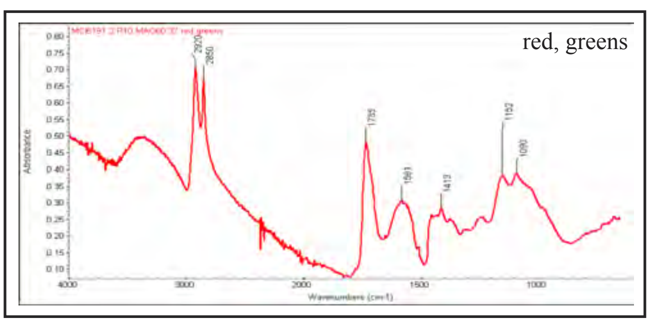
Representative Analysis Compilation—sample R10, continued



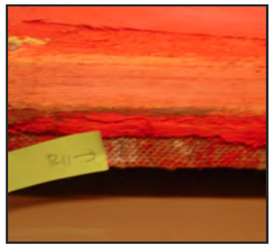
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	20.83	34.10	15.99	2.11
Sulfur	K-series	11.58	18.96	31.18	0.43
Barium	L-series	7.94	13.00	4.99	0.73
Titanium	K-series	6.01	9.83	10.83	0.63
Sodium	K-series	5.17	8.47	19.41	4.10
Zinc	K-series	4.37	7.16	5.77	0.18
Potassium	K-series	3.01	4.93	6.65	0.72
Chlorine	K-series	0.78	1.28	1.91	0.06
Aluminium	K-series	0.58	0.95	1.86	0.47
Selenium	L-series	0.49	0.80	0.54	0.07
Phosphorus	K-series	0.24	0.39	0.67	0.04
Silicon	K-series	0.05	0.08	0.15	0.03
Calcium	K-series	0.03	0.04	0.06	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	61.09	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil



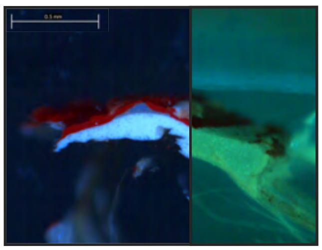
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

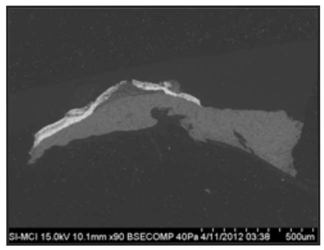


acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: threads with ground layer

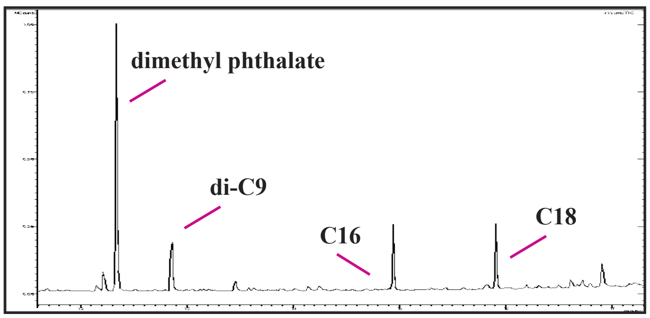
sample location: left edge, 7.1" from top
(T 18.0 x L 0.0 cm.)

Representative Analysis Compilation—sample R11

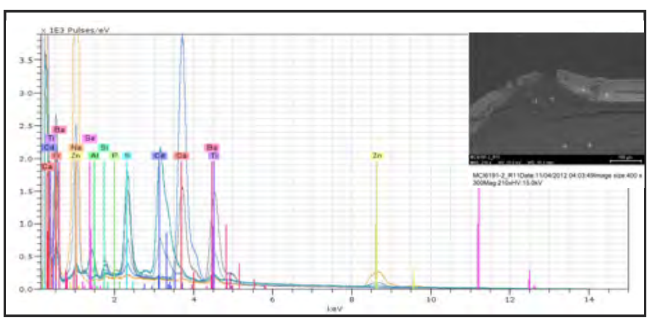




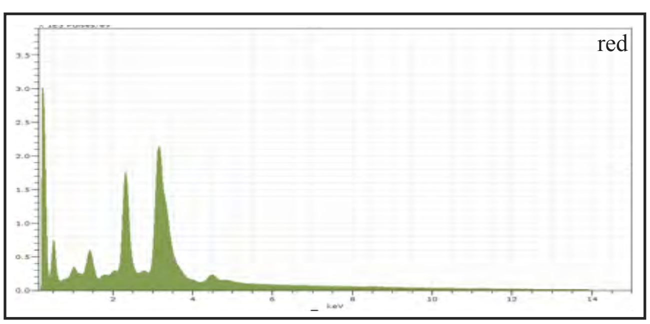
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.1 mm.



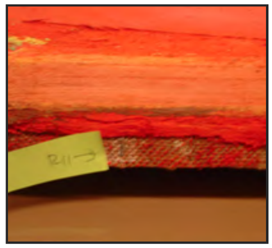
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.130
scan range: 1 - 1479
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd, oil



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 10.1 mm.
mag: 210x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, grey: none
significant elements, white: Ti
interpretation: cadmium red, titanium white, possible carbon black



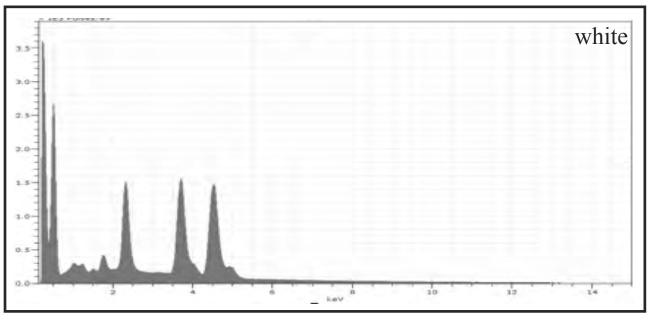
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	31.10	43.84	24.66	2.73
Sulfur	K-series	9.59	13.51	26.65	0.36
Zinc	L-series	7.81	11.01	10.65	0.29
Barium	L-series	7.41	10.45	4.81	0.53
Potassium	K-series	6.39	9.01	14.57	0.91
Selenium	L-series	4.48	6.32	5.06	0.32
Sodium	K-series	1.71	2.41	6.62	1.37
Aluminium	K-series	1.08	1.52	3.55	0.84
Calcium	K-series	0.66	0.94	1.48	0.20
Phosphorus	K-series	0.27	0.38	0.77	0.04
Silicon	K-series	0.20	0.28	0.64	0.04
Titanium	K-series	0.17	0.24	0.31	0.14
Magnesium	K-series	0.06	0.09	0.23	0.07
Chlorine	K-series	0.00	0.00	0.00	0.03
	Sum:	70.93	100.00	100.00	



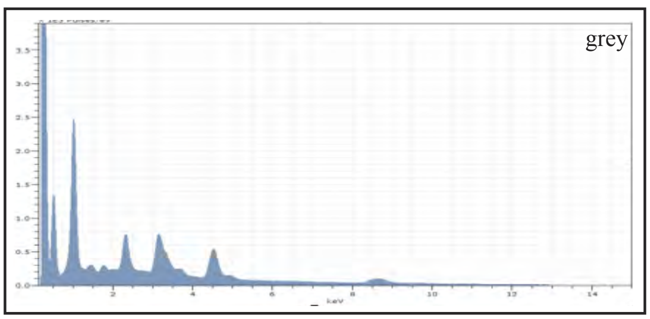
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: threads with ground layer

sample location: left edge, 7.1" from top
(T 18.0 x L 0.0 cm.)

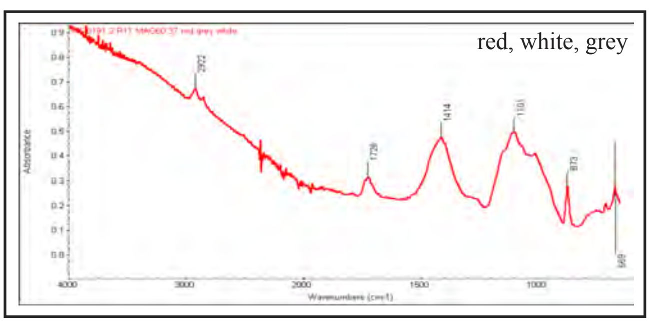
Representative Analysis Compilation—sample R11, continued



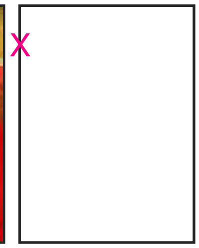
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	38.78	40.57	38.16	1.71
Calcium	K-series	24.32	25.44	28.59	0.81
Sulfur	K-series	11.63	12.16	17.08	0.44
Barium	L-series	9.74	10.19	3.34	1.78
Zinc	K-series	4.21	4.41	3.03	0.18
Silicon	K-series	1.77	1.85	2.97	0.10
Cadmium	L-series	1.70	1.78	0.71	0.44
Magnesium	K-series	1.21	1.27	2.35	0.09
Sodium	K-series	1.01	1.06	2.07	0.82
Chlorine	K-series	0.87	0.91	1.16	0.06
Phosphorus	K-series	0.26	0.27	0.40	0.04
Aluminium	K-series	0.09	0.09	0.15	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
	Sum:	95.60	100.00	100.00	

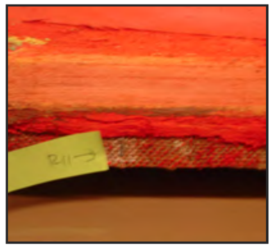


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	19.67	27.76	19.30	0.68
Cadmium	L-series	13.73	19.37	7.84	1.68
Sodium	K-series	13.17	18.59	36.77	10.39
Titanium	K-series	10.34	14.59	13.86	0.67
Sulfur	K-series	4.59	6.47	9.18	0.19
Barium	L-series	2.60	3.67	1.22	0.78
Calcium	K-series	1.54	2.17	2.46	0.14
Potassium	K-series	1.50	2.11	2.46	0.66
Selenium	L-series	1.01	1.43	0.82	0.11
Silicon	K-series	0.70	0.98	1.59	0.06
Aluminium	K-series	0.63	0.88	1.49	0.50
Chlorine	K-series	0.56	0.79	1.01	0.05
Magnesium	K-series	0.48	0.68	1.27	0.13
Phosphorus	K-series	0.35	0.50	0.73	0.04
	Sum:	70.87	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: carbon interference

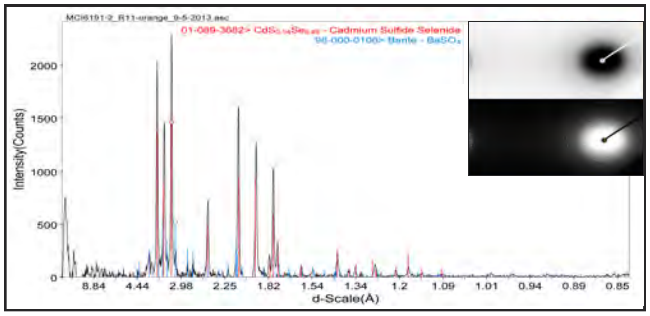




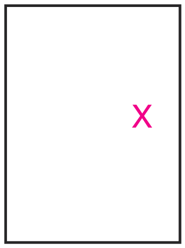
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: threads with ground layer

sample location: left edge, 7.1" from top
(T 18.0 x L 0.0 cm.)

Representative Analysis Compilation—sample R11, continued



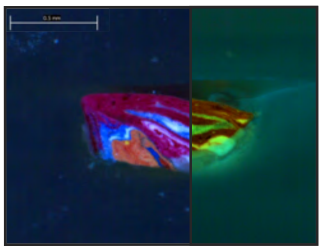
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: fixed at 0º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, barite
note: a polymorph match to other cadmium red pigments

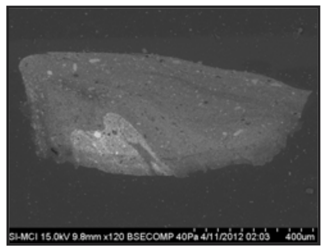


acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: pink

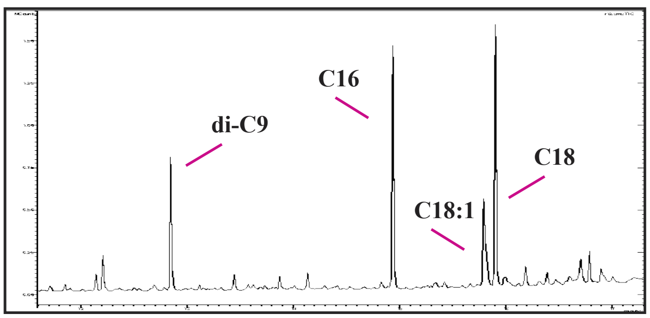
sample location: 30.7" from bottom, 10.2" from right
(B 78.0 x R 26.0 cm.)

Representative Analysis Compilation—sample R12

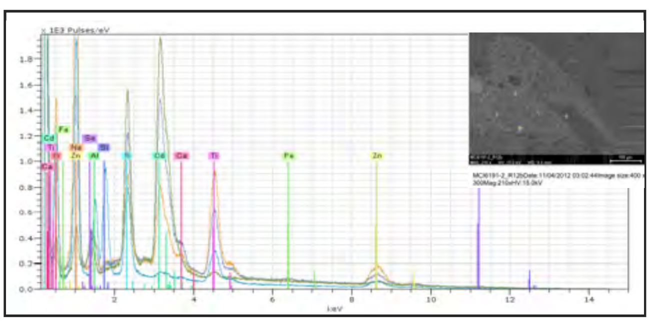




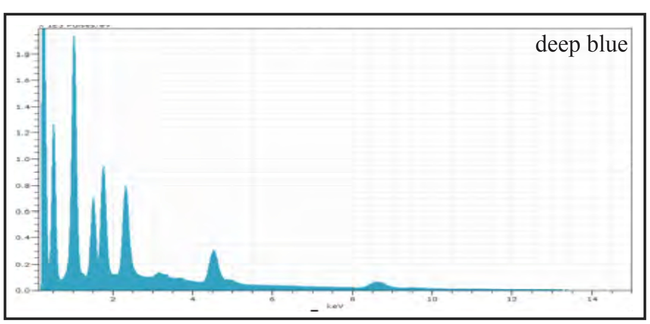
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.8 mm.



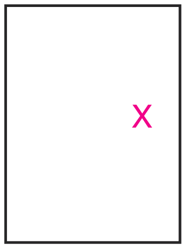
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.198
scan range: 1 - 1484
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.8 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Al
significant elements, orange: Cd, S
significant elements, white: Zn/Ti
interpretation: ultramarine blue, cadmium orange, Zn/Ti white



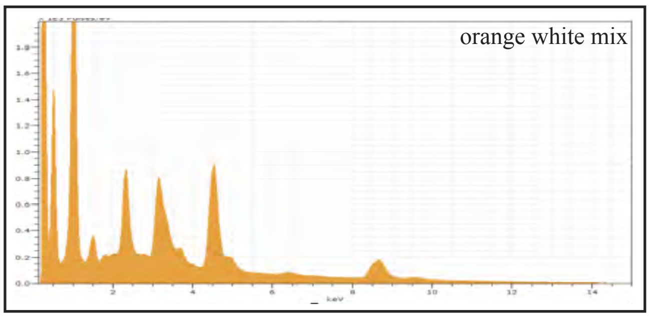
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Sodium	K-series	14.90	16.68	16.92	11.75
Zinc	K-series	13.92	15.59	5.56	0.49
Titanium	K-series	6.40	7.17	3.49	0.43
Silicon	K-series	6.16	6.89	5.72	0.28
Sulfur	K-series	5.60	6.27	4.56	0.22
Aluminium	K-series	3.55	3.97	3.43	1.73
Cadmium	L-series	1.00	1.11	0.23	0.27
Copper	K-series	0.33	0.37	0.13	0.05
Potassium	K-series	0.29	0.32	0.19	0.18
Barium	L-series	0.23	0.26	0.04	0.14
Calcium	K-series	0.23	0.26	0.15	0.06
Chlorine	K-series	0.16	0.18	0.12	0.03
Iron	K-series	0.16	0.17	0.07	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	36.39	40.74	59.37	19.66
	Sum:	89.30	100.00	100.00	



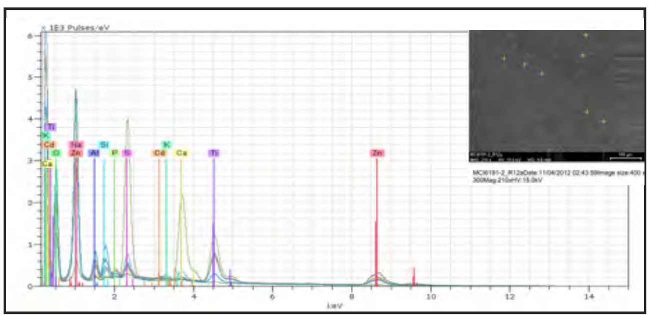
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: pink

sample location: 30.7" from bottom, 10.2" from right
(B 78.0 x R 26.0 cm.)

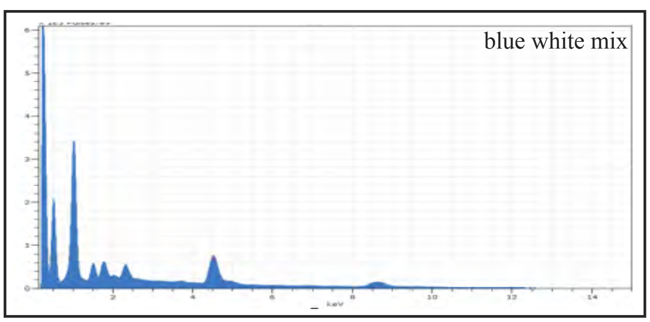
Representative Analysis Compilation—sample R12, continued



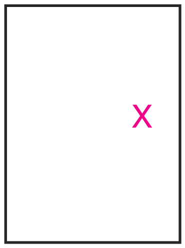
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	32.34	38.35	26.60	1.09
Titanium	K-series	15.50	18.38	17.41	0.73
Sodium	K-series	14.07	16.69	32.93	11.10
Cadmium	L-series	9.78	11.59	4.68	1.32
Sulfur	K-series	5.01	5.94	8.40	0.20
Aluminium	K-series	1.67	1.98	3.33	1.17
Potassium	K-series	1.51	1.80	2.08	0.48
Iron	K-series	1.38	1.63	1.33	0.07
Barium	L-series	1.30	1.54	0.51	0.66
Calcium	K-series	0.94	1.11	1.26	0.11
Phosphorus	K-series	0.36	0.43	0.62	0.04
Silicon	K-series	0.36	0.42	0.68	0.04
Chlorine	K-series	0.11	0.13	0.17	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	84.32	100.00	100.00	



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.8 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Si, Al
significant elements, white: Zn, Ti
significant elements, pink: Al
interpretation: ultramarine blue, Zn/Ti white, possible synthetic alizarin



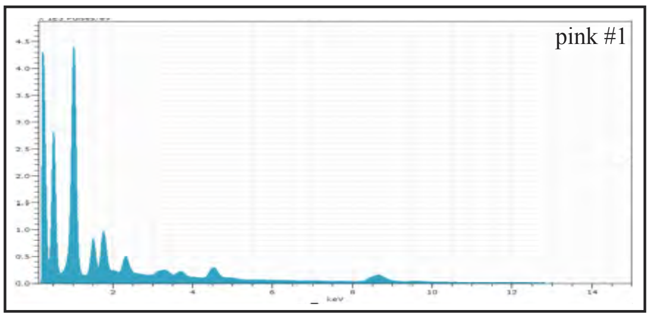
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	26.76	39.49	23.51	0.91
Sodium	K-series	16.60	24.50	41.49	13.09
Titanium	K-series	12.83	18.94	15.40	0.64
Silicon	K-series	2.87	4.23	5.87	0.14
Sulfur	K-series	2.50	3.69	4.48	0.11
Aluminium	K-series	2.17	3.21	4.63	0.13
Barium	L-series	1.03	1.53	0.43	0.53
Phosphorus	K-series	0.83	1.22	1.53	0.06
Cobalt	K-series	0.77	1.14	0.75	0.05
Calcium	K-series	0.44	0.65	0.63	0.06
Chlorine	K-series	0.41	0.61	0.67	0.04
Cadmium	L-series	0.35	0.51	0.18	0.11
Magnesium	K-series	0.15	0.22	0.36	0.04
Potassium	K-series	0.04	0.06	0.06	0.05
	Sum:	67.77	100.00	100.00	



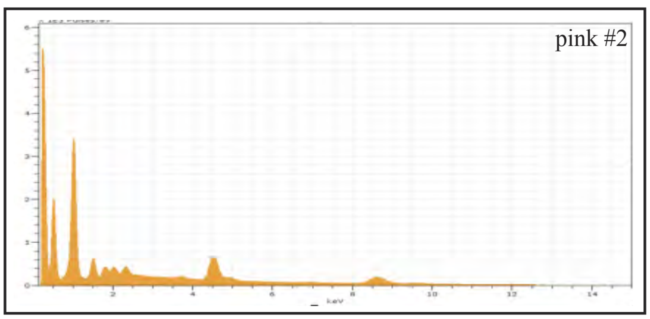
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: pink

sample location: 30.7" from bottom, 10.2" from right
(B 78.0 x R 26.0 cm.)

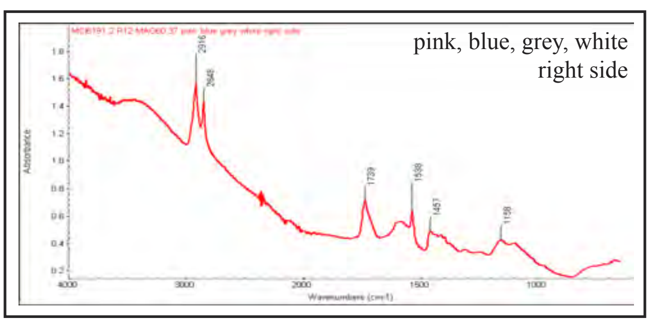
Representative Analysis Compilation—sample R12, continued



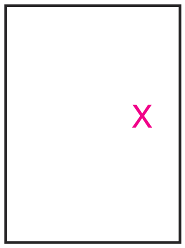
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	31.32	40.59	22.26	1.06
Sodium	K-series	23.03	29.85	46.55	18.15
Silicon	K-series	6.40	8.30	10.59	0.29
Aluminium	K-series	4.51	5.84	7.76	2.02
Titanium	K-series	4.16	5.40	4.04	0.33
Sulfur	K-series	2.79	3.62	4.05	0.12
Cadmium	L-series	1.40	1.81	0.58	0.37
Calcium	K-series	1.25	1.62	1.45	0.10
Potassium	K-series	1.09	1.41	1.29	0.26
Phosphorus	K-series	0.69	0.90	1.04	0.05
Barium	L-series	0.29	0.37	0.10	0.17
Chlorine	K-series	0.23	0.29	0.30	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	77.15	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	30.38	41.01	24.25	1.03
Sodium	K-series	18.39	24.83	41.76	14.50
Titanium	K-series	9.72	13.13	10.60	0.51
Aluminium	K-series	3.72	5.03	7.20	1.87
Phosphorus	K-series	2.55	3.44	4.30	0.12
Sulfur	K-series	2.29	3.09	3.72	0.11
Silicon	K-series	1.89	2.56	3.52	0.11
Cadmium	L-series	1.26	1.70	0.58	0.33
Chlorine	K-series	1.03	1.39	1.51	0.06
Barium	L-series	1.00	1.35	0.38	0.51
Cobalt	K-series	0.90	1.21	0.80	0.05
Calcium	K-series	0.76	1.02	0.98	0.08
Magnesium	K-series	0.18	0.24	0.39	0.09
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	74.08	100.00	100.00	



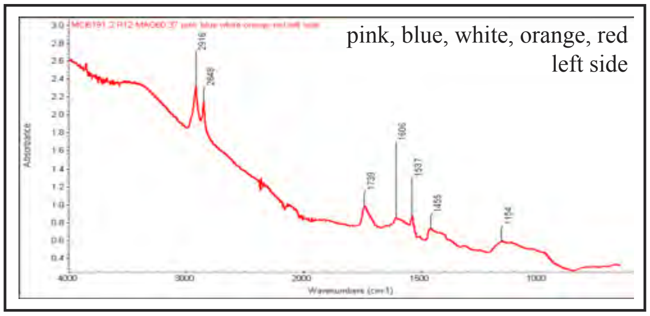
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



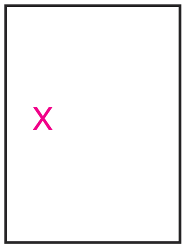
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: pink

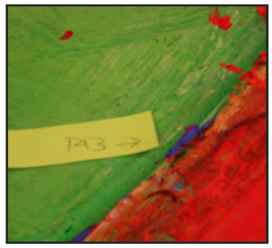
sample location: 30.7" from bottom, 10.2" from right
(B 78.0 x R 26.0 cm.)

Representative Analysis Compilation—sample R12, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

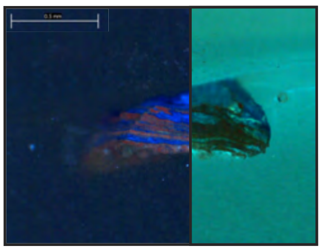
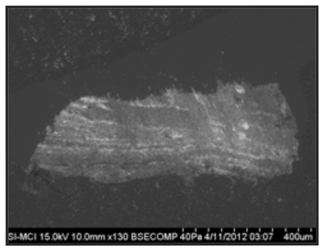





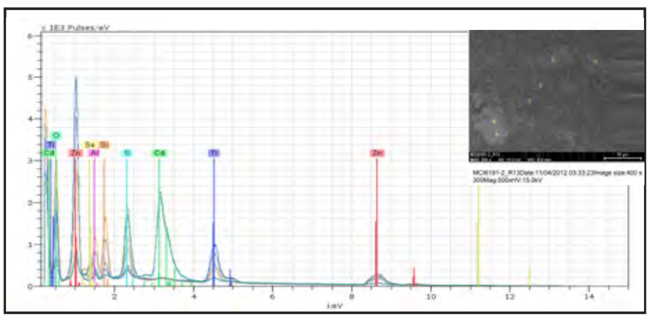
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: deep blue

sample location: 27.6" from bottom, 12.2" from left
(B 70.0 x L 31.0 cm.)

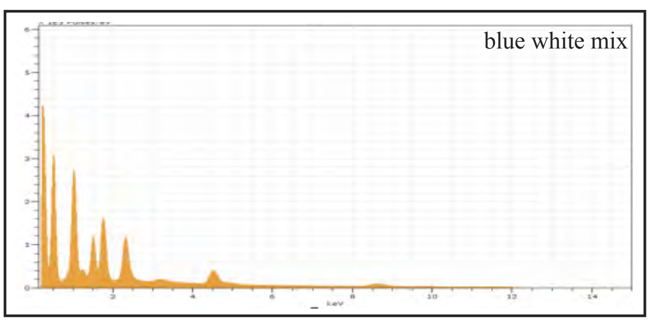
Representative Analysis Compilation—sample R13

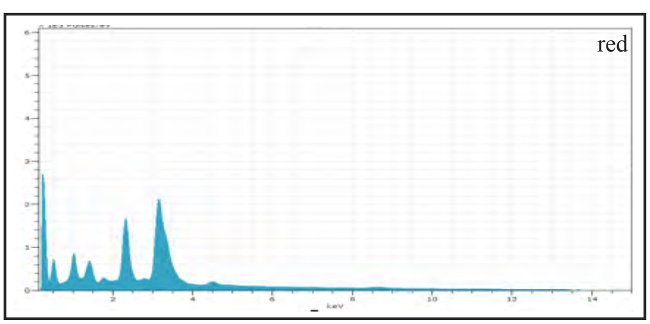
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Si, Al
significant elements, white: Zn, Ti
significant elements, red: Cd, S
interpretation: ultramarine blue, Zn/Ti white, cadmium red

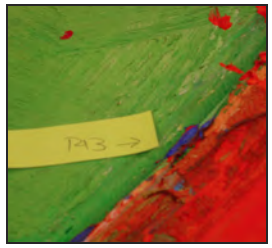


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Sodium	K-series	14.12	25.21	35.40	11.14
Zinc	K-series	12.15	21.69	10.71	0.43
Silicon	K-series	9.23	16.47	18.93	0.41
Sulfur	K-series	6.81	12.15	12.23	0.27
Titanium	K-series	5.75	10.27	6.92	0.36
Aluminium	K-series	5.22	9.32	11.15	0.27
Magnesium	K-series	1.51	2.69	3.57	0.11
Cadmium	L-series	0.75	1.35	0.39	0.21
Potassium	K-series	0.30	0.53	0.44	0.15
Chlorine	K-series	0.15	0.27	0.25	0.03
Barium	L-series	0.03	0.05	0.01	0.04
Phosphorus	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
	Sum:	56.01	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	60.47	40.74	22.95	4.51
Zinc	K-series	29.43	19.83	19.20	1.00
Sulfur	K-series	15.97	10.76	21.25	0.59
Barium	L-series	14.75	9.94	4.58	1.00
Selenium	L-series	8.50	5.73	4.59	0.59
Potassium	K-series	7.23	4.87	7.89	1.57
Sodium	K-series	6.44	4.34	11.95	5.09
Calcium	K-series	1.53	1.03	1.63	0.28
Chlorine	K-series	1.09	0.73	1.31	0.08
Silicon	K-series	1.08	0.73	1.64	0.07
Aluminium	K-series	1.07	0.72	1.68	0.84
Phosphorus	K-series	0.52	0.35	0.71	0.05
Magnesium	K-series	0.35	0.23	0.61	0.20
Titanium	K-series	0.00	0.00	0.00	0.03
	Sum:	148.42	100.00	100.00	

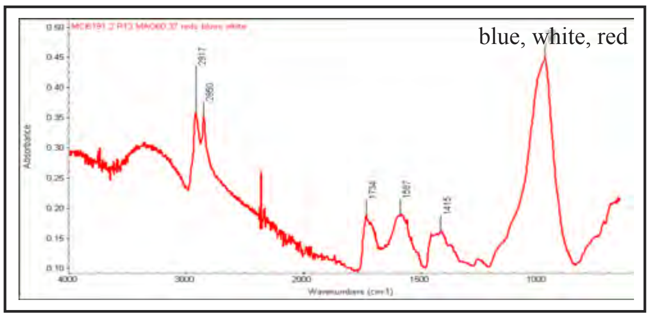
X



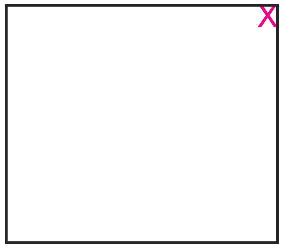
acc. no.: MAG 60.37
title, year: *Ruby Gold*, 1959
Marion Stratton Gould Fund
medium noted in file: oil on canvas
meas.: 55.4 x 40.5" (140.7 x 102.9 cm.)
notes: deep blue

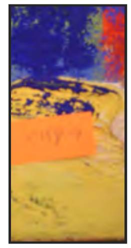
sample location: 27.6" from bottom, 12.2" from left
(B 70.0 x L 31.0 cm.)

Representative Analysis Compilation—sample R13, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

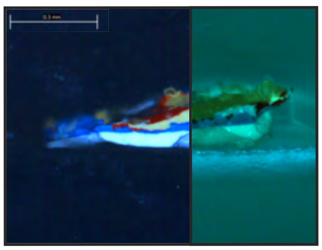


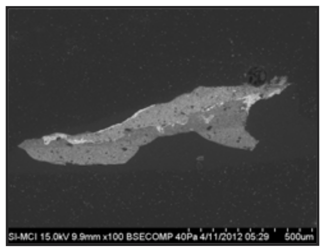


acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: compositional white

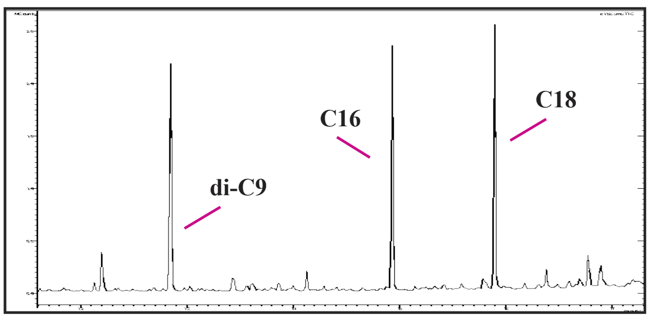
sample location: 1.0" from top,
1.5" from right (T 2.5 x R 3.8 cm.)

Representative Analysis Compilation—sample C158

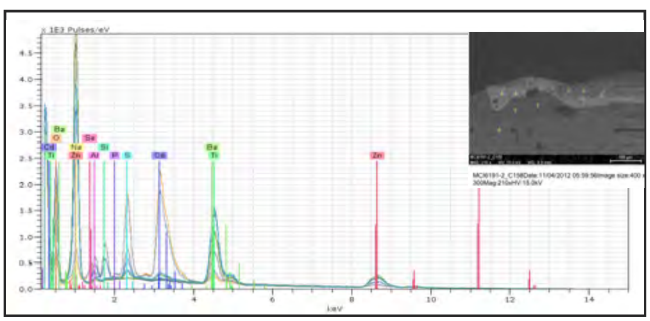




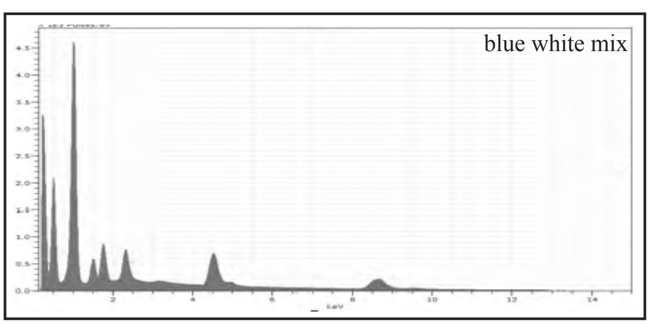
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.9 mm.



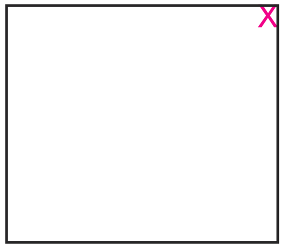
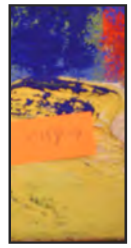
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.145
scan range: 1 - 1482
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.9 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Si, Al
significant elements, red: Cd, S, Se
significant elements, yellow: Cd, S
interpretation: ultramarine blue, cadmium red, cadmium yellow



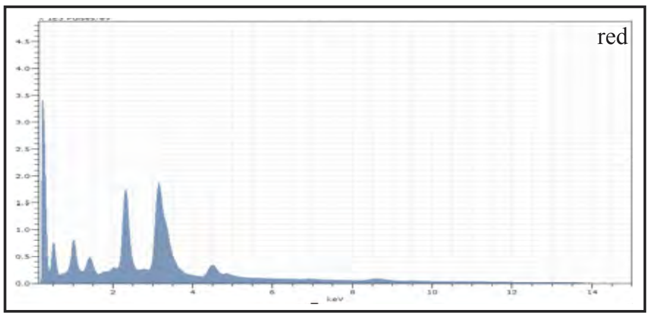
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	60.75	46.63	29.78	2.03
Sodium	K-series	29.12	22.35	40.61	22.95
Titanium	K-series	12.34	9.47	8.26	0.96
Barium	L-series	8.70	6.68	2.03	1.01
Silicon	K-series	6.42	4.93	7.33	0.29
Sulfur	K-series	5.76	4.42	5.76	0.23
Aluminium	K-series	3.49	2.68	4.15	0.19
Cadmium	L-series	2.00	1.53	0.57	0.51
Chlorine	K-series	0.81	0.63	0.74	0.05
Calcium	K-series	0.45	0.35	0.36	0.08
Phosphorus	K-series	0.25	0.19	0.26	0.04
Potassium	K-series	0.20	0.15	0.16	0.16
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	130.29	100.00	100.00	

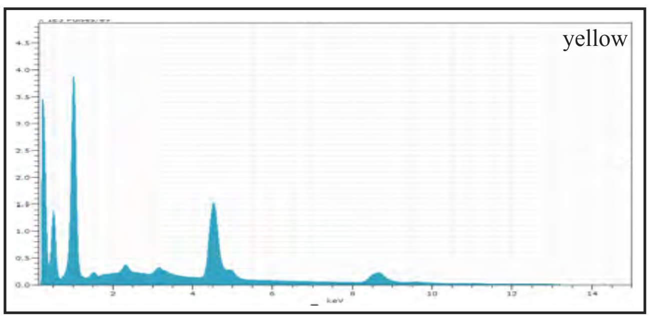
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: compositional white

sample location: 1.0" from top,
1.5" from right (T 2.5 x R 3.8 cm.)

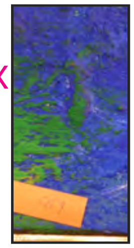
Representative Analysis Compilation—sample C158, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	36.77	43.58	22.45	3.01
Sulfur	K-series	13.10	15.53	28.04	0.49
Zinc	K-series	11.75	13.92	12.33	0.42
Potassium	K-series	4.85	5.75	8.52	1.02
Sodium	K-series	4.71	5.58	14.06	3.73
Barium	L-series	4.53	5.37	2.26	0.52
Titanium	K-series	3.45	4.09	4.95	0.41
Selenium	L-series	3.15	3.73	2.74	0.23
Aluminium	K-series	0.73	0.87	1.86	0.58
Phosphorus	K-series	0.70	0.83	1.54	0.05
Chlorine	K-series	0.52	0.62	1.00	0.05
Silicon	K-series	0.06	0.07	0.15	0.03
Calcium	K-series	0.06	0.07	0.10	0.06
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	84.38	100.00	100.00	



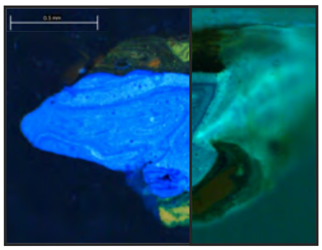
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	60.47	40.74	22.95	4.51
Zinc	K-series	91.17	43.35	32.92	3.03
Barium	L-series	35.34	16.80	6.08	2.73
Titanium	K-series	33.51	15.93	16.52	2.28
Sodium	K-series	20.46	9.73	21.01	16.13
Cadmium	L-series	9.55	4.54	2.01	1.45
Sulfur	K-series	3.35	1.59	2.47	0.14
Chlorine	K-series	2.19	1.04	1.46	0.10
Calcium	K-series	1.88	0.89	1.11	0.18
Phosphorus	K-series	1.32	0.63	1.00	0.08
Aluminium	K-series	1.24	0.59	1.09	0.97
Silicon	K-series	0.79	0.38	0.66	0.06
Potassium	K-series	0.33	0.16	0.20	0.25
Magnesium	K-series	0.16	0.07	0.15	0.10
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	9.03	4.30	13.33	4.62
	Sum:	210.32	100.00	100.00	

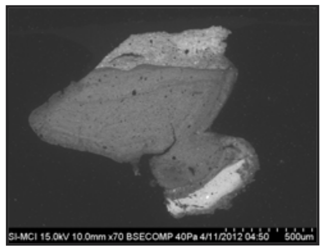


acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: blues, green

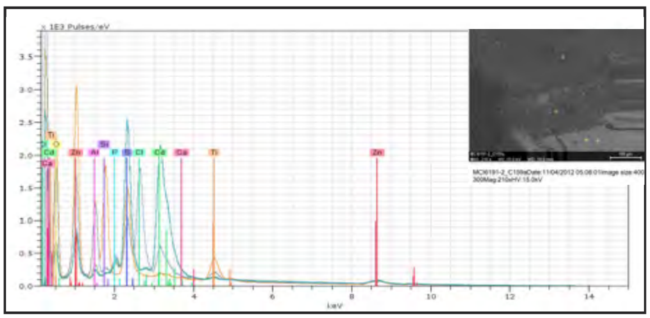
sample location: right edge,
8.0" from top (T 20.3 x R 0.0 cm.)

Representative Analysis Compilation—sample C159

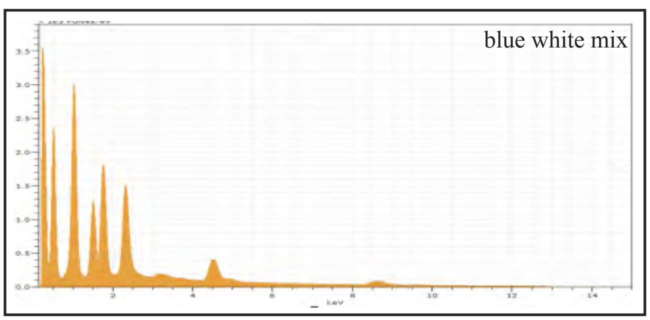




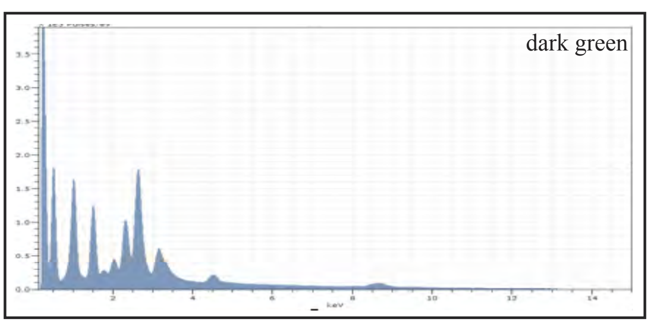
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



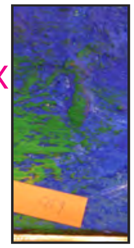
analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 10.0 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Si, Al
significant elements, green: Cd, S, Cl, Cu
significant elements, yellow: Cd, S
interpretation: ultramarine blue, phthalo green, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	33.80	21.90	11.08	1.15
Sodium	K-series	23.97	15.53	22.35	18.89
Barium	L-series	18.86	12.22	2.94	1.35
Silicon	K-series	17.64	11.43	13.46	0.76
Sulfur	K-series	16.16	10.47	10.81	0.60
Aluminium	K-series	9.83	6.37	7.81	0.48
Titanium	K-series	5.09	3.30	2.28	0.67
Cadmium	L-series	5.03	3.26	0.96	1.15
Chlorine	K-series	2.12	1.37	1.28	0.10
Calcium	K-series	1.68	1.09	0.90	0.15
Phosphorus	K-series	0.61	0.39	0.42	0.05
Potassium	K-series	0.55	0.36	0.30	0.39
Magnesium	K-series	0.11	0.07	0.09	0.03
Oxygen	K-series	18.88	12.24	25.31	7.74
	Sum:	154.31	100.00	100.00	



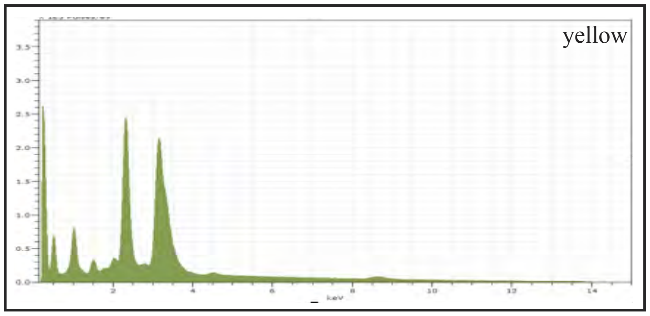
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	60.47	40.74	22.95	4.51
Chlorine	K-series	12.75	14.37	10.48	0.45
Zinc	K-series	11.59	13.06	5.17	0.41
Cadmium	L-series	9.32	10.50	2.42	1.22
Aluminium	K-series	6.03	6.80	6.51	0.30
Sodium	K-series	5.35	6.03	6.79	4.24
Sulfur	K-series	5.25	5.91	4.77	0.21
Phosphorus	K-series	1.68	1.90	1.59	0.09
Copper	K-series	1.42	1.60	0.65	0.08
Titanium	K-series	0.81	0.91	0.49	0.12
Potassium	K-series	0.79	0.89	0.59	0.44
Silicon	K-series	0.60	0.67	0.62	0.05
Calcium	K-series	0.22	0.25	0.16	0.08
Barium	L-series	0.13	0.15	0.03	0.09
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	32.80	36.96	59.74	14.92
	Sum:	88.74	100.00	100.00	



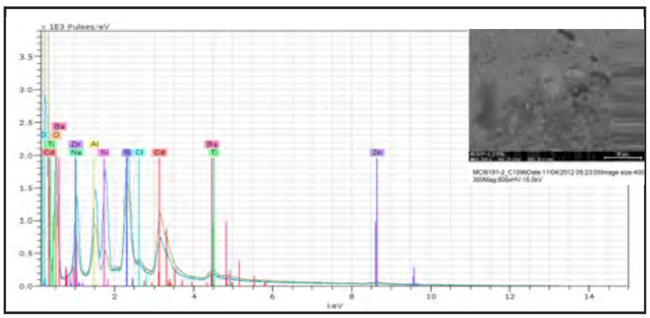
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: blues, green

sample location: right edge,
8.0" from top (T 20.3 x R 0.0 cm.)

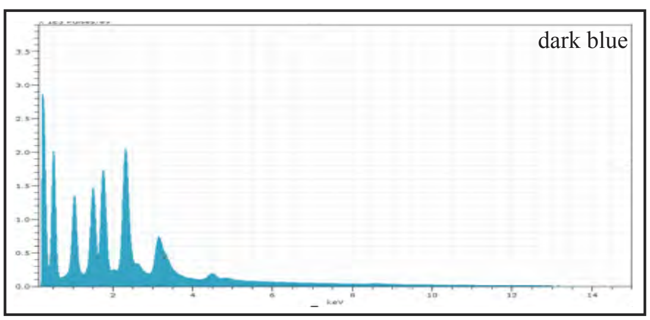
Representative Analysis Compilation—sample C159, continued



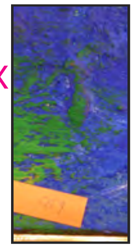
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	49.48	43.31	15.68	3.69
Sulfur	K-series	21.71	19.00	24.11	0.79
Zinc	K-series	10.34	9.05	5.63	0.37
Potassium	K-series	5.98	5.23	5.45	1.25
Sodium	K-series	5.67	4.96	8.79	4.49
Phosphorus	K-series	1.70	1.49	1.95	0.09
Aluminium	K-series	1.68	1.47	2.22	1.27
Chlorine	K-series	1.22	1.07	1.22	0.08
Silicon	K-series	0.37	0.32	0.47	0.04
Calcium	K-series	0.37	0.32	0.33	0.20
Titanium	K-series	0.27	0.24	0.20	0.07
Magnesium	K-series	0.21	0.19	0.31	0.09
Barium	L-series	0.16	0.14	0.04	0.10
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	15.09	13.21	33.59	10.46
	Sum:	114.24	100.00	100.00	



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, dark blue: Na, Si, Al
interpretation: ultramarine blue



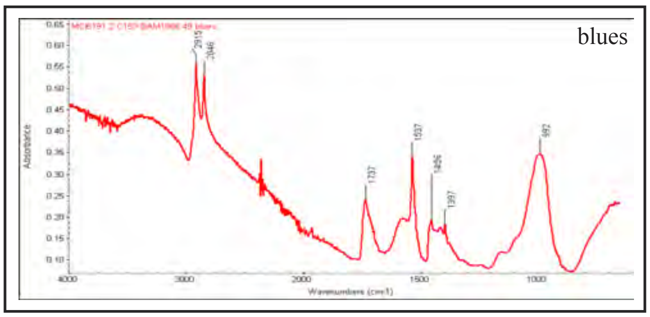
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Sulfur	K-series	13.94	20.29	24.58	0.52
Cadmium	L-series	13.86	20.18	6.97	1.77
Silicon	K-series	9.87	14.36	19.87	0.44
Sodium	K-series	8.54	12.43	21.01	6.75
Barium	L-series	6.61	9.62	2.72	0.48
Aluminium	K-series	6.56	9.55	13.76	0.33
Zinc	K-series	4.66	6.78	4.03	0.19
Potassium	K-series	1.94	2.83	2.81	0.65
Chlorine	K-series	1.91	2.78	3.04	0.09
Calcium	K-series	0.42	0.62	0.60	0.12
Phosphorus	K-series	0.24	0.34	0.43	0.03
Titanium	K-series	0.15	0.22	0.18	0.13
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	68.70	100.00	100.00	



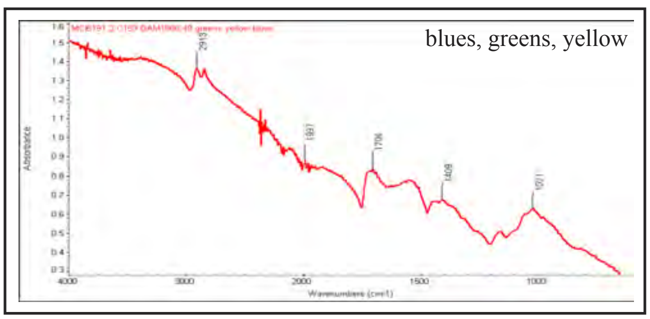
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: blues, green

sample location: right edge,
8.0" from top (T 20.3 x R 0.0 cm.)

Representative Analysis Compilation—sample C159, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

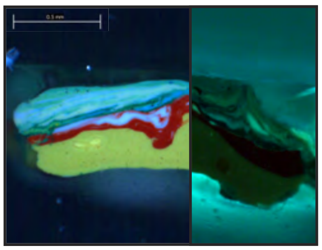


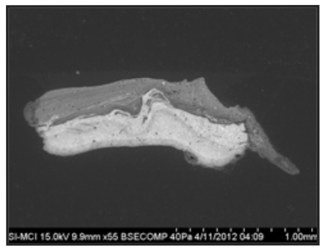
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: bright green

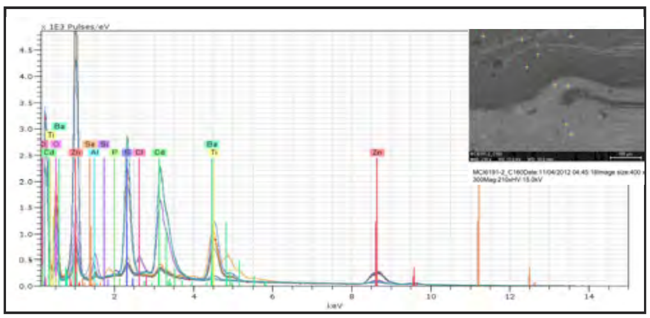
sample location: right edge,
10.0" from bottom (B 25.4 x R 0.0 cm.)

Representative Analysis Compilation—sample C160

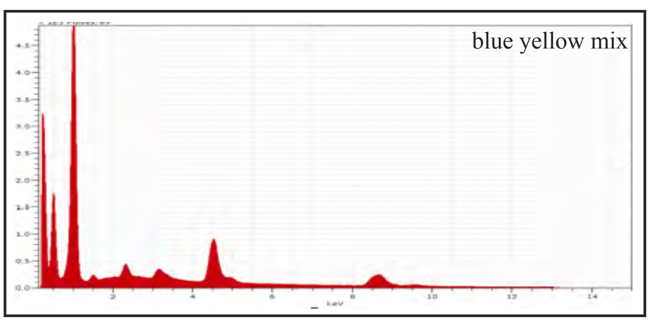




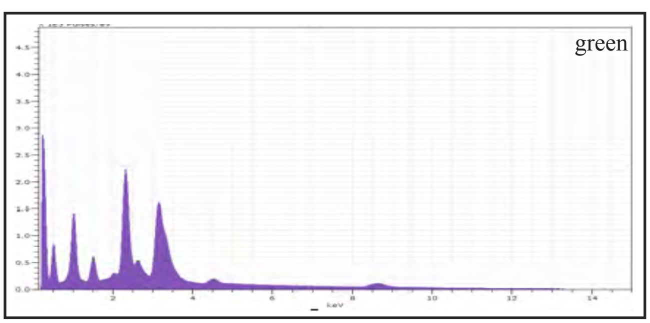
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.9 mm.



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 10.0 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Al
significant elements, green: Zn, Cd, S, Cl
significant elements, red: Cd, S
significant elements, yellow: Cd, S
interpretation: ultramarine blue, cadmium green, phthalo green, cadmium red, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	36.54	43.58	27.07	1.23
Sodium	K-series	22.46	26.79	47.33	17.70
Titanium	K-series	14.08	16.79	14.24	0.63
Cadmium	L-series	4.74	5.66	2.04	0.87
Sulfur	K-series	2.71	3.23	4.09	0.12
Aluminium	K-series	1.21	1.44	2.16	0.94
Chlorine	K-series	0.81	0.96	1.10	0.05
Phosphorus	K-series	0.63	0.75	0.98	0.05
Potassium	K-series	0.35	0.41	0.43	0.26
Silicon	K-series	0.32	0.38	0.55	0.04
Barium	L-series	0.01	0.01	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	83.85	100.00	100.00	



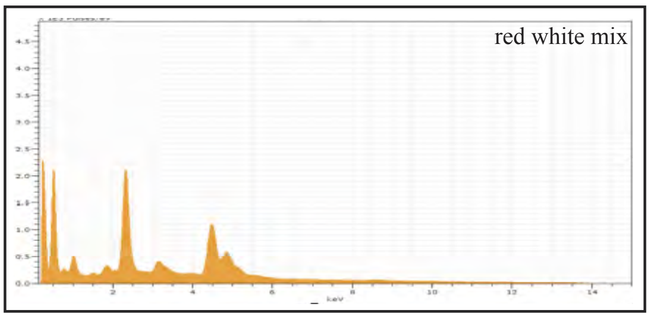
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	39.71	32.14	15.00	3.33
Zinc	K-series	31.28	25.32	20.31	1.06
Sulfur	K-series	17.97	14.55	23.79	0.66
Sodium	K-series	10.28	8.32	18.98	8.11
Barium	L-series	9.29	7.52	2.87	0.65
Potassium	K-series	4.83	3.91	5.25	1.19
Chlorine	K-series	4.53	3.67	5.42	0.18
Aluminium	K-series	4.08	3.31	6.43	2.12
Calcium	K-series	0.80	0.65	0.85	0.20
Phosphorus	K-series	0.67	0.54	0.91	0.05
Magnesium	K-series	0.11	0.09	0.19	0.07
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
	Sum:	123.56	100.00	100.00	



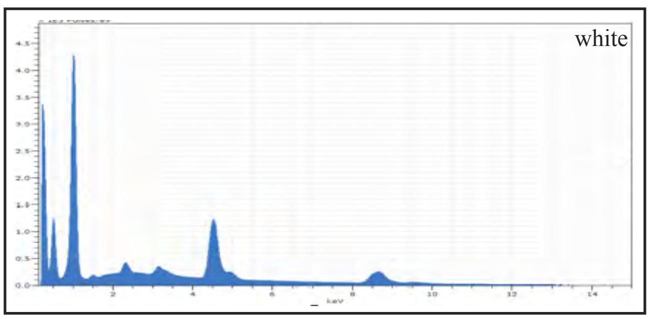
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: bright green

sample location: right edge,
10.0" from bottom (B 25.4 x R 0.0 cm.)

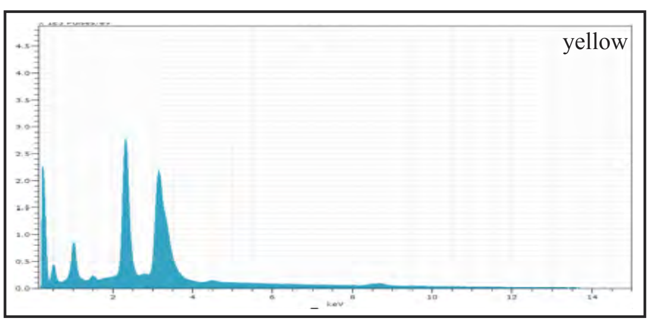
Representative Analysis Compilation—sample C160, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	16.36	26.68	10.22	1.15
Sulfur	K-series	15.82	25.79	42.29	0.58
Zinc	K-series	11.57	18.86	15.17	0.41
Titanium	K-series	7.77	12.66	13.91	0.80
Cadmium	L-series	5.18	8.45	3.95	0.88
Sodium	K-series	1.81	2.96	6.76	1.45
Silicon	K-series	0.92	1.49	2.80	0.06
Phosphorus	K-series	0.78	1.27	2.16	0.06
Chlorine	K-series	0.70	1.14	1.69	0.05
Potassium	K-series	0.30	0.49	0.66	0.23
Aluminium	K-series	0.12	0.20	0.39	0.12
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	61.34	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	33.97	39.78	24.70	1.14
Sodium	K-series	22.50	26.35	46.53	17.73
Titanium	K-series	18.48	21.64	18.35	0.75
Cadmium	L-series	4.76	5.58	2.01	0.81
Sulfur	K-series	2.51	2.94	3.72	0.11
Chlorine	K-series	1.02	1.19	1.36	0.06
Phosphorus	K-series	0.77	0.91	1.19	0.06
Aluminium	K-series	0.54	0.63	0.95	0.05
Silicon	K-series	0.34	0.39	0.57	0.04
Calcium	K-series	0.22	0.26	0.26	0.06
Potassium	K-series	0.18	0.22	0.22	0.15
Magnesium	K-series	0.06	0.07	0.11	0.03
Barium	L-series	0.04	0.05	0.01	0.05
	Sum:	85.38	100.00	100.00	



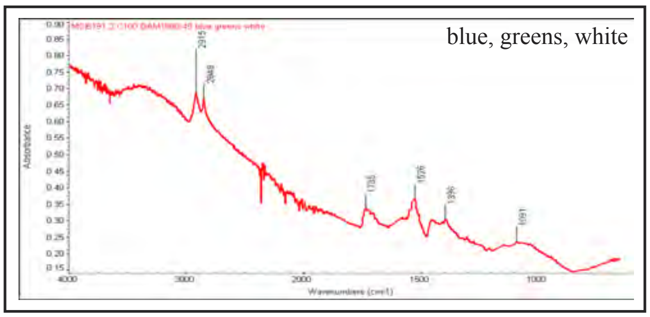
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	68.01	38.91	19.27	4.94
Zinc	K-series	39.96	22.86	19.46	1.35
Sulfur	K-series	28.45	16.27	28.26	1.03
Barium	L-series	14.67	8.39	3.40	1.00
Potassium	K-series	7.67	4.39	6.25	1.74
Sodium	K-series	6.22	3.56	8.62	4.92
Calcium	K-series	1.85	1.06	1.47	0.31
Chlorine	K-series	1.43	0.82	1.29	0.09
Phosphorus	K-series	0.54	0.31	0.56	0.05
Aluminium	K-series	0.47	0.27	0.55	0.38
Silicon	K-series	0.15	0.09	0.18	0.03
Magnesium	K-series	0.02	0.01	0.02	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	5.36	3.07	10.68	4.78
	Sum:	174.82	100.00	100.00	

acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: bright green

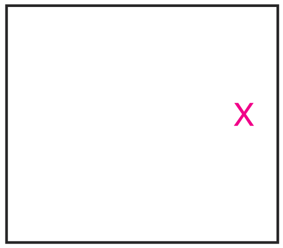
sample location: right edge,
10.0" from bottom (B 25.4 x R 0.0 cm.)

Representative Analysis Compilation—sample C160, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

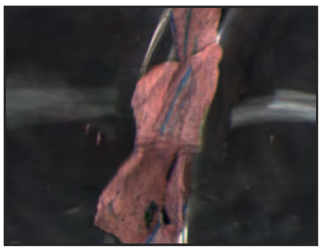
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

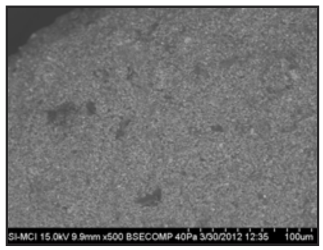


acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: pale pinkish purple

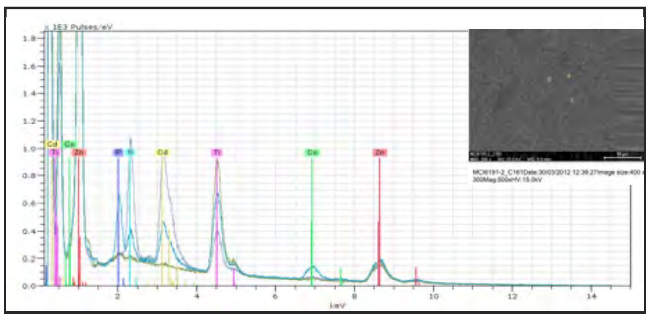
sample location: 19.5" from bottom,
6.0" from right (B 49.5 x R 15.2 cm.)

Representative Analysis Compilation—sample C161

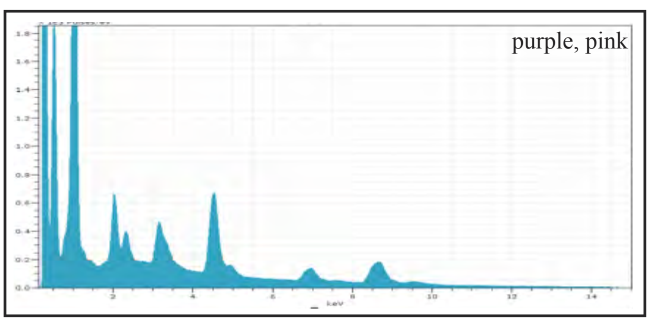




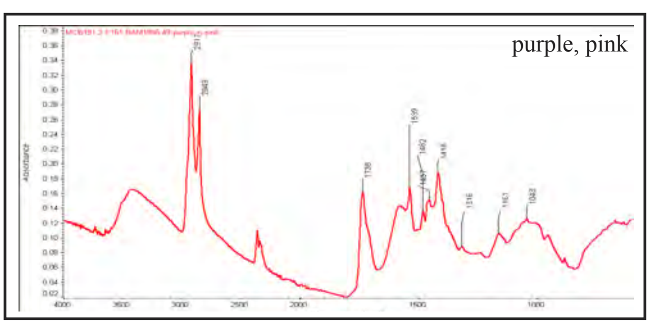
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



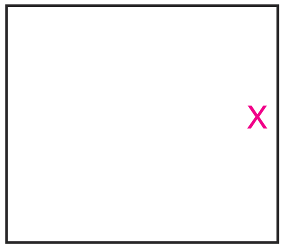
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Co, P
significant elements, pink: Cd, S, Se, Zn, Ti
interpretation: cobalt violet, cadmium red,
Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	38.41	35.09	18.78	1.29
Sodium	K-series	13.66	12.48	18.99	10.77
Titanium	K-series	12.09	11.04	8.07	0.68
Cadmium	L-series	7.63	6.97	2.17	1.14
Cobalt	K-series	7.18	6.56	3.89	0.24
Phosphorus	K-series	3.74	3.41	3.86	0.17
Barium	L-series	2.27	2.08	0.53	0.85
Sulfur	K-series	2.10	1.92	2.10	0.10
Magnesium	K-series	0.91	0.83	1.20	0.17
Selenium	L-series	0.63	0.58	0.26	0.07
Potassium	K-series	0.56	0.51	0.46	0.41
Chlorine	K-series	0.42	0.38	0.38	0.04
Calcium	K-series	0.31	0.28	0.25	0.08
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	19.54	17.86	39.06	8.68
	Sum:	109.45	100.00	100.00	



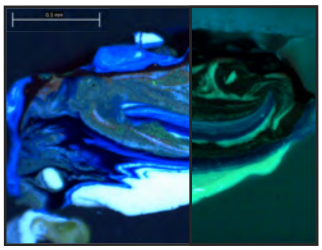
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

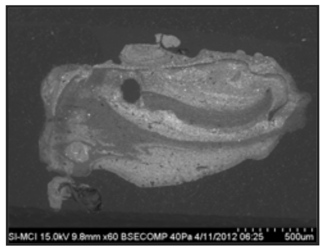


acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: blues

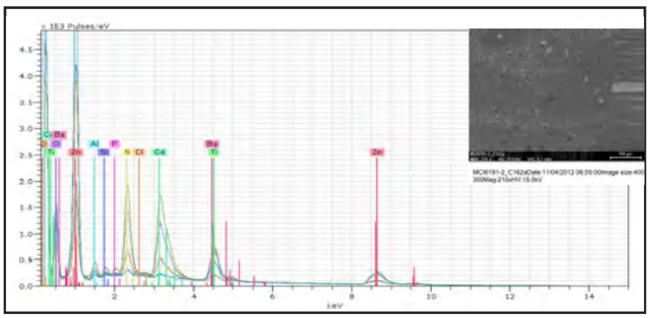
sample location: 17.0" from top,
3.5" from right (T 43.2 x R 8.9 cm.)

Representative Analysis Compilation—sample C162

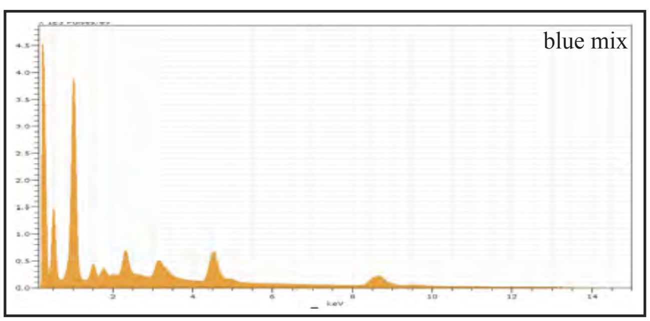




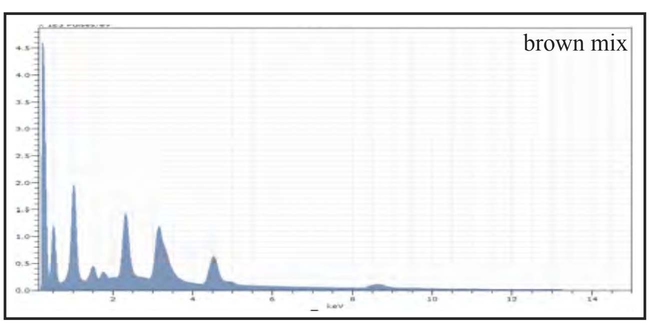
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.8 mm.



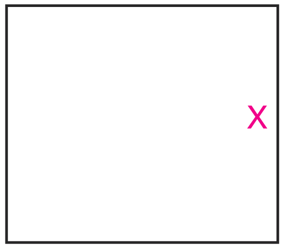
analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Al, Si
significant elements, brown: none
significant elements, white: Zn
interpretation: ultramarine blue, zinc white, moxied colors



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	33.16	42.19	25.94	1.12
Sodium	K-series	20.58	26.18	45.79	16.22
Titanium	K-series	9.19	11.69	9.82	0.46
Cadmium	L-series	6.26	7.96	2.85	1.02
Sulfur	K-series	3.88	4.93	6.18	0.16
Aluminium	K-series	2.04	2.59	3.86	1.32
Silicon	K-series	1.43	1.82	2.61	0.09
Potassium	K-series	0.82	1.05	1.08	0.38
Chlorine	K-series	0.72	0.92	1.04	0.05
Phosphorus	K-series	0.50	0.63	0.82	0.04
Barium	L-series	0.02	0.03	0.01	0.04
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	78.61	100.00	100.00	



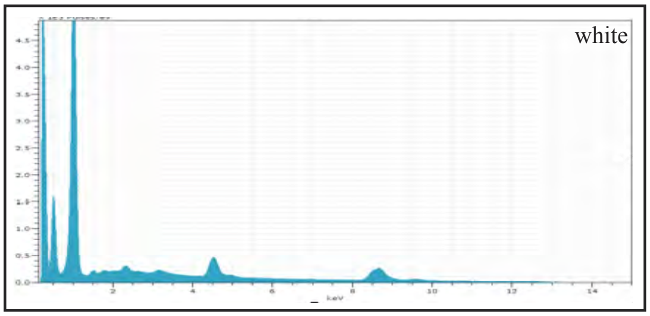
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	31.68	26.50	20.78	1.08
Cadmium	L-series	28.10	23.51	10.72	2.71
Sodium	K-series	13.76	11.51	25.67	10.85
Barium	L-series	13.57	11.35	4.24	1.19
Sulfur	K-series	11.80	9.87	15.78	0.44
Titanium	K-series	10.40	8.70	9.32	1.03
Potassium	K-series	3.34	2.79	3.66	1.00
Aluminium	K-series	2.55	2.14	4.06	1.58
Silicon	K-series	1.44	1.20	2.19	0.09
Chlorine	K-series	1.25	1.04	1.51	0.07
Calcium	K-series	0.95	0.80	1.02	0.18
Phosphorus	K-series	0.57	0.48	0.79	0.05
Magnesium	K-series	0.15	0.12	0.26	0.08
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	119.55	100.00	100.00	



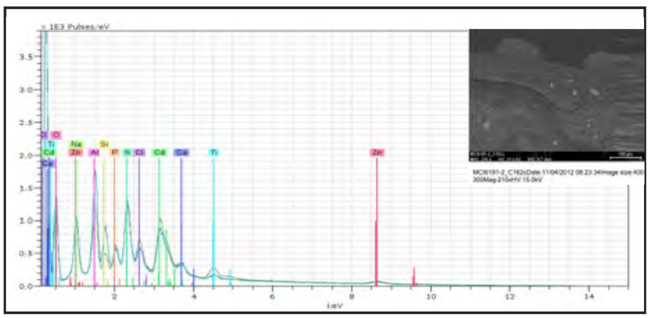
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: blues

sample location: 17.0" from top,
3.5" from right (T 43.2 x R 8.9 cm.)

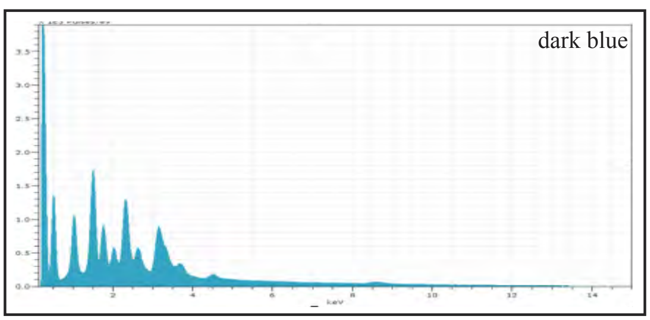
Representative Analysis Compilation—sample C162, continued



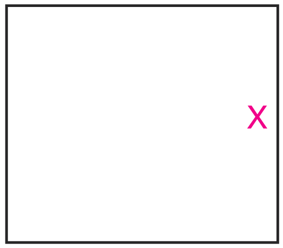
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	73.70	55.57	34.79	2.45
Sodium	K-series	24.40	18.40	32.76	19.23
Barium	L-series	9.24	6.96	2.08	0.83
Titanium	K-series	6.12	4.61	3.95	0.69
Cadmium	L-series	3.40	2.57	0.93	0.77
Sulfur	K-series	1.66	1.25	1.59	0.08
Chlorine	K-series	0.94	0.71	0.82	0.06
Phosphorus	K-series	0.68	0.51	0.68	0.05
Silicon	K-series	0.58	0.44	0.64	0.05
Aluminium	K-series	0.55	0.42	0.63	0.05
Calcium	K-series	0.54	0.41	0.42	0.09
Potassium	K-series	0.16	0.12	0.12	0.13
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	10.67	8.04	20.58	5.35
	Sum:	132.63	100.00	100.00	



analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, dark blue: Al, Na, Si
interpretation: ultramarine blue



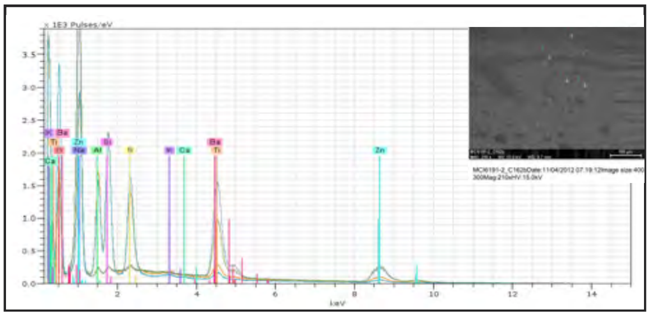
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	5.32	9.05	1.79	0.79
Aluminium	K-series	5.26	8.95	7.39	0.27
Sodium	K-series	4.45	7.57	7.33	3.53
Zinc	K-series	4.21	7.16	2.44	0.17
Sulfur	K-series	3.63	6.17	4.29	0.15
Silicon	K-series	2.22	3.77	2.99	0.12
Chlorine	K-series	1.21	2.07	1.30	0.07
Potassium	K-series	1.13	1.92	1.10	0.28
Phosphorus	K-series	0.99	1.68	1.21	0.06
Calcium	K-series	0.75	1.28	0.71	0.08
Titanium	K-series	0.40	0.68	0.32	0.07
Barium	L-series	0.01	0.02	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	29.23	49.69	69.15	15.55
	Sum:	58.82	100.00	100.00	



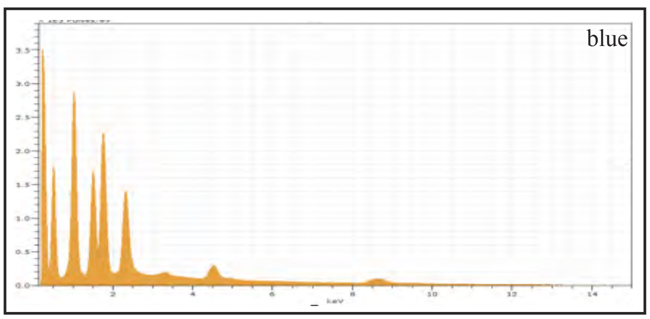
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: blues

sample location: 17.0" from top,
3.5" from right (T 43.2 x R 8.9 cm.)

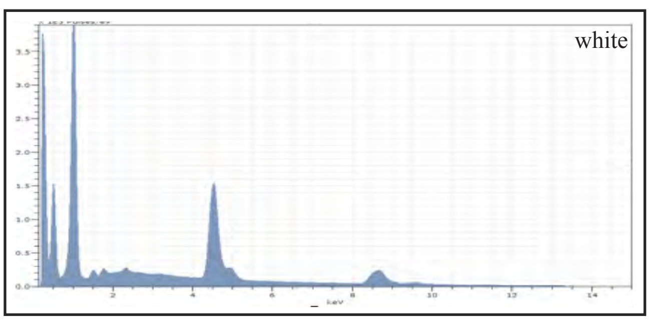
Representative Analysis Compilation—sample C162, continued



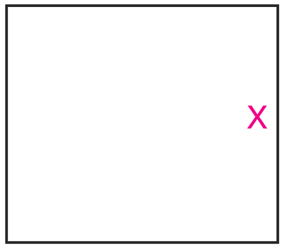
analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Si, Al
significant elements, white: Zn, Ti
interpretation: ultramarine blue, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	18.90	25.31	12.98	0.65
Sodium	K-series	17.41	23.32	34.00	13.73
Silicon	K-series	13.43	17.98	21.47	0.58
Sulfur	K-series	9.05	12.12	12.67	0.34
Aluminium	K-series	7.60	10.18	12.64	0.38
Titanium	K-series	3.55	4.75	3.33	0.39
Barium	L-series	2.37	3.18	0.78	0.40
Cadmium	L-series	0.83	1.11	0.33	0.23
Potassium	K-series	0.65	0.86	0.74	0.20
Chlorine	K-series	0.58	0.77	0.73	0.05
Calcium	K-series	0.30	0.40	0.34	0.07
Phosphorus	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	74.66	100.00	100.00	



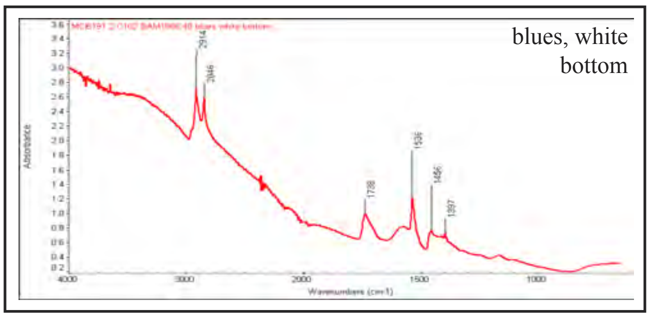
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	41.56	42.33	27.25	1.39
Titanium	K-series	27.67	28.18	24.77	1.08
Sodium	K-series	22.00	22.41	41.03	17.34
Cadmium	L-series	1.46	1.49	0.56	0.38
Sulfur	K-series	1.17	1.19	1.56	0.07
Barium	L-series	1.12	1.14	0.35	0.57
Silicon	K-series	0.90	0.91	1.37	0.06
Chlorine	K-series	0.79	0.80	0.95	0.05
Aluminium	K-series	0.70	0.71	1.11	0.06
Phosphorus	K-series	0.56	0.57	0.77	0.05
Calcium	K-series	0.24	0.24	0.25	0.06
Potassium	K-series	0.02	0.02	0.03	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	98.20	100.00	100.00	



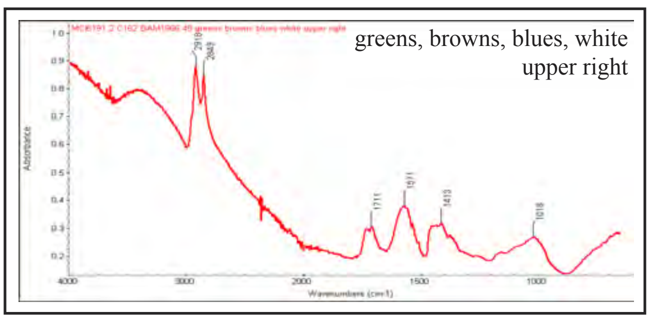
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: blues

sample location: 17.0" from top,
3.5" from right (T 43.2 x R 8.9 cm.)

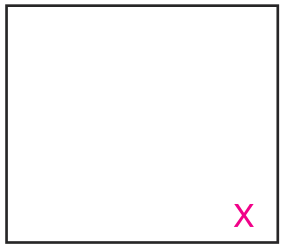
Representative Analysis Compilation—sample C162, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



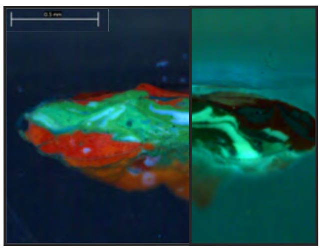
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

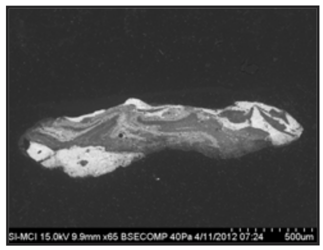


acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: bright orange (can't sample other)

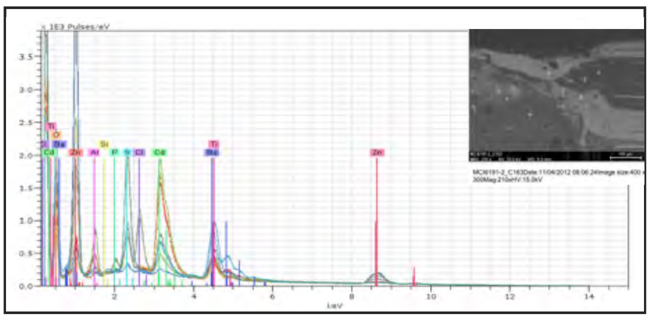
sample location: 4.5" from bottom,
6.0" from right (B 11.4 x R 15.2 cm.)

Representative Analysis Compilation—sample C163

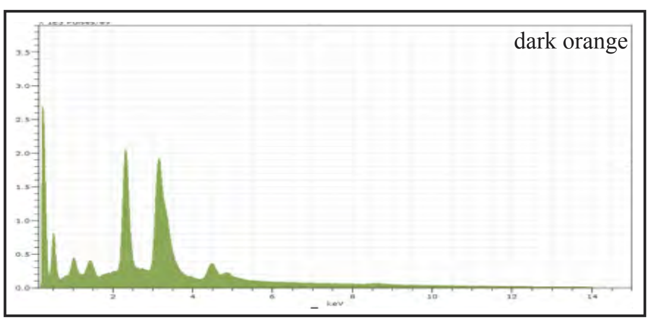




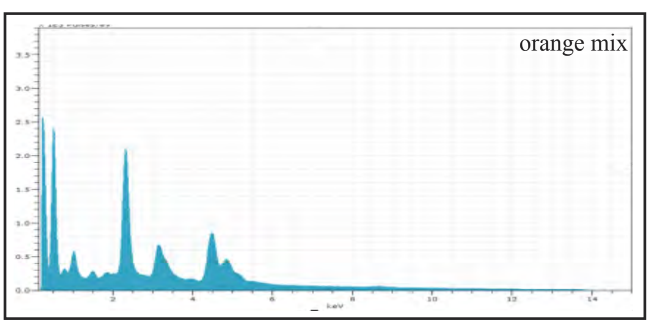
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.9 mm.



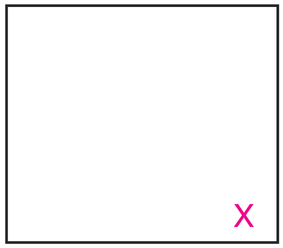
analysis: EDS
by: DVR (MCI)
date: 04/11/12
working distance: 9.9 mm.
mag: 210x; HV: 15 kV
significant elements, orange: Cd, S, Se
significant elements, green: Zn, Cd, S, Na
significant elements, white: Zn, Ti
interpretation: cadmium orange, cadmium green, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	42.02	50.11	26.08	3.34
Sulfur	K-series	17.73	21.14	38.57	0.65
Barium	L-series	5.73	6.83	2.91	0.54
Potassium	K-series	5.28	6.30	9.43	1.12
Zinc	K-series	3.30	3.94	3.52	0.14
Titanium	K-series	3.24	3.86	4.71	0.40
Sodium	K-series	2.35	2.81	7.14	1.88
Chlorine	K-series	1.39	1.65	2.73	0.08
Selenium	L-series	1.20	1.43	1.06	0.11
Phosphorus	K-series	0.69	0.82	1.56	0.05
Aluminium	K-series	0.62	0.74	1.61	0.50
Silicon	K-series	0.17	0.21	0.43	0.03
Calcium	K-series	0.14	0.17	0.24	0.12
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	83.86	100.00	100.00	



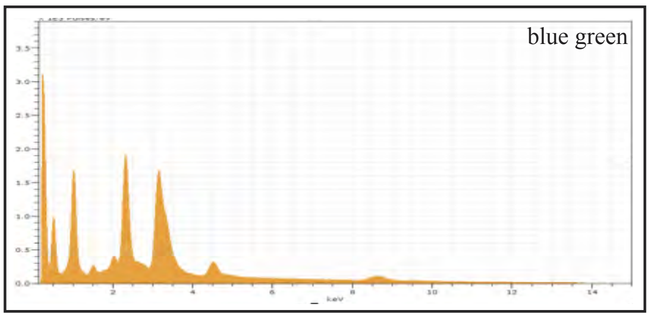
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	15.13	18.38	3.37	1.01
Sulfur	K-series	10.20	12.39	9.73	0.38
Cadmium	L-series	7.16	8.70	1.95	0.98
Titanium	K-series	2.95	3.58	1.89	0.39
Zinc	K-series	2.79	3.38	1.30	0.12
Sodium	K-series	1.21	1.47	1.61	0.98
Potassium	K-series	0.82	1.00	0.64	0.38
Chlorine	K-series	0.38	0.46	0.32	0.04
Aluminium	K-series	0.35	0.42	0.40	0.29
Phosphorus	K-series	0.19	0.23	0.19	0.03
Silicon	K-series	0.10	0.12	0.11	0.03
Magnesium	K-series	0.04	0.05	0.05	0.05
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	41.03	49.82	78.44	17.75
	Sum:	82.35	100.00	100.00	



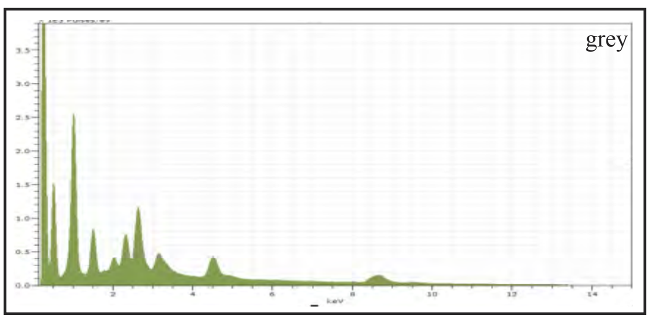
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: bright orange (can't sample other)

sample location: 4.5" from bottom,
6.0" from right (B 11.4 x R 15.2 cm.)

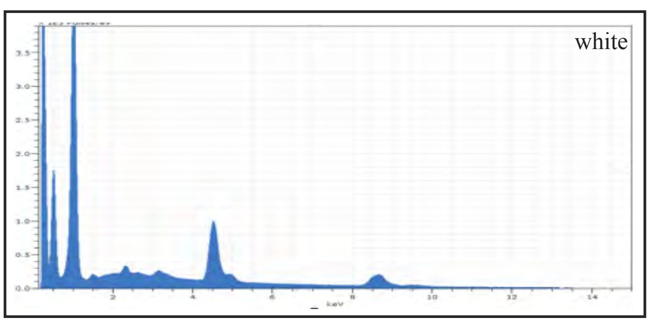
Representative Analysis Compilation—sample C163, continued



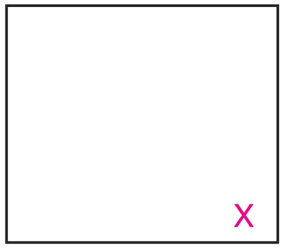
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	34.72	36.75	15.83	2.93
Zinc	K-series	17.87	18.92	14.00	0.62
Sulfur	K-series	15.42	16.32	24.64	0.57
Sodium	K-series	11.61	12.29	25.88	9.16
Titanium	K-series	4.48	4.74	4.79	0.37
Potassium	K-series	4.36	4.62	5.72	1.01
Phosphorus	K-series	1.91	2.02	3.16	0.10
Chlorine	K-series	1.81	1.92	2.62	0.09
Aluminium	K-series	1.14	1.21	2.17	0.90
Barium	L-series	0.64	0.67	0.24	0.34
Magnesium	K-series	0.30	0.31	0.63	0.10
Silicon	K-series	0.12	0.12	0.21	0.03
Calcium	K-series	0.10	0.10	0.13	0.09
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	94.48	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	28.00	33.17	20.96	0.95
Sodium	K-series	14.33	16.98	30.51	11.31
Chlorine	K-series	10.12	11.99	13.97	0.36
Cadmium	L-series	8.48	10.04	3.69	1.23
Aluminium	K-series	6.17	7.31	11.20	0.31
Titanium	K-series	5.04	5.97	5.15	0.48
Sulfur	K-series	4.86	5.75	7.41	0.20
Barium	L-series	3.62	4.29	1.29	0.50
Phosphorus	K-series	2.27	2.69	3.59	0.11
Potassium	K-series	0.59	0.70	0.74	0.43
Silicon	K-series	0.43	0.51	0.75	0.04
Calcium	K-series	0.34	0.40	0.41	0.08
Magnesium	K-series	0.16	0.19	0.33	0.04
	Sum:	84.42	100.00	100.00	



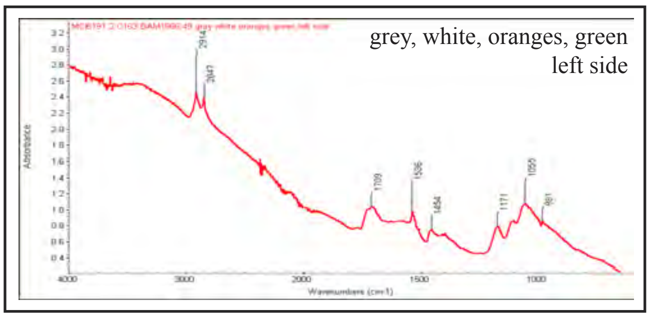
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	60.59	46.40	33.79	2.02
Sodium	K-series	24.87	19.05	39.45	19.60
Titanium	K-series	18.69	14.31	14.23	1.35
Barium	L-series	15.30	11.72	4.06	1.49
Cadmium	L-series	4.93	3.78	1.60	0.96
Sulfur	K-series	2.01	1.54	2.29	0.10
Chlorine	K-series	1.46	1.12	1.51	0.08
Phosphorus	K-series	0.87	0.66	1.02	0.06
Calcium	K-series	0.78	0.60	0.71	0.11
Aluminium	K-series	0.53	0.40	0.71	0.05
Silicon	K-series	0.31	0.23	0.40	0.04
Potassium	K-series	0.24	0.18	0.22	0.19
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	130.59	100.00	100.00	



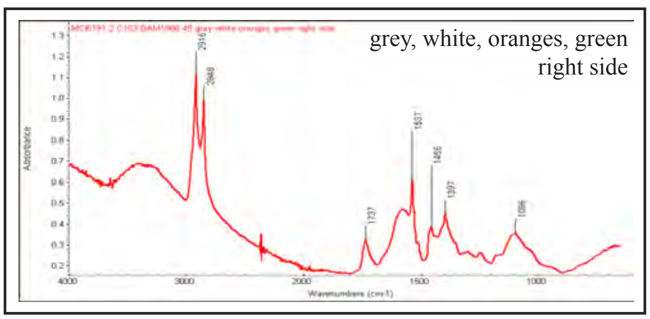
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: bright orange (can't sample other)

sample location: 4.5" from bottom,
6.0" from right (B 11.4 x R 15.2 cm.)

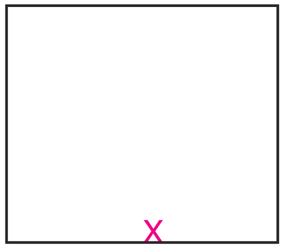
Representative Analysis Compilation—sample C163, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



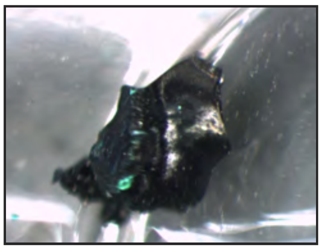
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

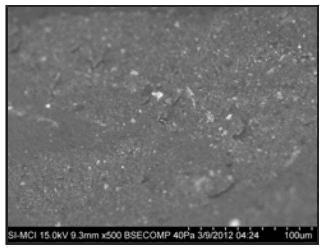


acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: black oil and black enamel

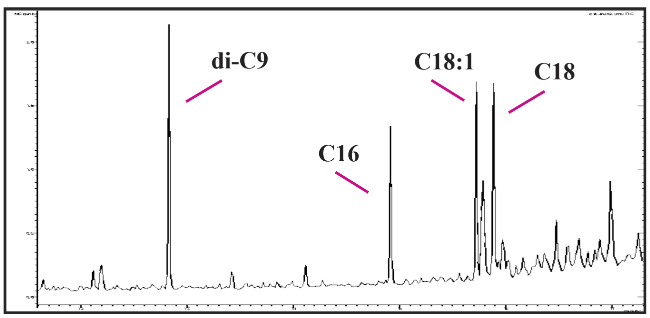
sample location: 2.0" from bottom,
22.0" from right (B 5.1 x R 55.9 cm.)

Representative Analysis Compilation—sample C164

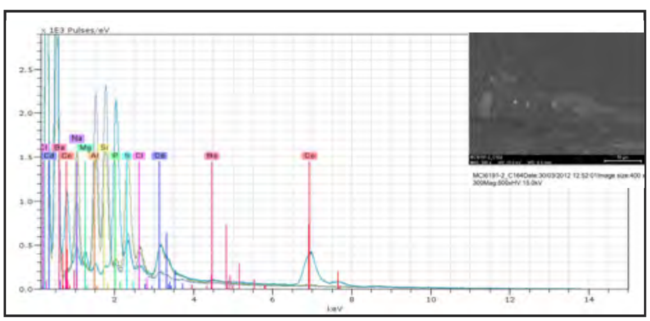




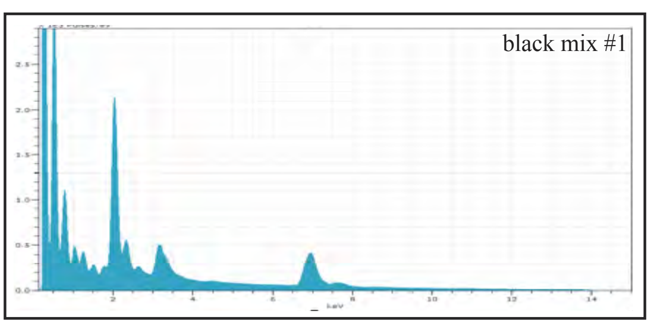
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.3 mm.



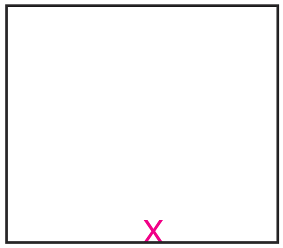
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.131
scan range: 1 - 1477
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 8.8 mm.
mag: 500x; HV: 15 kV
significant elements, black mix #1: Co, P
significant elements, black mix #2: Si, Al, Na
interpretation: cobalt violet and ultramarine blue, possible carbon black



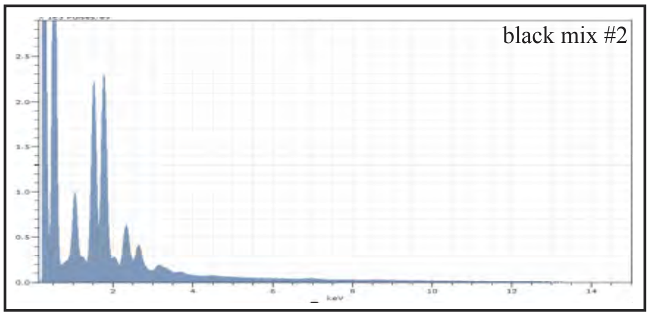
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	31.47	34.60	16.99	0.96
Phosphorus	K-series	12.06	13.26	12.39	0.48
Cadmium	L-series	7.24	7.97	2.05	1.16
Sodium	K-series	3.91	4.29	5.41	0.37
Sulfur	K-series	2.90	3.19	2.88	0.13
Magnesium	K-series	1.98	2.18	2.60	0.20
Potassium	K-series	1.06	1.16	0.86	0.44
Chlorine	K-series	1.02	1.12	0.91	0.06
Barium	L-series	0.81	0.90	0.19	0.08
Aluminium	K-series	0.53	0.58	0.62	0.43
Calcium	K-series	0.33	0.36	0.26	0.09
Silicon	K-series	0.15	0.16	0.17	0.03
Vanadium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	27.49	30.23	54.68	15.73
	Sum:	90.94	100.00	100.00	



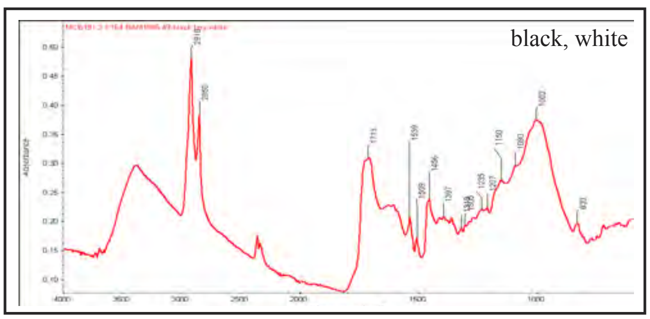
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: black oil and black enamel

sample location: 2.0" from bottom, 22.0" from right (B 5.1 x R 55.9 cm.)

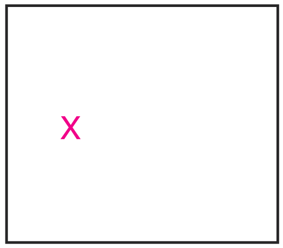
Representative Analysis Compilation—sample C164, continued

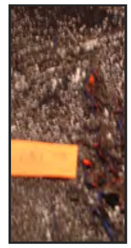


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	10.89	11.86	8.55	0.48
Aluminium	K-series	8.07	8.78	6.59	2.13
Sodium	K-series	4.27	4.65	4.10	3.39
Zinc	K-series	4.00	4.35	1.35	0.17
Sulfur	K-series	2.94	3.20	2.02	0.13
Chlorine	K-series	2.20	2.39	1.37	0.10
Cobalt	K-series	1.82	1.98	0.68	0.08
Cadmium	L-series	1.70	1.85	0.33	0.44
Barium	L-series	0.95	1.03	0.15	0.11
Phosphorus	K-series	0.72	0.79	0.52	0.05
Magnesium	K-series	0.34	0.37	0.31	0.08
Potassium	K-series	0.23	0.25	0.13	0.18
Calcium	K-series	0.23	0.25	0.12	0.06
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	53.51	58.26	73.77	16.78
	Sum:	91.85	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

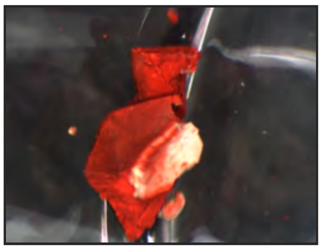
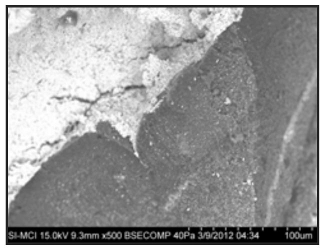





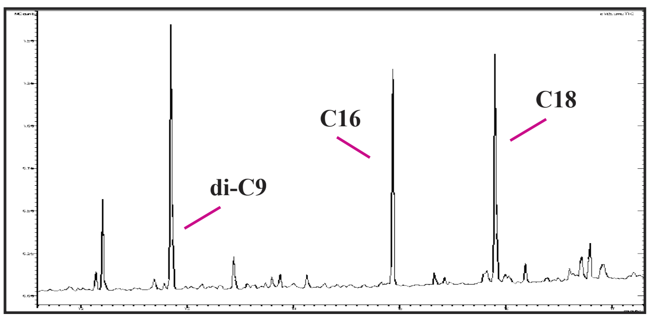
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: orange on top of black

sample location: 14.5" from bottom, 11.0" from left (B 36.8 x L 27.9 cm.)

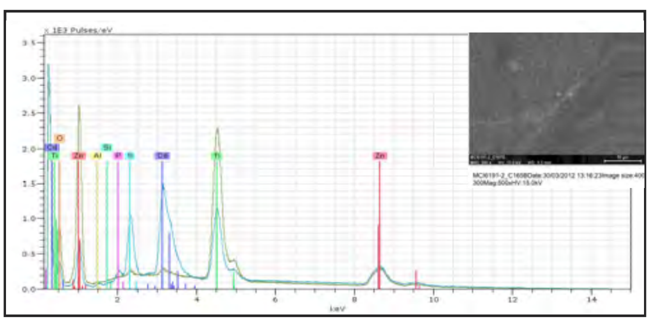
Representative Analysis Compilation—sample C165

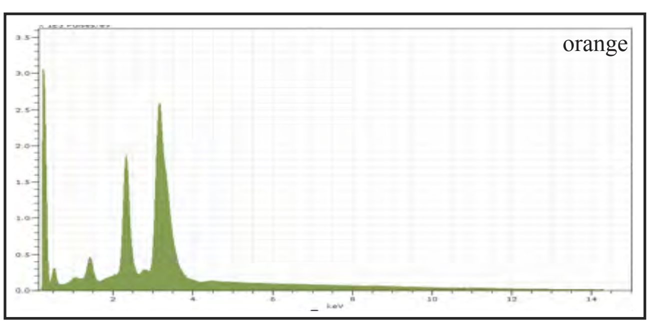
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.3 mm.



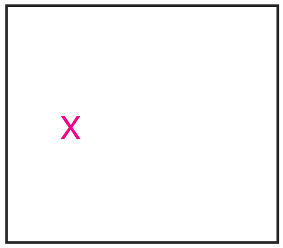
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.391
scan range: 1 - 1484
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil

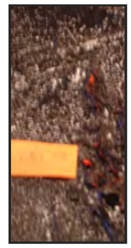


analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
significant elements, white: Zn, Ti
interpretation: cadmium orange, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	60.48	54.23	31.31	4.36
Sulfur	K-series	18.16	16.28	32.96	0.67
Zinc	K-series	13.28	11.91	11.82	0.47
Potassium	K-series	8.86	7.94	13.18	1.39
Selenium	L-series	5.84	5.23	4.30	0.40
Barium	L-series	2.26	2.03	0.96	0.20
Sodium	K-series	0.76	0.68	1.91	0.62
Chlorine	K-series	0.72	0.65	1.19	0.07
Phosphorus	K-series	0.58	0.52	1.09	0.05
Aluminium	K-series	0.56	0.50	1.21	0.45
Silicon	K-series	0.03	0.02	0.05	0.03
Calcium	K-series	0.01	0.01	0.02	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
	Sum:	111.54	100.00	100.00	

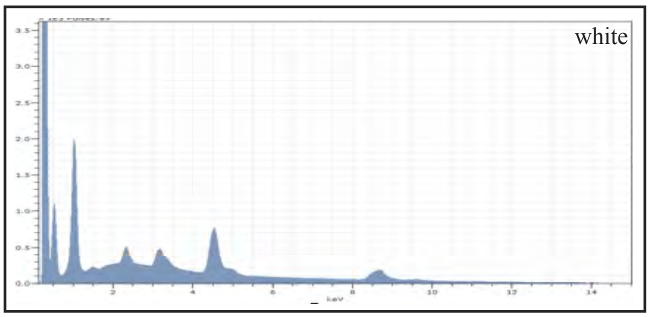




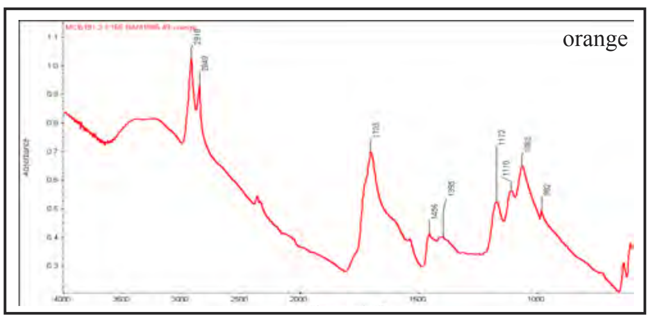
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: orange on top of black

sample location: 14.5" from bottom, 11.0" from left (B 36.8 x L 27.9 cm.)

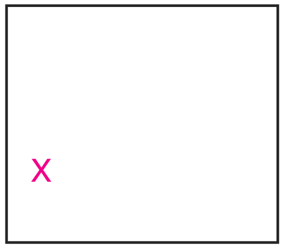
Representative Analysis Compilation—sample C165, continued

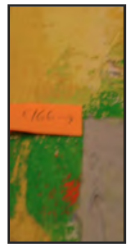


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	36.72	45.79	34.75	1.24
Sodium	K-series	13.68	17.06	36.81	10.79
Titanium	K-series	9.42	11.75	12.18	0.79
Barium	L-series	9.01	11.23	4.06	0.90
Cadmium	L-series	6.76	8.44	3.72	1.02
Sulfur	K-series	2.22	2.76	4.28	0.10
Chlorine	K-series	0.76	0.95	1.33	0.05
Phosphorus	K-series	0.52	0.64	1.03	0.05
Potassium	K-series	0.49	0.61	0.78	0.36
Calcium	K-series	0.47	0.59	0.73	0.09
Aluminium	K-series	0.09	0.11	0.21	0.09
Silicon	K-series	0.06	0.08	0.14	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	80.20	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

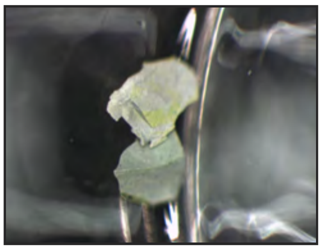


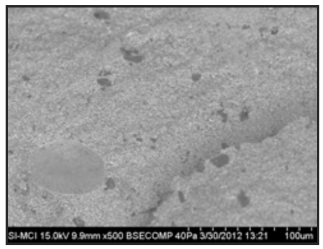


acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: light blue gray

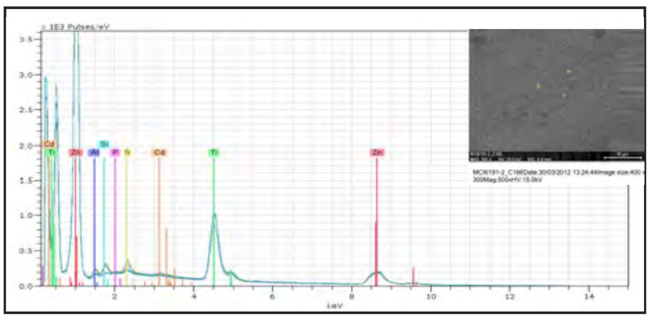
sample location: 10.5" from bottom,
5.5" from left (B 26.7 x L 14.0 cm.)

Representative Analysis Compilation—sample C166

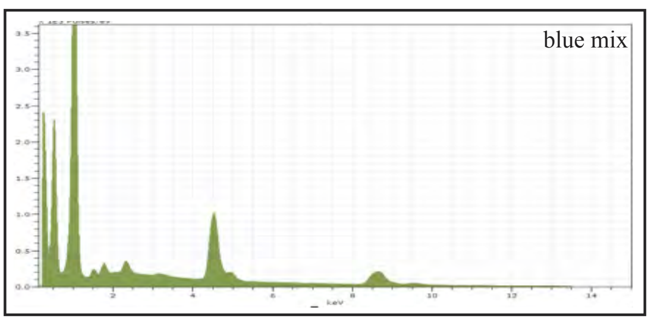




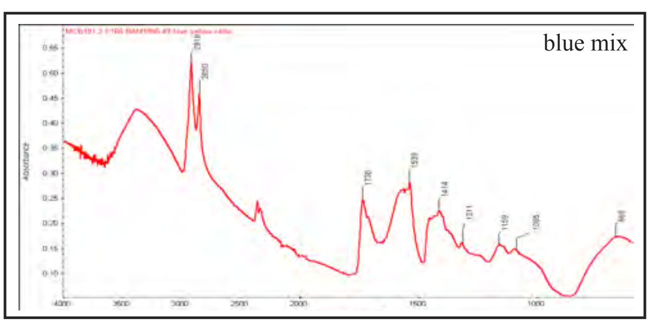
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



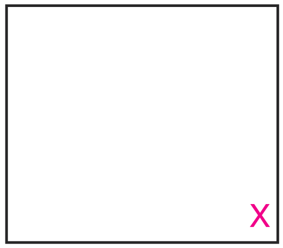
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, blue mix: Zn, Ti
interpretation: Zn/Ti white with mixed colors



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	53.86	44.26	23.61	1.80
Titanium	K-series	19.71	16.20	11.80	0.99
Sodium	K-series	15.48	12.72	19.30	12.20
Barium	L-series	5.04	4.14	1.05	1.08
Sulfur	K-series	1.57	1.29	1.40	0.08
Cadmium	L-series	1.35	1.11	0.34	0.35
Silicon	K-series	1.03	0.85	1.06	0.07
Aluminium	K-series	0.42	0.34	0.44	0.34
Chlorine	K-series	0.29	0.24	0.23	0.04
Phosphorus	K-series	0.22	0.18	0.20	0.03
Calcium	K-series	0.12	0.10	0.08	0.05
Potassium	K-series	0.05	0.04	0.04	0.06
Selenium	L-series	0.00	0.00	0.00	0.02
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	22.58	18.55	40.45	9.22
	Sum:	121.69	100.00	100.00	



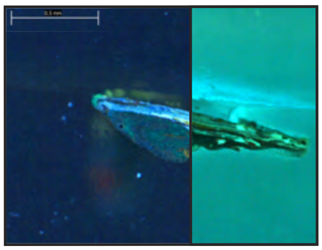
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

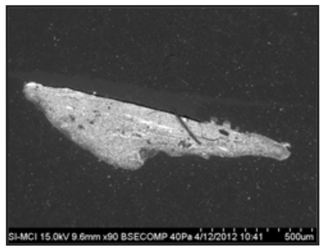


acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: stratigraphy, no ground included

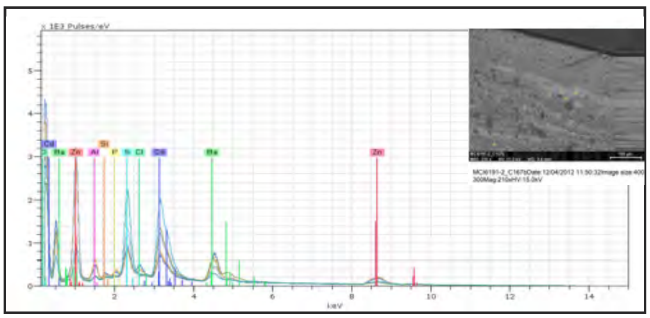
sample location: 3.5" from bottom,
3.0" from right (B 8.9 x R 7.6 cm.)

Representative Analysis Compilation—sample C167

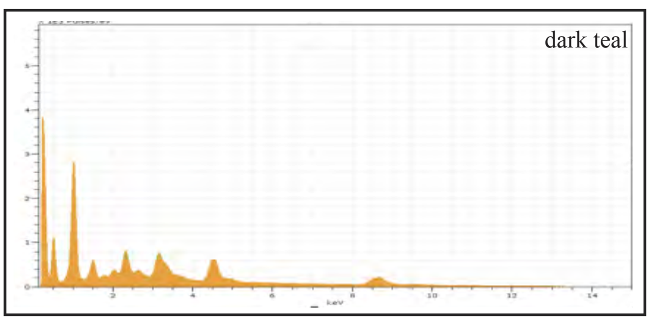




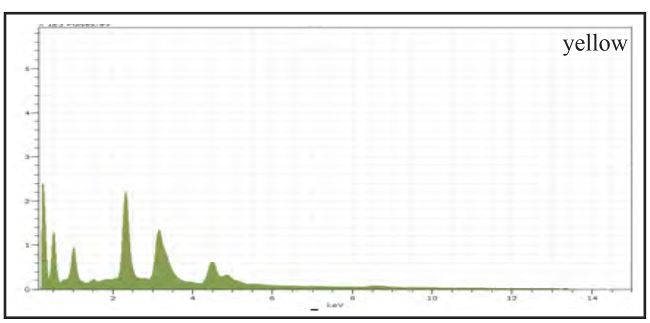
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.6 mm.



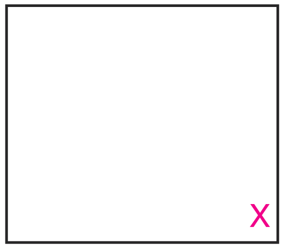
analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.6 mm.
mag: 210x; HV: 15 kV
significant elements, teal: Zn, Na, Cd, S
significant elements, yellow: Cd, S
interpretation: cadmium green, cadmium yellow, possible ultramarine blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	36.89	44.65	31.01	1.24
Sodium	K-series	15.46	18.71	36.96	12.19
Cadmium	L-series	9.55	11.56	4.67	1.28
Titanium	K-series	9.05	10.95	10.39	0.55
Sulfur	K-series	3.52	4.27	6.04	0.15
Barium	L-series	2.24	2.71	0.90	0.64
Aluminium	K-series	2.13	2.58	4.34	1.23
Potassium	K-series	1.38	1.67	1.94	0.47
Chlorine	K-series	1.14	1.38	1.77	0.07
Phosphorus	K-series	0.65	0.78	1.15	0.05
Calcium	K-series	0.60	0.72	0.82	0.10
Silicon	K-series	0.01	0.01	0.02	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
	Sum:	82.62	100.00	100.00	



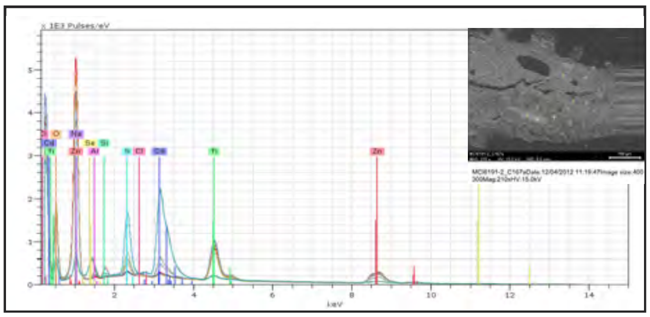
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	51.24	31.44	14.95	3.25
Cadmium	L-series	39.34	24.14	14.03	3.54
Zinc	K-series	33.52	20.57	20.54	1.14
Sulfur	K-series	22.52	13.82	28.14	0.82
Sodium	K-series	6.78	4.16	11.82	5.36
Potassium	K-series	4.58	2.81	4.69	1.28
Chlorine	K-series	1.78	1.09	2.01	0.09
Calcium	K-series	1.37	0.84	1.37	0.23
Phosphorus	K-series	0.75	0.46	0.98	0.06
Silicon	K-series	0.51	0.31	0.72	0.05
Aluminium	K-series	0.36	0.22	0.53	0.30
Titanium	K-series	0.24	0.15	0.20	0.19
Magnesium	K-series	0.01	0.00	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	163.00	100.00	100.00	

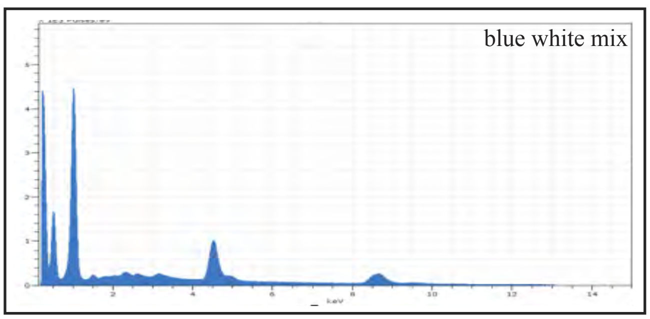
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: stratigraphy, no ground included

sample location: 3.5" from bottom, 3.0" from right (B 8.9 x R 7.6 cm.)

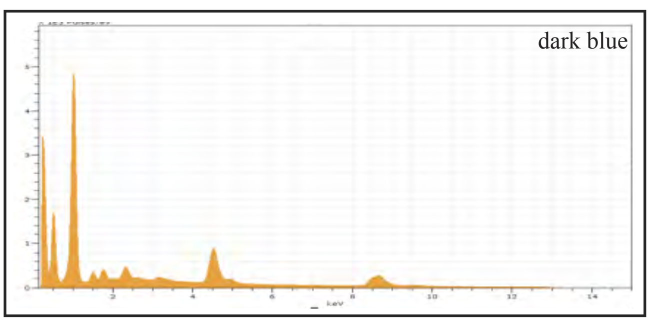
Representative Analysis Compilation—sample C167, continued



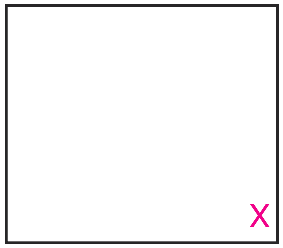
analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.6 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na
significant elements, green: Zn, Na, Cd, S
significant elements, red: Cd, S, Se
interpretation: ultramarine blue, cadmium green, cadmium red



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	94.34	51.61	39.76	3.13
Sodium	K-series	29.35	16.05	35.18	23.12
Barium	L-series	25.02	13.69	5.02	1.92
Titanium	K-series	18.34	10.03	10.56	1.55
Cadmium	L-series	6.41	3.51	1.57	1.15
Chlorine	K-series	2.34	1.28	1.82	0.11
Sulfur	K-series	2.25	1.23	1.93	0.11
Calcium	K-series	1.34	0.73	0.92	0.14
Phosphorus	K-series	1.15	0.63	1.02	0.07
Aluminium	K-series	1.15	0.63	1.17	0.08
Silicon	K-series	0.74	0.41	0.73	0.06
Potassium	K-series	0.25	0.14	0.18	0.20
Magnesium	K-series	0.12	0.07	0.14	0.04
	Sum:	182.80	100.00	100.00	



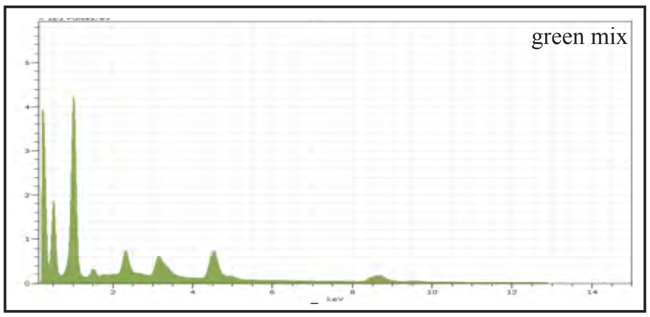
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	83.05	47.83	34.85	2.76
Sodium	K-series	40.09	23.08	47.85	31.57
Barium	L-series	36.80	21.19	7.35	1.36
Cadmium	L-series	3.58	2.06	0.87	0.86
Sulfur	K-series	3.32	1.91	2.84	0.14
Silicon	K-series	2.57	1.48	2.51	0.13
Aluminium	K-series	1.78	1.03	1.81	1.33
Chlorine	K-series	1.29	0.74	1.00	0.07
Phosphorus	K-series	0.49	0.28	0.43	0.04
Calcium	K-series	0.38	0.22	0.26	0.08
Potassium	K-series	0.33	0.19	0.23	0.25
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	173.66	100.00	100.00	

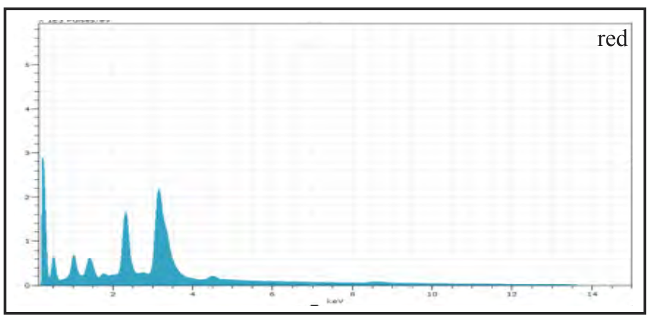
acc. no.: BAM 1966.49
title, year: *The Vanquished*, 1959
Bequest of the artist
medium noted in file: oil/enamel on canvas
meas.: 36.1 x 48.1" (91.7 x 122.2 cm.)
notes: stratigraphy, no ground included

sample location: 3.5" from bottom,
3.0" from right (B 8.9 x R 7.6 cm.)

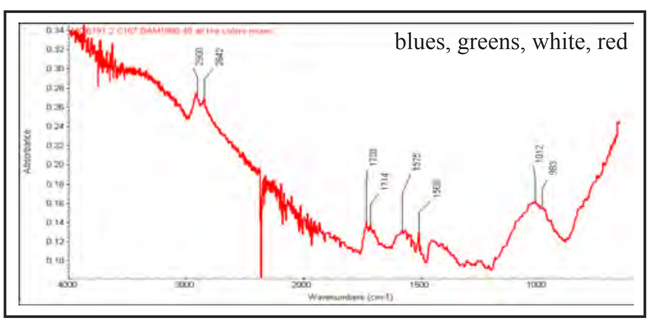
Representative Analysis Compilation—sample C167, continued



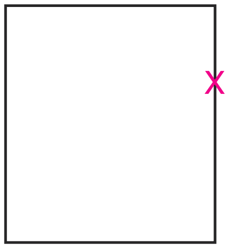
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	45.45	42.52	29.54	1.53
Sodium	K-series	21.66	20.26	40.04	17.07
Titanium	K-series	14.68	13.73	13.02	0.88
Cadmium	L-series	11.41	10.67	4.31	1.56
Sulfur	K-series	4.92	4.60	6.52	0.20
Barium	L-series	4.83	4.51	1.49	0.94
Potassium	K-series	1.41	1.32	1.53	0.60
Aluminium	K-series	1.18	1.10	1.85	0.92
Chlorine	K-series	0.80	0.75	0.96	0.06
Calcium	K-series	0.23	0.22	0.25	0.10
Phosphorus	K-series	0.22	0.21	0.30	0.03
Silicon	K-series	0.12	0.11	0.19	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
	Sum:	106.91	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	59.10	40.26	22.68	4.41
Zinc	K-series	31.54	21.49	20.81	1.07
Barium	L-series	15.36	10.46	4.82	1.03
Sulfur	K-series	15.18	10.34	20.42	0.56
Potassium	K-series	7.29	4.97	8.05	1.53
Sodium	K-series	6.20	4.22	11.63	4.90
Selenium	L-series	5.94	4.04	3.24	0.41
Aluminium	K-series	1.89	1.29	3.03	1.47
Calcium	K-series	1.65	1.12	1.78	0.28
Chlorine	K-series	1.44	0.98	1.75	0.08
Silicon	K-series	0.67	0.46	1.03	0.05
Phosphorus	K-series	0.54	0.37	0.75	0.05
Magnesium	K-series	0.01	0.00	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
	Sum:	146.80	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

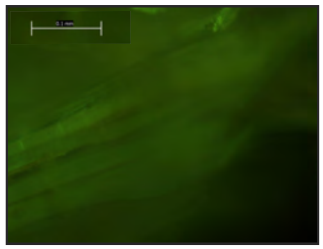


no image
available

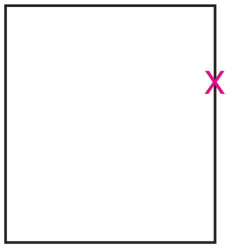
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: threads, possibly warp

sample location: right edge, 18.5" from top
(T 47.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C023



photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
20x objective, 0.55x tube, 11.15 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

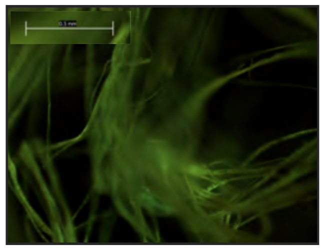


no image
available

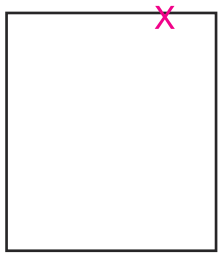
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: threads, possibly weft

sample location: right edge, 18.5" from top
(T 47.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C024



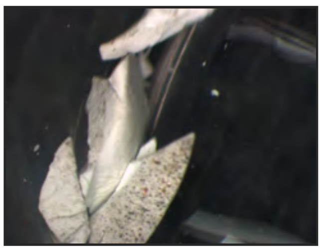
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

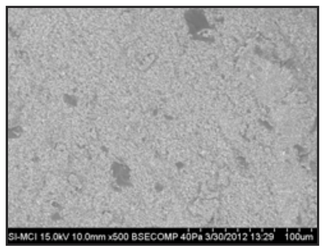


acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: compositional white

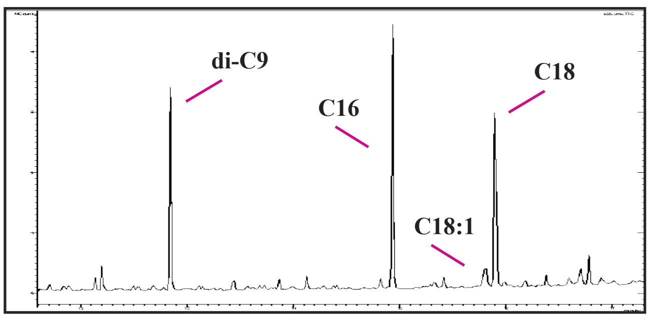
sample location: 0.5" from top, 13.0" from right
(T 1.3 x R 33.0 cm.)

Representative Analysis Compilation—sample C025

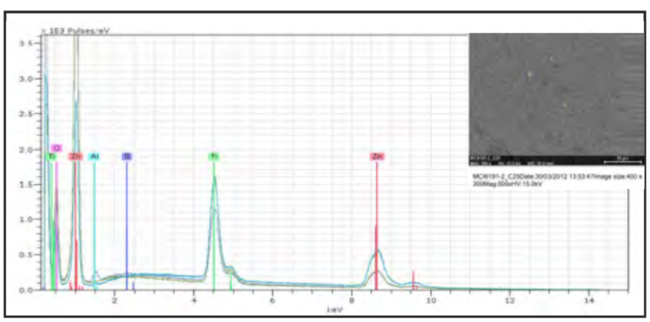




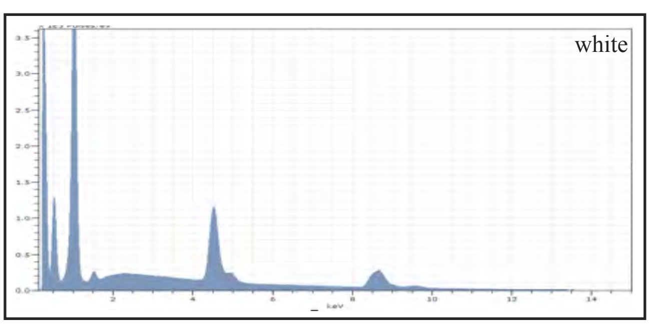
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



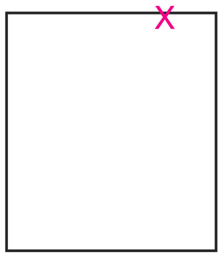
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.221
scan range: 1 - 1483
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



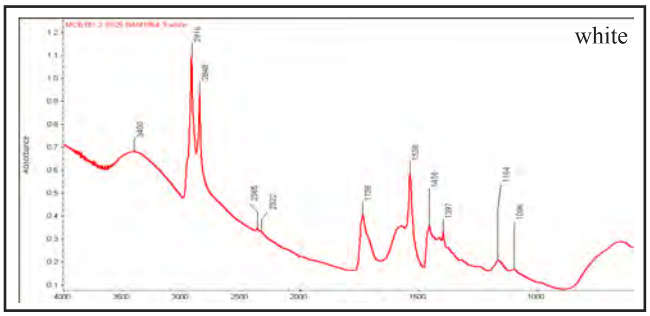
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	43.06	46.84	24.85	1.44
Sodium	K-series	18.03	19.61	29.59	14.21
Titanium	K-series	13.36	14.53	10.53	0.58
Aluminium	K-series	1.17	1.27	1.64	0.08
Chlorine	K-series	0.92	1.00	0.98	0.06
Sulfur	K-series	0.73	0.80	0.86	0.05
Phosphorus	K-series	0.68	0.74	0.83	0.05
Barium	L-series	0.65	0.71	0.18	0.34
Potassium	K-series	0.44	0.48	0.43	0.04
Silicon	K-series	0.20	0.21	0.26	0.03
Calcium	K-series	0.05	0.06	0.05	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	12.63	13.74	29.80	6.54
	Sum:	91.93	100.00	100.00	



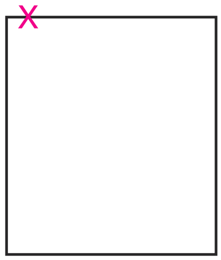
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: compositional white

sample location: 0.5" from top, 13.0" from right
(T 1.3 x R 33.0 cm.)

Representative Analysis Compilation—sample C025, continued



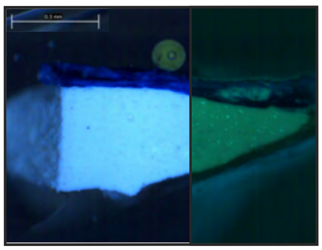
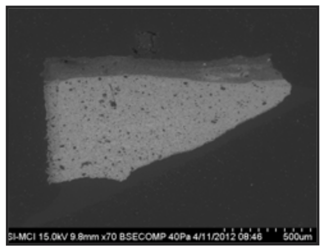
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

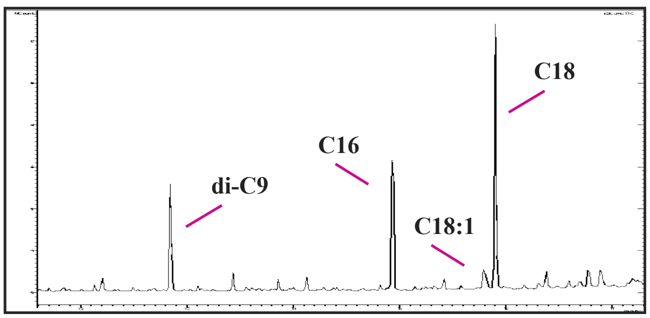

acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: compositional white

sample location: top edge, 5.0" from left
(T 0.0 x L 12.7 cm.)

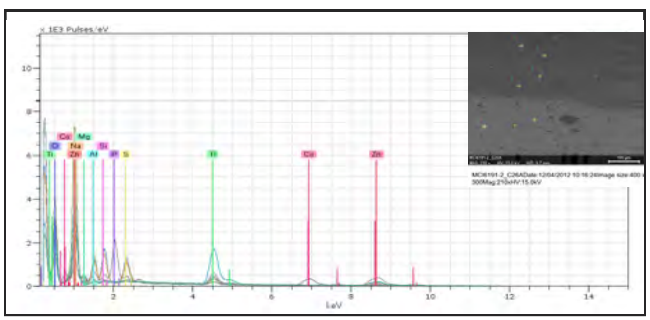
Representative Analysis Compilation—sample C026a

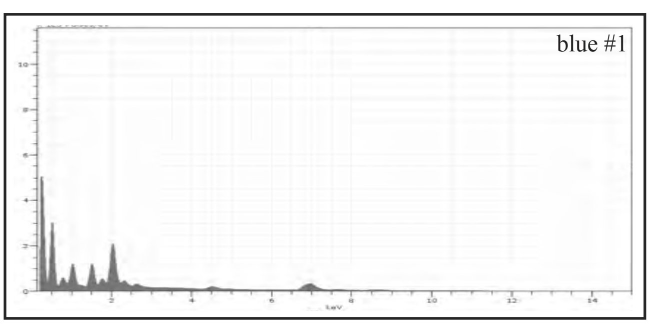
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.8 mm.



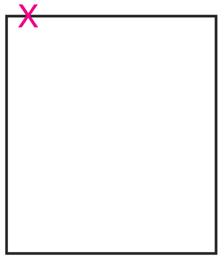
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.268
scan range: 1 - 1484
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, blue #1: Co
significant elements, blue #2: Na, Si, Al
significant elements, white: Zn, Ti
interpretation: cobalt blue, ultramarine blue, Zn/Ti white



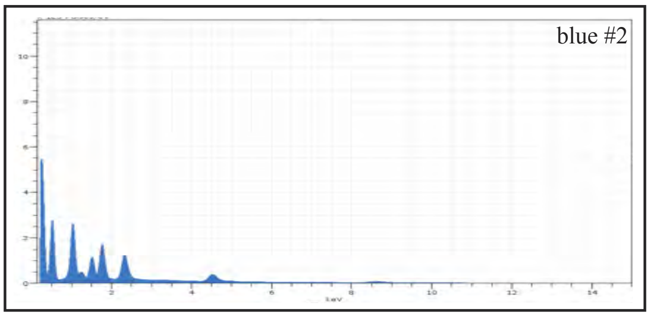
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	19.54	26.25	11.94	0.61
Phosphorus	K-series	8.96	12.04	10.41	0.37
Zinc	K-series	7.26	9.76	4.00	0.27
Sodium	K-series	5.15	6.92	8.06	2.05
Aluminium	K-series	3.93	5.28	5.24	0.21
Titanium	K-series	1.56	2.09	1.17	0.07
Sulfur	K-series	1.40	1.88	1.57	0.07
Silicon	K-series	1.07	1.44	1.37	0.07
Chlorine	K-series	0.88	1.18	0.89	0.05
Magnesium	K-series	0.25	0.34	0.37	0.04
Oxygen	K-series	24.43	32.82	54.97	10.09
	Sum:	74.41	100.00	100.00	

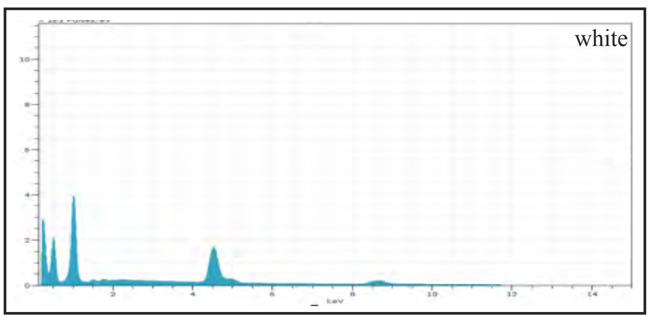

acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: compositional white

sample location: top edge, 5.0" from left
(T 0.0 x L 12.7 cm.)

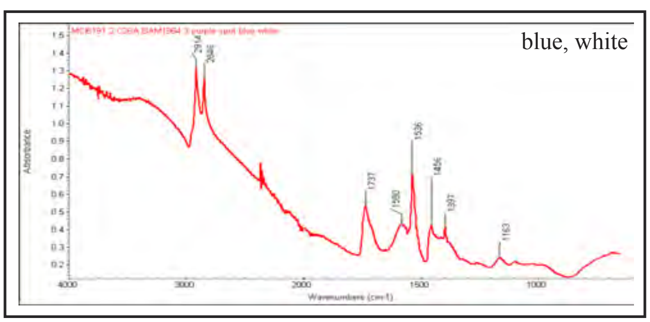
Representative Analysis Compilation—sample C026a, continued



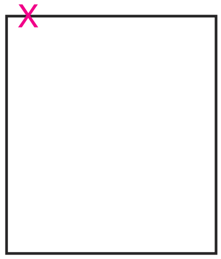
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	11.87	15.63	5.45	0.42
Sodium	K-series	10.29	13.54	13.43	1.68
Silicon	K-series	5.93	7.80	6.33	0.27
Titanium	K-series	5.54	7.29	3.47	0.19
Sulfur	K-series	5.29	6.97	4.95	0.21
Aluminium	K-series	2.94	3.87	3.27	0.16
Magnesium	K-series	0.92	1.21	1.14	0.07
Chlorine	K-series	0.28	0.37	0.24	0.04
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	32.90	43.32	61.72	14.08
	Sum:	75.96	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	67.69	38.17	25.03	2.26
Titanium	K-series	37.04	20.89	18.71	1.91
Barium	L-series	23.24	13.11	4.09	2.21
Sodium	K-series	19.50	11.00	20.51	15.37
Cobalt	K-series	6.29	3.55	2.58	0.22
Chlorine	K-series	1.85	1.04	1.26	0.09
Potassium	K-series	1.50	0.84	0.93	0.07
Sulfur	K-series	1.24	0.70	0.94	0.07
Silicon	K-series	1.04	0.59	0.90	0.07
Calcium	K-series	1.03	0.58	0.62	0.06
Phosphorus	K-series	0.89	0.50	0.70	0.06
Aluminium	K-series	0.70	0.40	0.63	0.06
Magnesium	K-series	0.01	0.01	0.01	0.03
Oxygen	K-series	15.29	8.62	23.11	6.31
	Sum:	177.31	100.00	100.00	



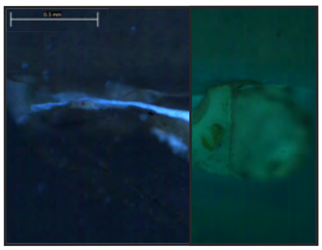
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

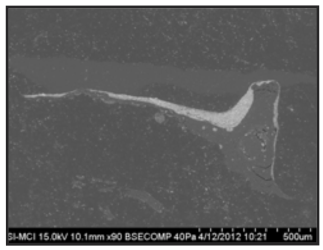


acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: thread and ground layer

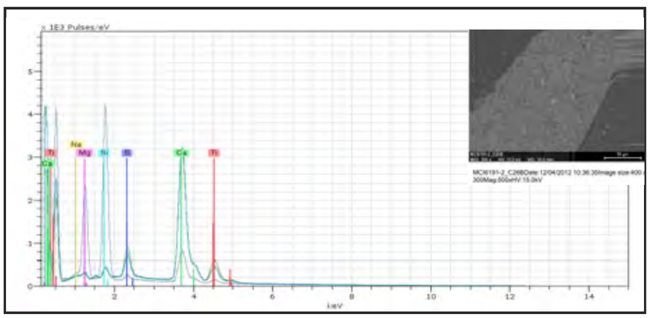
sample location: top edge, 5.0" from left
(T 0.0 x L 12.7 cm.)

Representative Analysis Compilation—sample C026b

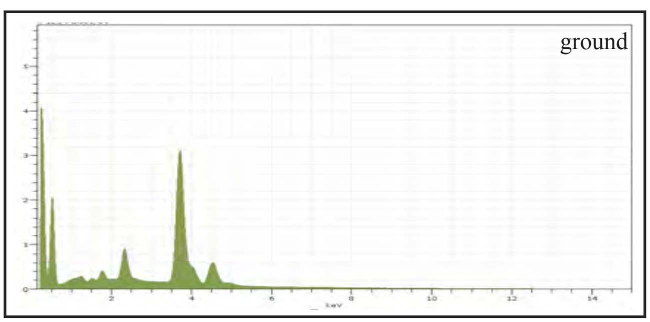




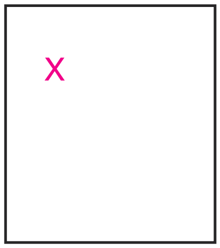
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.1 mm.

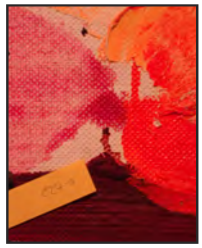


analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti
interpretation: titanium white (possible alkyd)



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	43.26	60.01	63.28	1.31
Titanium	K-series	12.32	17.09	15.08	0.86
Barium	L-series	5.57	7.72	2.38	0.88
Sulfur	K-series	5.16	7.16	9.43	0.21
Zinc	K-series	1.72	2.38	1.54	0.09
Silicon	K-series	1.15	1.60	2.41	0.07
Magnesium	K-series	1.09	1.52	2.64	0.08
Chlorine	K-series	0.85	1.18	1.41	0.05
Potassium	K-series	0.46	0.64	0.69	0.07
Sodium	K-series	0.20	0.27	0.51	0.18
Aluminium	K-series	0.16	0.22	0.35	0.03
Phosphorus	K-series	0.15	0.21	0.28	0.03
	Sum:	72.09	100.00	100.00	

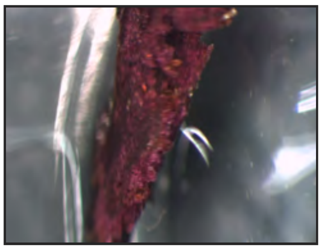


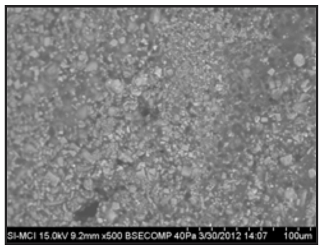


acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: purple, gooey

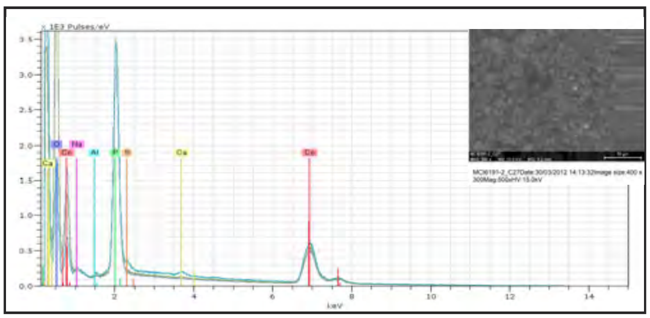
sample location: 11.5" from top, 14.0" from left (T 29.2 x L 35.6 cm.)

Representative Analysis Compilation—sample C027

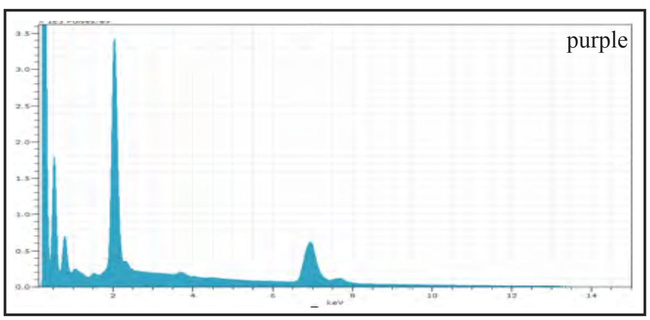




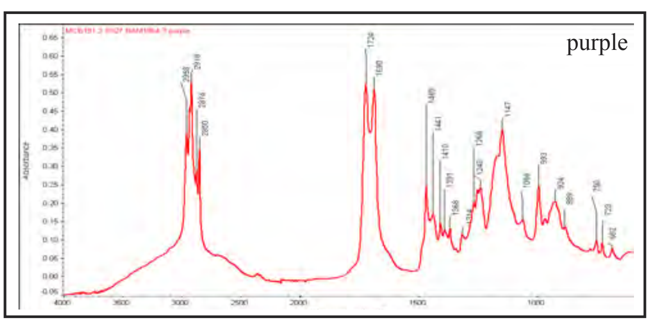
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.2 mm.



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Co, P
interpretation: cobalt violet



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	32.23	44.33	23.30	0.98
Phosphorus	K-series	19.03	26.18	26.18	0.75
Sodium	K-series	1.83	2.51	3.38	1.46
Sulfur	K-series	1.00	1.38	1.33	0.06
Magnesium	K-series	0.77	1.07	1.36	0.07
Zinc	K-series	0.56	0.77	0.37	0.05
Calcium	K-series	0.43	0.59	0.45	0.04
Aluminium	K-series	0.28	0.39	0.45	0.04
Barium	L-series	0.25	0.34	0.08	0.06
Potassium	K-series	0.10	0.14	0.11	0.03
Chlorine	K-series	0.08	0.11	0.10	0.03
Titanium	K-series	0.03	0.05	0.03	0.05
Silicon	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	16.09	22.14	42.86	7.40
	Sum:	72.69	100.00	100.00	

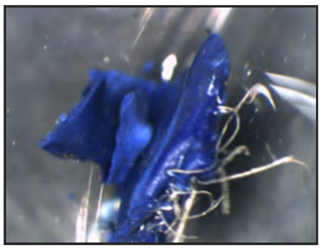


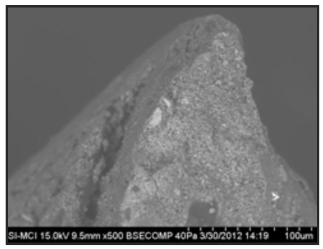
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: blue

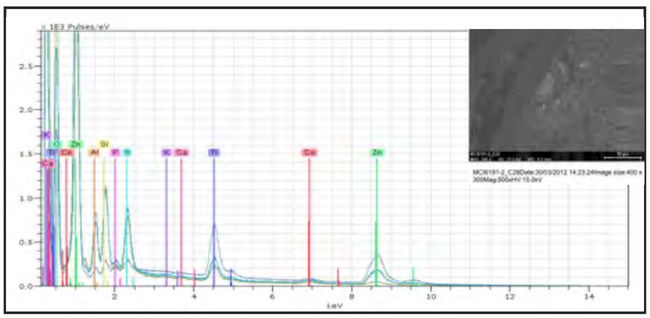
sample location: left edge, 7.0" from top
(T 17.8 x L 0.0 cm.)

Representative Analysis Compilation—sample C028

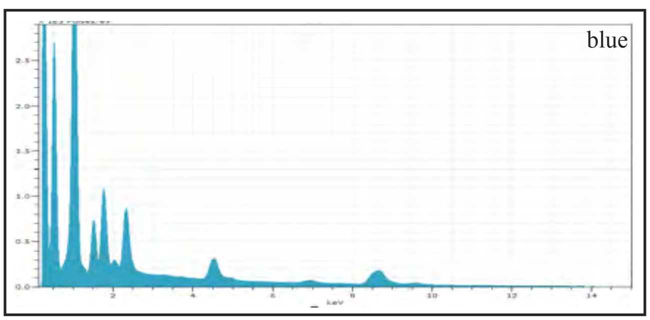




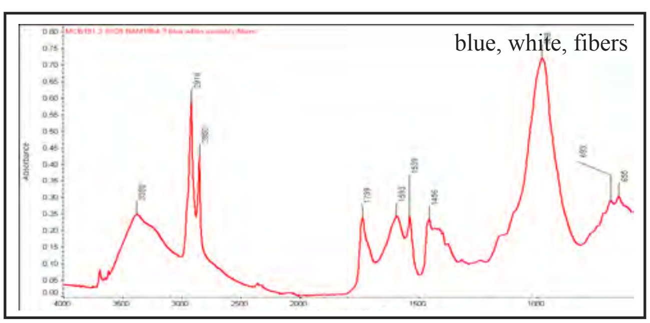
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



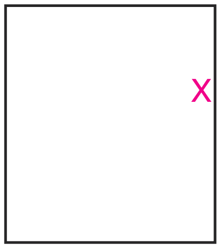
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Si, Al
interpretation: ultramarine blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	39.23	38.29	17.18	1.32
Sodium	K-series	18.51	18.07	23.06	14.59
Silicon	K-series	5.66	5.52	5.77	0.26
Sulfur	K-series	4.87	4.76	4.35	0.20
Titanium	K-series	4.60	4.49	2.75	0.32
Aluminium	K-series	3.04	2.97	3.23	0.17
Cobalt	K-series	2.17	2.12	1.05	0.10
Phosphorus	K-series	0.74	0.72	0.68	0.05
Magnesium	K-series	0.15	0.15	0.18	0.04
Chlorine	K-series	0.11	0.11	0.09	0.03
Barium	L-series	0.08	0.08	0.02	0.07
Potassium	K-series	0.04	0.04	0.03	0.03
Iron	K-series	0.03	0.03	0.02	0.03
Calcium	K-series	0.01	0.01	0.00	0.03
Oxygen	K-series	23.23	22.67	41.59	9.07
	Sum:	102.47	100.00	100.00	



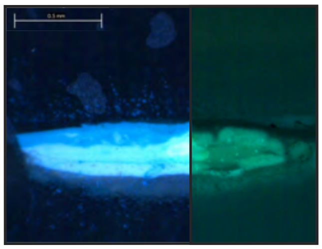
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

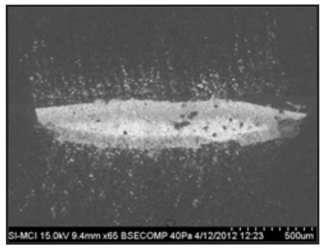


acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: teal, white underlayer

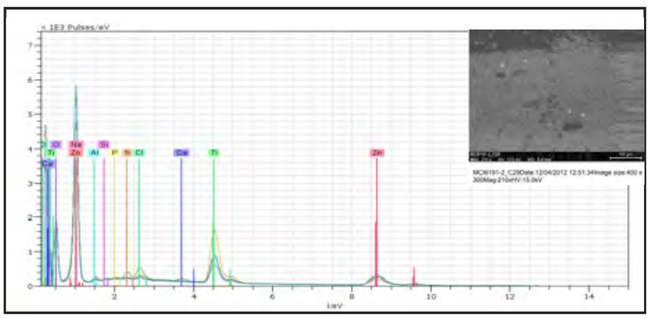
sample location: 21.0" from top, 4.0" from right
(T 53.3 x R 10.2 cm.)

Representative Analysis Compilation—sample C029

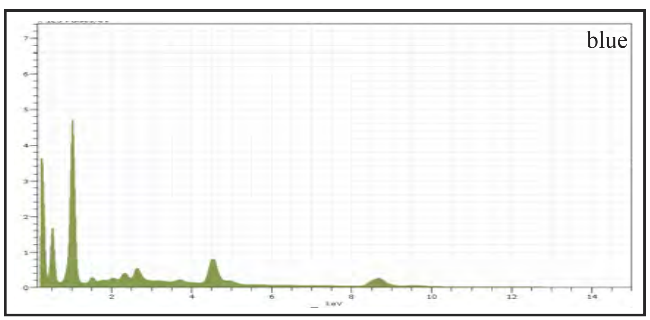




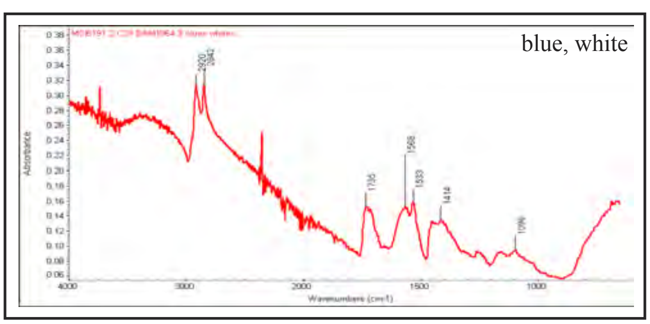
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.4 mm.



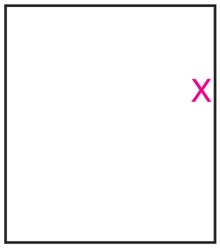
analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.4 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na
interpretation: ultramarine blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	43.85	44.22	22.36	1.47
Sodium	K-series	22.28	22.48	32.33	5.85
Titanium	K-series	12.04	12.15	8.39	0.37
Chlorine	K-series	2.57	2.59	2.42	0.11
Sulfur	K-series	1.35	1.36	1.40	0.07
Aluminium	K-series	1.01	1.02	1.25	0.07
Calcium	K-series	0.60	0.60	0.50	0.04
Phosphorus	K-series	0.54	0.55	0.59	0.05
Silicon	K-series	0.17	0.17	0.20	0.03
Potassium	K-series	0.12	0.12	0.10	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	14.62	14.74	30.47	6.60
	Sum:	99.15	100.00	100.00	



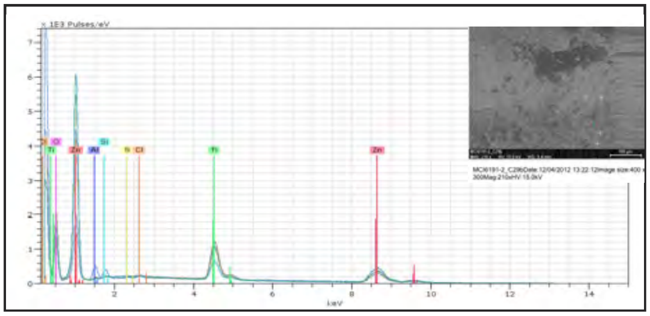
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil



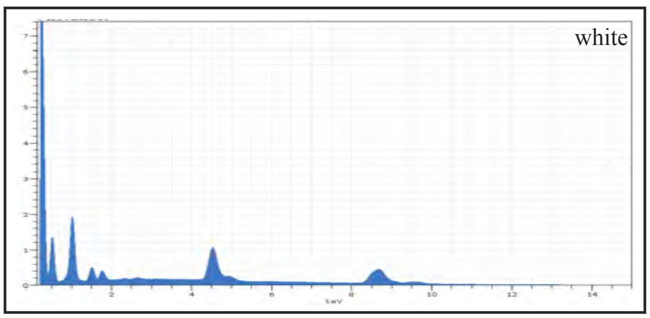
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: teal, white underlayer

sample location: 21.0" from top, 4.0" from right
(T 53.3 x R 10.2 cm.)

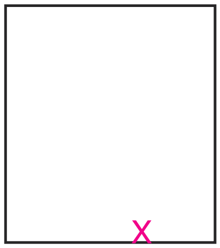
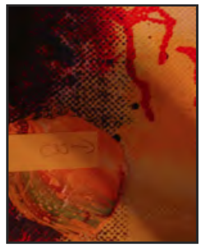
Representative Analysis Compilation—sample C029, continued



analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.4 mm.
mag: 210x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



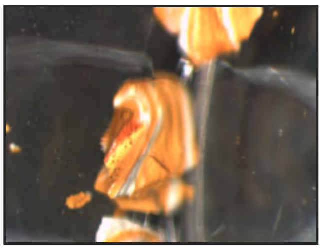
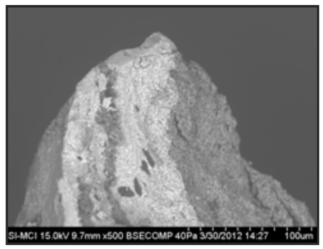
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	156.59	64.96	55.58	5.16
Barium	L-series	37.41	15.52	6.32	2.37
Sodium	K-series	22.77	9.45	22.99	17.95
Titanium	K-series	12.14	5.03	5.88	1.34
Aluminium	K-series	4.27	1.77	3.67	0.22
Silicon	K-series	3.02	1.25	2.49	0.15
Calcium	K-series	1.55	0.64	0.90	0.08
Potassium	K-series	1.40	0.58	0.83	0.07
Chlorine	K-series	1.25	0.52	0.82	0.07
Sulfur	K-series	0.38	0.16	0.27	0.04
Magnesium	K-series	0.18	0.08	0.17	0.04
Phosphorus	K-series	0.08	0.03	0.06	0.03
	Sum:	241.04	100.00	100.00	

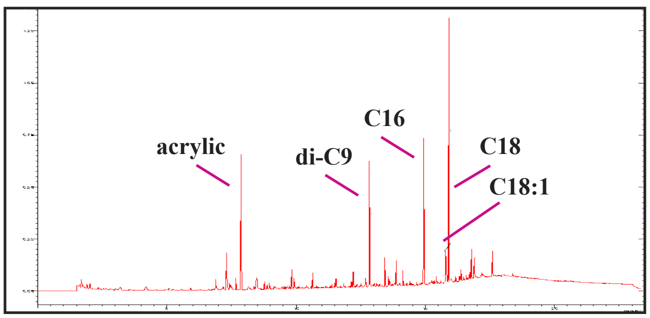
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: medium yellow

sample location: 4.0" from bottom, 19.0" from right
(B 10.2 x R 48.3 cm.)

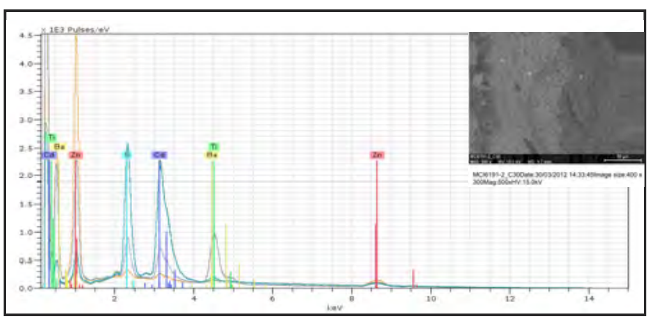
Representative Analysis Compilation—sample C030

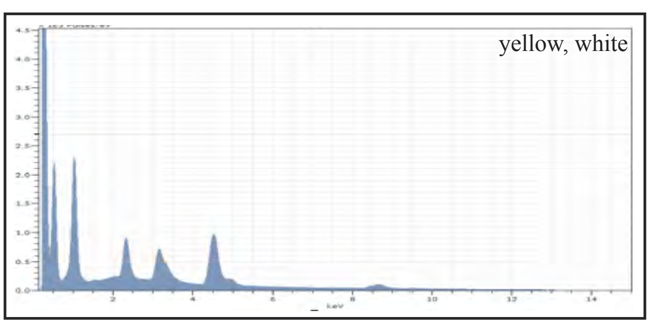
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



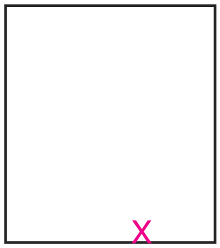
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.176
scan range: 1 - 1473
time range: 0.00 - 23.33 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, acrylic
interpretation: oil, conservation material

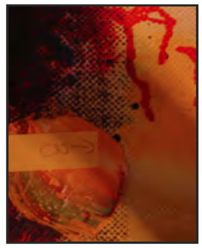


analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
significant elements, white: Ti, Zn
interpretation: cadmium yellow, Ti/Zn white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	17.18	19.01	11.00	0.74
Zinc	K-series	12.70	14.06	5.95	0.45
Cadmium	L-series	12.36	13.68	3.37	1.44
Sodium	K-series	6.30	6.98	8.40	4.99
Sulfur	K-series	5.89	6.51	5.63	0.23
Potassium	K-series	0.98	1.09	0.77	0.54
Phosphorus	K-series	0.77	0.85	0.76	0.06
Chlorine	K-series	0.54	0.60	0.47	0.05
Silicon	K-series	0.32	0.36	0.35	0.04
Aluminium	K-series	0.19	0.21	0.21	0.17
Magnesium	K-series	0.17	0.19	0.22	0.08
Barium	L-series	0.10	0.11	0.02	0.08
Calcium	K-series	0.09	0.10	0.07	0.08
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	32.77	36.27	62.78	14.08
	Sum:	90.37	100.00	100.00	

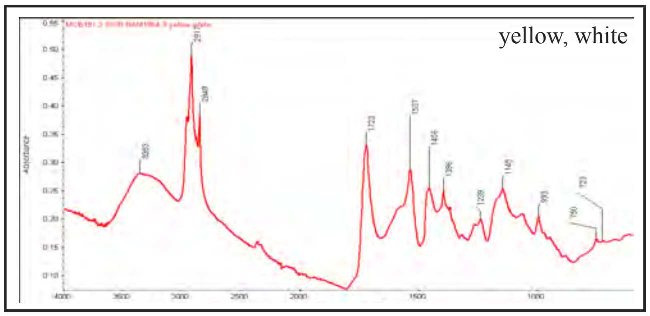




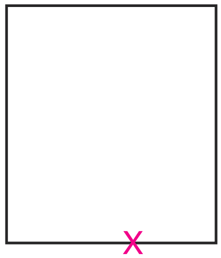
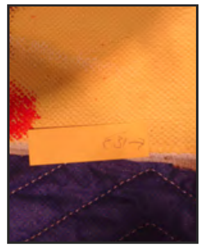
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: medium yellow

sample location: 4.0" from bottom, 19.0" from right
(B 10.2 x R 48.3 cm.)

Representative Analysis Compilation—sample C030, continued



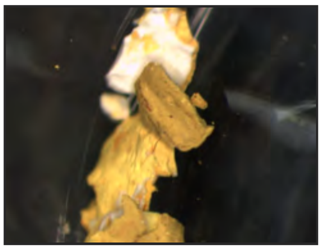
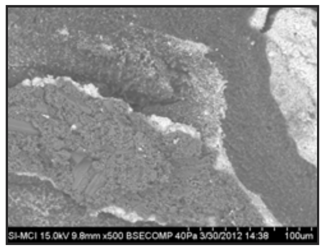
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

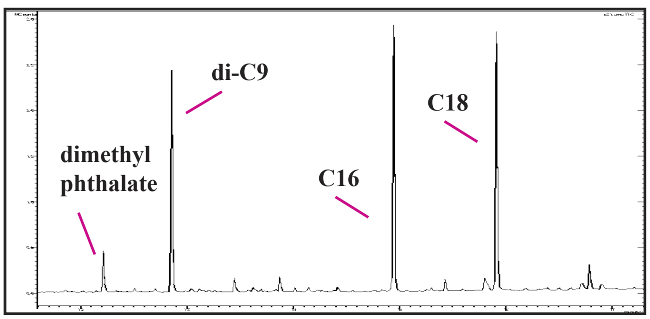
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: lemon yellow, white underlayer

sample location: bottom edge, 17.0" from right
(B 0.0 x R 43.2 cm.)

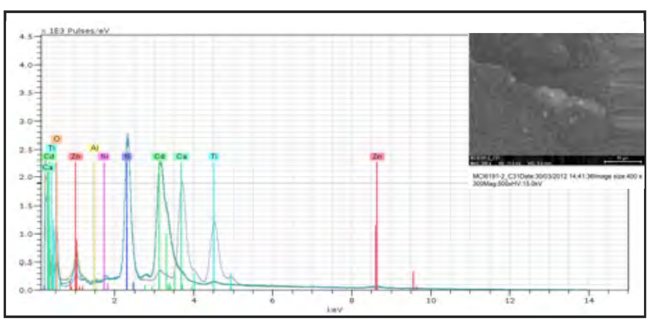
Representative Analysis Compilation—sample C031

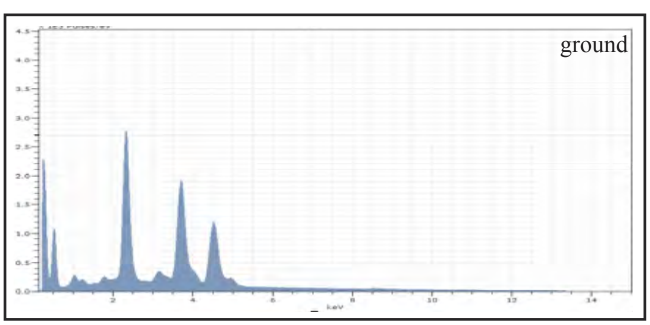
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



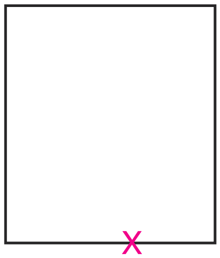
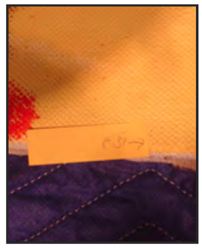
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.169
scan range: 1 - 1483
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results:dimethyl phthalate, di-C9, C16, C18
interpretation: oil, possible alkyd



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S, Zn
significant elements, ground: Ti
interpretation: cadmium yellow, titanium white



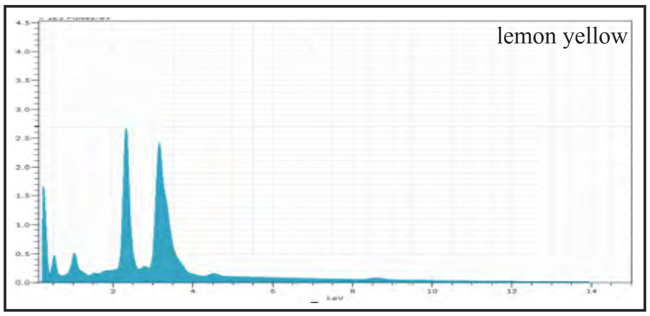
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	21.18	21.49	15.26	0.70
Sulfur	K-series	20.82	21.12	18.76	0.76
Titanium	K-series	19.38	19.67	11.70	0.79
Cadmium	L-series	5.37	5.45	1.38	0.85
Sodium	K-series	1.54	1.56	1.93	1.24
Silicon	K-series	0.99	1.00	1.02	0.07
Zinc	K-series	0.88	0.89	0.39	0.06
Chlorine	K-series	0.86	0.87	0.70	0.06
Phosphorus	K-series	0.57	0.58	0.53	0.05
Magnesium	K-series	0.48	0.49	0.57	0.11
Potassium	K-series	0.03	0.03	0.02	0.05
Barium	L-series	0.01	0.01	0.00	0.03
Aluminium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	26.43	26.82	47.73	14.74
	Sum:	98.56	100.00	100.00	

acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: lemon yellow, white underlayer

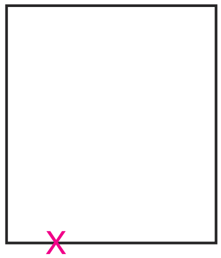
sample location: bottom edge, 17.0" from right
(B 0.0 x R 43.2 cm.)

Representative Analysis Compilation—sample C031, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	61.57	48.23	20.14	4.27
Sulfur	K-series	26.79	20.98	30.72	0.97
Zinc	K-series	12.19	9.55	6.85	0.43
Potassium	K-series	6.02	4.72	5.67	1.49
Sodium	K-series	3.86	3.03	6.18	3.06
Calcium	K-series	1.49	1.17	1.37	0.23
Barium	L-series	1.38	1.08	0.37	0.18
Chlorine	K-series	1.05	0.82	1.09	0.08
Phosphorus	K-series	0.79	0.62	0.94	0.06
Silicon	K-series	0.79	0.62	1.03	0.06
Magnesium	K-series	0.64	0.50	0.97	0.15
Titanium	K-series	0.35	0.27	0.27	0.12
Aluminium	K-series	0.31	0.24	0.42	0.26
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	10.43	8.17	23.98	8.63
	Sum:	127.65	100.00	100.00	

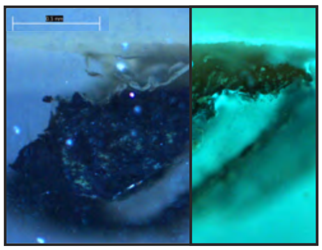
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

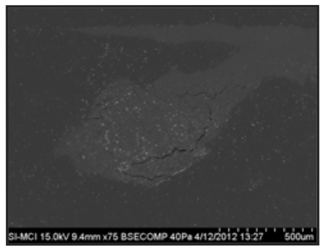


acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: black and fibers

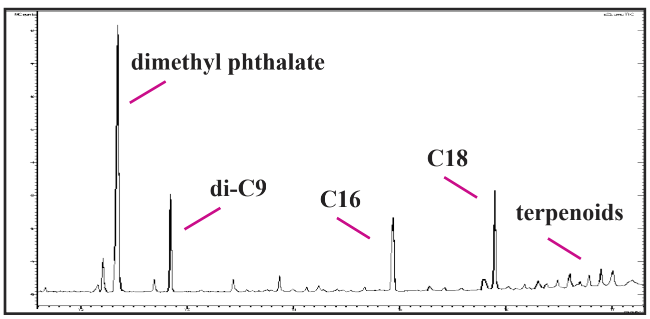
sample location: bottom edge, 12.0" from left
(B 0.0 x L 30.5 cm.)

Representative Analysis Compilation—sample C032

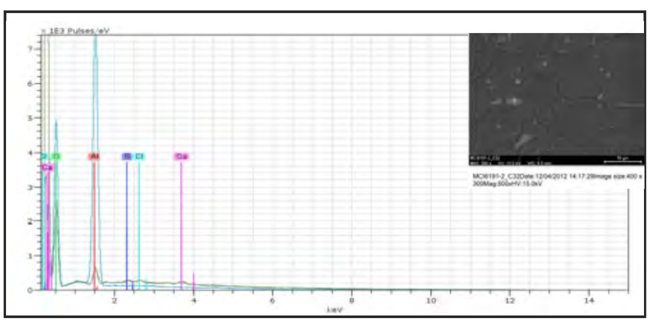




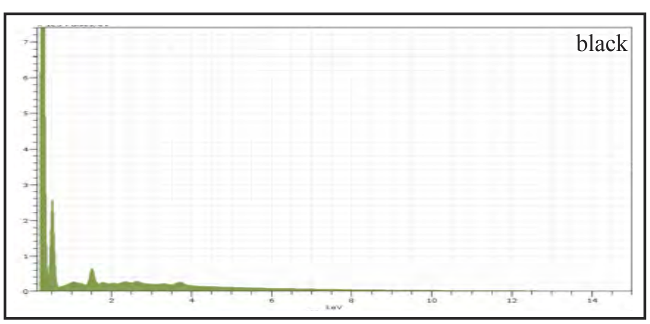
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.4 mm.



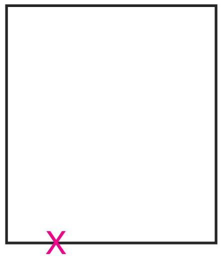
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.305
scan range: 1 - 1475
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16,
C18, terpenoids
interpretation: alkyd



analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, black: none
interpretation: possible carbon black



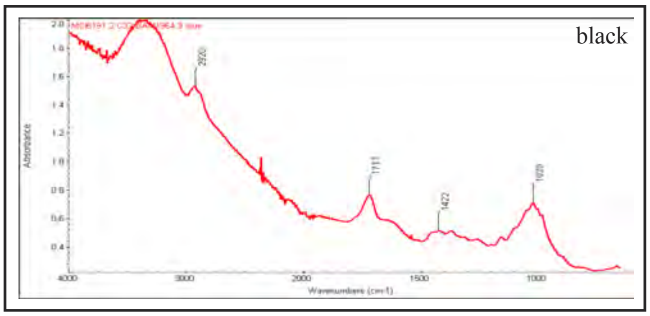
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	1.71	1.71	0.70	0.08
Aluminium	K-series	1.44	1.44	0.88	0.09
Chlorine	K-series	0.63	0.63	0.29	0.05
Potassium	K-series	0.61	0.61	0.25	0.05
Sodium	K-series	0.23	0.23	0.16	0.04
Sulfur	K-series	0.21	0.21	0.11	0.03
Silicon	K-series	0.08	0.08	0.05	0.03
Magnesium	K-series	0.05	0.05	0.03	0.03
Phosphorus	K-series	0.02	0.02	0.01	0.03
Oxygen	K-series	95.02	95.02	97.51	0.61
	Sum:	100.00	100.00	100.00	

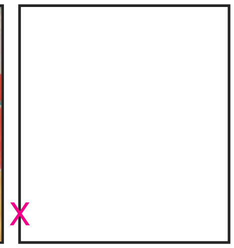

acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: black and fibers

sample location: bottom edge, 12.0" from left
(B 0.0 x L 30.5 cm.)

Representative Analysis Compilation—sample C032, continued



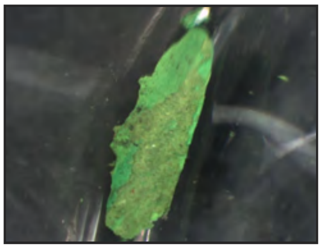
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: carbon interference

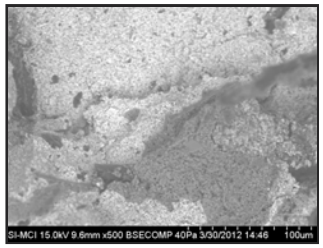


acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: bright green and green mix

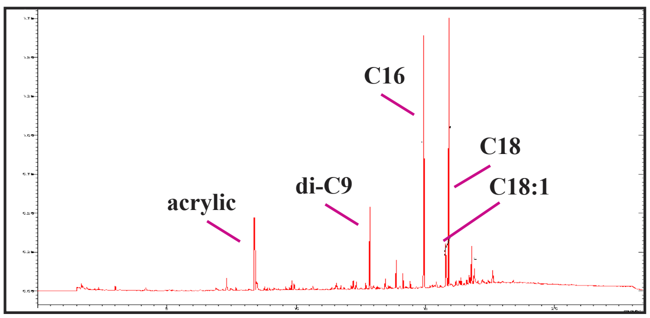
sample location: left edge, 6.0" from bottom
(B 15.2 x L 0.0 cm.)

Representative Analysis Compilation—sample C033

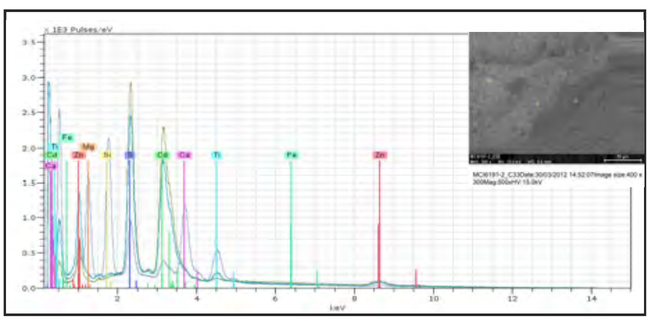




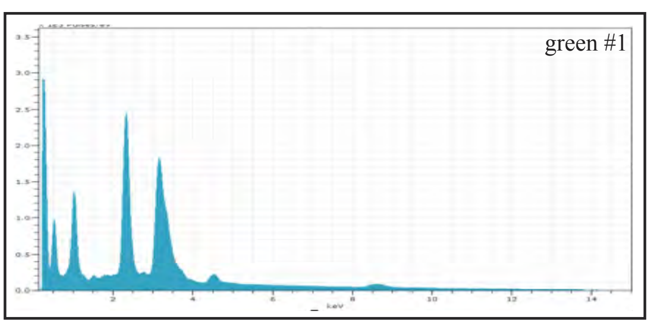
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.169
scan range: 1 - 1480
time range: 0.00 - 23.39 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, acrylic
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, green #1: Cd, S, Na, Zn
significant elements, green #2: none
interpretation: cadmium green and mixed colors

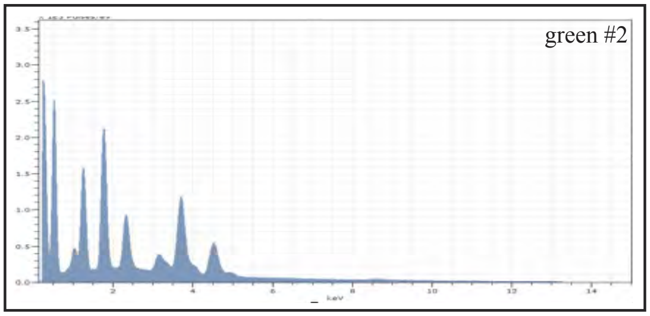


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	39.05	35.81	12.10	3.12
Sulfur	K-series	19.37	17.77	21.05	0.71
Zinc	K-series	15.81	14.49	8.42	0.55
Sodium	K-series	6.20	5.69	9.40	4.91
Potassium	K-series	4.40	4.04	3.92	1.10
Titanium	K-series	1.79	1.65	1.31	0.21
Calcium	K-series	0.90	0.83	0.79	0.18
Chlorine	K-series	0.78	0.72	0.77	0.06
Magnesium	K-series	0.66	0.61	0.95	0.14
Iron	K-series	0.55	0.51	0.34	0.04
Phosphorus	K-series	0.35	0.32	0.39	0.04
Barium	L-series	0.33	0.30	0.08	0.18
Silicon	K-series	0.32	0.29	0.39	0.04
Aluminium	K-series	0.29	0.27	0.38	0.25
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	18.24	16.72	39.71	11.49
	Sum:	109.05	100.00	100.00	

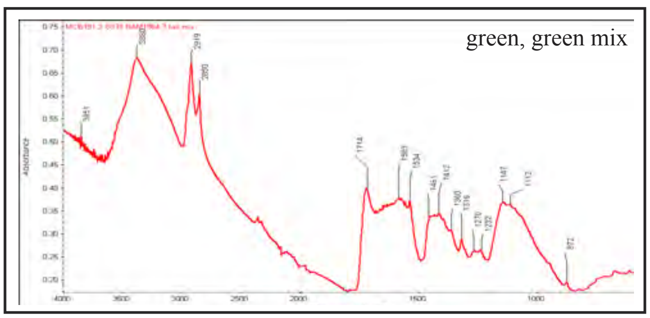
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: bright green

sample location: left edge, 6.0" from bottom
(B 15.2 x L 0.0 cm.)

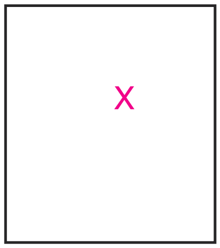
Representative Analysis Compilation—sample C033, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	12.23	12.68	7.58	0.43
Silicon	K-series	11.87	12.31	10.51	0.52
Titanium	K-series	8.42	8.73	4.37	0.45
Magnesium	K-series	8.37	8.68	8.56	0.59
Sulfur	K-series	5.72	5.93	4.44	0.23
Cadmium	L-series	5.57	5.78	1.23	0.87
Zinc	K-series	3.27	3.39	1.24	0.14
Sodium	K-series	0.67	0.70	0.73	0.55
Chlorine	K-series	0.56	0.58	0.39	0.05
Phosphorus	K-series	0.31	0.33	0.25	0.04
Potassium	K-series	0.22	0.23	0.14	0.17
Barium	L-series	0.14	0.14	0.02	0.10
Iron	K-series	0.14	0.14	0.06	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Aluminium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	38.93	40.37	60.47	15.72
	Sum:	96.43	100.00	100.00	



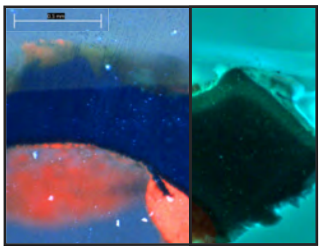
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

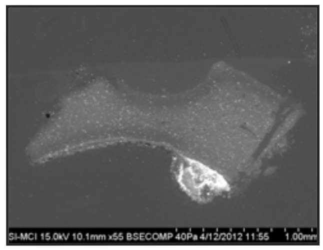


acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: black, maybe dark blue

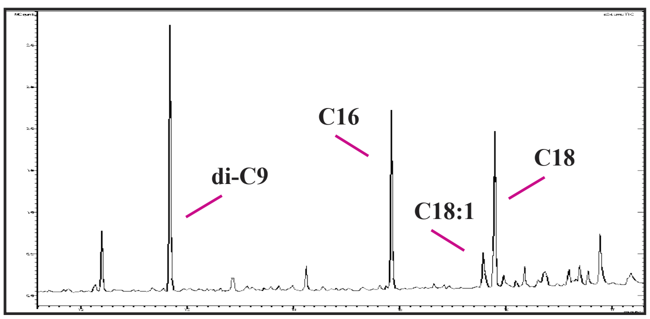
sample location: 22.5" from top, 20.0" from right
(T 57.2 x R 50.8 cm.)

Representative Analysis Compilation—sample C034

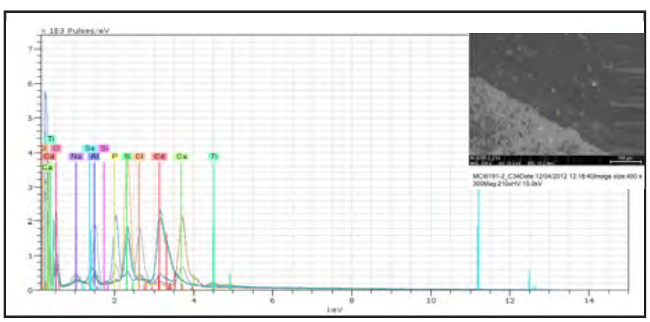




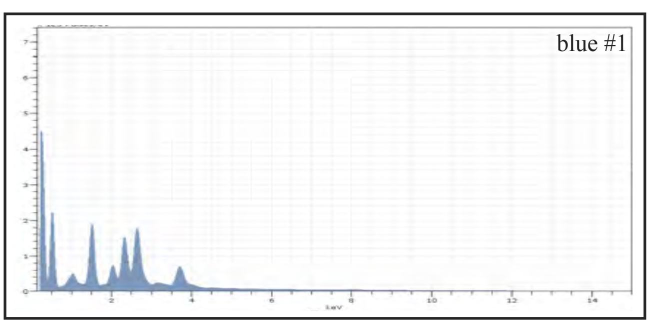
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.1 mm.



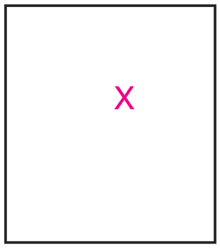
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.193
scan range: 1 - 1486
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil

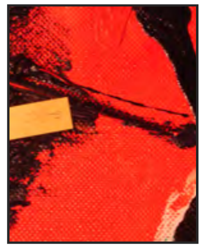


analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 10.2 mm.
mag: 210x; HV: 15 kV
significant elements, blue #1: Cl, Cu
significant elements, blue #2: Ca, P
significant elements, orange: Cd, S, Se
interpretation: phthalo green, bone black, cadmium orange



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Chlorine	K-series	7.40	10.88	6.28	0.27
Aluminium	K-series	6.19	9.10	6.91	0.31
Sulfur	K-series	5.16	7.60	4.85	0.21
Calcium	K-series	3.87	5.70	2.91	0.17
Phosphorus	K-series	2.06	3.03	2.00	0.10
Copper	K-series	1.94	2.86	0.92	0.09
Sodium	K-series	1.64	2.42	2.15	1.13
Cadmium	L-series	0.40	0.59	0.11	0.12
Barium	L-series	0.07	0.10	0.01	0.04
Potassium	K-series	0.01	0.02	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Silicon	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	39.23	57.71	73.85	16.55
	Sum:	67.98	100.00	100.00	

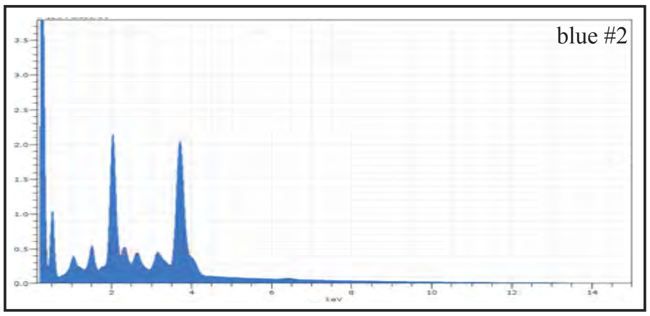




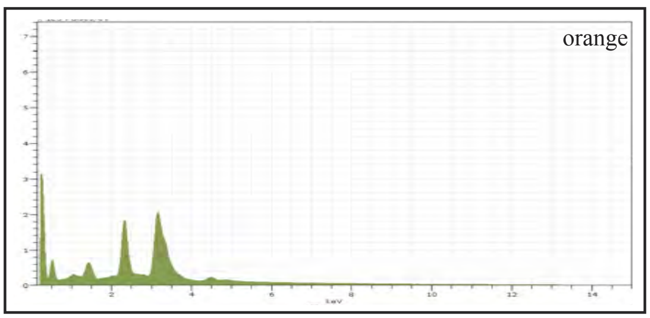
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: black, maybe dark blue

sample location: 22.5" from top, 20.0" from right (T 57.2 x R 50.8 cm.)

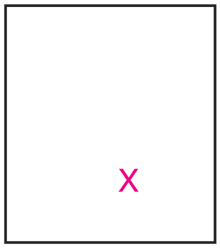
Representative Analysis Compilation—sample C034, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	13.92	21.85	12.40	0.46
Phosphorus	K-series	8.89	13.96	10.25	0.36
Cadmium	L-series	2.75	4.32	0.87	0.51
Sulfur	K-series	1.62	2.54	1.80	0.08
Sodium	K-series	1.56	2.45	2.42	0.21
Aluminium	K-series	1.48	2.32	1.96	0.88
Chlorine	K-series	1.23	1.94	1.24	0.07
Copper	K-series	0.86	1.35	0.48	0.06
Iron	K-series	0.67	1.05	0.43	0.05
Potassium	K-series	0.22	0.35	0.20	0.18
Magnesium	K-series	0.08	0.12	0.11	0.04
Titanium	K-series	0.02	0.04	0.02	0.03
Silicon	K-series	0.02	0.03	0.02	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	30.38	47.69	67.78	17.41
	Sum:	63.71	100.00	100.00	



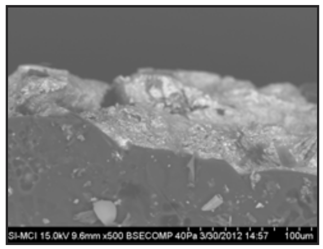
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	30.72	42.74	14.64	1.02
Barium	L-series	8.93	12.42	3.48	0.62
Sulfur	K-series	7.95	11.06	13.27	0.31
Selenium	L-series	3.00	4.18	2.04	0.21
Aluminium	K-series	1.85	2.58	3.68	1.44
Sodium	K-series	1.24	1.72	2.89	0.17
Calcium	K-series	0.42	0.58	0.56	0.10
Phosphorus	K-series	0.03	0.05	0.06	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	17.74	24.68	59.38	13.62
	Sum:	71.88	100.00	100.00	

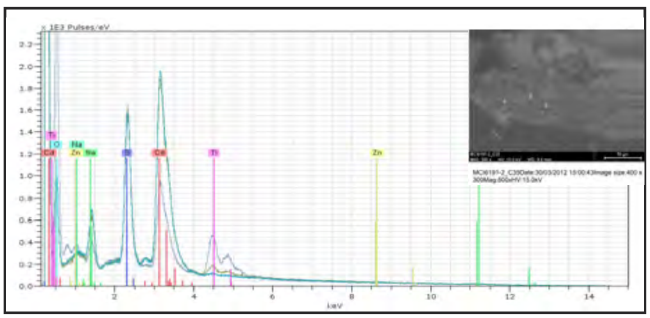
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: orange red, gooey

sample location: 16.0" from bottom, 19.0" from right
(B 40.6 x R 48.3 cm.)

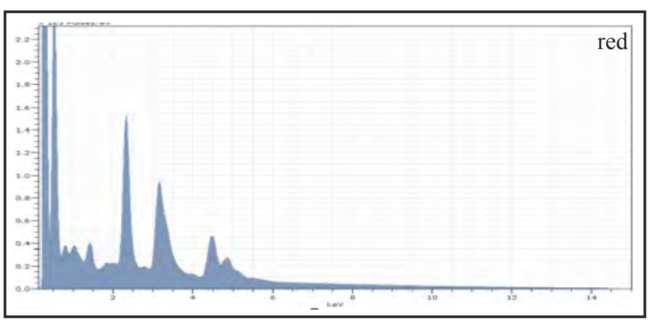
Representative Analysis Compilation—sample C035

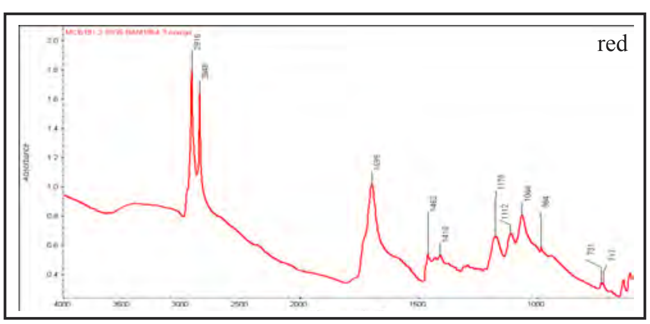
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



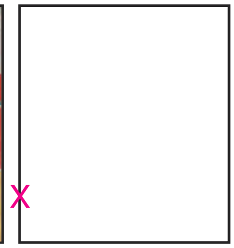
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red

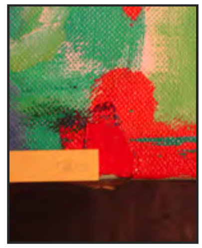


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	29.53	22.98	5.26	1.90
Cadmium	L-series	20.48	15.94	4.46	2.15
Zinc	K-series	11.91	9.27	4.45	0.43
Sulfur	K-series	11.09	8.63	8.46	0.42
Selenium	L-series	3.01	2.34	0.93	0.26
Potassium	K-series	2.06	1.60	1.29	0.85
Magnesium	K-series	0.68	0.53	0.68	0.16
Sodium	K-series	0.53	0.41	0.56	0.44
Phosphorus	K-series	0.46	0.36	0.36	0.04
Calcium	K-series	0.37	0.29	0.23	0.14
Chlorine	K-series	0.35	0.27	0.24	0.05
Silicon	K-series	0.19	0.15	0.16	0.03
Titanium	K-series	0.16	0.13	0.08	0.13
Aluminium	K-series	0.02	0.02	0.02	0.04
Oxygen	K-series	47.64	37.08	72.82	20.11
	Sum:	128.48	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

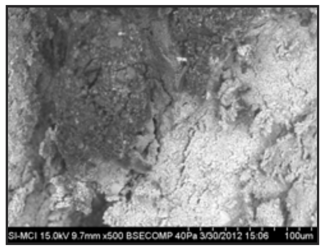




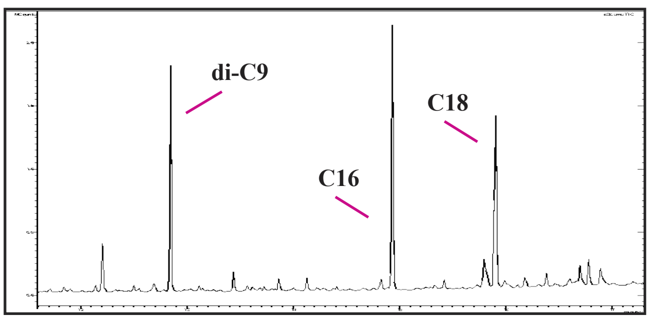
acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: medium red

sample location: left edge, 12.5" from bottom
(B 31.8.0 x L 0.0 cm.)

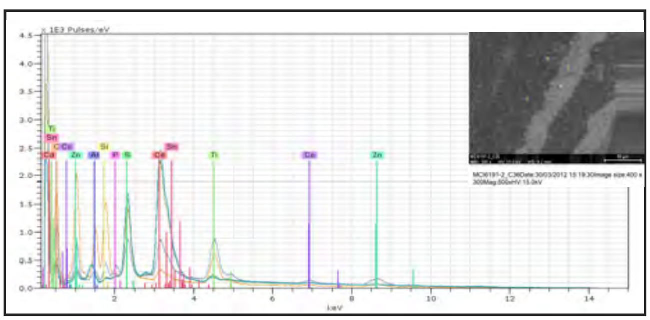
Representative Analysis Compilation—sample C036



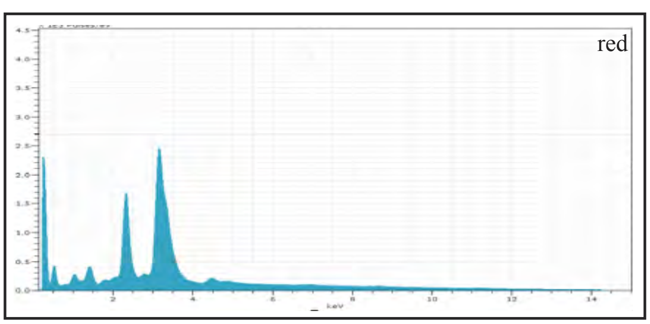
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.315
scan range: 1 - 1472
time range: 0.00 - 23.30 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, blue: Si, Na, Al, Co
interpretation: cadmium red, ultramarine blue, possible cobalt blue

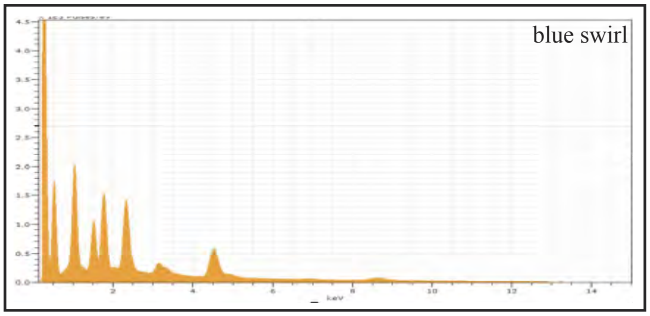


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	64.75	43.02	21.69	10.90
Zinc	K-series	20.91	13.89	12.04	0.72
Sulfur	K-series	18.96	12.60	22.27	0.69
Selenium	L-series	8.01	5.32	3.82	0.55
Barium	L-series	7.83	5.20	2.15	0.67
Potassium	K-series	7.00	4.65	6.74	3.72
Cobalt	K-series	6.84	4.54	4.37	0.24
Sodium	K-series	3.66	2.43	6.00	2.91
Iron	K-series	2.31	1.53	1.56	0.13
Phosphorus	K-series	1.19	0.79	1.44	0.07
Chlorine	K-series	1.10	0.73	1.17	0.08
Silicon	K-series	0.68	0.45	0.91	0.06
Tin	L-series	0.57	0.38	0.18	0.34
Aluminium	K-series	0.11	0.07	0.15	0.11
Magnesium	K-series	0.05	0.03	0.07	0.06
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	6.55	4.35	15.42	5.81
	Sum:	150.53	100.00	100.00	

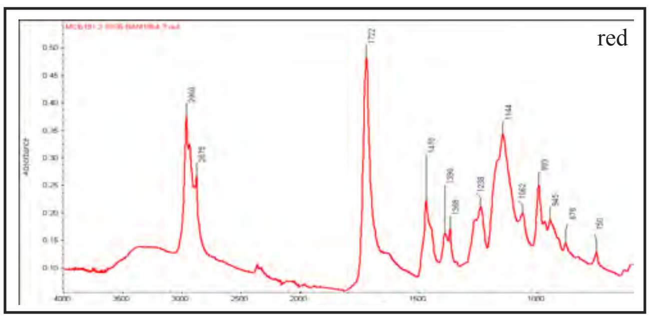

acc. no.: BAM 1964.3
title, year: *Bald Eagle*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.3 x 52.3" (153.2 x 132.8 cm.)
notes: medium red

sample location: left edge, 12.5" from bottom
(B 31.8.0 x L 0.0 cm.)

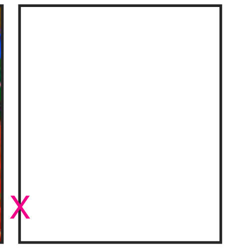
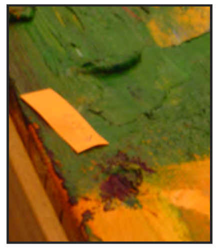
Representative Analysis Compilation—sample C036, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	10.72	14.52	5.43	0.39
Titanium	K-series	8.50	11.51	5.88	0.48
Sulfur	K-series	6.27	8.49	6.47	0.25
Silicon	K-series	5.73	7.76	6.75	0.26
Sodium	K-series	3.63	4.91	5.23	2.88
Aluminium	K-series	2.89	3.91	3.54	1.21
Cadmium	L-series	2.46	3.33	0.72	0.63
Cobalt	K-series	1.19	1.61	0.67	0.06
Barium	L-series	0.58	0.78	0.14	0.31
Potassium	K-series	0.48	0.65	0.41	0.35
Phosphorus	K-series	0.14	0.18	0.14	0.03
Magnesium	K-series	0.07	0.09	0.09	0.05
Chlorine	K-series	0.04	0.06	0.04	0.03
Tin	L-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	31.18	42.21	64.50	14.66
	Sum:	73.88	100.00	100.00	



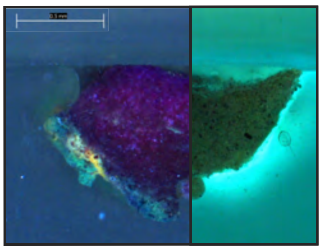
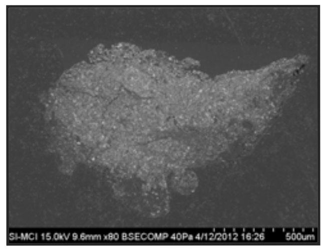
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

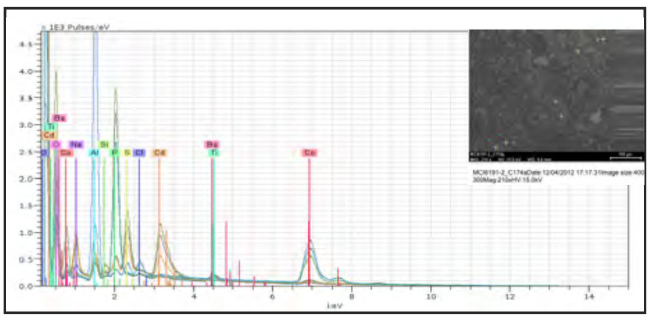
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: brownish mix

sample location: left edge, 8.5" from bottom
(B 21.6 x L 0.0 cm.)

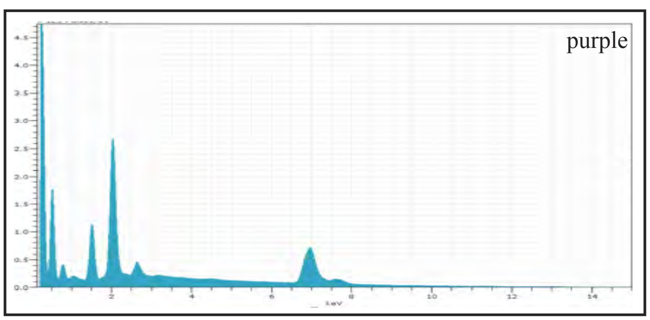
Representative Analysis Compilation—sample C174

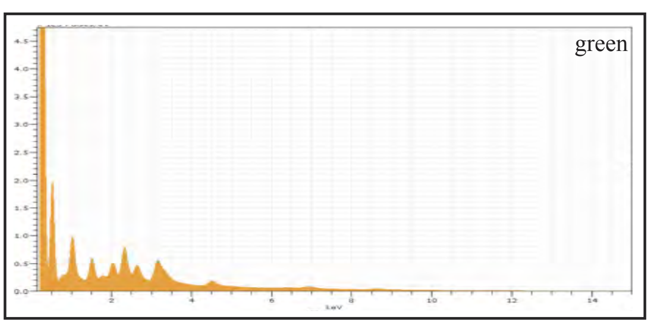
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.6 mm.



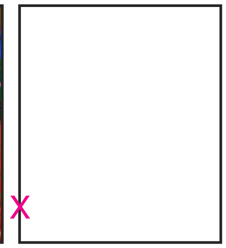
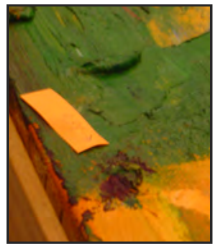
analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.6 mm.
mag: 210x; HV: 15 kV
significant elements, purple: Co, P
significant elements, green: Zn, Cd, S
significant elements, yellow: Cd, S
interpretation: cobalt violet, cadmium green, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	43.62	52.47	31.88	1.32
Phosphorus	K-series	15.44	18.57	21.46	0.61
Aluminium	K-series	7.48	8.99	11.93	0.37
Barium	L-series	2.57	3.10	0.81	0.21
Chlorine	K-series	1.34	1.61	1.63	0.07
Sodium	K-series	0.42	0.50	0.79	0.10
Cadmium	L-series	0.34	0.41	0.13	0.11
Calcium	K-series	0.27	0.32	0.29	0.05
Potassium	K-series	0.13	0.16	0.15	0.10
Sulfur	K-series	0.08	0.10	0.11	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	11.46	13.78	30.84	5.38
	Sum:	83.15	100.00	100.00	



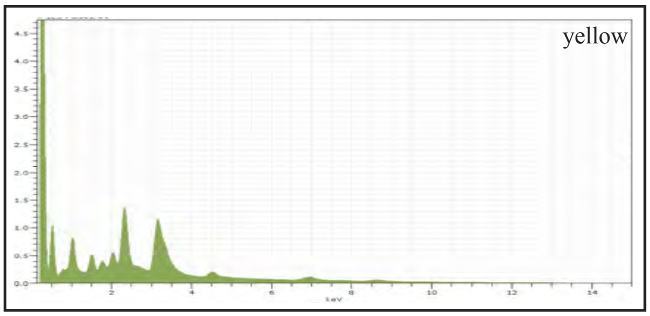
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	5.67	8.89	1.70	0.86
Zinc	K-series	4.03	6.32	2.08	0.17
Sodium	K-series	2.71	4.25	3.98	2.16
Sulfur	K-series	2.58	4.05	2.71	0.12
Cobalt	K-series	2.52	3.94	1.44	0.11
Chlorine	K-series	1.66	2.60	1.58	0.08
Aluminium	K-series	1.42	2.23	1.77	0.83
Titanium	K-series	1.16	1.82	0.82	0.16
Phosphorus	K-series	1.15	1.80	1.25	0.07
Potassium	K-series	0.71	1.12	0.62	0.34
Iron	K-series	0.70	1.10	0.42	0.07
Barium	L-series	0.64	1.00	0.16	0.20
Calcium	K-series	0.13	0.21	0.11	0.07
Magnesium	K-series	0.13	0.20	0.18	0.06
Silicon	K-series	0.08	0.12	0.09	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	38.49	60.35	81.10	17.46
	Sum:	63.79	100.00	100.00	

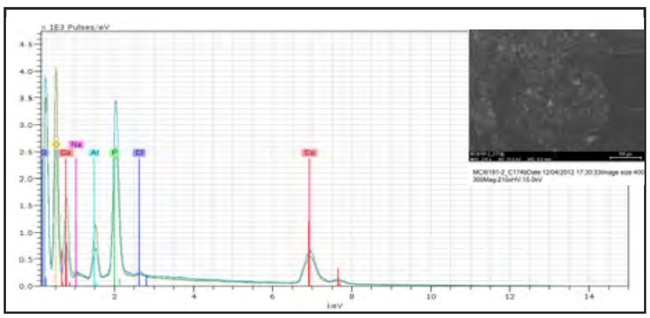
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: brownish mix

sample location: left edge, 8.5" from bottom
(B 21.6 x L 0.0 cm.)

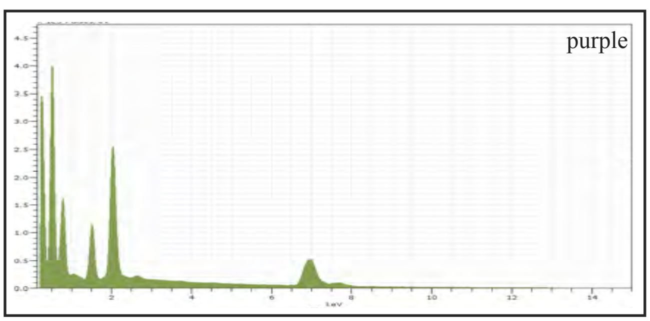
Representative Analysis Compilation—sample C174, continued



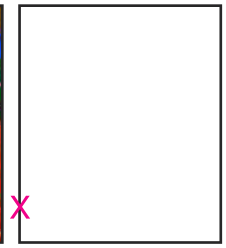
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	10.03	17.08	3.68	1.16
Zinc	K-series	4.53	7.71	2.85	0.18
Sulfur	K-series	4.19	7.13	5.39	0.17
Cobalt	K-series	3.11	5.29	2.17	0.12
Sodium	K-series	2.47	4.20	4.42	1.97
Potassium	K-series	1.84	3.14	1.94	0.41
Aluminium	K-series	1.15	1.96	1.76	0.75
Titanium	K-series	1.00	1.71	0.86	0.13
Phosphorus	K-series	0.67	1.14	0.89	0.05
Chlorine	K-series	0.24	0.40	0.28	0.04
Silicon	K-series	0.19	0.32	0.28	0.03
Barium	L-series	0.03	0.06	0.01	0.04
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	29.31	49.88	75.47	18.37
	Sum:	58.77	100.00	100.00	

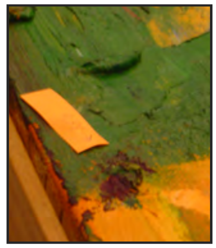


analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.6 mm.
mag: 210x; HV: 15 kV
significant elements, purple: Co, P
interpretation: cobalt violet



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	42.65	62.91	46.80	1.30
Phosphorus	K-series	16.24	23.96	33.91	0.64
Aluminium	K-series	6.94	10.24	16.64	0.35
Zinc	K-series	1.03	1.52	1.02	0.07
Magnesium	K-series	0.29	0.43	0.77	0.04
Chlorine	K-series	0.23	0.34	0.42	0.03
Barium	L-series	0.21	0.31	0.10	0.07
Sulfur	K-series	0.08	0.12	0.16	0.03
Calcium	K-series	0.08	0.11	0.13	0.03
Titanium	K-series	0.03	0.05	0.04	0.05
Potassium	K-series	0.01	0.01	0.02	0.03
Sodium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
	Sum:	67.79	100.00	100.00	

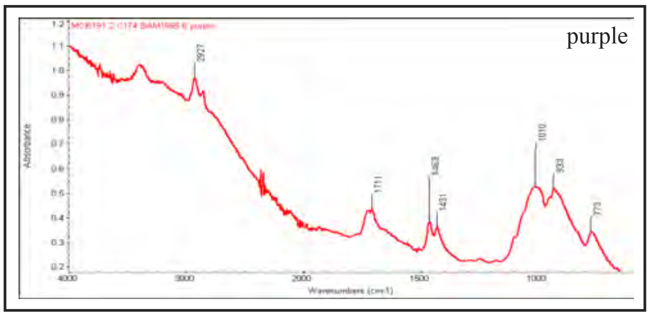




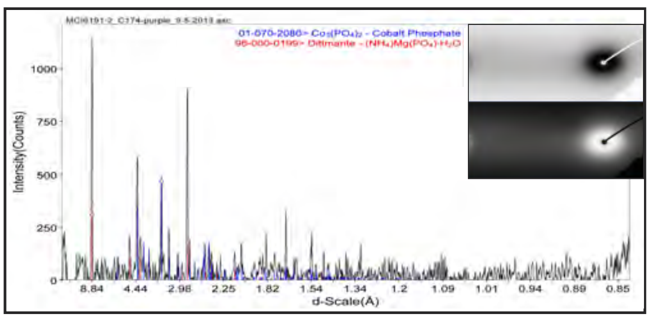
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: brownish mix

sample location: left edge, 8.5" from bottom
(B 21.6 x L 0.0 cm.)

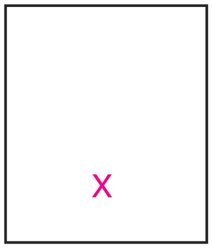
Representative Analysis Compilation—sample C174, continued

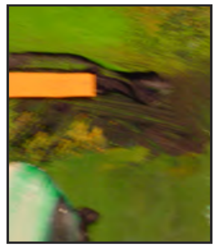


analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: inconclusive; consistent with three other spectra



analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: fixed at 0º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cobalt phosphate, dittmarite
interpretation: cobalt violet

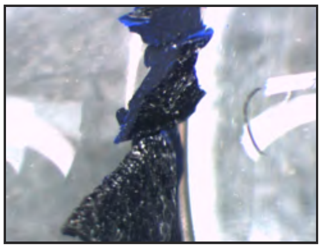


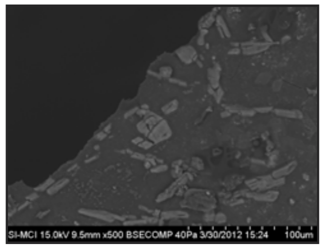


acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: dark green

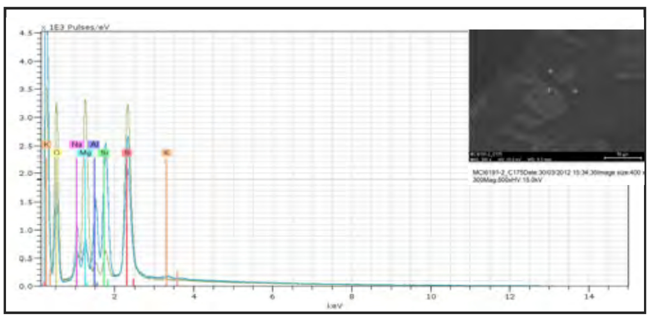
sample location: 20.5" from bottom, 33.0" from right
(B 52.1 x R 83.8 cm.)

Representative Analysis Compilation—sample C175

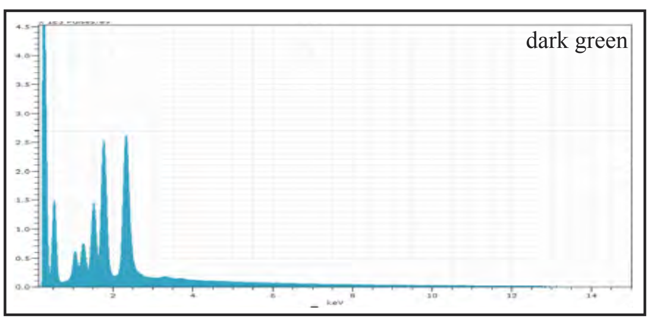




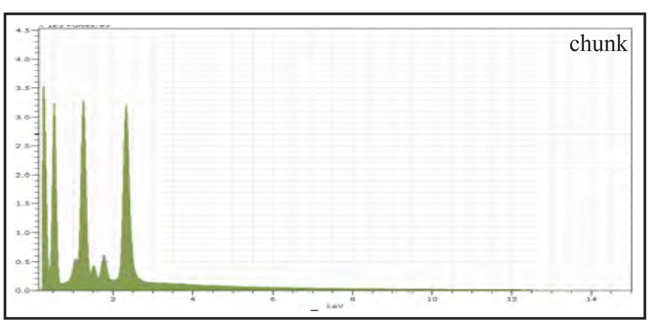
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



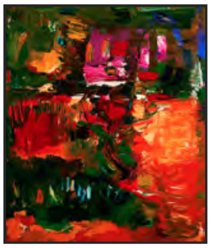
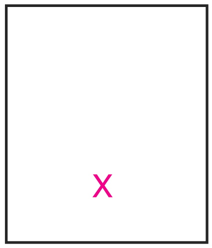
analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, dark green: Si, Al, Na
interpretation: ultramarine blue

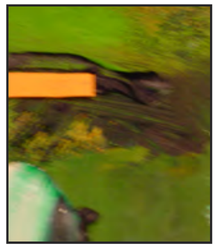


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Sulfur	K-series	13.26	17.92	13.17	0.49
Silicon	K-series	11.75	15.87	13.32	0.51
Aluminium	K-series	5.60	7.56	6.61	1.85
Zinc	K-series	4.66	6.30	2.27	0.19
Sodium	K-series	3.53	4.78	4.90	2.81
Magnesium	K-series	3.52	4.76	4.61	0.31
Barium	L-series	2.68	3.62	0.62	0.22
Chlorine	K-series	0.87	1.17	0.78	0.06
Cadmium	L-series	0.67	0.90	0.19	0.19
Calcium	K-series	0.61	0.82	0.48	0.07
Potassium	K-series	0.38	0.51	0.31	0.16
Selenium	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	26.49	35.80	52.74	13.18
	Sum:	74.00	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Sulfur	K-series	12.22	17.11	10.20	0.46
Magnesium	K-series	10.57	14.80	11.64	0.66
Silicon	K-series	1.17	1.63	1.11	0.07
Sodium	K-series	1.01	1.41	1.17	0.82
Zinc	K-series	0.80	1.11	0.33	0.06
Aluminium	K-series	0.50	0.69	0.49	0.40
Chlorine	K-series	0.20	0.28	0.15	0.03
Barium	L-series	0.13	0.18	0.03	0.05
Calcium	K-series	0.07	0.09	0.04	0.04
Potassium	K-series	0.03	0.05	0.02	0.05
Selenium	L-series	0.00	0.00	0.00	0.03
Cadmium	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	44.75	62.64	74.82	16.45
	Sum:	71.43	100.00	100.00	

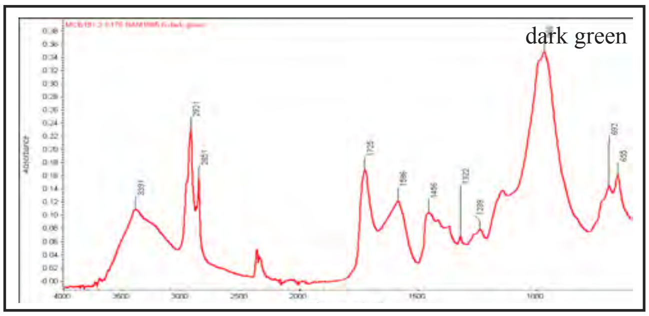





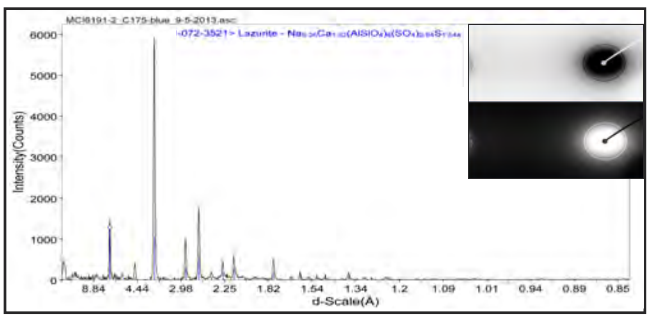
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: dark green

sample location: 20.5" from bottom, 33.0" from right
(B 52.1 x R 83.8 cm.)

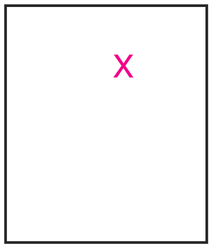
Representative Analysis Compilation—sample C175, continued

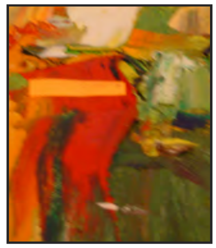


analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish



analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-90º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: lazurite
interpretation: inconclusive

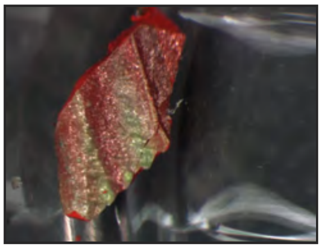


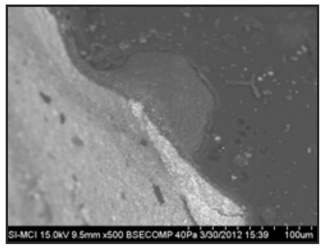


acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: red, possible stratigraphy

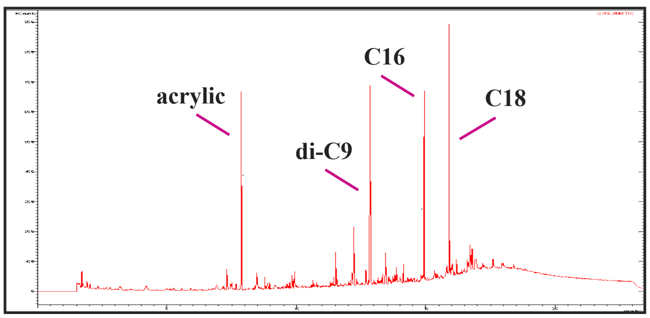
sample location: 15.5" from top, 27.0" from right
(T 39.4 x R 68.6 cm.)

Representative Analysis Compilation—sample C176

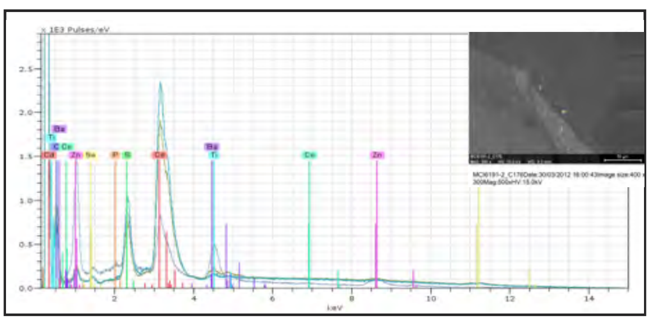




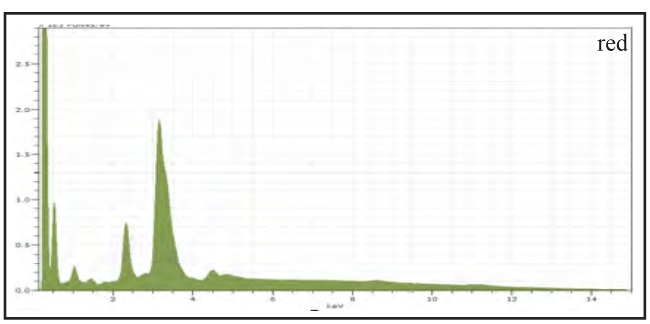
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



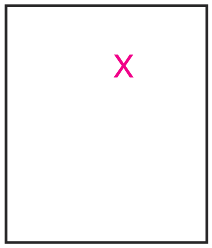
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.207
scan range: 1 - 1480
time range: 0.00 - 23.39 min.
notes: SS600, TMAH
results: di-C9, C16, C18, acrylic
interpretation: oil, conservation material

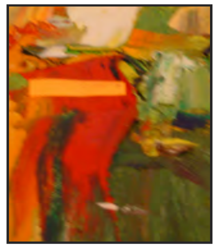


analysis: EDS
by: DVR (MCI)
date: 03/30/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, green mix: Zn, Cd, S, Na
interpretation: cadmium red, cadmium green



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	52.14	46.31	15.57	4.42
Sulfur	K-series	9.24	8.21	9.67	0.35
Potassium	K-series	9.24	8.20	7.93	1.36
Barium	L-series	4.91	4.36	1.20	0.40
Zinc	K-series	4.73	4.20	2.43	0.18
Sodium	K-series	1.81	1.61	2.64	1.45
Titanium	K-series	0.87	0.78	0.61	0.21
Calcium	K-series	0.82	0.73	0.69	0.25
Aluminium	K-series	0.58	0.51	0.72	0.46
Chlorine	K-series	0.28	0.25	0.26	0.05
Selenium	L-series	0.15	0.13	0.06	0.05
Silicon	K-series	0.10	0.09	0.12	0.03
Phosphorus	K-series	0.04	0.04	0.04	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	27.68	24.59	58.06	16.73
	Sum:	112.59	100.00	100.00	

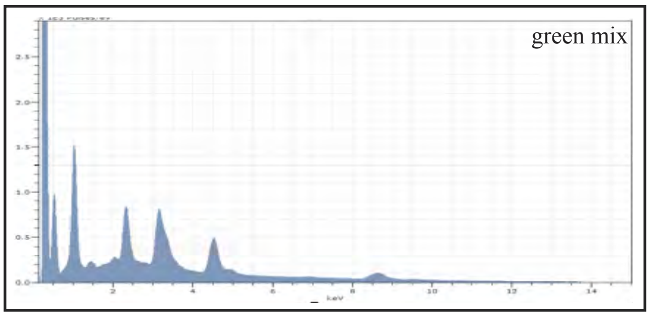





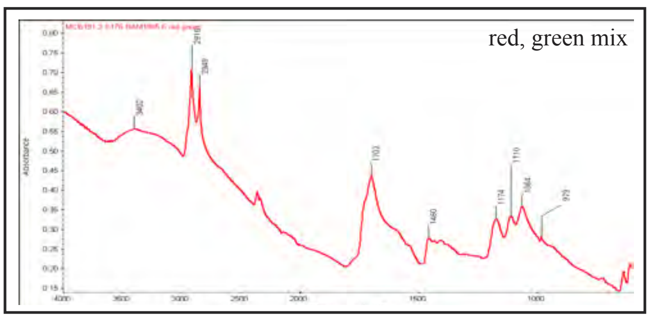
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: red, possible stratigraphy

sample location: 15.5" from top, 27.0" from right
(T 39.4 x R 68.6 cm.)

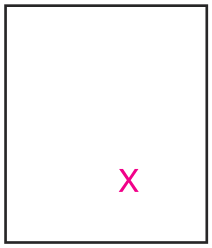
Representative Analysis Compilation—sample C176, continued

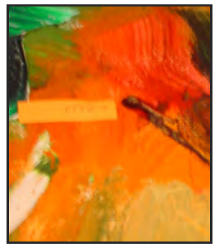


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	19.71	22.93	12.10	0.68
Cadmium	L-series	16.20	18.86	5.79	1.78
Titanium	K-series	7.72	8.98	6.47	0.63
Sodium	K-series	7.24	8.42	12.63	5.72
Sulfur	K-series	5.80	6.75	7.26	0.23
Barium	L-series	3.93	4.57	1.15	0.64
Cobalt	K-series	1.64	1.91	1.12	0.08
Potassium	K-series	1.37	1.60	1.41	0.68
Phosphorus	K-series	0.92	1.07	1.19	0.06
Chlorine	K-series	0.92	1.07	1.04	0.06
Calcium	K-series	0.53	0.61	0.53	0.12
Aluminium	K-series	0.31	0.36	0.46	0.26
Silicon	K-series	0.20	0.23	0.28	0.03
Selenium	L-series	0.12	0.14	0.06	0.04
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	19.34	22.50	48.52	11.94
	Sum:	85.94	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

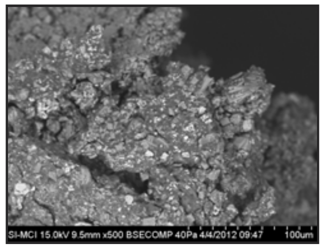





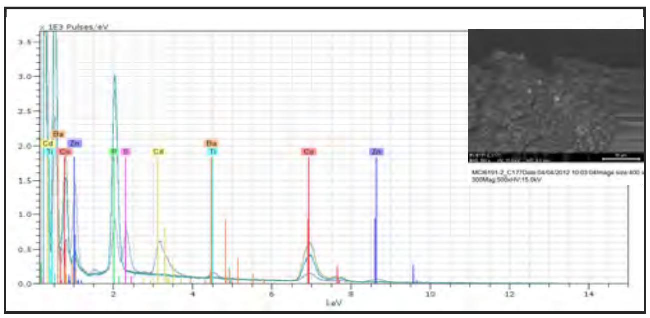
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: deep purple

sample location: 18.5" from bottom, 22.5" from right
(B 47.0 x R 57.2 cm.)

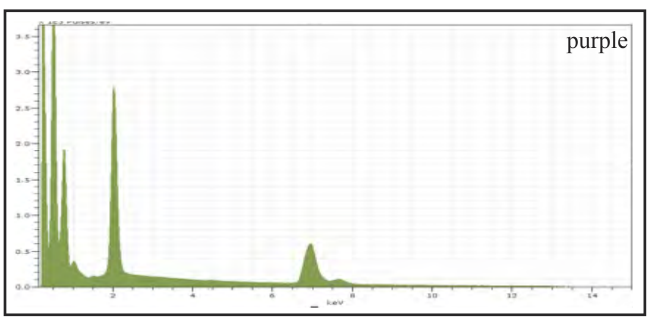
Representative Analysis Compilation—sample C177

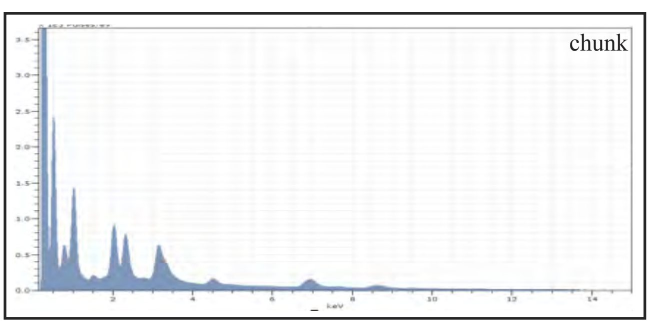
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



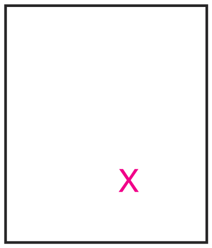
analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Co, P
interpretation: cobalt violet

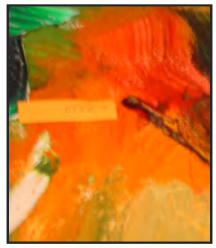


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	53.52	47.61	26.16	1.62
Phosphorus	K-series	21.45	19.08	19.94	0.84
Zinc	K-series	4.15	3.70	1.83	0.17
Sodium	K-series	2.47	2.19	3.09	1.97
Barium	L-series	1.44	1.28	0.30	0.15
Cadmium	L-series	1.29	1.15	0.33	0.34
Chlorine	K-series	0.73	0.65	0.59	0.05
Sulfur	K-series	0.68	0.60	0.61	0.05
Magnesium	K-series	0.64	0.57	0.76	0.13
Calcium	K-series	0.45	0.40	0.33	0.07
Aluminium	K-series	0.03	0.03	0.03	0.05
Potassium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.56	22.74	46.02	8.15
	Sum:	112.41	100.00	100.00	



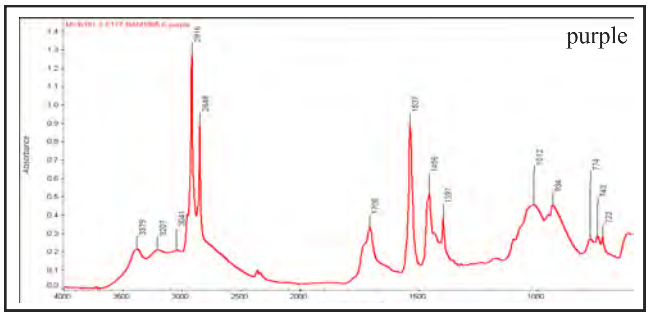
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	21.95	19.03	9.46	0.76
Cobalt	K-series	16.92	14.67	8.09	0.53
Cadmium	L-series	15.29	13.26	3.83	1.93
Phosphorus	K-series	6.74	5.84	6.13	0.28
Sulfur	K-series	6.59	5.72	5.79	0.26
Sodium	K-series	6.34	5.50	7.78	5.02
Barium	L-series	6.31	5.47	1.30	0.48
Potassium	K-series	1.46	1.27	1.05	0.73
Calcium	K-series	0.76	0.66	0.54	0.14
Chlorine	K-series	0.69	0.60	0.55	0.05
Magnesium	K-series	0.69	0.60	0.80	0.14
Aluminium	K-series	0.53	0.46	0.56	0.43
Titanium	K-series	0.41	0.36	0.24	0.21
Silicon	K-series	0.12	0.11	0.12	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	30.52	26.46	53.76	12.34
	Sum:	115.34	100.00	100.00	

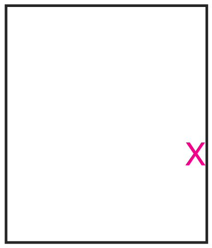


acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: deep purple
sample location: 18.5" from bottom, 22.5" from right
(B 47.0 x R 57.2 cm.)

Representative Analysis Compilation—sample C177, continued



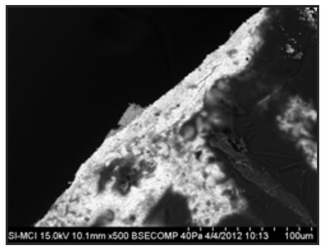
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil



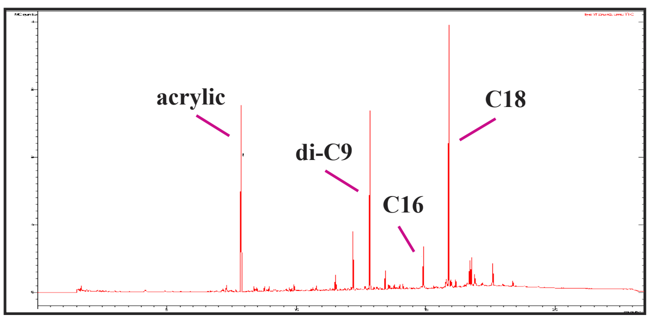
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: orange, brittle, lots of cracking

sample location: 24.5" from bottom, 2.5" from right
(B 62.2 x R 6.4 cm.)

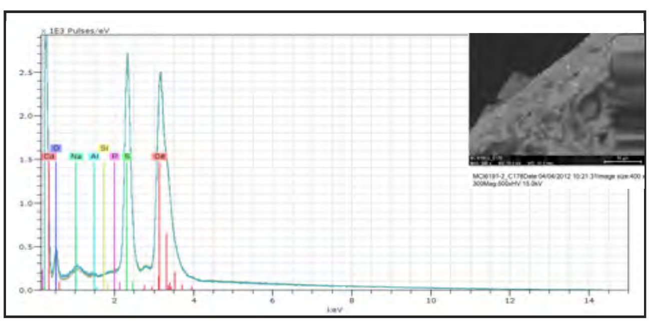
Representative Analysis Compilation—sample C178



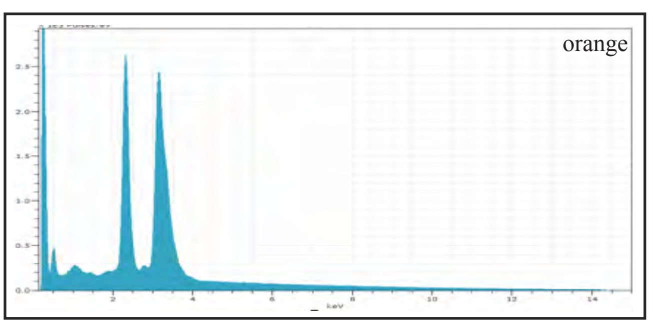
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



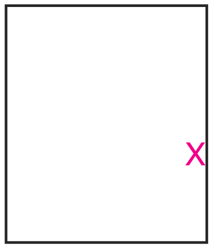
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.425
scan range: 1 - 1487
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, acrylic
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
interpretation: cadmium orange



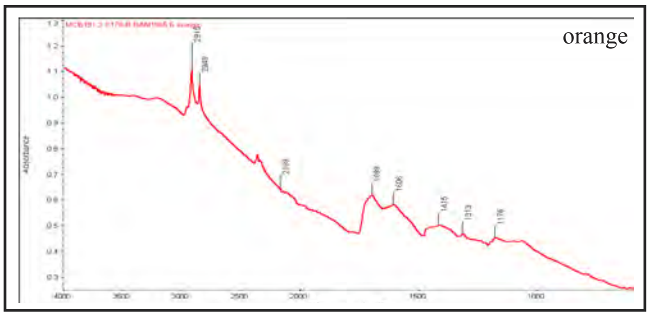
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	52.66	52.69	20.66	3.83
Sulfur	K-series	20.55	20.56	28.27	0.75
Potassium	K-series	7.02	7.02	7.92	1.27
Zinc	K-series	3.44	3.44	2.32	0.15
Sodium	K-series	0.84	0.85	1.62	0.69
Magnesium	K-series	0.77	0.77	1.41	0.15
Chlorine	K-series	0.52	0.52	0.65	0.06
Phosphorus	K-series	0.29	0.29	0.41	0.04
Selenium	L-series	0.28	0.28	0.15	0.05
Barium	L-series	0.21	0.21	0.07	0.06
Calcium	K-series	0.14	0.14	0.16	0.12
Silicon	K-series	0.06	0.06	0.09	0.03
Aluminium	K-series	0.02	0.02	0.04	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	13.14	13.15	36.24	12.56
	Sum:	99.94	100.00	100.00	

acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: orange, brittle, lots of cracking

sample location: 24.5" from bottom, 2.5" from right
(B 62.2 x R 6.4 cm.)

Representative Analysis Compilation—sample C178, continued



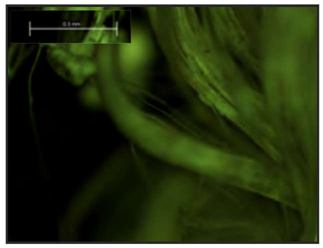
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

no image available

acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: warp and weft threads

sample location: upper right corner
(T 0.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C179



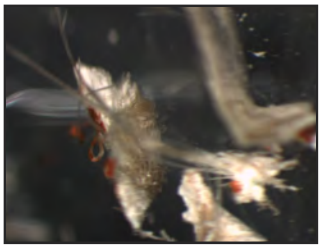
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

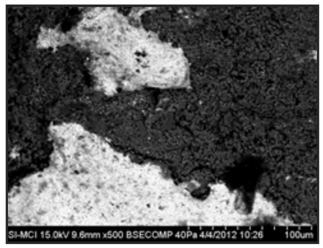
no image available

acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: ground layer

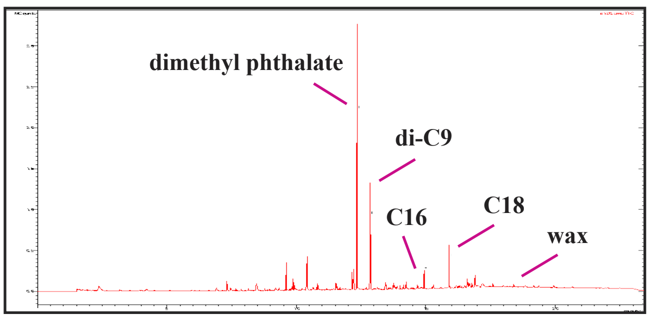
sample location: lower left corner
(B 0.0 x L 0.0 cm.)

Representative Analysis Compilation—sample C180

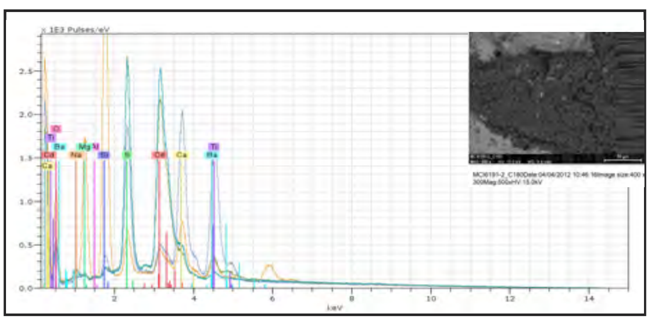




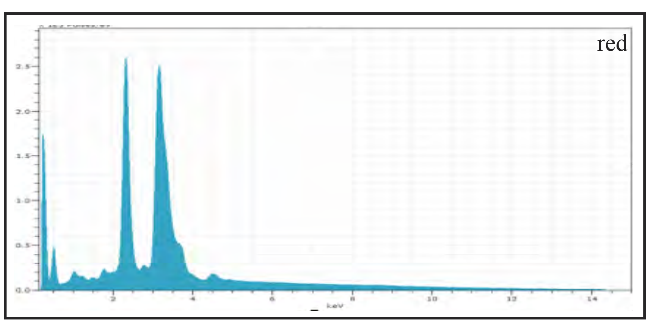
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.288
scan range: 1 - 1470
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18, terpenoids, wax
interpretation: alkyd, conservation material



analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S
significant elements, ground: Ti
interpretation: cadmium red, titanium white



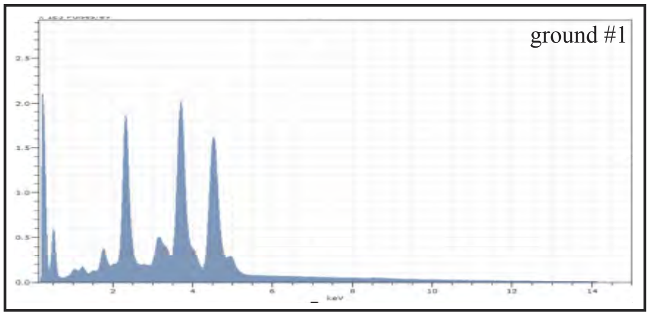
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	55.83	45.25	19.38	4.16
Sulfur	K-series	23.10	18.72	28.10	0.84
Zinc	K-series	13.23	10.72	7.89	0.47
Potassium	K-series	8.10	6.57	8.08	1.31
Barium	L-series	4.57	3.70	1.30	0.35
Calcium	K-series	3.83	3.11	3.73	0.27
Sodium	K-series	2.26	1.83	3.84	1.81
Chlorine	K-series	0.75	0.61	0.83	0.07
Magnesium	K-series	0.72	0.58	1.16	0.16
Silicon	K-series	0.65	0.52	0.90	0.05
Phosphorus	K-series	0.33	0.27	0.41	0.04
Aluminium	K-series	0.05	0.04	0.07	0.06
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	9.97	8.08	24.31	8.14
	Sum:	123.40	100.00	100.00	

no image available

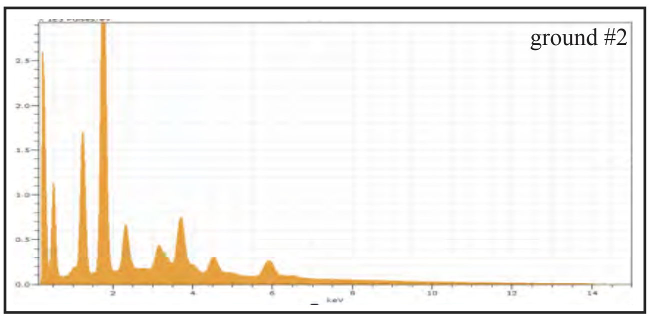
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: ground layer

sample location: lower left corner
(B 0.0 x L 0.0 cm.)

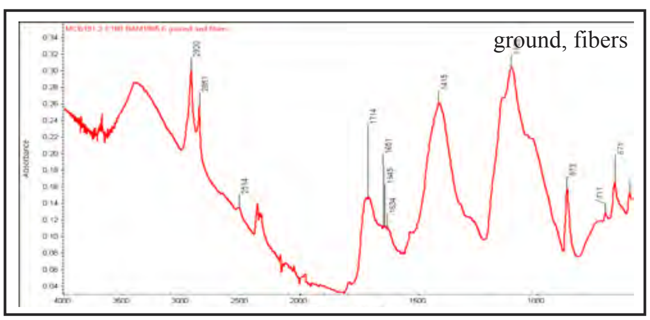
Representative Analysis Compilation—sample C180, continued



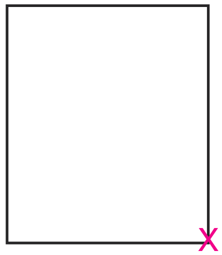
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	25.48	28.06	19.93	0.96
Calcium	K-series	21.43	23.61	20.03	0.71
Sulfur	K-series	14.79	16.30	17.28	0.55
Cadmium	L-series	8.09	8.91	2.69	1.17
Silicon	K-series	2.36	2.60	3.15	0.12
Sodium	K-series	1.18	1.30	1.92	0.95
Zinc	K-series	1.17	1.29	0.67	0.07
Chlorine	K-series	0.95	1.04	1.00	0.06
Magnesium	K-series	0.94	1.04	1.45	0.18
Potassium	K-series	0.70	0.77	0.67	0.40
Phosphorus	K-series	0.58	0.64	0.70	0.05
Barium	L-series	0.08	0.09	0.02	0.07
Aluminium	K-series	0.04	0.05	0.06	0.06
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	12.99	14.31	30.42	9.26
	Sum:	90.78	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	23.39	26.81	23.50	1.00
Magnesium	K-series	12.57	14.41	14.60	0.85
Calcium	K-series	5.56	6.37	3.91	0.22
Manganese	K-series	5.00	5.74	2.57	0.18
Cadmium	L-series	4.24	4.86	1.06	0.75
Sulfur	K-series	2.88	3.30	2.53	0.13
Titanium	K-series	2.66	3.05	1.57	0.21
Zinc	K-series	2.59	2.97	1.12	0.12
Potassium	K-series	0.49	0.56	0.35	0.27
Sodium	K-series	0.28	0.32	0.34	0.24
Chlorine	K-series	0.09	0.11	0.07	0.03
Barium	L-series	0.07	0.08	0.01	0.06
Selenium	L-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	27.42	31.43	48.36	35.02
	Sum:	87.23	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

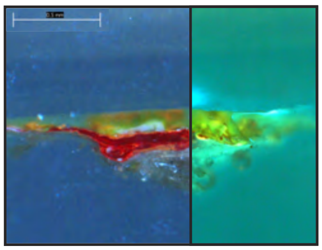


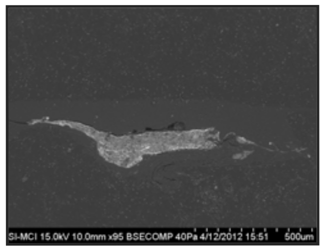
no image available

acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: orange, no ground in area

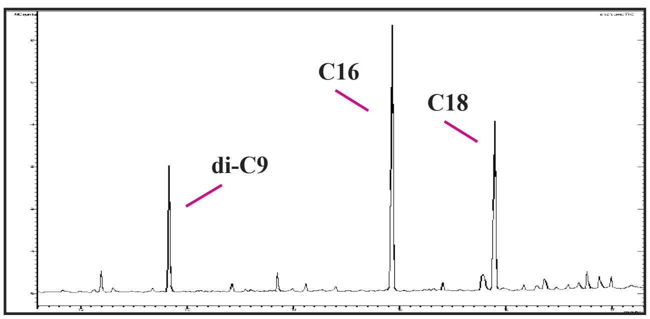
sample location: lower right corner
(B 0.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C181

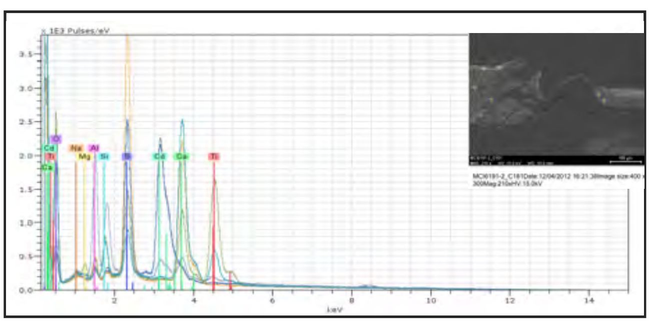




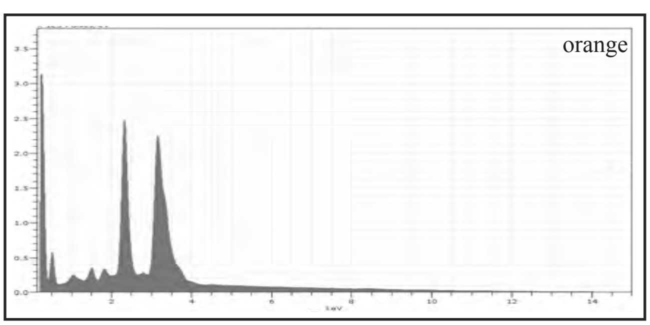
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



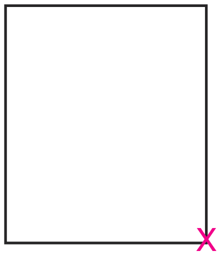
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.222
scan range: 1 - 1486
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 10.0 mm.
mag: 210x; HV: 15 kV
significant elements, orange: Cd, S
significant elements, red: Al
significant elements, white: Ti, Zn
interpretation: cadmium orange, possible
synthetic alizarin, Ti/Zn white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	26.29	35.06	11.58	2.29
Sulfur	K-series	12.32	16.42	19.01	0.46
Zinc	K-series	10.76	14.34	8.14	0.39
Potassium	K-series	5.57	7.43	7.05	0.76
Aluminium	K-series	1.11	1.48	2.04	0.87
Barium	L-series	0.95	1.27	0.34	0.12
Sodium	K-series	0.94	1.25	2.01	0.76
Calcium	K-series	0.92	1.23	1.14	0.17
Silicon	K-series	0.76	1.02	1.35	0.06
Magnesium	K-series	0.11	0.14	0.22	0.06
Phosphorus	K-series	0.09	0.12	0.15	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	15.17	20.23	46.95	11.66
	Sum:	75.00	100.00	100.00	

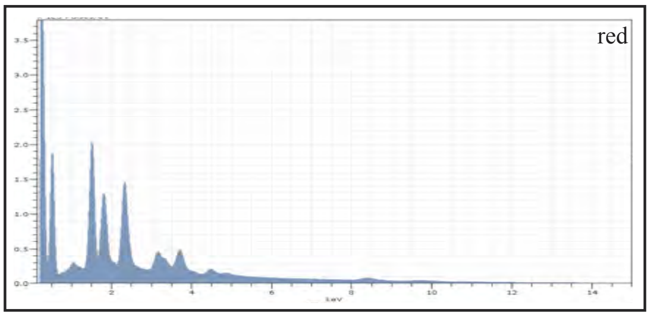


no image available

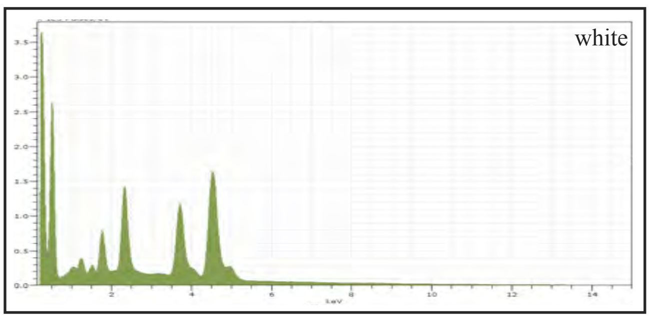
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: orange, no ground in area

sample location: lower right corner
(B 0.0 x R 0.0 cm.)

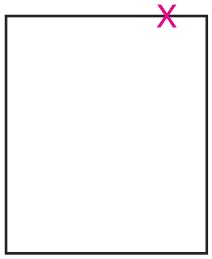
Representative Analysis Compilation—sample C181, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	10.66	15.67	5.85	0.38
Aluminium	K-series	7.47	10.99	9.94	2.03
Sulfur	K-series	5.67	8.33	6.34	0.23
Silicon	K-series	5.26	7.73	6.72	0.24
Barium	L-series	2.79	4.09	0.73	0.22
Cadmium	L-series	2.49	3.66	0.79	0.63
Calcium	K-series	2.49	3.65	2.22	0.13
Sodium	K-series	0.89	1.30	1.39	0.72
Phosphorus	K-series	0.77	1.13	0.89	0.05
Potassium	K-series	0.73	1.07	0.67	0.22
Magnesium	K-series	0.12	0.17	0.17	0.06
Chlorine	K-series	0.05	0.08	0.05	0.03
Titanium	K-series	0.01	0.02	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	28.64	42.09	64.22	12.96
	Sum:	68.03	100.00	100.00	



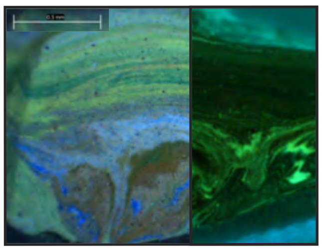
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Titanium	K-series	29.31	29.68	16.63	1.20
Calcium	K-series	11.42	11.56	7.74	0.37
Sulfur	K-series	6.62	6.70	5.61	0.26
Barium	L-series	4.98	5.04	0.98	1.31
Zinc	K-series	4.37	4.42	1.81	0.18
Silicon	K-series	2.83	2.87	2.74	0.14
Magnesium	K-series	1.38	1.39	1.54	0.10
Sodium	K-series	0.73	0.74	0.86	0.60
Potassium	K-series	0.41	0.41	0.28	0.06
Aluminium	K-series	0.33	0.33	0.33	0.04
Chlorine	K-series	0.33	0.33	0.25	0.04
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	36.06	36.52	61.23	13.72
	Sum:	98.75	100.00	100.00	

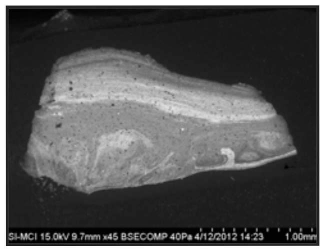


acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: light green mix

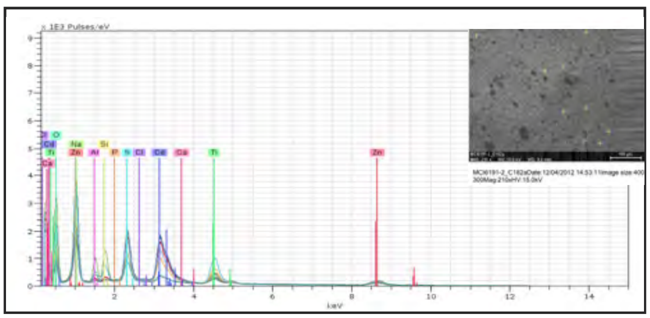
sample location: top edge, 14.0" from right
(T 0.0 x R 35.6 cm.)

Representative Analysis Compilation—sample C182

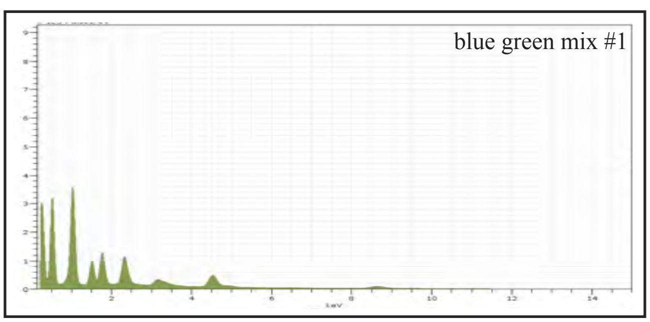




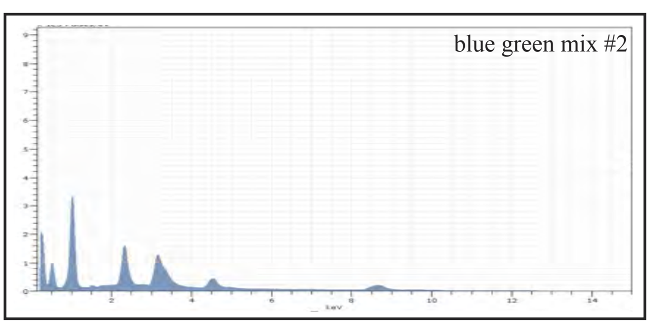
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



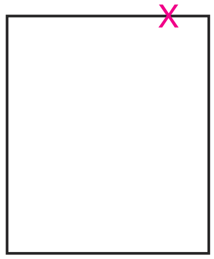
analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.8 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Si, Al
significant elements, green: Zn, Cd, S, Na
interpretation: ultramarine blue, cadmium green



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	25.15	22.03	9.42	0.86
Sodium	K-series	19.39	16.99	20.65	15.28
Silicon	K-series	7.73	6.77	6.74	0.35
Titanium	K-series	7.60	6.66	3.89	0.66
Sulfur	K-series	7.56	6.62	5.77	0.29
Cadmium	L-series	5.28	4.62	1.15	1.05
Barium	L-series	5.02	4.40	0.90	0.68
Aluminium	K-series	4.67	4.09	4.24	1.89
Potassium	K-series	0.85	0.74	0.53	0.39
Chlorine	K-series	0.40	0.35	0.28	0.04
Calcium	K-series	0.24	0.21	0.15	0.08
Phosphorus	K-series	0.01	0.01	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	30.24	26.50	46.29	10.94
	Sum:	114.13	100.00	100.00	



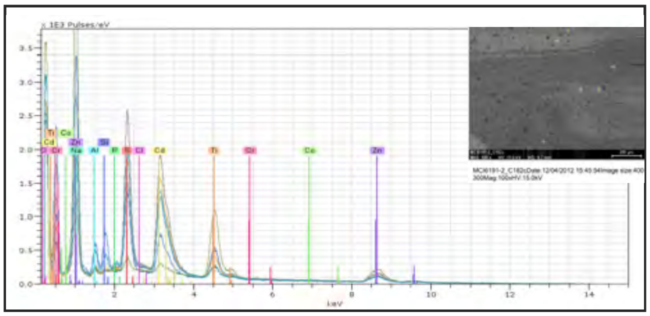
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	39.82	38.63	22.04	1.34
Sodium	K-series	18.97	18.41	29.87	14.96
Cadmium	L-series	12.78	12.40	4.12	1.55
Sulfur	K-series	9.29	9.01	10.48	0.35
Titanium	K-series	5.46	5.30	4.13	0.42
Potassium	K-series	3.07	2.98	2.85	0.51
Barium	L-series	1.43	1.39	0.38	0.49
Silicon	K-series	0.68	0.66	0.88	0.06
Aluminium	K-series	0.54	0.52	0.72	0.44
Phosphorus	K-series	0.32	0.31	0.38	0.04
Magnesium	K-series	0.09	0.09	0.14	0.08
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	10.61	10.30	24.02	6.18
	Sum:	103.07	100.00	100.00	



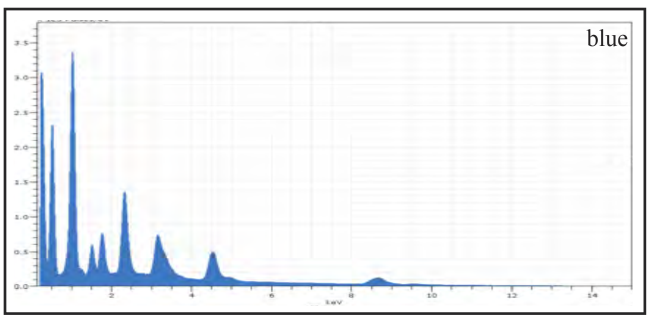
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: light green mix

sample location: top edge, 14.0" from right
(T 0.0 x R 35.6 cm.)

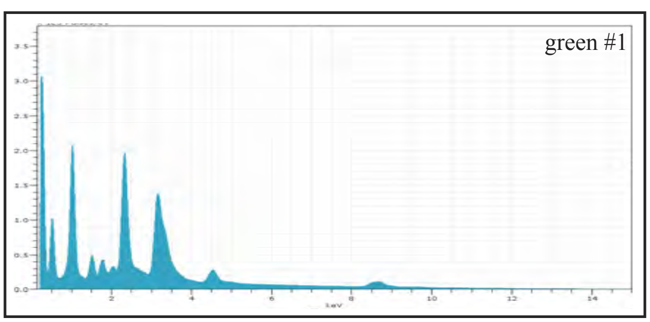
Representative Analysis Compilation—sample C182, continued



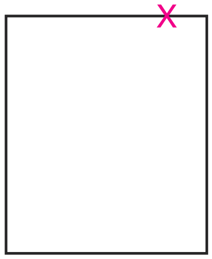
analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.7 mm.
mag: 100x; HV: 15 kV
significant elements, blue: Na, Si. Al
significant elements, green #1: Zn, Cd, S, Na
significant elements, green #2: Zn, Cd, S, Na
interpretation: ultramarine blue, cadmium green



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	24.77	25.89	11.15	0.85
Sodium	K-series	13.95	14.58	17.86	11.01
Titanium	K-series	7.68	8.03	4.72	0.50
Sulfur	K-series	7.26	7.59	6.67	0.28
Cadmium	L-series	6.13	6.41	1.61	1.01
Silicon	K-series	3.22	3.36	3.37	0.16
Aluminium	K-series	1.74	1.82	1.90	1.06
Barium	L-series	1.48	1.54	0.32	0.64
Potassium	K-series	1.46	1.52	1.10	0.35
Magnesium	K-series	0.17	0.17	0.20	0.07
Chlorine	K-series	0.02	0.02	0.02	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.02
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	27.78	29.04	51.10	11.28
	Sum:	95.67	100.00	100.00	



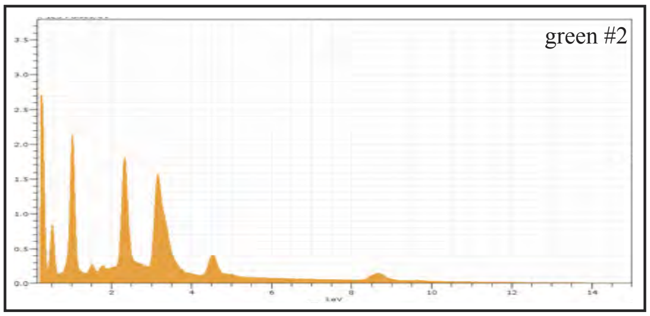
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	25.97	31.42	23.46	0.89
Cadmium	L-series	25.01	30.26	13.14	0.79
Sodium	K-series	12.35	14.94	31.73	3.69
Sulfur	K-series	8.59	10.39	15.82	0.33
Titanium	K-series	5.18	6.27	6.39	0.18
Aluminium	K-series	2.09	2.53	4.57	0.12
Cobalt	K-series	1.49	1.80	1.49	0.07
Silicon	K-series	1.02	1.23	2.15	0.07
Chromium	K-series	0.66	0.80	0.75	0.05
Chlorine	K-series	0.20	0.24	0.33	0.04
Phosphorus	K-series	0.09	0.11	0.17	0.03
	Sum:	82.66	100.00	100.00	



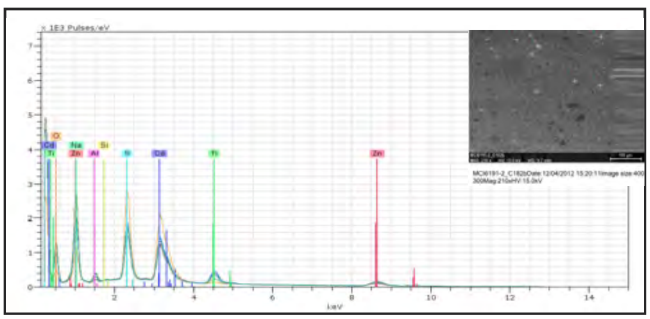
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: light green mix

sample location: top edge, 14.0" from right
(T 0.0 x R 35.6 cm.)

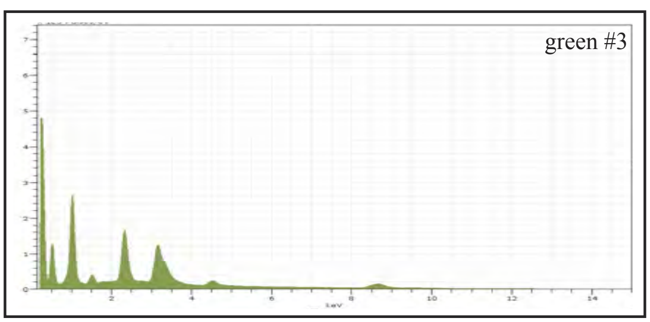
Representative Analysis Compilation—sample C182, continued



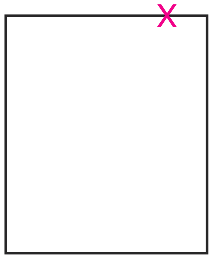
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	17.79	25.08	11.87	0.62
Cadmium	L-series	12.23	17.23	4.75	1.30
Sodium	K-series	9.12	12.85	17.30	7.20
Sulfur	K-series	6.42	9.04	8.73	0.25
Titanium	K-series	3.52	4.96	3.20	0.24
Potassium	K-series	2.70	3.80	3.01	0.46
Aluminium	K-series	0.62	0.88	1.01	0.50
Silicon	K-series	0.18	0.26	0.29	0.03
Chlorine	K-series	0.08	0.12	0.10	0.03
Magnesium	K-series	0.07	0.11	0.13	0.06
Cobalt	K-series	0.02	0.04	0.02	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Barium	L-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	18.19	25.64	49.59	11.42
	Sum:	70.95	100.00	100.00	



analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.7 mm.
mag: 210x; HV: 15 kV
significant elements, green #3: Zn, Cd, S, Na
interpretation: cadmium green



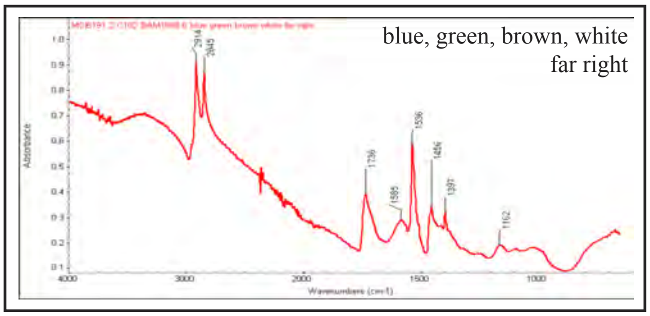
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	24.21	29.65	14.01	0.83
Cadmium	L-series	11.76	14.40	3.96	1.40
Sodium	K-series	11.21	13.73	18.46	8.85
Sulfur	K-series	7.86	9.63	9.28	0.30
Potassium	K-series	2.53	3.10	2.45	0.48
Titanium	K-series	1.98	2.43	1.57	0.20
Aluminium	K-series	1.65	2.02	2.31	1.11
Magnesium	K-series	0.11	0.14	0.18	0.07
Silicon	K-series	0.10	0.12	0.13	0.03
Barium	L-series	0.07	0.08	0.02	0.06
Phosphorus	K-series	0.04	0.05	0.05	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	20.11	24.63	47.58	10.60
	Sum:	81.65	100.00	100.00	



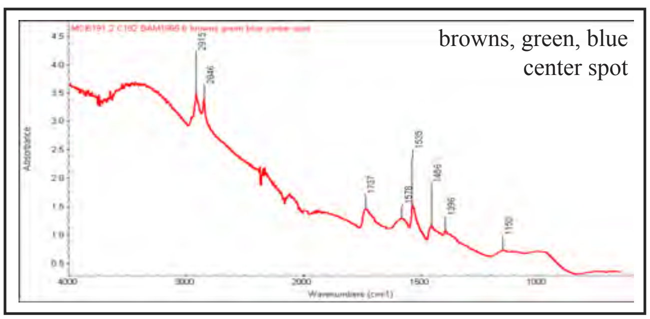
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: light green mix

sample location: top edge, 14.0" from right
(T 0.0 x R 35.6 cm.)

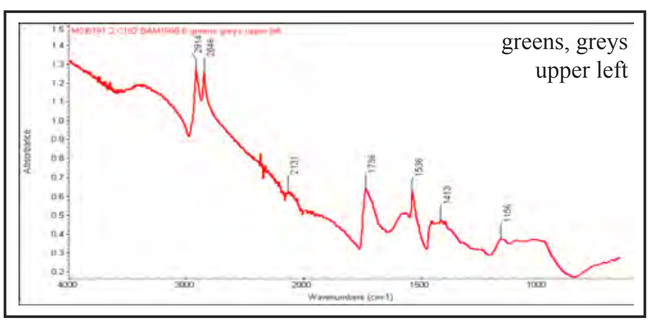
Representative Analysis Compilation—sample C182, continued



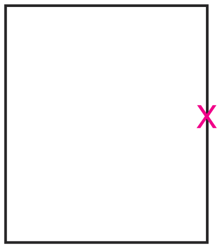
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



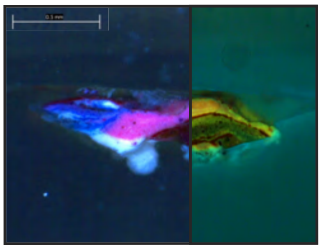
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

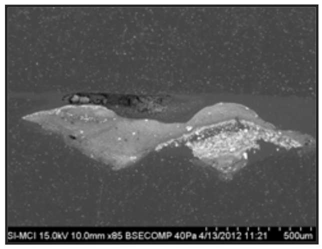
  

acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: another purple

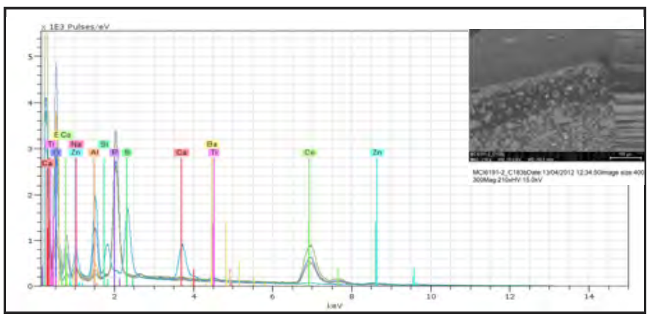
sample location: right edge, 31.0" from top
(T 78.7 x R 0.0 cm.)

Representative Analysis Compilation—sample C183

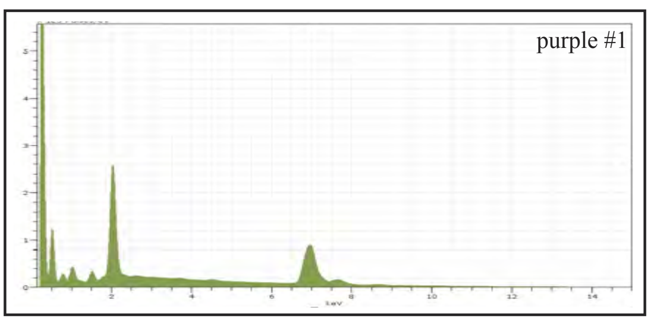




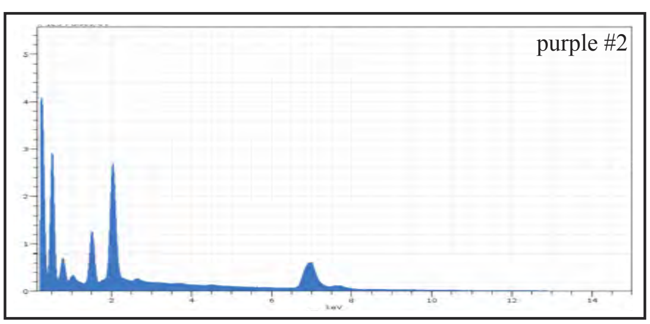
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



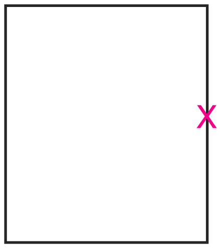
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.1 mm.
mag: 210x; HV: 15 kV
significant elements, purple: Co, P
significant elements, red: Al
interpretation: cobalt violet, possible synthetic alizarin



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	52.43	57.67	39.86	1.58
Phosphorus	K-series	16.73	18.41	24.21	0.66
Zinc	K-series	6.23	6.85	4.27	0.24
Sodium	K-series	4.36	4.80	8.50	3.46
Aluminium	K-series	1.95	2.14	3.23	0.12
Barium	L-series	1.68	1.85	0.55	0.15
Magnesium	K-series	0.43	0.47	0.79	0.05
Calcium	K-series	0.27	0.30	0.30	0.04
Sulfur	K-series	0.22	0.24	0.31	0.03
Chlorine	K-series	0.14	0.16	0.18	0.03
Potassium	K-series	0.14	0.15	0.16	0.03
Silicon	K-series	0.07	0.08	0.12	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	6.26	6.88	17.52	3.37
	Sum:	90.91	100.00	100.00	



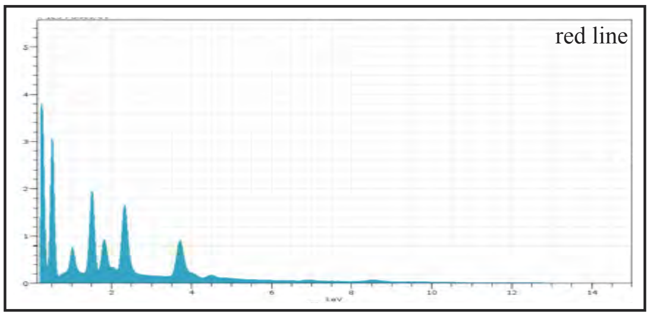
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	38.37	46.35	24.83	1.17
Phosphorus	K-series	13.42	16.22	16.53	0.53
Aluminium	K-series	6.51	7.86	9.20	0.33
Zinc	K-series	3.02	3.65	1.76	0.13
Sodium	K-series	0.96	1.16	1.59	0.78
Barium	L-series	0.95	1.14	0.26	0.11
Calcium	K-series	0.22	0.27	0.21	0.03
Chlorine	K-series	0.18	0.21	0.19	0.03
Sulfur	K-series	0.15	0.18	0.18	0.03
Potassium	K-series	0.04	0.05	0.04	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	18.97	22.91	45.21	7.21
	Sum:	82.77	100.00	100.00	



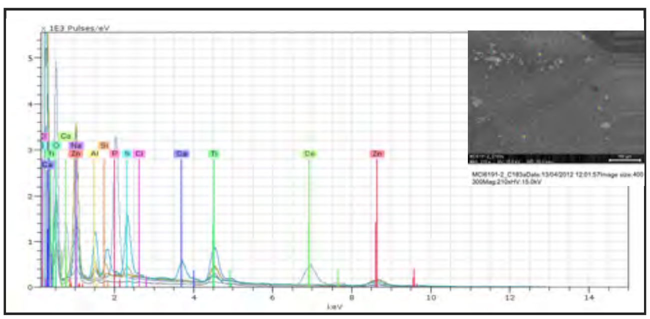
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: another purple

sample location: right edge, 31.0" from top
(T 78.7 x R 0.0 cm.)

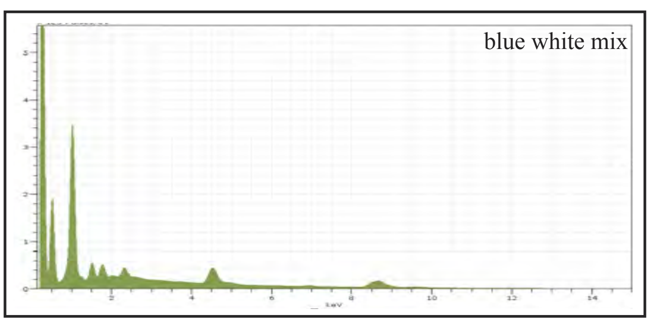
Representative Analysis Compilation—sample C183, continued



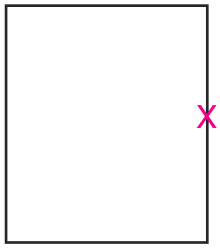
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	6.20	6.20	1.73	0.23
Calcium	K-series	3.95	3.95	1.80	0.14
Sulfur	K-series	3.61	3.61	2.05	0.15
Aluminium	K-series	3.28	3.28	2.22	0.18
Sodium	K-series	1.38	1.38	1.09	1.11
Silicon	K-series	1.31	1.31	0.85	0.08
Cobalt	K-series	0.71	0.71	0.22	0.05
Titanium	K-series	0.48	0.48	0.18	0.08
Phosphorus	K-series	0.20	0.20	0.12	0.03
Barium	L-series	0.08	0.08	0.01	0.06
Potassium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	78.80	78.80	89.74	23.11
	Sum:	100.00	100.00	100.00	



analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.0 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Na, Al, Si
significant elements, purple: Co, P
significant elements, pink: Zn, Ti, Al
significant elements, red: Al
interpretation: ultramarine blue, cobalt violet, possible synthetic alizarin, Zn/Ti white



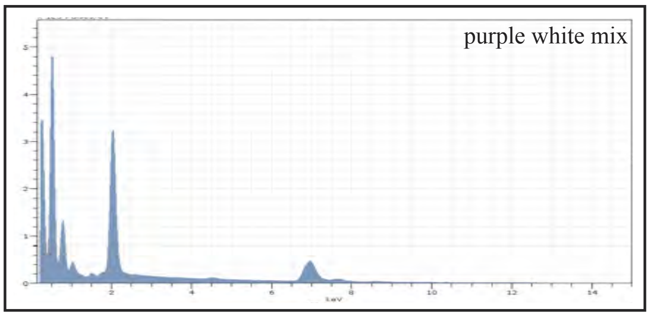
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	24.26	34.07	13.53	0.83
Sodium	K-series	12.29	17.26	19.50	9.70
Titanium	K-series	4.65	6.53	3.54	0.29
Aluminium	K-series	1.52	2.14	2.06	0.94
Silicon	K-series	1.17	1.65	1.52	0.07
Sulfur	K-series	0.63	0.89	0.72	0.05
Cobalt	K-series	0.62	0.87	0.38	0.05
Magnesium	K-series	0.30	0.42	0.45	0.09
Barium	L-series	0.17	0.24	0.05	0.11
Phosphorus	K-series	0.03	0.04	0.04	0.03
Chlorine	K-series	0.02	0.03	0.02	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Cadmium	L-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.52	35.85	58.18	11.57
	Sum:	71.20	100.00	100.00	

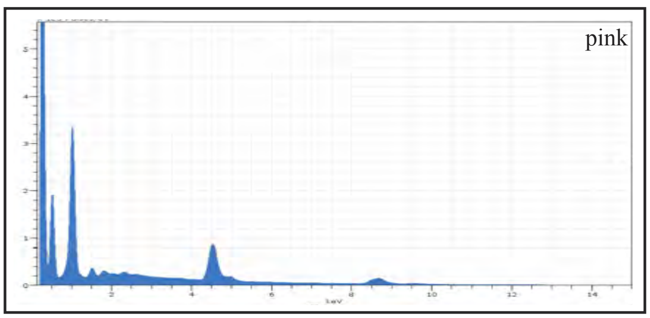
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: another purple

sample location: right edge, 31.0" from top
(T 78.7 x R 0.0 cm.)

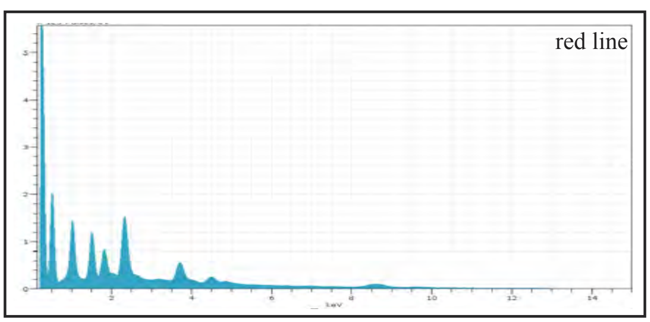
Representative Analysis Compilation—sample C183, continued



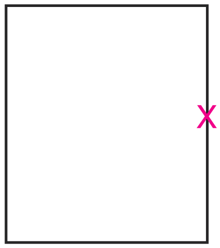
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	40.88	39.19	19.81	1.24
Phosphorus	K-series	19.37	18.57	17.86	0.76
Zinc	K-series	6.66	6.38	2.91	0.26
Sodium	K-series	4.37	4.19	5.43	3.46
Barium	L-series	2.63	2.52	0.55	0.22
Magnesium	K-series	0.33	0.31	0.38	0.09
Aluminium	K-series	0.29	0.28	0.31	0.25
Calcium	K-series	0.13	0.13	0.09	0.05
Silicon	K-series	0.12	0.11	0.12	0.03
Sulfur	K-series	0.11	0.11	0.10	0.03
Chlorine	K-series	0.03	0.03	0.03	0.03
Potassium	K-series	0.01	0.01	0.01	0.03
Cadmium	L-series	0.01	0.01	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	29.36	28.15	52.40	9.08
	Sum:	104.31	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	34.99	34.85	17.50	1.18
Titanium	K-series	14.31	14.25	9.77	0.92
Sodium	K-series	12.56	12.51	17.87	9.91
Barium	L-series	7.76	7.73	1.85	0.96
Cobalt	K-series	2.18	2.18	1.21	0.09
Aluminium	K-series	1.25	1.25	1.51	0.08
Chlorine	K-series	1.20	1.19	1.11	0.07
Sulfur	K-series	0.98	0.97	1.00	0.06
Silicon	K-series	0.83	0.83	0.97	0.06
Phosphorus	K-series	0.81	0.81	0.85	0.06
Potassium	K-series	0.68	0.68	0.57	0.05
Calcium	K-series	0.63	0.63	0.52	0.05
Magnesium	K-series	0.18	0.18	0.25	0.04
Oxygen	K-series	22.03	21.95	45.03	9.66
	Sum:	100.39	100.00	100.00	



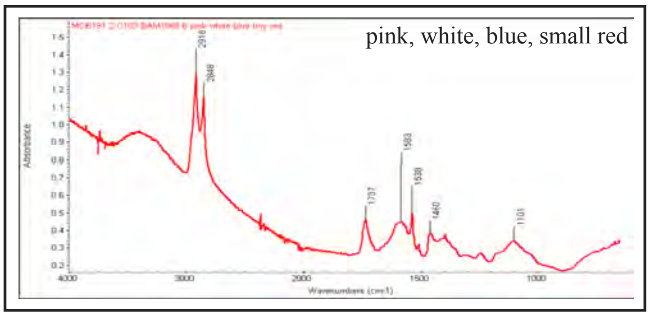
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	14.16	21.27	7.69	0.50
Sulfur	K-series	4.81	7.22	5.32	0.19
Sodium	K-series	4.55	6.83	7.03	3.61
Calcium	K-series	3.05	4.58	2.70	0.14
Aluminium	K-series	3.03	4.55	3.99	1.16
Barium	L-series	1.87	2.81	0.48	0.22
Silicon	K-series	1.52	2.28	1.92	0.09
Titanium	K-series	1.02	1.54	0.76	0.15
Cobalt	K-series	0.61	0.92	0.37	0.05
Chlorine	K-series	0.31	0.46	0.31	0.04
Phosphorus	K-series	0.29	0.43	0.33	0.04
Cadmium	L-series	0.25	0.37	0.08	0.09
Potassium	K-series	0.04	0.06	0.04	0.05
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	31.08	46.67	68.98	13.59
	Sum:	66.58	100.00	100.00	



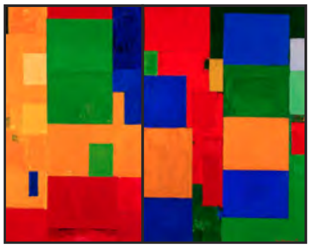
acc. no.: BAM 1965.6
title, year: *In the Wake of the Hurricane*, 1960
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 74.3 x 60.0" (153.2 x 132.8 cm.)
notes: another purple

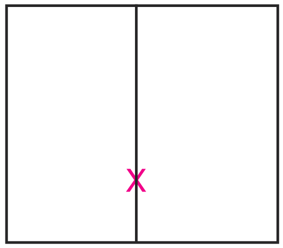
sample location: right edge, 31.0" from top
(T 78.7 x R 0.0 cm.)

Representative Analysis Compilation—sample C183, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

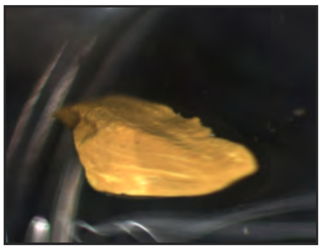


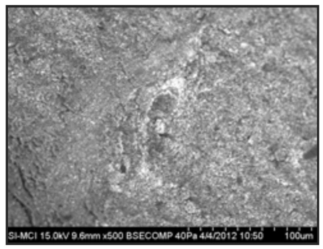


acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: ochre

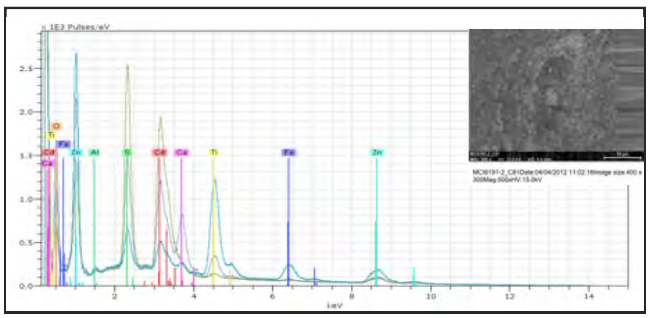
sample location: center join,
26.5" from bottom (B 67.3 x R *?* cm.)

Representative Analysis Compilation—sample C081

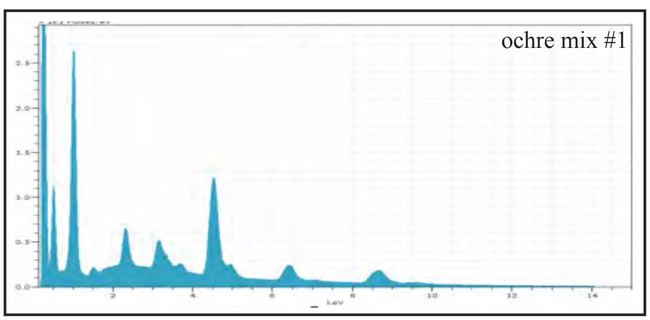




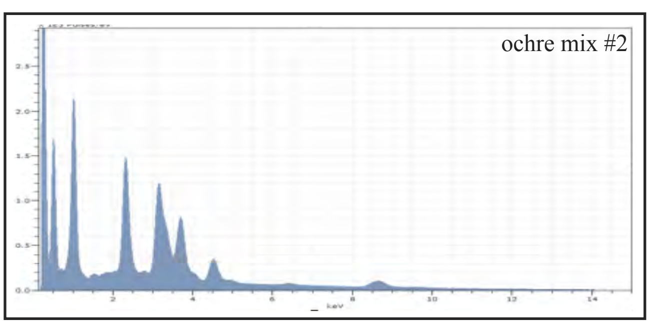
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



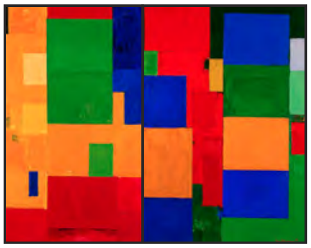
analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, ochre #1: Fe
significant elements, ochre #2: Cd, S
interpretation: yellow ochre and cadmium yellow

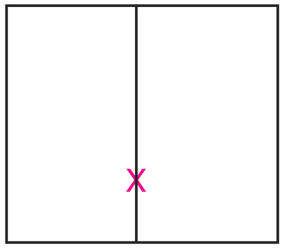


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	35.16	30.65	18.95	1.19
Titanium	K-series	19.50	16.99	14.35	0.93
Sodium	K-series	15.39	13.42	23.60	12.14
Iron	K-series	11.01	9.60	6.95	0.35
Cadmium	L-series	8.24	7.18	2.58	1.15
Barium	L-series	4.90	4.27	1.26	1.00
Sulfur	K-series	4.16	3.63	4.57	0.17
Copper	K-series	1.93	1.68	1.07	0.10
Calcium	K-series	1.41	1.23	1.24	0.12
Chlorine	K-series	0.89	0.78	0.89	0.06
Phosphorus	K-series	0.69	0.60	0.78	0.05
Aluminium	K-series	0.61	0.53	0.79	0.49
Potassium	K-series	0.53	0.46	0.48	0.39
Silicon	K-series	0.26	0.23	0.33	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	10.05	8.76	22.15	5.83
	Sum:	114.73	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	22.90	21.02	6.17	2.27
Zinc	K-series	20.05	18.40	9.29	0.69
Sulfur	K-series	10.18	9.34	9.62	0.38
Calcium	K-series	10.10	9.27	7.64	0.39
Sodium	K-series	6.89	6.33	9.09	5.45
Titanium	K-series	5.79	5.32	3.67	0.47
Potassium	K-series	2.51	2.30	1.95	0.85
Iron	K-series	1.55	1.42	0.84	0.07
Barium	L-series	1.39	1.28	0.31	0.57
Chlorine	K-series	0.45	0.41	0.39	0.05
Phosphorus	K-series	0.24	0.22	0.23	0.03
Magnesium	K-series	0.14	0.13	0.17	0.07
Silicon	K-series	0.04	0.04	0.05	0.03
Aluminium	K-series	0.03	0.03	0.04	0.05
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	26.68	24.49	50.55	12.53
	Sum:	108.94	100.00	100.00	

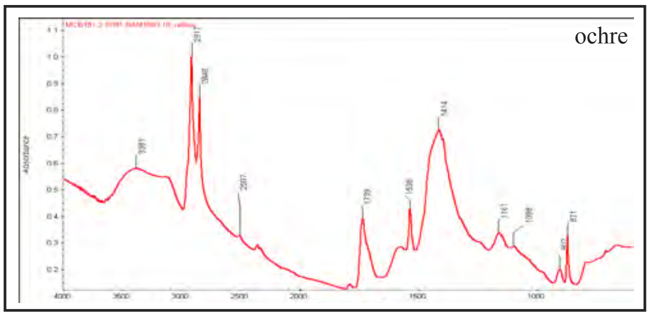




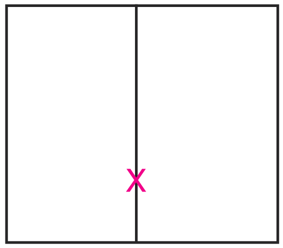
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: ochre

sample location: center join,
26.5" from bottom (B 67.3 x R *?* cm.)

Representative Analysis Compilation—sample C081, continued



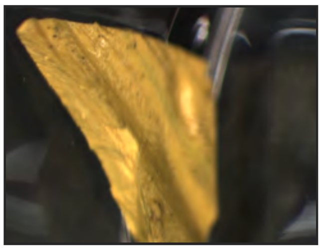
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

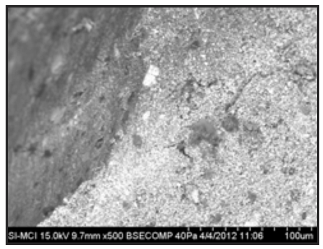


acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: lemon yellow

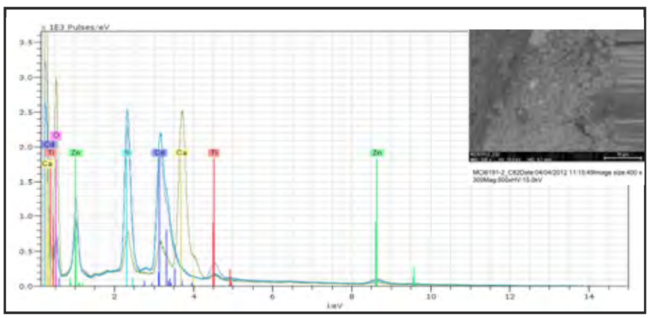
sample location: center join,
26.5" from bottom (B 67.3 x R *?* cm.)

Representative Analysis Compilation—sample C082

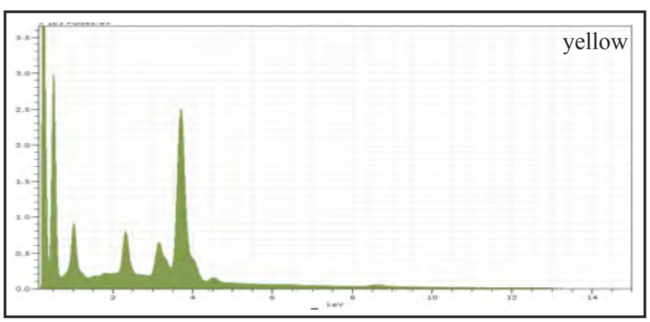




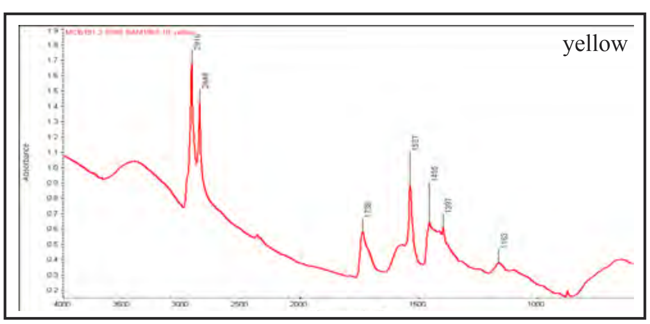
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



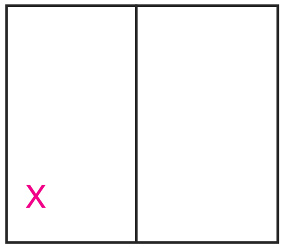
analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Ca, Cd, S
interpretation: cadmium yellow mixed with calcium sulfate

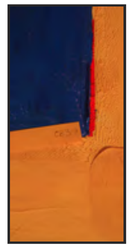


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	24.03	25.92	15.01	0.78
Cadmium	L-series	8.14	8.78	1.81	1.01
Sulfur	K-series	4.08	4.40	3.19	0.17
Zinc	K-series	3.97	4.28	1.52	0.16
Sodium	K-series	2.63	2.83	2.86	2.09
Titanium	K-series	0.73	0.79	0.38	0.11
Magnesium	K-series	0.62	0.66	0.63	0.12
Phosphorus	K-series	0.41	0.45	0.33	0.04
Silicon	K-series	0.38	0.41	0.34	0.04
Chlorine	K-series	0.36	0.38	0.25	0.04
Potassium	K-series	0.33	0.36	0.21	0.25
Aluminium	K-series	0.12	0.12	0.11	0.11
Barium	L-series	0.05	0.05	0.01	0.05
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	46.87	50.56	73.34	17.74
	Sum:	92.71	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation:oil

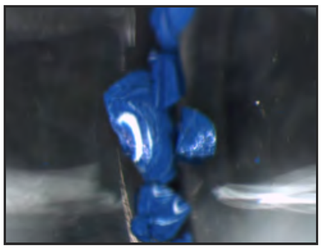


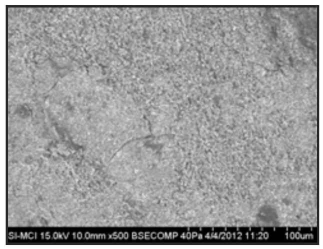


acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: warm blue

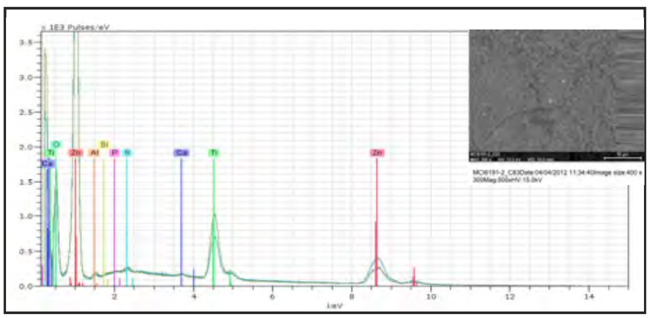
sample location: 16.0" from bottom,
13.5" from left (B 40.6 x L 34.3 cm.)

Representative Analysis Compilation—sample C083

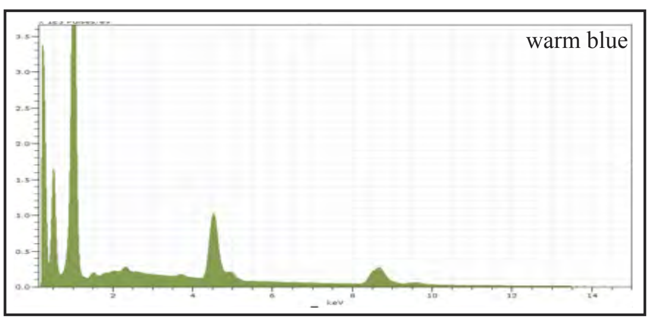




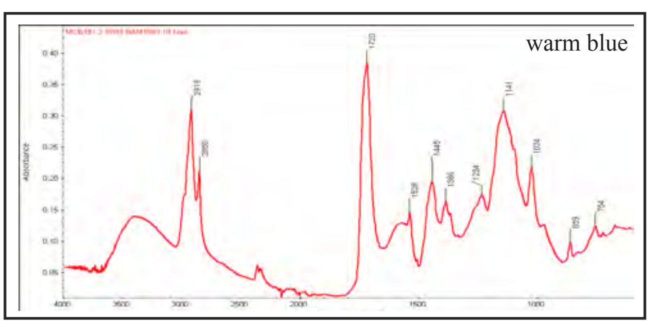
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



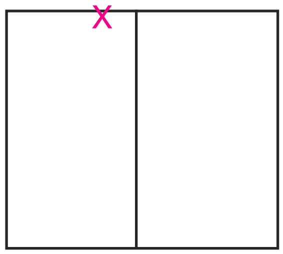
analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na
interpretation: ultramarine blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	37.18	42.72	20.99	1.25
Sodium	K-series	14.50	16.66	23.29	11.44
Titanium	K-series	13.91	15.98	10.72	0.60
Sulfur	K-series	1.04	1.20	1.20	0.06
Phosphorus	K-series	0.67	0.78	0.80	0.05
Chlorine	K-series	0.60	0.69	0.63	0.05
Aluminium	K-series	0.45	0.51	0.61	0.37
Cadmium	L-series	0.37	0.43	0.12	0.12
Calcium	K-series	0.28	0.32	0.26	0.05
Silicon	K-series	0.22	0.25	0.29	0.04
Barium	L-series	0.00	0.00	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	17.80	20.45	41.08	8.37
	Sum:	87.02	100.00	100.00	



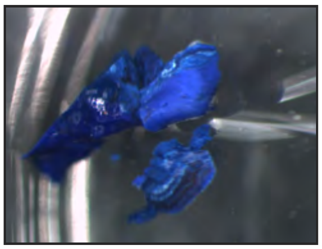
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard
for F10/B67/72 varnish

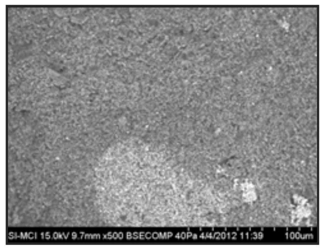


acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: purplish blue, stratigraphy

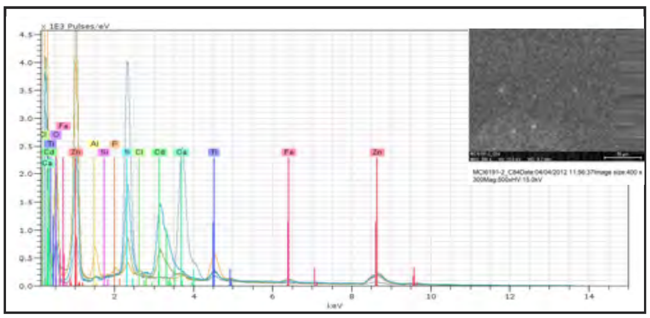
sample location: 0.5" from top,
42.0" from left (T 1.3 x L 106.68 cm.)

Representative Analysis Compilation—sample C084

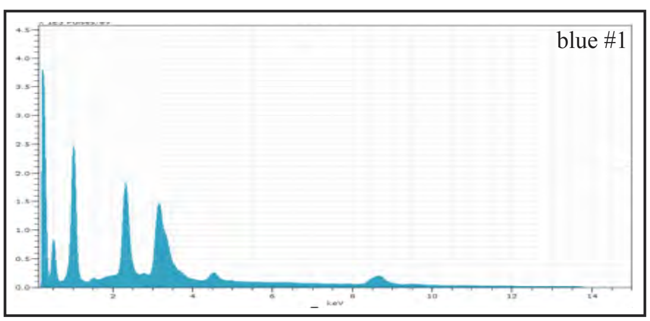




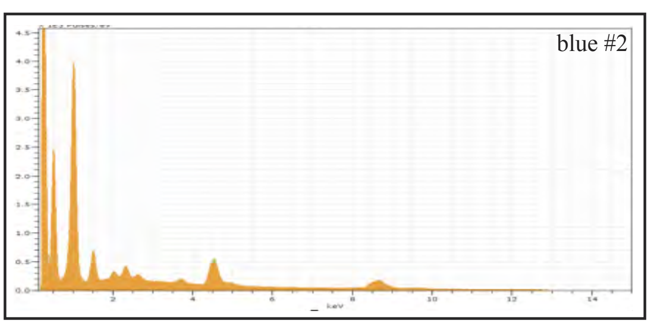
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



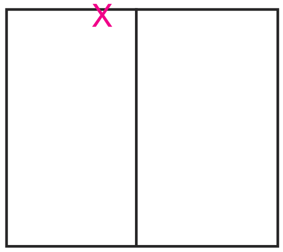
analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, blue #1: Cd, S, Na
significant elements, blue #2: Cu, Cl
interpretation: cadmium red, ultramarine blue, phthalo green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	42.88	33.79	22.34	1.44
Cadmium	L-series	30.38	23.93	9.20	2.75
Sulfur	K-series	15.98	12.59	16.97	0.59
Sodium	K-series	15.97	12.59	23.67	12.60
Potassium	K-series	3.97	3.13	3.46	0.94
Iron	K-series	2.28	1.79	1.39	0.09
Titanium	K-series	2.11	1.66	1.50	0.26
Barium	L-series	1.69	1.33	0.42	0.30
Calcium	K-series	1.10	0.86	0.93	0.16
Chlorine	K-series	0.95	0.74	0.91	0.07
Phosphorus	K-series	0.65	0.51	0.71	0.05
Aluminium	K-series	0.52	0.41	0.66	0.42
Silicon	K-series	0.18	0.14	0.22	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	8.28	6.53	17.63	5.37
	Sum:	126.92	100.00	100.00	



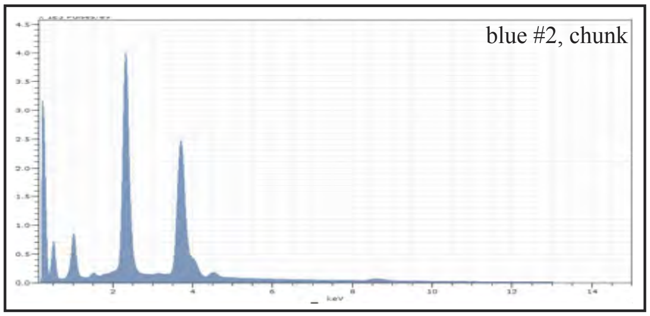
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	36.76	37.33	17.09	1.24
Sodium	K-series	13.81	14.03	18.26	10.90
Titanium	K-series	9.32	9.46	5.91	0.55
Aluminium	K-series	3.20	3.25	3.60	1.56
Copper	K-series	2.91	2.96	1.39	0.13
Sulfur	K-series	1.76	1.78	1.66	0.09
Barium	L-series	1.37	1.39	0.30	0.69
Chlorine	K-series	1.06	1.07	0.91	0.06
Phosphorus	K-series	0.98	1.00	0.97	0.06
Calcium	K-series	0.97	0.98	0.73	0.09
Cadmium	L-series	0.51	0.52	0.14	0.15
Potassium	K-series	0.02	0.02	0.02	0.04
Silicon	K-series	0.01	0.01	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.80	26.20	49.01	10.43
	Sum:	98.47	100.00	100.00	

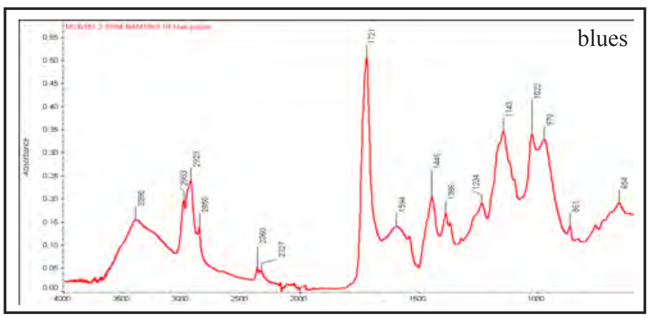
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: purplish blue, stratigraphy

sample location: 0.5" from top,
42.0" from left (T 1.3 x L 106.68 cm.)

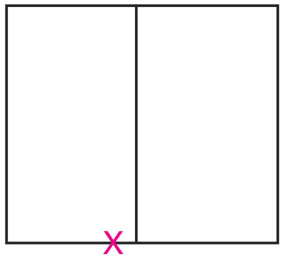
Representative Analysis Compilation—sample C084, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Sulfur	K-series	30.13	31.27	27.27	1.09
Calcium	K-series	27.90	28.96	20.20	0.90
Zinc	K-series	6.36	6.60	2.82	0.24
Sodium	K-series	5.75	5.97	7.26	4.55
Cadmium	L-series	1.22	1.26	0.31	0.32
Titanium	K-series	1.16	1.20	0.70	0.14
Chlorine	K-series	0.92	0.96	0.76	0.06
Aluminium	K-series	0.52	0.54	0.56	0.42
Phosphorus	K-series	0.44	0.46	0.41	0.04
Silicon	K-series	0.10	0.11	0.11	0.03
Magnesium	K-series	0.03	0.03	0.03	0.05
Barium	L-series	0.02	0.02	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	21.81	22.64	39.57	14.61
	Sum:	96.35	100.00	100.00	



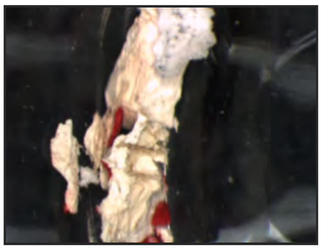
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

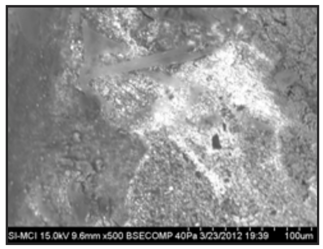


acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: pink and ground layer

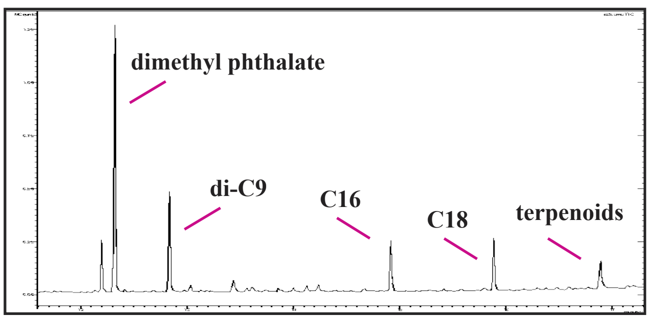
sample location: bottom edge,
49.0" from left (B 0.0 x L 124.5 cm.)

Representative Analysis Compilation—sample C085

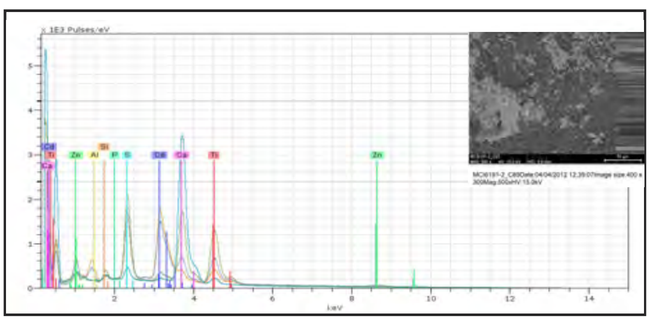




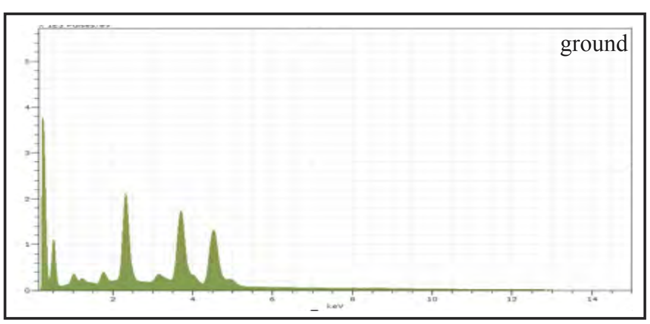
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



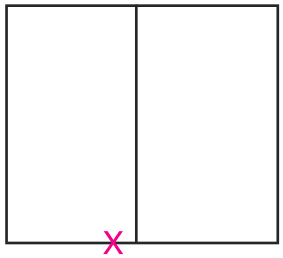
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/04/12
sample weight: 0.154
scan range: 1 - 1485
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18, terpenoids
interpretation: alkyd, oil



analysis: EDS
by: DVR (MCI)
date: 04/04/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ba, Ca
significant elements, red: Cd, S, Se
interpretation: bulked ground, cadmium red



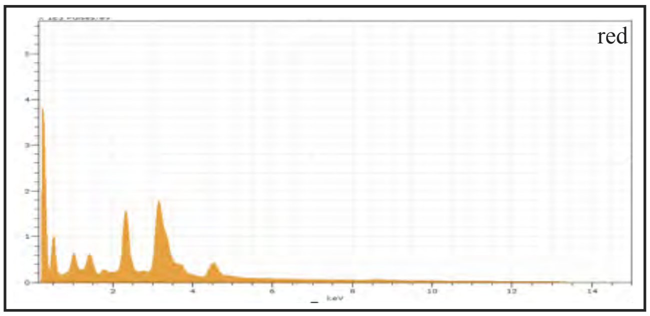
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	137.08	40.48	16.13	4.98
Calcium	K-series	58.63	17.32	23.64	1.91
Zinc	K-series	48.43	14.30	11.97	1.64
Sulfur	K-series	38.12	11.26	19.21	1.37
Cadmium	L-series	20.27	5.99	2.91	2.73
Silicon	K-series	5.92	1.75	3.41	0.27
Chlorine	K-series	4.45	1.31	2.03	0.18
Magnesium	K-series	4.37	1.29	2.91	0.52
Sodium	K-series	2.64	0.78	1.85	2.10
Phosphorus	K-series	2.47	0.73	1.29	0.12
Aluminium	K-series	1.24	0.37	0.74	0.97
Selenium	L-series	1.24	0.37	0.25	0.13
Potassium	K-series	0.40	0.12	0.16	0.29
Oxygen	K-series	13.34	3.94	13.48	1.52
	Sum:	338.61	100.00	100.00	

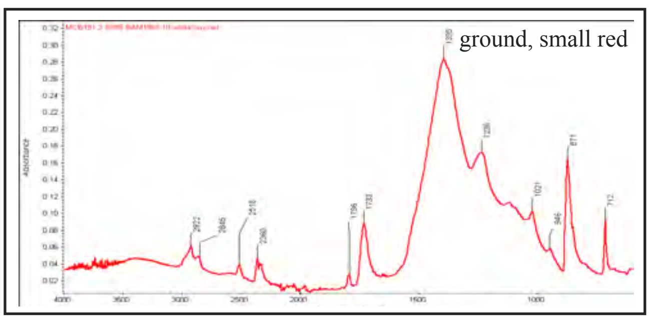
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: pink and ground layer

sample location: bottom edge,
49.0" from left (B 0.0 x L 124.5 cm.)

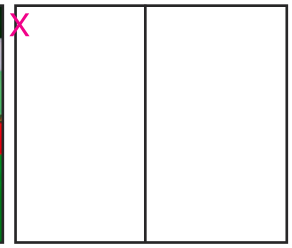
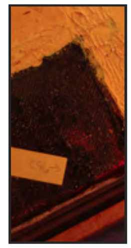
Representative Analysis Compilation—sample C085, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	43.36	31.87	13.87	3.61
Zinc	K-series	22.12	16.26	12.17	0.76
Barium	L-series	18.22	13.39	4.77	1.26
Sulfur	K-series	12.70	9.34	14.25	0.47
Selenium	L-series	6.06	4.45	2.76	0.47
Potassium	K-series	5.24	3.85	4.82	1.27
Calcium	K-series	4.40	3.23	3.94	0.29
Titanium	K-series	3.42	2.51	2.57	0.53
Sodium	K-series	2.54	1.86	3.97	2.02
Aluminium	K-series	1.24	0.91	1.65	0.97
Chlorine	K-series	0.76	0.56	0.77	0.06
Silicon	K-series	0.67	0.49	0.86	0.05
Magnesium	K-series	0.53	0.39	0.79	0.18
Phosphorus	K-series	0.38	0.28	0.44	0.04
Oxygen	K-series	14.40	10.59	32.37	8.68
	Sum:	136.04	100.00	100.00	



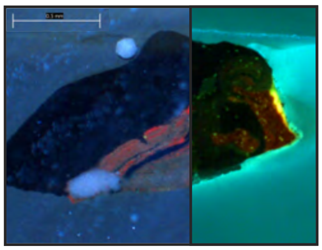
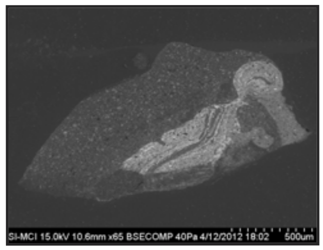
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

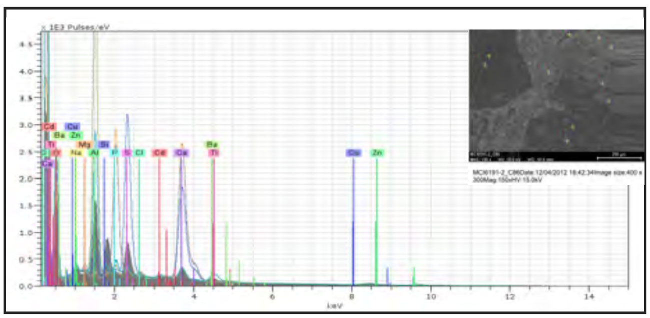
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: black-ish

sample location: 11.0" from top,
1.0" from left (T 27.9 x L 2.5 cm.)

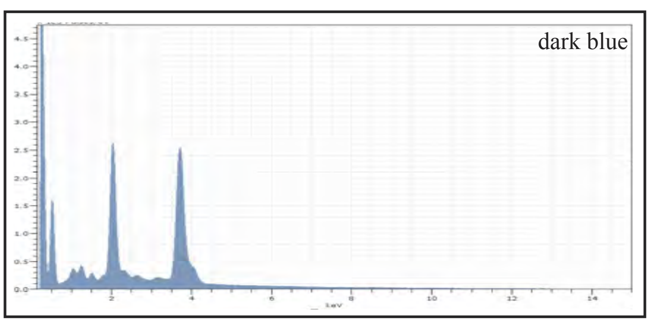
Representative Analysis Compilation—sample C086

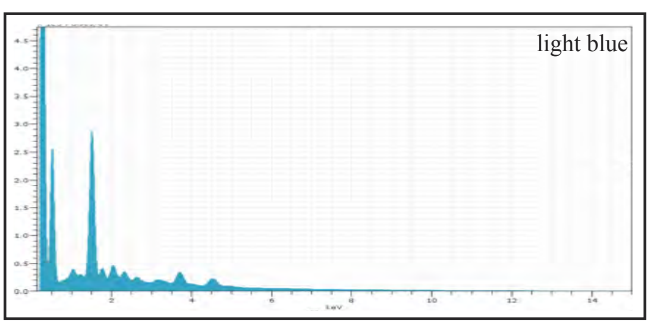
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.6 mm.



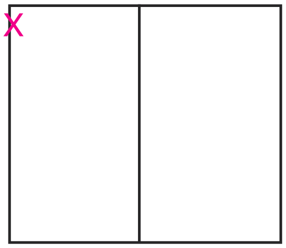
analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 10.6 mm.
mag: 150x; HV: 15 kV
significant elements, dark blue: Ca, P
significant elements, light blue: Cl, Cu
significant elements, red: Ca, Cd
interpretation: bone black, phthalo green,
possible cadmium red

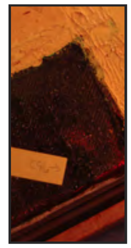


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	22.27	29.61	16.96	0.72
Phosphorus	K-series	13.13	17.45	12.93	0.52
Zinc	K-series	1.23	1.63	0.57	0.07
Sulfur	K-series	1.08	1.43	1.02	0.06
Sodium	K-series	0.81	1.07	1.07	0.66
Cadmium	L-series	0.72	0.95	0.19	0.20
Magnesium	K-series	0.59	0.79	0.75	0.10
Chlorine	K-series	0.55	0.73	0.47	0.04
Aluminium	K-series	0.23	0.30	0.25	0.20
Barium	L-series	0.12	0.15	0.03	0.05
Silicon	K-series	0.05	0.07	0.06	0.03
Potassium	K-series	0.04	0.05	0.03	0.05
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	34.43	45.77	65.66	16.47
	Sum:	75.23	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Aluminium	K-series	6.75	6.75	4.31	0.34
Titanium	K-series	1.53	1.53	0.55	0.16
Calcium	K-series	1.47	1.47	0.63	0.09
Phosphorus	K-series	0.73	0.73	0.41	0.05
Sodium	K-series	0.68	0.68	0.51	0.56
Zinc	K-series	0.60	0.60	0.16	0.05
Cadmium	L-series	0.51	0.51	0.08	0.15
Sulfur	K-series	0.49	0.49	0.26	0.04
Silicon	K-series	0.42	0.42	0.26	0.04
Barium	L-series	0.25	0.25	0.03	0.15
Chlorine	K-series	0.23	0.23	0.11	0.03
Copper	K-series	0.22	0.22	0.06	0.04
Potassium	K-series	0.14	0.14	0.06	0.10
Magnesium	K-series	0.11	0.11	0.08	0.03
Oxygen	K-series	85.85	85.85	92.48	28.02
	Sum:	100.00	100.00	100.00	

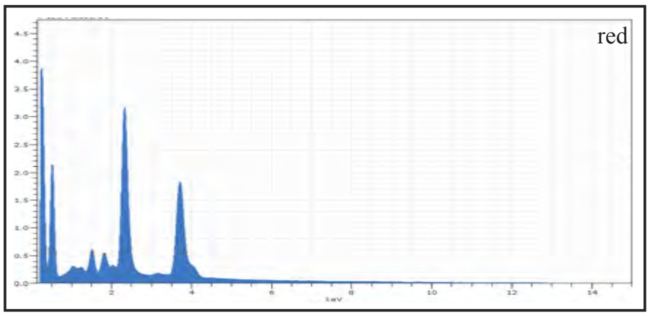




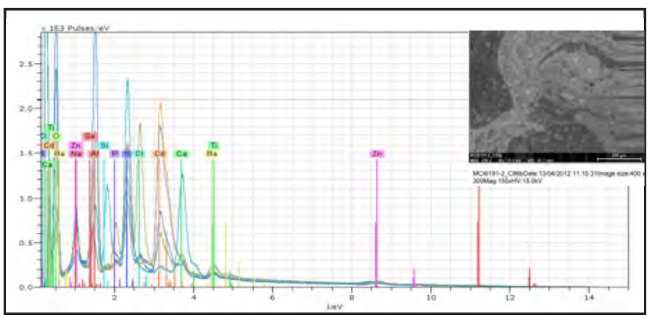
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: black-ish

sample location: 11.0" from top,
1.0" from left (T 27.9 x L 2.5 cm.)

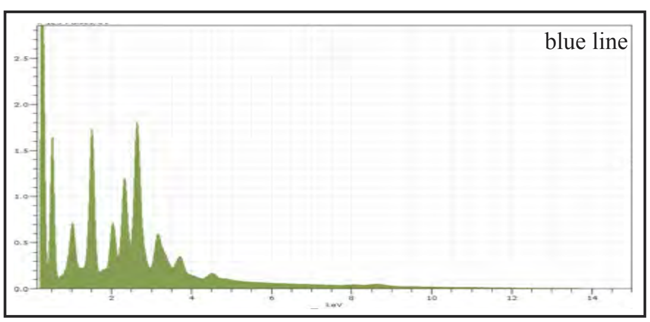
Representative Analysis Compilation—sample C086, continued



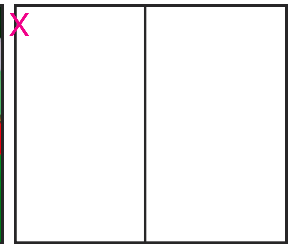
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	14.08	19.11	10.29	0.48
Sulfur	K-series	13.98	18.97	12.77	0.52
Zinc	K-series	1.59	2.16	0.71	0.08
Aluminium	K-series	1.38	1.87	1.49	0.80
Silicon	K-series	1.25	1.69	1.30	0.08
Sodium	K-series	0.78	1.06	1.00	0.64
Phosphorus	K-series	0.68	0.92	0.64	0.05
Cadmium	L-series	0.38	0.52	0.10	0.12
Magnesium	K-series	0.35	0.47	0.42	0.08
Copper	K-series	0.21	0.28	0.09	0.04
Chlorine	K-series	0.20	0.27	0.16	0.03
Titanium	K-series	0.03	0.04	0.02	0.04
Barium	L-series	0.02	0.02	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	38.76	52.61	70.98	16.41
	Sum:	73.68	100.00	100.00	

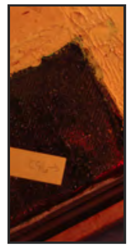


analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.7 mm.
mag: 150x; HV: 15 kV
significant elements, deep red: Ca, Cd
significant elements, blue: Cl, Cu
significant elements, orange: Cd, S
interpretation: cadmium red, phthalo green, cadmium orange



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Chlorine	K-series	6.65	10.20	6.35	0.25
Aluminium	K-series	6.05	9.28	7.59	1.73
Zinc	K-series	4.13	6.34	2.14	0.17
Sulfur	K-series	3.68	5.64	3.88	0.16
Cadmium	L-series	3.14	4.81	0.94	0.56
Phosphorus	K-series	2.12	3.26	2.32	0.11
Copper	K-series	1.39	2.13	0.74	0.07
Calcium	K-series	1.19	1.82	1.00	0.09
Sodium	K-series	0.99	1.51	1.45	0.80
Titanium	K-series	0.71	1.09	0.50	0.11
Potassium	K-series	0.50	0.77	0.43	0.22
Barium	L-series	0.33	0.51	0.08	0.15
Silicon	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	34.31	52.63	72.57	16.35
	Sum:	65.19	100.00	100.00	

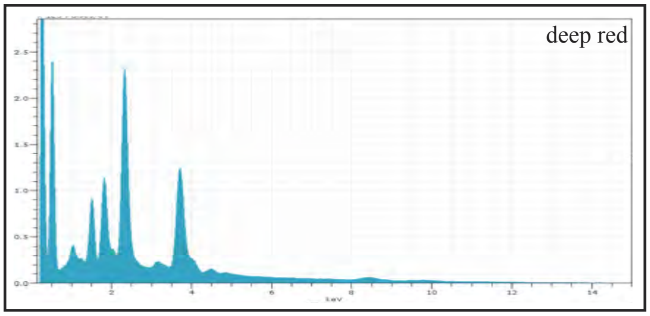




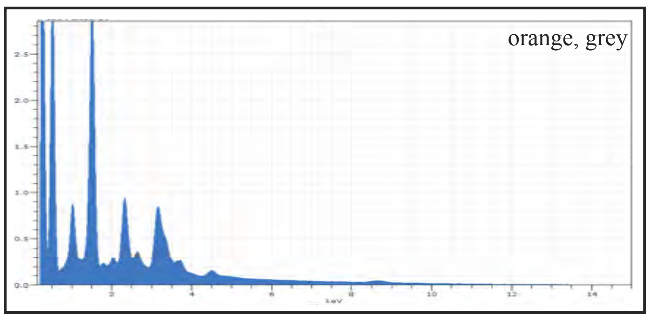
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: black-ish

sample location: 11.0" from top,
1.0" from left (T 27.9 x L 2.5 cm.)

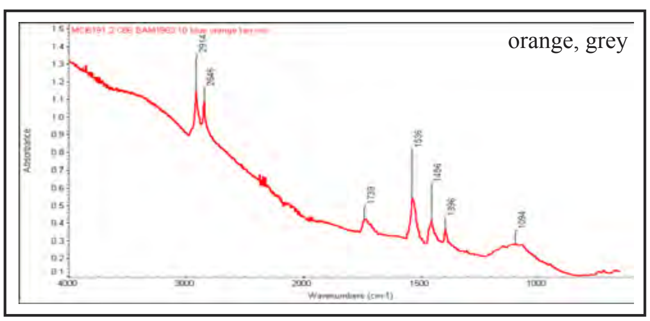
Representative Analysis Compilation—sample C086, continued



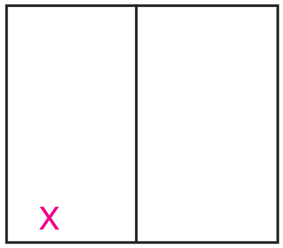
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	12.17	14.04	8.89	0.43
Zinc	K-series	11.33	13.08	5.07	0.41
Sulfur	K-series	10.88	12.56	9.94	0.41
Barium	L-series	3.73	4.31	0.80	0.29
Silicon	K-series	3.61	4.17	3.76	0.18
Copper	K-series	3.06	3.53	1.41	0.13
Aluminium	K-series	2.44	2.81	2.65	1.10
Cadmium	L-series	1.46	1.68	0.38	0.38
Phosphorus	K-series	1.24	1.43	1.17	0.07
Sodium	K-series	1.23	1.42	1.57	0.99
Chlorine	K-series	0.41	0.47	0.34	0.04
Magnesium	K-series	0.19	0.21	0.22	0.06
Potassium	K-series	0.08	0.09	0.06	0.08
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	34.83	40.19	63.74	14.02
	Sum:	86.66	100.00	100.00	

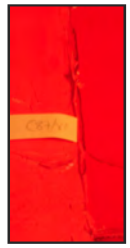


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	12.79	13.58	11.76	2.72
Cadmium	L-series	11.59	12.30	2.56	1.39
Zinc	K-series	6.10	6.48	2.31	0.24
Sulfur	K-series	4.10	4.35	3.17	0.17
Barium	L-series	3.55	3.77	0.64	0.28
Sodium	K-series	2.07	2.20	2.23	1.65
Copper	K-series	1.66	1.77	0.65	0.09
Calcium	K-series	1.53	1.62	0.94	0.13
Potassium	K-series	1.46	1.55	0.92	0.52
Chlorine	K-series	1.36	1.44	0.95	0.07
Phosphorus	K-series	0.42	0.44	0.33	0.04
Magnesium	K-series	0.23	0.25	0.24	0.07
Silicon	K-series	0.08	0.08	0.07	0.03
Titanium	K-series	0.06	0.06	0.03	0.06
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	47.19	50.11	73.18	17.22
	Sum:	94.18	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference,
zinc soaps

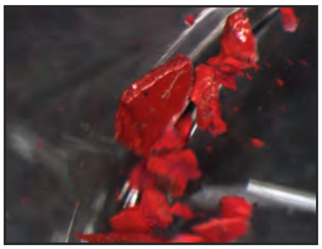
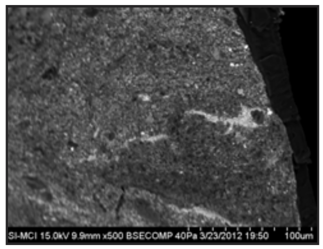





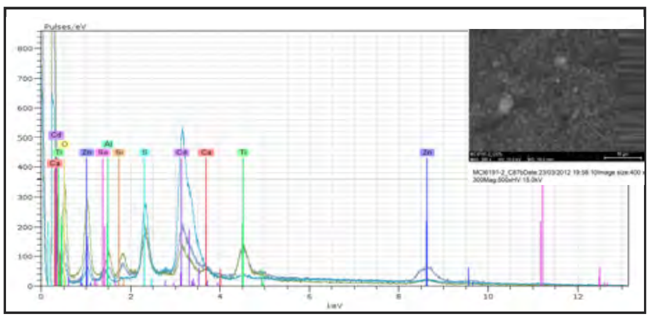
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: standard red

sample location: 7.0" from bottom,
17.5" from left (B 17.8 x L 44.5 cm.)

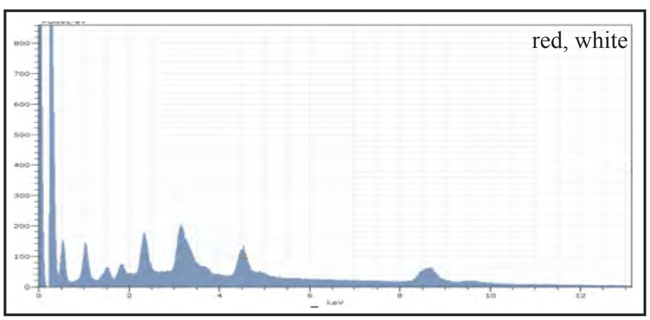
Representative Analysis Compilation—sample C087

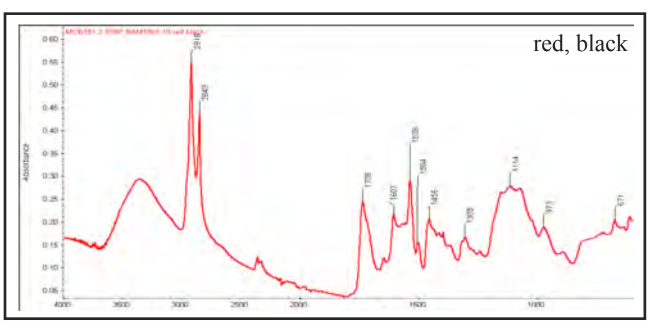
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



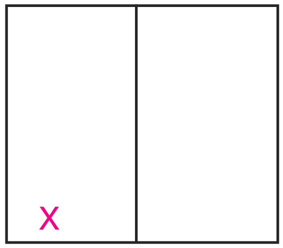
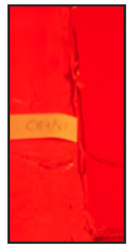
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S
significant elements, white: Zn, Ti
interpretation: cadmium red, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	36.17	40.50	26.66	1.24
Cadmium	L-series	17.18	19.23	7.36	3.47
Sulfur	K-series	6.73	7.54	10.12	0.27
Sodium	K-series	5.73	6.42	12.02	4.54
Titanium	K-series	5.61	6.29	5.65	0.59
Silicon	K-series	2.49	2.79	4.28	0.14
Aluminium	K-series	2.34	2.62	4.19	1.81
Potassium	K-series	1.37	1.53	1.69	0.95
Calcium	K-series	1.26	1.41	1.51	0.20
Phosphorus	K-series	1.11	1.24	1.73	0.07
Chlorine	K-series	0.92	1.03	1.25	0.08
Barium	L-series	0.65	0.73	0.23	0.34
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	7.74	8.66	23.31	10.31
	Sum:	89.31	100.00	100.00	



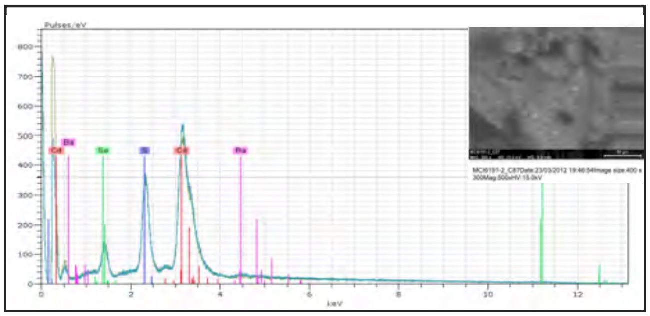
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

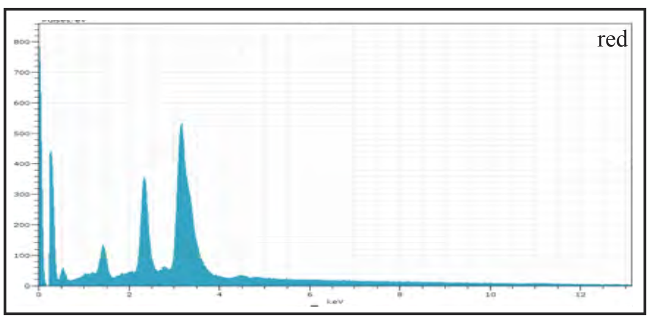
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: standard red

sample location: 7.0" from bottom,
17.5" from left (B 17.8 x L 44.5 cm.)

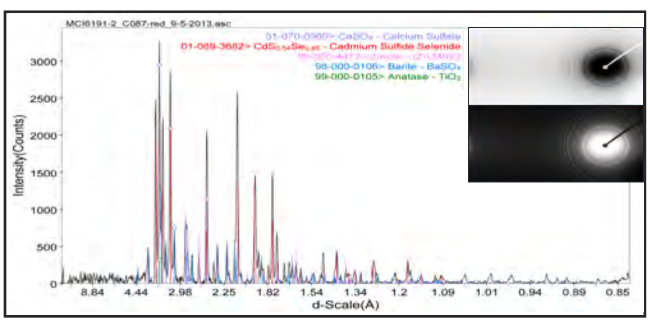
Representative Analysis Compilation—sample C087, continued



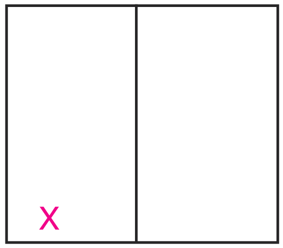
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se, Zn
interpretation: cadmium red mixed with zinc white

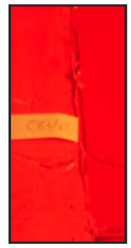


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	67.03	50.50	27.21	8.88
Sulfur	K-series	17.84	13.44	25.39	0.66
Zinc	K-series	15.95	12.02	11.13	0.60
Selenium	L-series	8.30	6.25	4.80	0.61
Potassium	K-series	7.65	5.77	8.93	3.26
Barium	L-series	7.20	5.43	2.39	0.66
Chlorine	K-series	1.02	0.77	1.31	0.10
Phosphorus	K-series	0.88	0.66	1.29	0.06
Sodium	K-series	0.78	0.58	1.54	0.64
Calcium	K-series	0.52	0.39	0.59	0.37
Silicon	K-series	0.21	0.16	0.34	0.04
Aluminium	K-series	0.19	0.14	0.32	0.17
Magnesium	K-series	0.01	0.01	0.02	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	5.17	3.90	14.75	8.40
	Sum:	132.74	100.00	100.00	



analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-90º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: calcium sulfate, cadmium sulfide selenide, zincite, barite, anatase titanium
interpretation: cadmium red

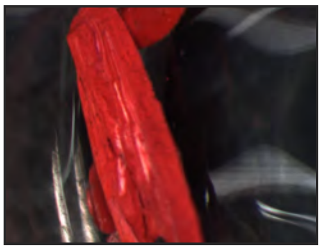


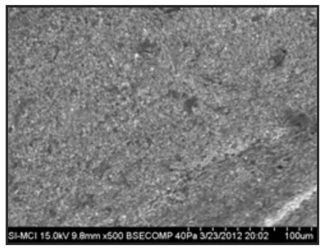


acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: warm red

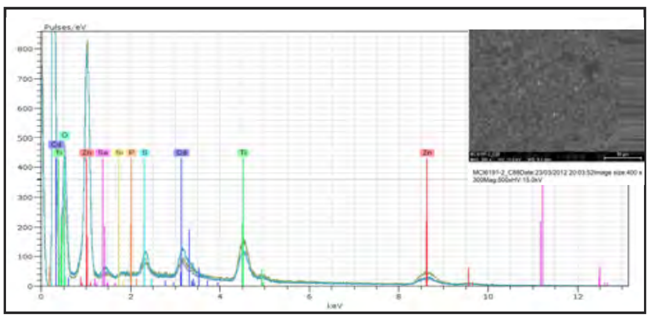
sample location: 7.0" from bottom,
17.5" from left (B 17.8 x L 44.5 cm.)

Representative Analysis Compilation—sample C088

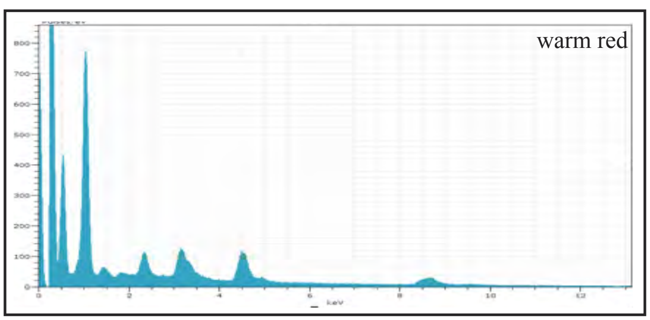




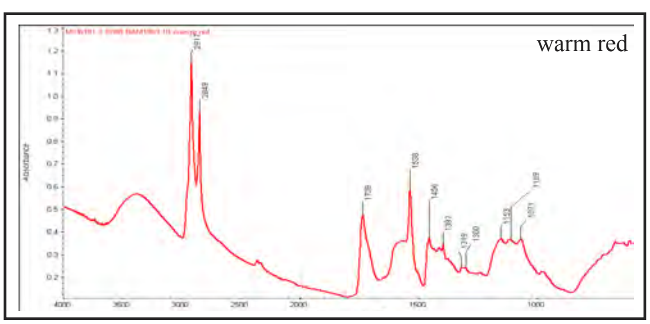
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



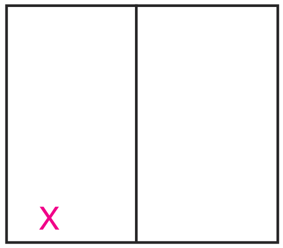
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, warm red: Cd, S, Se, Ti
interpretation: cadmium red mixed with
titanium white

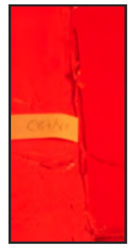


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	39.26	35.02	18.21	1.38
Cadmium	L-series	11.66	10.40	3.15	2.87
Sodium	K-series	11.62	10.37	15.33	9.17
Titanium	K-series	10.29	9.18	6.52	1.20
Barium	L-series	5.59	4.99	1.23	1.48
Sulfur	K-series	3.42	3.05	3.24	0.15
Selenium	L-series	1.49	1.33	0.57	0.15
Potassium	K-series	1.11	0.99	0.86	0.78
Aluminium	K-series	0.45	0.40	0.50	0.37
Silicon	K-series	0.34	0.30	0.37	0.04
Phosphorus	K-series	0.34	0.30	0.33	0.04
Calcium	K-series	0.28	0.25	0.21	0.16
Chlorine	K-series	0.24	0.22	0.21	0.05
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.99	23.19	49.27	21.85
	Sum:	112.08	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

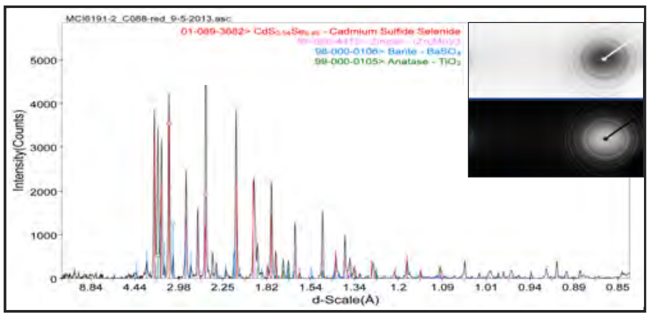




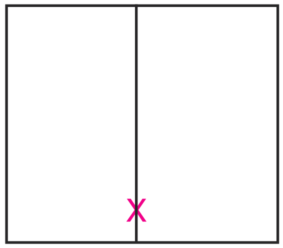
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: warm red

sample location: 7.0" from bottom,
17.5" from left (B 17.8 x L 44.5 cm.)

Representative Analysis Compilation—sample C088, continued



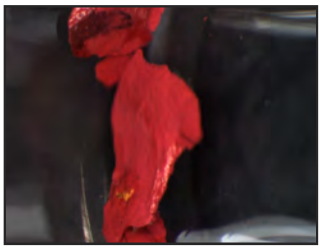
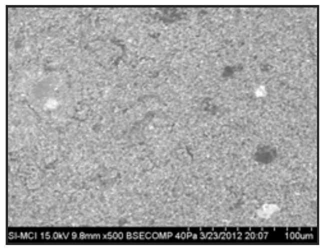
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-120º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide,
zincite, barite, anatase titanium
interpretation : cadmium red

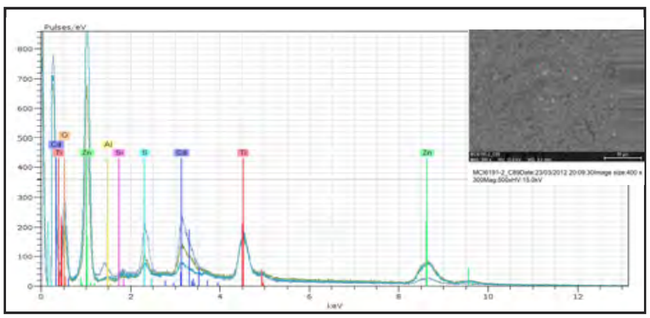
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: pink

sample location: center join,
10.0" from bottom (B 25.4 x R *?* cm.)

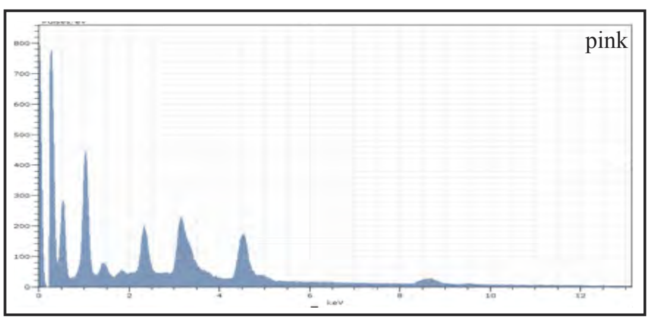
Representative Analysis Compilation—sample C089

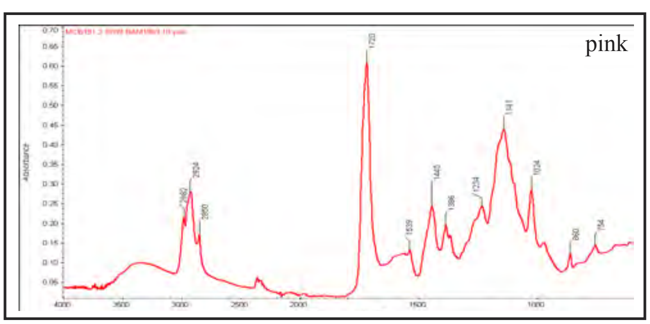
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



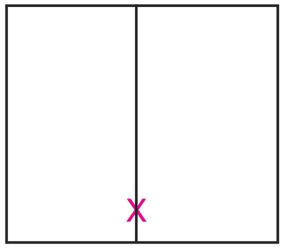
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, pink: Cd, S, Zn, Ti
interpretation: cadmium red and Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	39.70	29.22	19.14	1.39
Cadmium	L-series	24.71	18.19	6.93	4.83
Titanium	K-series	14.51	10.68	9.55	1.66
Barium	L-series	13.64	10.04	3.13	1.96
Sodium	K-series	10.84	7.98	14.86	8.56
Sulfur	K-series	7.16	5.27	7.04	0.28
Potassium	K-series	2.48	1.82	2.00	1.61
Selenium	L-series	2.17	1.59	0.86	0.20
Calcium	K-series	1.75	1.29	1.38	0.31
Chlorine	K-series	0.66	0.49	0.59	0.07
Aluminium	K-series	0.58	0.43	0.68	0.47
Phosphorus	K-series	0.54	0.40	0.55	0.05
Silicon	K-series	0.48	0.35	0.54	0.05
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	16.63	12.24	32.77	16.17
	Sum:	135.85	100.00	100.00	



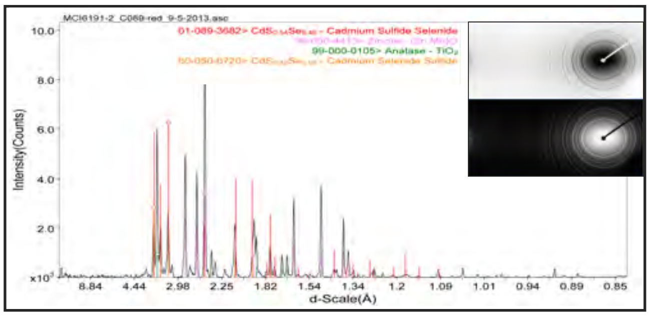
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard
for F10/B67/72 varnish

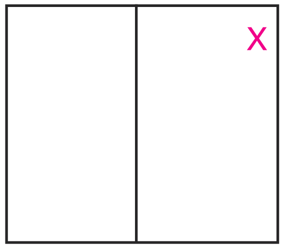

acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: pink

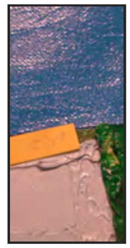
sample location: center join,
10.0" from bottom (B 25.4 x R *?* cm.)

Representative Analysis Compilation—sample C089, continued



analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-90º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, zincite, anatase titanium, cadmium selenide sulfide
interpretation: cadmium red

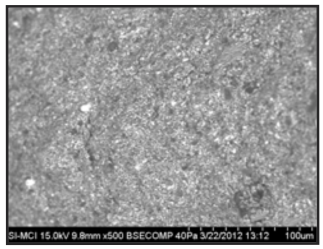




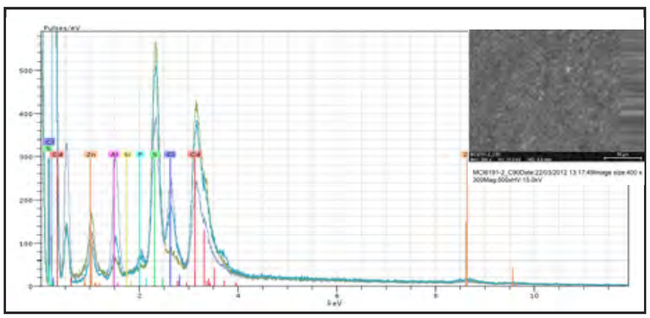
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: deep green

sample location: 14.0" from top,
7.0" from right (T 35.6 x R 17.8 cm.)

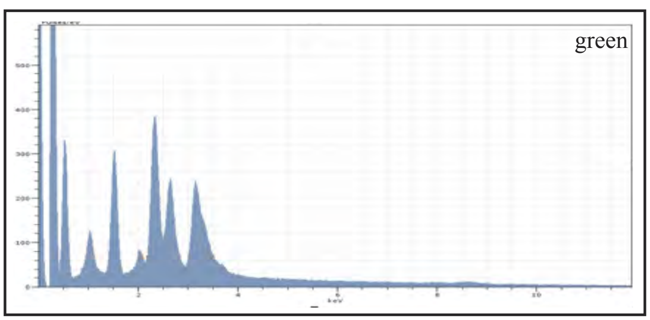
Representative Analysis Compilation—sample C090



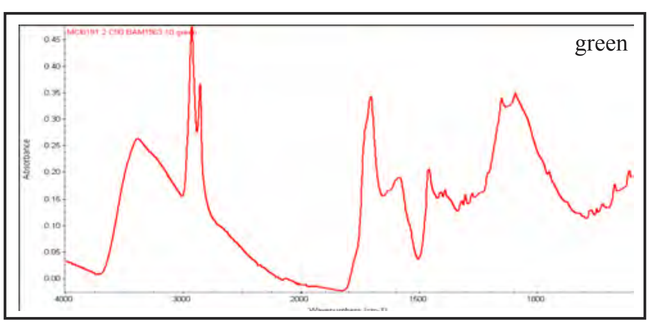
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



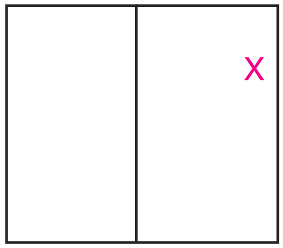
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cd, S, Na, Zn, Cl
interpretation: cadmium green, phthalo green

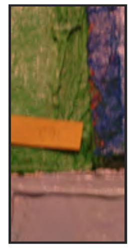


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	19.20	22.33	5.69	3.81
Sulfur	K-series	12.24	14.24	12.71	0.46
Aluminium	K-series	11.08	12.89	13.67	7.19
Chlorine	K-series	8.74	10.17	8.21	0.32
Zinc	K-series	4.38	5.09	2.23	0.20
Potassium	K-series	2.02	2.35	1.72	1.35
Phosphorus	K-series	1.59	1.85	1.71	0.09
Sodium	K-series	1.48	1.72	2.14	1.19
Calcium	K-series	0.28	0.33	0.24	0.18
Magnesium	K-series	0.22	0.26	0.30	0.16
Barium	L-series	0.04	0.05	0.01	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	24.69	28.72	51.38	3.04
	Sum:	85.95	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 01/30/13
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

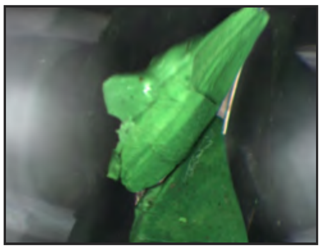


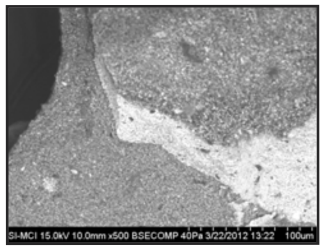


acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: yellow green

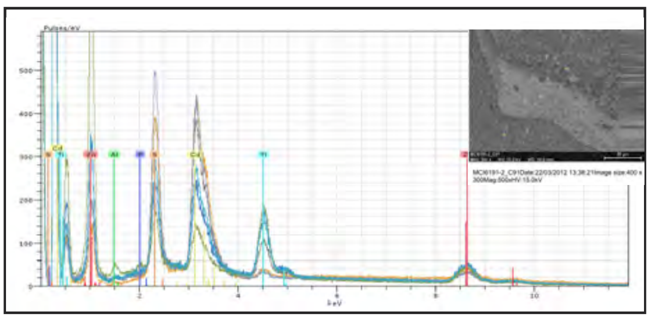
sample location: 22.5" from top,
7.5" from right (T 57.2 x R 19.1 cm.)

Representative Analysis Compilation—sample C091

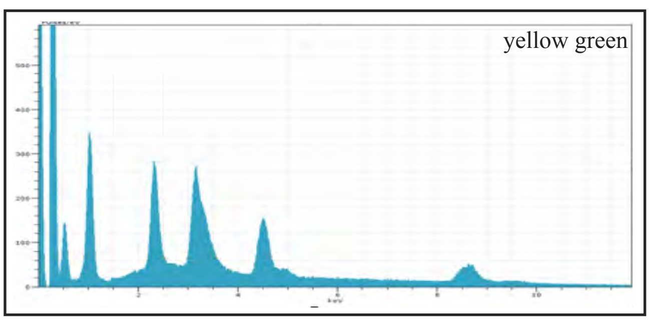




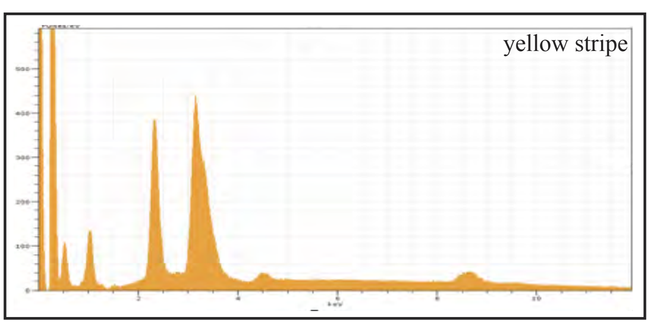
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



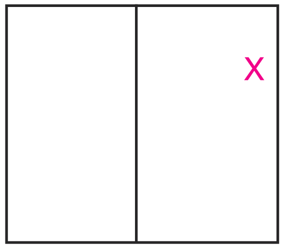
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, yellow green: Zn, Cd, S, Na, Cu, Cl
significant elements, yellow stripe: Cd, S
interpretation: phthalo green, cadmium green, cadmium yellow

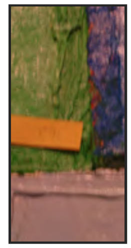


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	38.49	25.63	16.33	1.33
Sodium	K-series	33.07	22.02	39.91	26.05
Cadmium	L-series	32.66	21.75	8.06	5.70
Sulfur	K-series	15.09	10.05	13.06	0.56
Titanium	K-series	10.89	7.25	6.31	1.23
Barium	L-series	4.07	2.71	0.82	1.50
Copper	K-series	3.24	2.16	1.42	0.16
Potassium	K-series	2.95	1.96	2.09	2.01
Chlorine	K-series	2.00	1.33	1.57	0.12
Phosphorus	K-series	1.09	0.73	0.98	0.08
Calcium	K-series	1.00	0.67	0.69	0.30
Magnesium	K-series	0.55	0.37	0.63	0.36
Silicon	K-series	0.51	0.34	0.50	0.06
Aluminium	K-series	0.41	0.27	0.42	0.34
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	4.16	2.77	7.21	5.73
	Sum:	150.18	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	72.36	44.60	17.48	11.22
Sulfur	K-series	35.70	22.00	30.24	1.29
Sodium	K-series	13.95	8.60	16.48	11.01
Potassium	K-series	11.36	7.00	7.89	3.99
Zinc	K-series	9.84	6.07	4.09	0.37
Magnesium	K-series	2.11	1.30	2.36	1.16
Chlorine	K-series	1.62	1.00	1.24	0.14
Titanium	K-series	1.44	0.89	0.82	0.31
Barium	L-series	1.41	0.87	0.28	0.54
Aluminium	K-series	1.25	0.77	1.26	0.98
Phosphorus	K-series	0.96	0.59	0.84	0.08
Silicon	K-series	0.45	0.28	0.44	0.06
Calcium	K-series	0.02	0.01	0.02	0.04
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	9.76	6.01	16.56	14.79
	Sum:	162.25	100.00	100.00	

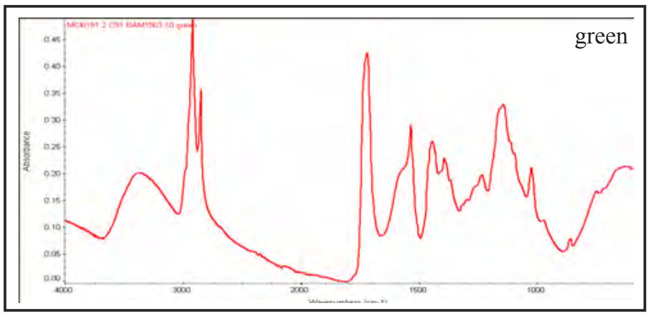




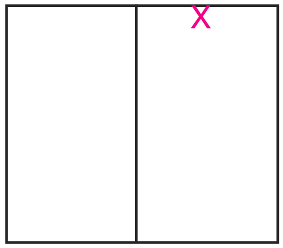
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: yellow green

sample location: 22.5" from top,
7.5" from right (T 57.2 x R 19.1 cm.)

Representative Analysis Compilation—sample C091, continued



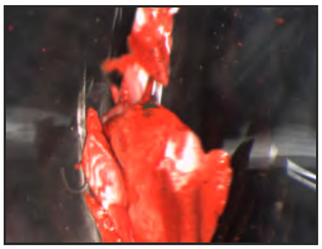
analysis: ATR-FTIR
by: DVR (MCI)
date: 01/30/13
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

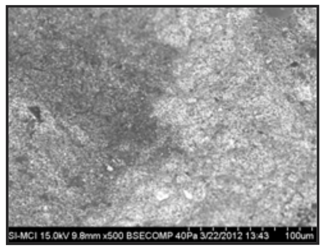


acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: medium orange

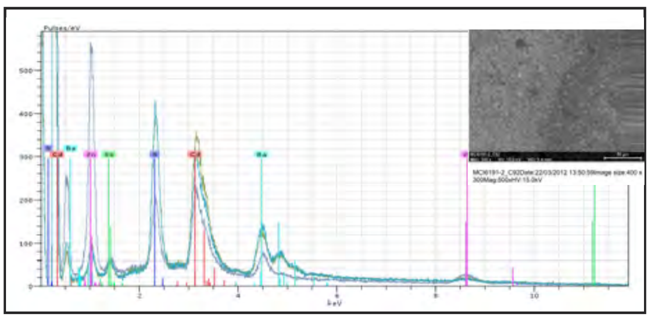
sample location: 3.0" from top,
36.0" from right (T 7.6 x R 91.4 cm.)

Representative Analysis Compilation—sample C092

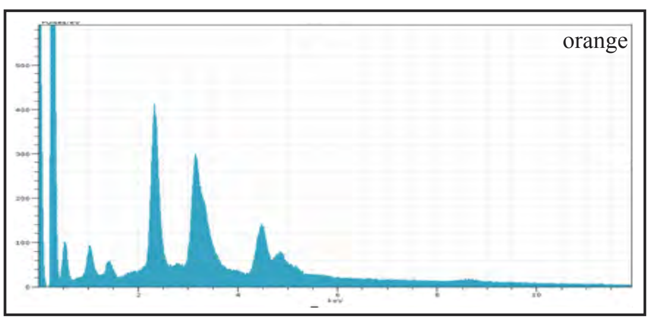




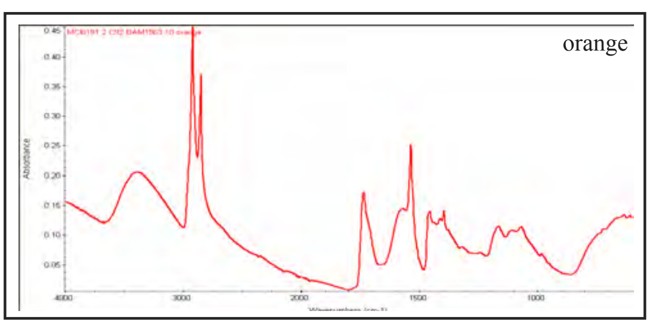
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



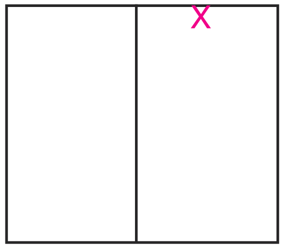
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se, Zn, Ba
interpretation: cadmium orange mixed with
zinc white and barium sulfate



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	27.47	27.51	12.03	5.00
Sulfur	K-series	18.92	18.95	29.05	0.70
Barium	L-series	18.47	18.50	6.62	1.41
Zinc	K-series	10.90	10.91	8.20	0.42
Selenium	L-series	5.45	5.46	3.40	0.46
Sodium	K-series	4.38	4.38	9.37	3.47
Potassium	K-series	3.29	3.30	4.15	1.77
Titanium	K-series	1.70	1.70	1.75	0.70
Chlorine	K-series	0.70	0.70	0.97	0.08
Phosphorus	K-series	0.61	0.62	0.98	0.06
Silicon	K-series	0.43	0.43	0.75	0.05
Aluminium	K-series	0.28	0.28	0.51	0.24
Magnesium	K-series	0.07	0.07	0.14	0.08
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	7.18	7.19	22.09	11.59
	Sum:	99.85	100.00	100.00	



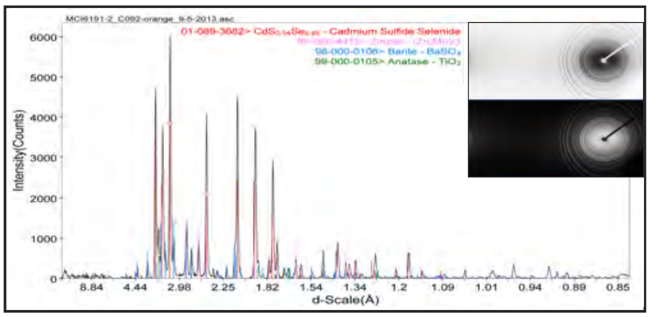
analysis: ATR-FTIR
by: DVR (MCI)
date: 01/30/13
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

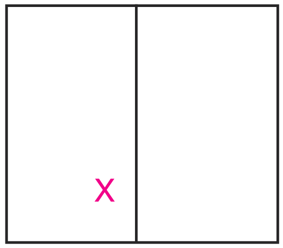
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: medium orange

sample location: 3.0" from top,
36.0" from right (T 7.6 x R 91.4 cm.)

Representative Analysis Compilation—sample C092, continued



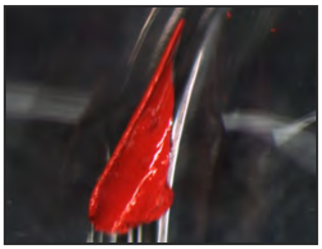
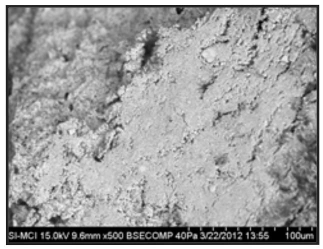
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-90º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, zincite, barite, anatase titanium
note: a polymorph match to other cadmium red pigments

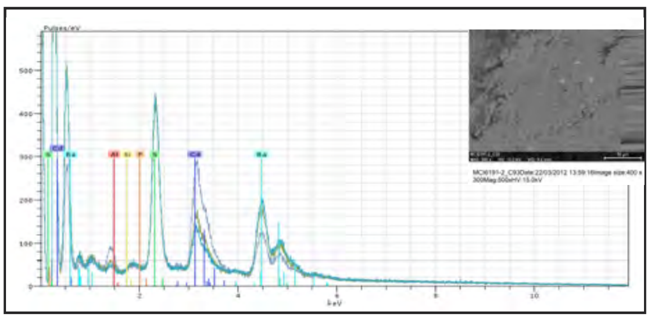
acc. no.: BAM 1963.10
title, year: *Combinable Wall I and II*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.5 x 112.5" (214.6 x 285.8 cm.)
notes: dark orange

sample location: 33.5" from bottom, 39.0" from right (B 85.1 x R 99.1 cm.)

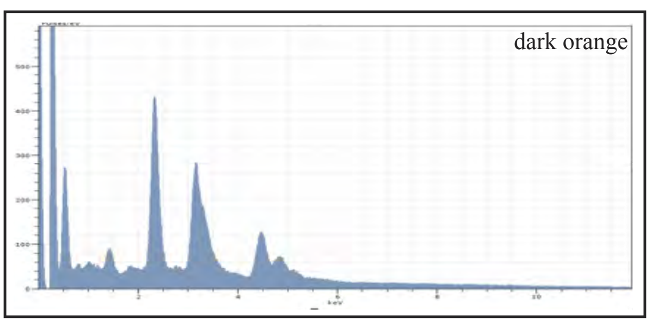
Representative Analysis Compilation—sample C093

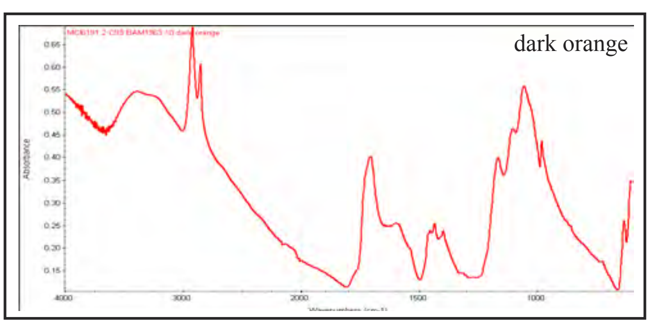
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



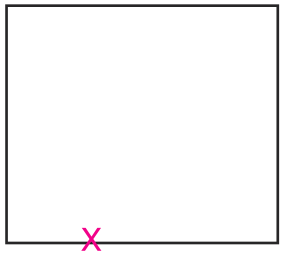
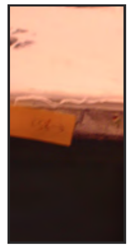
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, dark orange: Cd, S, Se, Zn, Ba
interpretation: cadmium orange mixed with higher barium sulfate



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	26.31	27.22	9.62	4.80
Barium	L-series	20.08	20.77	6.01	1.53
Sulfur	K-series	17.00	17.59	21.80	0.63
Zinc	K-series	4.23	4.38	2.66	0.20
Potassium	K-series	2.84	2.94	2.99	1.71
Selenium	L-series	2.51	2.60	1.31	0.22
Titanium	K-series	1.57	1.63	1.35	0.71
Silicon	K-series	0.67	0.69	0.98	0.06
Phosphorus	K-series	0.63	0.66	0.84	0.06
Chlorine	K-series	0.41	0.43	0.48	0.06
Sodium	K-series	0.41	0.43	0.74	0.35
Aluminium	K-series	0.12	0.12	0.18	0.11
Calcium	K-series	0.01	0.01	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	19.85	20.54	51.02	22.17
	Sum:	96.66	100.00	100.00	



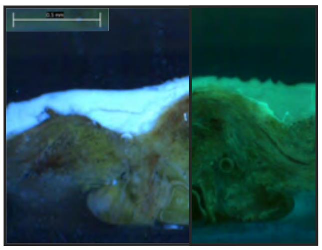
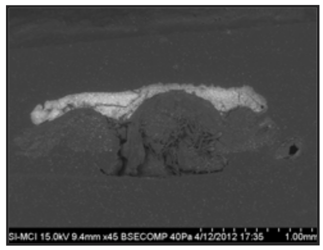
analysis: ATR-FTIR
by: DVR (MCI)
date: 01/30/13
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

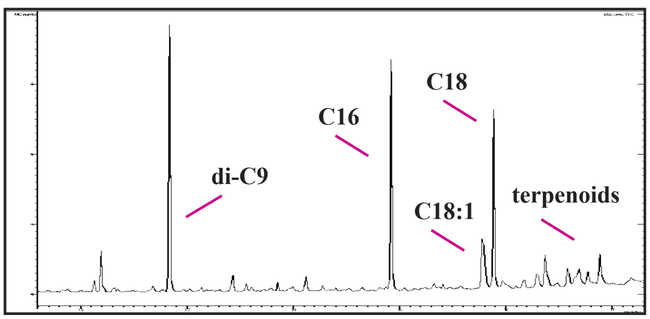
acc. no.: BAM 1963.6
title, year: *Tormented Bull*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 84.3" (152.7 x 214.1 cm.)
notes: fibers and ground layer

sample location: bottom edge,
25.0" from left (B 0.0 x L 63.5 cm.)

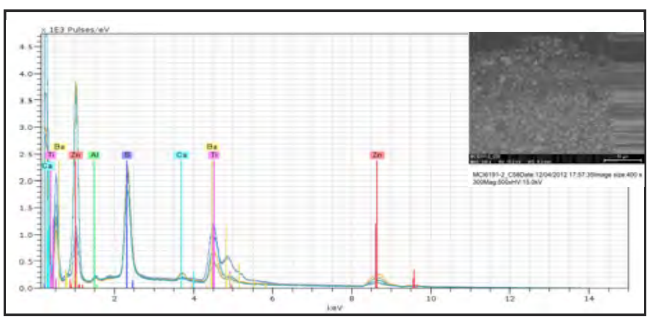
Representative Analysis Compilation—sample C058

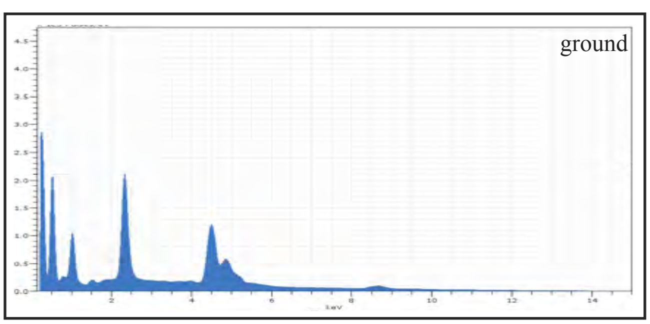
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.4 mm.



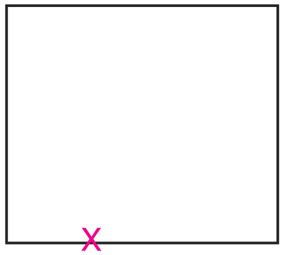
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/04/12
sample weight: 0.205
scan range: 1 - 1487
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, terpenoids
interpretation: oil

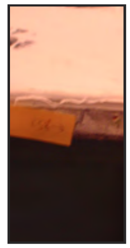


analysis: EDS
by: DVR (MCI)
date: 04/12/12
working distance: 9.3 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ba, S, Zn
significant elements, white: Zn, Ti
interpretation: bulked zinc ground, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	28.72	28.95	6.88	1.76
Sulfur	K-series	15.38	15.50	15.77	0.57
Zinc	K-series	14.12	14.23	7.10	0.50
Sodium	K-series	5.64	5.68	8.06	4.46
Titanium	K-series	5.24	5.28	3.60	0.65
Chlorine	K-series	1.19	1.20	1.10	0.07
Aluminium	K-series	0.61	0.61	0.74	0.05
Phosphorus	K-series	0.57	0.57	0.60	0.05
Silicon	K-series	0.45	0.46	0.53	0.05
Potassium	K-series	0.29	0.29	0.24	0.04
Calcium	K-series	0.11	0.11	0.09	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	26.91	27.12	55.30	11.61
	Sum:	99.23	100.00	100.00	

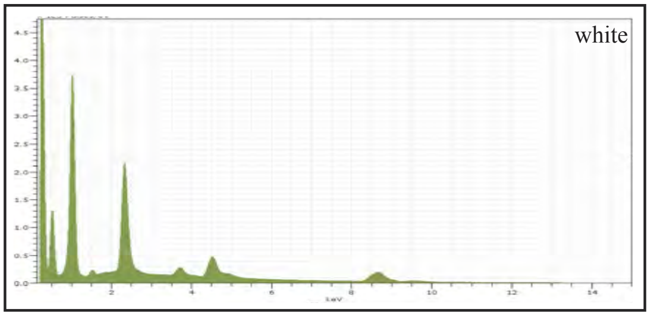




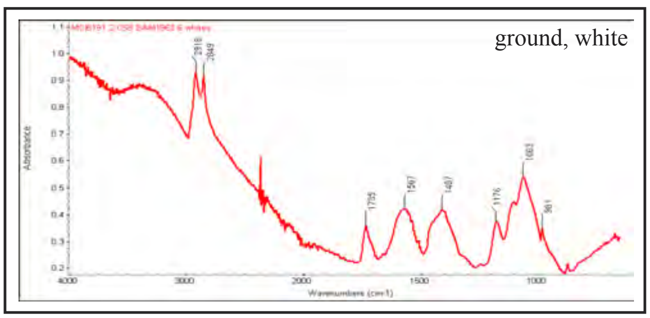
acc. no.: BAM 1963.6
title, year: *Tormented Bull*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 84.3" (152.7 x 214.1 cm.)
notes: fibers and ground layer

sample location: bottom edge,
25.0" from left (B 0.0 x L 63.5 cm.)

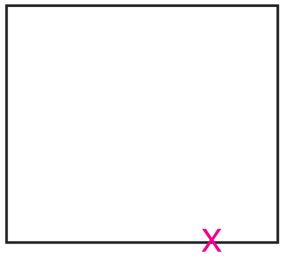
Representative Analysis Compilation—sample C058, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	26.10	33.06	15.09	0.89
Sodium	K-series	15.48	19.60	25.45	12.20
Sulfur	K-series	13.07	16.55	15.41	0.49
Titanium	K-series	5.28	6.69	4.17	0.34
Calcium	K-series	1.18	1.50	1.12	0.09
Chlorine	K-series	0.77	0.98	0.83	0.05
Barium	L-series	0.65	0.82	0.18	0.34
Aluminium	K-series	0.52	0.66	0.73	0.42
Phosphorus	K-series	0.24	0.31	0.29	0.04
Silicon	K-series	0.17	0.21	0.23	0.03
Cadmium	L-series	0.05	0.07	0.02	0.04
Potassium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	15.44	19.55	36.48	8.07
	Sum:	78.96	100.00	100.00	



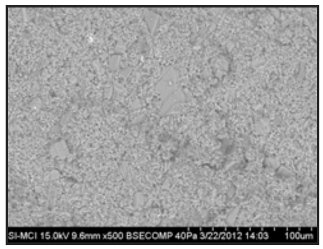
analysis: µFTIR
by: DVR (MCI)
date: 01/16/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: fillers



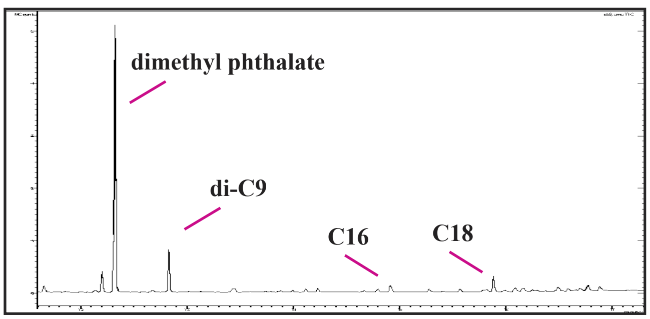
acc. no.: BAM 1963.6
title, year: *Tormented Bull*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 84.3" (152.7 x 214.1 cm.)
notes: upper white layer

sample location: bottom edge,
18.0" from right (B 0.0 x R 45.7 cm.)

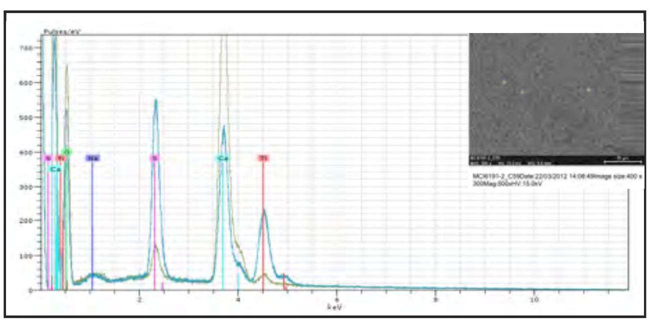
Representative Analysis Compilation—sample C059



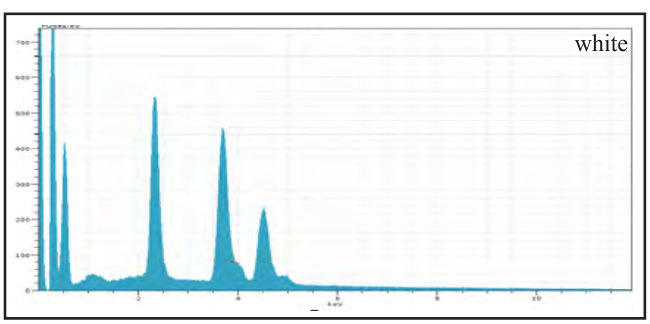
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



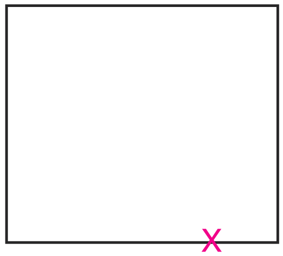
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/04/12
sample weight: 0.188
scan range: 1 - 1489
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, white: Ti
interpretation: titanium white



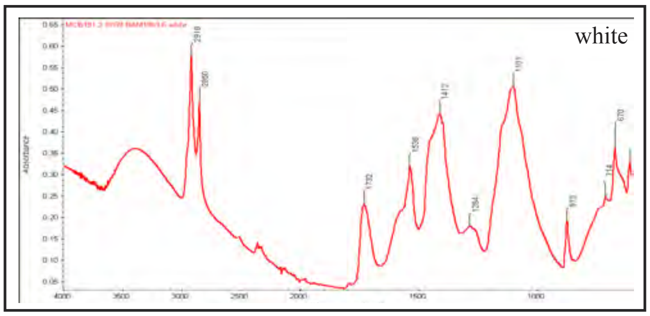
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	23.70	22.23	15.16	0.74
Titanium	K-series	19.97	18.73	10.70	1.75
Sulfur	K-series	19.30	18.10	15.43	0.71
Zinc	K-series	3.63	3.40	1.42	0.19
Barium	L-series	3.49	3.27	0.65	1.72
Sodium	K-series	0.82	0.77	0.91	0.67
Magnesium	K-series	0.60	0.56	0.63	0.07
Silicon	K-series	0.47	0.44	0.42	0.05
Chlorine	K-series	0.44	0.42	0.32	0.05
Phosphorus	K-series	0.39	0.36	0.32	0.05
Aluminium	K-series	0.16	0.15	0.16	0.04
Potassium	K-series	0.08	0.08	0.05	0.03
Oxygen	K-series	33.58	31.49	53.82	28.06
	Sum:	106.62	100.00	100.00	



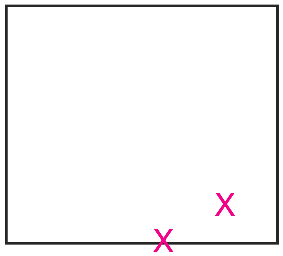
acc. no.: BAM 1963.6
title, year: *Tormented Bull*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 84.3" (152.7 x 214.1 cm.)
notes: upper white layer

sample location: bottom edge,
18.0" from right (B 0.0 x R 45.7 cm.)

Representative Analysis Compilation—sample C059, continued



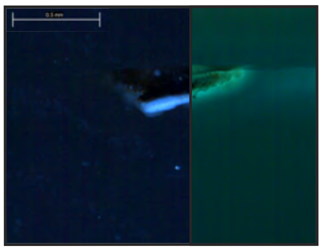
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

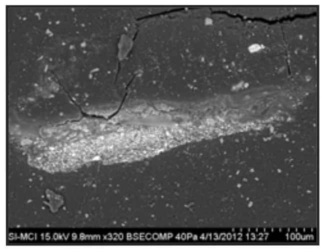


acc. no.: BAM 1963.6
title, year: *Tormented Bull*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 84.3" (152.7 x 214.1 cm.)
notes: enamel black

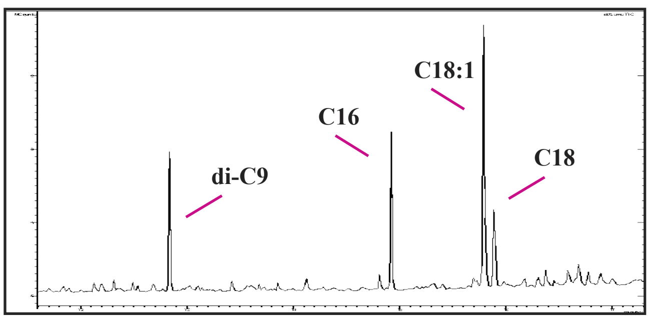
sample location: bottom edge and 12.5" from bottom, 14.0" from right (B 31.8 x R 35.6 cm.)

Representative Analysis Compilation—sample C060

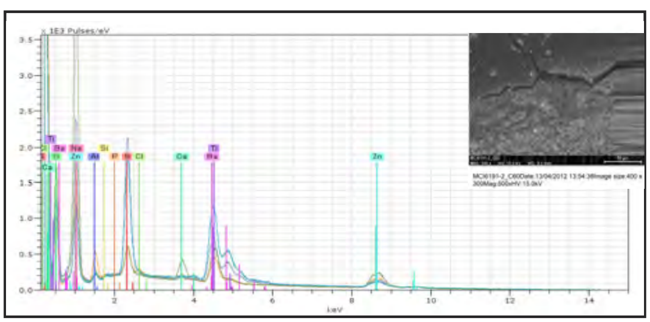




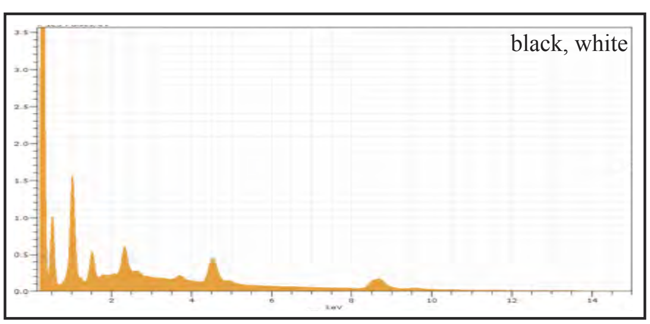
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.8 mm.



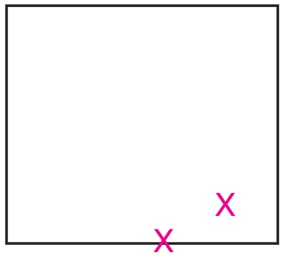
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/04/12
sample weight: 0.152
scan range: 1 - 1482
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, black: none
significant elements, white: Zn, Ti
interpretation: Zn/Ti white, possible carbon black



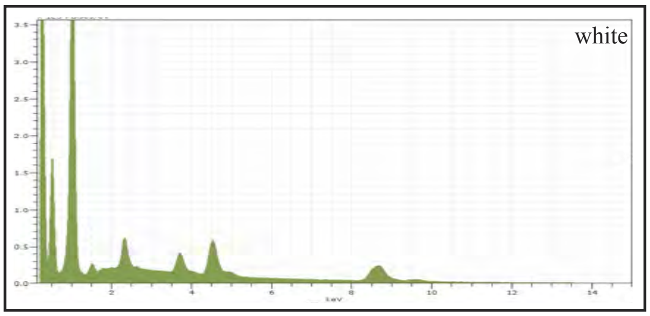
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	28.17	40.53	18.41	0.96
Sodium	K-series	9.73	13.99	18.08	7.68
Titanium	K-series	5.04	7.25	4.50	0.38
Sulfur	K-series	2.43	3.50	3.24	0.11
Aluminium	K-series	1.93	2.78	3.06	0.12
Barium	L-series	1.43	2.05	0.44	0.44
Chlorine	K-series	0.90	1.29	1.08	0.06
Calcium	K-series	0.68	0.97	0.72	0.05
Phosphorus	K-series	0.24	0.34	0.33	0.03
Potassium	K-series	0.18	0.26	0.20	0.04
Silicon	K-series	0.14	0.20	0.21	0.03
Magnesium	K-series	0.04	0.06	0.08	0.03
Oxygen	K-series	18.60	26.76	49.66	10.64
	Sum:	69.50	100.00	100.00	



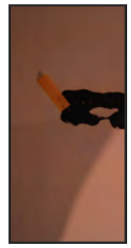
acc. no.: BAM 1963.6
title, year: *Tormented Bull*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 84.3" (152.7 x 214.1 cm.)
notes: enamel black

sample location: bottom edge and 12.5" from bottom, 14.0" from right (B 31.8 x R 35.6 cm.)

Representative Analysis Compilation—sample C060, continued



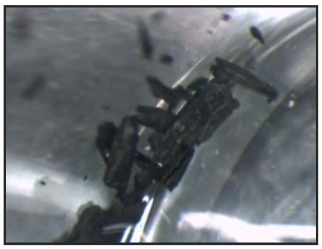
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	44.75	43.53	21.94	1.50
Sodium	K-series	28.15	27.38	39.26	22.18
Titanium	K-series	7.54	7.33	5.05	0.49
Sulfur	K-series	2.91	2.83	2.91	0.13
Calcium	K-series	2.44	2.38	1.95	0.10
Barium	L-series	2.01	1.96	0.47	0.56
Aluminium	K-series	0.91	0.89	1.08	0.07
Chlorine	K-series	0.41	0.40	0.37	0.04
Phosphorus	K-series	0.26	0.25	0.27	0.04
Silicon	K-series	0.18	0.18	0.21	0.03
Magnesium	K-series	0.04	0.04	0.05	0.03
Potassium	K-series	0.01	0.01	0.01	0.03
Oxygen	K-series	13.18	12.82	26.42	6.07
	Sum:	102.81	100.00	100.00	

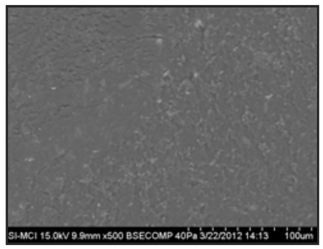


acc. no.: BAM 1963.6
title, year: *Tormented Bull*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 84.3" (152.7 x 214.1 cm.)
notes: black, brittle

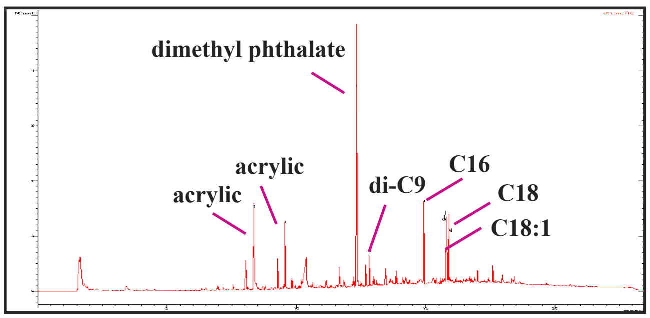
sample location: 7.0" from top,
4.0" from left (T 17.8 x L 10.2 cm.)

Representative Analysis Compilation—sample C061

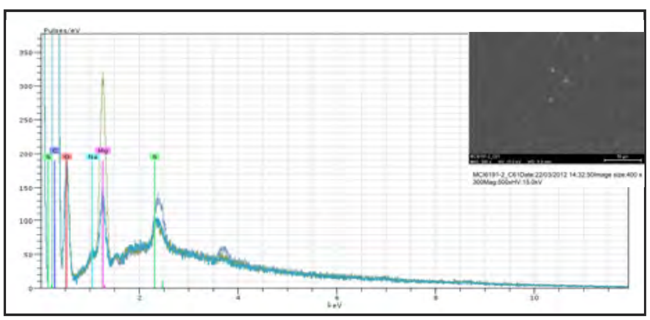




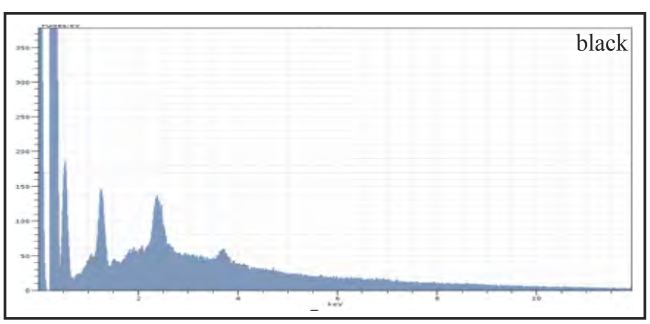
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



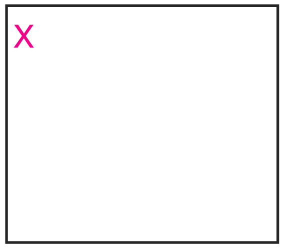
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/04/12
sample weight: 0.140
scan range: 1 - 1474
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18:1, C18, acrylics
interpretation: alkyd, conservation material

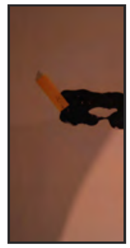


analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, black: none
interpretation: possible carbon black



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Magnesium	K-series	2.28	2.28	1.56	0.15
Zinc	K-series	1.64	1.64	0.42	0.09
Sulfur	K-series	0.94	0.94	0.49	0.06
Cobalt	K-series	0.67	0.67	0.19	0.06
Iron	K-series	0.26	0.26	0.08	0.05
Barium	L-series	0.25	0.25	0.03	0.07
Calcium	K-series	0.22	0.22	0.09	0.03
Sodium	K-series	0.17	0.17	0.13	0.16
Chlorine	K-series	0.17	0.17	0.08	0.03
Aluminium	K-series	0.10	0.10	0.06	0.03
Silicon	K-series	0.10	0.10	0.06	0.03
Phosphorus	K-series	0.04	0.04	0.02	0.03
Potassium	K-series	0.02	0.02	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	93.15	93.15	96.80	122.66
	Sum:	100.00	100.00	100.00	



acc. no.: BAM 1963.6
title, year: *Tormented Bull*, 1961
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 60.1 x 84.3" (152.7 x 214.1 cm.)
notes: black, brittle

sample location: 7.0" from top,
4.0" from left (T 17.8 x L 10.2 cm.)

Representative Analysis Compilation—sample C061, continued

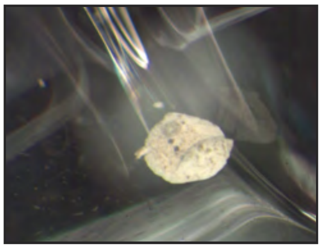
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: carbon interference

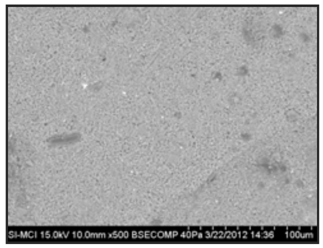
no image available

acc. no.: BAM 1965.17
title, year: *Heraldic Call*, 1962
Gift of Hans Hofmann
medium noted in file: oil and duco on canvas
meas.: 60.3 x 48.4" (153.2 x 122.9 cm.)
notes: ground layer

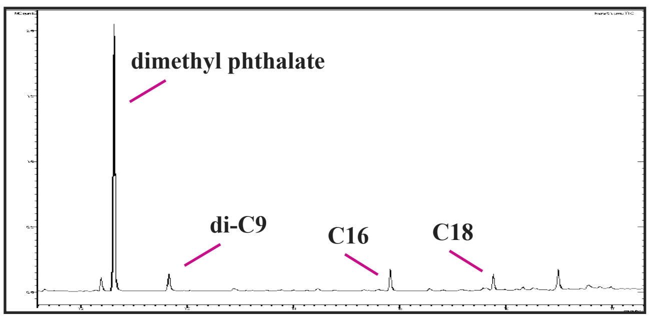
sample location: right edge, 27.0" from top
(T 68.6 x R 0.0 cm.)

Representative Analysis Compilation—sample Hera1

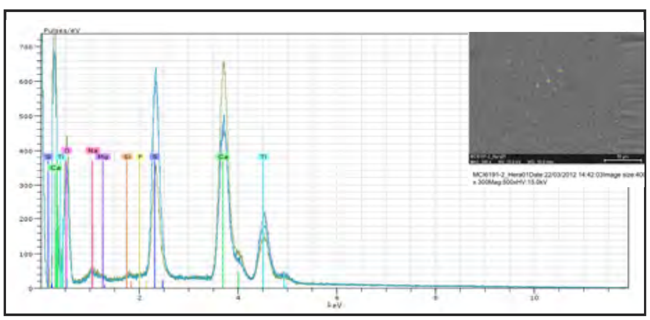




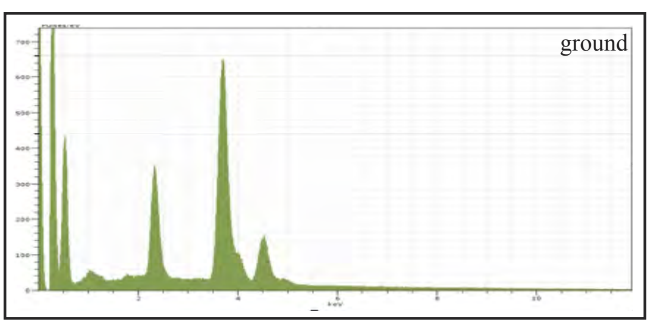
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 03/16/12
sample weight: 0.185
scan range: 1 - 1492
time range: 0.00 - 23.36 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti
interpretation: titanium white



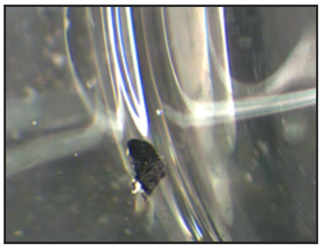
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	33.66	33.41	21.73	1.04
Titanium	K-series	11.48	11.39	6.20	1.29
Sulfur	K-series	7.69	7.63	6.21	0.30
Zinc	K-series	4.12	4.09	1.63	0.20
Barium	L-series	3.97	3.94	0.75	1.58
Sodium	K-series	0.65	0.64	0.73	0.53
Magnesium	K-series	0.54	0.54	0.58	0.06
Potassium	K-series	0.23	0.23	0.15	0.05
Silicon	K-series	0.09	0.09	0.08	0.03
Chlorine	K-series	0.07	0.07	0.05	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Aluminium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	38.26	37.98	61.89	31.05
	Sum:	100.75	100.00	100.00	

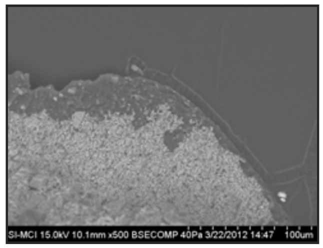
no image available

acc. no.: BAM 1965.17
title, year: *Heraldic Call*, 1962
Gift of Hans Hofmann
medium noted in file: oil and duco on canvas
meas.: 60.3 x 48.4" (153.2 x 122.9 cm.)
notes: black, glossy

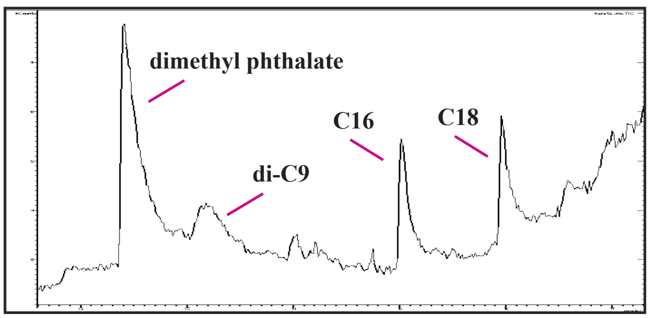
sample location: 27.4" from top, 1.1" from right
(T 69.6 x R 2.8 cm.)

Representative Analysis Compilation—sample Hera2

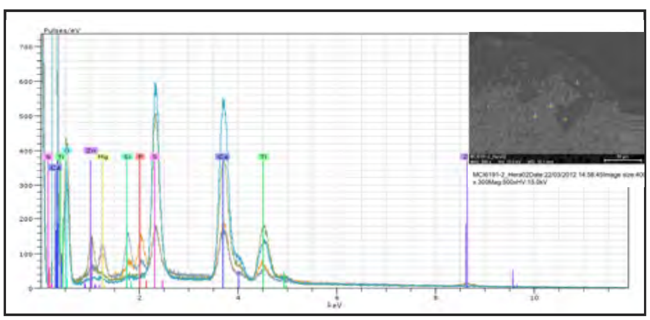




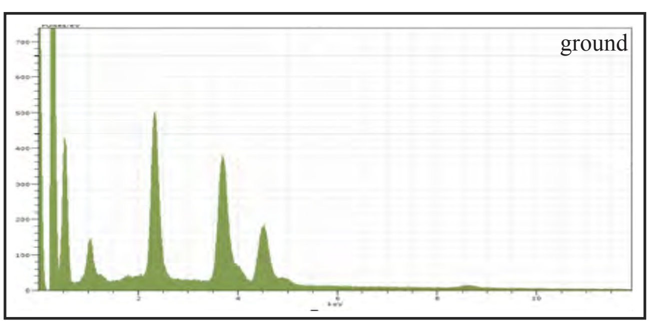
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 03/16/12
sample weight: 0.106
scan range: 1 - 1492
time range: 0.00 - 23.34 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: low count; inconclusive



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti
significant elements, black: Ca, P
interpretation: titanium white, bone black



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	16.99	18.29	11.78	0.54
Sulfur	K-series	13.74	14.79	11.91	0.51
Titanium	K-series	13.70	14.75	7.95	1.22
Zinc	K-series	8.66	9.33	3.68	0.35
Sodium	K-series	4.50	4.84	5.44	3.57
Barium	L-series	0.85	0.91	0.17	0.44
Magnesium	K-series	0.72	0.78	0.82	0.07
Silicon	K-series	0.22	0.24	0.22	0.04
Phosphorus	K-series	0.10	0.11	0.09	0.03
Chlorine	K-series	0.09	0.10	0.07	0.03
Potassium	K-series	0.02	0.02	0.02	0.03
Aluminium	K-series	0.01	0.01	0.01	0.03
Oxygen	K-series	33.28	35.83	57.83	27.81
	Sum:	92.88	100.00	100.00	

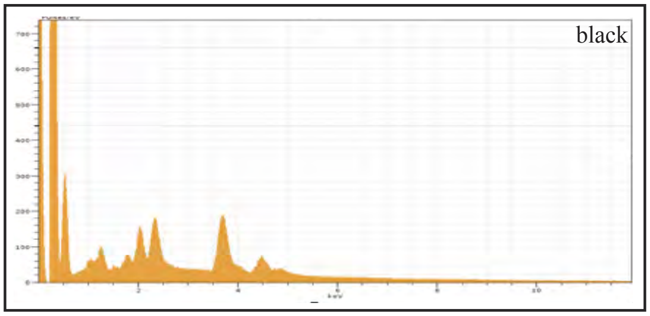
X

no image available

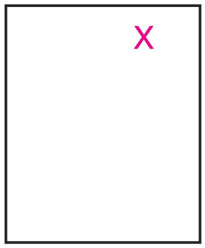
acc. no.: BAM 1965.17
title, year: *Heraldic Call*, 1962
Gift of Hans Hofmann
medium noted in file: oil and duco on canvas
meas.: 60.3 x 48.4" (153.2 x 122.9 cm.)
notes: black, glossy

sample location: 27.4" from top, 1.1" from right
(T 69.6 x R 2.8 cm.)

Representative Analysis Compilation—sample Hera2, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	7.11	11.11	6.41	0.25
Barium	L-series	6.86	10.71	1.80	0.69
Sulfur	K-series	4.65	7.27	5.24	0.19
Zinc	K-series	3.56	5.57	1.97	0.18
Phosphorus	K-series	3.41	5.32	3.97	0.16
Magnesium	K-series	2.00	3.13	2.98	0.14
Silicon	K-series	1.15	1.79	1.48	0.08
Titanium	K-series	1.09	1.71	0.83	0.43
Chlorine	K-series	0.77	1.20	0.78	0.05
Sodium	K-series	0.70	1.09	1.10	0.57
Potassium	K-series	0.19	0.30	0.18	0.04
Aluminium	K-series	0.11	0.18	0.15	0.03
Oxygen	K-series	32.38	50.61	73.11	34.45
	Sum:	63.99	100.00	100.00	

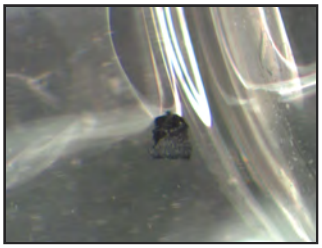


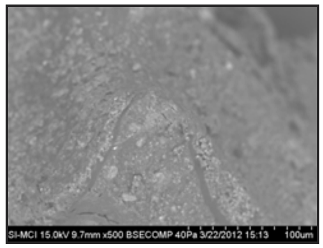
no image available

acc. no.: BAM 1965.17
title, year: *Heraldic Call*, 1962
Gift of Hans Hofmann
medium noted in file: oil and duco on canvas
meas.: 60.3 x 48.4" (153.2 x 122.9 cm.)
notes: black, matte

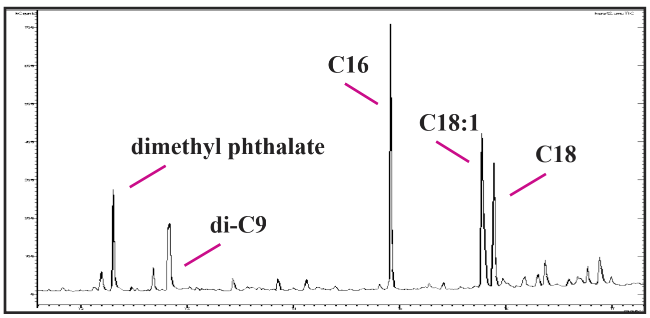
sample location: 8.9" from top, 17.4" from right
(T 21.8 x R 44.2 cm.)

Representative Analysis Compilation—sample Hera3

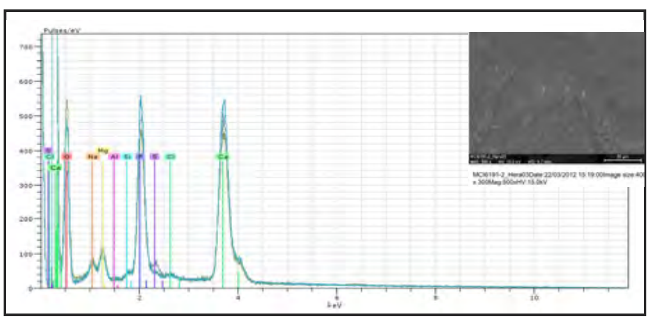




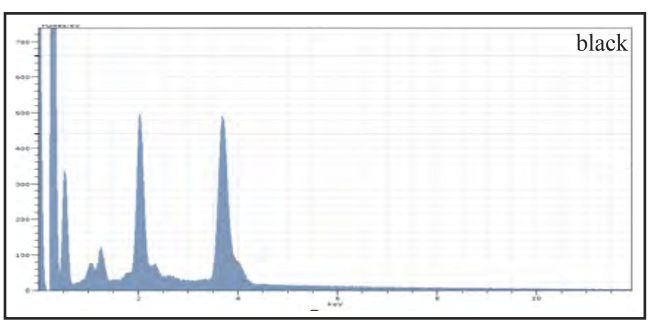
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



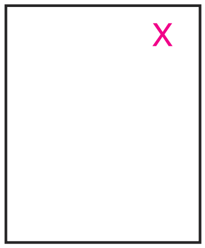
analysis: Py-GC-MS
by: DVR (NGA)
date: 03/16/12
sample weight: 0.102
scan range: 1 - 1491
time range: 0.00 - 23.36 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18:1, C18
interpretation: alkyd, oil



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, black: Ca, P
interpretation: bone black



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	35.90	33.97	22.84	1.11
Phosphorus	K-series	20.79	19.67	17.11	0.82
Zinc	K-series	5.58	5.28	2.18	0.26
Magnesium	K-series	3.84	3.63	4.03	0.24
Sulfur	K-series	2.74	2.59	2.18	0.13
Barium	L-series	2.24	2.12	0.42	0.32
Sodium	K-series	1.93	1.83	2.14	1.55
Chlorine	K-series	1.92	1.81	1.38	0.10
Potassium	K-series	0.95	0.90	0.62	0.12
Silicon	K-series	0.55	0.52	0.50	0.05
Aluminium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	29.26	27.68	46.62	27.57
	Sum:	105.70	100.00	100.00	

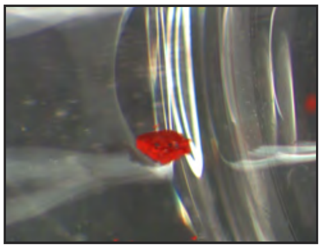


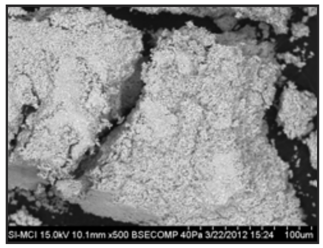
no image available

acc. no.: BAM 1965.17
title, year: *Heraldic Call*, 1962
Gift of Hans Hofmann
medium noted in file: oil and duco on canvas
meas.: 60.3 x 48.4" (153.2 x 122.9 cm.)
notes: red

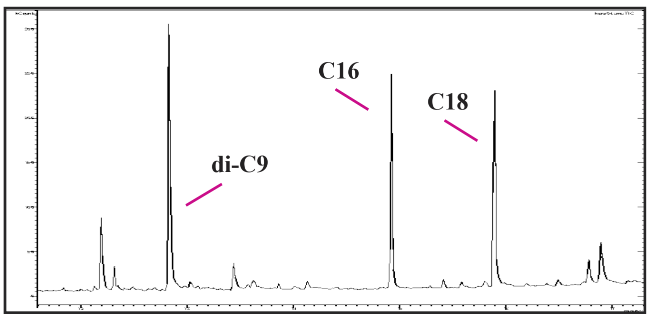
sample location: 7.9" from top, 10.3" from right
(T 20.1 x R 26.2 cm.)

Representative Analysis Compilation—sample Hera4

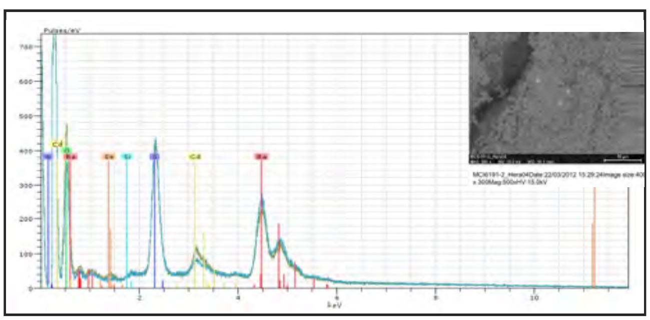




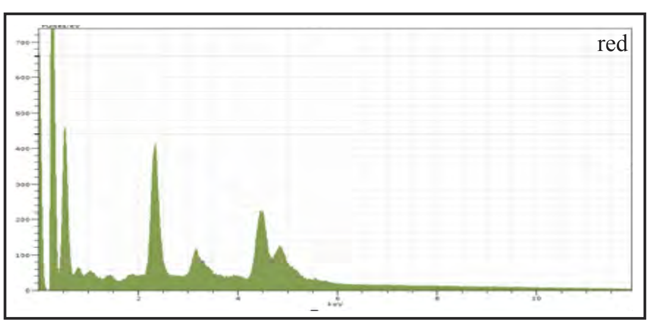
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



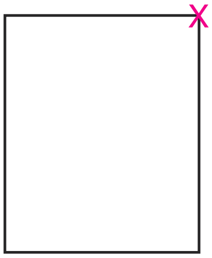
analysis: Py-GC-MS
by: DVR (NGA)
date: 03/16/12
sample weight: 0.142
scan range: 1 - 1490
time range: 0.00 - 23.33 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	30.45	33.62	7.78	2.14
Sulfur	K-series	11.51	12.71	12.60	0.43
Zinc	K-series	6.18	6.83	3.32	0.27
Cadmium	L-series	5.39	5.95	1.68	1.34
Titanium	K-series	2.74	3.02	2.01	0.95
Potassium	K-series	0.76	0.84	0.68	0.54
Selenium	L-series	0.56	0.62	0.25	0.08
Silicon	K-series	0.37	0.41	0.47	0.05
Sodium	K-series	0.23	0.25	0.35	0.20
Phosphorus	K-series	0.10	0.11	0.12	0.03
Aluminium	K-series	0.08	0.09	0.10	0.08
Calcium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	32.20	35.55	70.65	27.94
	Sum:	90.56	100.00	100.00	

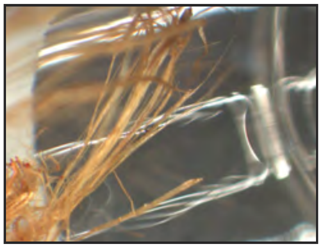


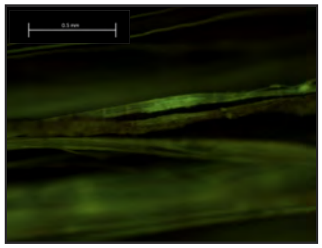
no image available

acc. no.: BAM 1965.17
title, year: *Heraldic Call*, 1962
Gift of Hans Hofmann
medium noted in file: oil and duco on canvas
meas.: 60.3 x 48.4" (153.2 x 122.9 cm.)
notes: threads, possibly warp

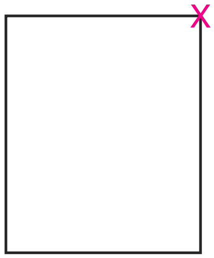
sample location: top right corner
(T 0.0 x R 0.0 cm.)

Representative Analysis Compilation—sample Hera5





photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

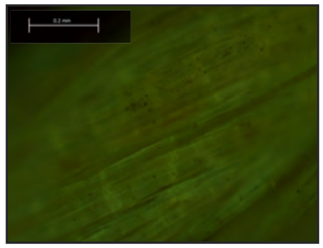


no image available

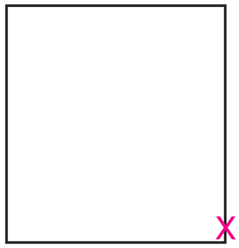
acc. no.: BAM 1965.17
title, year: *Heraldic Call*, 1962
Gift of Hans Hofmann
medium noted in file: oil and duco on canvas
meas.: 60.3 x 48.4" (153.2 x 122.9 cm.)
notes: threads, possibly weft

sample location: top right corner
(T 0.0 x R 0.0 cm.)

Representative Analysis Compilation—sample Hera6



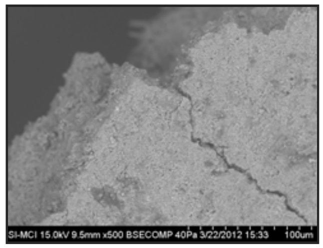
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

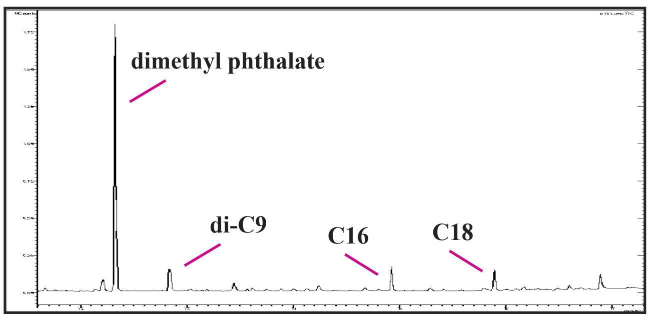

acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: ground layer

sample location: right edge, 2.5" from bottom
(B 13.2 x R 0.0 cm.)

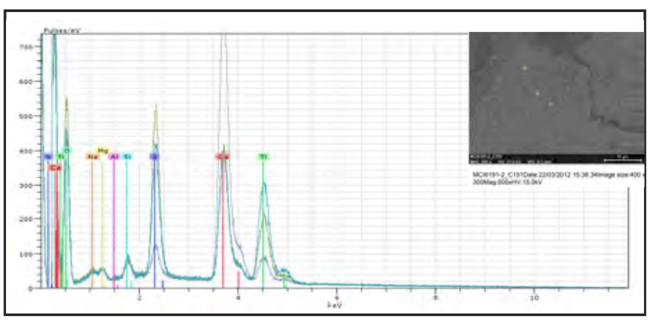
Representative Analysis Compilation—sample C151

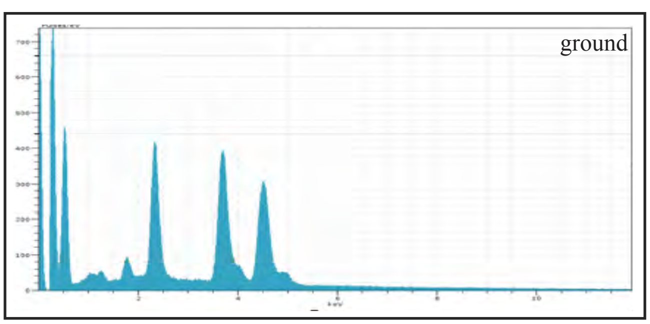
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.5 mm.



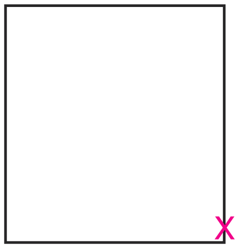
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.200
scan range: 1 - 1481
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti
interpretation: titanium white



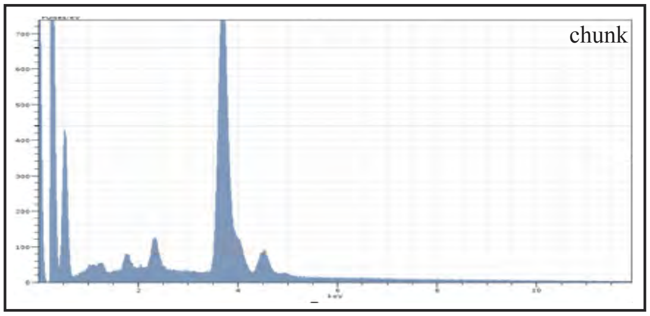
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	26.20	26.24	14.90	0.79
Calcium	K-series	21.09	21.13	14.33	0.66
Sulfur	K-series	14.70	14.72	12.48	0.55
Silicon	K-series	2.51	2.52	2.43	0.13
Zinc	K-series	1.39	1.39	0.58	0.10
Magnesium	K-series	1.28	1.28	1.43	0.10
Chlorine	K-series	0.94	0.94	0.72	0.06
Potassium	K-series	0.40	0.40	0.28	0.06
Phosphorus	K-series	0.35	0.35	0.31	0.05
Sodium	K-series	0.27	0.27	0.32	0.24
Aluminium	K-series	0.03	0.03	0.03	0.03
Oxygen	K-series	30.68	30.73	52.20	23.59
	Sum:	99.84	100.00	100.00	



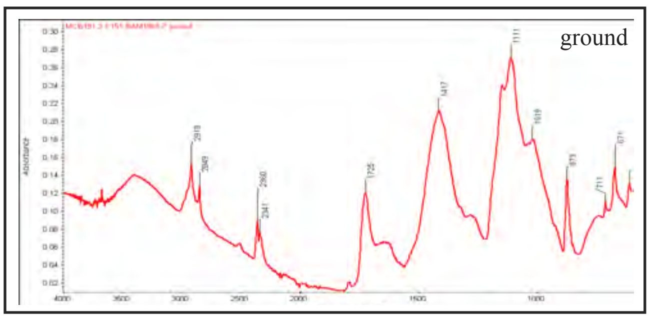
acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: ground layer

sample location: right edge, 2.5" from bottom
(B 13.2 x R 0.0 cm.)

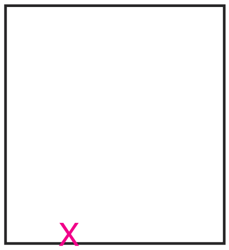
Representative Analysis Compilation—sample C151, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	48.22	44.33	30.28	1.47
Barium	L-series	6.37	5.86	1.17	1.14
Titanium	K-series	5.76	5.29	3.03	0.79
Zinc	K-series	5.70	5.24	2.19	0.26
Sulfur	K-series	2.54	2.34	2.00	0.12
Silicon	K-series	1.01	0.93	0.91	0.07
Magnesium	K-series	0.93	0.85	0.96	0.08
Sodium	K-series	0.90	0.83	0.99	0.73
Chlorine	K-series	0.14	0.12	0.10	0.03
Potassium	K-series	0.11	0.10	0.07	0.04
Phosphorus	K-series	0.06	0.05	0.05	0.03
Aluminium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	37.04	34.05	58.27	30.66
	Sum:	108.77	100.00	100.00	



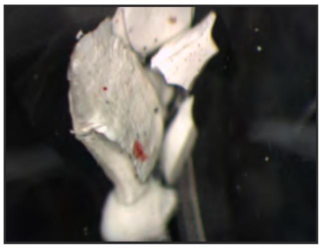
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

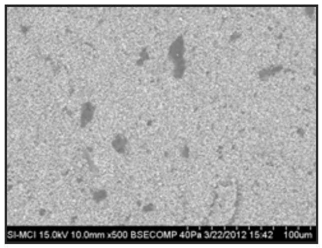


acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: compositional white

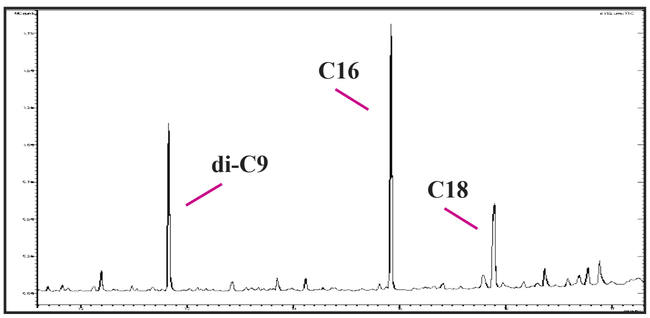
sample location: 1.0" from bottom, 21.3" from left (B 2.5 x L 54.1 cm.)

Representative Analysis Compilation—sample C152

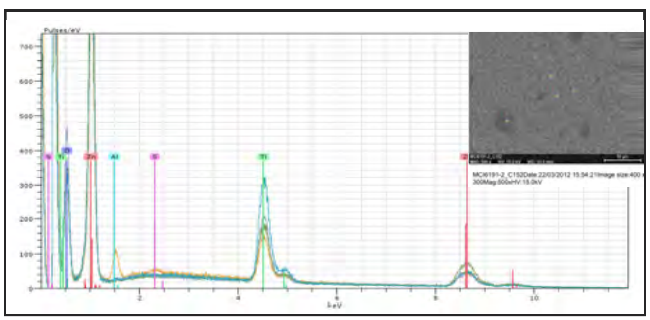




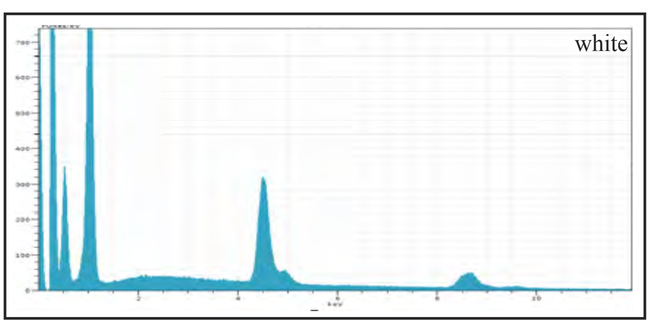
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



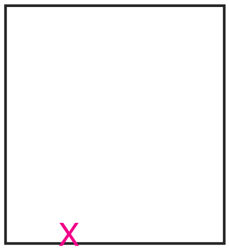
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.175
scan range: 1 - 1488
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



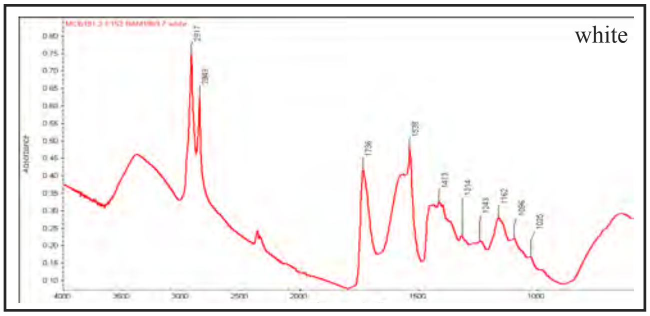
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	60.65	49.02	28.47	2.07
Sodium	K-series	22.10	17.86	29.51	17.42
Titanium	K-series	20.08	16.22	12.87	1.72
Barium	L-series	5.51	4.45	1.23	1.94
Calcium	K-series	0.40	0.32	0.30	0.05
Chlorine	K-series	0.37	0.30	0.32	0.04
Phosphorus	K-series	0.33	0.27	0.33	0.04
Sulfur	K-series	0.26	0.21	0.25	0.04
Potassium	K-series	0.15	0.12	0.12	0.04
Silicon	K-series	0.05	0.04	0.05	0.03
Aluminium	K-series	0.02	0.01	0.02	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	13.82	11.17	26.52	12.79
	Sum:	123.74	100.00	100.00	



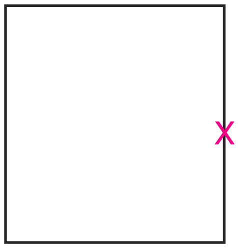
acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: compositional white

sample location: 1.0" from bottom, 21.3" from left
(B 2.5 x L 54.1 cm.)

Representative Analysis Compilation—sample C152, continued



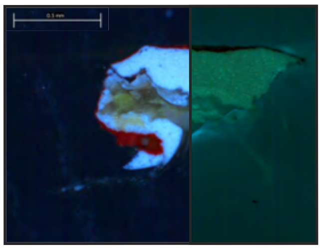
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

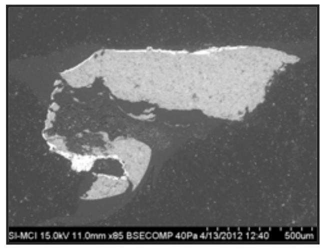


acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: red wash and ground layer

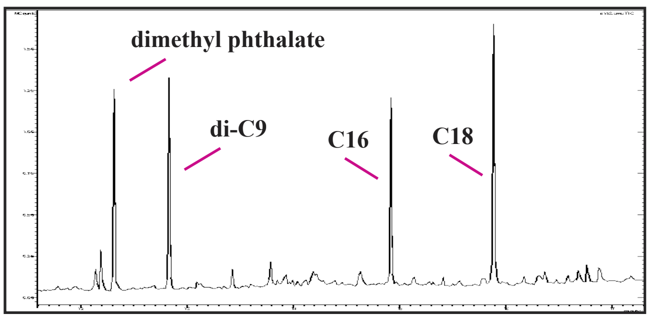
sample location: right edge, 39.5" from bottom
(B 100.3 x R 0.0 cm.)

Representative Analysis Compilation—sample C153

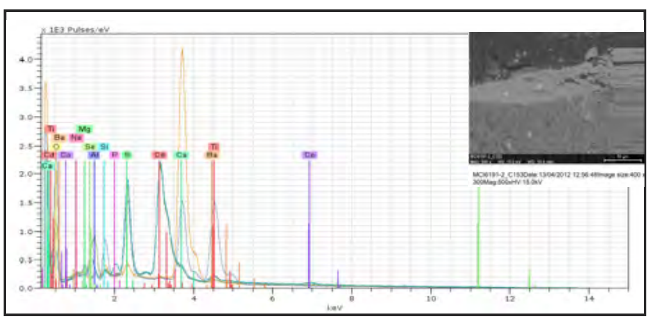




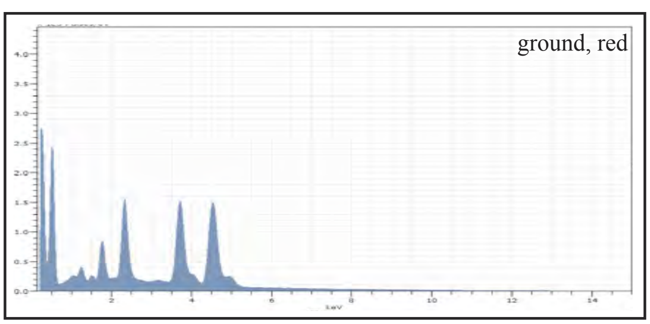
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 11.0 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.163
scan range: 1 - 1488
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: oil and alkyd



analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.8 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti, Ca
significant elements, red: Cd, S, Se
interpretation: cadmium red, titanium white

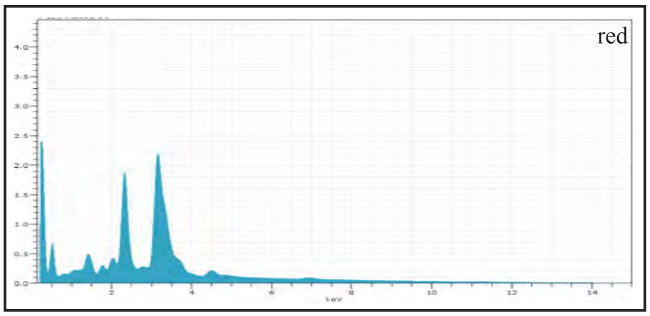


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	30.65	26.57	16.45	1.39
Calcium	K-series	19.10	16.56	12.25	0.64
Barium	L-series	9.21	7.99	1.72	1.44
Sulfur	K-series	9.12	7.90	7.31	0.35
Zinc	K-series	5.85	5.07	2.30	0.23
Silicon	K-series	3.62	3.14	3.31	0.18
Cadmium	L-series	1.63	1.41	0.37	0.42
Magnesium	K-series	1.54	1.33	1.63	0.19
Chlorine	K-series	0.61	0.53	0.44	0.05
Sodium	K-series	0.50	0.43	0.56	0.42
Aluminium	K-series	0.15	0.13	0.14	0.14
Phosphorus	K-series	0.14	0.12	0.11	0.03
Potassium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	33.23	28.81	53.39	13.15
	Sum:	115.35	100.00	100.00	

acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: red wash and ground layer

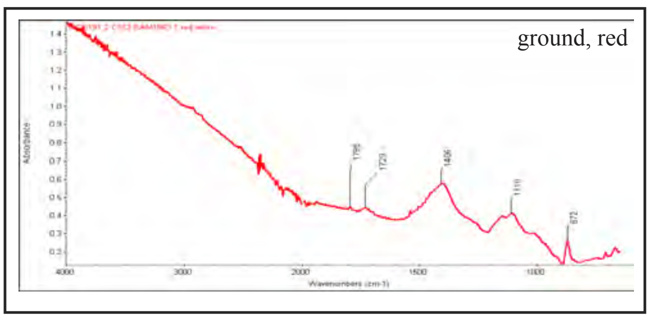
sample location: right edge, 39.5" from bottom (B 100.3 x R 0.0 cm.)

Representative Analysis Compilation—sample C153, continued



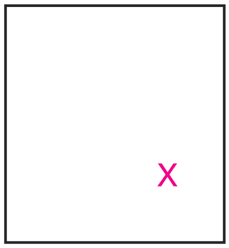
red

Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	22.81	32.73	10.15	2.05
Sulfur	K-series	7.69	11.03	11.99	0.30
Cobalt	K-series	5.05	7.25	4.29	0.18
Potassium	K-series	4.95	7.11	6.34	0.68
Barium	L-series	3.81	5.47	1.39	0.31
Selenium	L-series	3.15	4.51	1.99	0.22
Calcium	K-series	1.12	1.61	1.40	0.15
Aluminium	K-series	0.69	0.99	1.28	0.55
Sodium	K-series	0.66	0.94	1.43	0.12
Phosphorus	K-series	0.54	0.77	0.87	0.05
Titanium	K-series	0.35	0.51	0.37	0.16
Silicon	K-series	0.31	0.44	0.54	0.04
Magnesium	K-series	0.08	0.11	0.16	0.08
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	18.49	26.53	57.81	13.34
	Sum:	69.69	100.00	100.00	



ground, red

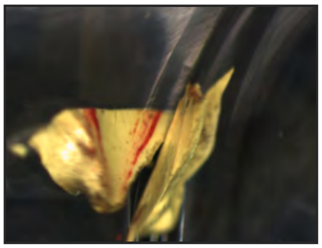
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

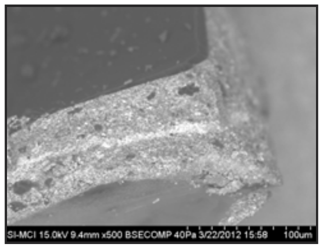


acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: yellow, maybe a little red

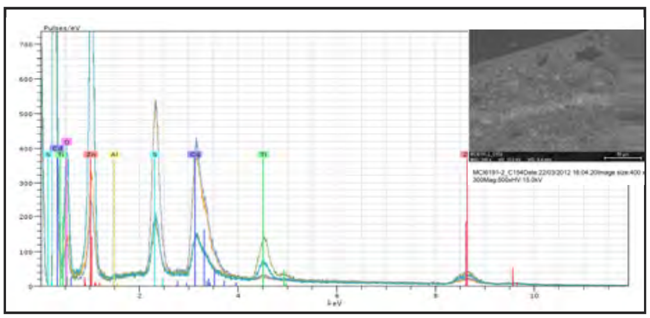
sample location: 23.0" from bottom, 18.0" from right
(B 58.4 x R 45.7 cm.)

Representative Analysis Compilation—sample C154

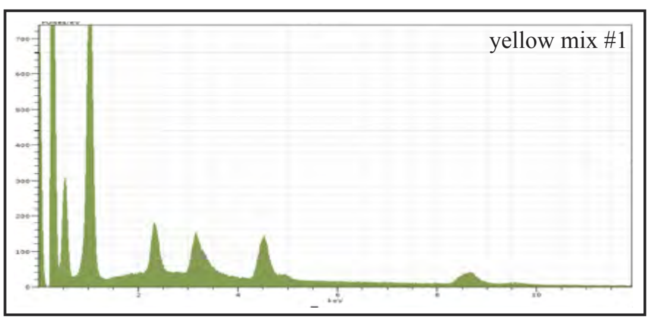




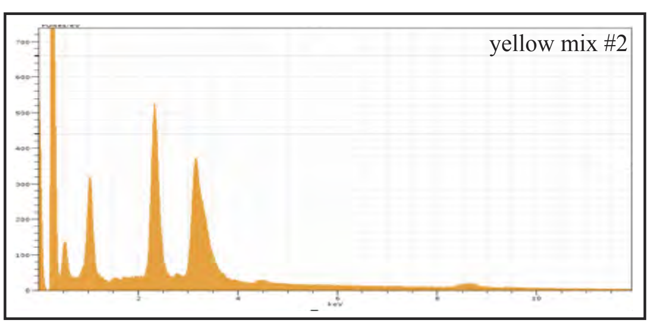
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



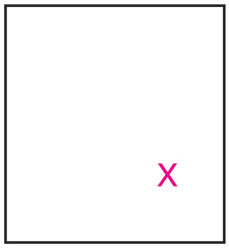
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S, Zn, Ti
interpretation: cadmium yellow, Zn/Ti white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	36.83	35.40	18.20	1.28
Sodium	K-series	29.07	27.94	40.86	22.90
Titanium	K-series	9.21	8.86	6.22	1.05
Cadmium	L-series	7.35	7.07	2.11	1.82
Sulfur	K-series	4.44	4.27	4.47	0.19
Barium	L-series	2.49	2.40	0.59	1.24
Potassium	K-series	1.16	1.12	0.96	0.77
Aluminium	K-series	0.27	0.26	0.32	0.23
Silicon	K-series	0.22	0.21	0.25	0.04
Magnesium	K-series	0.16	0.16	0.22	0.15
Phosphorus	K-series	0.10	0.09	0.10	0.03
Selenium	L-series	0.01	0.01	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	12.71	12.22	25.68	12.89
	Sum:	104.03	100.00	100.00	

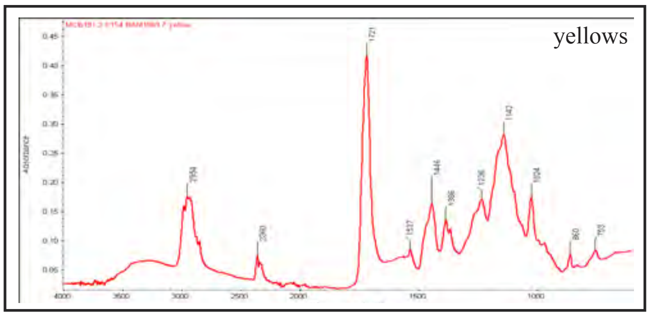


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	47.08	36.84	14.63	7.31
Zinc	K-series	25.03	19.59	13.37	0.91
Sulfur	K-series	22.43	17.56	24.43	0.82
Sodium	K-series	12.67	9.92	19.25	10.00
Potassium	K-series	5.19	4.06	4.64	2.80
Barium	L-series	4.19	3.28	1.07	0.49
Calcium	K-series	0.66	0.52	0.58	0.39
Magnesium	K-series	0.31	0.24	0.45	0.20
Chlorine	K-series	0.24	0.19	0.24	0.05
Phosphorus	K-series	0.17	0.13	0.19	0.04
Silicon	K-series	0.15	0.12	0.19	0.04
Aluminium	K-series	0.08	0.06	0.10	0.08
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	9.57	7.49	20.88	14.44
	Sum:	127.77	100.00	100.00	

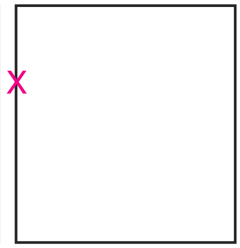
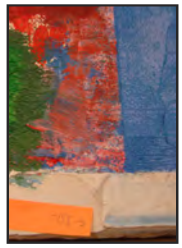


acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: yellow, maybe a little red
sample location: 23.0" from bottom, 18.0" from right
(B 58.4 x R 45.7 cm.)

Representative Analysis Compilation—sample C154, continued



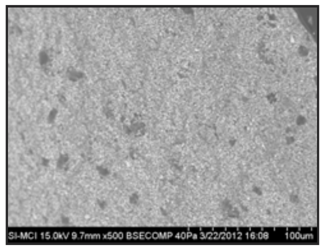
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

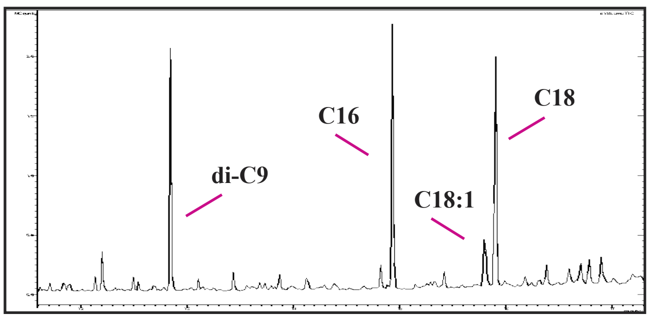
acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: compositional white

sample location: left edge, 25.5" from top
(T 64.8 x L 0.0 cm.)

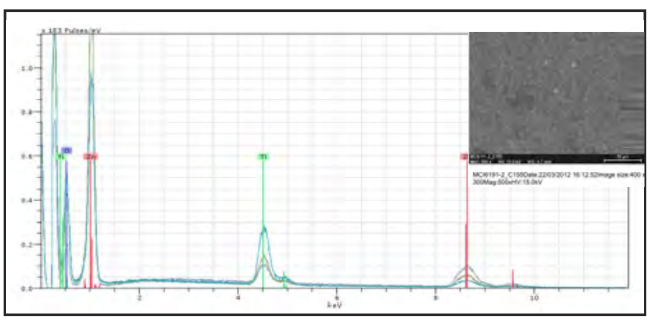
Representative Analysis Compilation—sample C155

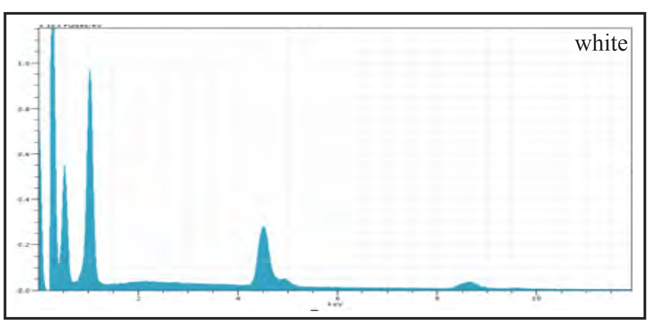
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



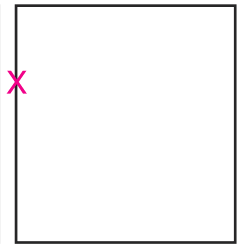
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.226
scan range: 1 - 1484
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil

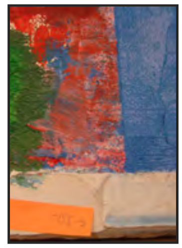


analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	29.44	31.41	13.61	1.04
Titanium	K-series	21.73	23.18	13.72	1.52
Sodium	K-series	11.56	12.34	15.21	9.13
Barium	L-series	0.51	0.55	0.11	0.30
Aluminium	K-series	0.23	0.24	0.26	0.04
Silicon	K-series	0.07	0.07	0.07	0.03
Phosphorus	K-series	0.02	0.02	0.02	0.03
Calcium	K-series	0.01	0.01	0.01	0.03
Chlorine	K-series	0.01	0.01	0.01	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Sulfur	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	30.15	32.16	56.98	22.86
	Sum:	93.74	100.00	100.00	

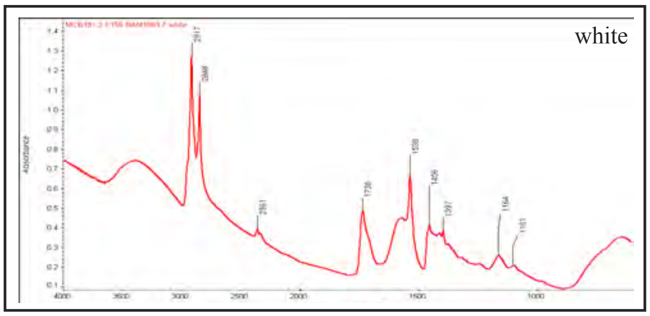




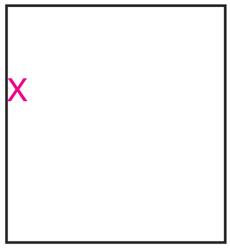
acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: compositional white

sample location: left edge, 25.5" from top
(T 64.8 x L 0.0 cm.)

Representative Analysis Compilation—sample C155, continued



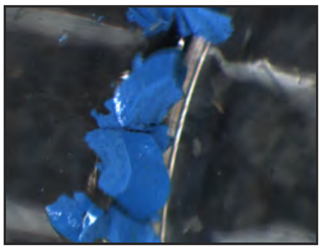
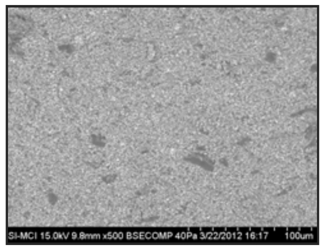
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

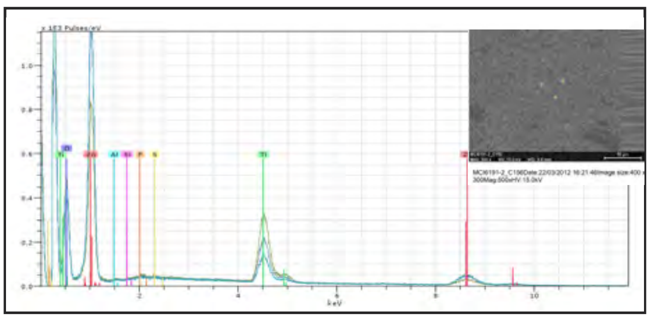
acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: blue

sample location: 27.0" from top, 2.0" from left
(T 68.6 x L 5.1 cm.)

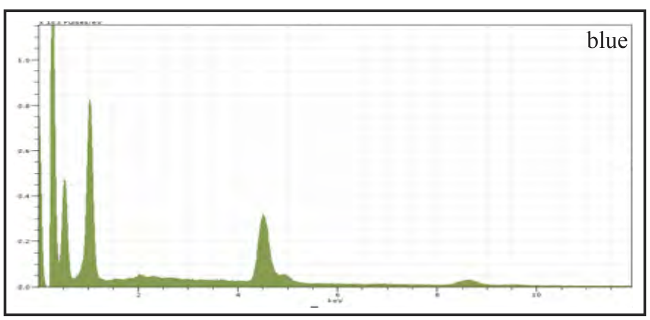
Representative Analysis Compilation—sample C156

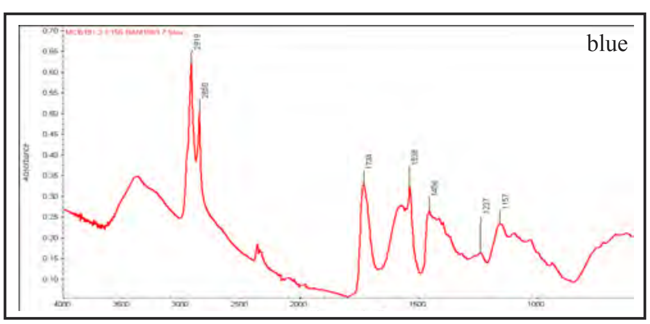
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



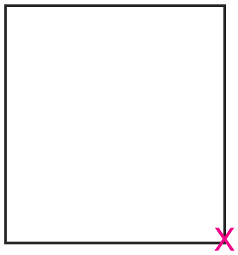
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Co
interpretation: ultramarine blue, possible cobalt blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	31.15	28.72	13.74	1.10
Titanium	K-series	28.73	26.48	17.30	2.14
Sodium	K-series	12.24	11.28	15.34	9.65
Barium	L-series	3.86	3.56	0.81	1.91
Cobalt	K-series	1.66	1.53	0.81	0.11
Phosphorus	K-series	0.88	0.81	0.82	0.06
Chlorine	K-series	0.72	0.66	0.58	0.05
Sulfur	K-series	0.64	0.59	0.57	0.05
Iron	K-series	0.39	0.36	0.20	0.07
Potassium	K-series	0.37	0.34	0.27	0.05
Calcium	K-series	0.36	0.33	0.26	0.05
Aluminium	K-series	0.12	0.11	0.13	0.03
Magnesium	K-series	0.11	0.10	0.13	0.04
Silicon	K-series	0.10	0.09	0.10	0.03
Oxygen	K-series	27.16	25.04	48.94	21.42
	Sum:	108.48	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

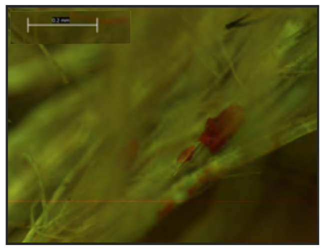


no image
available

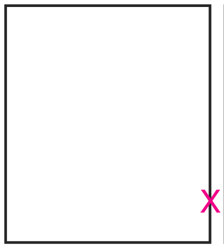
acc. no.: BAM 1963.7
title, year: *Magnum Opus*, 1962
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 78.1" (213.6 x 198.4 cm.)
notes: warp and weft fibers

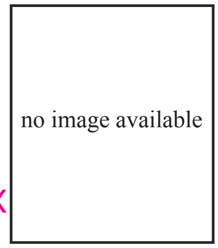
sample location: lower right corner
(B 0.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C157



photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

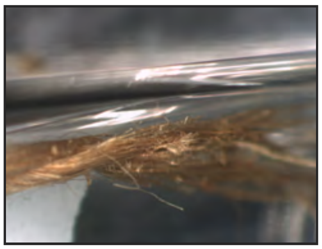


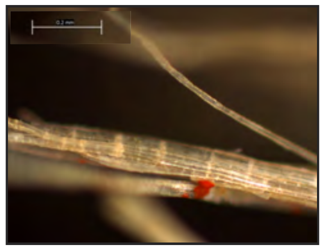


acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: threads, possibly warp

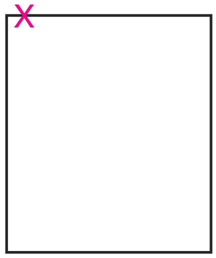
sample location: right edge, 13.0" from bottom
(B 33.0 x R 0.0 cm.)

Representative Analysis Compilation—sample N01





photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification
interpretation: linen

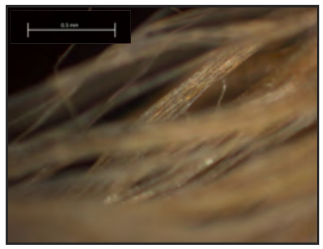


no image available

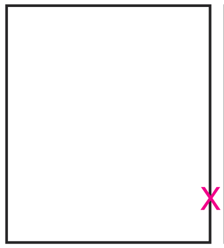
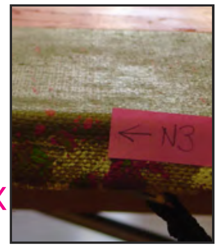
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: threads, possibly weft

sample location: top edge, 4.0" from right
(T 0.0 x R 10.2 cm.)

Representative Analysis Compilation—sample N02



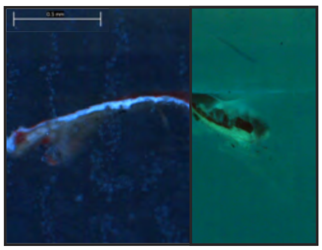
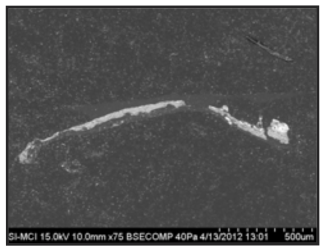
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
5x objective, 0.55x tube, 2.79 magnification
interpretation: linen

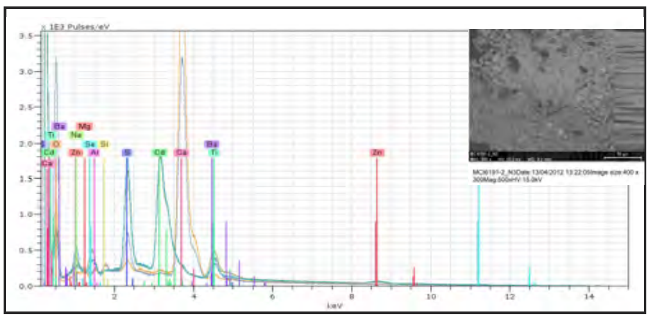
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: orange

sample location: right edge, 14.0" from bottom
(B 35.6 x R 0.0 cm.)

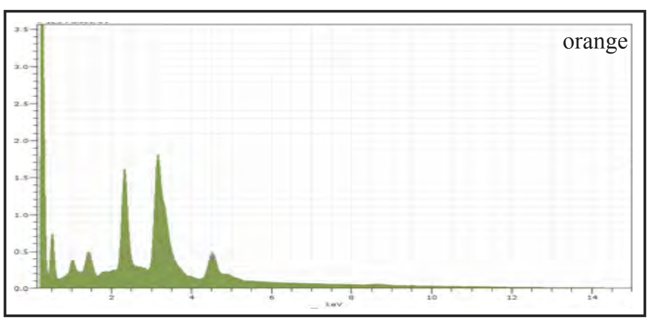
Representative Analysis Compilation—sample N03

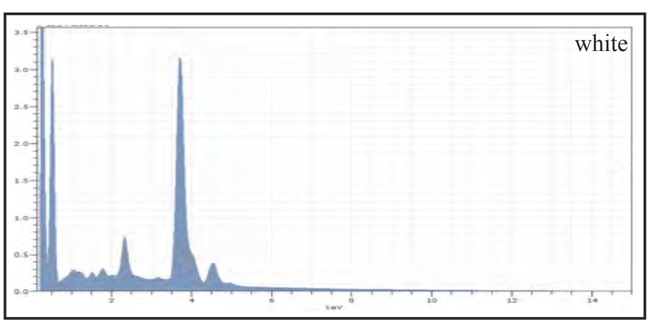
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



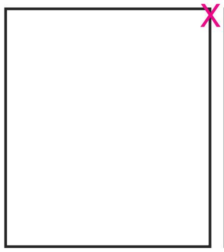
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
significant elements, white: Ca, Ti
interpretation: cadmium orange, titanium white
(possibly alkyd)

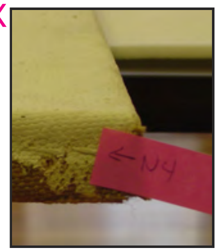


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	19.60	26.80	8.41	1.86
Zinc	K-series	8.17	11.18	6.03	0.30
Sulfur	K-series	7.31	9.99	11.00	0.28
Barium	L-series	4.89	6.69	1.72	0.56
Titanium	K-series	4.83	6.61	4.87	0.50
Potassium	K-series	3.93	5.38	4.85	0.62
Selenium	L-series	2.79	3.81	1.70	0.21
Sodium	K-series	1.72	2.35	3.61	1.38
Aluminium	K-series	1.16	1.59	2.08	0.91
Calcium	K-series	0.17	0.23	0.20	0.13
Silicon	K-series	0.12	0.17	0.21	0.03
Chlorine	K-series	0.11	0.16	0.15	0.03
Phosphorus	K-series	0.05	0.06	0.07	0.03
Magnesium	K-series	0.01	0.02	0.03	0.04
Oxygen	K-series	18.25	24.96	55.05	12.34
	Sum:	73.13	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	39.57	35.49	22.06	1.25
Barium	L-series	5.90	5.29	0.96	0.65
Titanium	K-series	5.12	4.59	2.39	0.58
Zinc	K-series	4.72	4.23	1.61	0.19
Sulfur	K-series	3.45	3.10	2.41	0.15
Cadmium	L-series	1.41	1.27	0.28	0.37
Chlorine	K-series	0.57	0.51	0.36	0.05
Silicon	K-series	0.54	0.49	0.43	0.05
Magnesium	K-series	0.49	0.44	0.45	0.10
Sodium	K-series	0.40	0.36	0.39	0.34
Phosphorus	K-series	0.17	0.16	0.13	0.03
Aluminium	K-series	0.15	0.13	0.12	0.14
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	49.00	43.94	68.41	17.89
	Sum:	111.50	100.00	100.00	

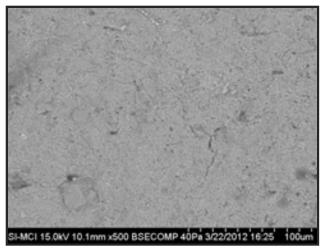




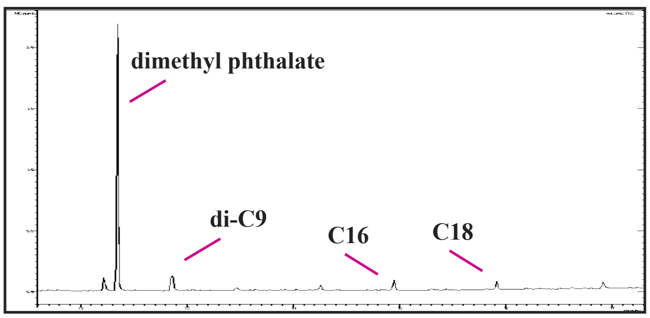
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: ground layer

sample location: right edge, 0.5" from top
(T 1.3 x R 0.0 cm.)

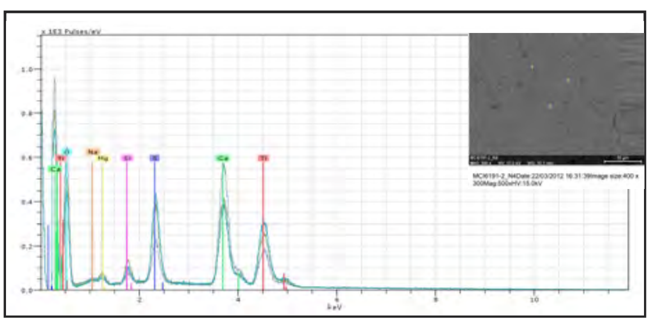
Representative Analysis Compilation—sample N04



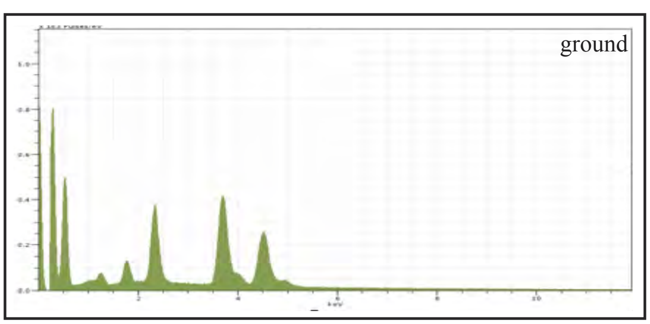
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



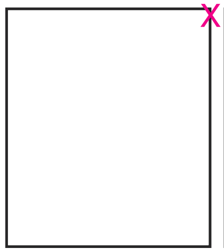
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.107
scan range: 1 - 1478
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd

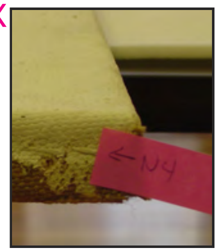


analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ca, Ti
interpretation: bulked titanium white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	27.38	21.82	15.77	0.85
Titanium	K-series	26.39	21.03	12.72	2.51
Barium	L-series	10.31	8.22	1.73	2.70
Sulfur	K-series	10.14	8.08	7.30	0.39
Zinc	K-series	7.67	6.11	2.71	0.33
Silicon	K-series	3.40	2.71	2.79	0.17
Magnesium	K-series	1.10	0.87	1.04	0.09
Potassium	K-series	0.33	0.26	0.20	0.06
Sodium	K-series	0.25	0.20	0.25	0.22
Chlorine	K-series	0.09	0.07	0.06	0.03
Phosphorus	K-series	0.01	0.01	0.01	0.03
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	38.41	30.61	55.42	29.55
	Sum:	125.49	100.00	100.00	

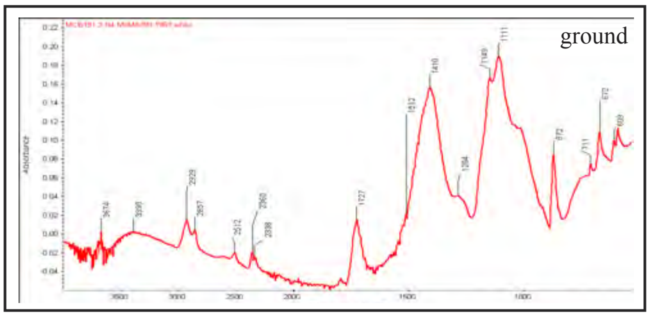




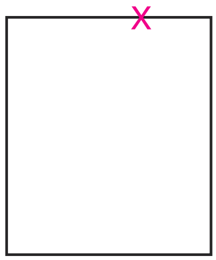
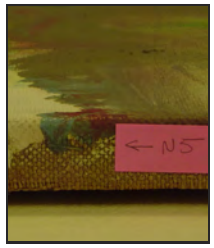
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: ground layer

sample location: right edge, 0.5" from top
(T 1.3 x R 0.0 cm.)

Representative Analysis Compilation—sample N04, continued



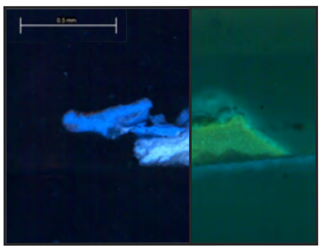
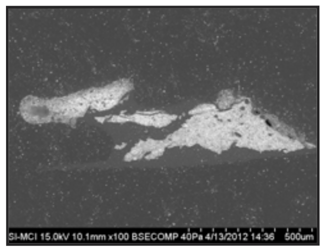
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

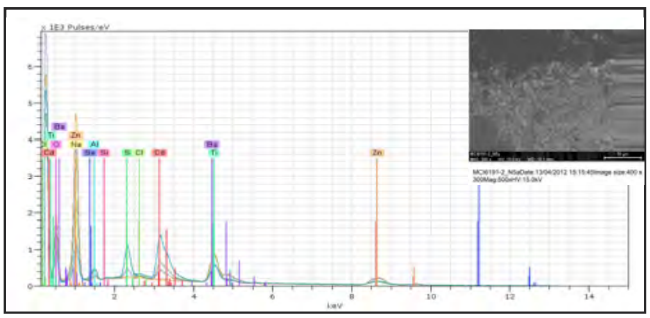
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: stratigraphy

sample location: top edge, 26.5" from right
(T 0.0 x R 67.3 cm.)

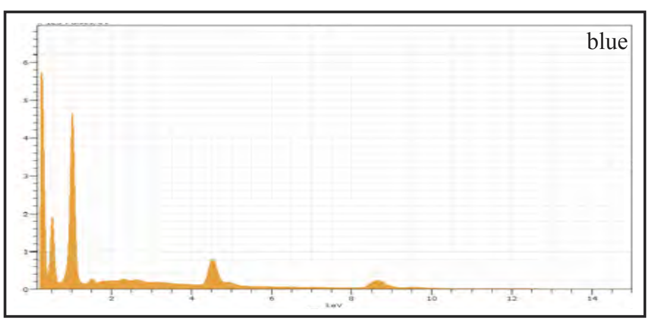
Representative Analysis Compilation—sample N05

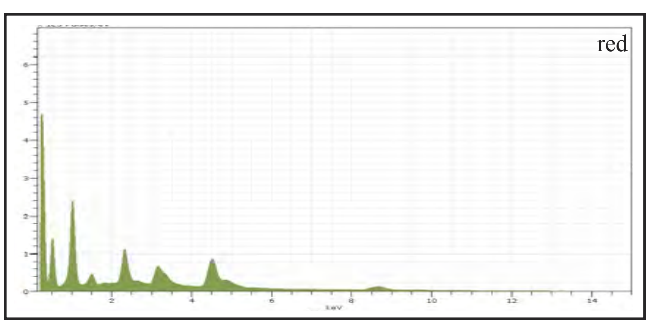
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.1 mm.



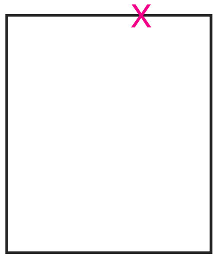
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na
significant elements, red: Cd, S, Se
interpretation: ultramarine blue, cadmium red

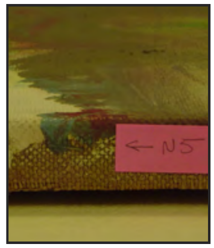


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	61.90	49.03	28.66	2.06
Sodium	K-series	20.19	15.99	26.59	15.91
Titanium	K-series	13.91	11.01	8.79	0.95
Barium	L-series	8.39	6.64	1.85	1.01
Cadmium	L-series	1.73	1.37	0.47	0.45
Chlorine	K-series	1.34	1.06	1.15	0.07
Sulfur	K-series	1.02	0.81	0.97	0.06
Aluminium	K-series	0.81	0.64	0.91	0.64
Phosphorus	K-series	0.65	0.52	0.64	0.05
Calcium	K-series	0.47	0.37	0.35	0.08
Silicon	K-series	0.33	0.26	0.36	0.04
Potassium	K-series	0.10	0.08	0.08	0.09
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	15.43	12.22	29.19	6.85
	Sum:	126.27	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	22.88	25.96	13.64	0.78
Barium	L-series	10.97	12.45	3.12	0.94
Titanium	K-series	9.77	11.08	7.96	0.81
Sodium	K-series	9.41	10.67	15.95	7.43
Cadmium	L-series	6.75	7.65	2.34	1.15
Sulfur	K-series	5.62	6.37	6.83	0.22
Aluminium	K-series	2.02	2.29	2.92	1.25
Potassium	K-series	1.58	1.79	1.58	0.38
Chlorine	K-series	0.53	0.60	0.58	0.05
Silicon	K-series	0.16	0.18	0.22	0.03
Phosphorus	K-series	0.12	0.14	0.15	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	18.35	20.81	44.71	9.37
	Sum:	88.15	100.00	100.00	

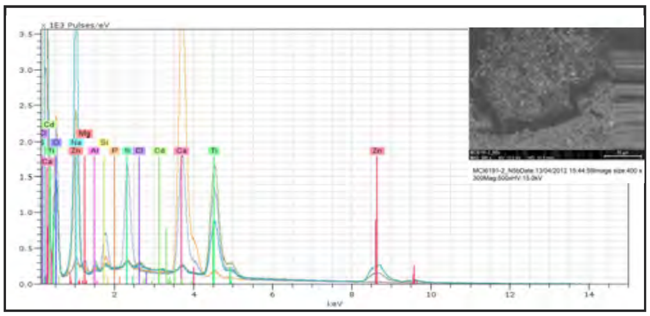




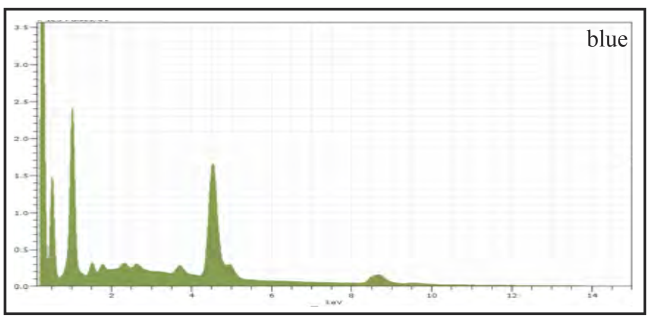
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: stratigraphy

sample location: top edge, 26.5" from right
(T 0.0 x R 67.3 cm.)

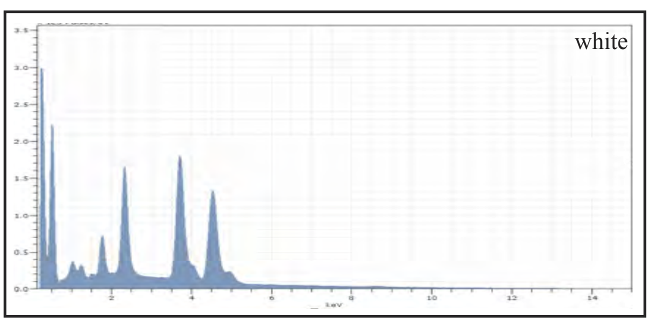
Representative Analysis Compilation—sample N05, continued



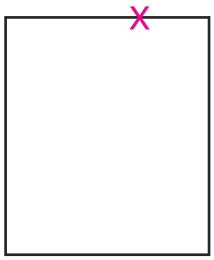
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na
significant elements, white: Ti, Ca
interpretation: ultramarine blue, bulked titanium white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	25.46	29.34	14.17	0.87
Titanium	K-series	23.42	26.99	17.80	0.95
Sodium	K-series	8.52	9.82	13.49	6.73
Barium	L-series	2.89	3.33	0.77	1.13
Aluminium	K-series	0.89	1.03	1.20	0.70
Calcium	K-series	0.83	0.96	0.76	0.07
Chlorine	K-series	0.81	0.93	0.83	0.05
Cobalt	K-series	0.80	0.92	0.49	0.05
Sulfur	K-series	0.80	0.92	0.90	0.05
Silicon	K-series	0.68	0.78	0.88	0.05
Phosphorus	K-series	0.31	0.36	0.37	0.04
Magnesium	K-series	0.12	0.13	0.17	0.07
Cadmium	L-series	0.09	0.10	0.03	0.05
Selenium	L-series	0.00	0.00	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	21.15	24.38	48.13	10.40
	Sum:	86.76	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	15.35	20.49	10.15	0.63
Calcium	K-series	11.18	14.92	8.83	0.36
Sulfur	K-series	7.76	10.35	7.66	0.30
Silicon	K-series	2.55	3.40	2.87	0.13
Zinc	K-series	1.51	2.01	0.73	0.08
Sodium	K-series	1.36	1.82	1.87	1.10
Magnesium	K-series	0.91	1.21	1.18	0.07
Barium	L-series	0.35	0.47	0.08	0.20
Chlorine	K-series	0.34	0.46	0.31	0.04
Phosphorus	K-series	0.11	0.14	0.11	0.03
Aluminium	K-series	0.06	0.07	0.07	0.03
Potassium	K-series	0.05	0.07	0.04	0.03
Oxygen	K-series	33.41	44.59	66.10	13.49
	Sum:	74.93	100.00	100.00	

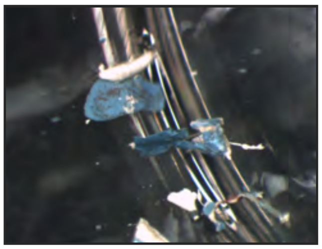


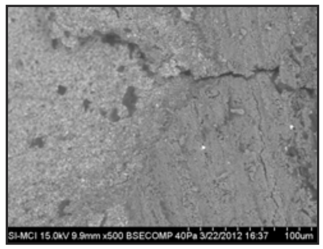
no image available

acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: light blue

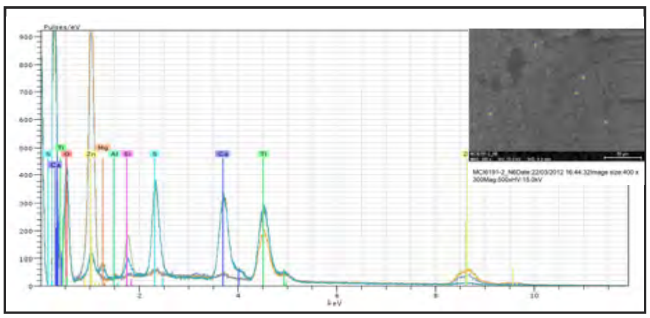
sample location: top edge, 26.5" from right
(T 0.0 x R 67.3 cm.)

Representative Analysis Compilation—sample N06

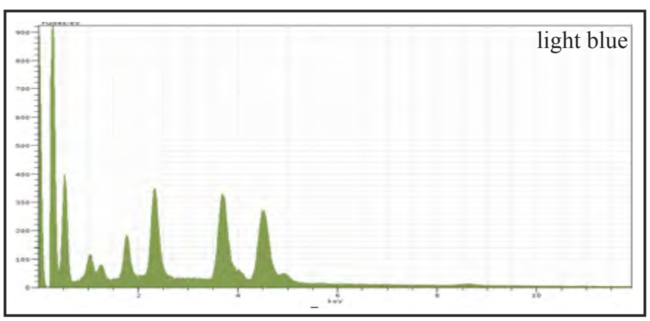




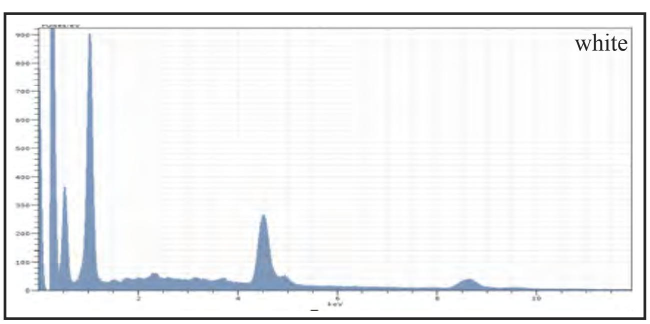
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



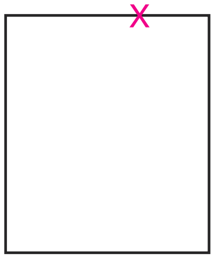
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Si, Na
significant elements, white: Zn, Ti
interpretation: ultramarine blue, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	25.11	24.02	15.13	2.12
Calcium	K-series	17.90	17.12	12.89	0.57
Sulfur	K-series	11.70	11.19	10.52	0.44
Zinc	K-series	9.43	9.02	4.16	0.38
Barium	L-series	5.12	4.90	1.08	2.52
Silicon	K-series	4.99	4.77	5.12	0.24
Sodium	K-series	2.36	2.26	2.96	1.88
Magnesium	K-series	2.02	1.93	2.40	0.14
Chlorine	K-series	0.54	0.51	0.44	0.05
Potassium	K-series	0.28	0.27	0.21	0.05
Phosphorus	K-series	0.17	0.17	0.16	0.04
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	24.93	23.85	44.95	21.38
	Sum:	104.55	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	35.15	34.16	16.98	1.22
Sodium	K-series	22.93	22.28	31.51	18.07
Titanium	K-series	21.32	20.71	14.07	1.72
Barium	L-series	2.79	2.71	0.64	1.39
Cadmium	L-series	1.04	1.01	0.29	0.28
Calcium	K-series	0.72	0.70	0.57	0.13
Sulfur	K-series	0.56	0.54	0.55	0.05
Aluminium	K-series	0.25	0.24	0.29	0.22
Silicon	K-series	0.21	0.20	0.24	0.04
Chlorine	K-series	0.18	0.17	0.16	0.04
Phosphorus	K-series	0.10	0.10	0.10	0.03
Selenium	L-series	0.09	0.09	0.04	0.06
Magnesium	K-series	0.08	0.08	0.11	0.09
Potassium	K-series	0.07	0.07	0.06	0.07
Oxygen	K-series	17.42	16.93	34.40	16.15
	Sum:	102.91	100.00	100.00	

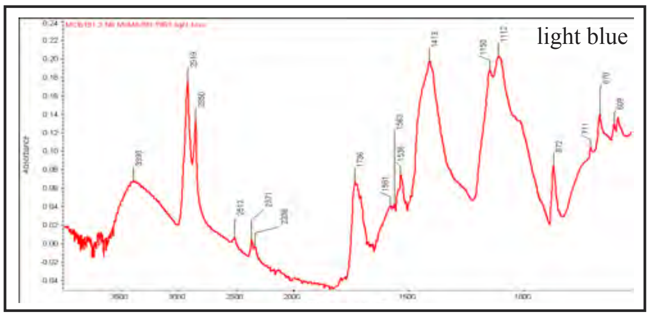


no image available

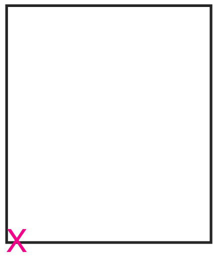
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: light blue

sample location: top edge, 26.5" from right
(T 0.0 x R 67.3 cm.)

Representative Analysis Compilation—sample N06, continued



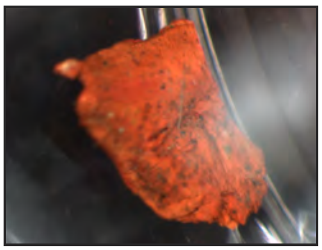
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

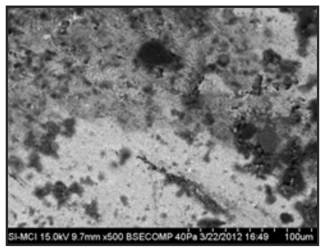


acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: orange from studio floor

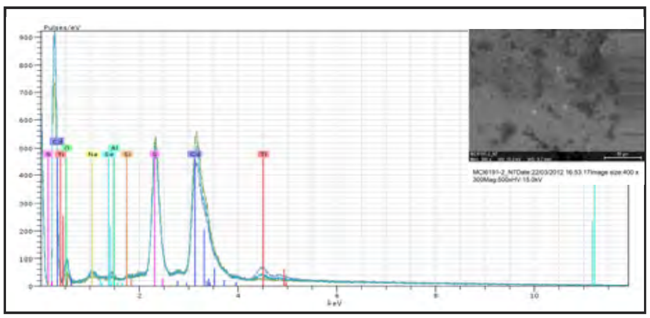
sample location: bottom edge, 2.0" from left
(B 0.0 x L 5.1 cm.)

Representative Analysis Compilation—sample N07

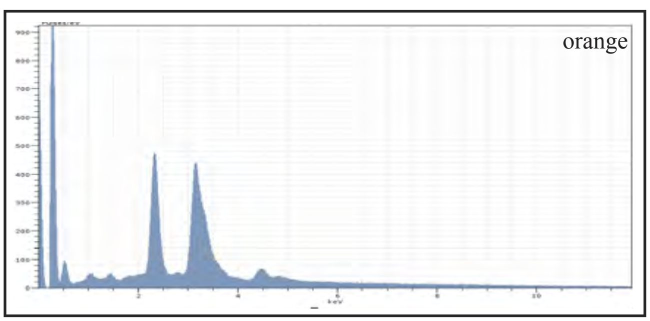




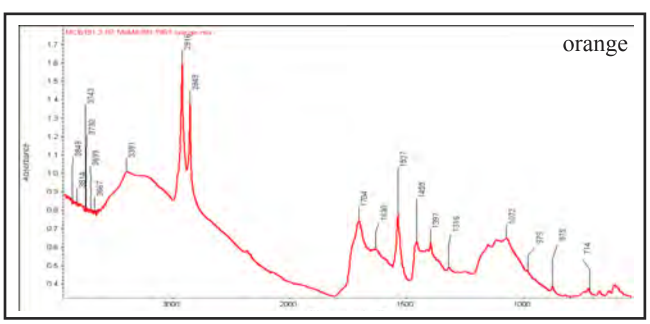
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



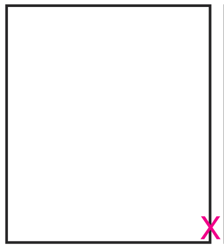
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
interpretation: cadmium orange



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	22.64	35.47	10.17	3.91
Sulfur	K-series	11.22	17.58	17.67	0.42
Potassium	K-series	4.28	6.70	5.52	1.51
Titanium	K-series	2.27	3.56	2.39	0.31
Zinc	K-series	1.66	2.60	1.28	0.10
Sodium	K-series	1.38	2.17	3.04	1.11
Selenium	L-series	1.24	1.94	0.79	0.13
Barium	L-series	0.27	0.42	0.10	0.16
Silicon	K-series	0.16	0.24	0.28	0.04
Phosphorus	K-series	0.09	0.14	0.14	0.03
Aluminium	K-series	0.08	0.13	0.15	0.09
Magnesium	K-series	0.08	0.12	0.16	0.08
Calcium	K-series	0.00	0.01	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	18.47	28.94	58.30	29.78
	Sum:	63.82	100.00	100.00	



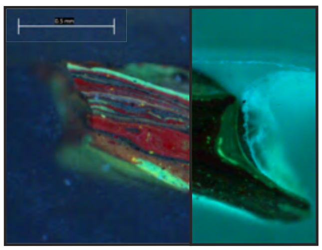
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

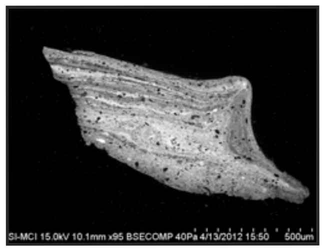
  

acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: green, brown, white

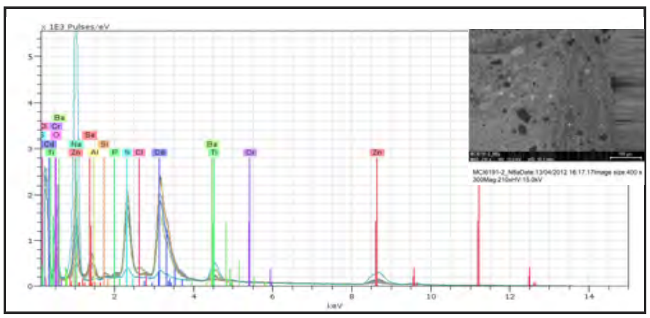
sample location: right edge, 2.0" from bottom
(B 5.1 x R 0.0 cm.)

Representative Analysis Compilation—sample N08

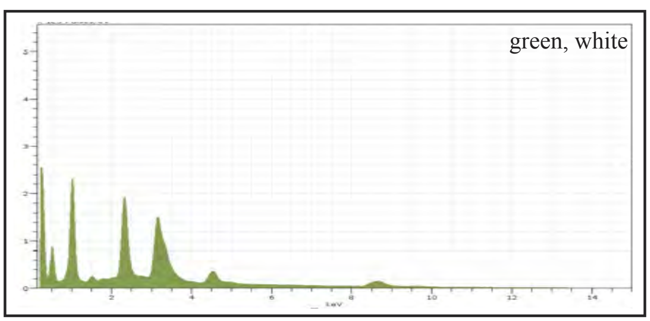




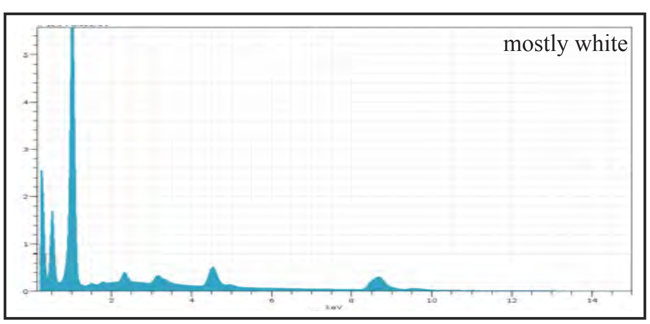
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.1 mm.



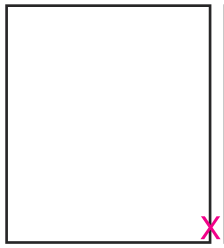
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.1 mm.
mag: 210x; HV: 15 kV
significant elements, green: Zn, Cd, S, Na
significant elements, blue: Na, Al
significant elements, red: Cd, S, Se
significant elements, white: Zn, Ti
interpretation: cadmium green, ultramarine blue, cadmium red, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	36.66	36.16	21.98	1.24
Cadmium	L-series	16.02	15.80	5.59	1.69
Sodium	K-series	12.46	12.29	21.24	9.83
Sulfur	K-series	10.65	10.50	13.02	0.40
Barium	L-series	5.94	5.86	1.70	0.56
Potassium	K-series	3.45	3.40	3.46	0.58
Titanium	K-series	3.36	3.31	2.75	0.41
Aluminium	K-series	0.79	0.78	1.14	0.62
Silicon	K-series	0.24	0.24	0.33	0.04
Phosphorus	K-series	0.09	0.09	0.11	0.03
Magnesium	K-series	0.06	0.06	0.10	0.06
Chlorine	K-series	0.01	0.01	0.02	0.03
Calcium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	11.64	11.49	28.54	7.22
	Sum:	101.38	100.00	100.00	



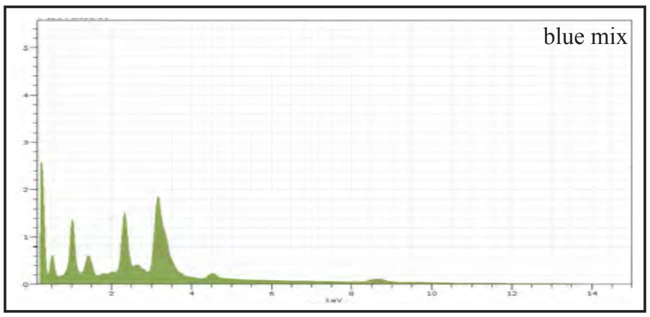
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	69.81	56.53	33.09	2.32
Sodium	K-series	26.16	21.18	35.26	20.61
Titanium	K-series	7.79	6.31	5.04	0.57
Barium	L-series	2.76	2.24	0.62	0.61
Cadmium	L-series	2.35	1.90	0.65	0.60
Sulfur	K-series	1.70	1.38	1.65	0.09
Potassium	K-series	0.57	0.46	0.45	0.24
Silicon	K-series	0.29	0.23	0.32	0.04
Aluminium	K-series	0.21	0.17	0.24	0.19
Phosphorus	K-series	0.18	0.14	0.18	0.03
Chlorine	K-series	0.07	0.06	0.06	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	11.58	9.38	22.43	5.45
	Sum:	123.48	100.00	100.00	


acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: green, brown, white

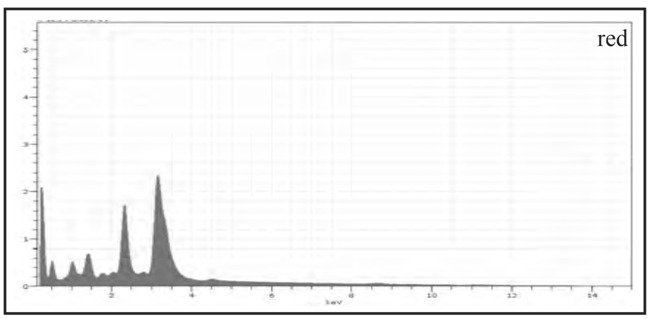
sample location: right edge, 2.0" from bottom
(B 5.1 x R 0.0 cm.)

Representative Analysis Compilation—sample N08, continued



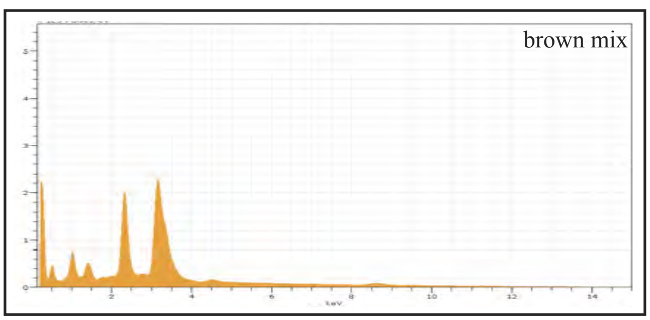
blue mix

Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	24.55	30.19	18.02	0.84
Cadmium	L-series	19.10	23.49	8.15	1.80
Sulfur	K-series	6.13	7.54	9.17	0.24
Sodium	K-series	5.73	7.04	11.95	4.53
Potassium	K-series	3.81	4.69	4.68	0.62
Barium	L-series	3.11	3.83	1.09	0.31
Selenium	L-series	1.96	2.41	1.19	0.16
Aluminium	K-series	1.29	1.59	2.30	1.01
Titanium	K-series	1.12	1.38	1.12	0.19
Chlorine	K-series	0.67	0.82	0.91	0.05
Silicon	K-series	0.08	0.10	0.14	0.03
Phosphorus	K-series	0.01	0.01	0.01	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	13.76	16.92	41.27	10.05
	Sum:	81.32	100.00	100.00	



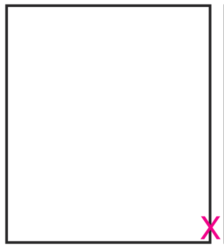
red

Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	30.15	36.72	13.96	2.51
Zinc	K-series	13.92	16.95	11.08	0.49
Sulfur	K-series	8.09	9.86	13.14	0.31
Potassium	K-series	6.07	7.39	8.08	0.83
Selenium	L-series	4.10	4.99	2.70	0.29
Barium	L-series	3.16	3.85	1.20	0.26
Sodium	K-series	2.30	2.81	5.22	1.84
Aluminium	K-series	0.82	1.00	1.58	0.65
Silicon	K-series	0.35	0.42	0.65	0.04
Phosphorus	K-series	0.16	0.19	0.27	0.03
Calcium	K-series	0.04	0.05	0.05	0.05
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	12.94	15.76	42.09	10.00
	Sum:	82.11	100.00	100.00	



brown mix

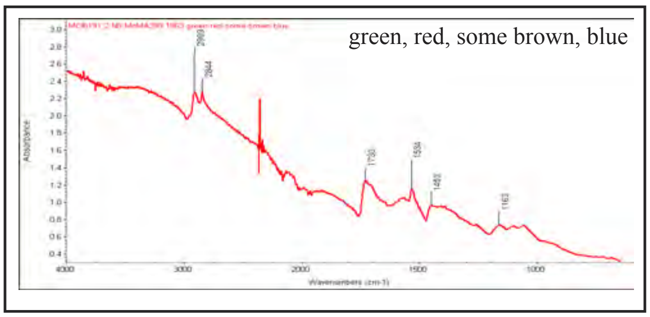
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	15.35	20.49	10.15	0.63
Cadmium	L-series	26.94	37.01	13.09	2.29
Zinc	K-series	11.42	15.69	9.54	0.41
Sulfur	K-series	8.87	12.19	15.12	0.34
Potassium	K-series	5.43	7.46	7.59	0.76
Sodium	K-series	3.45	4.73	8.19	2.74
Selenium	L-series	2.74	3.76	1.89	0.20
Titanium	K-series	0.62	0.85	0.70	0.10
Aluminium	K-series	0.61	0.84	1.24	0.49
Barium	L-series	0.21	0.28	0.08	0.13
Silicon	K-series	0.08	0.11	0.15	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	12.42	17.06	42.40	11.20
	Sum:	72.78	100.00	100.00	



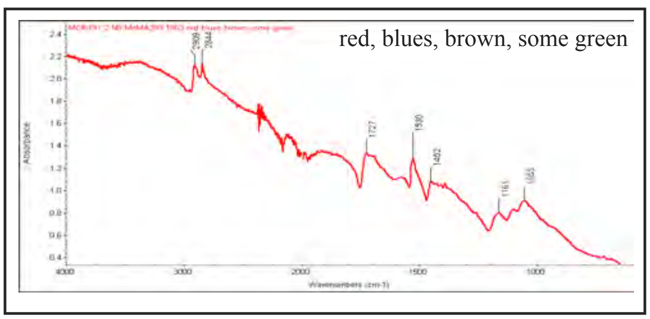
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: green, brown, white

sample location: right edge, 2.0" from bottom
(B 5.1 x R 0.0 cm.)

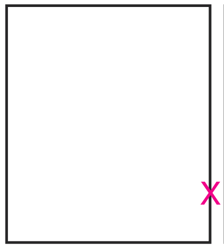
Representative Analysis Compilation—sample N08, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



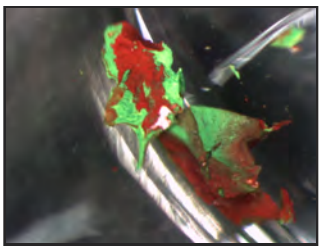
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

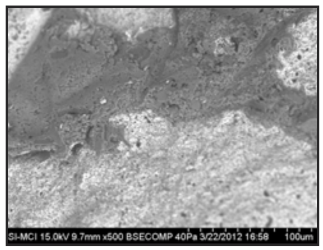


acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: green, red

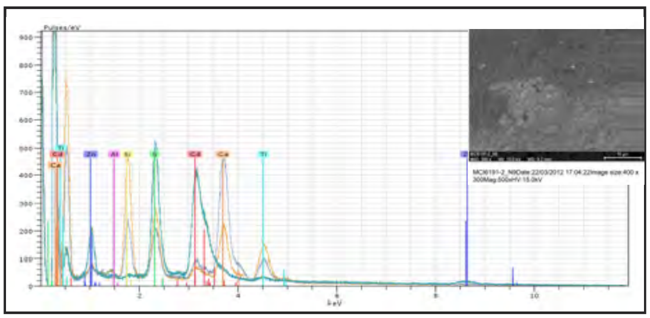
sample location: right edge, 14.5" from bottom
(B 36.8 x R 0.0 cm.)

Representative Analysis Compilation—sample N09

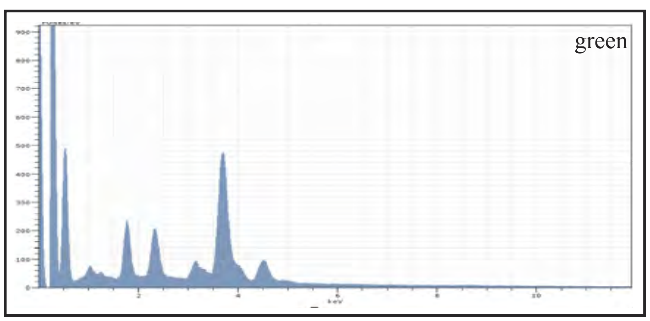




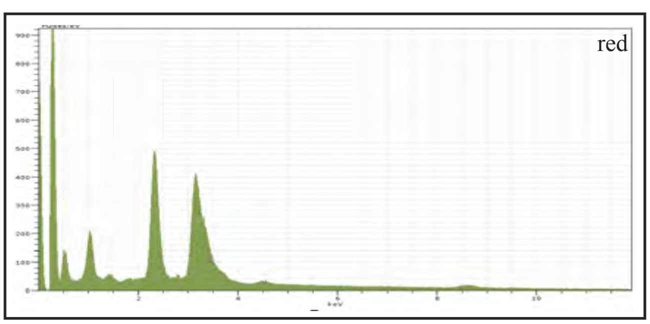
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



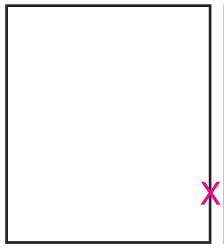
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cd, S, Se, Na, Zn
significant elements, red: Cd, S, Se
interpretation: cadmium green, cadmium red



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	24.34	25.81	15.89	0.97
Titanium	K-series	6.53	6.92	3.57	0.79
Silicon	K-series	5.28	5.60	4.92	0.25
Cadmium	L-series	4.56	4.83	1.06	1.14
Zinc	K-series	4.19	4.44	1.68	0.20
Sulfur	K-series	4.15	4.40	3.39	0.17
Barium	L-series	2.48	2.63	0.47	1.14
Magnesium	K-series	0.60	0.63	0.64	0.21
Sodium	K-series	0.50	0.53	0.57	0.42
Potassium	K-series	0.23	0.24	0.15	0.18
Selenium	L-series	0.10	0.11	0.03	0.04
Aluminium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	41.37	43.86	67.64	32.59
	Sum:	94.31	100.00	100.00	



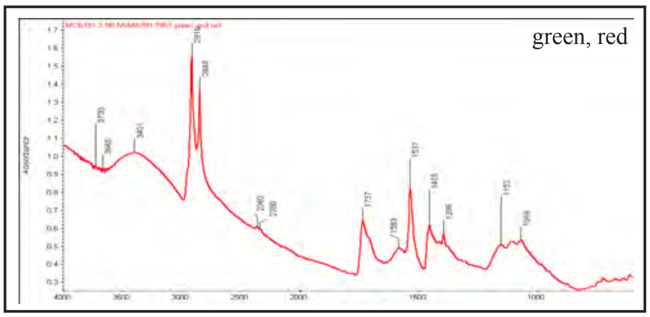
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	30.67	32.63	12.26	5.07
Zinc	K-series	18.12	19.28	12.45	0.68
Sulfur	K-series	18.11	19.27	25.39	0.67
Sodium	K-series	5.05	5.37	9.86	4.00
Potassium	K-series	4.67	4.96	5.36	2.13
Barium	L-series	4.11	4.37	1.34	0.47
Calcium	K-series	1.00	1.06	1.12	0.36
Selenium	L-series	0.60	0.63	0.34	0.08
Phosphorus	K-series	0.32	0.35	0.47	0.05
Aluminium	K-series	0.26	0.27	0.43	0.22
Silicon	K-series	0.12	0.12	0.18	0.03
Titanium	K-series	0.03	0.03	0.02	0.04
Chlorine	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	10.95	11.65	30.76	15.72
	Sum:	93.99	100.00	100.00	

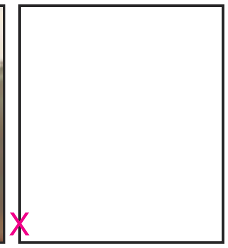

acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: green, red

sample location: right edge, 14.5" from bottom (B 36.8 x R 0.0 cm.)

Representative Analysis Compilation—sample N09, continued



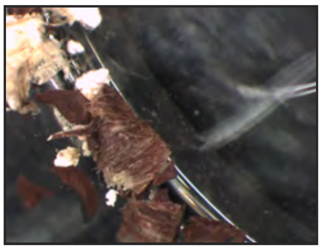
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

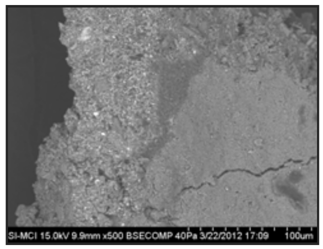


acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: brown

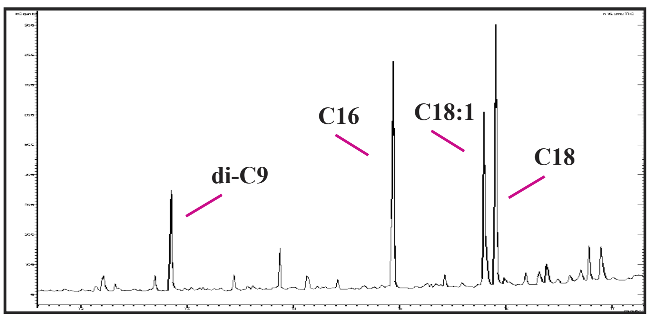
sample location: left edge, 4.0" from bottom
(B 10.2 x L 0.0 cm.)

Representative Analysis Compilation—sample N10

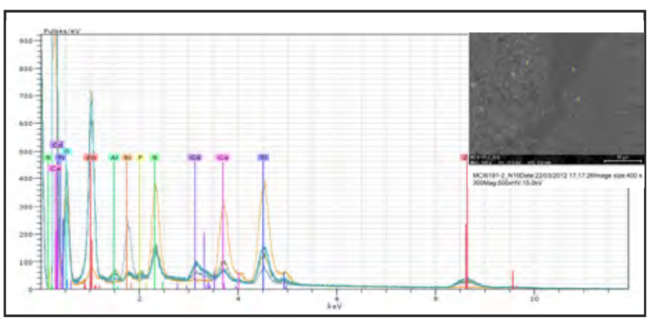




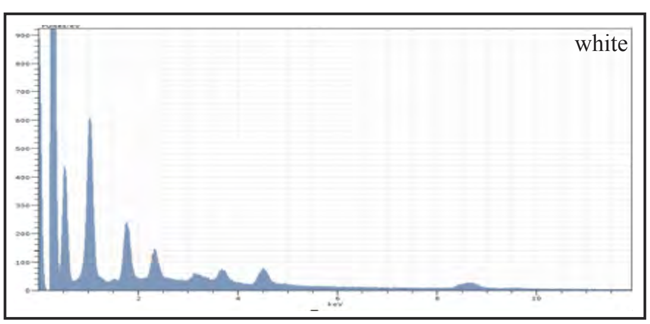
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.117
scan range: 1 - 1484
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn
significant elements, brown: none
interpretation: zinc white, mixed colors

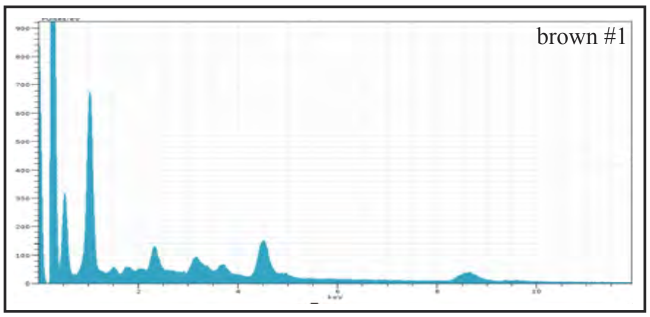


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	32.93	32.75	15.42	1.17
Sodium	K-series	14.73	14.65	19.62	11.62
Silicon	K-series	6.82	6.78	7.44	0.32
Titanium	K-series	4.77	4.75	3.05	0.68
Barium	L-series	4.61	4.58	1.03	1.02
Cadmium	L-series	4.33	4.30	1.18	1.08
Sulfur	K-series	4.23	4.21	4.04	0.18
Calcium	K-series	3.73	3.71	2.85	0.33
Chlorine	K-series	0.63	0.63	0.54	0.06
Potassium	K-series	0.34	0.34	0.27	0.26
Phosphorus	K-series	0.24	0.23	0.23	0.04
Magnesium	K-series	0.06	0.06	0.07	0.07
Aluminium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	23.12	22.99	44.25	20.00
	Sum:	100.55	100.00	100.00	

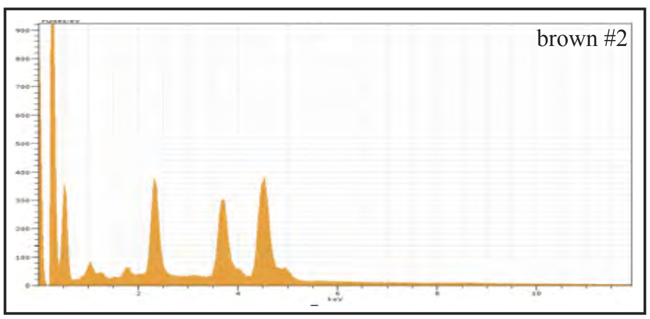
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: brown

sample location: left edge, 4.0" from bottom
(B 10.2 x L 0.0 cm.)

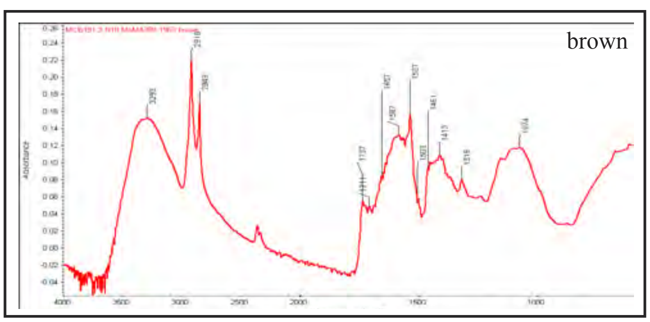
Representative Analysis Compilation—sample N10, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	39.40	38.16	20.33	1.37
Sodium	K-series	18.68	18.10	27.42	14.73
Titanium	K-series	11.76	11.39	8.29	1.32
Cadmium	L-series	5.97	5.78	1.79	1.48
Barium	L-series	3.56	3.45	0.87	1.65
Sulfur	K-series	3.33	3.22	3.50	0.15
Calcium	K-series	2.25	2.18	1.89	0.25
Silicon	K-series	0.68	0.66	0.82	0.06
Potassium	K-series	0.58	0.56	0.50	0.42
Phosphorus	K-series	0.46	0.45	0.50	0.05
Chlorine	K-series	0.38	0.36	0.36	0.05
Aluminium	K-series	0.33	0.32	0.41	0.27
Magnesium	K-series	0.21	0.20	0.29	0.15
Selenium	L-series	0.01	0.01	0.00	0.03
Oxygen	K-series	15.66	15.17	33.03	15.76
	Sum:	103.23	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	38.10	32.86	22.25	2.80
Calcium	K-series	17.67	15.24	12.33	0.79
Sulfur	K-series	13.69	11.81	11.94	0.51
Zinc	K-series	8.23	7.10	3.52	0.35
Barium	L-series	7.40	6.38	1.51	3.51
Sodium	K-series	2.45	2.11	2.98	1.95
Silicon	K-series	1.34	1.15	1.33	0.09
Magnesium	K-series	1.29	1.12	1.49	0.38
Cadmium	L-series	1.12	0.96	0.28	0.31
Chlorine	K-series	0.51	0.44	0.40	0.05
Phosphorus	K-series	0.27	0.24	0.25	0.04
Aluminium	K-series	0.00	0.00	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	23.87	20.59	41.72	22.16
	Sum:	115.94	100.00	100.00	

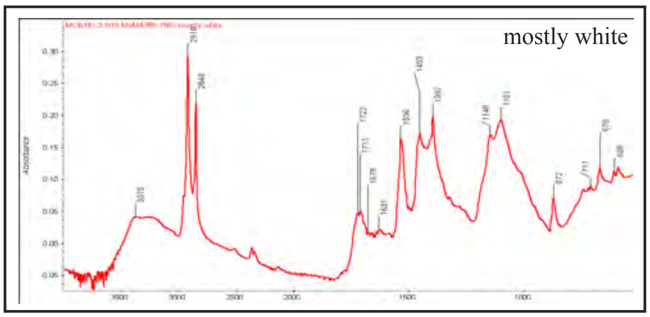


analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

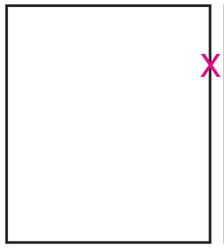
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: brown

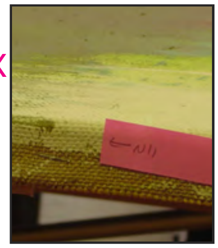
sample location: left edge, 4.0" from bottom
(B 10.2 x L 0.0 cm.)

Representative Analysis Compilation—sample N10, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

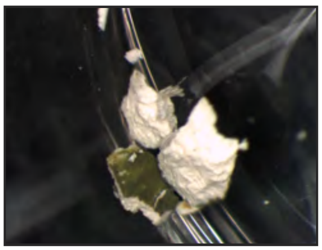


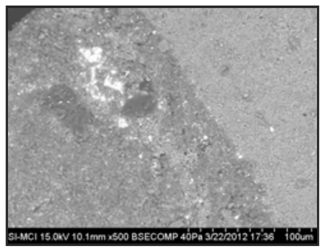


acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: green mix

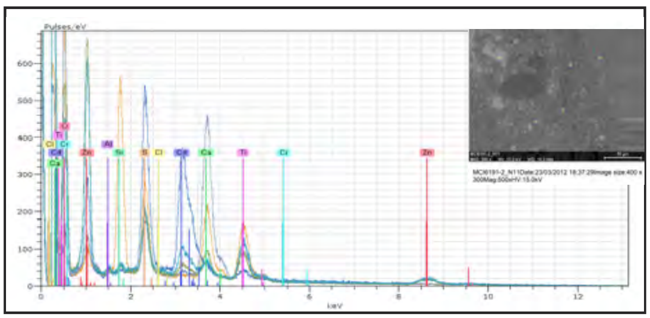
sample location: right edge, 18.5" from top
(T 47.0 x R 0.0 cm.)

Representative Analysis Compilation—sample N11

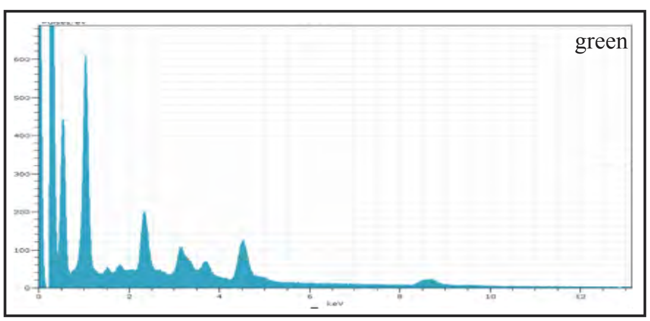




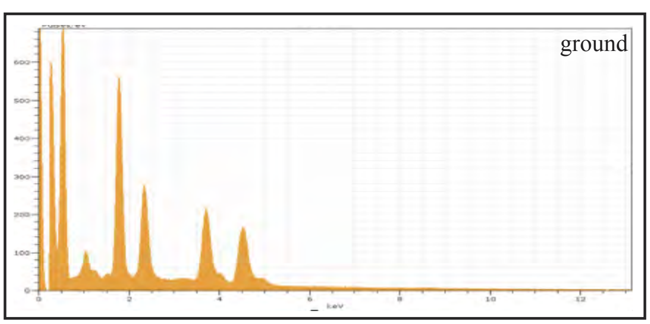
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



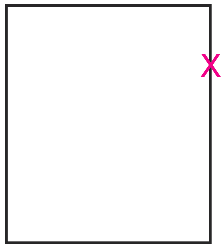
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.3 mm.
mag: 500x; HV: 15 kV
significant elements, green: Zn, Na, Cd, S
significant elements, ground: Ti
interpretation: cadmium green, titanium white
(possible alkyd)

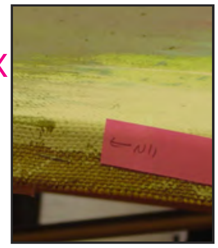


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	21.98	24.47	10.29	0.80
Titanium	K-series	10.51	11.70	6.72	0.99
Sodium	K-series	7.05	7.85	9.38	5.57
Cadmium	L-series	6.58	7.32	1.79	1.63
Sulfur	K-series	4.81	5.36	4.59	0.20
Calcium	K-series	2.61	2.90	1.99	0.24
Potassium	K-series	0.85	0.94	0.66	0.60
Barium	L-series	0.71	0.79	0.16	0.38
Chromium	K-series	0.52	0.58	0.31	0.05
Chlorine	K-series	0.45	0.50	0.39	0.05
Silicon	K-series	0.41	0.46	0.45	0.05
Aluminium	K-series	0.35	0.39	0.39	0.29
Phosphorus	K-series	0.17	0.19	0.17	0.03
Magnesium	K-series	0.11	0.13	0.14	0.10
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	32.70	36.41	62.56	52.32
	Sum:	89.81	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Titanium	K-series	14.86	15.29	7.76	1.39
Silicon	K-series	12.42	12.78	11.06	0.54
Calcium	K-series	11.63	11.96	7.25	0.56
Sulfur	K-series	6.53	6.72	5.09	0.26
Zinc	K-series	4.13	4.25	1.58	0.21
Barium	L-series	3.47	3.57	0.63	1.72
Sodium	K-series	1.37	1.41	1.49	1.10
Magnesium	K-series	0.87	0.90	0.90	0.08
Cadmium	L-series	0.82	0.84	0.18	0.23
Chlorine	K-series	0.12	0.12	0.08	0.03
Potassium	K-series	0.04	0.04	0.03	0.05
Aluminium	K-series	0.04	0.04	0.03	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	40.89	42.08	63.91	26.85
	Sum:	97.17	100.00	100.00	

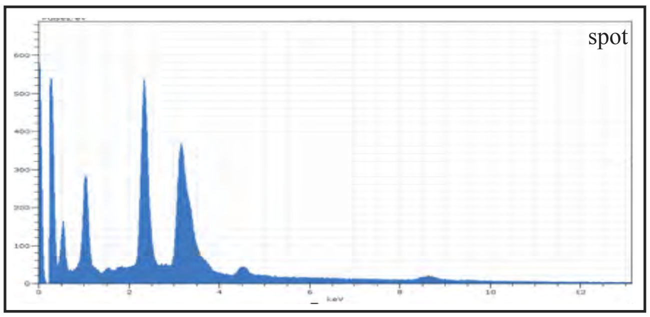




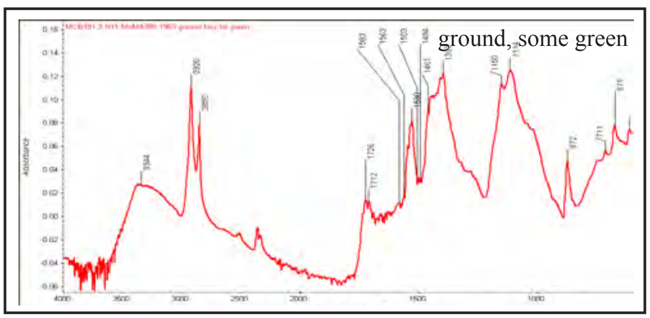
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: green mix

sample location: right edge, 18.5" from top
(T 47.0 x R 0.0 cm.)

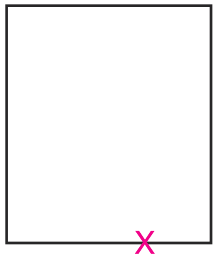
Representative Analysis Compilation—sample N11, continued

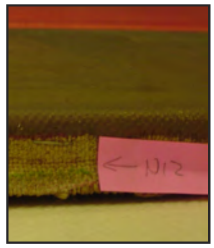


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	39.03	35.93	12.87	6.22
Sulfur	K-series	21.70	19.98	25.08	0.80
Zinc	K-series	16.62	15.30	9.42	0.62
Sodium	K-series	5.72	5.27	9.22	4.53
Potassium	K-series	4.47	4.11	4.23	2.18
Titanium	K-series	1.65	1.52	1.27	0.31
Barium	L-series	1.57	1.44	0.42	0.52
Calcium	K-series	0.90	0.83	0.84	0.33
Chlorine	K-series	0.87	0.80	0.90	0.08
Silicon	K-series	0.60	0.55	0.79	0.06
Phosphorus	K-series	0.51	0.47	0.60	0.05
Aluminium	K-series	0.29	0.27	0.40	0.24
Magnesium	K-series	0.14	0.13	0.21	0.12
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	14.57	13.41	33.74	19.55
	Sum:	108.62	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

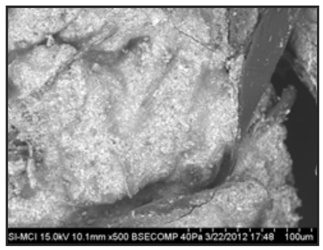




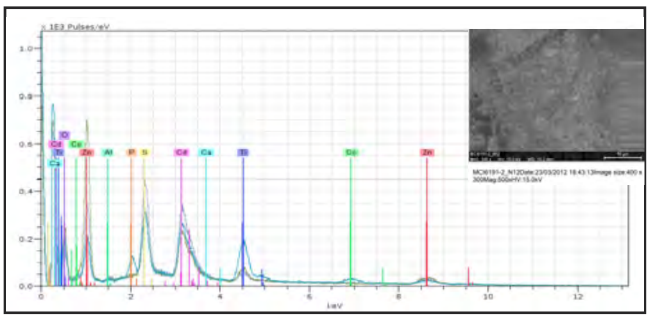
acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: green on fibers

sample location: bottom edge, 26.0" from right
(B 0.0 x R 66.0 cm.)

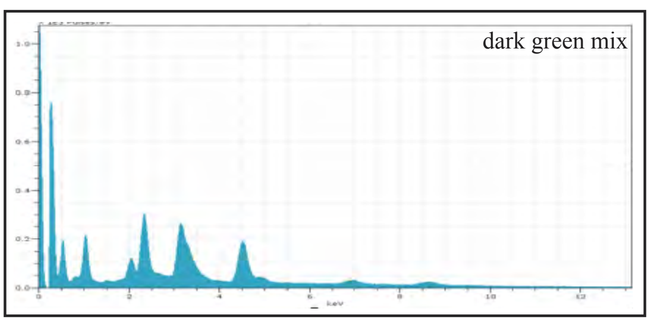
Representative Analysis Compilation—sample N12



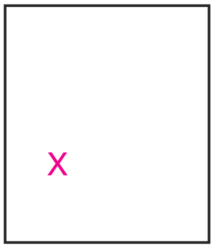
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.2 mm.
mag: 500x; HV: 15 kV
significant elements, green: Zn, Cd, S, Na, Co
interpretation: cadmium green, possible cobalt green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	27.54	21.34	8.22	5.04
Zinc	K-series	25.81	20.00	13.24	0.92
Titanium	K-series	13.93	10.79	9.76	1.51
Sulfur	K-series	12.85	9.95	13.44	0.48
Cobalt	K-series	10.99	8.52	6.26	0.37
Sodium	K-series	8.08	6.26	11.80	6.39
Barium	L-series	7.73	5.99	1.89	1.62
Phosphorus	K-series	3.85	2.99	4.18	0.18
Potassium	K-series	2.96	2.30	2.54	1.68
Chlorine	K-series	1.68	1.30	1.59	0.10
Magnesium	K-series	1.35	1.04	1.86	0.48
Aluminium	K-series	0.37	0.29	0.46	0.31
Calcium	K-series	0.15	0.12	0.13	0.13
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	11.75	9.10	24.64	13.85
	Sum:	129.05	100.00	100.00	

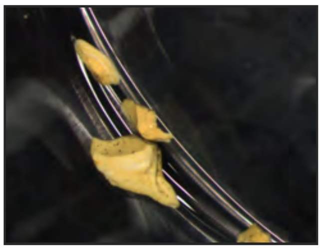


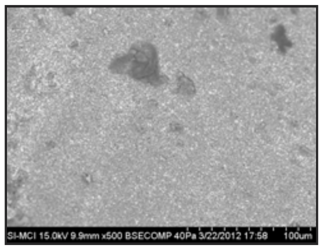
no image available

acc. no.: MoMA 399.1963
title, year: *Memoria in Aeternum*, 1962
Gift of the artist
medium noted in file: oil on canvas
meas.: 84.0 x 72.1" (213.4 x 183.2 cm.)
notes: yellow

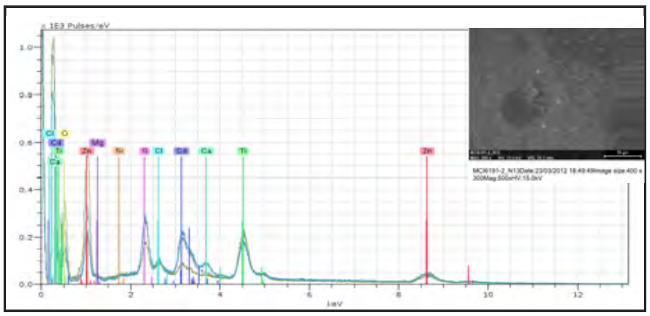
sample location: 29.0" from bottom, 15.0" from left
(B 73.7 x L 38.1 cm.)

Representative Analysis Compilation—sample N13

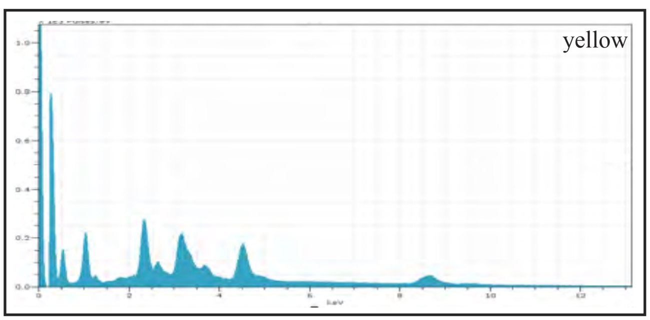




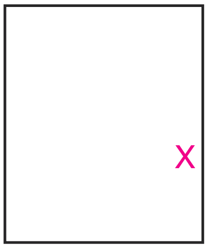
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.

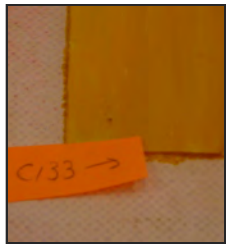


analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
interpretation: cadmium yellow



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	38.29	37.92	24.09	1.32
Cadmium	L-series	12.02	11.91	4.40	2.77
Sodium	K-series	11.61	11.50	20.78	9.16
Titanium	K-series	9.33	9.24	8.02	1.05
Sulfur	K-series	8.57	8.49	10.99	0.33
Barium	L-series	4.95	4.90	1.48	1.15
Calcium	K-series	1.97	1.95	2.02	0.23
Chlorine	K-series	1.89	1.88	2.20	0.10
Potassium	K-series	1.75	1.73	1.84	0.94
Magnesium	K-series	1.57	1.56	2.66	0.47
Silicon	K-series	0.87	0.87	1.28	0.07
Phosphorus	K-series	0.45	0.45	0.60	0.05
Selenium	L-series	0.06	0.06	0.03	0.04
Oxygen	K-series	7.62	7.54	19.59	10.18
	Sum:	100.98	100.00	100.00	

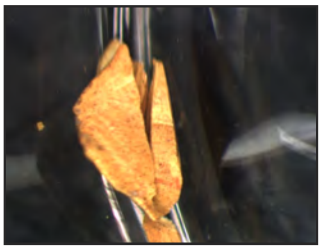


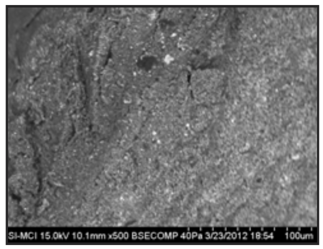


acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: dark yellow

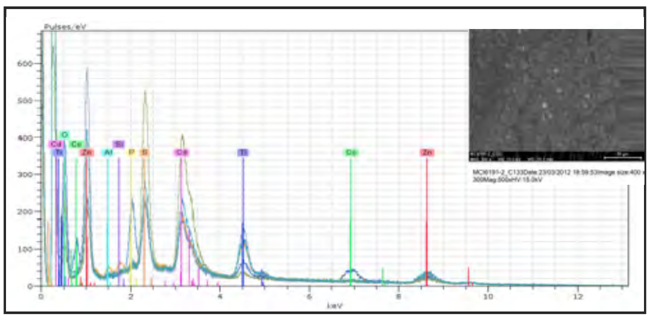
sample location: 25.8" from bottom, 4.3" from right
(B 65.5 x R 10.9 cm.)

Representative Analysis Compilation—sample C133

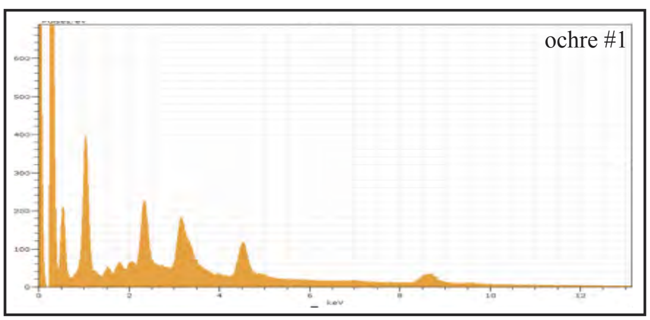




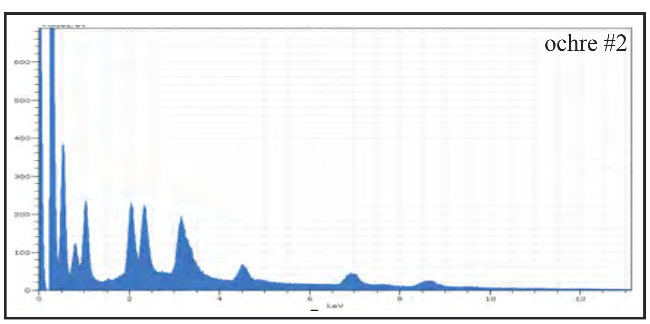
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



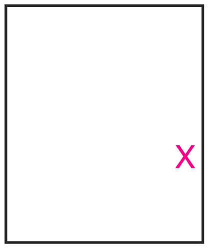
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, ochre #1: Zn, Na
significant elements, ochre #2: Zn, Co
interpretation: inconclusive

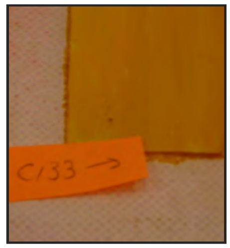


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	27.54	33.64	17.97	0.97
Sodium	K-series	11.81	14.43	21.92	9.32
Cadmium	L-series	8.25	10.07	3.13	2.04
Titanium	K-series	6.00	7.32	5.34	0.72
Sulfur	K-series	4.39	5.36	5.84	0.18
Barium	L-series	3.65	4.46	1.14	0.92
Cobalt	K-series	2.32	2.83	1.68	0.12
Potassium	K-series	1.46	1.78	1.59	0.77
Iron	K-series	0.68	0.83	0.52	0.09
Silicon	K-series	0.24	0.29	0.37	0.04
Phosphorus	K-series	0.22	0.26	0.30	0.04
Magnesium	K-series	0.19	0.24	0.34	0.14
Aluminium	K-series	0.15	0.19	0.24	0.14
Calcium	K-series	0.14	0.17	0.14	0.12
Chlorine	K-series	0.08	0.09	0.09	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	14.77	18.03	39.38	17.69
	Sum:	81.87	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	19.86	23.59	11.00	0.72
Cobalt	K-series	11.23	13.34	6.90	0.39
Potassium	K-series	7.67	9.11	7.11	0.26
Sulfur	K-series	6.56	7.79	7.41	0.26
Phosphorus	K-series	6.54	7.77	7.64	0.28
Sodium	K-series	4.46	5.30	7.03	3.54
Titanium	K-series	2.37	2.82	1.79	0.35
Barium	L-series	2.02	2.39	0.53	0.54
Chlorine	K-series	0.93	1.10	0.95	0.06
Iron	K-series	0.63	0.75	0.41	0.09
Magnesium	K-series	0.32	0.38	0.47	0.19
Aluminium	K-series	0.06	0.07	0.07	0.07
Silicon	K-series	0.05	0.06	0.07	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	21.48	25.52	48.61	18.24
	Sum:	84.16	100.00	100.00	

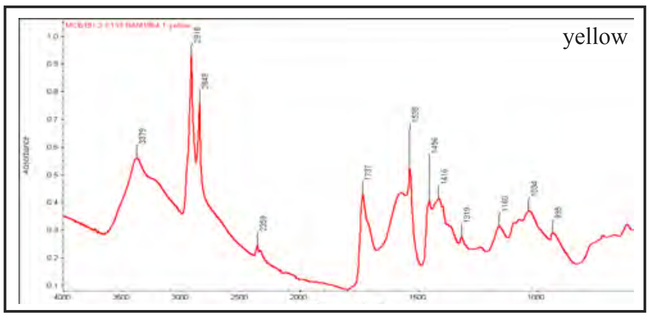




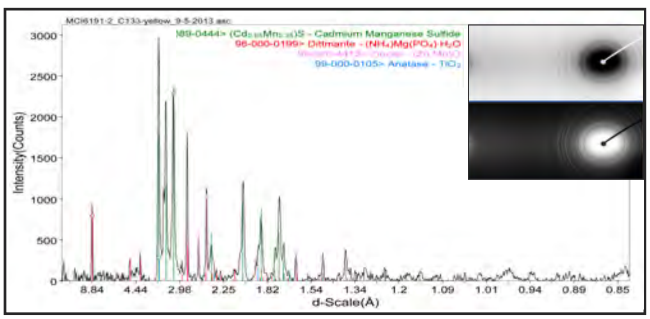
acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: dark yellow

sample location: 25.8" from bottom, 4.3" from right
(B 65.5 x R 10.9 cm.)

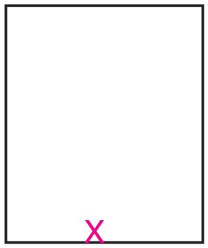
Representative Analysis Compilation—sample C133, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil



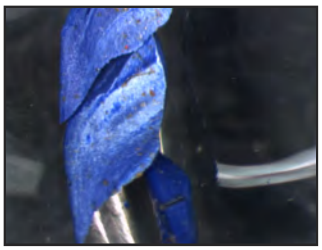
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, spin 360º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium manganese sulfide, dittmarite, zincite, anatase titanium
interpretation: cadmium yellow

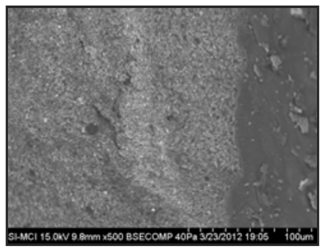


acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: blue

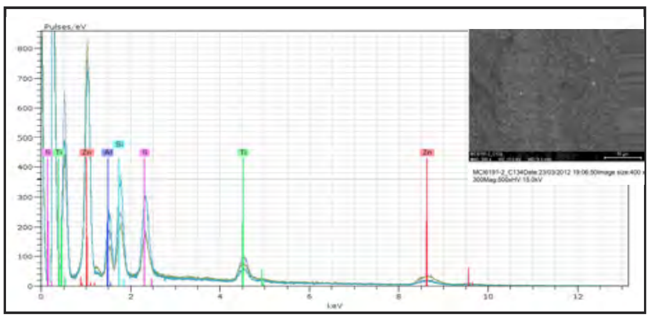
sample location: 2.0" from bottom, 28.3" from left
(B 5.1 x L 71.9 cm.)

Representative Analysis Compilation—sample C134

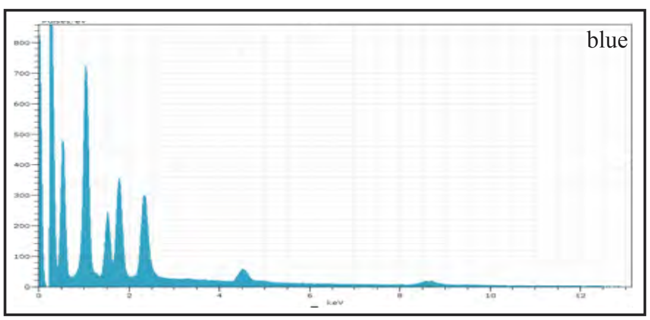




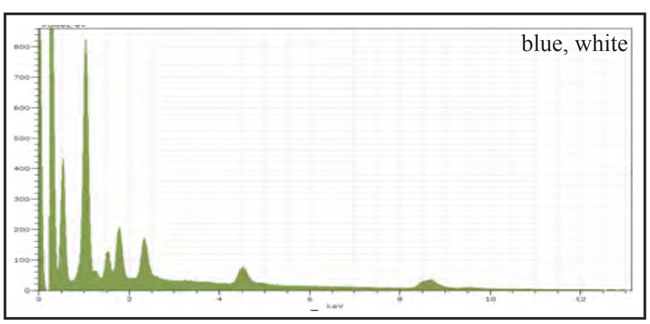
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



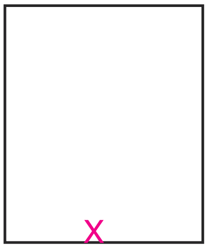
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Si, Al
significant elements, white: Zn, Ti
interpretation: ultramarine blue, Zn/Ti white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	18.70	21.10	8.20	0.69
Sodium	K-series	16.93	19.11	21.13	13.35
Silicon	K-series	8.99	10.15	9.19	0.40
Sulfur	K-series	8.39	9.47	7.50	0.32
Aluminium	K-series	4.67	5.27	4.96	0.25
Titanium	K-series	2.68	3.03	1.61	0.39
Barium	L-series	1.88	2.12	0.39	0.61
Chlorine	K-series	0.13	0.14	0.10	0.03
Potassium	K-series	0.06	0.06	0.04	0.03
Magnesium	K-series	0.06	0.06	0.07	0.03
Calcium	K-series	0.02	0.03	0.02	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	26.10	29.45	46.79	20.08
	Sum:	88.60	100.00	100.00	



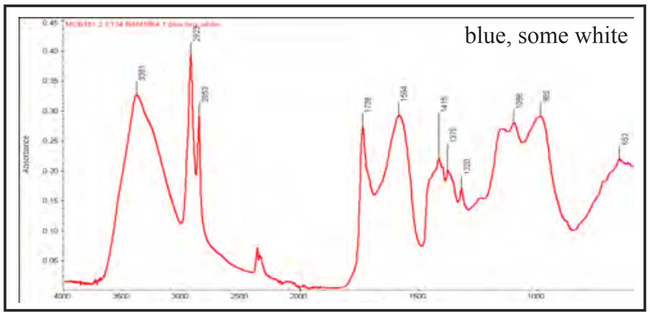
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	37.99	35.45	17.13	1.33
Sodium	K-series	23.55	21.98	30.21	18.56
Silicon	K-series	6.01	5.61	6.31	0.28
Barium	L-series	5.78	5.39	1.24	0.88
Sulfur	K-series	4.91	4.58	4.51	0.20
Titanium	K-series	3.74	3.49	2.31	0.57
Aluminium	K-series	3.01	2.81	3.29	0.17
Copper	K-series	2.44	2.28	1.13	0.14
Magnesium	K-series	1.13	1.05	1.37	0.10
Chlorine	K-series	0.71	0.66	0.59	0.05
Potassium	K-series	0.48	0.45	0.36	0.05
Calcium	K-series	0.40	0.37	0.29	0.05
Phosphorus	K-series	0.08	0.08	0.08	0.03
Oxygen	K-series	16.92	15.79	31.18	13.72
	Sum:	107.16	100.00	100.00	



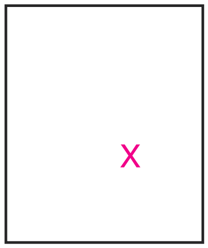
acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: blue

sample location: 2.0" from bottom, 28.3" from left
(B 5.1 x L 71.9 cm.)

Representative Analysis Compilation—sample C134, continued



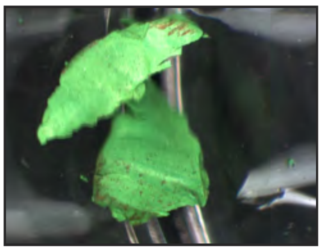
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: filler

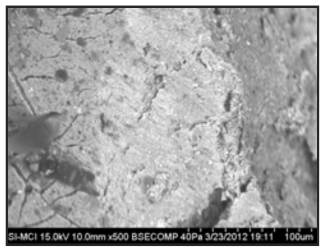


acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: green

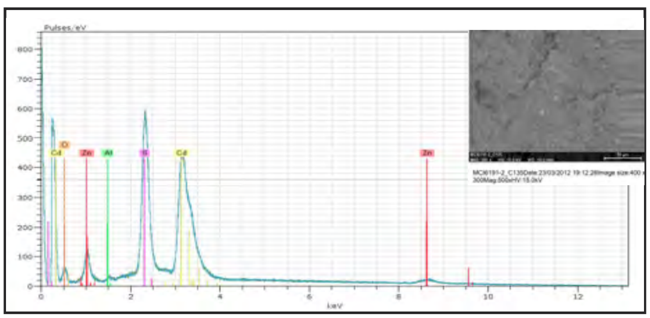
sample location: 28.0" from bottom, 19.5" from right
(B 71.1 x R 49.5 cm.)

Representative Analysis Compilation—sample C135

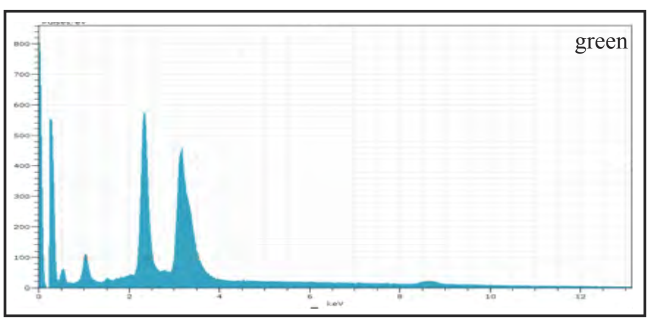




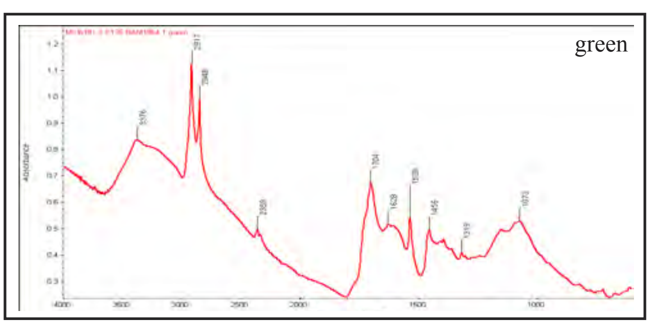
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



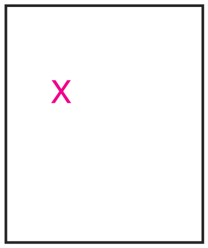
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, green: Zn, Cd, S, Na
interpretation: cadmium green



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	36.11	33.79	14.66	5.63
Zinc	K-series	29.49	27.59	20.59	1.05
Sulfur	K-series	19.91	18.63	28.35	0.73
Sodium	K-series	7.26	6.79	14.41	5.74
Potassium	K-series	5.71	5.34	6.66	2.05
Barium	L-series	2.84	2.65	0.94	0.35
Chlorine	K-series	0.46	0.43	0.59	0.06
Magnesium	K-series	0.40	0.37	0.74	0.26
Aluminium	K-series	0.20	0.19	0.34	0.18
Phosphorus	K-series	0.08	0.07	0.11	0.03
Silicon	K-series	0.03	0.02	0.04	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	4.40	4.12	12.55	7.13
	Sum:	106.89	100.00	100.00	



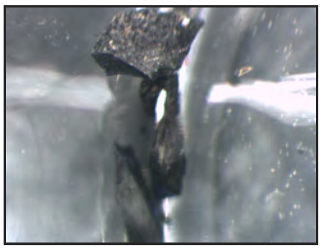
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

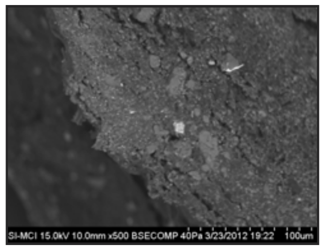


acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: black

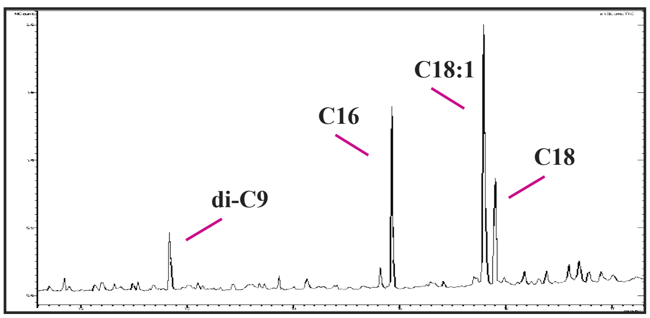
sample location: 27.8" from top, 16.5" from left (T 70.6 x L 41.9 cm.)

Representative Analysis Compilation—sample C136

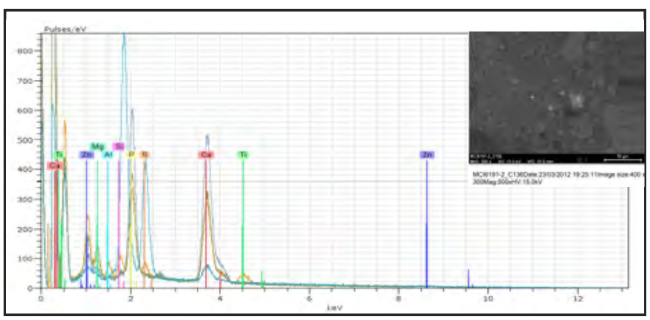




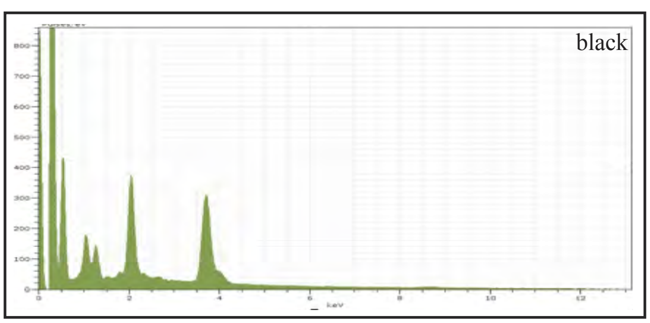
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



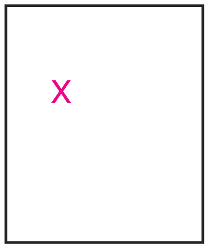
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.162
scan range: 1 - 1484
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, black: Ca, P
interpretation: bone black



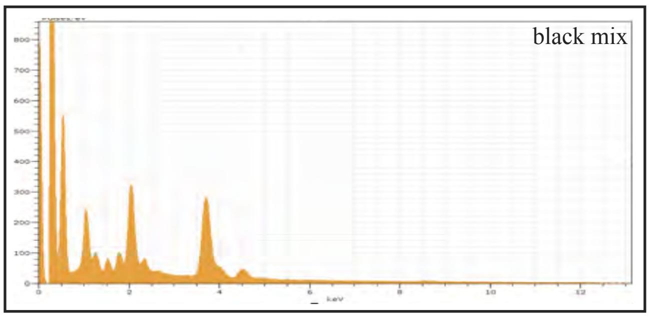
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	14.08	19.02	10.16	0.45
Phosphorus	K-series	8.94	12.07	8.34	0.37
Zinc	K-series	3.85	5.21	1.70	0.19
Magnesium	K-series	2.76	3.73	3.28	0.18
Sodium	K-series	2.31	3.12	2.90	1.84
Sulfur	K-series	0.57	0.77	0.51	0.05
Barium	L-series	0.45	0.61	0.10	0.12
Chlorine	K-series	0.45	0.61	0.37	0.04
Iron	K-series	0.42	0.56	0.22	0.05
Silicon	K-series	0.23	0.31	0.24	0.04
Potassium	K-series	0.04	0.06	0.03	0.03
Aluminium	K-series	0.02	0.03	0.02	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	39.91	53.90	72.12	33.27
	Sum:	74.05	100.00	100.00	



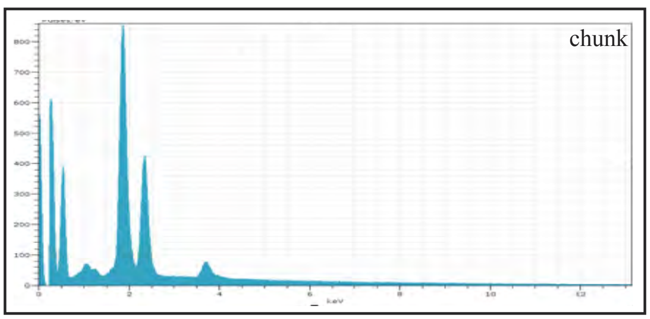
acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: black

sample location: 27.8" from top, 16.5" from left
(T 70.6 x L 41.9 cm.)

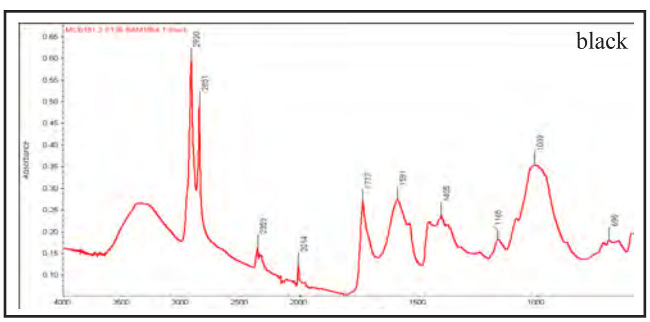
Representative Analysis Compilation—sample C136, continued



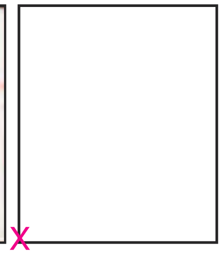
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	13.13	16.57	8.75	0.42
Phosphorus	K-series	6.47	8.17	5.58	0.27
Sodium	K-series	4.00	5.05	4.65	3.18
Zinc	K-series	3.77	4.76	1.54	0.19
Titanium	K-series	2.30	2.90	1.28	0.33
Magnesium	K-series	1.36	1.72	1.49	0.10
Sulfur	K-series	1.12	1.41	0.93	0.07
Silicon	K-series	0.88	1.11	0.84	0.06
Barium	L-series	0.60	0.76	0.12	0.32
Aluminium	K-series	0.51	0.65	0.51	0.05
Iron	K-series	0.48	0.61	0.23	0.05
Chlorine	K-series	0.33	0.41	0.25	0.04
Potassium	K-series	0.04	0.05	0.03	0.03
Oxygen	K-series	44.22	55.83	73.81	32.88
	Sum:	79.21	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	16.33	18.40	15.45	0.71
Sulfur	K-series	12.03	13.55	9.97	0.45
Phosphorus	K-series	10.47	11.80	8.98	0.43
Zinc	K-series	7.88	8.87	3.20	0.32
Calcium	K-series	3.03	3.42	2.01	0.13
Barium	L-series	2.19	2.47	0.42	0.27
Sodium	K-series	1.12	1.26	1.29	0.91
Magnesium	K-series	0.50	0.56	0.55	0.06
Chlorine	K-series	0.22	0.24	0.16	0.04
Potassium	K-series	0.16	0.18	0.11	0.04
Titanium	K-series	0.00	0.00	0.00	0.02
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	34.84	39.25	57.85	29.66
	Sum:	88.78	100.00	100.00	



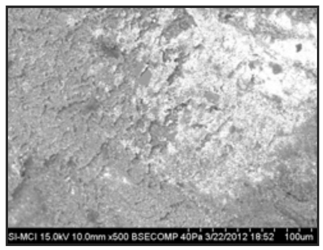
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil



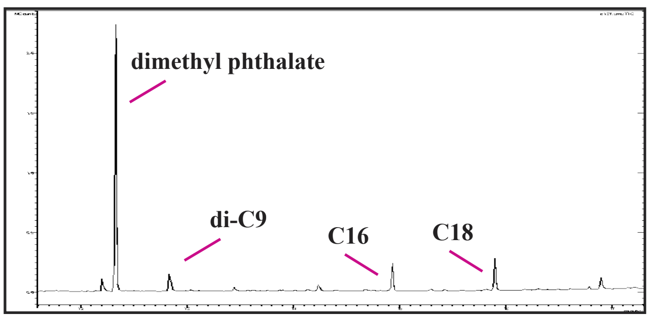
acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: magenta wash and ground layer

sample location: lower left corner
(B 0.0 x L 0.0 cm.)

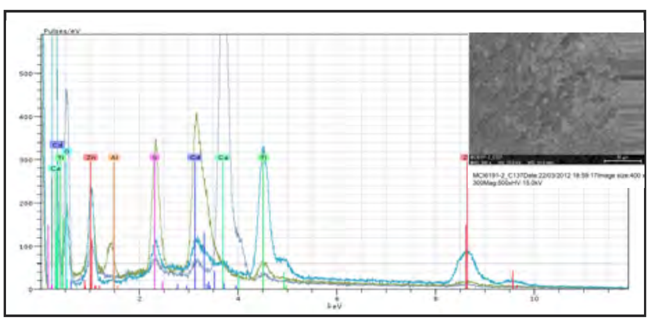
Representative Analysis Compilation—sample C137



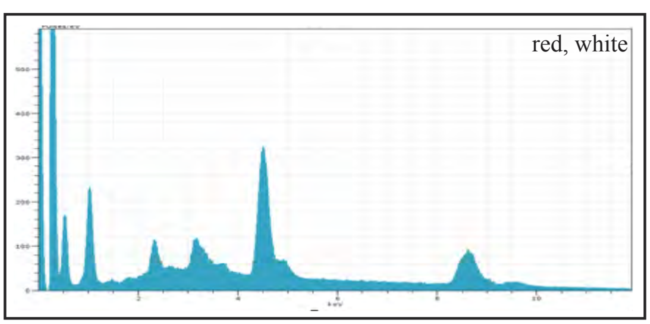
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.130
scan range: 1 - 1480
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd, possible oil



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, white: Ti
interpretation: cadmium red, titanium white

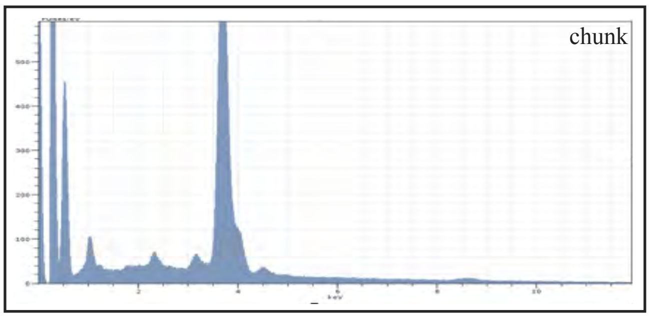


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	60.18	55.59	39.03	2.03
Titanium	K-series	14.90	13.76	13.20	1.19
Sodium	K-series	10.21	9.43	18.83	8.06
Cadmium	L-series	7.12	6.57	2.68	1.76
Sulfur	K-series	3.87	3.57	5.12	0.17
Barium	L-series	2.18	2.01	0.67	1.09
Chlorine	K-series	1.02	0.95	1.23	0.07
Potassium	K-series	0.76	0.70	0.83	0.54
Calcium	K-series	0.61	0.56	0.65	0.14
Selenium	L-series	0.51	0.47	0.28	0.08
Silicon	K-series	0.33	0.31	0.50	0.05
Phosphorus	K-series	0.24	0.22	0.33	0.04
Aluminium	K-series	0.09	0.09	0.15	0.10
Magnesium	K-series	0.02	0.01	0.03	0.04
Oxygen	K-series	6.22	5.75	16.50	7.96
	Sum:	108.26	100.00	100.00	

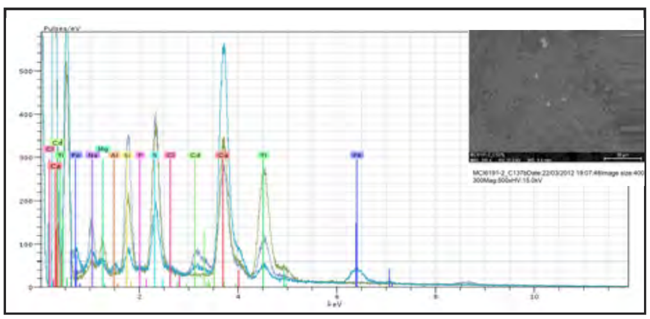
acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: magenta wash and ground layer

sample location: lower left corner
(B 0.0 x L 0.0 cm.)

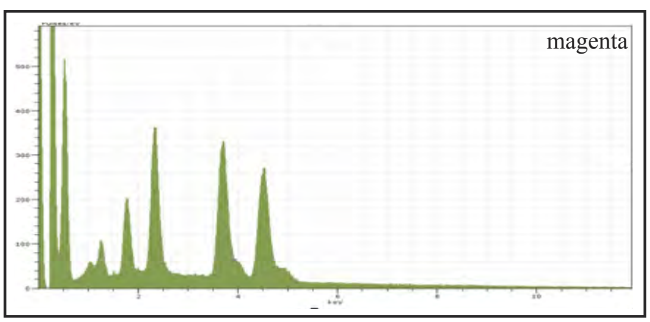
Representative Analysis Compilation—sample C137, continued



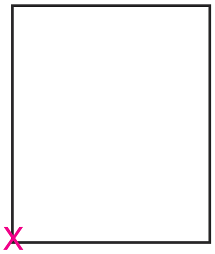
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	43.69	42.84	28.40	1.57
Zinc	K-series	9.10	8.92	3.63	0.37
Barium	L-series	3.85	3.77	0.73	0.46
Cadmium	L-series	2.55	2.50	0.59	0.66
Sodium	K-series	2.16	2.12	2.44	1.72
Sulfur	K-series	1.20	1.18	0.98	0.07
Magnesium	K-series	0.48	0.47	0.51	0.21
Titanium	K-series	0.26	0.25	0.14	0.20
Phosphorus	K-series	0.24	0.24	0.20	0.04
Silicon	K-series	0.17	0.17	0.16	0.04
Chlorine	K-series	0.10	0.10	0.08	0.03
Aluminium	K-series	0.04	0.04	0.04	0.05
Potassium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.01	0.01	0.00	0.03
Oxygen	K-series	38.12	37.38	62.09	31.23
	Sum:	101.97	100.00	100.00	



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, magenta: Ba
significant elements, red: Cd, S
interpretation: cadmium red, possible synthetic alizarin



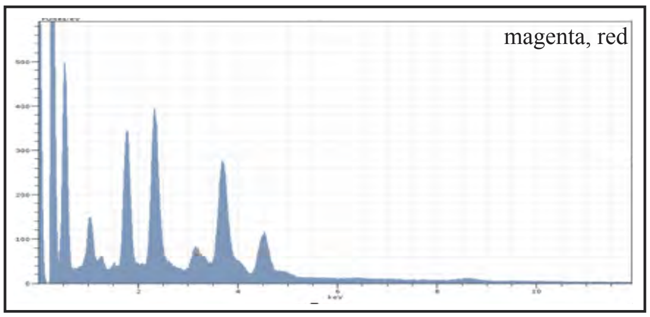
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	19.40	22.20	11.82	1.48
Calcium	K-series	12.69	14.52	9.24	0.41
Sulfur	K-series	9.90	11.32	9.00	0.38
Silicon	K-series	5.44	6.22	5.65	0.26
Zinc	K-series	2.82	3.22	1.26	0.15
Magnesium	K-series	2.82	3.22	3.38	0.18
Barium	L-series	1.45	1.66	0.31	0.74
Sodium	K-series	0.70	0.80	0.89	0.58
Phosphorus	K-series	0.13	0.15	0.12	0.03
Chlorine	K-series	0.07	0.08	0.06	0.03
Potassium	K-series	0.01	0.02	0.01	0.03
Aluminium	K-series	0.01	0.01	0.01	0.03
Oxygen	K-series	31.97	36.57	58.27	24.46
	Sum:	87.42	100.00	100.00	



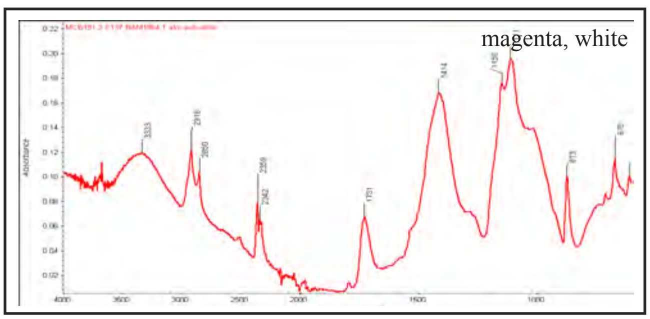
acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: magenta wash and ground layer

sample location: lower left corner
(B 0.0 x L 0.0 cm.)

Representative Analysis Compilation—sample C137, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	12.77	13.42	5.46	0.50
Sulfur	K-series	11.03	11.59	9.61	0.42
Calcium	K-series	10.01	10.52	6.98	0.49
Silicon	K-series	8.37	8.80	8.33	0.38
Titanium	K-series	6.87	7.23	4.01	0.82
Cadmium	L-series	3.99	4.19	0.99	1.00
Iron	K-series	2.50	2.63	1.25	0.12
Barium	L-series	2.45	2.57	0.50	1.12
Sodium	K-series	1.82	1.92	2.22	1.46
Magnesium	K-series	0.76	0.80	0.88	0.24
Chlorine	K-series	0.41	0.43	0.32	0.05
Potassium	K-series	0.23	0.24	0.17	0.18
Phosphorus	K-series	0.04	0.04	0.04	0.03
Aluminium	K-series	0.00	0.00	0.00	0.02
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	33.90	35.63	59.24	27.53
	Sum:	95.15	100.00	100.00	



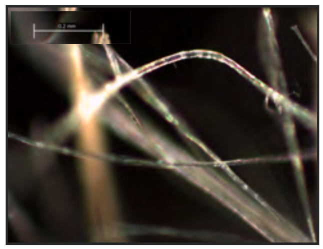
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fills

no image available

acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: threads, could be lining canvas

sample location: lower right corner
(B 0.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C138



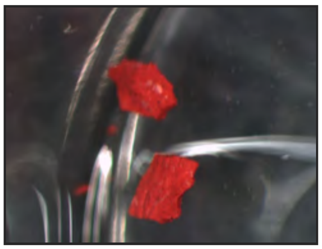
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification
interpretation: linen

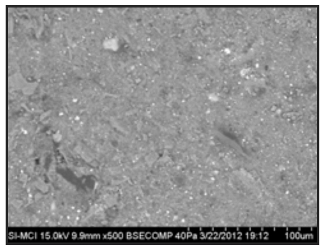
no image available

acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: none

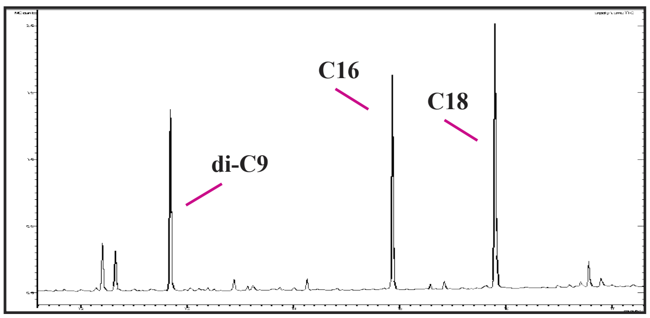
sample location: unknown, loose piece

Representative Analysis Compilation—sample Poly1

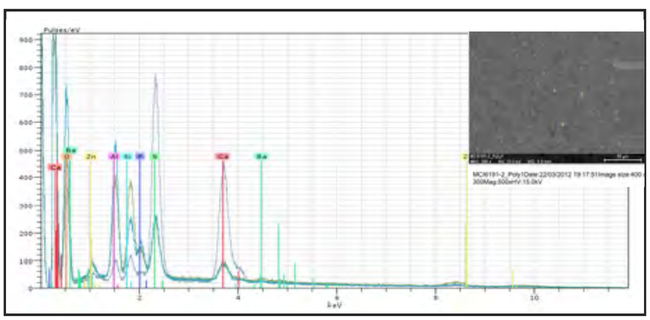




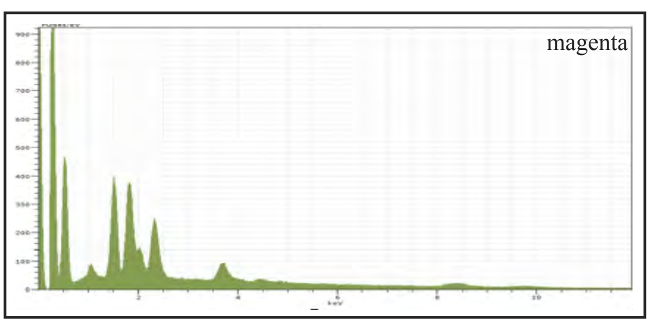
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.183
scan range: 1 - 1485
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, magenta: Al
interpretation: possible synthetic alizarin



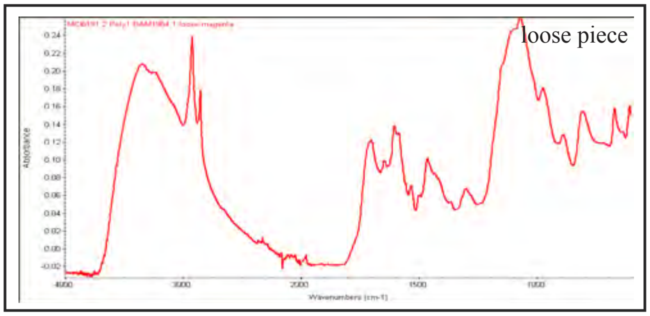
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	20.79	24.12	10.89	0.76
Silicon	K-series	7.84	9.10	9.56	0.35
Aluminium	K-series	7.68	8.91	9.75	0.38
Copper	K-series	6.49	7.53	3.50	0.27
Sulfur	K-series	5.72	6.63	6.11	0.23
Barium	L-series	5.43	6.30	1.35	0.51
Phosphorus	K-series	3.94	4.57	4.35	0.18
Calcium	K-series	3.84	4.45	3.28	0.15
Sodium	K-series	1.03	1.20	1.54	0.84
Potassium	K-series	0.25	0.29	0.22	0.05
Chlorine	K-series	0.14	0.16	0.13	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	23.05	26.74	49.33	18.62
	Sum:	86.21	100.00	100.00	

no image available

acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: none

sample location: unknown, loose piece

Representative Analysis Compilation—sample Poly1, continued



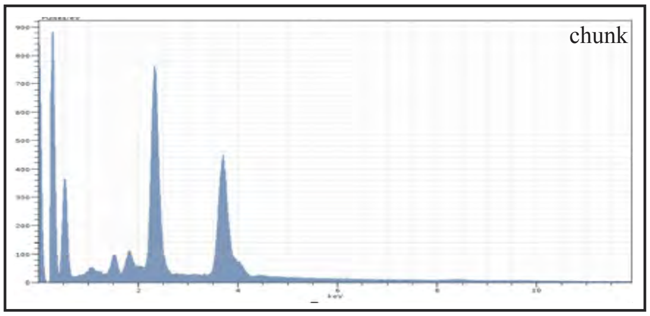
analysis: ATR-FTIR
by: DVR (MCI)
date: 03/14/13
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR81, but is a loose piece with no know origin and does not match spectra of magenta definitively tied to painting

no image available

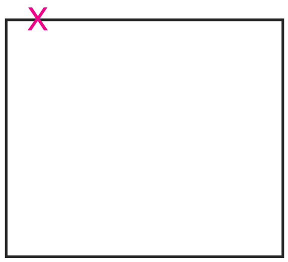
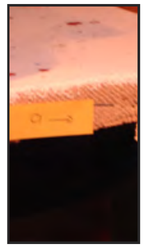
acc. no.: BAM 1964.1
title, year: *Polyhymnia*, 1963
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: none

sample location: unknown, loose piece

Representative Analysis Compilation—sample Poly1, continued



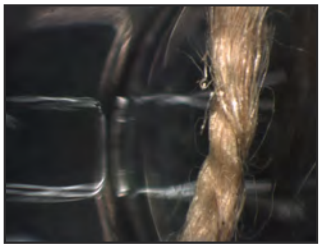
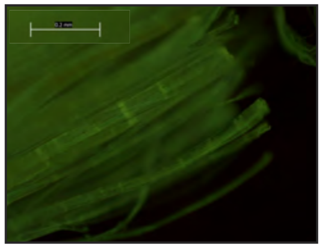
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	27.69	27.31	18.91	1.12
Sulfur	K-series	23.12	22.80	19.73	0.84
Zinc	K-series	7.92	7.81	3.31	0.34
Barium	L-series	4.10	4.05	0.82	0.46
Copper	K-series	3.32	3.28	1.43	0.17
Silicon	K-series	1.88	1.85	1.83	0.11
Aluminium	K-series	1.70	1.68	1.73	1.32
Sodium	K-series	1.37	1.35	1.63	1.10
Phosphorus	K-series	0.70	0.69	0.62	0.06
Cadmium	L-series	0.30	0.30	0.07	0.10
Magnesium	K-series	0.23	0.23	0.26	0.15
Chlorine	K-series	0.08	0.08	0.06	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	28.99	28.59	49.59	26.51
	Sum:	101.42	100.00	100.00	

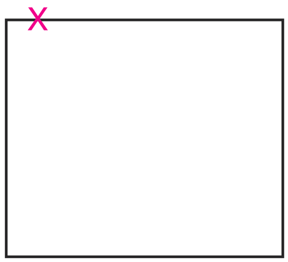
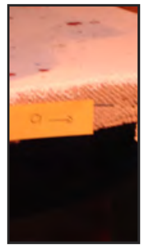
acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: threads, possible warp

sample location: top edge,
3.0" from left (T 0.0 x L 7.6 cm.)

Representative Analysis Compilation—sample C001

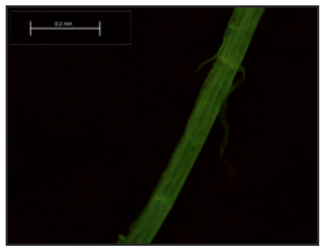
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: threads, possible weft

sample location: top edge,
3.0" from left (T 0.0 x L 7.6 cm.)

Representative Analysis Compilation—sample C002

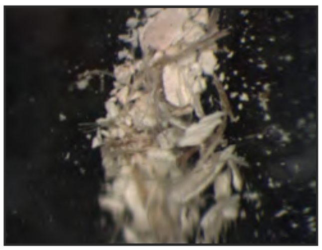



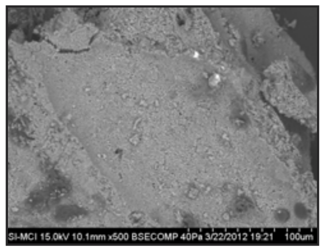
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: ground layer

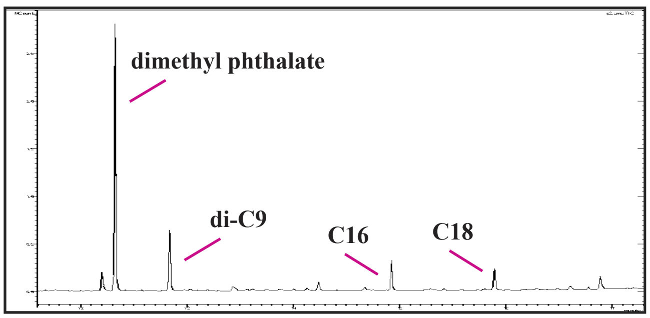
sample location: top edge,
3.0" from left (T 0.0 x L 7.6 cm.)

Representative Analysis Compilation—sample C003

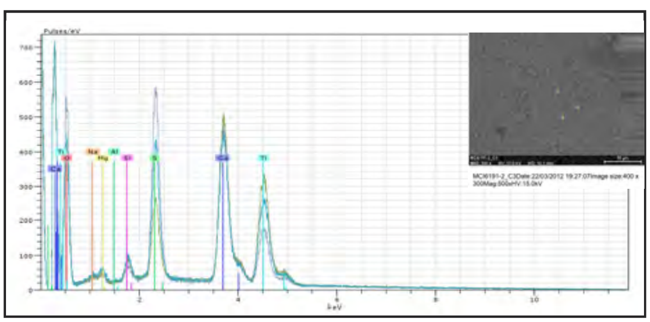




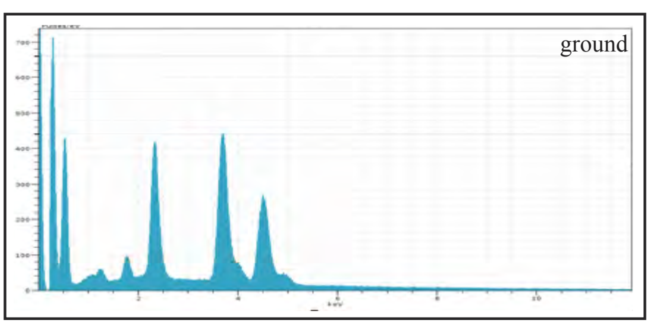
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



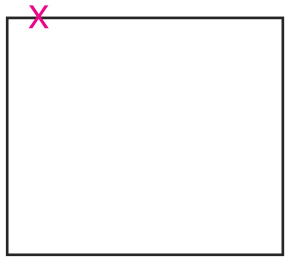
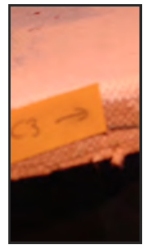
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.204
scan range: 1 - 1488
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti, Ca
interpretation: bulked titanium white



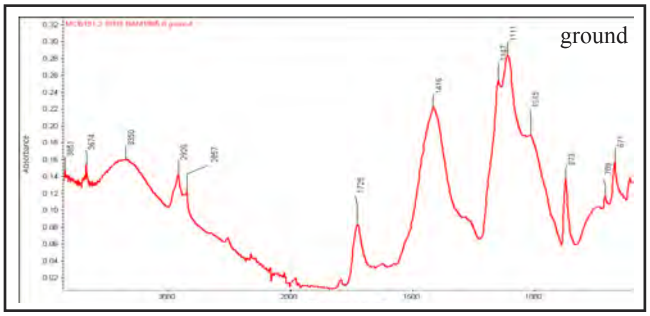
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	18.75	21.89	11.81	1.36
Calcium	K-series	17.39	20.31	13.09	0.55
Sulfur	K-series	11.84	13.82	11.14	0.45
Silicon	K-series	2.23	2.60	2.39	0.12
Magnesium	K-series	2.03	2.37	2.52	0.14
Zinc	K-series	1.60	1.87	0.74	0.11
Sodium	K-series	0.68	0.79	0.89	0.56
Barium	L-series	0.62	0.72	0.14	0.34
Phosphorus	K-series	0.12	0.14	0.11	0.03
Chlorine	K-series	0.11	0.13	0.09	0.03
Aluminium	K-series	0.01	0.02	0.02	0.03
Potassium	K-series	0.00	0.01	0.00	0.03
Oxygen	K-series	30.27	35.34	57.06	24.91
	Sum:	85.65	100.00	100.00	

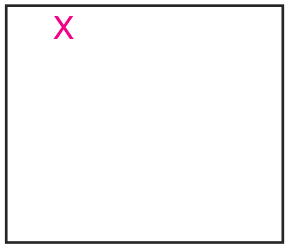
acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: ground layer

sample location: top edge,
3.0" from left (T 0.0 x L 7.6 cm.)

Representative Analysis Compilation—sample C003, continued



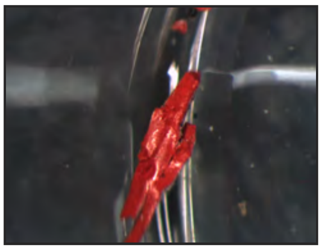
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

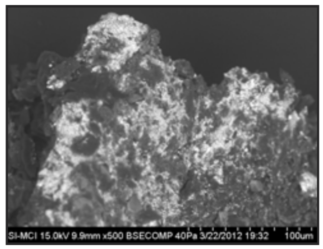


acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: red, likely varnish

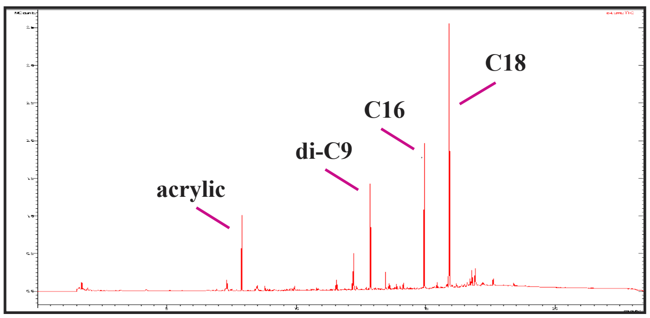
sample location: 4.0" from top,
14.0" from left (T 10.2 x L 35.6 cm.)

Representative Analysis Compilation—sample C004

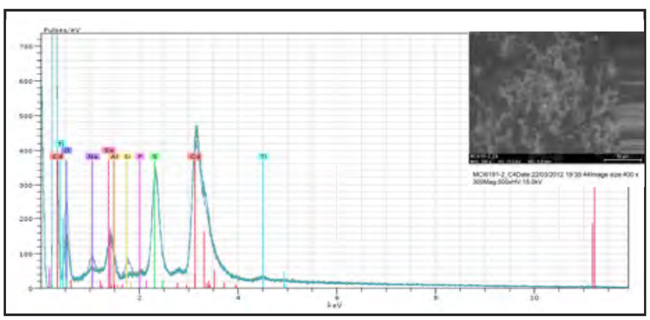




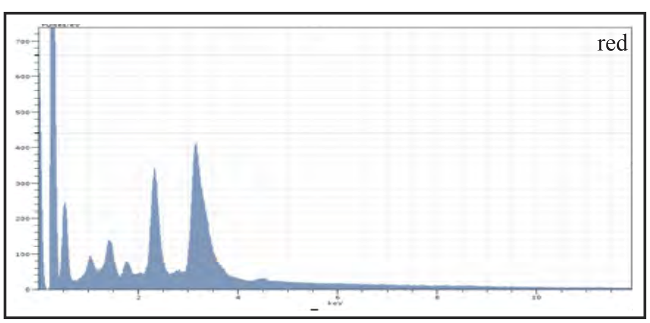
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



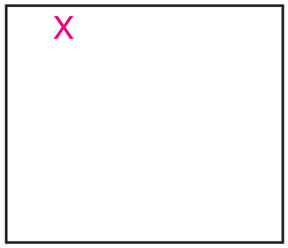
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.268
scan range: 1 - 1483
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, acrylic
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red



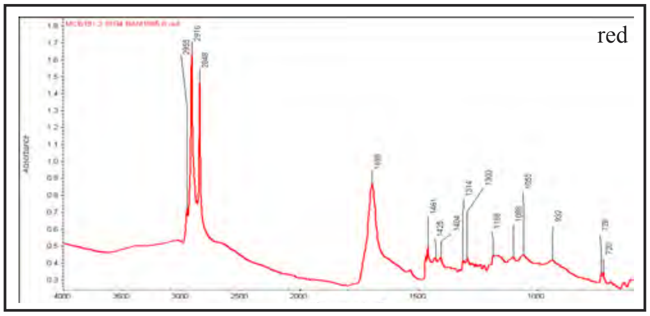
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	33.86	39.45	11.44	5.17
Sulfur	K-series	9.48	11.04	11.23	0.36
Zinc	K-series	4.11	4.79	2.39	0.20
Potassium	K-series	3.97	4.63	3.86	2.02
Selenium	L-series	2.70	3.15	1.30	0.23
Silicon	K-series	1.22	1.42	1.65	0.08
Sodium	K-series	1.12	1.30	1.85	0.90
Barium	L-series	1.04	1.21	0.29	0.21
Aluminium	K-series	0.75	0.87	1.05	0.59
Calcium	K-series	0.30	0.35	0.29	0.23
Phosphorus	K-series	0.05	0.05	0.06	0.03
Titanium	K-series	0.03	0.04	0.03	0.05
Chlorine	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	27.20	31.70	64.58	30.67
	Sum:	85.81	100.00	100.00	



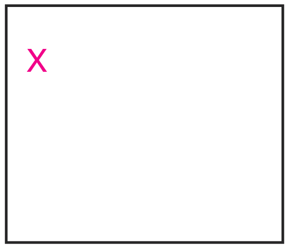
acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: red, likely varnish

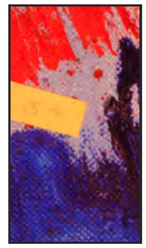
sample location: 4.0" from top,
14.0" from left (T 10.2 x L 35.6 cm.)

Representative Analysis Compilation—sample C004, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for wax

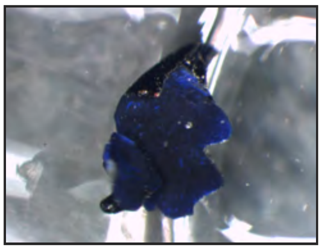


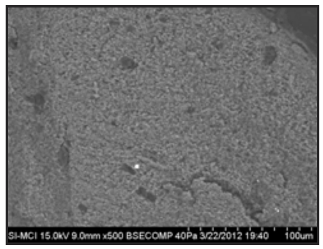


acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: deep blue, likely varnish

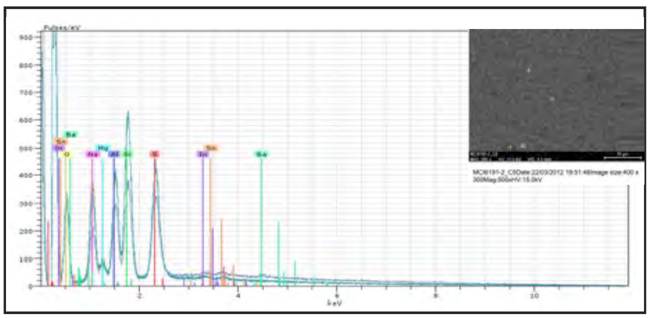
sample location: 11.5" from top,
7.5" from left (T 29.2 x L 19.1 cm.)

Representative Analysis Compilation—sample C005

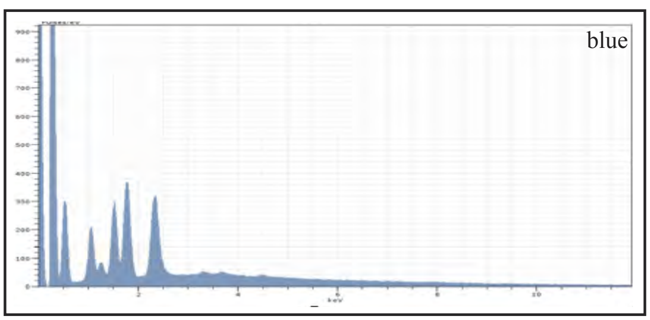




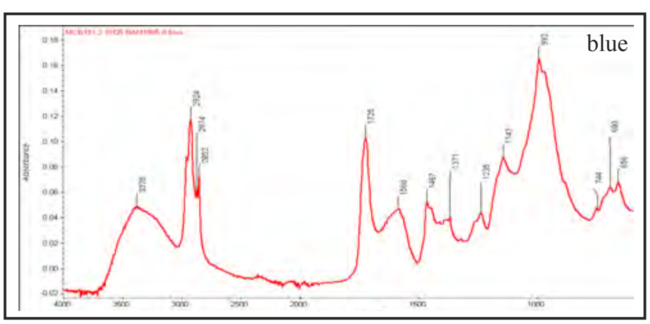
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.0 mm.



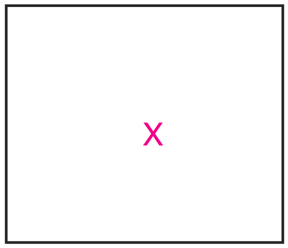
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.0 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Si, Na, Al
interpretation: ultramarine blue

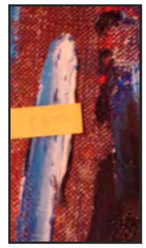


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Silicon	K-series	6.99	10.48	7.94	0.32
Sulfur	K-series	6.86	10.30	6.84	0.27
Sodium	K-series	5.63	8.45	7.82	4.46
Zinc	K-series	5.56	8.34	2.71	0.23
Aluminium	K-series	3.71	5.57	4.39	0.20
Barium	L-series	1.95	2.92	0.45	0.22
Magnesium	K-series	0.68	1.01	0.89	0.07
Calcium	K-series	0.53	0.80	0.42	0.05
Potassium	K-series	0.47	0.70	0.38	0.05
Chlorine	K-series	0.20	0.30	0.18	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	34.06	51.11	67.97	32.93
	Sum:	66.64	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

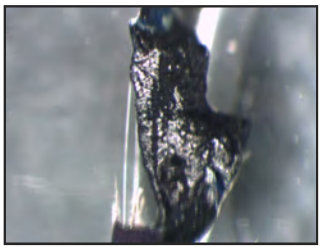


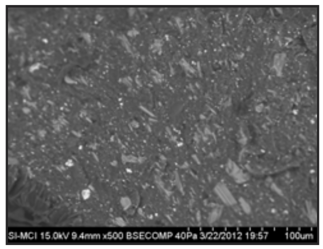


acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: greenish blue, likely varnish

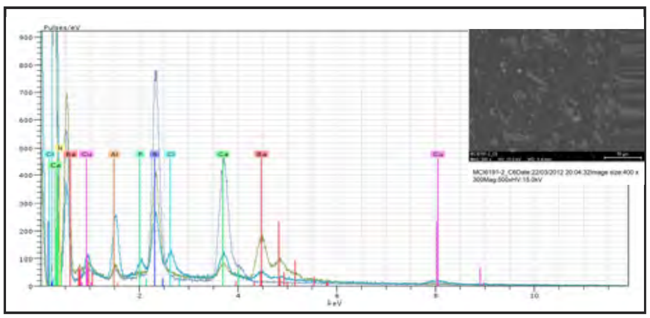
sample location: 27.0" from top,
34.0" from left (T 68.6 x L 86.4 cm.)

Representative Analysis Compilation—sample C006

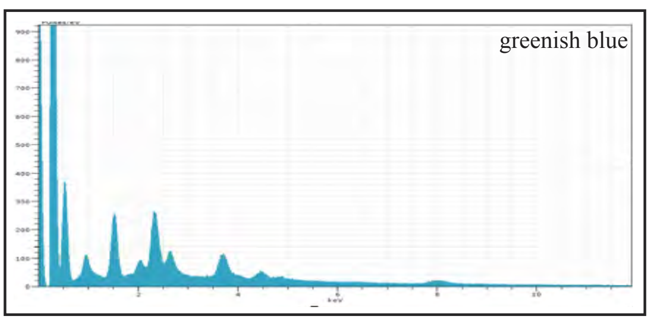




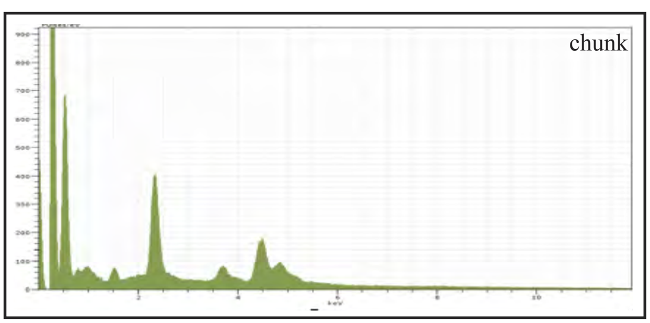
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



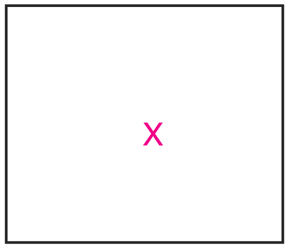
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, greenish blue: Cu, Cl
interpretation: phthalo green

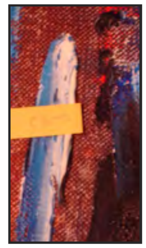


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Copper	K-series	12.03	23.51	15.78	0.44
Barium	L-series	8.81	17.21	5.34	0.77
Sulfur	K-series	7.63	14.91	19.84	0.30
Aluminium	K-series	6.89	13.46	21.28	0.35
Calcium	K-series	6.09	11.90	12.67	0.22
Chlorine	K-series	4.18	8.16	9.81	0.17
Sodium	K-series	2.38	4.65	8.63	1.90
Iron	K-series	1.35	2.63	2.01	0.08
Phosphorus	K-series	1.31	2.55	3.51	0.08
Potassium	K-series	0.40	0.77	0.84	0.06
Titanium	K-series	0.09	0.17	0.15	0.08
Magnesium	K-series	0.04	0.07	0.13	0.03
Nitrogen	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
	Sum:	51.19	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	43.20	35.99	8.39	2.82
Sulfur	K-series	15.52	12.93	12.92	0.58
Zinc	K-series	11.98	9.98	4.89	0.48
Calcium	K-series	3.76	3.13	2.50	0.16
Aluminium	K-series	1.86	1.55	1.84	0.12
Chlorine	K-series	1.33	1.11	1.00	0.08
Phosphorus	K-series	0.76	0.63	0.65	0.06
Titanium	K-series	0.74	0.62	0.41	0.52
Magnesium	K-series	0.56	0.47	0.61	0.07
Silicon	K-series	0.26	0.22	0.25	0.04
Potassium	K-series	0.23	0.19	0.16	0.05
Sodium	K-series	0.10	0.08	0.11	0.10
Oxygen	K-series	39.75	33.11	66.27	28.19
	Sum:	120.05	100.00	100.00	

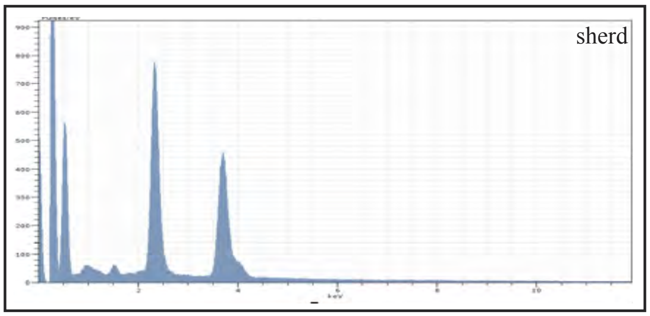




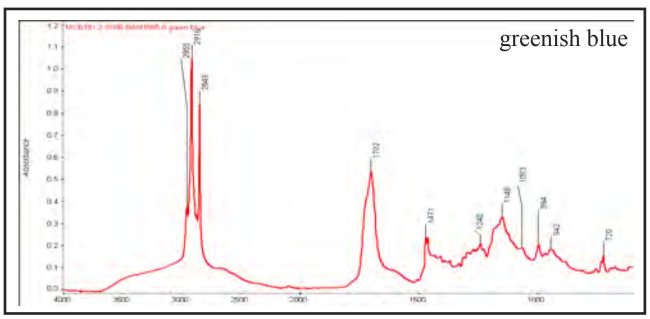
acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: greenish blue, likely varnish

sample location: 27.0" from top,
34.0" from left (T 68.6 x L 86.4 cm.)

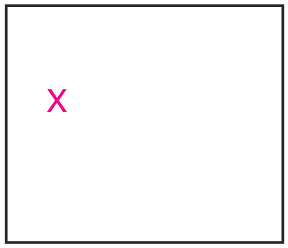
Representative Analysis Compilation—sample C006, continued

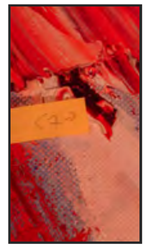


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	32.88	29.96	18.58	1.02
Sulfur	K-series	22.02	20.07	15.55	0.80
Zinc	K-series	6.70	6.11	2.32	0.30
Barium	L-series	2.83	2.58	0.47	0.38
Aluminium	K-series	1.00	0.91	0.84	0.08
Magnesium	K-series	0.53	0.48	0.50	0.06
Sodium	K-series	0.22	0.20	0.21	0.19
Chlorine	K-series	0.08	0.07	0.05	0.03
Potassium	K-series	0.07	0.06	0.04	0.03
Phosphorus	K-series	0.02	0.02	0.02	0.03
Silicon	K-series	0.02	0.02	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	43.38	39.53	61.41	32.39
	Sum:	109.74	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for wax

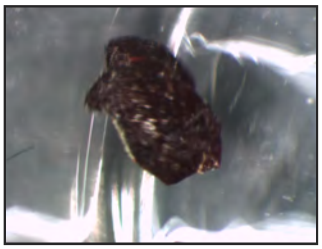


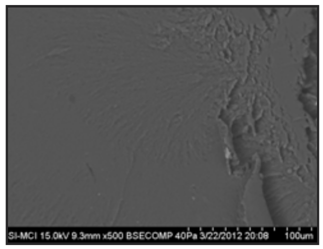


acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: magenta, likely varnish

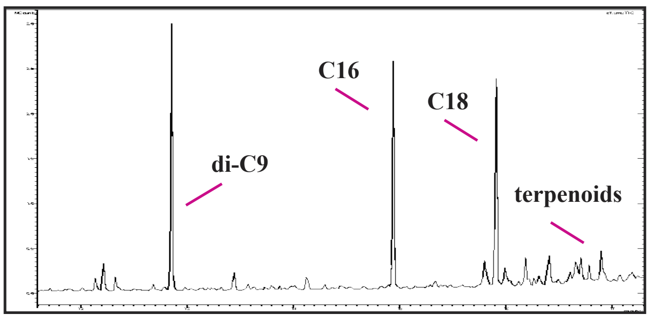
sample location: 16.8" from top,
7.0" from left (T 42.7 x L 17.8 cm.)

Representative Analysis Compilation—sample C007

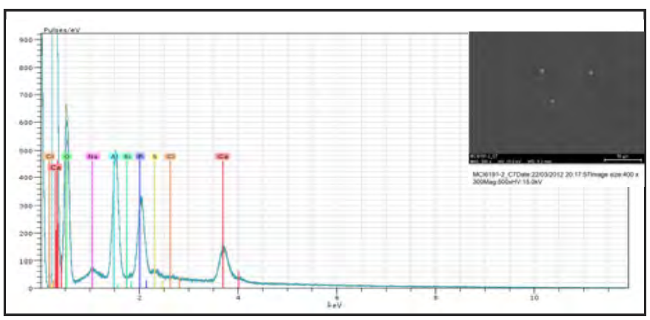




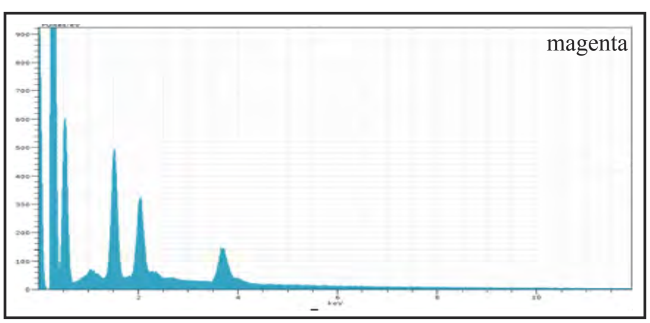
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.3 mm.



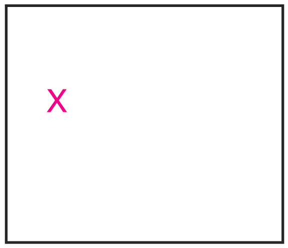
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/13/12
sample weight: 0.207
scan range: 1 - 1472
time range: 0.00 - 23.31 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil

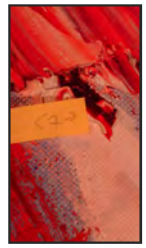


analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.3 mm.
mag: 500x; HV: 15 kV
significant elements, magenta: Al
interpretation: synthetic color



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	8.23	10.72	7.95	0.41
Calcium	K-series	6.30	8.21	4.10	0.22
Phosphorus	K-series	6.20	8.08	5.22	0.26
Zinc	K-series	3.85	5.01	1.53	0.19
Barium	L-series	1.43	1.87	0.27	0.22
Sodium	K-series	0.80	1.04	0.91	0.66
Sulfur	K-series	0.74	0.97	0.60	0.05
Chlorine	K-series	0.52	0.68	0.38	0.05
Potassium	K-series	0.28	0.37	0.19	0.05
Magnesium	K-series	0.04	0.05	0.04	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	48.35	63.00	78.79	35.51
	Sum:	76.76	100.00	100.00	

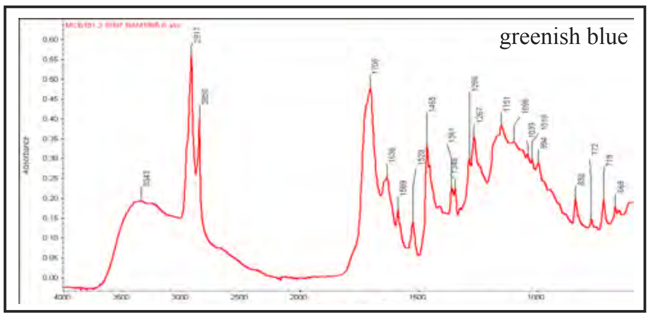




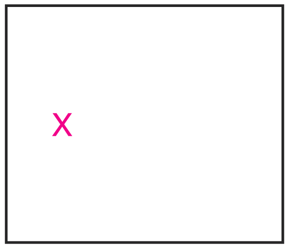
acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: magenta, likely varnish

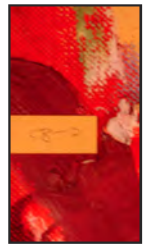
sample location: 16.8" from top,
7.0" from left (T 42.7 x L 17.8 cm.)

Representative Analysis Compilation—sample C007, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR83

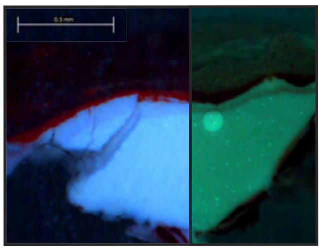


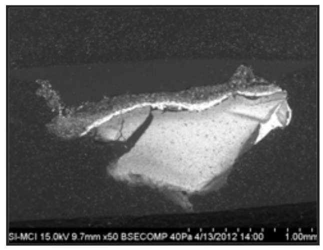


acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: purple, likely varnish

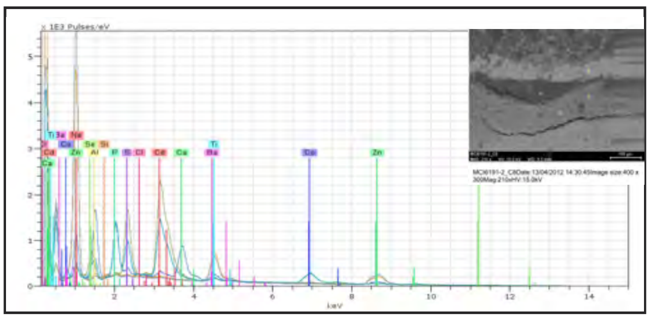
sample location: 21.5" from top,
12.0" from left (T 54.6 x L 30.5 cm.)

Representative Analysis Compilation—sample C008

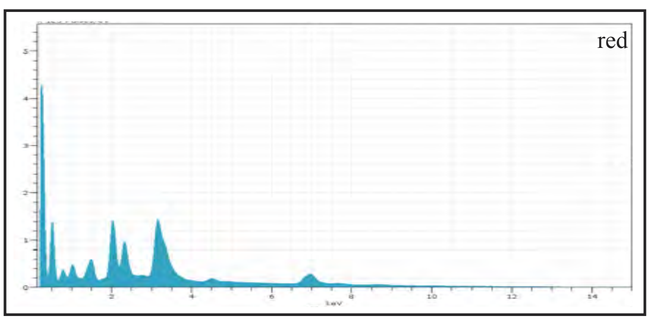




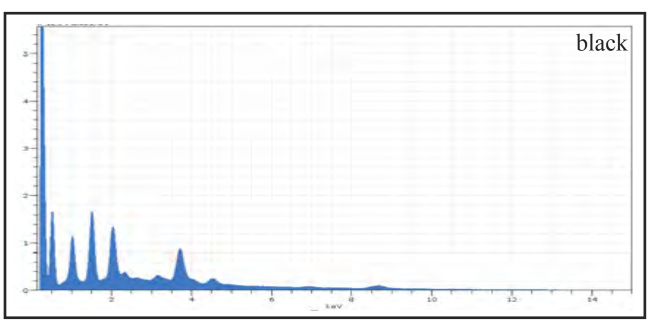
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



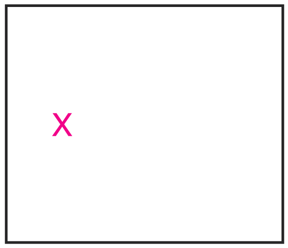
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 9.5 mm.
mag: 210x; HV: 15 kV
significant elements, red: Co, P, Cd, S, Se
significant elements, black: Ca, P
significant elements, white: Zn, Ti
interpretation: cobalt violet, cadmium red,
bone black, Zn/Ti white

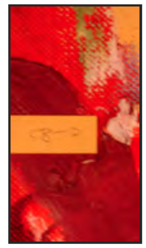


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	21.15	23.68	15.54	0.66
Cadmium	L-series	14.35	16.08	5.53	1.65
Zinc	K-series	12.78	14.31	8.46	0.45
Phosphorus	K-series	8.43	9.44	11.79	0.35
Sulfur	K-series	5.16	5.78	6.96	0.21
Barium	L-series	4.62	5.18	1.46	0.35
Aluminium	K-series	3.95	4.43	6.34	1.85
Potassium	K-series	3.63	4.06	4.02	0.55
Sodium	K-series	1.41	1.58	2.66	1.14
Selenium	L-series	0.03	0.04	0.02	0.04
Calcium	K-series	0.02	0.02	0.02	0.04
Chlorine	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	13.75	15.40	37.21	7.25
	Sum:	89.29	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	7.68	12.42	4.24	0.28
Aluminium	K-series	6.22	10.06	8.32	1.82
Phosphorus	K-series	5.02	8.12	5.85	0.22
Calcium	K-series	4.78	7.73	4.31	0.19
Sodium	K-series	3.10	5.02	4.87	2.47
Titanium	K-series	1.32	2.14	1.00	0.14
Cadmium	L-series	1.14	1.84	0.37	0.30
Sulfur	K-series	0.82	1.33	0.92	0.05
Cobalt	K-series	0.59	0.95	0.36	0.04
Chlorine	K-series	0.26	0.42	0.26	0.03
Potassium	K-series	0.08	0.13	0.08	0.08
Barium	L-series	0.06	0.10	0.02	0.06
Silicon	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	30.77	49.75	69.41	14.67
	Sum:	61.84	100.00	100.00	

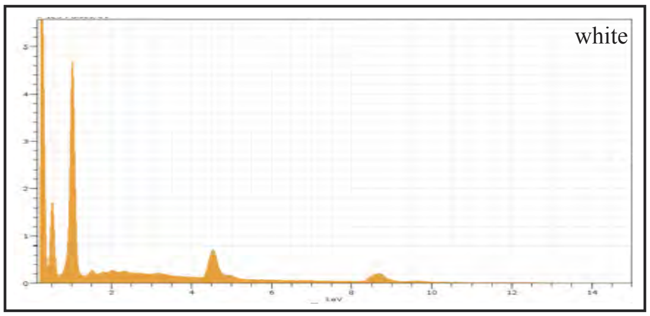





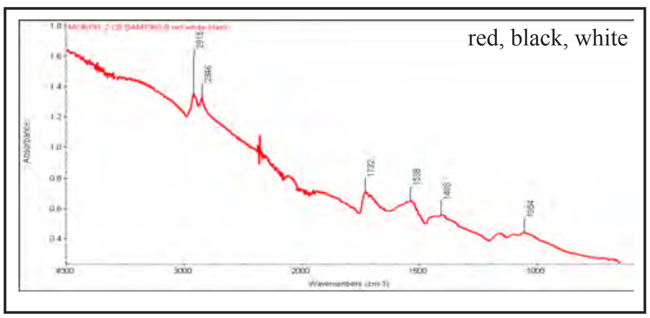
acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: purple, likely varnish

sample location: 21.5" from top,
12.0" from left (T 54.6 x L 30.5 cm.)

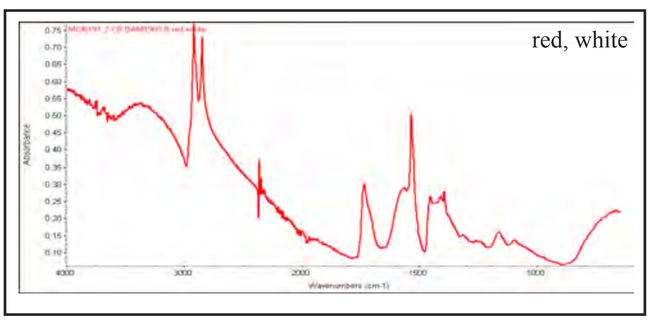
Representative Analysis Compilation—sample C008, continued



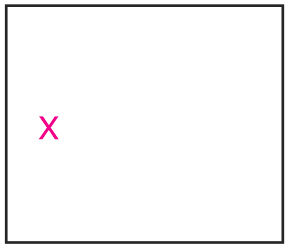
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	35.86	41.69	19.61	1.21
Sodium	K-series	17.08	19.86	26.58	13.47
Titanium	K-series	10.13	11.77	7.57	0.53
Barium	L-series	0.96	1.12	0.25	0.50
Cadmium	L-series	0.83	0.96	0.26	0.23
Aluminium	K-series	0.50	0.58	0.66	0.40
Phosphorus	K-series	0.32	0.37	0.37	0.04
Sulfur	K-series	0.29	0.34	0.33	0.04
Chlorine	K-series	0.17	0.20	0.18	0.03
Silicon	K-series	0.14	0.17	0.18	0.03
Potassium	K-series	0.06	0.07	0.06	0.07
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	19.66	22.86	43.96	9.20
	Sum:	86.01	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: carbon interference



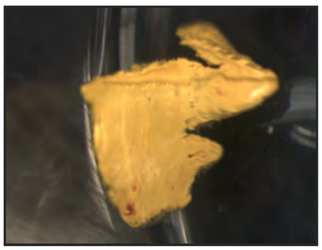
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

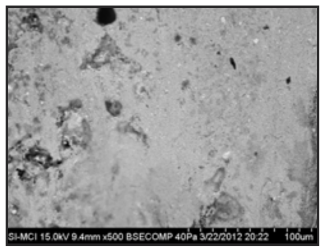


acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: yellow, likely varnish

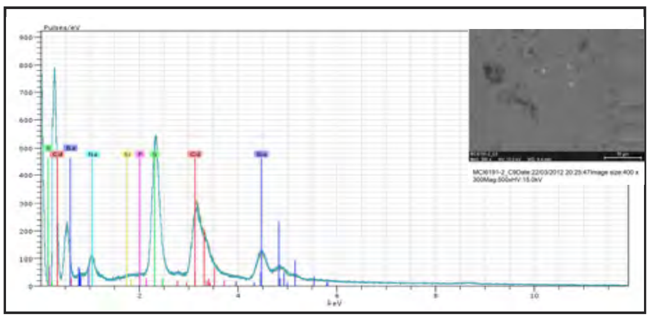
sample location: 24.5" from top,
9.0" from left (T 62.23 x L 22.9 cm.)

Representative Analysis Compilation—sample C009

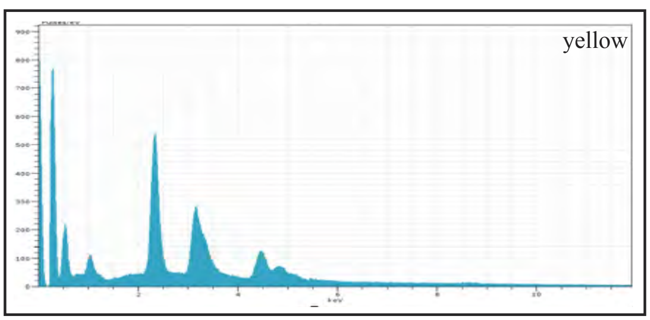




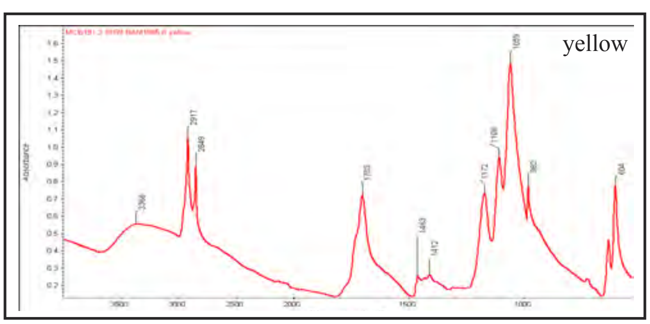
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



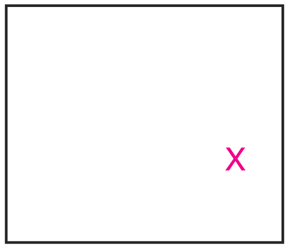
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
interpretation: cadmium yellow

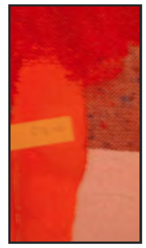


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	22.72	22.29	6.05	1.66
Cadmium	L-series	19.53	19.16	6.36	3.93
Sulfur	K-series	18.27	17.92	20.85	0.67
Zinc	K-series	9.99	9.80	5.59	0.40
Potassium	K-series	2.94	2.89	2.76	1.49
Sodium	K-series	2.91	2.85	4.63	2.31
Iron	K-series	1.34	1.32	0.88	0.08
Titanium	K-series	0.84	0.83	0.65	0.59
Magnesium	K-series	0.62	0.61	0.94	0.27
Silicon	K-series	0.39	0.38	0.50	0.05
Phosphorus	K-series	0.30	0.29	0.35	0.04
Aluminium	K-series	0.03	0.03	0.05	0.05
Chlorine	K-series	0.02	0.02	0.02	0.03
Calcium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	22.03	21.61	50.38	27.97
	Sum:	101.95	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

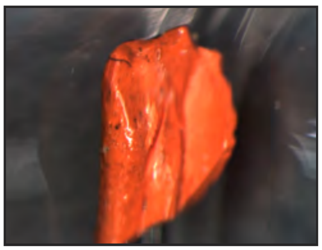


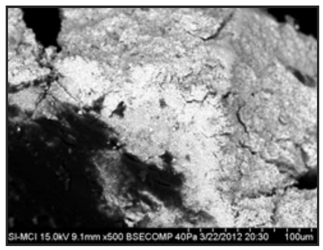


acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: orange, likely varnish

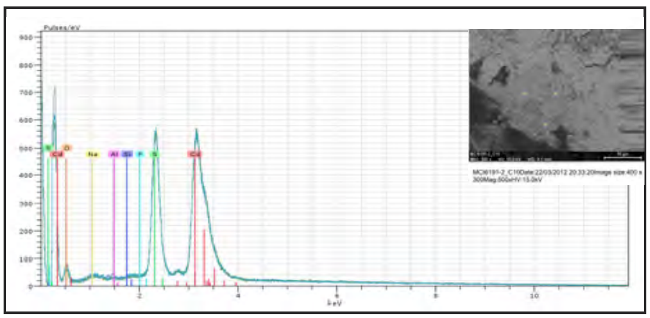
sample location: 18.0" from bottom,
9.5" from right (B 45.7 x R 24.1 cm.)

Representative Analysis Compilation—sample C010

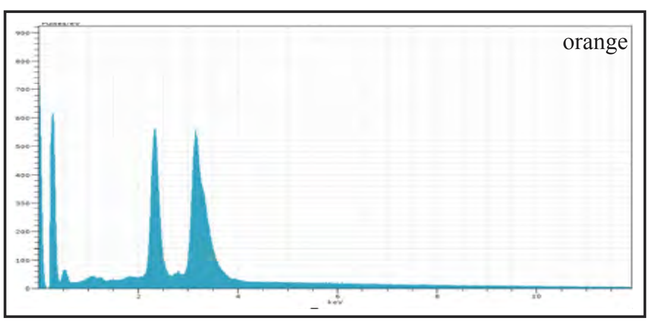




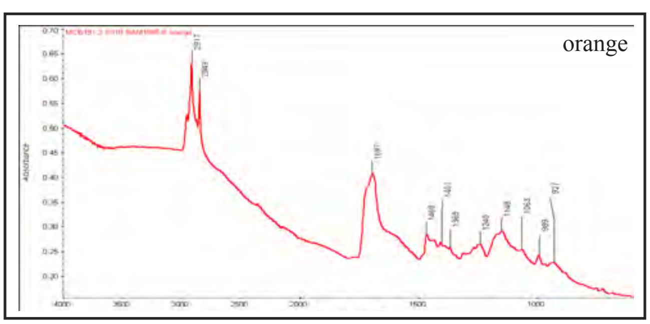
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.1 mm.



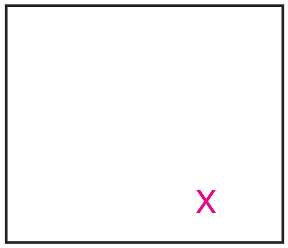
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 9.1 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S
interpretation: cadmium orange



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	42.69	48.38	19.91	6.30
Sulfur	K-series	16.59	18.80	27.12	0.61
Zinc	K-series	8.09	9.17	6.49	0.34
Potassium	K-series	7.41	8.40	9.94	2.50
Barium	L-series	1.43	1.62	0.55	0.25
Sodium	K-series	1.39	1.58	3.18	1.12
Magnesium	K-series	0.96	1.09	2.08	0.35
Aluminium	K-series	0.36	0.41	0.71	0.30
Silicon	K-series	0.26	0.29	0.48	0.04
Calcium	K-series	0.06	0.07	0.08	0.06
Selenium	L-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	8.99	10.19	29.47	14.55
	Sum:	88.23	100.00	100.00	



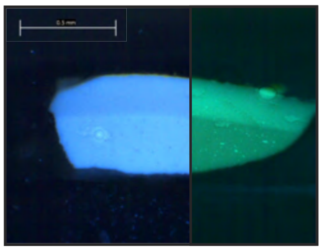
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

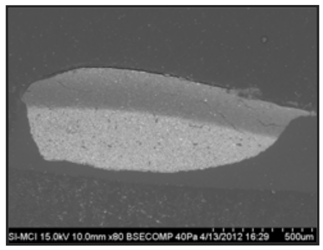


acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: compositional white, likely varnish

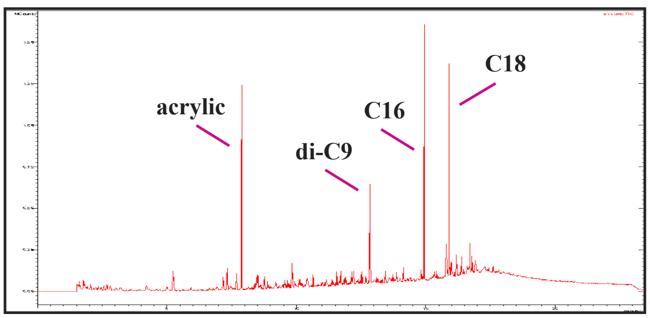
sample location: 9.0" from bottom,
17.0" from right (B 22.9 x R 43.2 cm.)

Representative Analysis Compilation—sample C011

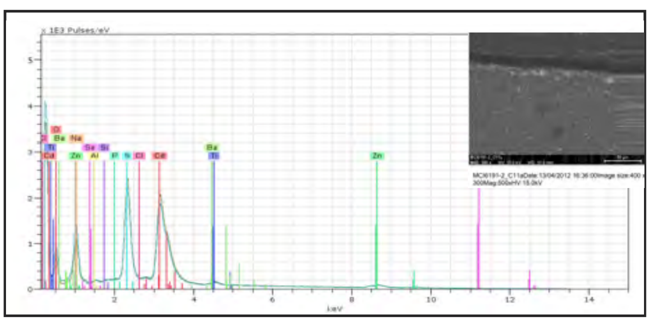




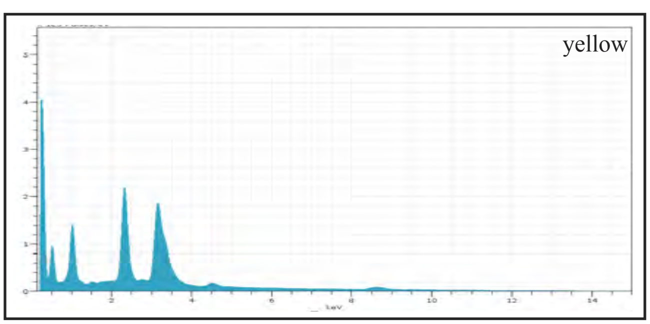
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



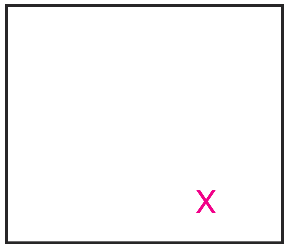
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/12/12
sample weight: 0.247
scan range: 1 - 1484
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18, acrylic
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
interpretation: cadmium yellow



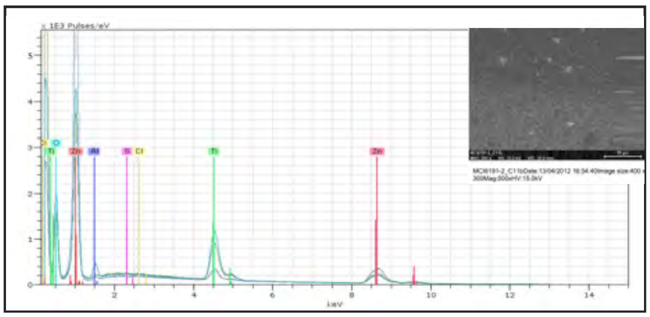
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	26.36	29.00	10.00	2.41
Zinc	K-series	23.43	25.78	15.28	0.81
Sodium	K-series	7.57	8.33	14.04	5.98
Sulfur	K-series	7.34	8.08	9.76	0.28
Potassium	K-series	5.18	5.70	5.65	0.82
Barium	L-series	3.52	3.88	1.09	0.32
Magnesium	K-series	0.62	0.68	1.09	0.14
Titanium	K-series	0.61	0.67	0.54	0.19
Aluminium	K-series	0.34	0.37	0.53	0.28
Silicon	K-series	0.26	0.29	0.39	0.04
Calcium	K-series	0.05	0.05	0.05	0.06
Phosphorus	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	15.60	17.16	41.57	9.88
	Sum:	90.89	100.00	100.00	



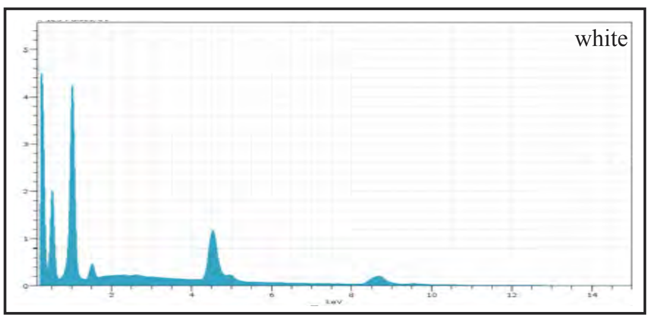
acc. no.: BAM 1965.8
title, year: *The Clash*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 52.1 x 60.3" (132.3 x 153.2 cm.)
notes: compositional white, likely varnish

sample location: 9.0" from bottom,
17.0" from right (B 22.9 x R 43.2 cm.)

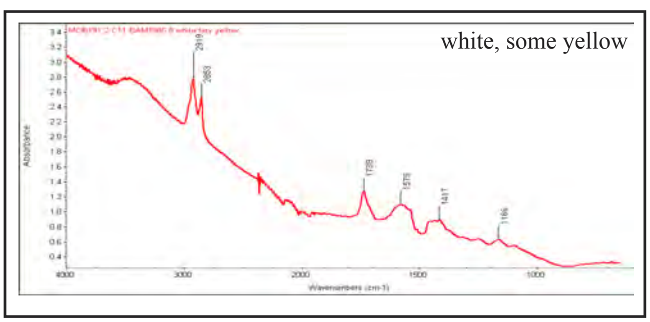
Representative Analysis Compilation—sample C011, continued



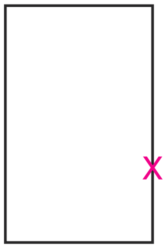
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	56.43	41.96	24.77	1.89
Titanium	K-series	19.95	14.83	11.96	1.28
Sodium	K-series	19.79	14.72	24.71	15.60
Barium	L-series	14.94	11.11	3.12	1.43
Aluminium	K-series	2.36	1.75	2.51	0.14
Chlorine	K-series	1.46	1.09	1.18	0.07
Potassium	K-series	1.04	0.78	0.77	0.06
Sulfur	K-series	0.78	0.58	0.70	0.05
Calcium	K-series	0.71	0.53	0.51	0.05
Phosphorus	K-series	0.65	0.48	0.60	0.05
Silicon	K-series	0.25	0.18	0.25	0.04
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	16.11	11.98	28.91	6.83
	Sum:	134.47	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



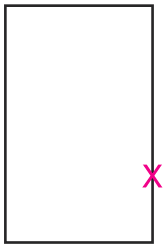
no image available

acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: fibers, possibly warp

sample location: right edge, 29.5" from bottom (B 74.9 x R 0.0 cm.)

Representative Analysis Compilation—sample Imp04

photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

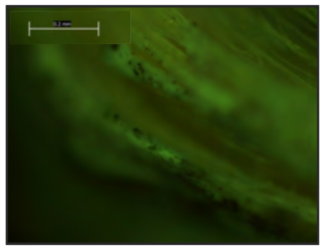


no image available

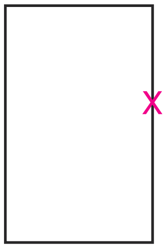
acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: fibers, possibly weft

sample location: right edge, 26.0" from bottom
(B 66.0 x R 0.0 cm.)

Representative Analysis Compilation—sample Imp05



photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

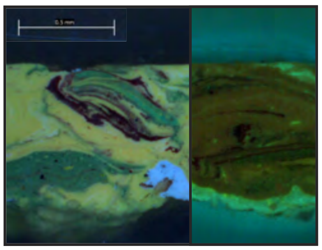


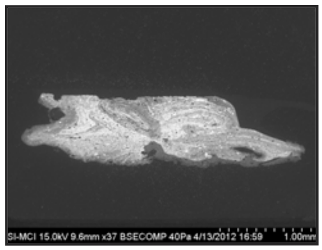
no image available

acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: stratigraphy

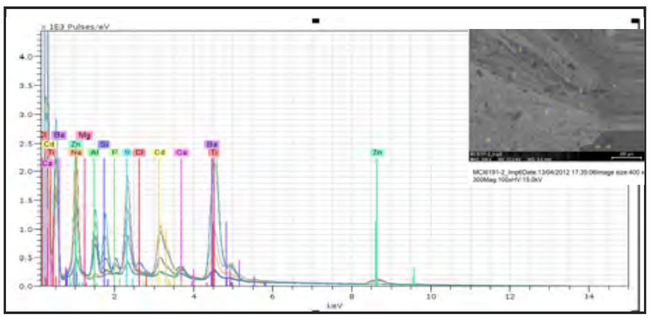
sample location: right edge, 52.6" from bottom, transfer to frame (B 133.6 x R 0.0 cm.)

Representative Analysis Compilation—sample Imp06

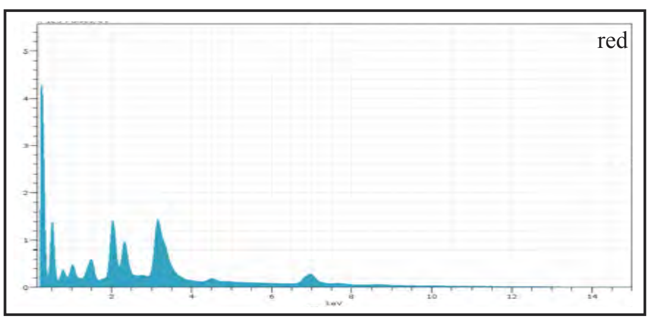




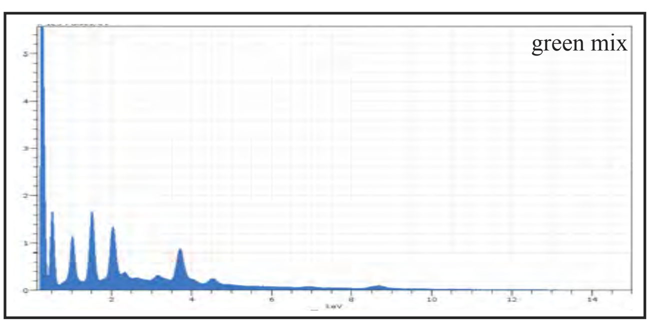
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.6 mm.



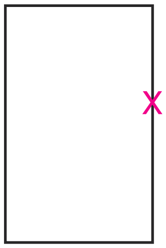
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 9.6 mm.
mag: 100x; HV: 15 kV
significant elements, red: Cd, S
significant elements, green: Zn, Cd, S, Na
significant elements, yellow: Cd, S
interpretation: cadmium red, cadmium green, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	15.20	20.04	8.37	0.53
Cadmium	L-series	7.72	10.17	2.47	1.05
Sodium	K-series	5.85	7.72	9.17	4.63
Sulfur	K-series	5.03	6.63	5.65	0.20
Barium	L-series	3.40	4.48	0.89	0.34
Aluminium	K-series	2.56	3.37	3.41	1.27
Titanium	K-series	1.76	2.32	1.33	0.24
Potassium	K-series	1.52	2.00	1.40	0.37
Calcium	K-series	1.29	1.70	1.16	0.11
Silicon	K-series	1.23	1.62	1.58	0.08
Phosphorus	K-series	1.06	1.40	1.24	0.07
Iron	K-series	0.86	1.14	0.56	0.05
Chlorine	K-series	0.83	1.10	0.85	0.05
Magnesium	K-series	0.04	0.06	0.06	0.05
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	27.49	36.24	61.87	12.97
	Sum:	75.85	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	22.41	23.44	12.01	0.77
Cadmium	L-series	13.43	14.05	4.19	1.59
Sodium	K-series	11.06	11.57	16.86	8.73
Barium	L-series	9.09	9.50	2.32	0.76
Sulfur	K-series	8.55	8.94	9.34	0.33
Titanium	K-series	5.74	6.00	4.20	0.64
Potassium	K-series	2.40	2.51	2.15	0.55
Silicon	K-series	0.51	0.54	0.64	0.05
Chlorine	K-series	0.41	0.42	0.40	0.04
Aluminium	K-series	0.16	0.17	0.21	0.15
Calcium	K-series	0.16	0.17	0.14	0.10
Phosphorus	K-series	0.00	0.00	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	21.71	22.70	47.54	10.23
	Sum:	95.64	100.00	100.00	

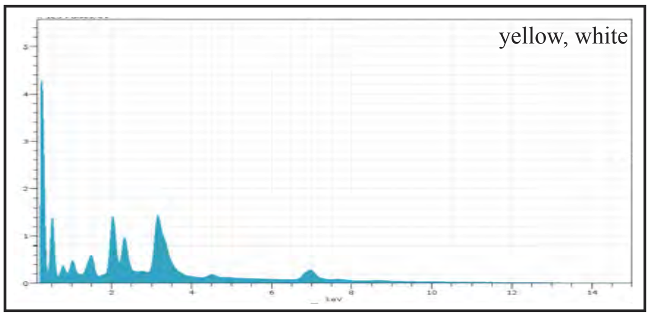


no image available

acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: stratigraphy

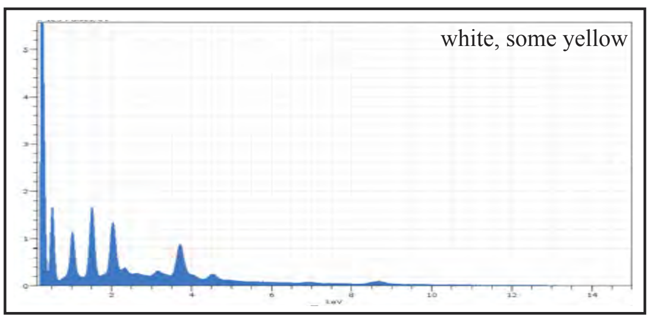
sample location: right edge, 52.6" from bottom, transfer to frame (B 133.6 x R 0.0 cm.)

Representative Analysis Compilation—sample Imp06, continued



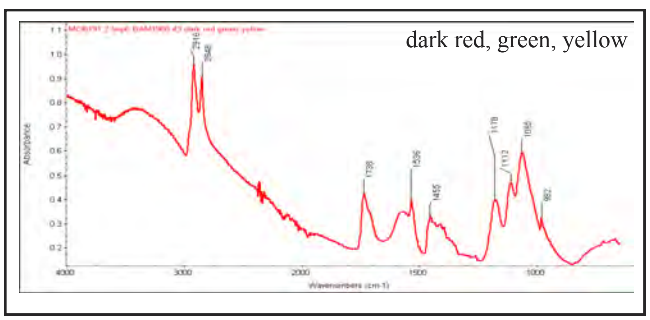
yellow, white

Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	14.00	15.49	11.26	2.25
Zinc	K-series	9.49	10.50	5.59	1.57
Sodium	K-series	7.41	8.20	12.41	5.86
Sulfur	K-series	7.32	8.10	8.79	5.29
Lead	M-series	6.23	6.89	1.16	4.18
Cadmium	L-series	4.65	5.14	1.59	2.65
Barium	L-series	1.61	1.78	0.45	0.82
Aluminium	K-series	0.06	0.06	0.08	0.07
Silicon	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	21.24	23.49	51.09	33.90
	Sum:	90.39	100.00	100.00	



white, some yellow

Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	33.40	39.71	21.49	1.19
Aluminium	K-series	4.36	5.18	4.98	1.65
Zinc	K-series	4.03	4.80	1.90	0.17
Silicon	K-series	3.40	4.05	3.73	0.17
Sodium	K-series	1.68	2.00	2.25	1.35
Barium	L-series	1.55	1.85	0.35	0.78
Calcium	K-series	1.13	1.35	0.87	0.08
Sulfur	K-series	0.80	0.96	0.77	0.05
Cadmium	L-series	0.62	0.74	0.17	0.18
Magnesium	K-series	0.12	0.15	0.16	0.06
Potassium	K-series	0.08	0.09	0.06	0.08
Phosphorus	K-series	0.06	0.07	0.06	0.03
Chlorine	K-series	0.05	0.06	0.05	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	32.80	39.01	63.16	13.63
	Sum:	84.09	100.00	100.00	



dark red, green, yellow

analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

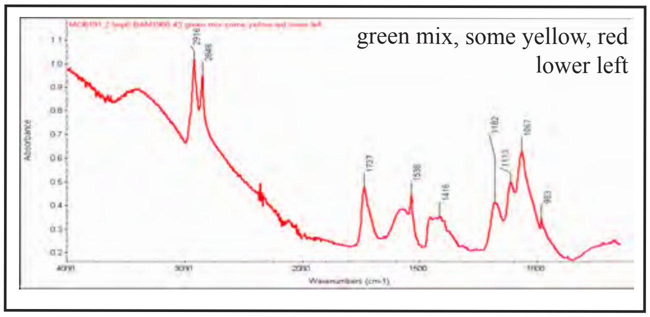
X

no image available

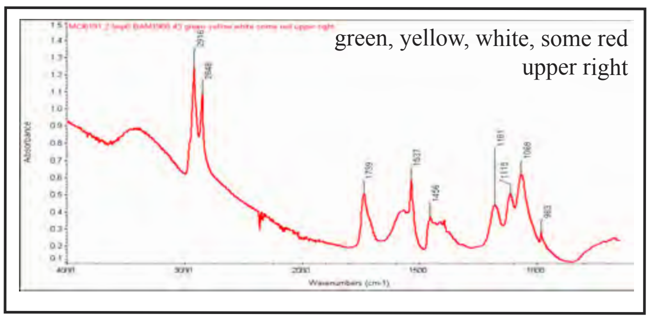
acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: stratigraphy

sample location: right edge, 52.6" from bottom, transfer to frame (B 133.6 x R 0.0 cm.)

Representative Analysis Compilation—sample Imp06, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

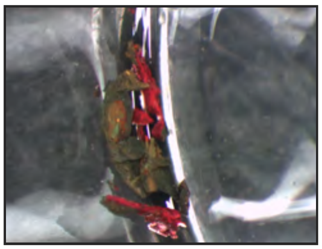
X

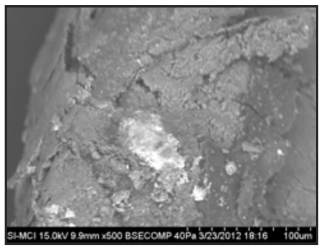
no image available

acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: stratigraphy

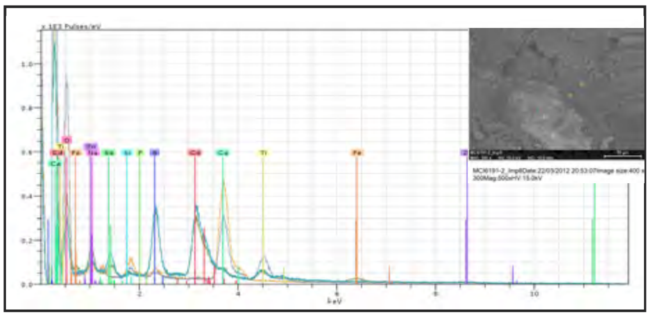
sample location: 42.5" from bottom, 6.1" from left (B 108.0 x L 15.5 cm.)

Representative Analysis Compilation—sample Imp08

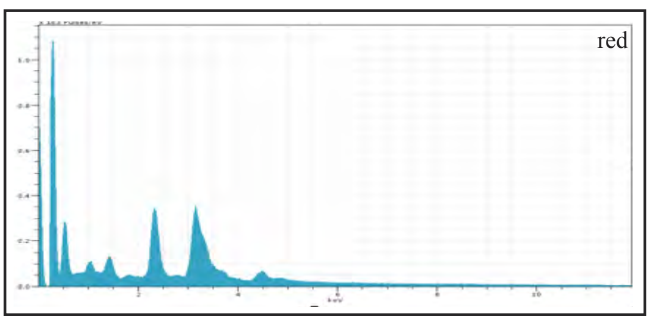




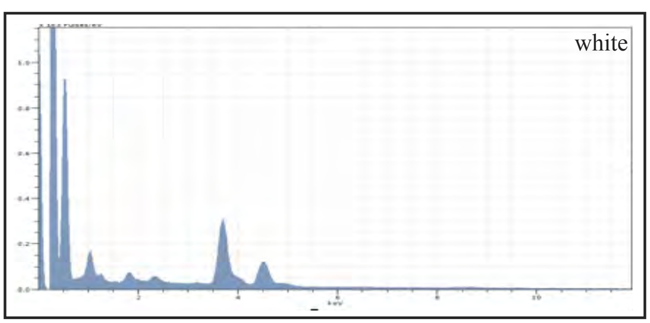
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



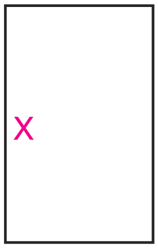
analysis: EDS
by: DVR (MCI)
date: 03/22/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, white: Ca, Ti
interpretation: cadmium red, bulked titanium white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	43.58	33.28	13.94	6.98
Barium	L-series	21.52	16.43	5.64	1.66
Zinc	K-series	14.91	11.38	8.20	0.58
Sulfur	K-series	14.08	10.75	15.79	0.53
Selenium	L-series	7.50	5.72	3.41	0.61
Potassium	K-series	4.39	3.35	4.04	2.67
Calcium	K-series	3.13	2.39	2.81	0.52
Sodium	K-series	1.53	1.17	2.39	1.23
Magnesium	K-series	0.60	0.46	0.89	0.38
Chlorine	K-series	0.50	0.39	0.51	0.07
Silicon	K-series	0.40	0.31	0.52	0.05
Aluminium	K-series	0.23	0.17	0.30	0.20
Phosphorus	K-series	0.22	0.16	0.25	0.04
Titanium	K-series	0.01	0.01	0.01	0.03
Oxygen	K-series	18.38	14.03	41.31	20.90
	Sum:	130.97	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	18.91	17.27	9.89	0.60
Titanium	K-series	11.37	10.39	4.98	1.31
Zinc	K-series	9.90	9.04	3.17	0.41
Barium	L-series	4.25	3.88	0.65	1.69
Sodium	K-series	3.71	3.38	3.38	2.94
Magnesium	K-series	1.18	1.08	1.02	0.10
Silicon	K-series	1.04	0.95	0.77	0.07
Sulfur	K-series	1.00	0.92	0.66	0.06
Potassium	K-series	0.43	0.40	0.23	0.07
Phosphorus	K-series	0.40	0.37	0.27	0.04
Chlorine	K-series	0.21	0.20	0.13	0.04
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	57.10	52.14	74.84	34.47
	Sum:	109.51	100.00	100.00	

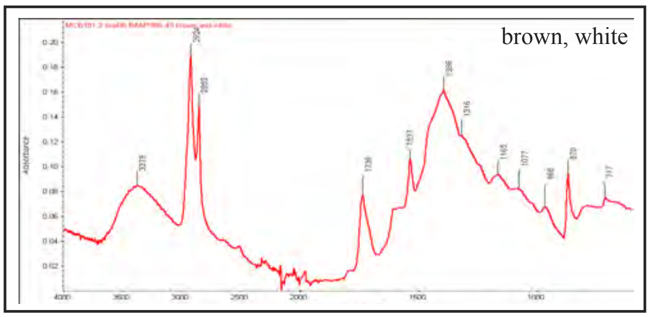


no image available

acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: stratigraphy

sample location: 42.5" from bottom, 6.1" from left
(B 108.0 x L 15.5 cm.)

Representative Analysis Compilation—sample Imp08, continued



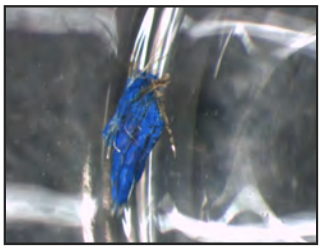
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

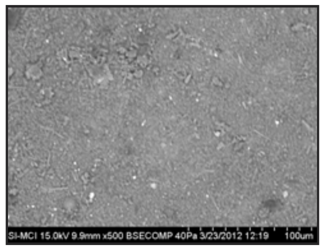
no image available

acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: blues

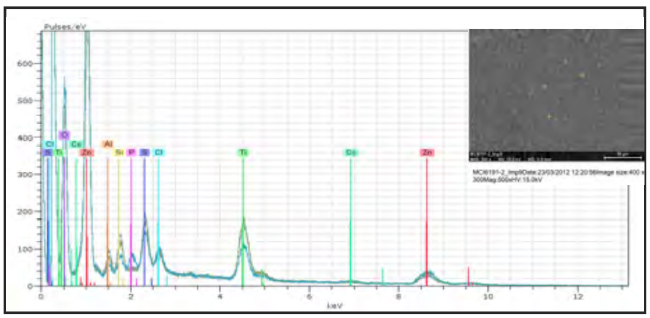
sample location: 54.8" from bottom, 26.3" from left
(B 139.2 x L 59.2 cm.)

Representative Analysis Compilation—sample Imp09

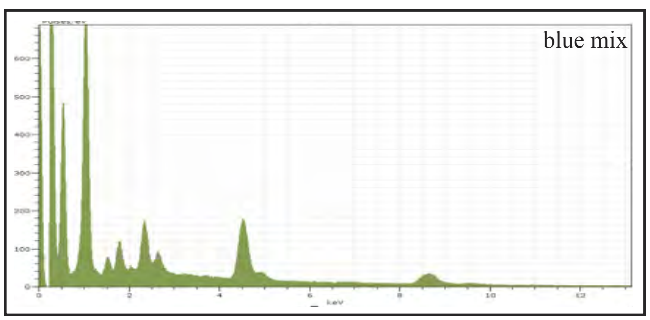




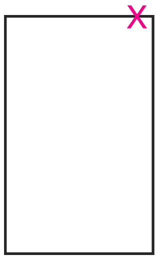
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Cl, Co
interpretation: ultramarine blue, possible cobalt blue



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	34.46	34.38	16.05	1.21
Titanium	K-series	13.88	13.85	8.83	1.26
Sodium	K-series	12.79	12.76	16.95	10.09
Sulfur	K-series	3.91	3.90	3.72	0.17
Barium	L-series	2.79	2.78	0.62	1.38
Chlorine	K-series	2.26	2.25	1.94	0.10
Silicon	K-series	2.08	2.08	2.26	0.12
Cobalt	K-series	1.72	1.71	0.89	0.09
Aluminium	K-series	0.84	0.84	0.95	0.07
Phosphorus	K-series	0.25	0.24	0.24	0.04
Calcium	K-series	0.24	0.24	0.18	0.04
Potassium	K-series	0.23	0.23	0.18	0.04
Magnesium	K-series	0.04	0.04	0.06	0.03
Oxygen	K-series	24.76	24.70	47.15	18.94
	Sum:	100.25	100.00	100.00	

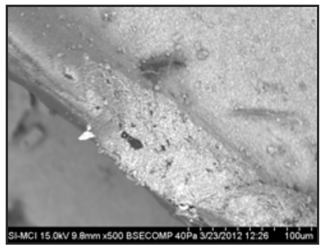


no image available

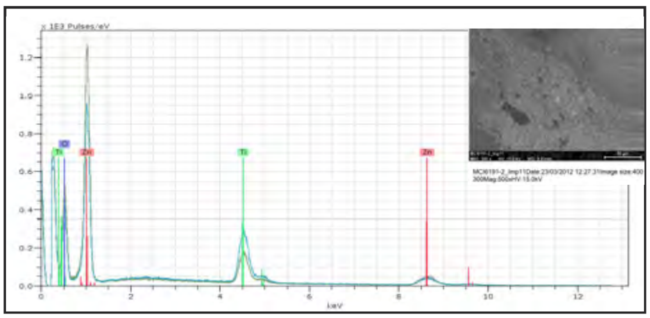
acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: pinkish compositional white

sample location: top edge, 6.5" from right
(T 0.0 x R 16.5 cm.)

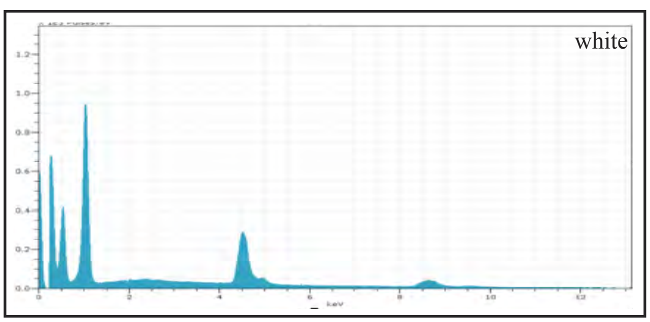
Representative Analysis Compilation—sample Imp11



photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	33.82	33.77	15.94	1.18
Sodium	K-series	22.65	22.61	30.37	17.85
Titanium	K-series	20.96	20.93	13.49	1.41
Barium	L-series	1.92	1.92	0.43	0.96
Sulfur	K-series	0.09	0.09	0.09	0.03
Phosphorus	K-series	0.07	0.07	0.07	0.03
Chlorine	K-series	0.07	0.07	0.06	0.03
Calcium	K-series	0.03	0.03	0.02	0.03
Aluminium	K-series	0.02	0.02	0.03	0.03
Silicon	K-series	0.02	0.02	0.03	0.03
Potassium	K-series	0.02	0.02	0.02	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	20.48	20.45	39.45	16.44
	Sum:	100.16	100.00	100.00	

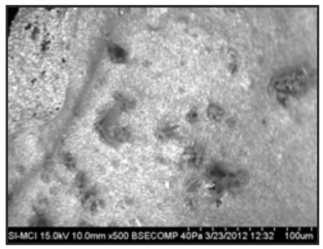
X

no image available

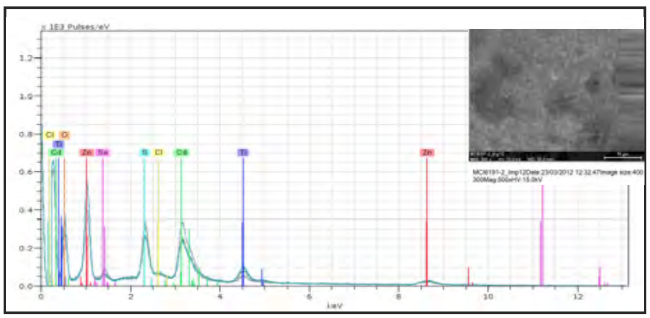
acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: orange

sample location: 55.9" from bottom, 7.5" from left
(B 142.0 x L 19.1 cm.)

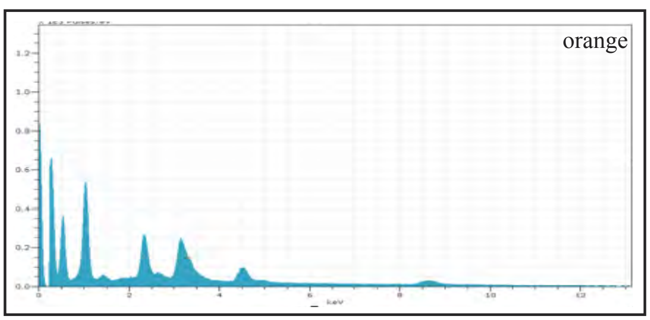
Representative Analysis Compilation—sample Imp12



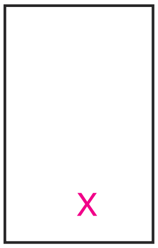
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
interpretation: cadmium orange



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	23.76	28.03	12.95	0.85
Cadmium	L-series	11.12	13.12	3.53	2.62
Sodium	K-series	8.41	9.92	13.04	6.65
Sulfur	K-series	5.91	6.97	6.57	0.24
Titanium	K-series	4.43	5.23	3.30	0.54
Potassium	K-series	1.98	2.34	1.81	0.94
Barium	L-series	1.80	2.12	0.47	0.76
Selenium	L-series	0.81	0.96	0.37	0.10
Chlorine	K-series	0.50	0.59	0.51	0.05
Aluminium	K-series	0.22	0.26	0.29	0.19
Silicon	K-series	0.18	0.21	0.23	0.04
Phosphorus	K-series	0.18	0.21	0.21	0.04
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	25.46	30.04	56.74	23.08
	Sum:	84.77	100.00	100.00	

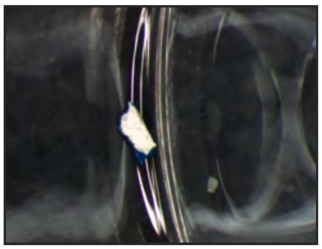


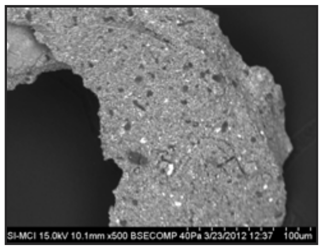
no image available

acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: blue, possible ground layer

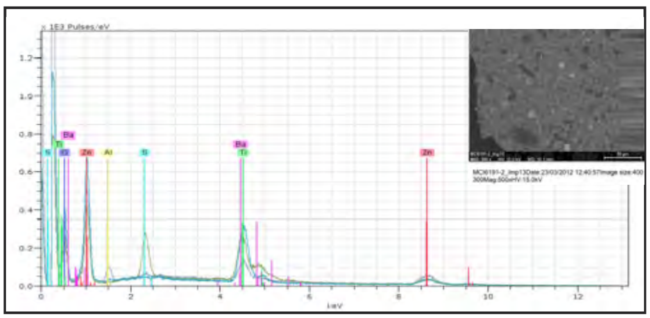
sample location: 13.5" from bottom, 27.1" from left (B 34.3 x L 68.8 cm.)

Representative Analysis Compilation—sample Imp13

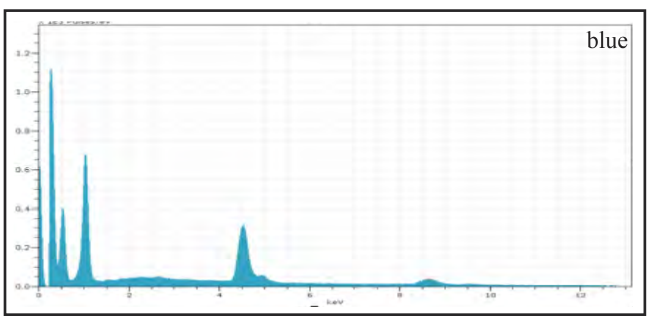




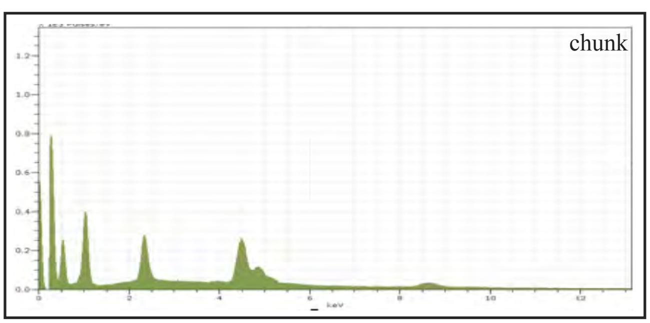
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Na, Al
interpretation: ultramarine blue



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	26.79	31.22	13.86	0.94
Titanium	K-series	20.00	23.31	14.13	1.25
Sodium	K-series	12.47	14.54	18.36	9.84
Barium	L-series	0.87	1.02	0.22	0.46
Aluminium	K-series	0.24	0.28	0.30	0.04
Phosphorus	K-series	0.19	0.22	0.21	0.04
Sulfur	K-series	0.16	0.19	0.17	0.03
Silicon	K-series	0.15	0.17	0.18	0.03
Chlorine	K-series	0.11	0.13	0.11	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	24.81	28.91	52.46	20.34
	Sum:	85.81	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	43.46	36.86	12.38	2.87
Zinc	K-series	36.31	30.80	21.73	1.27
Sulfur	K-series	9.01	7.64	11.00	0.35
Sodium	K-series	8.42	7.14	14.34	6.65
Titanium	K-series	5.51	4.67	4.50	1.19
Chlorine	K-series	0.31	0.27	0.35	0.04
Potassium	K-series	0.23	0.20	0.23	0.04
Calcium	K-series	0.14	0.12	0.13	0.04
Phosphorus	K-series	0.10	0.09	0.13	0.03
Silicon	K-series	0.02	0.02	0.03	0.03
Aluminium	K-series	0.01	0.01	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	14.38	12.19	35.16	15.25
	Sum:	117.91	100.00	100.00	

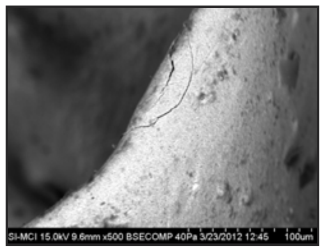
X

no image available

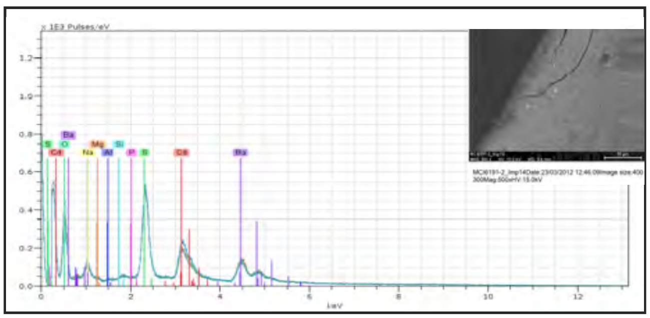
acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: yellow

sample location: 50.1" from bottom, 10.1" from left
(B 127.3 x L 25.7 cm.)

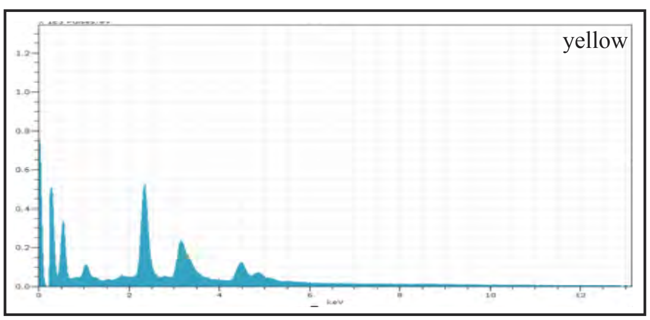
Representative Analysis Compilation—sample Imp14



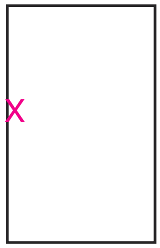
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Ba, Cd, S
interpretation: cadmium yellow mixed with barium sulfate



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	21.32	21.85	4.99	1.52
Cadmium	L-series	14.09	14.45	4.03	3.29
Sulfur	K-series	12.20	12.50	12.24	0.46
Zinc	K-series	9.38	9.61	4.61	0.38
Sodium	K-series	4.10	4.20	5.73	3.25
Potassium	K-series	2.53	2.59	2.08	1.15
Titanium	K-series	0.67	0.69	0.45	0.48
Magnesium	K-series	0.63	0.64	0.83	0.23
Silicon	K-series	0.27	0.28	0.31	0.04
Calcium	K-series	0.13	0.13	0.10	0.11
Phosphorus	K-series	0.12	0.13	0.13	0.03
Aluminium	K-series	0.10	0.10	0.12	0.10
Selenium	L-series	0.00	0.00	0.00	0.02
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	32.00	32.81	64.36	31.24
	Sum:	97.53	100.00	100.00	

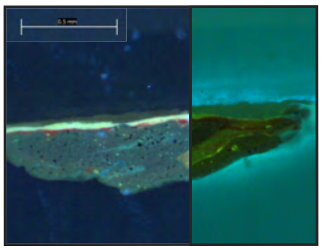


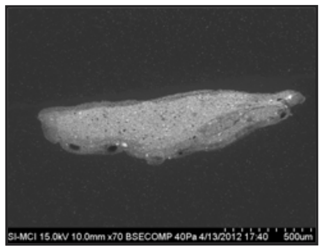
no image available

acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: stratigraphy

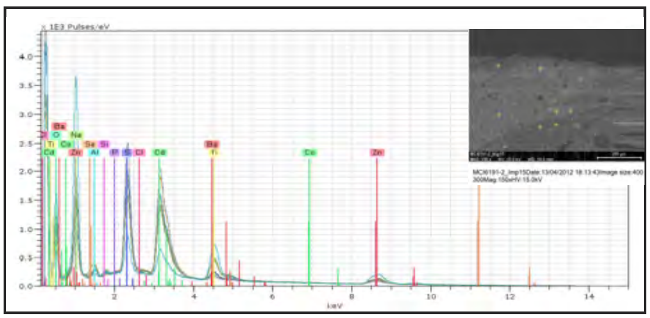
sample location: 44.9" from bottom, 0.5" from left (B 114.1 x L 1.3 cm.)

Representative Analysis Compilation—sample Imp15

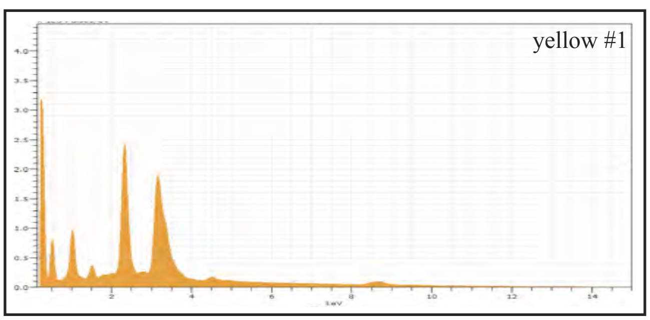




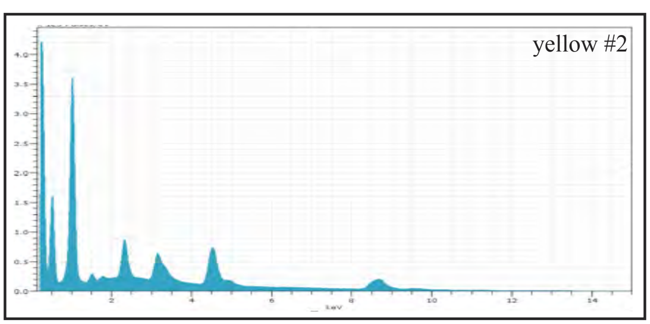
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.0 mm.
mag: 150x; HV: 15 kV
significant elements, yellow: Cd, S, Zn
significant elements, red: Cd, S, Se
significant elements, green: Zn, Cd, S, Na
interpretation: cadmium yellow, cadmium green, cadmium red



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	23.79	26.27	9.36	2.17
Zinc	K-series	23.12	25.52	15.64	0.79
Sulfur	K-series	12.88	14.22	17.76	0.48
Sodium	K-series	8.65	9.55	16.64	6.83
Potassium	K-series	4.74	5.23	5.36	0.73
Barium	L-series	4.48	4.95	1.44	0.34
Aluminium	K-series	1.28	1.41	2.09	0.98
Calcium	K-series	0.22	0.24	0.24	0.15
Magnesium	K-series	0.11	0.12	0.20	0.07
Phosphorus	K-series	0.02	0.02	0.02	0.03
Silicon	K-series	0.01	0.01	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	11.30	12.47	31.23	7.34
	Sum:	90.58	100.00	100.00	



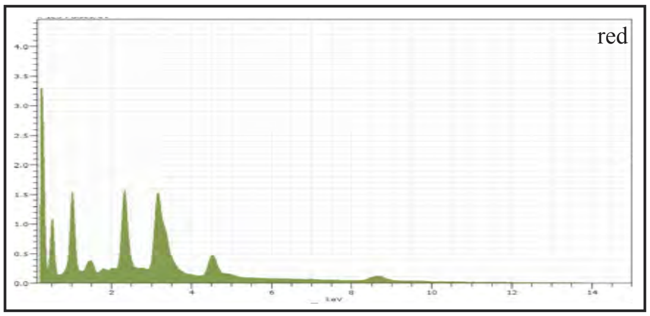
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	38.57	40.05	20.77	1.30
Sodium	K-series	14.23	14.78	21.80	11.23
Titanium	K-series	10.85	11.27	7.98	0.59
Cadmium	L-series	5.93	6.16	1.86	0.96
Sulfur	K-series	3.89	4.03	4.27	0.16
Barium	L-series	1.79	1.85	0.46	0.76
Potassium	K-series	1.00	1.03	0.90	0.35
Iron	K-series	0.74	0.77	0.47	0.05
Aluminium	K-series	0.57	0.59	0.74	0.46
Silicon	K-series	0.27	0.28	0.34	0.04
Chlorine	K-series	0.11	0.11	0.11	0.03
Phosphorus	K-series	0.10	0.10	0.11	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.02
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	18.26	18.96	40.20	8.76
	Sum:	96.30	100.00	100.00	

no image available

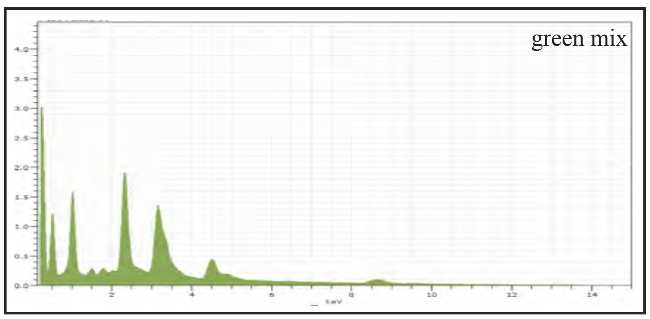
acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: stratigraphy

sample location: 44.9" from bottom, 0.5" from left (B 114.1 x L 1.3 cm.)

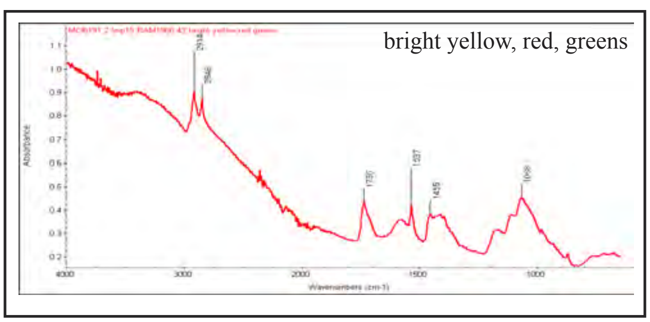
Representative Analysis Compilation—sample Imp15, continued



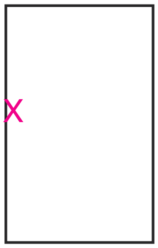
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	19.24	23.15	11.79	0.66
Cadmium	L-series	17.39	20.93	6.20	1.74
Sodium	K-series	6.35	7.64	11.06	5.02
Sulfur	K-series	6.19	7.45	7.73	0.24
Titanium	K-series	5.88	7.08	4.92	0.40
Potassium	K-series	3.22	3.87	3.30	0.59
Aluminium	K-series	1.51	1.81	2.24	1.13
Barium	L-series	1.06	1.27	0.31	0.53
Selenium	L-series	0.90	1.09	0.46	0.10
Iron	K-series	0.71	0.86	0.51	0.05
Silicon	K-series	0.18	0.21	0.25	0.03
Magnesium	K-series	0.02	0.02	0.03	0.04
Chlorine	K-series	0.01	0.01	0.01	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	20.45	24.61	51.21	11.62
	Sum:	83.10	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	21.98	25.35	13.63	0.76
Cadmium	L-series	13.89	16.02	5.01	1.57
Barium	L-series	8.78	10.13	2.59	0.70
Sulfur	K-series	6.49	7.49	8.21	0.25
Sodium	K-series	4.73	5.45	8.34	3.75
Titanium	K-series	3.83	4.42	3.24	0.46
Potassium	K-series	3.05	3.52	3.17	0.54
Iron	K-series	1.86	2.15	1.35	0.08
Aluminium	K-series	0.58	0.67	0.87	0.47
Silicon	K-series	0.55	0.64	0.80	0.05
Calcium	K-series	0.18	0.20	0.18	0.11
Phosphorus	K-series	0.03	0.04	0.05	0.03
Magnesium	K-series	0.03	0.04	0.05	0.05
Chlorine	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	20.71	23.89	52.50	11.33
	Sum:	86.70	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

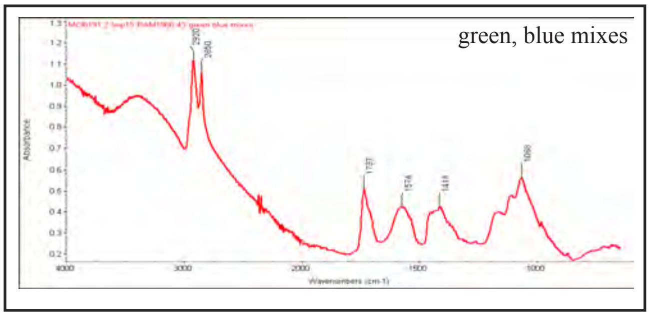


no image available

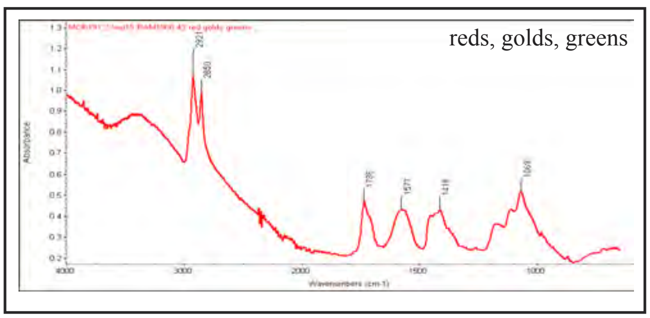
acc. no.: BAM 1966.43
title, year: *Imperium in Imperio*, 1964
Bequest of the artist
medium noted in file: oil on canvas
meas.: 84.1 x 52.0" (213.6 x 132.1 cm.)
notes: stratigraphy

sample location: 44.9" from bottom, 0.5" from left (B 114.1 x L 1.3 cm.)

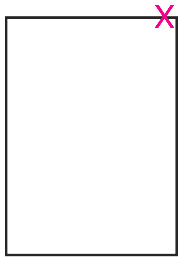
Representative Analysis Compilation—sample Imp15, continued



analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

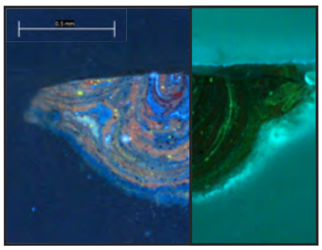


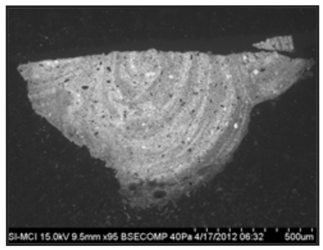
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



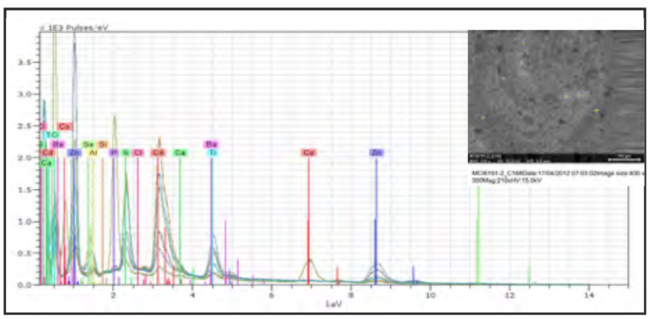
acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: brown, green
sample location: top edge, 3.0" from right
(T 0.0 x R 7.6 cm.)

Representative Analysis Compilation—sample C168

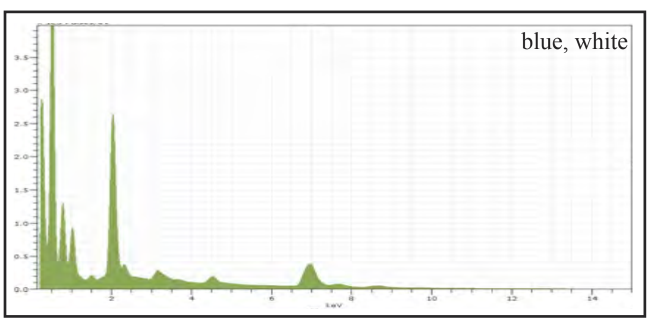




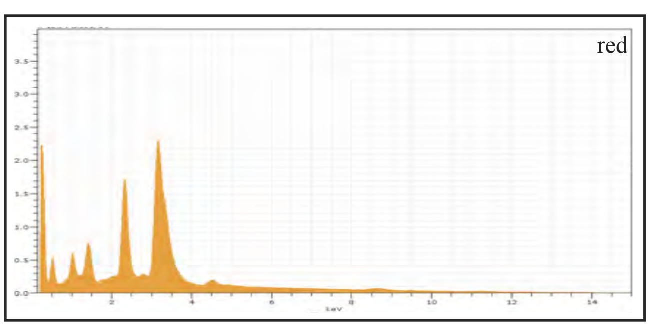
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



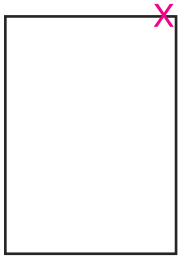
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.5 mm.
mag: 210x; HV: 15 kV
significant elements, blue: Co, P
significant elements, red: Cd, S, Se
significant elements, white: Zn, Ti
interpretation: cobalt violet, cadmium red,
Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	29.05	28.61	13.72	0.89
Phosphorus	K-series	16.46	16.21	14.79	0.65
Zinc	K-series	8.90	8.76	3.79	0.33
Sodium	K-series	8.16	8.03	9.88	6.45
Cadmium	L-series	2.26	2.23	0.56	0.58
Sulfur	K-series	1.70	1.68	1.48	0.09
Titanium	K-series	1.63	1.61	0.95	0.21
Barium	L-series	1.15	1.13	0.23	0.26
Magnesium	K-series	0.42	0.41	0.48	0.11
Aluminium	K-series	0.41	0.40	0.42	0.34
Potassium	K-series	0.41	0.40	0.29	0.23
Calcium	K-series	0.26	0.26	0.18	0.06
Chlorine	K-series	0.24	0.24	0.19	0.04
Selenium	L-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	30.49	30.02	53.04	9.38
	Sum:	101.55	100.00	100.00	

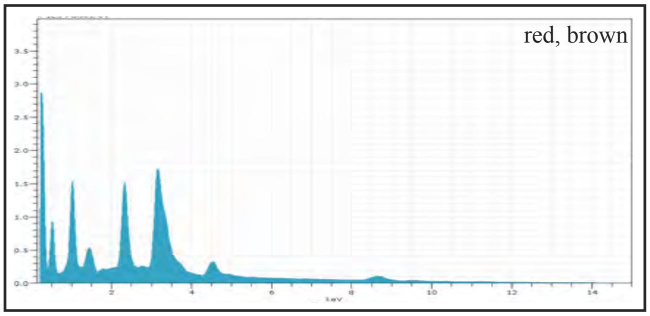


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	15.24	22.80	8.69	1.45
Zinc	K-series	13.55	20.27	13.27	0.48
Sulfur	K-series	7.23	10.82	14.46	0.28
Selenium	L-series	7.20	10.78	5.85	0.49
Sodium	K-series	3.93	5.88	10.95	3.12
Potassium	K-series	3.89	5.82	6.38	0.50
Cobalt	K-series	3.07	4.59	3.34	0.12
Barium	L-series	2.98	4.46	1.39	0.27
Aluminium	K-series	1.22	1.82	2.89	0.95
Titanium	K-series	0.40	0.60	0.54	0.16
Magnesium	K-series	0.08	0.13	0.22	0.09
Silicon	K-series	0.08	0.11	0.17	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	7.95	11.90	31.86	6.24
	Sum:	66.82	100.00	100.00	

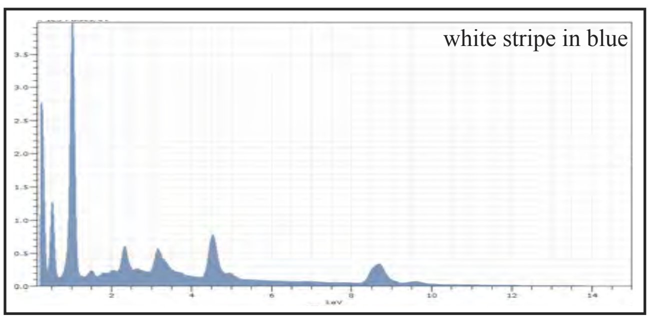




acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: brown, green
sample location: top edge, 3.0" from right
(T 0.0 x R 7.6 cm.)

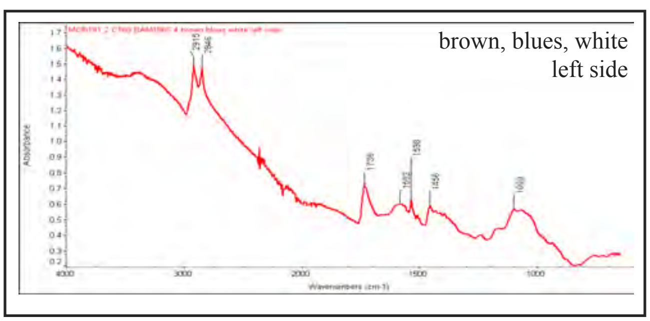
Representative Analysis Compilation—sample C168, continued



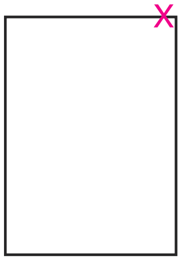
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	19.83	22.93	12.66	0.68
Cadmium	L-series	18.40	21.28	6.84	1.85
Sodium	K-series	7.69	8.89	13.96	6.08
Sulfur	K-series	7.06	8.16	9.19	0.27
Potassium	K-series	4.06	4.69	4.33	0.61
Barium	L-series	2.98	3.44	0.91	0.39
Titanium	K-series	2.93	3.39	2.56	0.35
Selenium	L-series	2.52	2.91	1.33	0.20
Cobalt	K-series	1.92	2.22	1.36	0.09
Aluminium	K-series	1.75	2.02	2.70	1.33
Calcium	K-series	0.65	0.76	0.68	0.13
Silicon	K-series	0.05	0.05	0.07	0.03
Phosphorus	K-series	0.02	0.02	0.03	0.03
Magnesium	K-series	0.01	0.01	0.01	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	16.61	19.21	43.36	10.07
	Sum:	86.47	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	68.30	52.79	35.03	2.27
Sodium	K-series	20.45	15.81	29.83	16.12
Titanium	K-series	9.85	7.62	6.90	0.72
Cadmium	L-series	6.83	5.28	2.04	1.09
Barium	L-series	6.22	4.81	1.52	0.76
Sulfur	K-series	2.45	1.89	2.56	0.11
Cobalt	K-series	2.41	1.87	1.37	0.10
Copper	K-series	1.80	1.39	0.95	0.09
Potassium	K-series	0.96	0.74	0.82	0.40
Aluminium	K-series	0.64	0.49	0.79	0.51
Chlorine	K-series	0.51	0.39	0.48	0.04
Calcium	K-series	0.49	0.38	0.41	0.09
Phosphorus	K-series	0.26	0.20	0.28	0.04
Silicon	K-series	0.19	0.15	0.23	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	8.00	6.18	16.77	4.23
	Sum:	129.37	100.00	100.00	

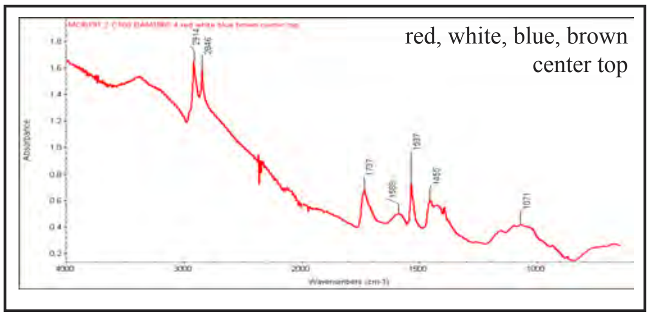


analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: brown, green
sample location: top edge, 3.0" from right
(T 0.0 x R 7.6 cm.)

Representative Analysis Compilation—sample C168, continued

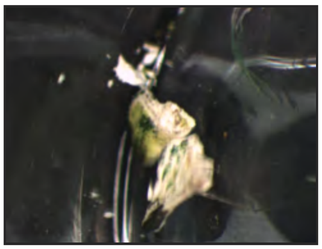


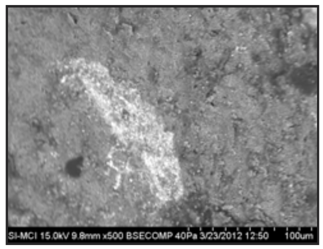
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

no image available

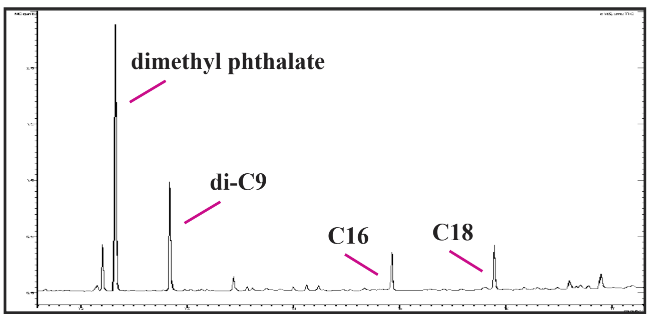
acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: ground layer
sample location: upper right corner
(T 0.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C169

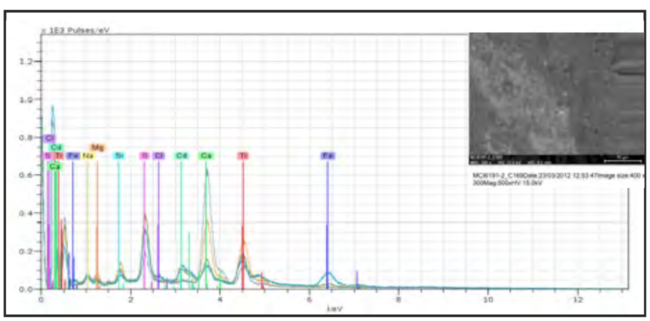




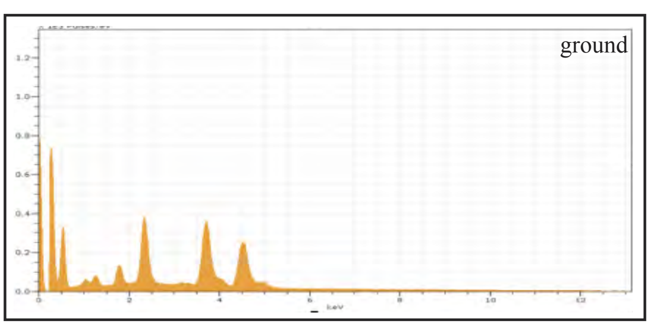
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/06/12
sample weight: 0.200
scan range: 1 - 1481
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd, oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti, Ca
significant elements, green: Fe, Cl
interpretation: titanium white, iron oxide green

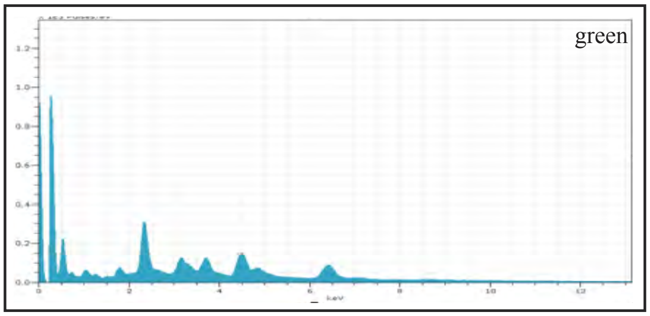


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	24.58	21.75	15.00	2.22
Calcium	K-series	22.99	20.34	16.77	0.94
Sulfur	K-series	11.89	10.52	10.83	0.45
Barium	L-series	11.53	10.21	2.46	2.37
Zinc	K-series	9.02	7.98	4.03	0.38
Silicon	K-series	3.59	3.18	3.74	0.18
Magnesium	K-series	3.13	2.77	3.76	0.20
Cadmium	L-series	2.18	1.93	0.57	0.56
Sodium	K-series	0.93	0.82	1.18	0.75
Chlorine	K-series	0.58	0.51	0.47	0.05
Phosphorus	K-series	0.06	0.06	0.06	0.03
Potassium	K-series	0.05	0.05	0.04	0.06
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	22.49	19.90	41.08	20.73
	Sum:	113.02	100.00	100.00	

no image available

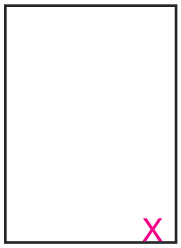
acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: ground layer
sample location: upper right corner
(T 0.0 x R 0.0 cm.)

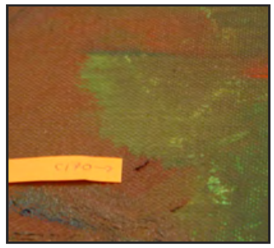
Representative Analysis Compilation—sample C169, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Iron	K-series	19.91	27.04	27.36	0.62
Barium	L-series	16.40	22.27	9.16	1.45
Zinc	K-series	8.95	12.15	10.50	0.36
Sulfur	K-series	8.26	11.22	19.78	0.32
Cadmium	L-series	5.87	7.97	4.00	1.46
Titanium	K-series	5.21	7.08	8.35	0.81
Calcium	K-series	4.56	6.19	8.73	0.32
Potassium	K-series	1.14	1.55	2.24	0.67
Sodium	K-series	1.10	1.50	3.69	0.89
Silicon	K-series	0.87	1.17	2.36	0.07
Magnesium	K-series	0.85	1.16	2.70	0.08
Chlorine	K-series	0.50	0.68	1.09	0.05
Aluminium	K-series	0.01	0.02	0.04	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
	Sum:	73.64	100.00	100.00	

analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

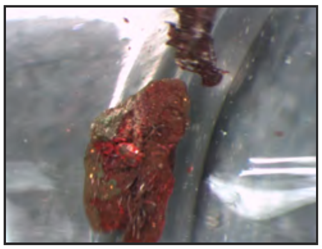


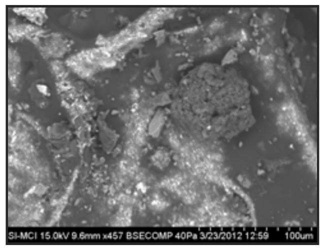


acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: red brown

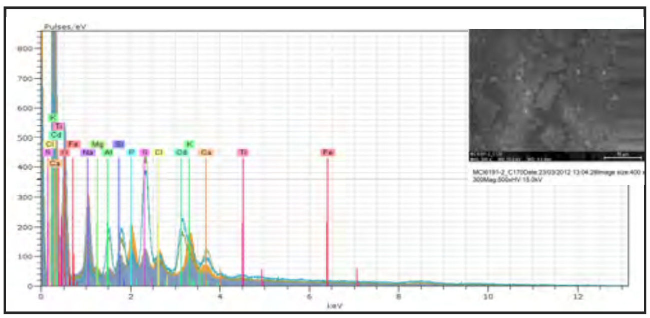
sample location: 4.5" from bottom, 7.5" from right (B 11.4 x R 19.1 cm.)

Representative Analysis Compilation—sample C170

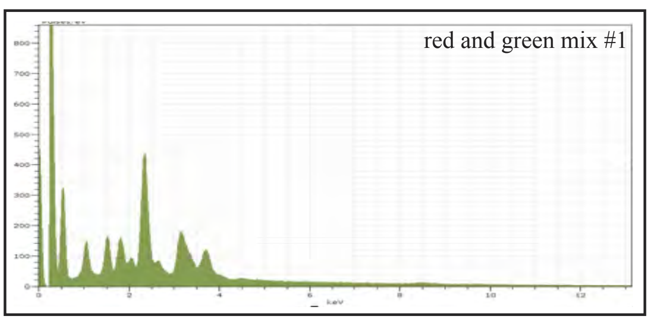




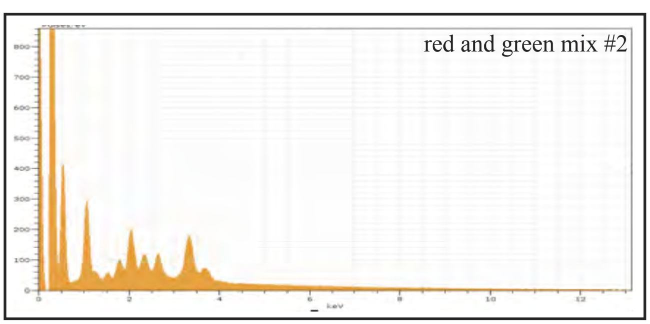
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



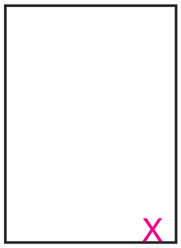
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S
significant elements, green: Na, Zn, Cd, S
interpretation: cadmium red, cadmium green, other mixed colors

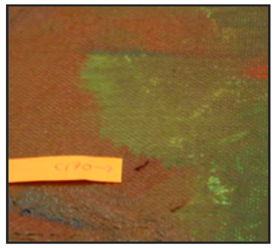


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	11.27	14.38	3.55	2.71
Sulfur	K-series	9.87	12.60	10.90	0.38
Zinc	K-series	9.78	12.48	5.29	0.39
Calcium	K-series	5.07	6.47	4.48	0.34
Sodium	K-series	4.29	5.47	6.60	3.40
Aluminium	K-series	2.73	3.49	3.59	2.11
Silicon	K-series	2.21	2.82	2.79	0.12
Barium	L-series	1.81	2.31	0.47	0.25
Chlorine	K-series	1.44	1.84	1.44	0.08
Iron	K-series	1.40	1.78	0.89	0.08
Potassium	K-series	1.34	1.71	1.21	0.89
Phosphorus	K-series	1.14	1.46	1.31	0.07
Magnesium	K-series	0.11	0.13	0.15	0.09
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.91	33.06	57.34	24.35
	Sum:	78.37	100.00	100.00	



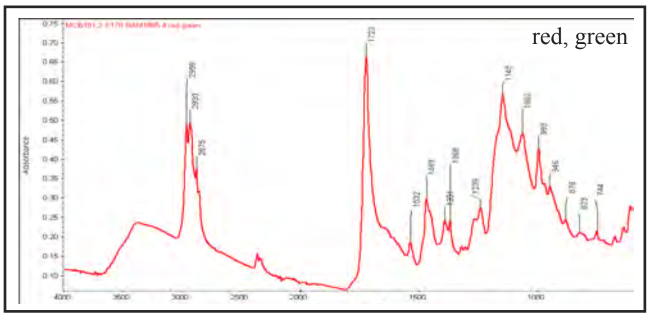
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Sodium	K-series	5.97	5.97	4.69	4.72
Potassium	K-series	3.73	3.73	1.72	0.57
Zinc	K-series	2.76	2.76	0.76	0.14
Phosphorus	K-series	2.42	2.42	1.41	0.12
Chlorine	K-series	1.49	1.49	0.76	0.08
Calcium	K-series	1.31	1.31	0.59	0.15
Sulfur	K-series	1.21	1.21	0.68	0.07
Iron	K-series	0.97	0.97	0.31	0.06
Barium	L-series	0.83	0.83	0.11	0.14
Silicon	K-series	0.63	0.63	0.41	0.05
Magnesium	K-series	0.48	0.48	0.36	0.06
Aluminium	K-series	0.17	0.17	0.11	0.03
Cadmium	L-series	0.02	0.02	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	78.01	78.01	88.08	65.28
	Sum:	100.00	100.00	100.00	



acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: red brown
sample location: 4.5" from bottom, 7.5" from right (B 11.4 x R 19.1 cm.)

Representative Analysis Compilation—sample C170, continued

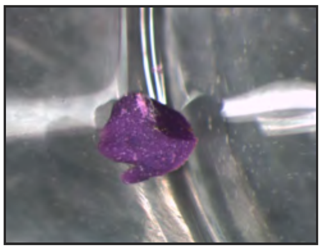


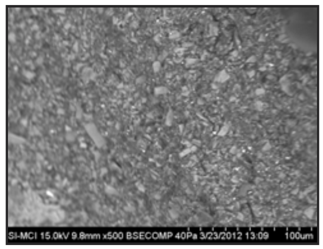
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

no image available

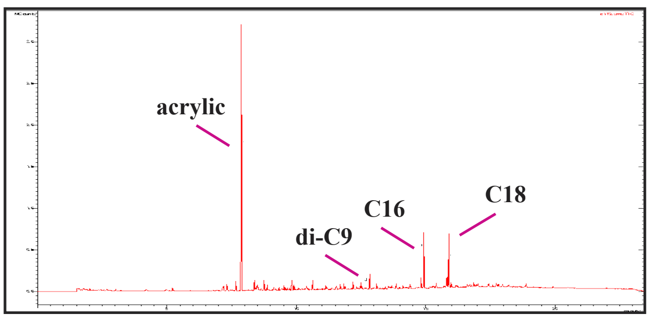
acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: new purple
sample location: no measurements available

Representative Analysis Compilation—sample C172

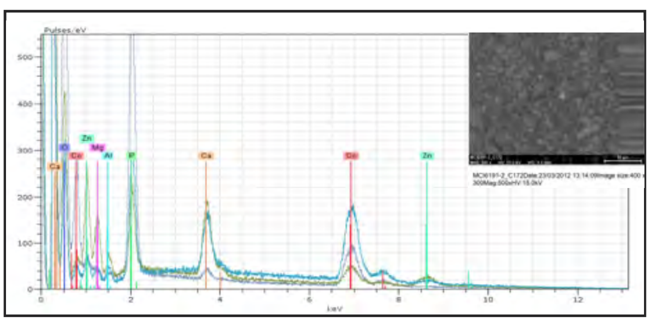




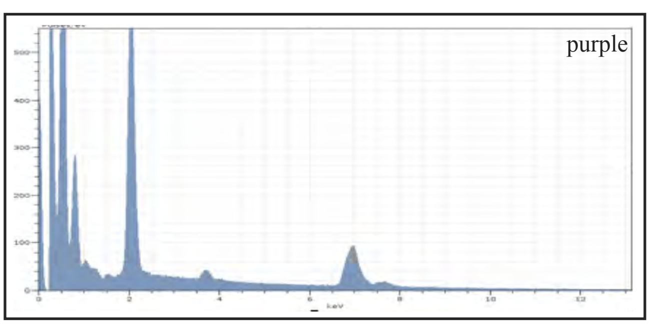
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.207
scan range: 1 - 1482
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18, acrylic
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Co, P
significant elements, white: Zn
interpretation: cobalt violet, zinc white

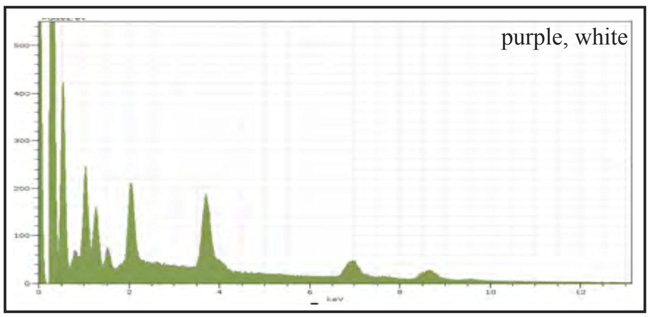


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cobalt	K-series	40.01	36.44	17.98	1.24
Phosphorus	K-series	24.31	22.14	20.79	0.95
Zinc	K-series	5.52	5.03	2.24	0.26
Calcium	K-series	1.68	1.53	1.11	0.09
Barium	L-series	1.47	1.34	0.28	0.23
Sodium	K-series	1.43	1.31	1.65	1.15
Magnesium	K-series	1.35	1.23	1.47	0.11
Chlorine	K-series	0.79	0.72	0.59	0.06
Sulfur	K-series	0.68	0.62	0.56	0.05
Potassium	K-series	0.36	0.32	0.24	0.06
Aluminium	K-series	0.27	0.25	0.26	0.04
Silicon	K-series	0.02	0.02	0.02	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	31.90	29.06	52.80	16.95
	Sum:	109.78	100.00	100.00	

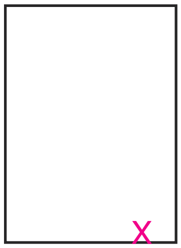
no image available

acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: new purple
sample location: no measurements available

Representative Analysis Compilation—sample C172, continued

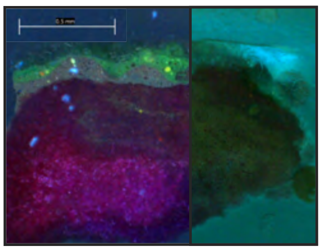
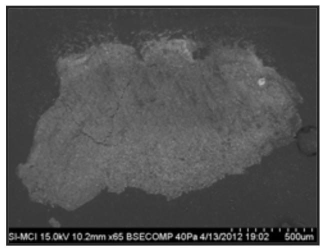


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	20.53	24.96	11.23	0.74
Cobalt	K-series	12.84	15.61	7.79	0.42
Calcium	K-series	7.24	8.80	6.46	0.25
Phosphorus	K-series	6.06	7.37	7.00	0.26
Magnesium	K-series	5.77	7.01	8.49	0.34
Sodium	K-series	4.51	5.49	7.02	3.58
Aluminium	K-series	1.53	1.86	2.03	0.10
Barium	L-series	0.94	1.14	0.24	0.16
Sulfur	K-series	0.48	0.58	0.53	0.05
Chlorine	K-series	0.47	0.57	0.47	0.04
Potassium	K-series	0.13	0.16	0.12	0.04
Silicon	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	21.75	26.44	48.61	17.85
	Sum:	82.25	100.00	100.00	

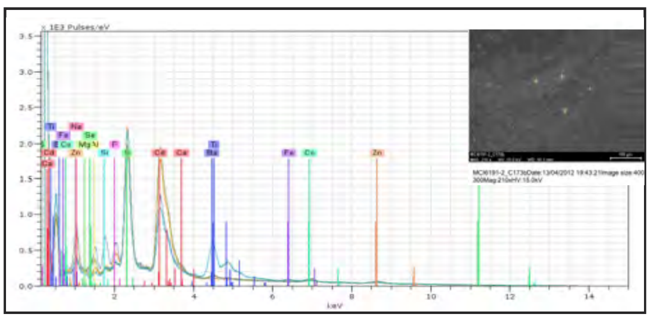
 

acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: stratigraphy, also fibers from edge
sample location: 2.0" from bottom, 10.0" from right (B 5.1 x R 25.4 cm.)

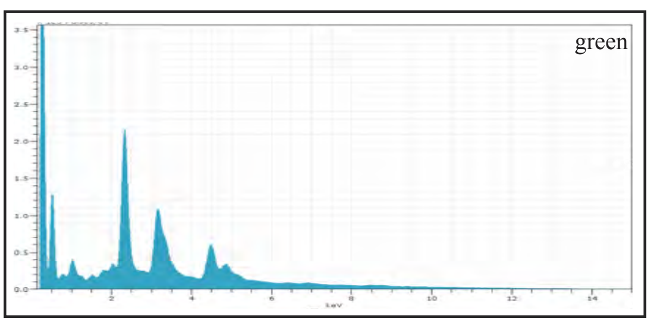
Representative Analysis Compilation—sample C173

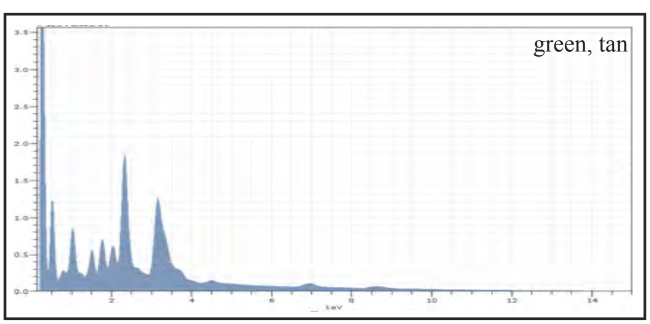
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.2 mm.



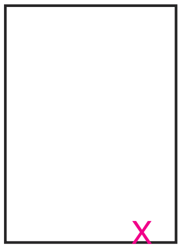
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.1 mm.
mag: 210x; HV: 15 kV
significant elements, green: Zn, Cd, S, Na
significant elements, tan: none
interpretation: cadmium green, mixed colors



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	19.04	21.71	5.04	1.24
Sulfur	K-series	11.44	13.04	12.98	0.43
Cadmium	L-series	10.71	12.21	3.47	1.35
Zinc	K-series	7.88	8.99	4.39	0.29
Cobalt	K-series	2.87	3.27	1.77	0.12
Potassium	K-series	2.24	2.55	2.08	0.46
Sodium	K-series	1.90	2.16	3.00	1.52
Iron	K-series	1.15	1.31	0.75	0.08
Titanium	K-series	0.84	0.95	0.64	0.35
Phosphorus	K-series	0.73	0.84	0.86	0.05
Silicon	K-series	0.32	0.36	0.41	0.04
Magnesium	K-series	0.22	0.25	0.33	0.08
Aluminium	K-series	0.21	0.24	0.28	0.18
Chlorine	K-series	0.04	0.04	0.04	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	28.13	32.07	63.96	15.39
	Sum:	87.72	100.00	100.00	

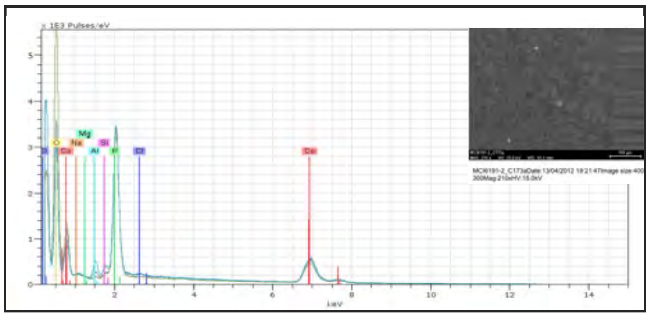


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	8.98	15.12	3.14	1.08
Sulfur	K-series	6.32	10.64	7.75	0.25
Zinc	K-series	3.21	5.40	1.93	0.14
Sodium	K-series	2.25	3.79	3.84	1.79
Potassium	K-series	1.89	3.19	1.90	0.37
Silicon	K-series	1.64	2.76	2.30	0.09
Cobalt	K-series	1.32	2.23	0.88	0.07
Phosphorus	K-series	1.29	2.17	1.64	0.07
Aluminium	K-series	1.20	2.02	1.75	0.77
Calcium	K-series	0.51	0.87	0.50	0.09
Titanium	K-series	0.39	0.66	0.32	0.08
Chlorine	K-series	0.16	0.27	0.18	0.03
Barium	L-series	0.15	0.26	0.04	0.10
Magnesium	K-series	0.02	0.04	0.04	0.04
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	30.04	50.58	73.79	16.72
	Sum:	59.39	100.00	100.00	

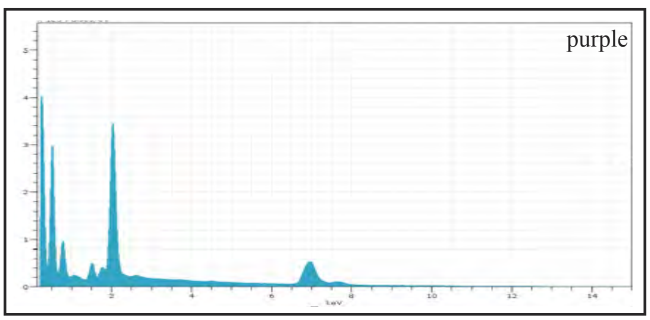




acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: stratigraphy, also fibers from edge
sample location: 2.0" from bottom, 10.0" from right (B 5.1 x R 25.4 cm.)

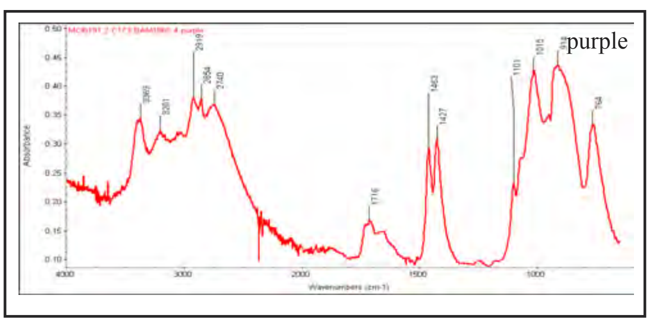
Representative Analysis Compilation—sample C173, continued



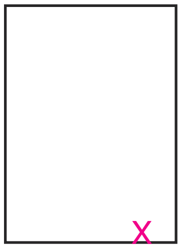
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.1 mm.
mag: 210x; HV: 15 kV
significant elements, purple: Co, P
interpretation: cobalt violet



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cobalt	K-series	35.10	42.88	21.50	1.07
Phosphorus	K-series	15.33	18.73	17.86	0.61
Sodium	K-series	2.26	2.76	3.55	1.80
Zinc	K-series	1.92	2.35	1.06	0.10
Aluminium	K-series	1.91	2.34	2.56	0.11
Barium	L-series	0.94	1.14	0.25	0.11
Silicon	K-series	0.61	0.75	0.79	0.05
Magnesium	K-series	0.45	0.55	0.67	0.05
Chlorine	K-series	0.30	0.37	0.30	0.04
Calcium	K-series	0.20	0.25	0.18	0.03
Potassium	K-series	0.15	0.18	0.13	0.03
Sulfur	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	22.67	27.70	51.14	8.29
	Sum:	81.85	100.00	100.00	

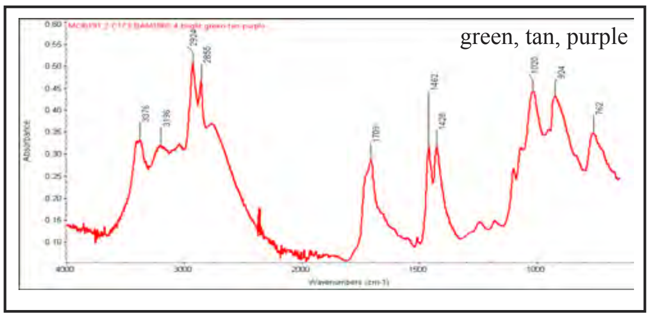


analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: inconclusive; consistent with three other spectra

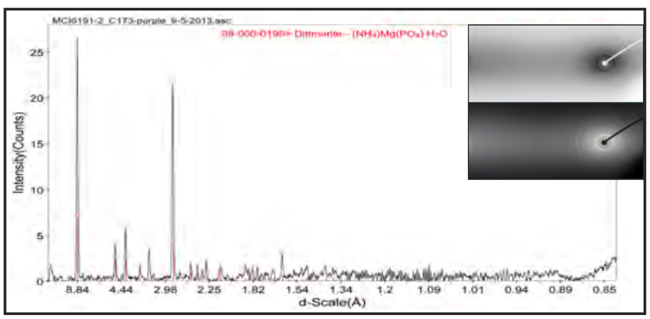
  

acc. no.: BAM 1965.4
title, year: *And Out of the Caves the Night Threw a Handful of Pale Tumbling Pigeons in the Light*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.1 x 60.3" (213.6 x 153.2 cm.)
notes: stratigraphy, also fibers from edge
sample location: 2.0" from bottom, 10.0" from right (B 5.1 x R 25.4 cm.)

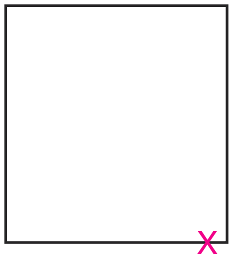
Representative Analysis Compilation—sample C173, continued



analysis: μFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: inconclusive; consistent with three other spectra



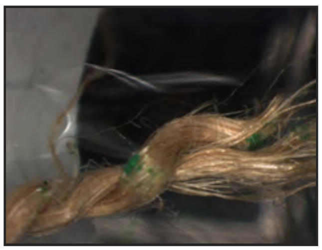
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-90º; omega: fixed at 0º; collimator: 0.8 mm
significant compounds: dittmarite
interpretation: cobalt violet

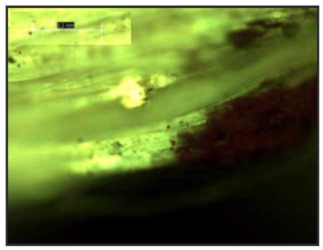


acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: threads, possibly warp, with dark green

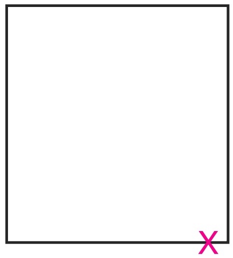
sample location: bottom edge, 4.0" from right
(B 0.0 x R 10.2 cm.)

Representative Analysis Compilation—sample C094





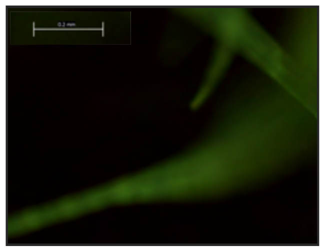
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

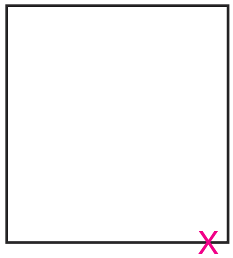
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: threads, possibly weft

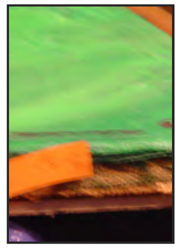
sample location: bottom edge, 4.0" from right
(B 0.0 x R 10.2 cm.)

Representative Analysis Compilation—sample C095

photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

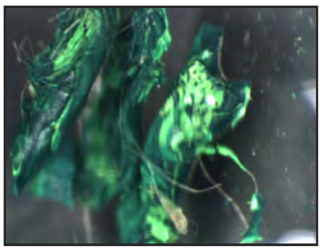


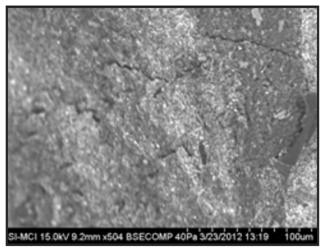


acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: dark green with black streaks

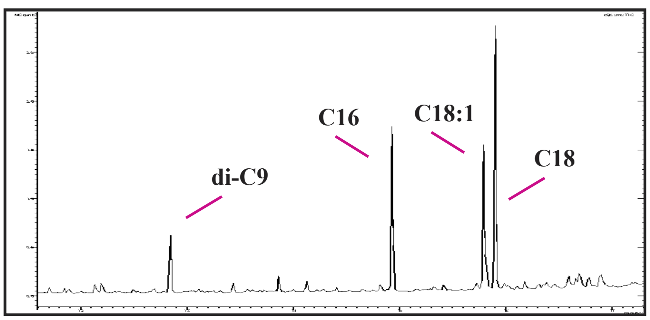
sample location: bottom edge, 4.0" from right
(B 0.0 x R 10.2 cm.)

Representative Analysis Compilation—sample C096

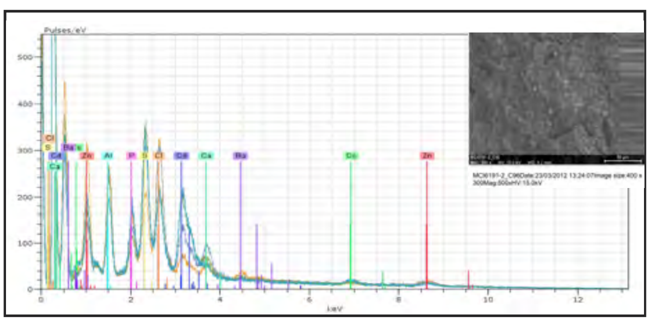




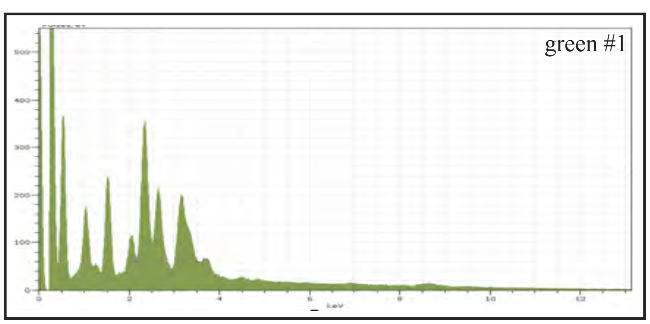
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.2 mm.



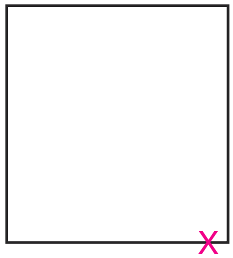
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.262
scan range: 1 - 1486
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil

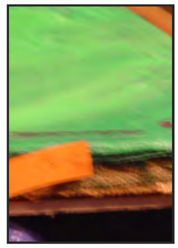


analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, green #1: Cl, Cu
significant elements, green #2: Cl, Cu, Zn, Co
interpretation: phthalo green, cobalt green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	15.93	18.23	4.60	3.49
Sulfur	K-series	11.40	13.05	11.55	0.43
Chlorine	K-series	8.24	9.43	7.55	0.31
Zinc	K-series	7.49	8.57	3.72	0.31
Aluminium	K-series	4.74	5.42	5.70	3.39
Sodium	K-series	2.80	3.21	3.96	2.23
Phosphorus	K-series	2.77	3.17	2.91	0.14
Calcium	K-series	1.90	2.17	1.54	0.24
Potassium	K-series	1.75	2.01	1.46	1.12
Cobalt	K-series	1.14	1.31	0.63	0.08
Copper	K-series	1.09	1.25	0.56	0.08
Barium	L-series	0.45	0.52	0.11	0.12
Magnesium	K-series	0.19	0.21	0.25	0.11
Iron	K-series	0.16	0.19	0.09	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	27.26	31.20	55.32	24.46
	Sum:	87.38	100.00	100.00	

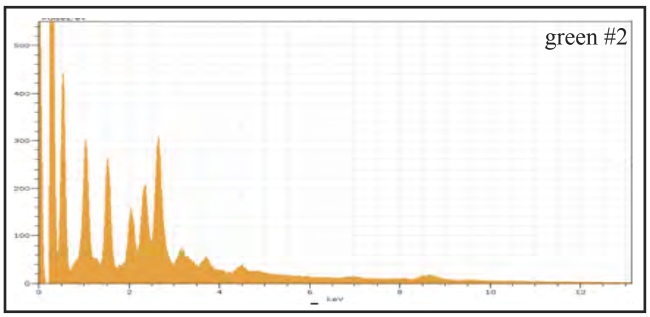




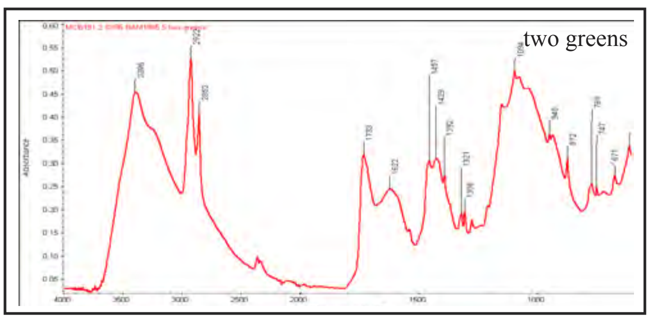
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: dark green with black streaks

sample location: bottom edge, 4.0" from right
(B 0.0 x R 10.2 cm.)

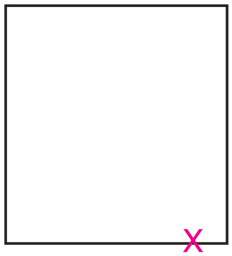
Representative Analysis Compilation—sample C096, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	11.71	15.72	6.17	0.45
Chlorine	K-series	8.04	10.79	7.82	0.30
Aluminium	K-series	5.04	6.77	6.44	3.43
Sulfur	K-series	4.51	6.06	4.85	0.19
Sodium	K-series	4.18	5.61	6.27	3.31
Phosphorus	K-series	3.44	4.61	3.82	0.16
Barium	L-series	2.81	3.78	0.71	0.31
Cadmium	L-series	2.18	2.93	0.67	0.56
Copper	K-series	1.70	2.29	0.92	0.11
Cobalt	K-series	1.62	2.18	0.95	0.09
Calcium	K-series	0.93	1.26	0.80	0.14
Potassium	K-series	0.26	0.35	0.23	0.20
Titanium	K-series	0.05	0.07	0.04	0.06
Silicon	K-series	0.03	0.04	0.03	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	27.97	37.56	60.27	23.24
	Sum:	74.47	100.00	100.00	



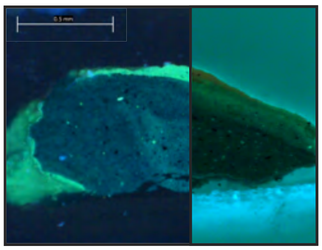
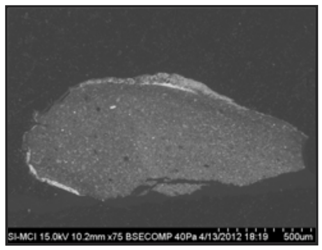
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

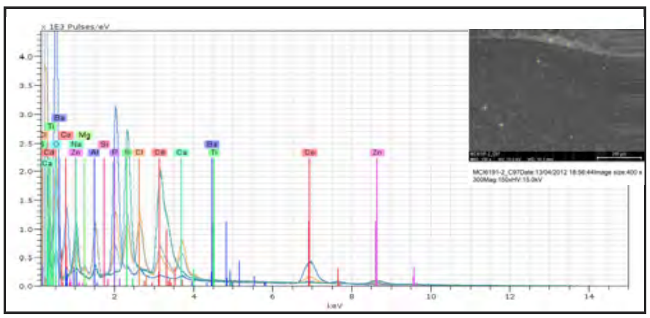

acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: light green, yellow and black streaks

sample location: bottom edge, 8.5" from right
(B 0.0 x R 21.6 cm.)

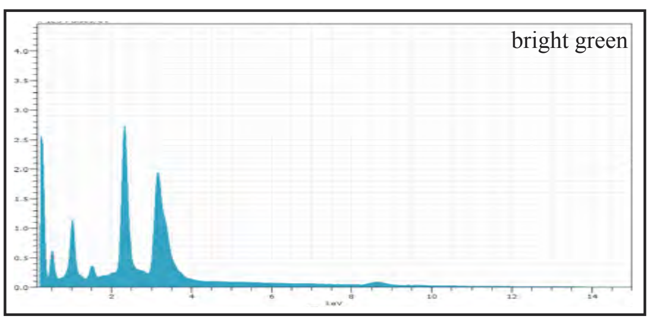
Representative Analysis Compilation—sample C097

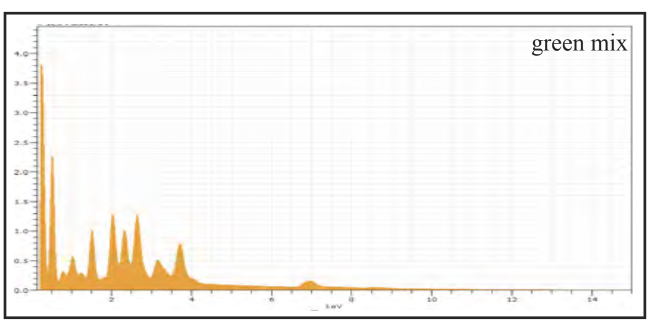
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.2 mm.



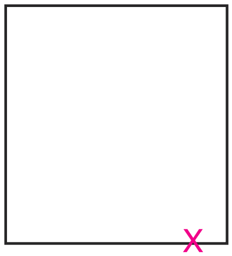
analysis: EDS
by: DVR (MCI)
date: 04/13/12
working distance: 10.1 mm.
mag: 150x; HV: 15 kV
significant elements, bright green: Zn, Cd, S, Na
significant elements, green mix: Cl, Co, Zn
interpretation: cadmium green, phthalo green, cobalt green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	24.42	28.28	9.83	2.19
Zinc	K-series	18.62	21.56	12.88	0.65
Sulfur	K-series	15.13	17.52	21.33	0.56
Sodium	K-series	6.94	8.03	13.65	5.48
Potassium	K-series	4.80	5.56	5.55	0.75
Cobalt	K-series	2.32	2.69	1.78	0.10
Aluminium	K-series	1.51	1.75	2.54	1.11
Barium	L-series	0.68	0.79	0.22	0.10
Magnesium	K-series	0.41	0.47	0.76	0.11
Chlorine	K-series	0.33	0.39	0.43	0.04
Calcium	K-series	0.23	0.26	0.26	0.15
Phosphorus	K-series	0.12	0.14	0.18	0.03
Silicon	K-series	0.03	0.04	0.05	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	10.81	12.52	30.55	7.86
	Sum:	86.35	100.00	100.00	



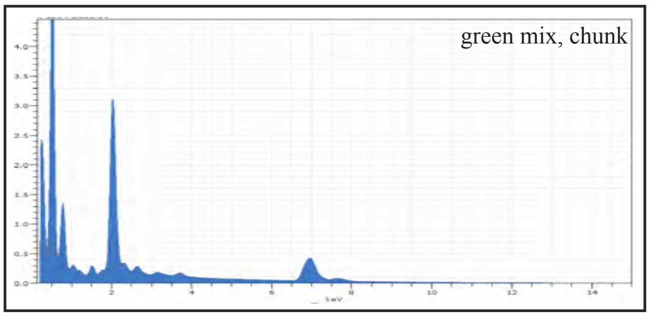
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Phosphorus	K-series	4.28	4.28	2.63	0.19
Chlorine	K-series	4.14	4.15	2.22	0.16
Cobalt	K-series	3.94	3.94	1.27	0.14
Calcium	K-series	3.41	3.41	1.62	0.15
Aluminium	K-series	3.04	3.04	2.14	1.20
Sulfur	K-series	2.99	2.99	1.77	0.13
Cadmium	L-series	2.49	2.49	0.42	0.45
Zinc	K-series	1.86	1.86	0.54	0.09
Sodium	K-series	0.45	0.45	0.38	0.38
Potassium	K-series	0.26	0.26	0.13	0.17
Barium	L-series	0.02	0.02	0.00	0.03
Magnesium	K-series	0.01	0.01	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	73.10	73.10	86.87	26.55
	Sum:	100.00	100.00	100.00	

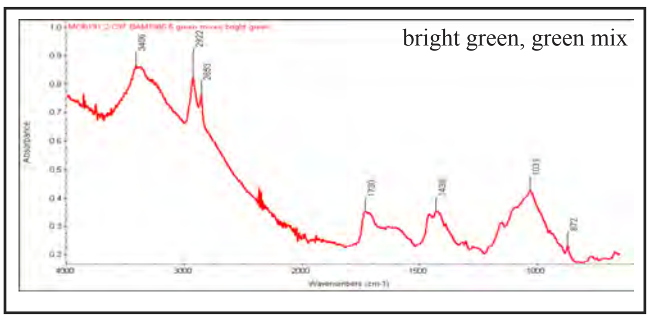

acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: light green, yellow and black streaks

sample location: bottom edge, 8.5" from right
(B 0.0 x R 21.6 cm.)

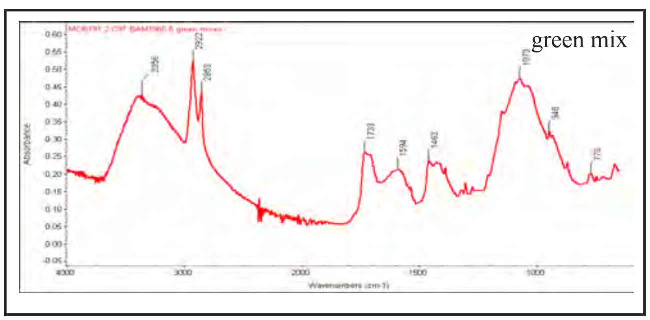
Representative Analysis Compilation—sample C097, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	24.08	28.98	12.05	0.74
Phosphorus	K-series	17.27	20.78	16.45	0.68
Sulfur	K-series	1.27	1.53	1.17	0.07
Sodium	K-series	1.12	1.35	1.44	0.91
Chlorine	K-series	1.03	1.23	0.85	0.06
Zinc	K-series	0.57	0.69	0.26	0.05
Cadmium	L-series	0.55	0.67	0.15	0.16
Aluminium	K-series	0.53	0.64	0.58	0.43
Calcium	K-series	0.41	0.49	0.30	0.06
Magnesium	K-series	0.14	0.17	0.17	0.06
Silicon	K-series	0.03	0.03	0.03	0.03
Barium	L-series	0.01	0.01	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	36.09	43.43	66.55	10.84
	Sum:	83.10	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7



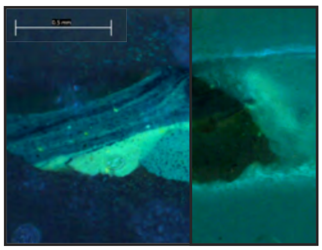
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

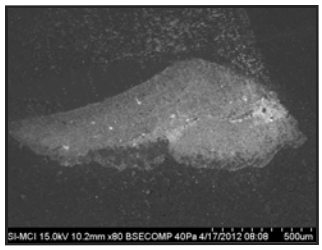
no image available

acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: green rectangle stratigraphy

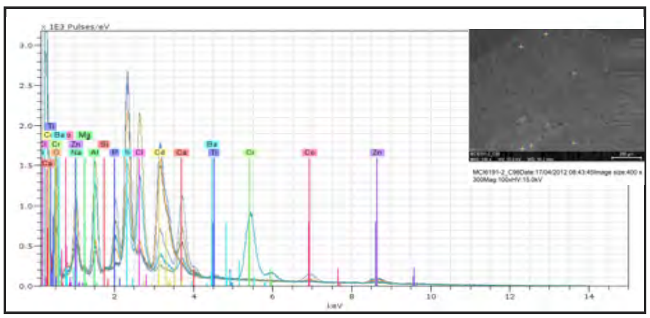
sample location: unknown

Representative Analysis Compilation—sample C098

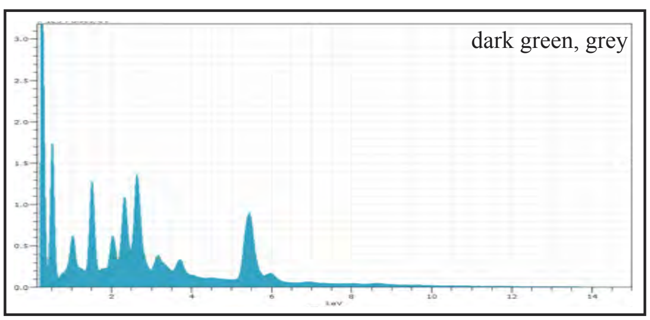




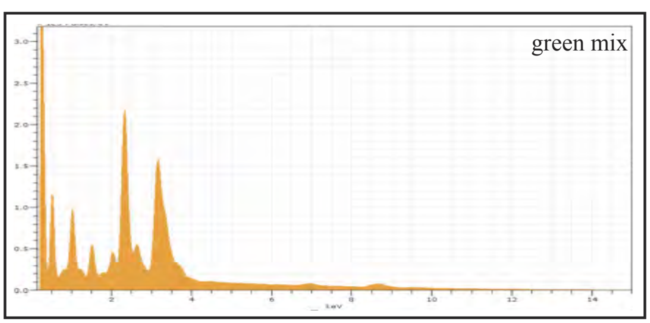
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.2 mm.



analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 10.2 mm.
mag: 100x; HV: 15 kV
significant elements, dark green: Cr, Cl
significant elements, green mix: Zn, Cd, S, Na, Cl, Co
significant elements, yellow: Cd, S
interpretation: chrome green, cadmium green, phthalo green, cobalt blue/green, cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Chromium	K-series	21.32	29.92	16.55	0.64
Chlorine	K-series	6.44	9.04	7.33	0.24
Aluminium	K-series	5.18	7.27	7.75	0.27
Zinc	K-series	4.91	6.89	3.03	0.19
Sulfur	K-series	3.55	4.98	4.46	0.15
Cadmium	L-series	2.91	4.08	1.04	0.59
Calcium	K-series	1.60	2.25	1.61	0.10
Sodium	K-series	1.50	2.11	2.63	1.21
Cobalt	K-series	1.27	1.79	0.87	0.07
Phosphorus	K-series	1.25	1.76	1.63	0.07
Potassium	K-series	0.29	0.41	0.30	0.21
Magnesium	K-series	0.17	0.24	0.28	0.04
Titanium	K-series	0.06	0.08	0.05	0.04
Barium	L-series	0.01	0.02	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	20.78	29.17	52.43	33.17
	Sum:	71.26	100.00	100.00	



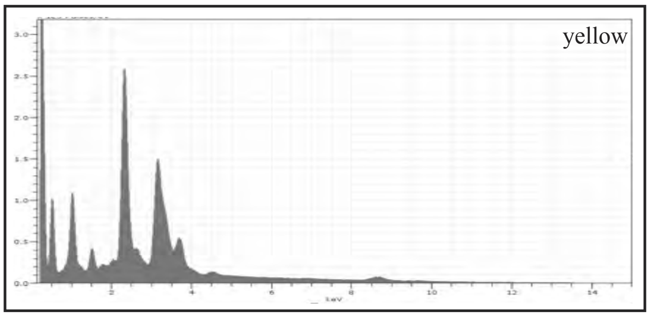
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	17.16	22.61	6.31	1.69
Zinc	K-series	12.87	16.96	8.14	0.46
Sulfur	K-series	10.59	13.95	13.66	0.40
Sodium	K-series	3.09	4.08	5.56	2.46
Potassium	K-series	3.08	4.06	3.26	0.58
Cobalt	K-series	2.77	3.65	1.94	0.11
Chlorine	K-series	1.86	2.46	2.17	0.09
Aluminium	K-series	1.54	2.02	2.35	0.97
Phosphorus	K-series	1.13	1.48	1.50	0.07
Calcium	K-series	0.61	0.80	0.62	0.12
Magnesium	K-series	0.17	0.22	0.28	0.07
Barium	L-series	0.06	0.07	0.02	0.04
Silicon	K-series	0.03	0.04	0.04	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	20.94	27.59	54.12	11.41
	Sum:	75.87	100.00	100.00	

no image available

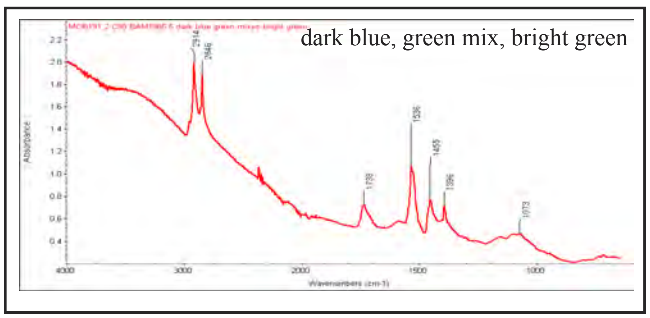
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: green rectangle stratigraphy

sample location: unknown

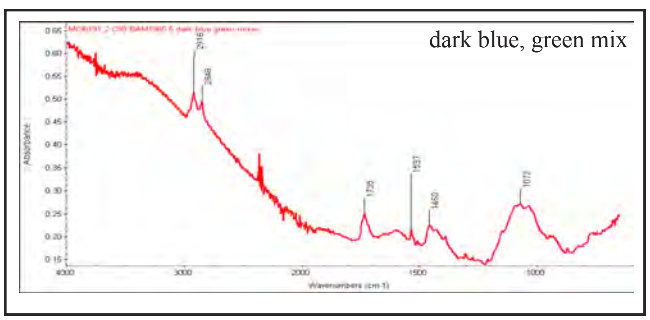
Representative Analysis Compilation—sample C098, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	11.53	17.46	4.55	1.24
Sulfur	K-series	11.37	17.22	15.72	0.43
Zinc	K-series	10.57	16.00	7.16	0.38
Sodium	K-series	3.97	6.01	7.66	3.15
Calcium	K-series	2.60	3.93	2.87	0.15
Potassium	K-series	2.16	3.27	2.45	0.45
Aluminium	K-series	1.37	2.07	2.25	0.95
Chlorine	K-series	0.94	1.42	1.17	0.06
Cobalt	K-series	0.89	1.34	0.67	0.05
Titanium	K-series	0.40	0.60	0.37	0.08
Barium	L-series	0.24	0.36	0.08	0.13
Magnesium	K-series	0.14	0.22	0.26	0.07
Silicon	K-series	0.10	0.15	0.16	0.03
Phosphorus	K-series	0.09	0.14	0.13	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	19.69	29.80	54.52	11.67
	Sum:	66.06	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



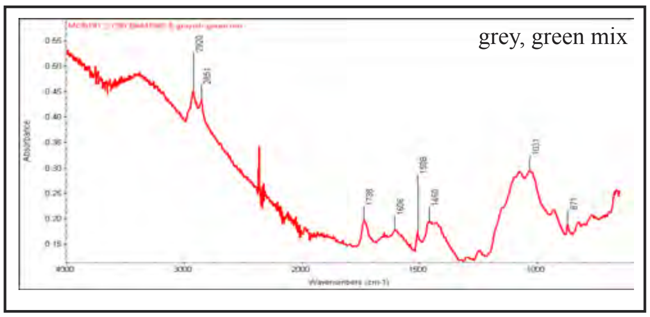
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

no image available

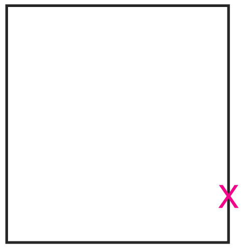
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: green rectangle stratigraphy

sample location: unknown

Representative Analysis Compilation—sample C098, continued



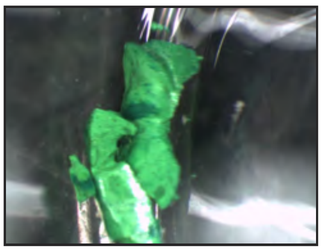
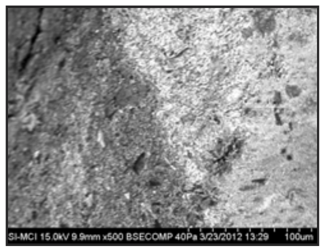
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

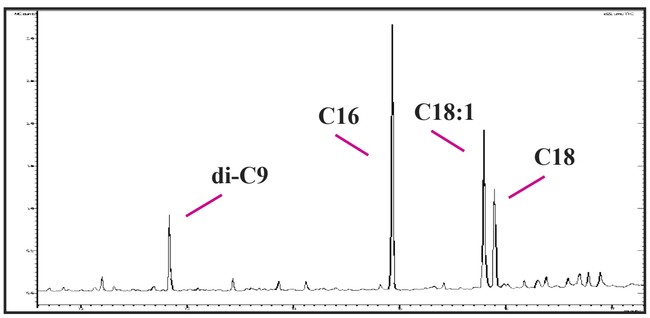

acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: bright green

sample location: right edge, 17.0" from bottom
(B 43.2 x R 0.0 cm.)

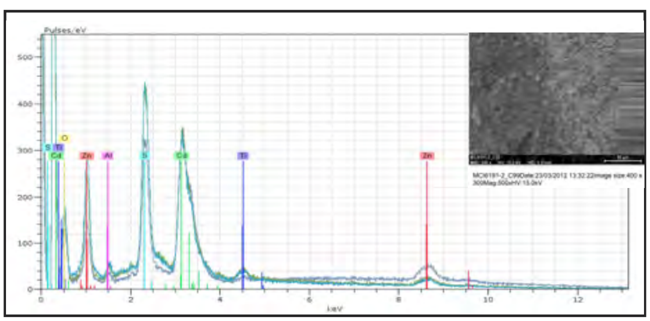
Representative Analysis Compilation—sample C099

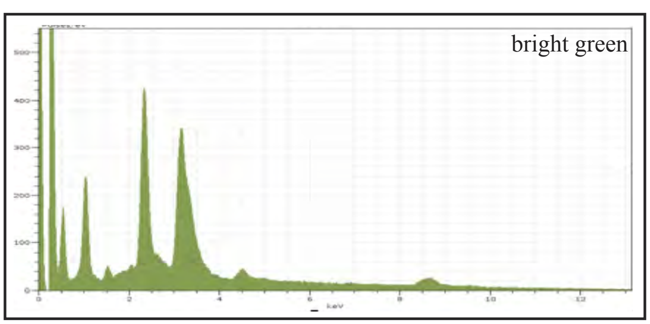
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



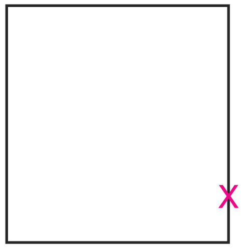
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.221
scan range: 1 - 1482
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, bright green: Cd, S, Na, Zn
interpretation: cadmium green



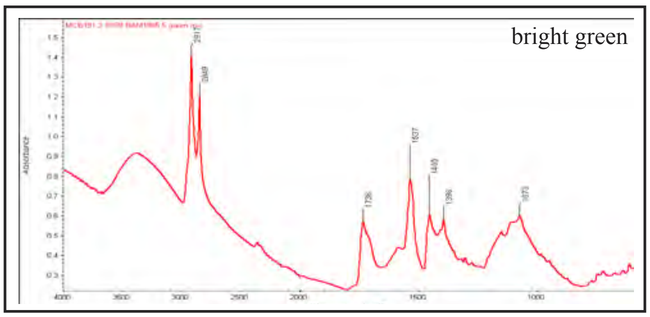
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	40.69	34.79	12.51	6.46
Sulfur	K-series	19.65	16.80	21.17	0.72
Zinc	K-series	19.05	16.29	10.06	0.69
Sodium	K-series	6.88	5.88	10.33	5.44
Potassium	K-series	4.16	3.56	3.68	2.20
Chlorine	K-series	3.04	2.60	2.96	0.15
Copper	K-series	1.42	1.22	0.77	0.10
Aluminium	K-series	1.42	1.22	1.82	1.11
Cobalt	K-series	1.40	1.19	0.82	0.08
Phosphorus	K-series	1.09	0.93	1.22	0.07
Calcium	K-series	1.04	0.89	0.89	0.33
Titanium	K-series	0.80	0.68	0.58	0.18
Barium	L-series	0.72	0.62	0.18	0.32
Silicon	K-series	0.52	0.45	0.64	0.05
Magnesium	K-series	0.27	0.23	0.39	0.19
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	14.81	12.66	31.97	18.77
	Sum:	116.95	100.00	100.00	



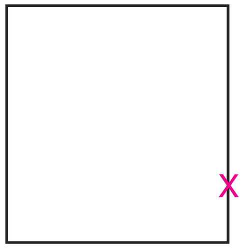
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: bright green

sample location: right edge, 17.0" from bottom
(B 43.2 x R 0.0 cm.)

Representative Analysis Compilation—sample C099, continued



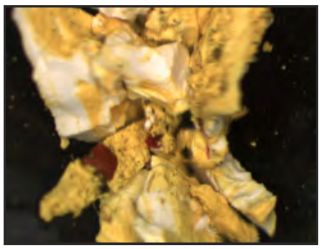
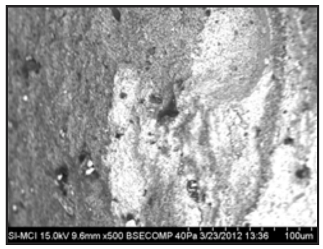
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

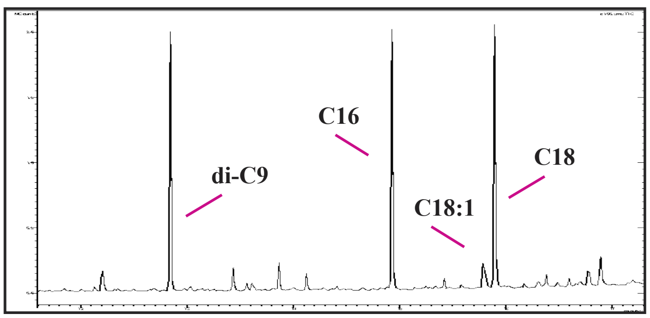

acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: lightest yellow, possibly some white

sample location: right edge, 22.0" from bottom
(B 55.9 x R 0.0 cm.)

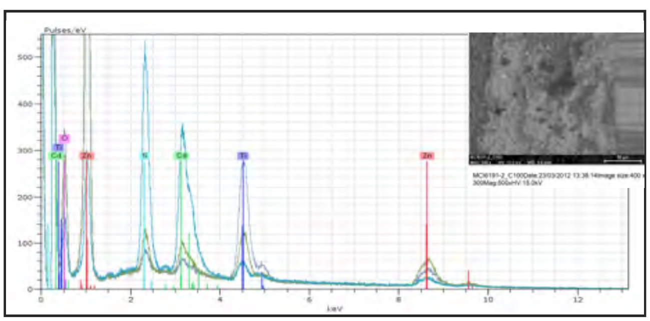
Representative Analysis Compilation—sample C100

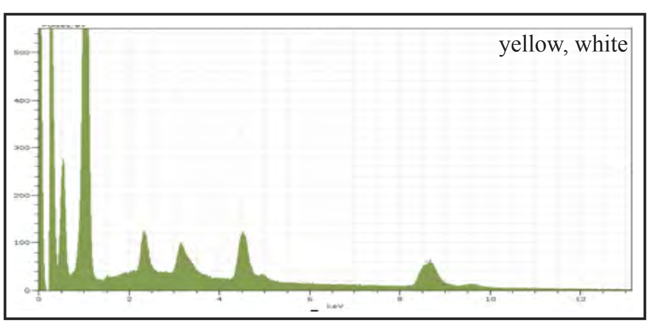
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



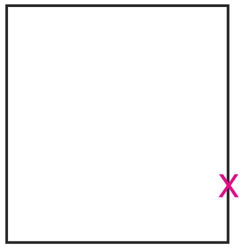
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.180
scan range: 1 - 1486
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
significant elements, white: Zn, Ti
interpretation: cadmium yellow, Zn/Ti white



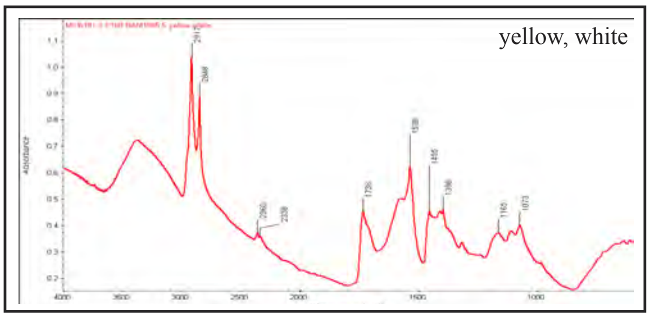
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	56.65	48.77	28.35	1.93
Sodium	K-series	24.80	21.35	35.30	19.54
Titanium	K-series	9.19	7.91	6.28	0.94
Cadmium	L-series	7.74	6.66	2.25	1.91
Sulfur	K-series	3.98	3.42	4.06	0.17
Barium	L-series	1.42	1.23	0.34	0.72
Potassium	K-series	0.70	0.60	0.58	0.50
Chlorine	K-series	0.45	0.39	0.42	0.05
Phosphorus	K-series	0.34	0.29	0.36	0.04
Calcium	K-series	0.12	0.11	0.10	0.11
Silicon	K-series	0.06	0.05	0.07	0.03
Aluminium	K-series	0.03	0.03	0.04	0.05
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	10.68	9.19	21.84	10.57
	Sum:	116.17	100.00	100.00	

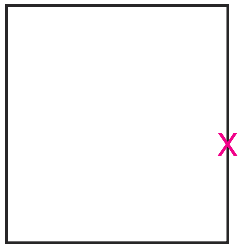
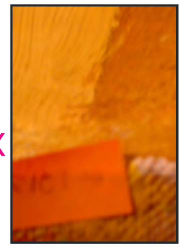

acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: lightest yellow, possibly some white

sample location: right edge, 22.0" from bottom
(B 55.9 x R 0.0 cm.)

Representative Analysis Compilation—sample C100, continued



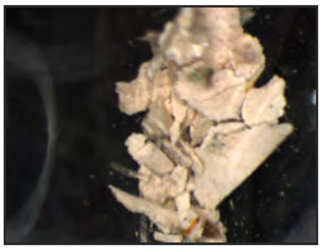
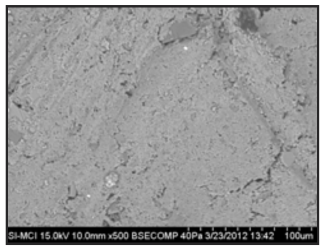
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

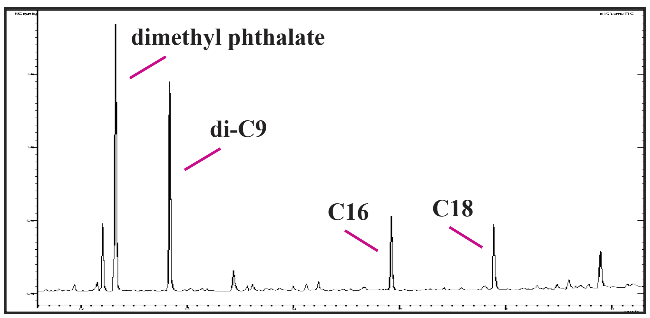
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: ground layer

sample location: right edge, 35.5" from bottom
(B 90.2 x R 0.0 cm.)

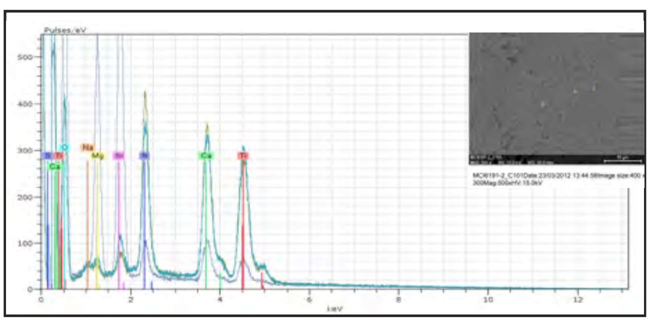
Representative Analysis Compilation—sample C101

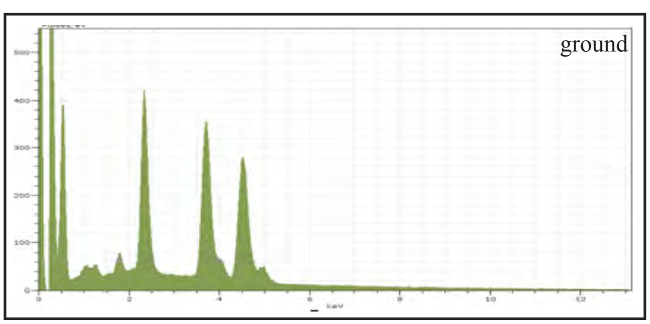
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



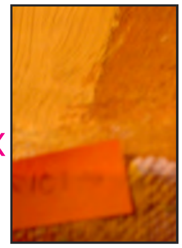
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.164
scan range: 1 - 1478
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18
interpretation: alkyd, oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti
interpretation: titanium white



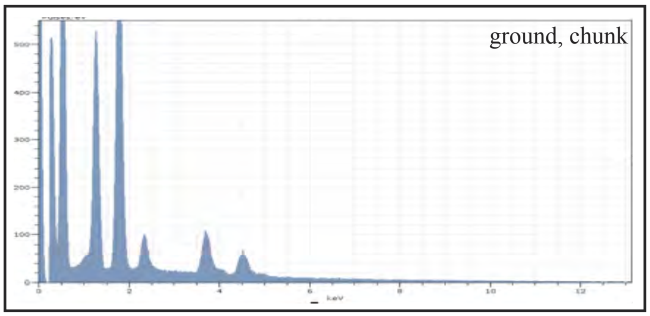
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	18.73	23.76	12.28	1.18
Calcium	K-series	12.83	16.27	10.04	0.41
Sulfur	K-series	10.76	13.65	10.53	0.41
Silicon	K-series	1.09	1.39	1.22	0.07
Zinc	K-series	0.99	1.25	0.47	0.08
Magnesium	K-series	0.82	1.04	1.06	0.08
Chlorine	K-series	0.47	0.59	0.41	0.04
Barium	L-series	0.37	0.47	0.08	0.22
Sodium	K-series	0.30	0.38	0.41	0.26
Phosphorus	K-series	0.20	0.25	0.20	0.04
Potassium	K-series	0.03	0.04	0.03	0.03
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	32.24	40.90	63.25	26.63
	Sum:	78.83	100.00	100.00	



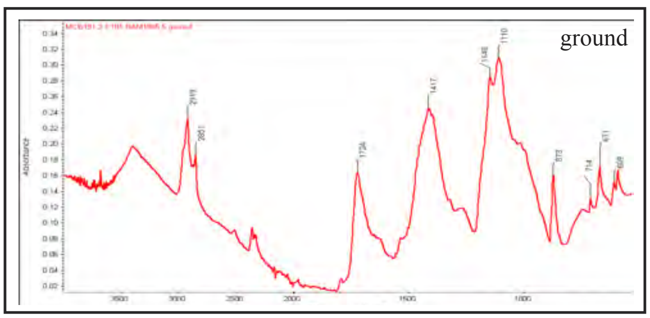
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: ground layer

sample location: right edge, 35.5" from bottom
(B 90.2 x R 0.0 cm.)

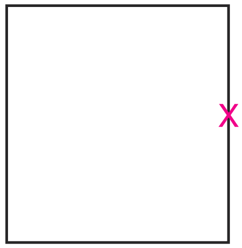
Representative Analysis Compilation—sample C101, continued

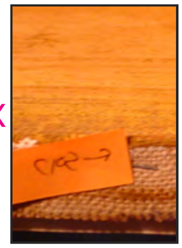


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Silicon	K-series	19.51	18.78	14.05	0.84
Magnesium	K-series	16.27	15.66	13.54	0.89
Calcium	K-series	5.16	4.97	2.60	0.19
Titanium	K-series	3.97	3.82	1.68	0.53
Barium	L-series	2.41	2.32	0.35	0.79
Zinc	K-series	2.18	2.10	0.67	0.13
Sulfur	K-series	2.14	2.06	1.35	0.10
Chlorine	K-series	0.16	0.16	0.09	0.03
Sodium	K-series	0.14	0.13	0.12	0.14
Potassium	K-series	0.13	0.12	0.07	0.04
Phosphorus	K-series	0.00	0.00	0.00	0.03
Aluminium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	51.81	49.87	65.47	29.85
	Sum:	103.89	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

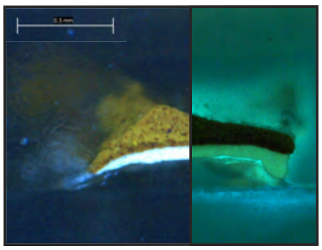


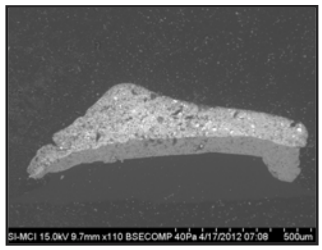


acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: ochre toned with yellow

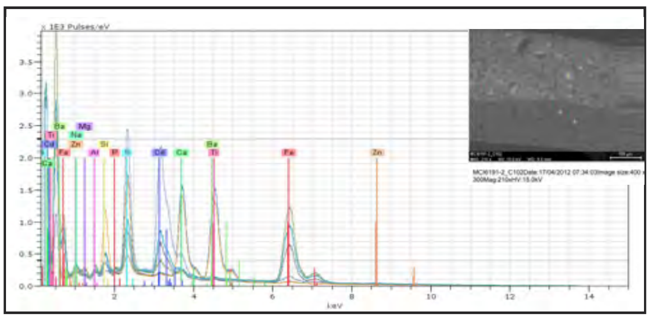
sample location: right edge, 47.5" from bottom
(B 120.7 x R 0.0 cm.)

Representative Analysis Compilation—sample C102

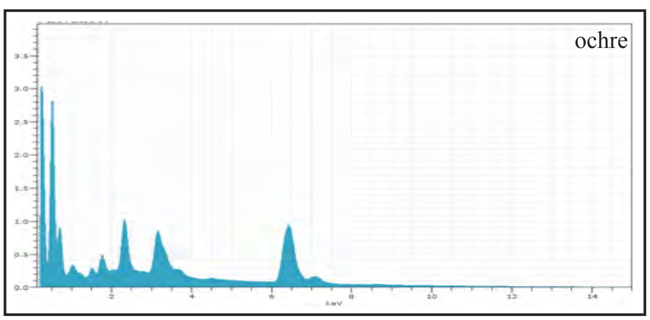




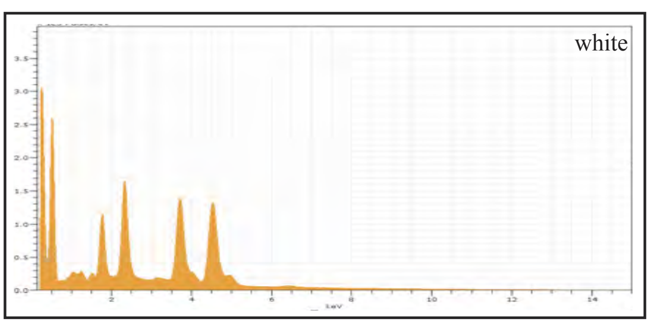
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



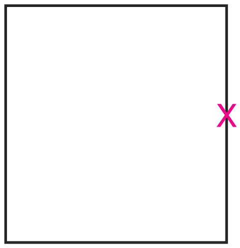
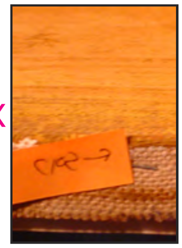
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.8 mm.
mag: 210x; HV: 15 kV
significant elements, ochre: Fe, Cd, S
significant elements, white: Ti
interpretation: yellow ochre, cadmium yellow, titanium white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Iron	K-series	50.63	50.54	32.99	1.50
Cadmium	L-series	8.87	8.85	2.87	1.21
Zinc	K-series	7.39	7.38	4.11	0.28
Sulfur	K-series	4.92	4.92	5.59	0.20
Silicon	K-series	1.84	1.84	2.38	0.10
Sodium	K-series	1.59	1.59	2.52	1.28
Potassium	K-series	1.57	1.56	1.46	0.43
Barium	L-series	1.35	1.34	0.36	0.14
Calcium	K-series	0.77	0.76	0.70	0.10
Aluminium	K-series	0.47	0.47	0.64	0.39
Magnesium	K-series	0.41	0.40	0.61	0.10
Phosphorus	K-series	0.31	0.31	0.36	0.04
Chlorine	K-series	0.17	0.17	0.17	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	19.90	19.86	45.25	7.74
	Sum:	100.17	100.00	100.00	



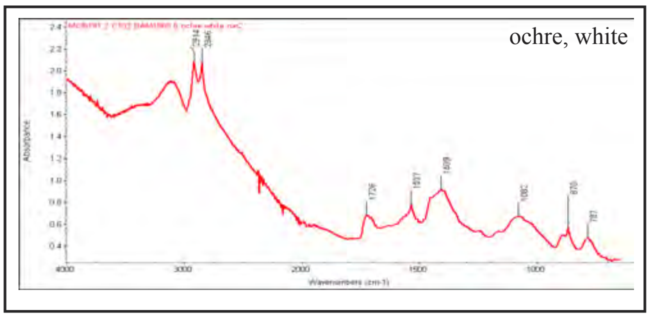
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	25.84	25.13	14.23	1.10
Calcium	K-series	15.42	15.00	10.15	0.53
Sulfur	K-series	8.59	8.35	7.06	0.33
Silicon	K-series	4.50	4.37	4.22	0.21
Zinc	K-series	3.74	3.64	1.51	0.16
Barium	L-series	3.62	3.52	0.70	1.32
Iron	K-series	2.33	2.27	1.10	0.10
Cadmium	L-series	1.30	1.27	0.31	0.34
Sodium	K-series	0.76	0.74	0.88	0.63
Magnesium	K-series	0.49	0.48	0.53	0.10
Chlorine	K-series	0.35	0.34	0.26	0.04
Potassium	K-series	0.04	0.04	0.03	0.06
Aluminium	K-series	0.02	0.02	0.02	0.04
Phosphorus	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	35.81	34.83	59.01	14.00
	Sum:	102.82	100.00	100.00	

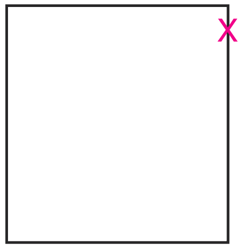
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: ochre toned with yellow

sample location: right edge, 47.5" from bottom
(B 120.7 x R 0.0 cm.)

Representative Analysis Compilation—sample C102, continued



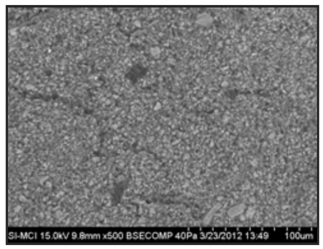
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



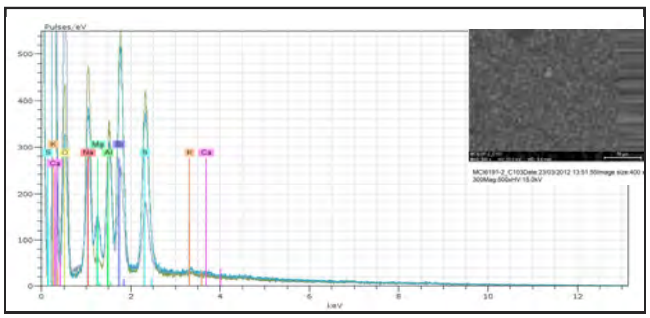
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: blue, some white and black mixed in

sample location: right edge, 6.0" from top
(T 15.2 x R 0.0 cm.)

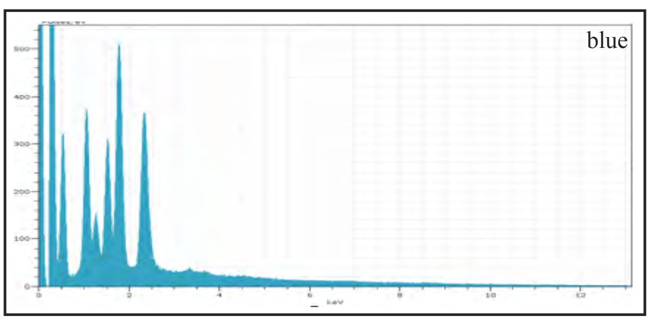
Representative Analysis Compilation—sample C103



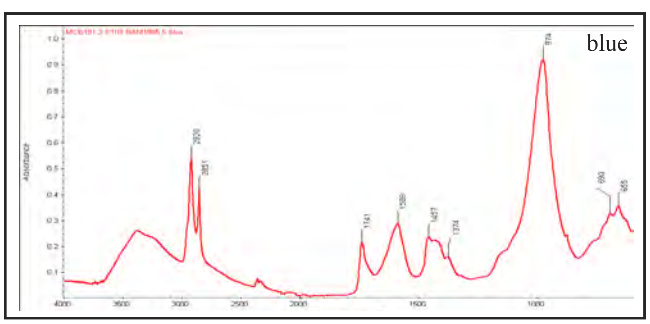
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



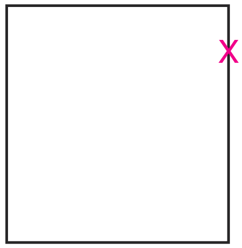
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Si, Na, Al
interpretation: ultramarine blue

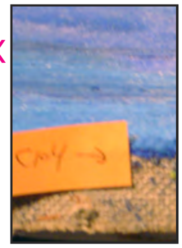


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	8.95	12.97	10.29	0.40
Sodium	K-series	8.57	12.41	12.03	6.77
Sulfur	K-series	6.92	10.02	6.96	0.27
Aluminium	K-series	4.31	6.24	5.16	0.23
Zinc	K-series	4.14	6.00	2.04	0.20
Magnesium	K-series	2.28	3.31	3.03	0.15
Barium	L-series	1.72	2.49	0.40	0.23
Cobalt	K-series	1.64	2.37	0.90	0.10
Iron	K-series	0.66	0.96	0.38	0.08
Potassium	K-series	0.50	0.73	0.42	0.05
Calcium	K-series	0.47	0.69	0.38	0.05
Chlorine	K-series	0.22	0.31	0.20	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	28.65	41.51	57.81	26.96
	Sum:	69.03	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil, fillers

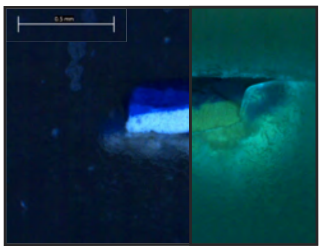


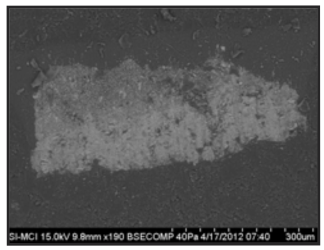


acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: blue stratigraphy

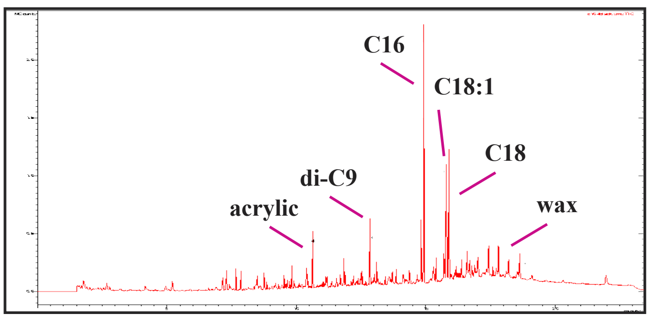
sample location: right edge, 13.0" from top
(T 33.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C104

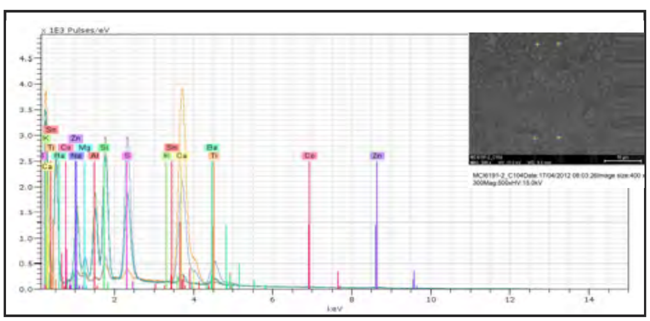




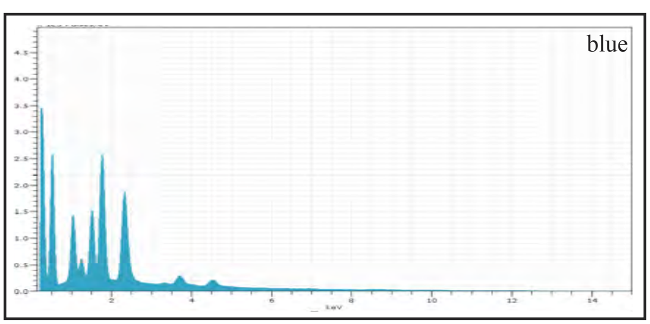
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.8 mm.



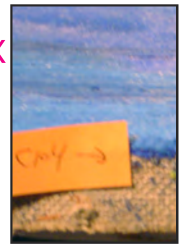
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.378
scan range: 1 - 1482
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, wax, acrylic
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Si, Na, Al
significant elements, white: Ca, Ti
interpretation: ultramarine blue, bulked
titanium white



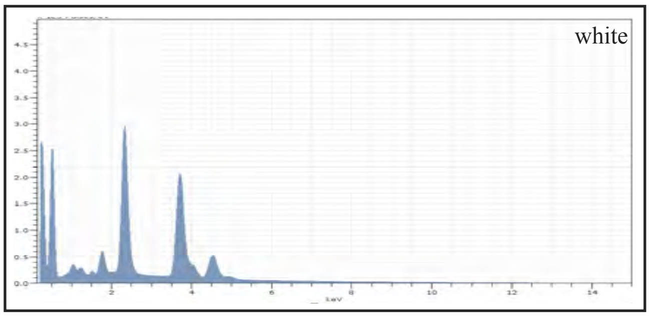
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	8.91	11.95	8.78	0.39
Sulfur	K-series	7.76	10.41	6.70	0.30
Sodium	K-series	5.50	7.38	6.62	4.35
Aluminium	K-series	3.81	5.11	3.91	0.20
Zinc	K-series	3.01	4.05	1.28	0.13
Titanium	K-series	1.54	2.07	0.89	0.19
Calcium	K-series	1.51	2.03	1.04	0.51
Magnesium	K-series	1.28	1.72	1.46	0.09
Cobalt	K-series	0.55	0.74	0.26	0.04
Barium	L-series	0.52	0.70	0.11	0.28
Chlorine	K-series	0.28	0.37	0.22	0.04
Potassium	K-series	0.15	0.20	0.11	0.04
Tin	L-series	0.01	0.01	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	39.67	53.24	68.63	15.38
	Sum:	74.51	100.00	100.00	



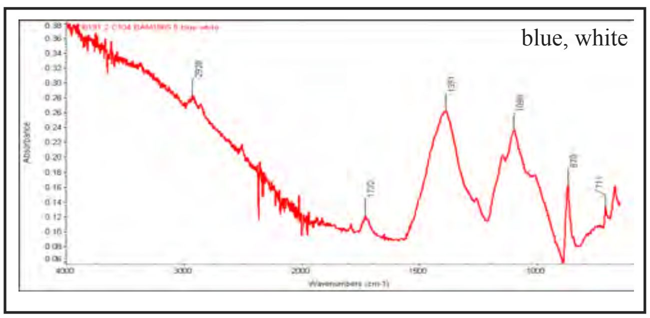
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: blue stratigraphy

sample location: right edge, 13.0" from top
(T 33.0 x R 0.0 cm.)

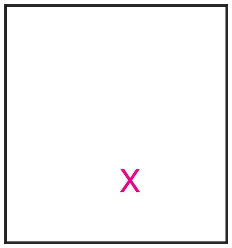
Representative Analysis Compilation—sample C104, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	16.54	19.36	11.39	0.52
Sulfur	K-series	15.40	18.03	13.25	0.57
Titanium	K-series	5.39	6.31	3.10	0.40
Zinc	K-series	3.62	4.23	1.53	0.15
Silicon	K-series	2.30	2.69	2.26	0.12
Barium	L-series	1.79	2.09	0.36	0.42
Sodium	K-series	1.53	1.80	1.84	1.23
Magnesium	K-series	0.70	0.82	0.80	0.06
Chlorine	K-series	0.18	0.21	0.14	0.03
Aluminium	K-series	0.15	0.17	0.15	0.03
Phosphorus	K-series	0.08	0.10	0.07	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	37.74	44.18	65.10	14.64
	Sum:	85.43	100.00	100.00	



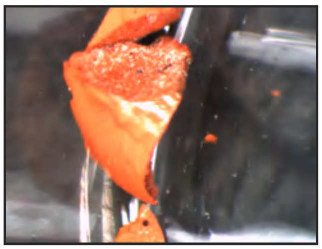
analysis: µFTIR
by: DVR (MCI)
date: 01/17/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

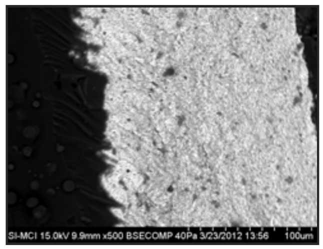


acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: orange

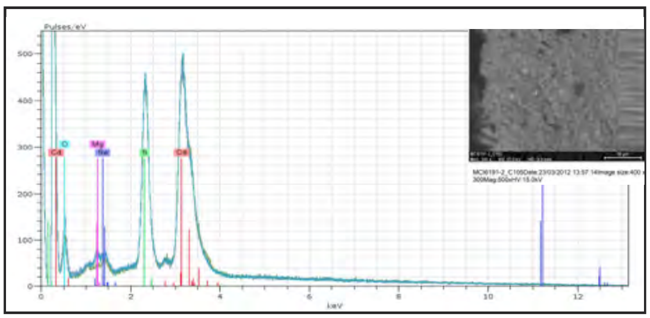
sample location: 23.5" from bottom, 26.0" from right
(B 59.7 x R 66.0 cm.)

Representative Analysis Compilation—sample C105

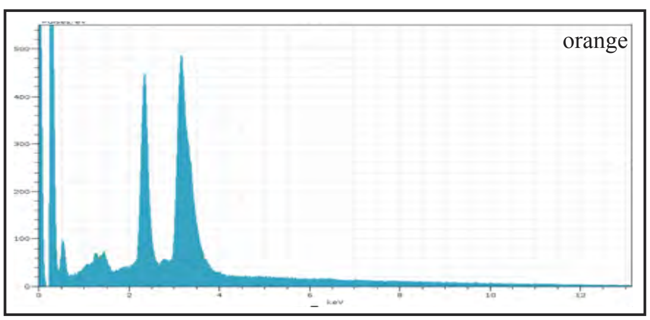




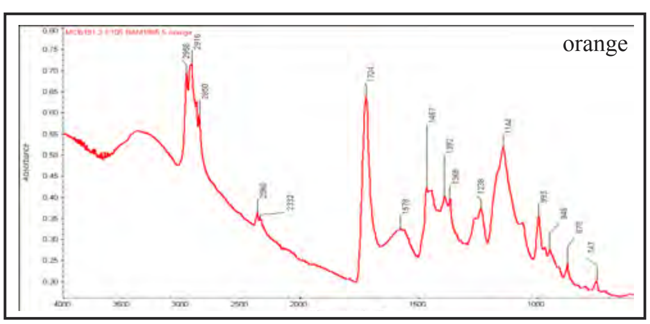
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



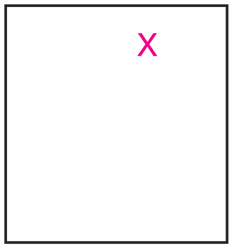
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
interpretation: cadmium orange



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	36.60	44.44	16.46	5.61
Sulfur	K-series	9.65	11.73	15.22	0.37
Zinc	K-series	7.49	9.10	5.79	0.32
Potassium	K-series	6.04	7.33	7.80	2.01
Selenium	L-series	2.40	2.91	1.53	0.22
Iron	K-series	2.16	2.62	1.95	0.10
Magnesium	K-series	1.63	1.98	3.39	0.41
Sodium	K-series	0.76	0.92	1.67	0.62
Barium	L-series	0.71	0.87	0.26	0.16
Aluminium	K-series	0.70	0.85	1.31	0.56
Silicon	K-series	0.11	0.13	0.20	0.03
Calcium	K-series	0.05	0.07	0.07	0.06
Phosphorus	K-series	0.01	0.01	0.02	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	14.03	17.04	44.32	22.63
	Sum:	82.34	100.00	100.00	



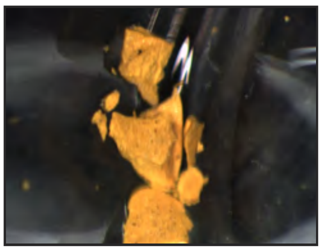
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

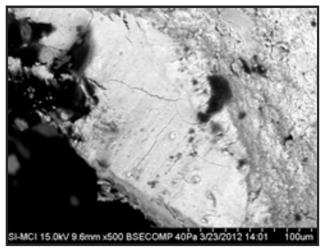


acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: light yellow, note tape marks

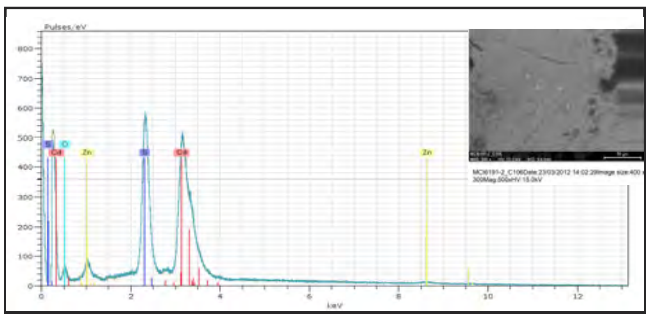
sample location: 14.0" from top, 26.5" from right
(T 35.6 x R 67.3 cm.)

Representative Analysis Compilation—sample C106

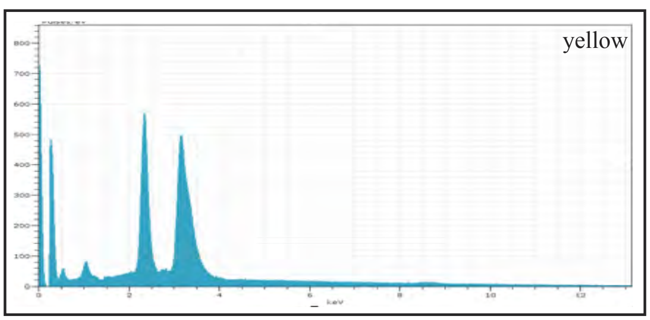




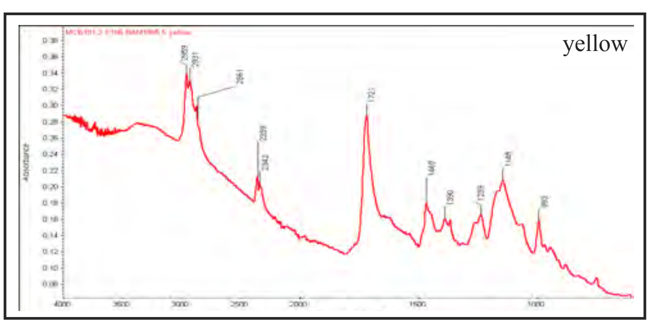
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
interpretation: cadmium yellow



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	52.48	49.49	21.51	7.46
Sulfur	K-series	23.55	22.21	33.83	0.86
Zinc	K-series	10.03	9.46	7.07	0.40
Potassium	K-series	7.06	6.65	8.31	2.62
Sodium	K-series	3.48	3.29	6.98	2.77
Barium	L-series	1.09	1.03	0.37	0.20
Chlorine	K-series	0.63	0.59	0.82	0.08
Phosphorus	K-series	0.39	0.36	0.57	0.04
Magnesium	K-series	0.28	0.26	0.53	0.18
Silicon	K-series	0.17	0.16	0.28	0.04
Aluminium	K-series	0.07	0.06	0.11	0.07
Calcium	K-series	0.00	0.00	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	6.81	6.42	19.60	11.04
	Sum:	106.04	100.00	100.00	



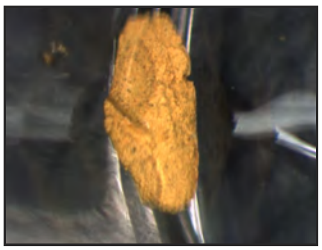
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

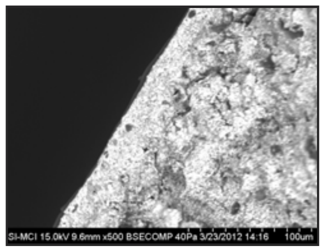
no image available

acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: middle shade of ochre

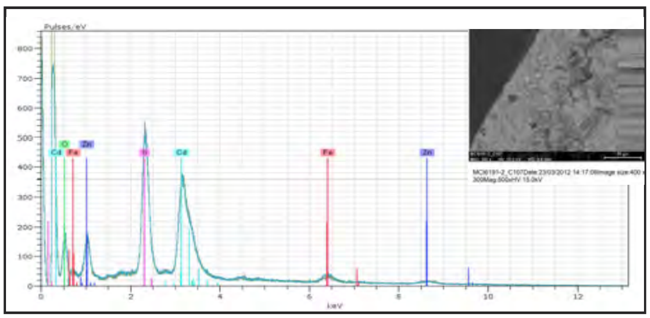
sample location: 33.0" from top, 30.0" from left (T 83.8 x L 76.2 cm.)

Representative Analysis Compilation—sample C107

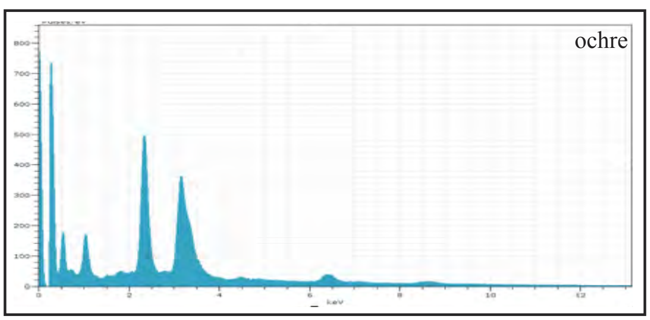




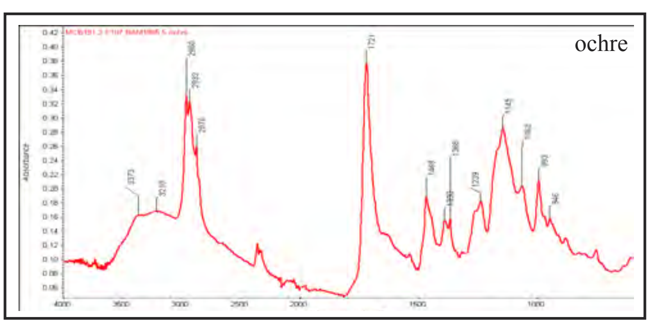
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



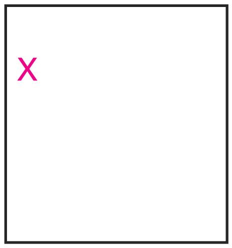
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, ochre: Cd, S, Fe
interpretation: cadmium yellow, yellow ochre



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	27.79	24.44	16.33	1.00
Cadmium	L-series	24.26	21.34	8.29	4.53
Iron	K-series	15.34	13.49	10.55	0.50
Sulfur	K-series	14.54	12.79	17.42	0.54
Barium	L-series	7.57	6.66	2.12	0.70
Sodium	K-series	5.65	4.97	9.44	4.47
Potassium	K-series	4.62	4.07	4.54	1.65
Magnesium	K-series	0.75	0.66	1.19	0.08
Silicon	K-series	0.50	0.44	0.69	0.05
Calcium	K-series	0.42	0.37	0.41	0.27
Aluminium	K-series	0.26	0.23	0.37	0.04
Phosphorus	K-series	0.09	0.08	0.11	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	11.89	10.46	28.55	15.45
	Sum:	113.71	100.00	100.00	



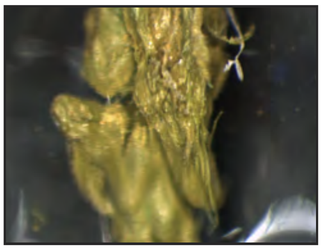
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

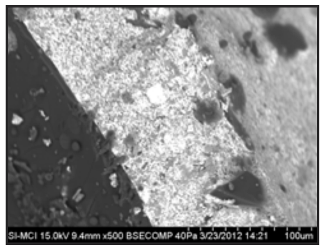


acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: ochre green mix

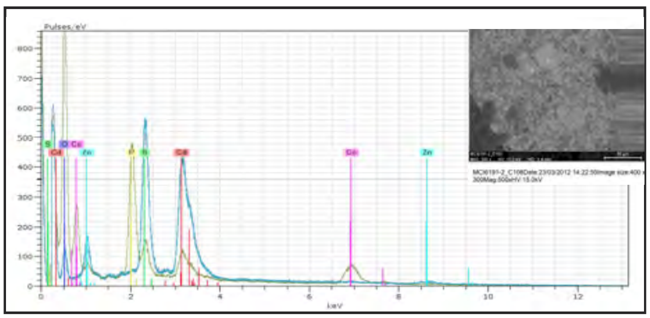
sample location: 21.0" from top, 6.0" from left (T 53.3 x L 15.2 cm.)

Representative Analysis Compilation—sample C108

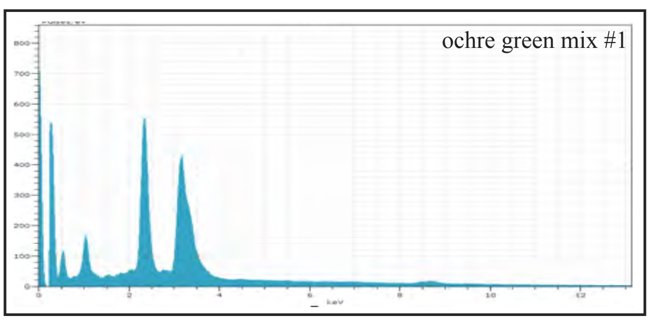




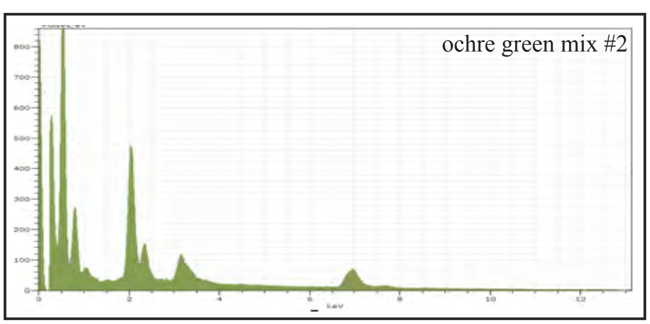
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



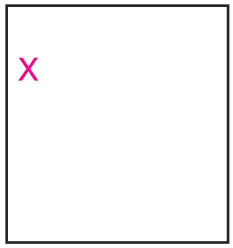
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, ochre: Cd, S
significant elements, green: Co, Zn
interpretation: cadmium yellow, cobalt green



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	35.69	38.62	13.08	5.64
Sulfur	K-series	20.47	22.15	26.31	0.75
Zinc	K-series	7.92	8.57	4.99	0.32
Sodium	K-series	5.87	6.36	10.53	4.65
Potassium	K-series	5.08	5.50	5.35	1.95
Magnesium	K-series	1.05	1.14	1.79	0.34
Cobalt	K-series	0.80	0.87	0.56	0.06
Phosphorus	K-series	0.72	0.78	0.96	0.06
Chlorine	K-series	0.50	0.55	0.59	0.07
Silicon	K-series	0.40	0.43	0.58	0.05
Aluminium	K-series	0.38	0.41	0.58	0.32
Barium	L-series	0.06	0.06	0.02	0.05
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	13.46	14.57	34.67	19.43
	Sum:	92.41	100.00	100.00	



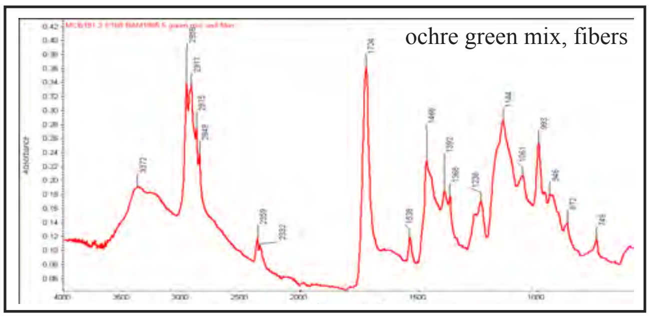
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cobalt	K-series	19.77	22.01	9.59	0.65
Phosphorus	K-series	15.23	16.95	14.06	0.61
Cadmium	L-series	8.02	8.92	2.04	1.98
Sulfur	K-series	5.02	5.59	4.47	0.21
Zinc	K-series	1.61	1.79	0.70	0.11
Sodium	K-series	1.50	1.67	1.87	1.21
Potassium	K-series	0.78	0.87	0.57	0.56
Chlorine	K-series	0.37	0.41	0.30	0.05
Magnesium	K-series	0.36	0.40	0.42	0.16
Aluminium	K-series	0.11	0.12	0.11	0.11
Calcium	K-series	0.09	0.11	0.07	0.09
Barium	L-series	0.08	0.09	0.02	0.07
Iron	K-series	0.07	0.07	0.03	0.03
Silicon	K-series	0.06	0.06	0.06	0.03
Titanium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	36.76	40.91	65.67	21.14
	Sum:	89.84	100.00	100.00	



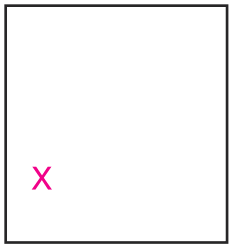
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: ochre green mix

sample location: 21.0" from top, 6.0" from left
(T 53.3 x L 15.2 cm.)

Representative Analysis Compilation—sample C108, continued



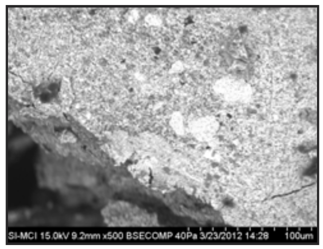
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish



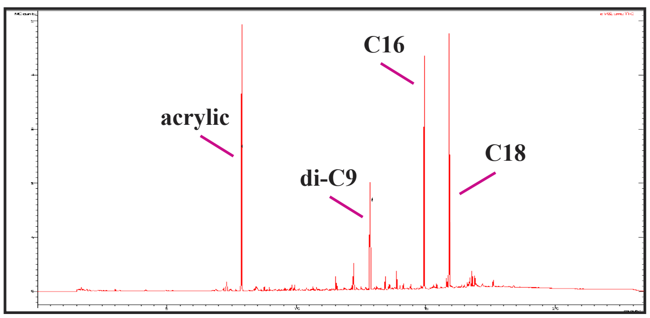
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: ochre yellow mix

sample location: 28.5" from bottom, 10.0" from left
(B 72.4 x L 25.4 cm.)

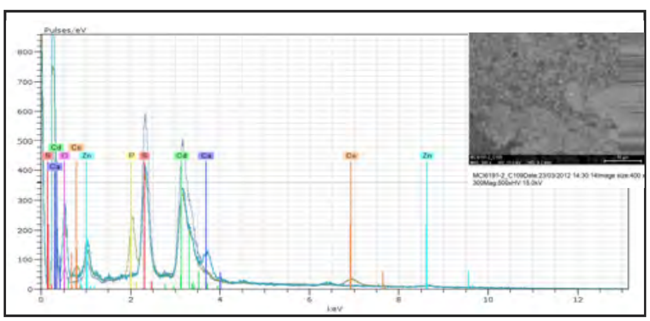
Representative Analysis Compilation—sample C109



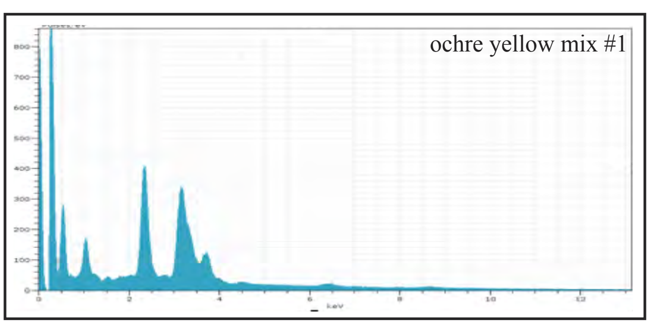
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.2 mm.



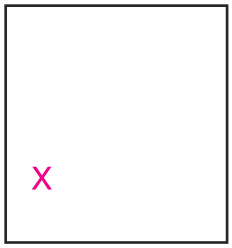
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.270
scan range: 1 - 1483
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, acrylic
interpretation: oil, conservation material



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.2 mm.
mag: 500x; HV: 15 kV
significant elements, ochre: Fe, Co
significant elements, yellow: Cd, S
interpretation: cadmium yellow, yellow ochre, cobalt green



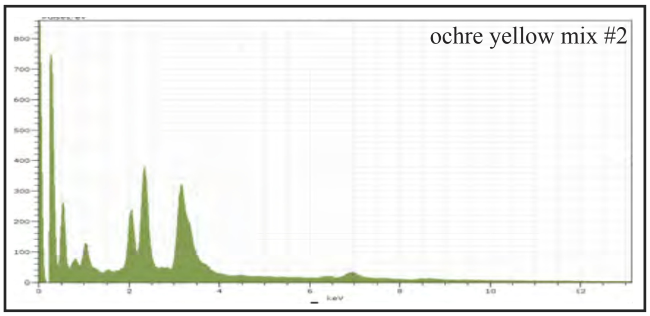
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	31.65	31.76	8.98	5.19
Sulfur	K-series	15.47	15.53	15.40	0.58
Zinc	K-series	5.44	5.46	2.65	0.24
Calcium	K-series	5.41	5.43	4.31	0.41
Sodium	K-series	4.20	4.22	5.83	3.33
Potassium	K-series	3.26	3.27	2.66	1.77
Magnesium	K-series	1.90	1.91	2.50	0.44
Iron	K-series	1.87	1.87	1.07	0.10
Phosphorus	K-series	0.73	0.74	0.76	0.06
Aluminium	K-series	0.69	0.69	0.82	0.55
Chlorine	K-series	0.68	0.68	0.61	0.07
Silicon	K-series	0.61	0.61	0.69	0.06
Cobalt	K-series	0.47	0.47	0.26	0.07
Barium	L-series	0.33	0.33	0.08	0.19
Titanium	K-series	0.25	0.25	0.17	0.12
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	26.69	26.78	53.23	26.60
	Sum:	99.66	100.00	100.00	



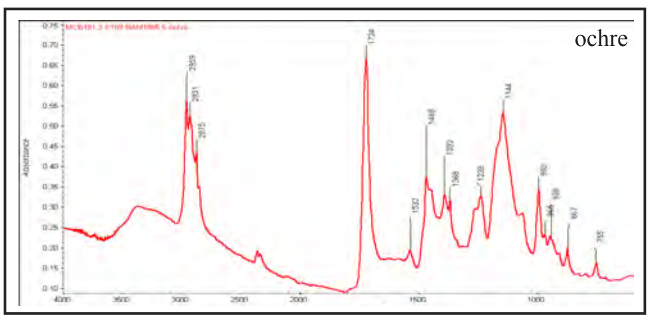
acc. no.: BAM 1965.5
title, year: *Silent Night*, 1964
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 84.0 x 78.3" (213.4 x 198.9 cm.)
notes: ochre yellow mix

sample location: 28.5" from bottom, 10.0" from left
(B 72.4 x L 25.4 cm.)

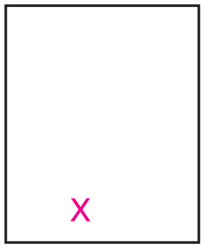
Representative Analysis Compilation—sample C109, continued

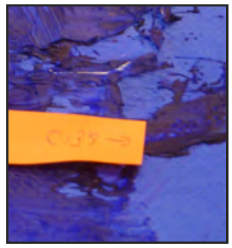


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	28.04	28.70	8.65	4.95
Sulfur	K-series	13.68	14.00	14.79	0.51
Cobalt	K-series	8.23	8.43	4.84	0.31
Zinc	K-series	7.50	7.68	3.98	0.31
Phosphorus	K-series	6.91	7.08	7.74	0.29
Potassium	K-series	3.57	3.66	3.17	1.73
Sodium	K-series	3.29	3.37	4.96	2.62
Iron	K-series	1.37	1.40	0.85	0.17
Calcium	K-series	0.99	1.01	0.85	0.27
Magnesium	K-series	0.85	0.87	1.21	0.27
Chlorine	K-series	0.53	0.54	0.52	0.07
Barium	L-series	0.29	0.29	0.07	0.10
Aluminium	K-series	0.24	0.24	0.31	0.21
Silicon	K-series	0.09	0.10	0.11	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	22.13	22.65	47.95	22.80
	Sum:	97.70	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for F10/B67/72 varnish

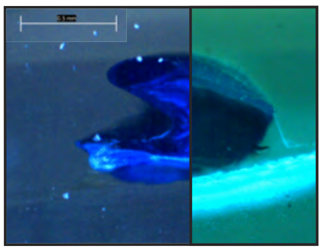
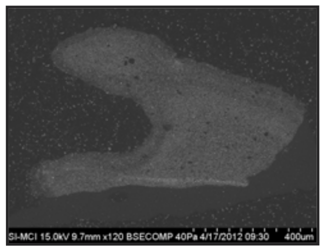





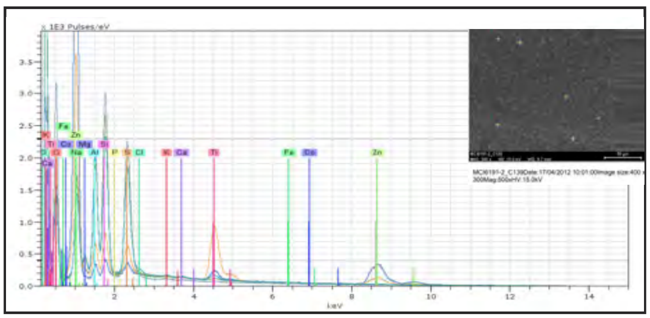
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: blue

sample location: 9.5" from bottom, 23.5" from left
(B 24.1 x L 59.7 cm.)

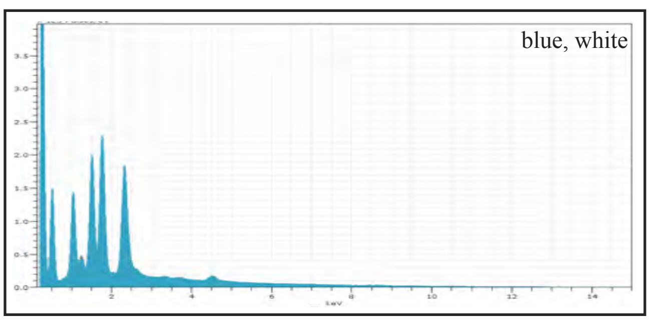
Representative Analysis Compilation—sample C139

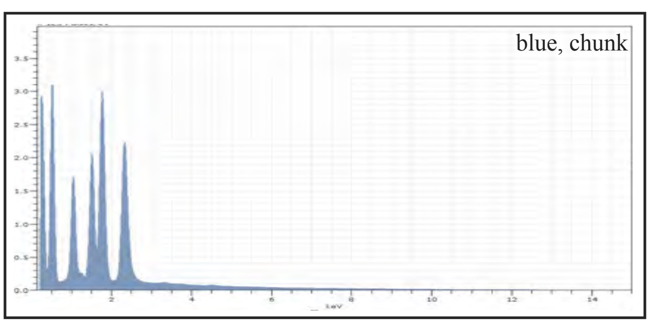
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



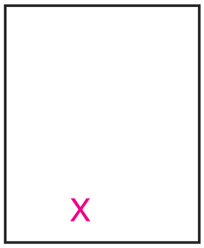
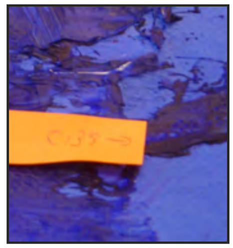
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Si, Na, Al
significant elements, white: Zn, Ti
interpretation: ultramarine blue, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	7.06	11.15	8.17	0.32
Sulfur	K-series	6.17	9.74	6.25	0.24
Sodium	K-series	5.91	9.33	8.34	4.67
Aluminium	K-series	5.11	8.07	6.15	0.26
Zinc	K-series	2.14	3.38	1.06	0.10
Magnesium	K-series	0.82	1.29	1.09	0.07
Titanium	K-series	0.73	1.15	0.49	0.11
Barium	L-series	0.62	0.97	0.15	0.15
Chlorine	K-series	0.55	0.87	0.50	0.04
Cobalt	K-series	0.51	0.80	0.28	0.05
Calcium	K-series	0.24	0.39	0.20	0.03
Potassium	K-series	0.24	0.38	0.20	0.03
Iron	K-series	0.21	0.34	0.12	0.04
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	33.01	52.14	67.00	16.29
	Sum:	63.32	100.00	100.00	



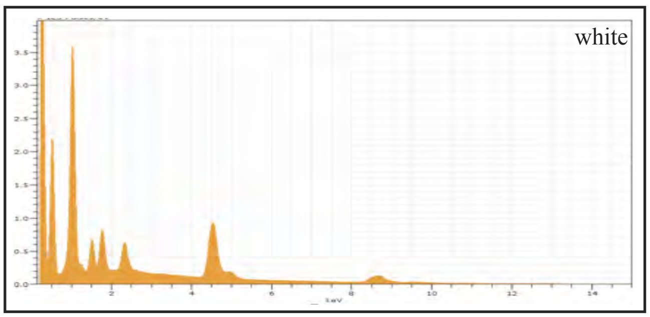
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	9.73	13.24	9.17	0.43
Sulfur	K-series	9.09	12.37	7.50	0.35
Sodium	K-series	6.25	8.51	7.20	4.95
Aluminium	K-series	4.82	6.56	4.73	0.25
Zinc	K-series	0.48	0.66	0.20	0.05
Chlorine	K-series	0.03	0.04	0.02	0.03
Potassium	K-series	0.01	0.02	0.01	0.03
Titanium	K-series	0.01	0.02	0.01	0.03
Barium	L-series	0.01	0.01	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	43.04	58.57	71.18	15.59
	Sum:	73.49	100.00	100.00	

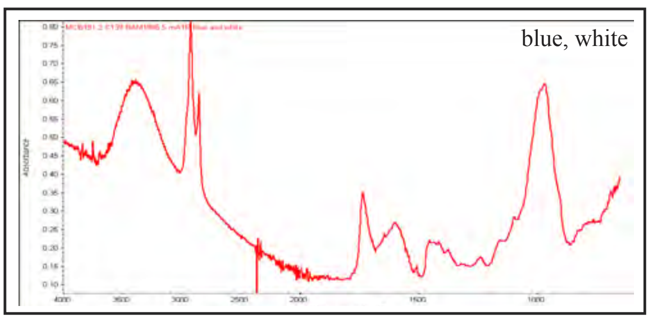
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: blue

sample location: 9.5" from bottom, 23.5" from left
(B 24.1 x L 59.7 cm.)

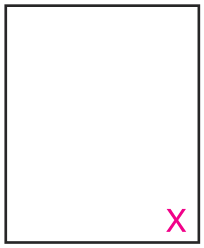
Representative Analysis Compilation—sample C139, continued

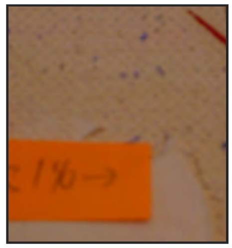


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	27.65	27.68	12.48	0.94
Sodium	K-series	19.20	19.23	24.66	15.14
Titanium	K-series	14.81	14.83	9.13	0.80
Barium	L-series	4.63	4.64	1.00	0.85
Silicon	K-series	3.74	3.74	3.93	0.18
Sulfur	K-series	2.96	2.96	2.72	0.13
Aluminium	K-series	2.47	2.47	2.70	0.14
Magnesium	K-series	0.60	0.60	0.72	0.06
Chlorine	K-series	0.55	0.55	0.46	0.04
Potassium	K-series	0.34	0.34	0.26	0.04
Calcium	K-series	0.22	0.22	0.17	0.04
Phosphorus	K-series	0.12	0.12	0.12	0.03
Oxygen	K-series	22.58	22.61	41.66	9.35
	Sum:	99.87	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 12/20/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

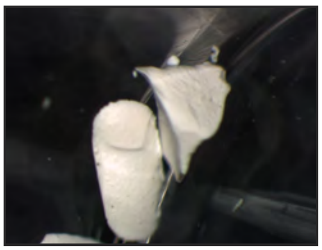
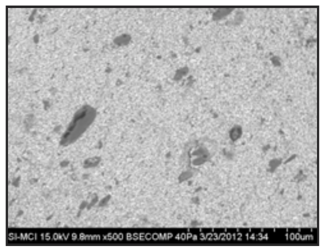





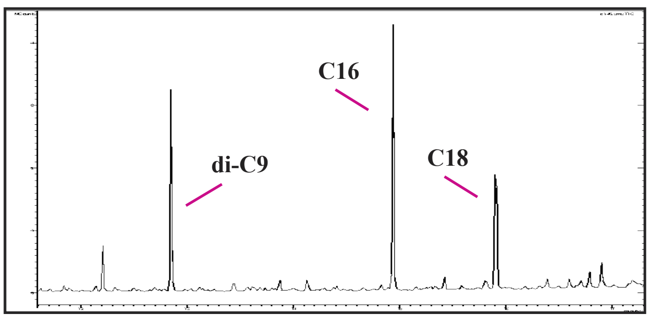
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: compositional white

sample location: 6.5" from bottom, 8.3" from right
(B 16.5 x R 21.1 cm.)

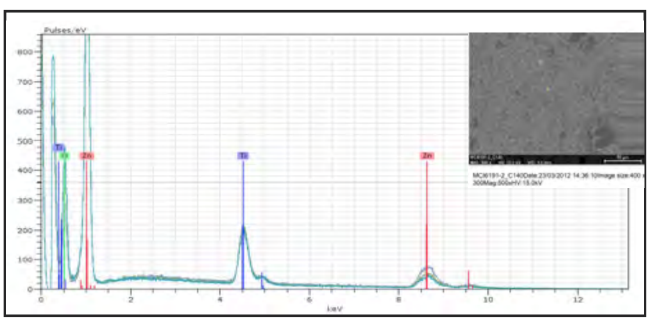
Representative Analysis Compilation—sample C140

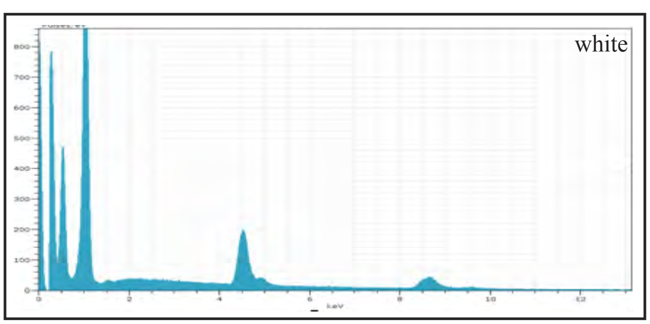
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



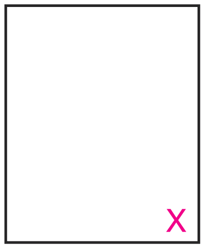
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/05/12
sample weight: 0.233
scan range: 1 - 1488
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil

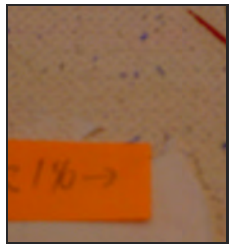


analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	56.74	48.90	25.00	1.95
Sodium	K-series	21.81	18.80	27.33	17.19
Titanium	K-series	12.23	10.54	7.36	1.12
Barium	L-series	2.86	2.46	0.60	1.42
Phosphorus	K-series	0.25	0.22	0.23	0.04
Sulfur	K-series	0.13	0.11	0.11	0.03
Aluminium	K-series	0.12	0.11	0.13	0.03
Chlorine	K-series	0.12	0.10	0.10	0.03
Silicon	K-series	0.05	0.04	0.05	0.03
Potassium	K-series	0.02	0.02	0.01	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	21.70	18.70	39.07	16.63
	Sum:	116.03	100.00	100.00	

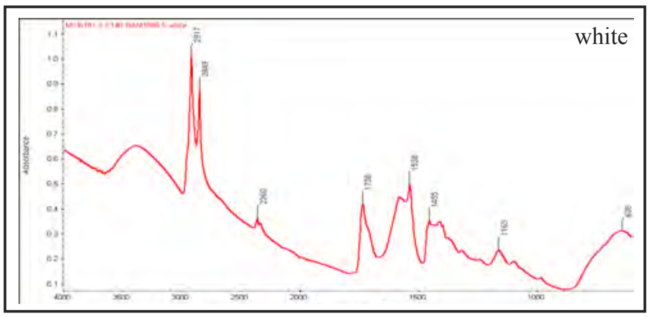
 



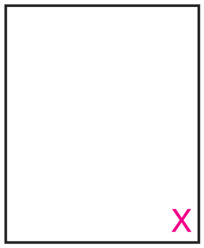
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: compositional white

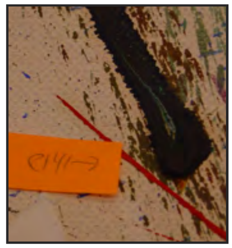
sample location: 6.5" from bottom, 8.3" from right (B 16.5 x R 21.1 cm.)

Representative Analysis Compilation—sample C140, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

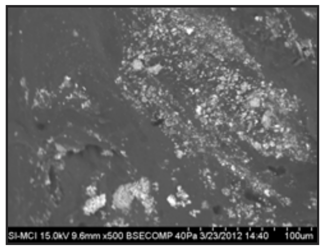




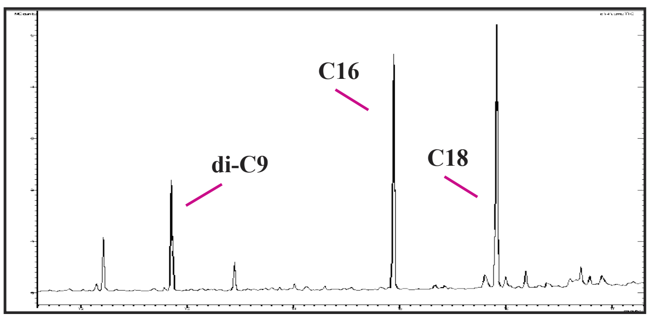
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: dark green, sticky

sample location: 6.5" from bottom, 7.0" from right (B 16.5 x R 17.8 cm.)

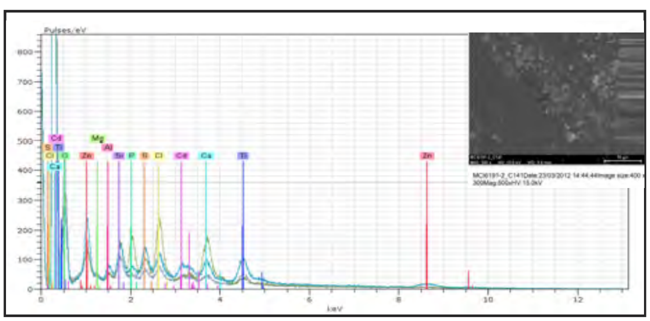
Representative Analysis Compilation—sample C141



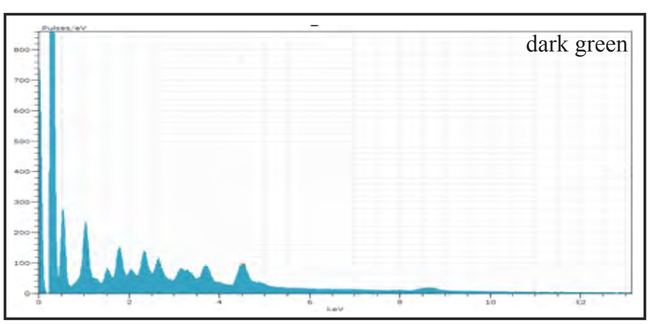
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



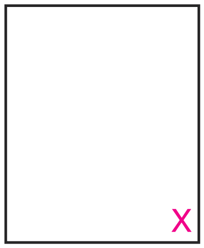
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.092
scan range: 1 - 1483
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil

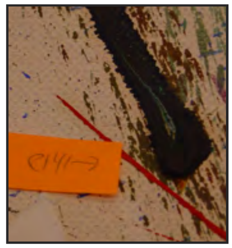


analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, dark green: Zn, Na Cd, S
interpretation: cadmium green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	4.87	4.87	1.35	0.20
Titanium	K-series	3.09	3.09	1.17	0.34
Sodium	K-series	2.01	2.01	1.59	1.61
Cadmium	L-series	1.71	1.71	0.28	0.44
Calcium	K-series	1.46	1.46	0.66	0.13
Sulfur	K-series	1.45	1.45	0.82	0.08
Silicon	K-series	1.41	1.41	0.91	0.09
Chlorine	K-series	1.39	1.39	0.71	0.07
Potassium	K-series	0.56	0.56	0.26	0.31
Phosphorus	K-series	0.45	0.45	0.26	0.04
Aluminium	K-series	0.31	0.31	0.21	0.26
Barium	L-series	0.11	0.11	0.01	0.09
Cobalt	K-series	0.10	0.10	0.03	0.03
Magnesium	K-series	0.05	0.05	0.04	0.06
Iron	K-series	0.01	0.01	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	81.00	81.00	91.70	81.02
	Sum:	100.00	100.00	100.00	

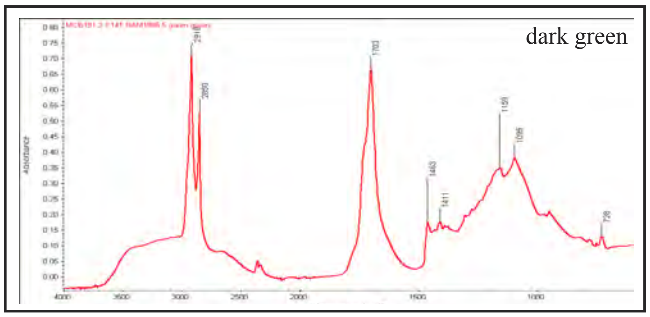




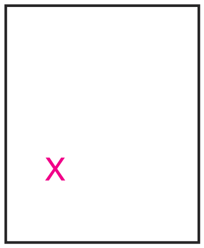
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: dark green, sticky

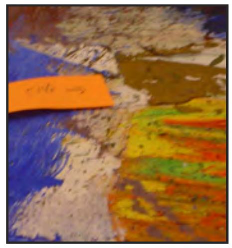
sample location: 6.5" from bottom, 7.0" from right (B 16.5 x R 17.8 cm.)

Representative Analysis Compilation—sample C141, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: mostly oil

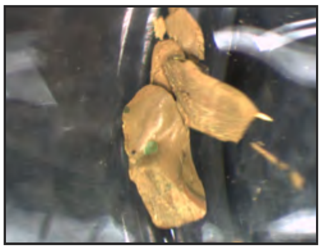


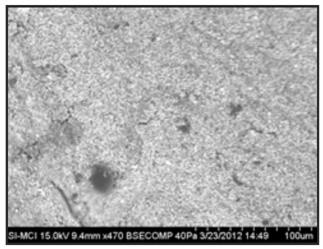


acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: brown mix

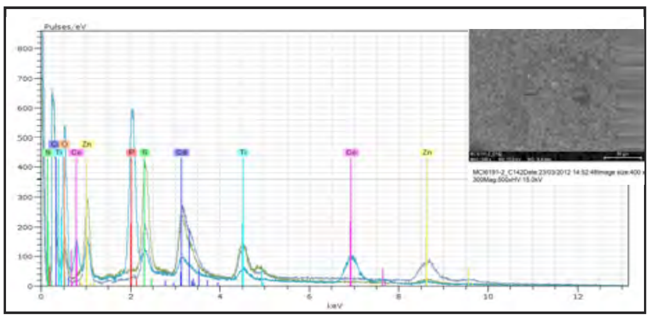
sample location: 23.0" from bottom, 15.8" from left
(B 58.4 x L 40.1 cm.)

Representative Analysis Compilation—sample C142

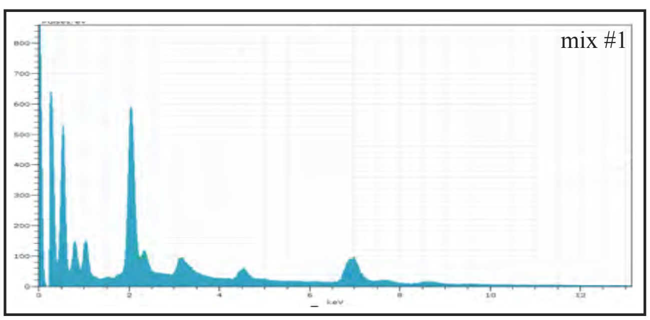




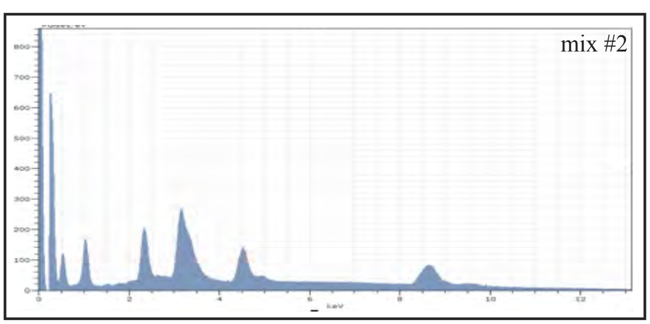
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



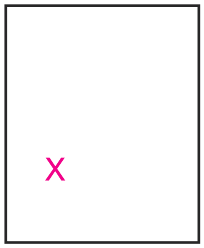
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, mix #1: Co, P, Zn, Cd, S, Na
significant elements, mix #2: Cu, Cl
interpretation: cobalt violet, phthalo green, cadmium yellow, cadmium green

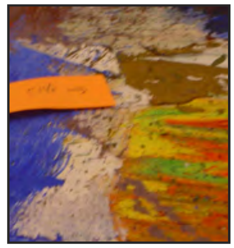


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cobalt	K-series	21.30	25.26	13.19	0.67
Phosphorus	K-series	20.63	24.47	24.32	0.81
Cadmium	L-series	6.83	8.10	2.22	1.69
Zinc	K-series	5.34	6.33	2.98	0.23
Sulfur	K-series	4.10	4.86	4.67	0.17
Sodium	K-series	3.34	3.97	5.31	2.66
Titanium	K-series	1.50	1.78	1.14	0.21
Chlorine	K-series	0.89	1.05	0.91	0.07
Potassium	K-series	0.62	0.74	0.58	0.45
Magnesium	K-series	0.11	0.13	0.16	0.10
Calcium	K-series	0.10	0.12	0.09	0.09
Silicon	K-series	0.06	0.07	0.08	0.03
Aluminium	K-series	0.05	0.06	0.07	0.07
Barium	L-series	0.04	0.05	0.01	0.05
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	19.40	23.01	44.26	14.43
	Sum:	84.31	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	30.06	30.96	22.14	1.03
Cadmium	L-series	24.95	25.70	10.69	5.28
Sulfur	K-series	9.90	10.19	14.86	0.38
Sodium	K-series	9.76	10.05	20.44	7.70
Titanium	K-series	7.23	7.45	7.27	0.83
Potassium	K-series	4.66	4.80	5.75	1.65
Barium	L-series	3.04	3.13	1.07	1.02
Chlorine	K-series	1.13	1.16	1.53	0.09
Copper	K-series	0.56	0.58	0.43	0.06
Phosphorus	K-series	0.39	0.40	0.61	0.05
Aluminium	K-series	0.37	0.39	0.67	0.31
Silicon	K-series	0.25	0.26	0.43	0.04
Calcium	K-series	0.10	0.10	0.12	0.09
Magnesium	K-series	0.09	0.09	0.17	0.09
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	4.60	4.73	13.83	6.62
	Sum:	97.09	100.00	100.00	

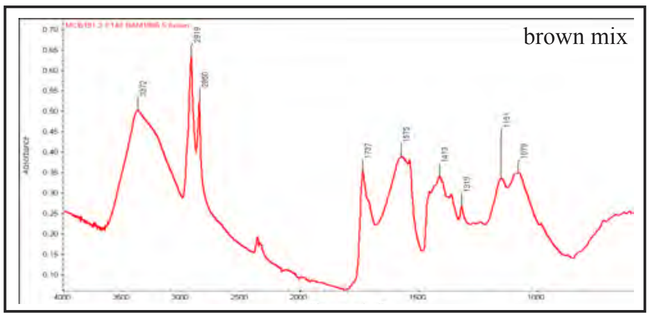




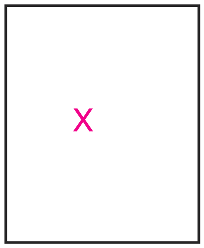
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: brown mix

sample location: 23.0" from bottom, 15.8" from left
(B 58.4 x L 40.1 cm.)

Representative Analysis Compilation—sample C142, continued



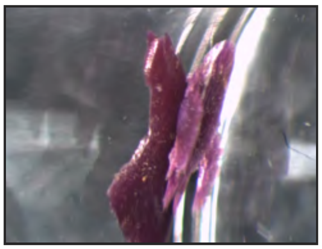
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

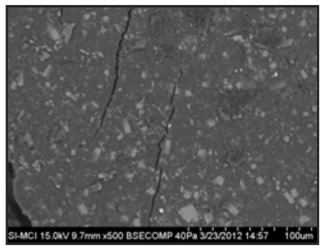


acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: deep purple, stiff, easily shattered

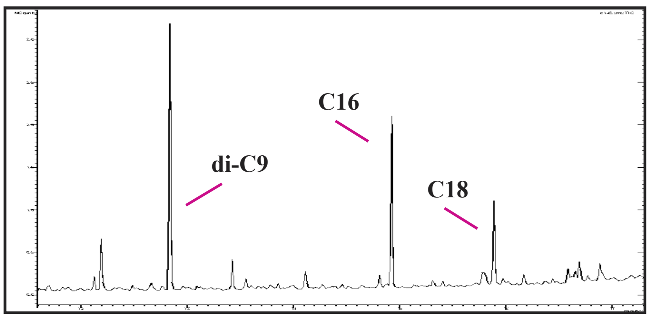
sample location: 32.0" from top, 21.0" from left (T 81.3 x L 53.3 cm.)

Representative Analysis Compilation—sample C143

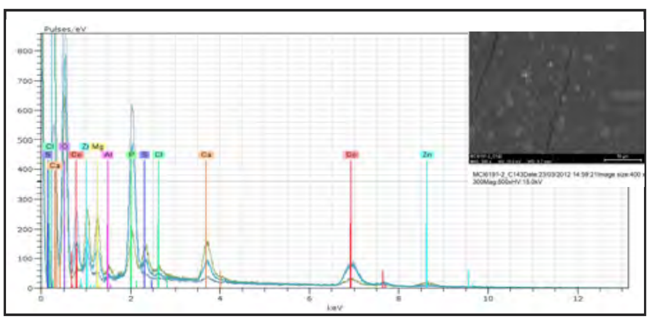




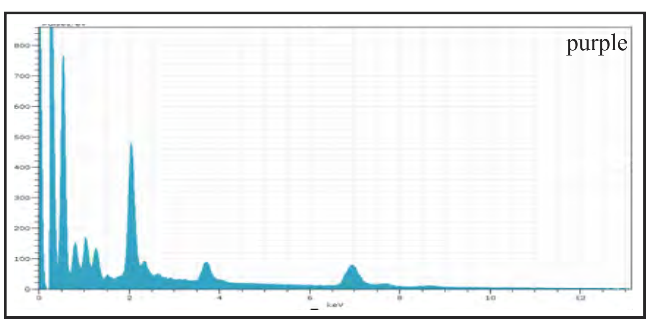
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



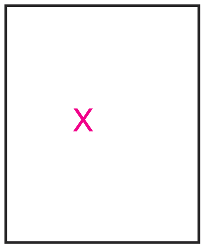
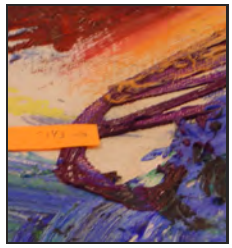
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.229
scan range: 1 - 1480
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, purple: Co, P
interpretation: cobalt violet



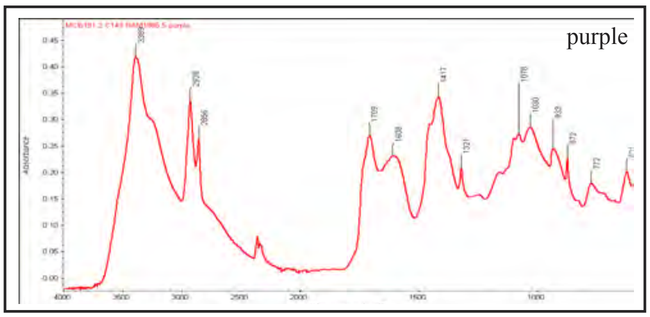
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cobalt	K-series	27.50	29.42	14.27	0.86
Phosphorus	K-series	14.25	15.24	14.07	0.57
Zinc	K-series	8.05	8.61	3.76	0.34
Sodium	K-series	5.26	5.63	7.00	4.17
Magnesium	K-series	4.40	4.70	5.53	0.27
Calcium	K-series	3.84	4.11	2.93	0.15
Sulfur	K-series	2.33	2.49	2.22	0.11
Chlorine	K-series	1.12	1.20	0.96	0.07
Barium	L-series	0.80	0.85	0.18	0.16
Aluminium	K-series	0.32	0.34	0.36	0.04
Potassium	K-series	0.22	0.23	0.17	0.05
Silicon	K-series	0.03	0.04	0.04	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.37	27.14	48.50	15.80
	Sum:	93.49	100.00	100.00	

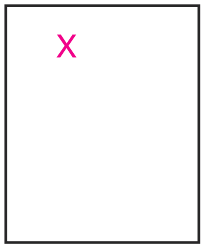
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: deep purple, stiff, easily shattered

sample location: 32.0" from top, 21.0" from left
(T 81.3 x L 53.3 cm.)

Representative Analysis Compilation—sample C143, continued



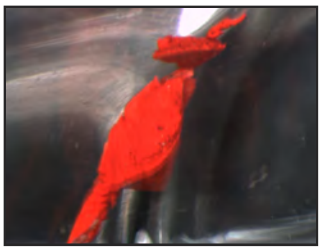
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

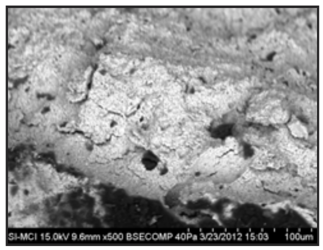


acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: reddish orange

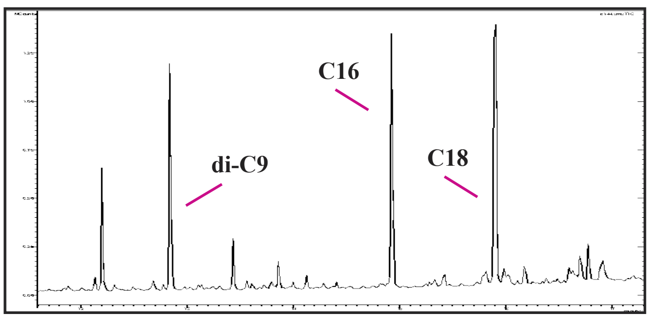
sample location: 10.5" from top, 17.0" from left (T 26.7 x L 43.2 cm.)

Representative Analysis Compilation—sample C144

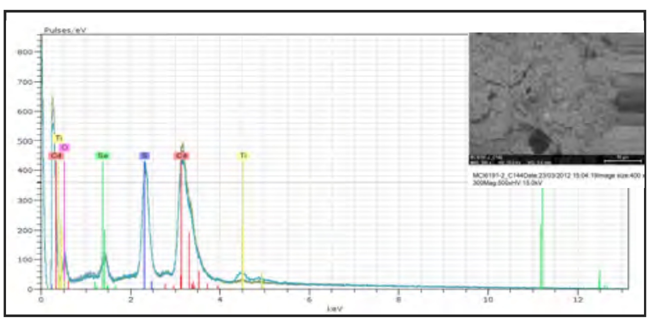




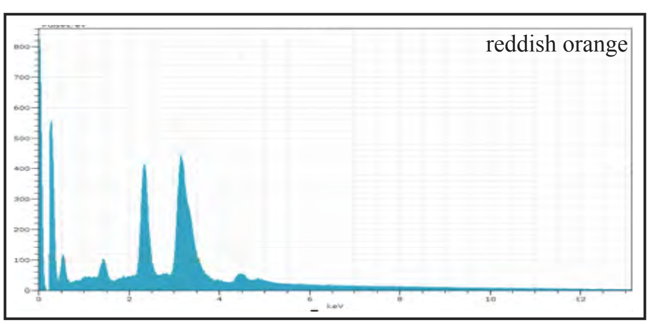
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



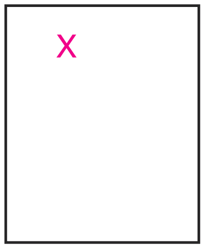
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.328
scan range: 1 - 1484
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, reddish orange: Cd, S, Se
interpretation: cadmium red light



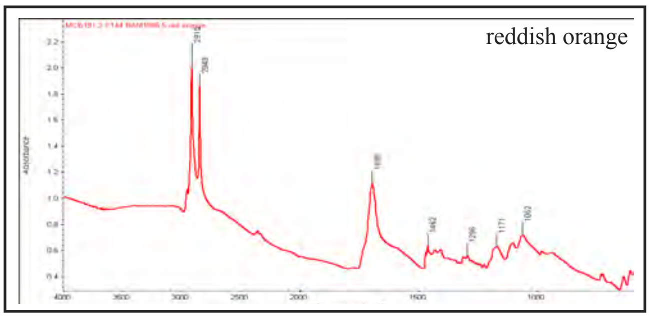
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	45.50	44.24	18.48	6.72
Sulfur	K-series	17.11	16.64	24.36	0.63
Barium	L-series	8.57	8.34	2.85	0.73
Zinc	K-series	6.98	6.78	4.87	0.30
Potassium	K-series	5.66	5.50	6.61	2.44
Selenium	L-series	3.81	3.70	2.20	0.32
Chlorine	K-series	0.64	0.62	0.83	0.08
Phosphorus	K-series	0.53	0.52	0.79	0.05
Aluminium	K-series	0.28	0.27	0.47	0.23
Sodium	K-series	0.26	0.25	0.51	0.23
Silicon	K-series	0.20	0.20	0.33	0.04
Titanium	K-series	0.08	0.08	0.08	0.08
Calcium	K-series	0.04	0.04	0.05	0.05
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	13.18	12.81	37.59	19.71
	Sum:	102.83	100.00	100.00	

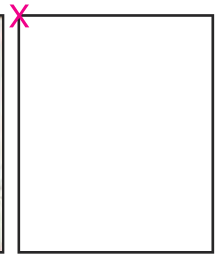
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: reddish orange

sample location: 10.5" from top, 17.0" from left (T 26.7 x L 43.2 cm.)

Representative Analysis Compilation—sample C144, continued



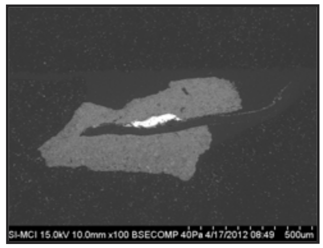
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil



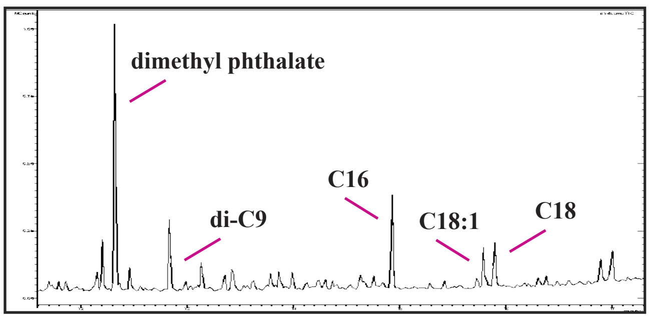
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: ground layer

sample location: upper left corner
(T 0.0 x L 0.0 cm.)

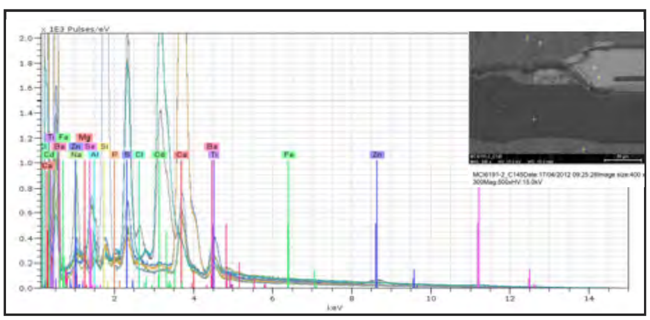
Representative Analysis Compilation—sample C145



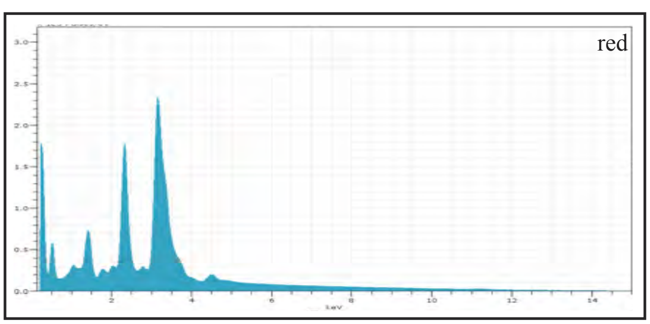
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/04/12
sample weight: 0.138
scan range: 1 - 1484
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16,
C18:1, C18
interpretation: alkyd, oil



analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, ground: Ca, Ti
interpretation: cadmium red, bulked titanium white

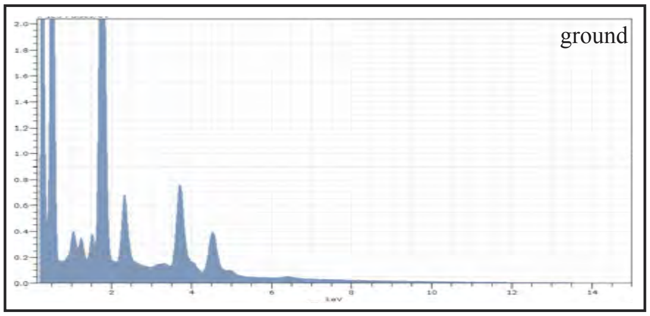


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	11.25	19.98	7.01	1.08
Zinc	K-series	10.49	18.63	11.24	0.38
Sulfur	K-series	8.29	14.72	18.10	0.32
Selenium	L-series	5.99	10.65	5.32	0.41
Barium	L-series	5.12	9.09	2.61	0.38
Potassium	K-series	2.80	4.98	5.02	0.39
Sodium	K-series	1.31	2.33	4.00	1.06
Silicon	K-series	0.33	0.59	0.83	0.04
Phosphorus	K-series	0.25	0.45	0.57	0.04
Aluminium	K-series	0.15	0.27	0.40	0.14
Magnesium	K-series	0.10	0.18	0.29	0.10
Titanium	K-series	0.02	0.03	0.03	0.04
Calcium	K-series	0.00	0.01	0.01	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	10.19	18.09	44.58	7.72
	Sum:	56.30	100.00	100.00	

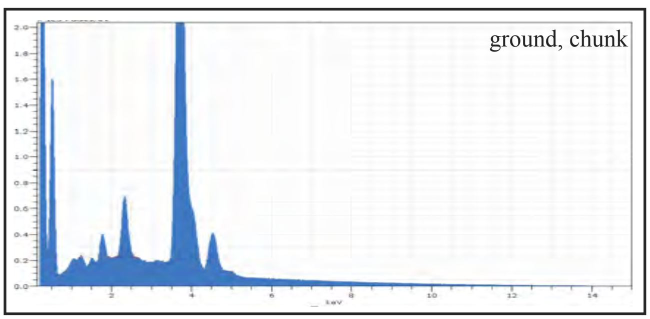
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: ground layer

sample location: upper left corner
(T 0.0 x L 0.0 cm.)

Representative Analysis Compilation—sample C145, continued

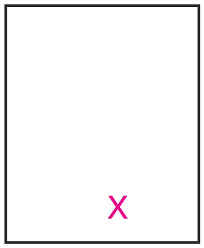


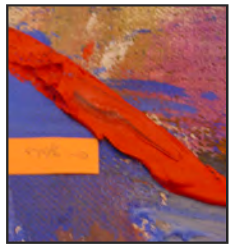
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Silicon	K-series	15.72	17.78	12.62	0.68
Calcium	K-series	6.50	7.35	3.66	0.25
Titanium	K-series	5.49	6.21	2.59	0.34
Sulfur	K-series	2.46	2.78	1.73	0.11
Zinc	K-series	0.81	0.91	0.28	0.06
Sodium	K-series	0.70	0.79	0.69	0.57
Iron	K-series	0.66	0.74	0.26	0.05
Magnesium	K-series	0.47	0.53	0.43	0.09
Potassium	K-series	0.27	0.30	0.15	0.11
Cadmium	L-series	0.18	0.21	0.04	0.07
Aluminium	K-series	0.13	0.14	0.11	0.12
Barium	L-series	0.09	0.10	0.02	0.07
Chlorine	K-series	0.06	0.06	0.04	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	54.91	62.09	77.39	18.21
	Sum:	88.43	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	42.80	43.93	29.43	1.34
Titanium	K-series	5.15	5.28	2.96	0.53
Barium	L-series	4.83	4.95	0.97	0.58
Zinc	K-series	3.55	3.65	1.50	0.15
Sulfur	K-series	2.74	2.81	2.35	0.12
Cadmium	L-series	1.30	1.34	0.32	0.35
Silicon	K-series	0.73	0.75	0.71	0.06
Chlorine	K-series	0.48	0.49	0.37	0.04
Sodium	K-series	0.28	0.29	0.34	0.25
Aluminium	K-series	0.18	0.18	0.18	0.16
Magnesium	K-series	0.16	0.16	0.18	0.06
Phosphorus	K-series	0.02	0.02	0.01	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	35.22	36.15	60.67	16.51
	Sum:	97.43	100.00	100.00	

analysis: µFTIR
by: DVR (MCI)
date: 12/20/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

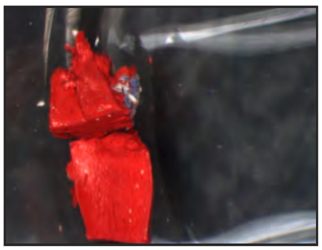


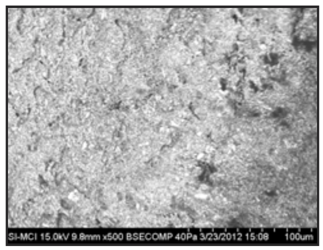


acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: red, soft

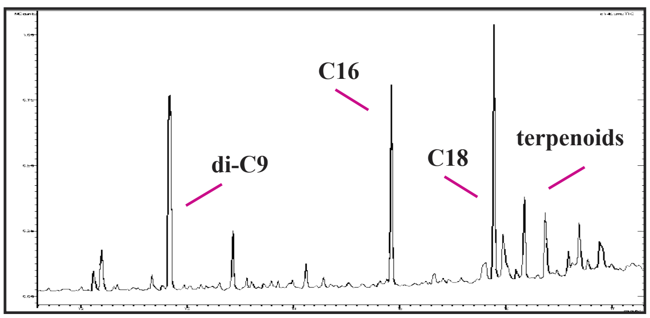
sample location: 11.0" from bottom, 28.0" from right
(B 27.9 x R 71.1 cm.)

Representative Analysis Compilation—sample C146

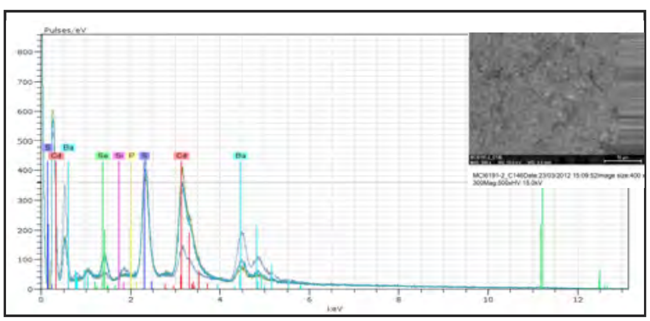




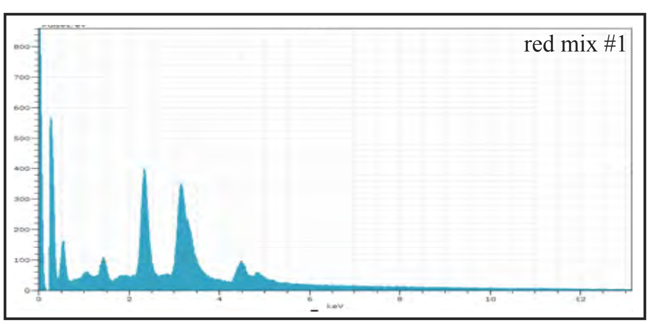
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



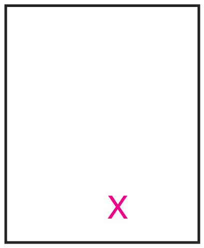
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.234
scan range: 1 - 1475
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil

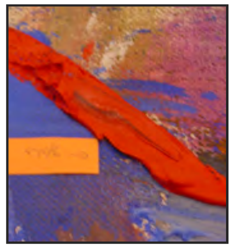


analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, red: Cd, S, Se
interpretation: cadmium red



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	31.03	33.07	12.14	5.09
Sulfur	K-series	15.65	16.67	21.46	0.58
Barium	L-series	10.90	11.62	3.49	0.94
Selenium	L-series	6.35	6.77	3.54	0.52
Zinc	K-series	3.97	4.23	2.67	0.19
Potassium	K-series	3.48	3.71	3.92	1.74
Sodium	K-series	2.24	2.38	4.28	1.78
Titanium	K-series	1.59	1.69	1.46	0.54
Silicon	K-series	0.83	0.88	1.29	0.07
Phosphorus	K-series	0.72	0.77	1.03	0.06
Aluminium	K-series	0.66	0.70	1.07	0.53
Chlorine	K-series	0.58	0.62	0.72	0.07
Magnesium	K-series	0.56	0.59	1.00	0.34
Calcium	K-series	0.05	0.06	0.06	0.06
Oxygen	K-series	15.23	16.23	41.87	20.52
	Sum:	93.83	100.00	100.00	

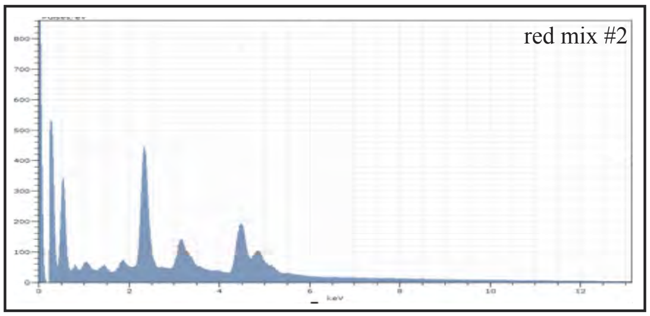




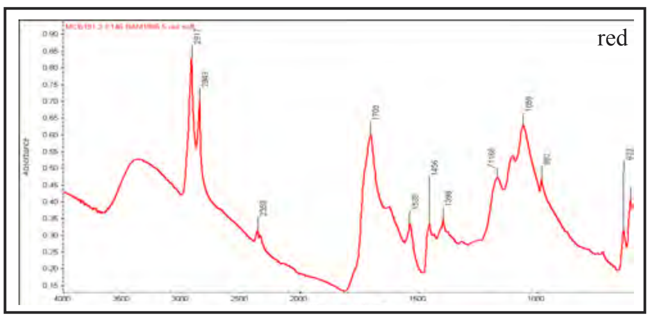
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: red, soft

sample location: 11.0" from bottom, 28.0" from right
(B 27.9 x R 71.1 cm.)

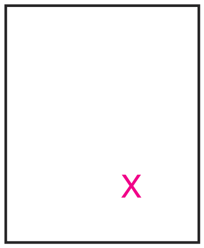
Representative Analysis Compilation—sample C146, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Barium	L-series	17.89	21.98	4.55	1.33
Sulfur	K-series	12.94	15.90	14.09	0.49
Cadmium	L-series	7.41	9.10	2.30	1.83
Titanium	K-series	2.84	3.49	2.07	0.62
Zinc	K-series	2.37	2.92	1.27	0.13
Selenium	L-series	1.56	1.92	0.69	0.15
Sodium	K-series	1.24	1.52	1.88	1.00
Silicon	K-series	1.05	1.29	1.30	0.08
Phosphorus	K-series	0.73	0.90	0.82	0.06
Potassium	K-series	0.56	0.69	0.50	0.40
Magnesium	K-series	0.50	0.61	0.71	0.24
Chlorine	K-series	0.38	0.47	0.38	0.05
Aluminium	K-series	0.19	0.24	0.25	0.17
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	31.72	38.98	69.20	30.74
	Sum:	81.39	100.00	100.00	



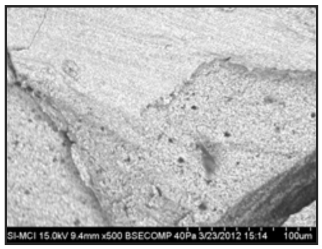
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



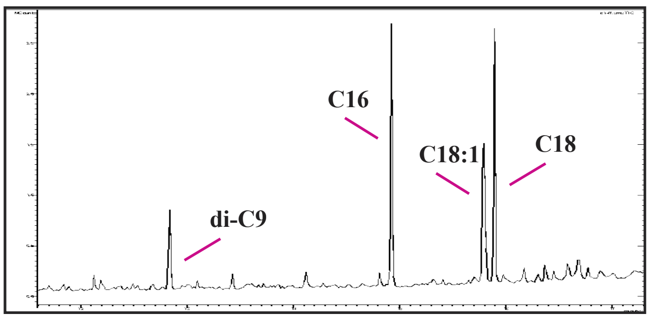
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: orange, soft

sample location: 19.0" from bottom, 22.0" from right
(B 48.3 x R 55.9 cm.)

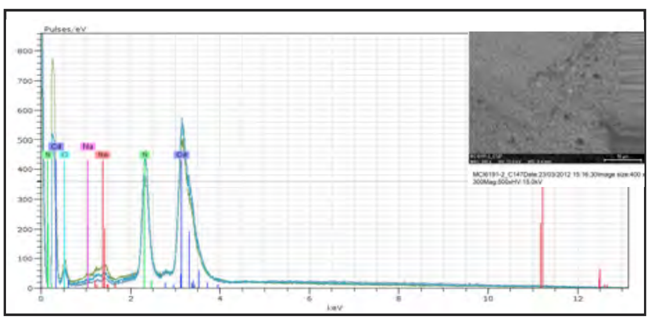
Representative Analysis Compilation—sample C147



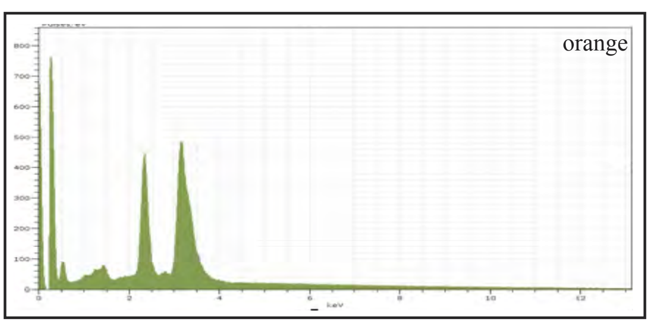
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.4 mm.



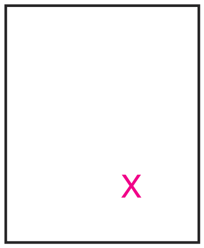
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.337
scan range: 1 - 1479
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.4 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
interpretation: cadmium orange

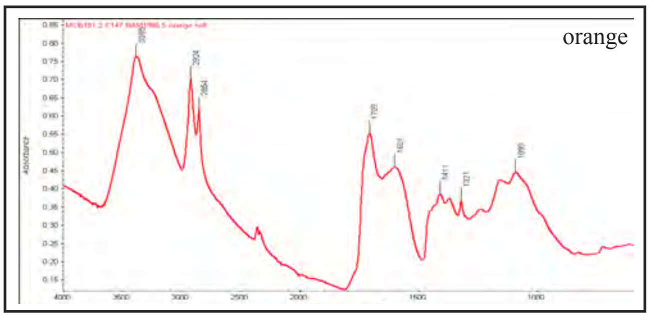


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	53.37	49.56	20.26	7.58
Sulfur	K-series	20.29	18.84	27.01	0.75
Zinc	K-series	7.17	6.66	4.68	0.31
Potassium	K-series	6.83	6.34	7.45	2.64
Selenium	L-series	2.88	2.67	1.56	0.25
Magnesium	K-series	1.20	1.12	2.11	0.35
Barium	L-series	0.95	0.88	0.29	0.19
Phosphorus	K-series	0.85	0.79	1.18	0.06
Chlorine	K-series	0.83	0.77	1.00	0.09
Sodium	K-series	0.53	0.49	0.98	0.44
Silicon	K-series	0.46	0.43	0.70	0.05
Aluminium	K-series	0.06	0.06	0.10	0.07
Calcium	K-series	0.02	0.02	0.02	0.04
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	12.25	11.37	32.67	19.60
	Sum:	107.69	100.00	100.00	

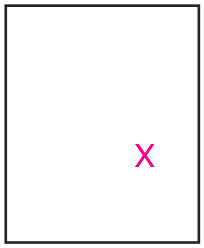



acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: orange, soft
sample location: 19.0" from bottom, 22.0" from right (B 48.3 x R 55.9 cm.)

Representative Analysis Compilation—sample C147, continued



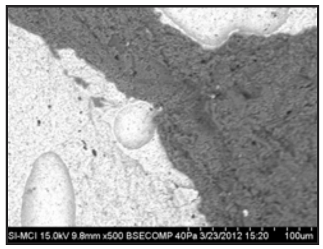
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers



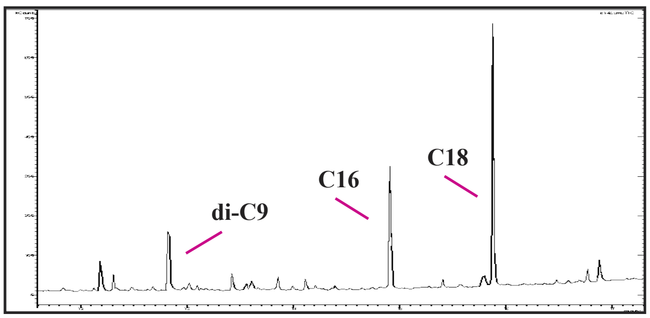
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: bright yellow, very dry

sample location: 27.5" from bottom, 14.0" from right
(B 69.9 x R 35.6 cm.)

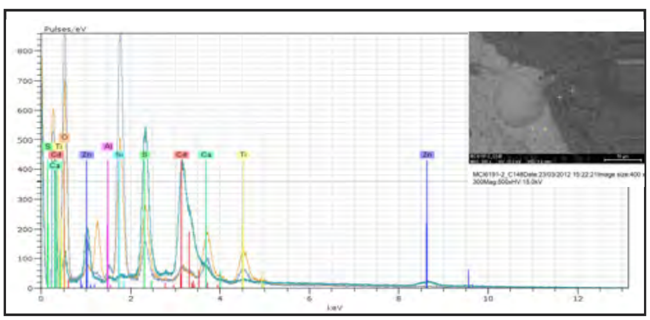
Representative Analysis Compilation—sample C148



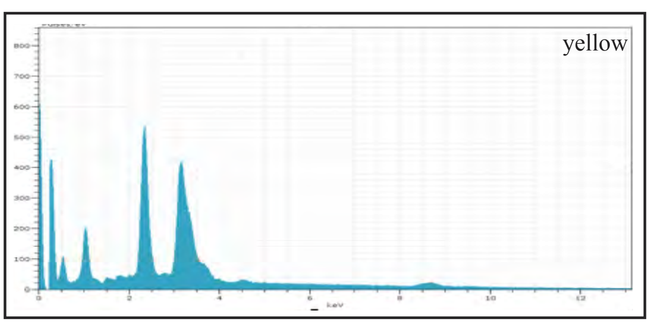
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.8 mm.



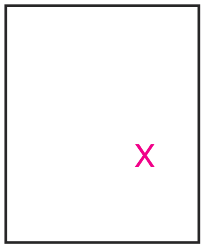
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/09/12
sample weight: 0.121
scan range: 1 - 1490
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, yellow: Cd, S
significant elements, white: Ti
interpretation: cadmium yellow, titanium white



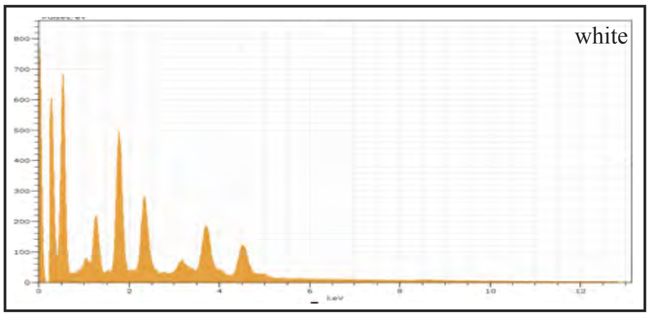
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	42.10	37.21	13.80	6.33
Sulfur	K-series	23.49	20.76	26.99	0.86
Zinc	K-series	15.90	14.05	8.96	0.59
Sodium	K-series	11.49	10.15	18.41	9.07
Potassium	K-series	4.78	4.23	4.51	2.23
Calcium	K-series	1.43	1.26	1.31	0.32
Silicon	K-series	1.21	1.07	1.59	0.08
Magnesium	K-series	1.04	0.92	1.57	0.37
Aluminium	K-series	0.85	0.75	1.16	0.67
Chlorine	K-series	0.78	0.69	0.81	0.08
Phosphorus	K-series	0.73	0.65	0.87	0.06
Barium	L-series	0.63	0.55	0.17	0.19
Titanium	K-series	0.16	0.14	0.12	0.11
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	8.57	7.57	19.74	13.37
	Sum:	113.16	100.00	100.00	



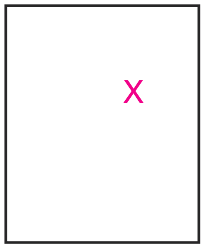
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: bright yellow, very dry

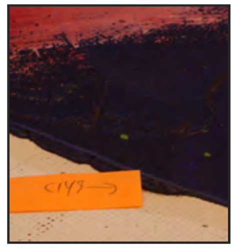
sample location: 27.5" from bottom, 14.0" from right (B 69.9 x R 35.6 cm.)

Representative Analysis Compilation—sample C148, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Silicon	K-series	9.70	11.09	7.99	0.43
Sulfur	K-series	5.87	6.71	4.24	0.23
Calcium	K-series	5.58	6.38	3.22	0.30
Titanium	K-series	5.36	6.13	2.59	0.52
Magnesium	K-series	4.64	5.30	4.41	0.55
Cadmium	L-series	2.18	2.49	0.45	0.56
Zinc	K-series	0.75	0.86	0.27	0.07
Potassium	K-series	0.25	0.29	0.15	0.20
Sodium	K-series	0.21	0.24	0.21	0.19
Barium	L-series	0.02	0.03	0.00	0.04
Chlorine	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Aluminium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	52.88	60.47	76.47	35.82
	Sum:	87.44	100.00	100.00	

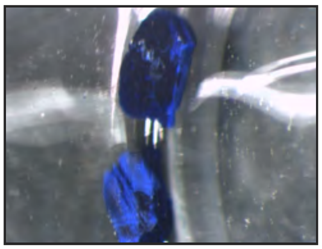


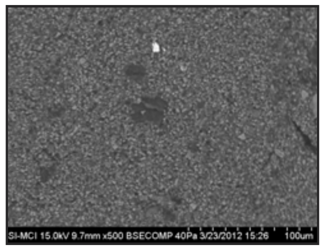


acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: deep blue

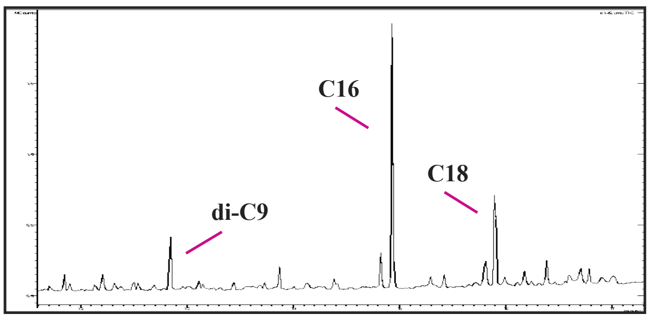
sample location: 27.5" from top, 23.0" from right
(T 69.9 x R 58.4 cm.)

Representative Analysis Compilation—sample C149

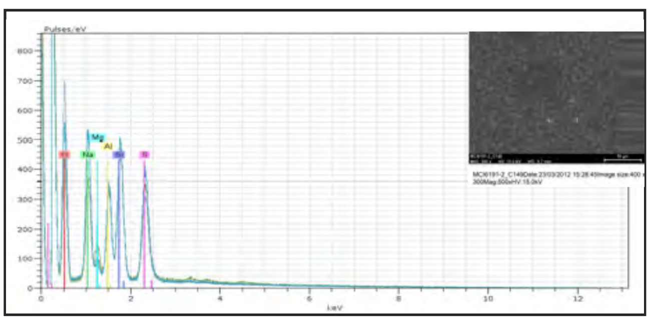




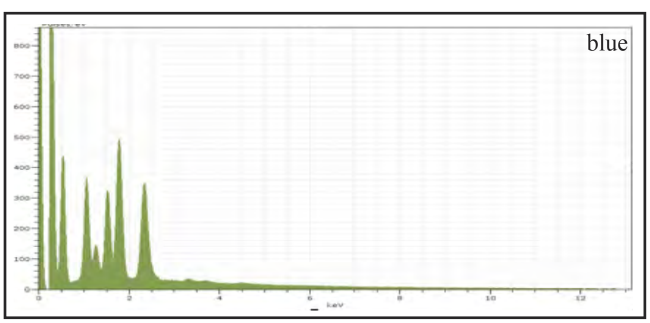
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



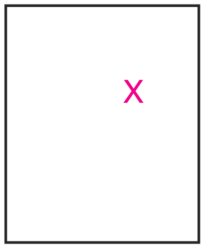
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/11/12
sample weight: 0.223
scan range: 1 - 1485
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, blue: Si, Na, Al
interpretation: ultramarine blue



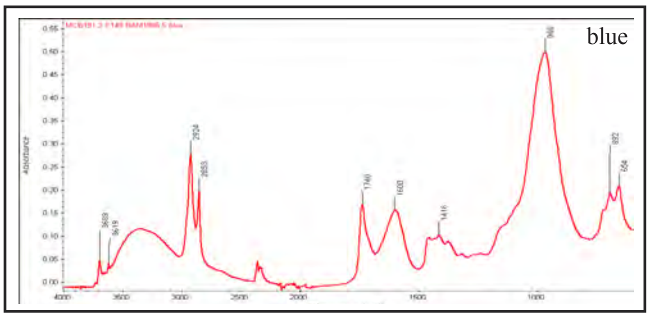
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Sulfur	K-series	8.34	11.50	7.58	0.32
Silicon	K-series	8.21	11.33	8.53	0.37
Sodium	K-series	7.62	10.52	9.67	6.02
Aluminium	K-series	4.41	6.09	4.77	0.23
Zinc	K-series	3.10	4.27	1.38	0.16
Barium	L-series	2.10	2.90	0.45	0.26
Magnesium	K-series	1.93	2.67	2.32	0.13
Potassium	K-series	0.62	0.86	0.47	0.06
Calcium	K-series	0.55	0.76	0.40	0.05
Chlorine	K-series	0.40	0.56	0.33	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	35.18	48.54	64.11	28.48
	Sum:	72.47	100.00	100.00	



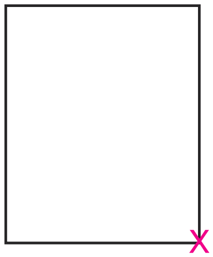
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: deep blue

sample location: 27.5" from top, 23.0" from right (T 69.9 x R 58.4 cm.)

Representative Analysis Compilation—sample C149, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/06/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

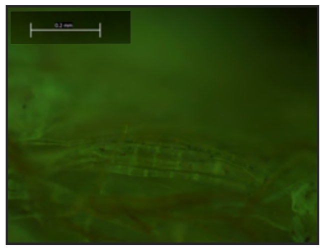


no image available

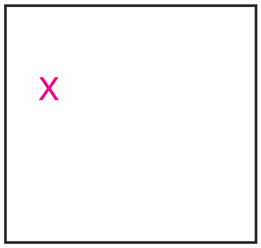
acc. no.: BAM 1966.5
title, year: *Struwel Peter*, 1965
Gift of Hans Hofmann
medium noted in file: oil on canvas
meas.: 72.1 x 60.3" (183.1 x 153.2 cm.)
notes: support threads, might be lining canvas

sample location: lower right corner
(B 0.0 x R 0.0 cm.)

Representative Analysis Compilation—sample C150



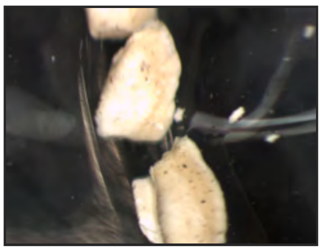
photomicrograph of fibers:
12x obj, 10x lens, 0.55x tube, 0.66 magnification
photomicrograph detail image:
10x objective, 0.55x tube, 5.55 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
interpretation: linen

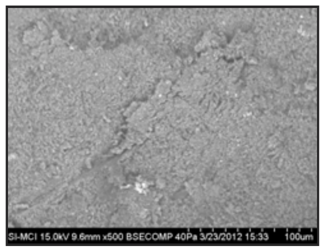


acc. no.: Estate M536-12
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 7.5 x 7.5" (19.1 x 19.1 cm.)
notes: full tube of white on board

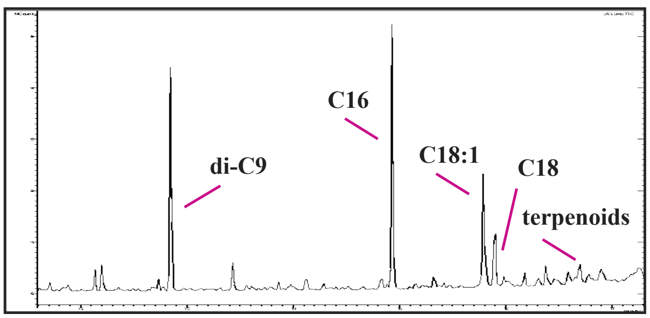
sample location: 2.5" from top,
1.2" from left (T 6.4 x L 3.1 cm.)

Representative Analysis Compilation—sample S01

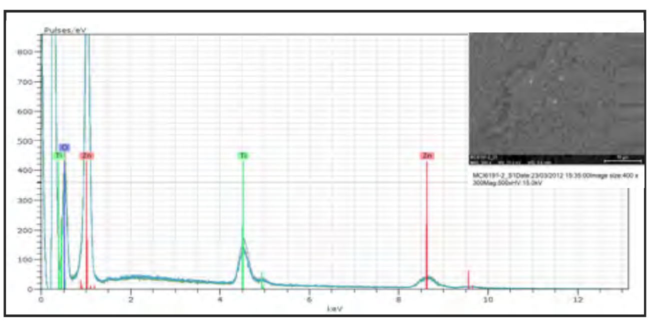




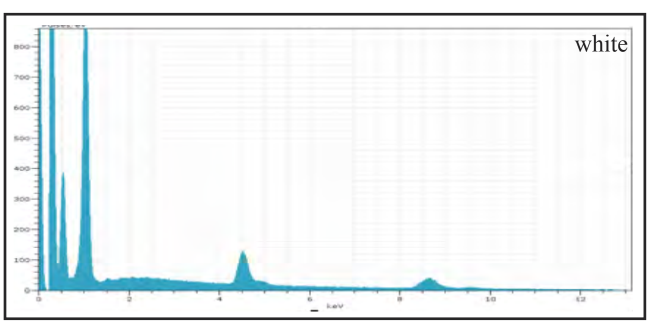
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



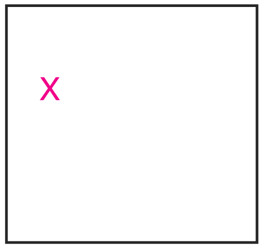
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/03/12
sample weight: 0.211
scan range: 1 - 1480
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



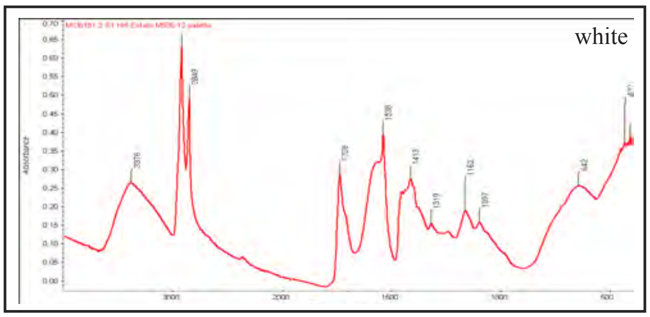
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	36.22	39.17	17.95	1.26
Sodium	K-series	25.69	27.78	36.22	20.24
Titanium	K-series	9.24	9.99	6.25	0.94
Barium	L-series	1.76	1.91	0.42	0.88
Aluminium	K-series	0.20	0.22	0.24	0.04
Magnesium	K-series	0.18	0.20	0.24	0.04
Silicon	K-series	0.06	0.07	0.07	0.03
Phosphorus	K-series	0.06	0.06	0.06	0.03
Chlorine	K-series	0.01	0.01	0.01	0.03
Potassium	K-series	0.01	0.01	0.01	0.03
Calcium	K-series	0.01	0.01	0.01	0.03
Sulfur	K-series	0.01	0.01	0.01	0.03
Oxygen	K-series	19.01	20.56	38.51	16.37
	Sum:	92.47	100.00	100.00	

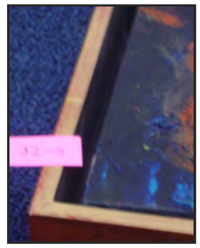
acc. no.: Estate M536-12
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 7.5 x 7.5" (19.1 x 19.1 cm.)
notes: full tube of white on board

sample location: 2.5" from top,
1.2" from left (T 6.4 x L 3.1 cm.)

Representative Analysis Compilation—sample S01, continued



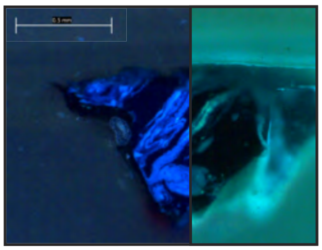
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

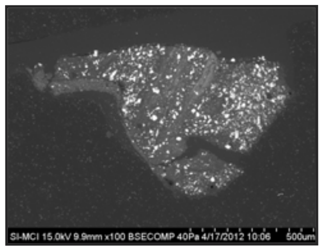


acc. no.: Estate M593-12
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.8 x 9.0" (21.1 x 22.9 cm.)
notes: black ground layer

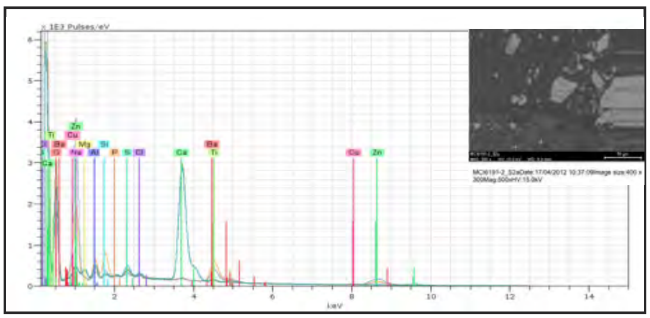
sample location: left edge,
1.0" from bottom (B 2.5 x L 0.0 cm.)

Representative Analysis Compilation—sample S02

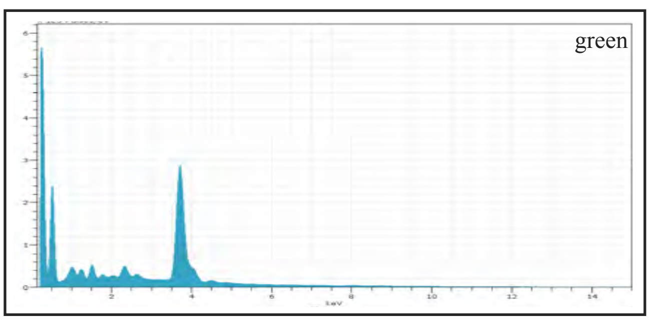




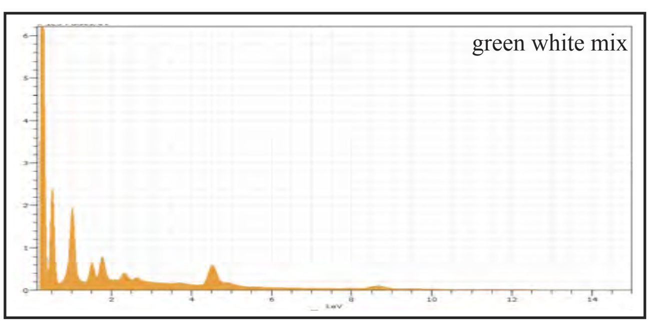
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.9 mm.



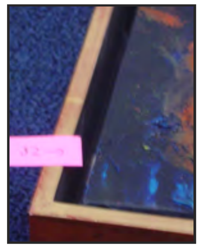
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cu, Cl
significant elements, white: Zn, Ti
interpretation: phthalo green, Zn/Ti white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Calcium	K-series	32.70	33.88	21.62	1.00
Barium	L-series	6.06	6.27	1.17	0.44
Zinc	K-series	5.50	5.69	2.23	0.22
Copper	K-series	4.17	4.32	1.74	0.16
Sulfur	K-series	1.88	1.95	1.56	0.09
Chlorine	K-series	1.43	1.48	1.07	0.07
Aluminium	K-series	1.36	1.41	1.34	0.09
Sodium	K-series	1.35	1.39	1.55	1.08
Magnesium	K-series	1.31	1.36	1.43	0.10
Potassium	K-series	0.62	0.64	0.42	0.08
Phosphorus	K-series	0.45	0.47	0.39	0.04
Silicon	K-series	0.37	0.39	0.35	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	39.33	40.74	65.14	15.62
	Sum:	96.54	100.00	100.00	



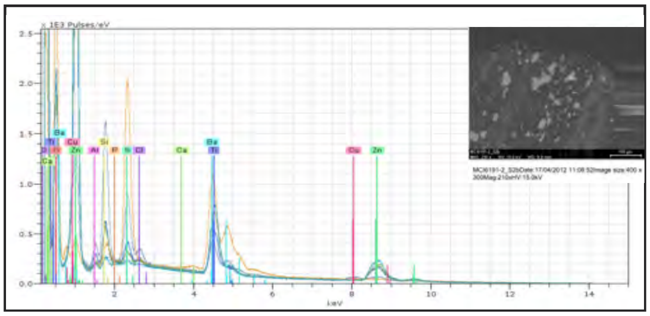
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	12.26	17.79	6.22	0.43
Titanium	K-series	6.32	9.18	4.38	0.40
Sodium	K-series	3.67	5.33	5.30	2.91
Silicon	K-series	2.94	4.27	3.47	0.15
Aluminium	K-series	1.81	2.63	2.23	0.11
Copper	K-series	1.67	2.43	0.87	0.08
Barium	L-series	1.49	2.17	0.36	0.47
Sulfur	K-series	1.13	1.65	1.17	0.07
Chlorine	K-series	0.92	1.34	0.86	0.06
Phosphorus	K-series	0.32	0.46	0.34	0.04
Calcium	K-series	0.30	0.44	0.25	0.04
Potassium	K-series	0.19	0.27	0.16	0.03
Magnesium	K-series	0.10	0.14	0.13	0.03
Oxygen	K-series	35.77	51.92	74.24	14.56
	Sum:	68.90	100.00	100.00	



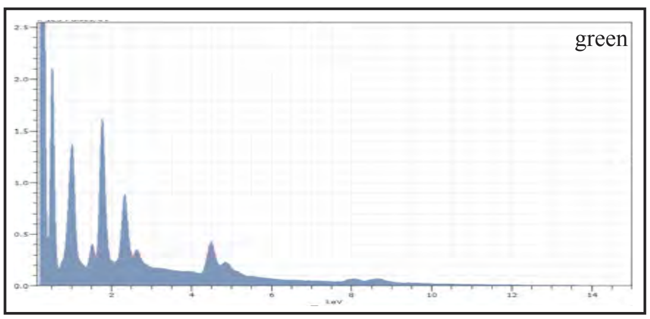
acc. no.: Estate M593-12
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.8 x 9.0" (21.1 x 22.9 cm.)
notes: black ground layer

sample location: left edge,
1.0" from bottom (B 2.5 x L 0.0 cm.)

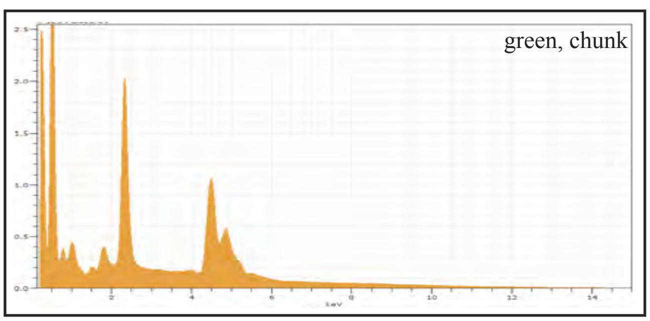
Representative Analysis Compilation—sample S02, continued



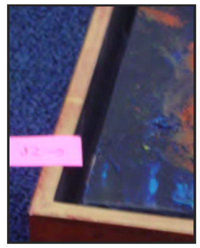
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.9 mm.
mag: 210x; HV: 15 kV
significant elements, green: Cu, Cl
significant elements, white: Zn, Ti
interpretation: phthalo green, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	7.45	11.35	4.09	0.28
Barium	L-series	7.31	11.13	1.91	0.51
Silicon	K-series	5.94	9.04	7.59	0.27
Copper	K-series	3.93	5.99	2.22	0.15
Sulfur	K-series	2.70	4.11	3.02	0.12
Sodium	K-series	1.65	2.51	2.58	1.32
Titanium	K-series	1.53	2.33	1.15	0.25
Chlorine	K-series	0.73	1.11	0.74	0.05
Aluminium	K-series	0.58	0.88	0.77	0.05
Magnesium	K-series	0.06	0.10	0.09	0.03
Potassium	K-series	0.01	0.01	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Calcium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	33.80	51.45	75.83	14.56
	Sum:	65.69	100.00	100.00	



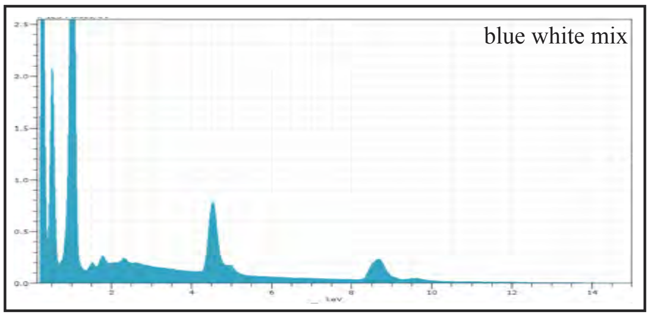
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	23.74	27.58	5.03	1.45
Sulfur	K-series	9.07	10.53	8.23	0.35
Zinc	K-series	3.65	4.24	1.63	0.15
Titanium	K-series	2.75	3.20	1.67	0.42
Sodium	K-series	1.14	1.33	1.44	0.92
Silicon	K-series	0.87	1.01	0.90	0.06
Cobalt	K-series	0.20	0.23	0.10	0.03
Magnesium	K-series	0.17	0.20	0.21	0.04
Aluminium	K-series	0.07	0.08	0.07	0.03
Chlorine	K-series	0.04	0.04	0.03	0.03
Phosphorus	K-series	0.03	0.04	0.03	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	44.35	51.51	80.65	15.64
	Sum:	86.09	100.00	100.00	



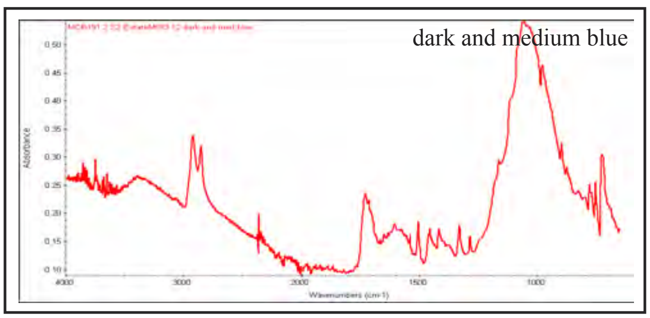
acc. no.: Estate M593-12
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.8 x 9.0" (21.1 x 22.9 cm.)
notes: black ground layer

sample location: left edge,
1.0" from bottom (B 2.5 x L 0.0 cm.)

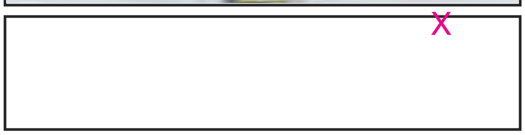
Representative Analysis Compilation—sample S02, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	43.49	44.42	21.54	1.46
Sodium	K-series	20.09	20.52	28.30	15.84
Titanium	K-series	12.17	12.43	8.23	0.58
Silicon	K-series	0.63	0.64	0.73	0.05
Barium	L-series	0.61	0.62	0.14	0.32
Copper	K-series	0.49	0.50	0.25	0.05
Aluminium	K-series	0.27	0.27	0.32	0.04
Sulfur	K-series	0.17	0.18	0.18	0.03
Chlorine	K-series	0.07	0.07	0.06	0.03
Potassium	K-series	0.03	0.03	0.03	0.03
Phosphorus	K-series	0.03	0.03	0.03	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	19.86	20.29	40.20	8.36
	Sum:	97.91	100.00	100.00	



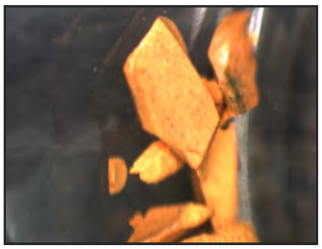
analysis: µFTIR
by: DVR (MCI)
date: 12/21/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: filler

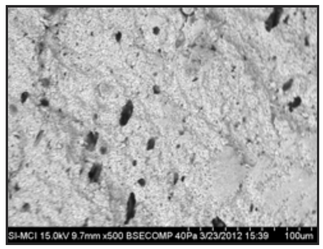


acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: light orange

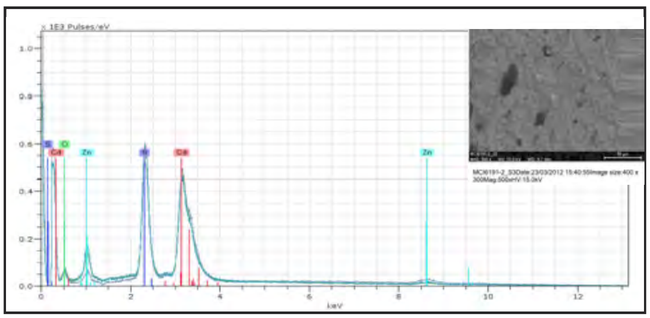
sample location: 0.5" from top,
9.2" from right (T 1.3 x R 23.4 cm.)

Representative Analysis Compilation—sample S03

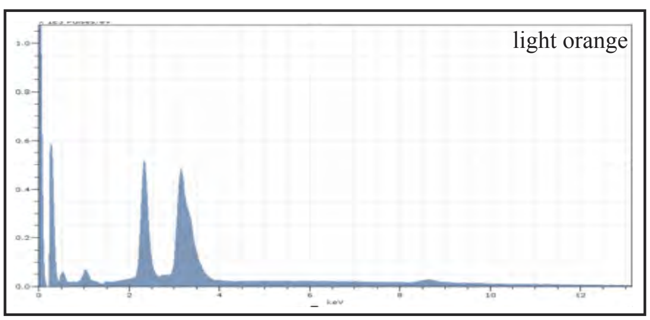




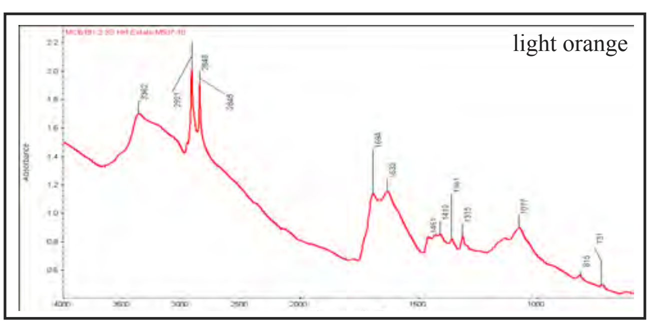
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, light orange: Cd, S
interpretation: cadmium yellow deep



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	56.64	49.92	21.06	8.44
Sulfur	K-series	27.83	24.53	36.28	1.01
Potassium	K-series	8.72	7.69	9.32	2.78
Zinc	K-series	7.39	6.51	4.72	0.29
Sodium	K-series	4.04	3.56	7.34	3.20
Chlorine	K-series	0.52	0.46	0.62	0.07
Phosphorus	K-series	0.27	0.23	0.36	0.04
Magnesium	K-series	0.20	0.18	0.35	0.18
Iron	K-series	0.17	0.15	0.13	0.04
Silicon	K-series	0.11	0.10	0.17	0.04
Aluminium	K-series	0.06	0.05	0.09	0.07
Barium	L-series	0.03	0.02	0.01	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	7.48	6.60	19.55	12.13
	Sum:	113.47	100.00	100.00	

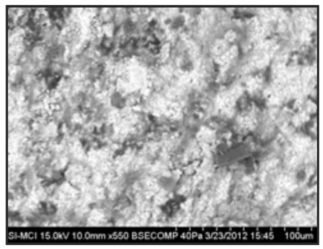


analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

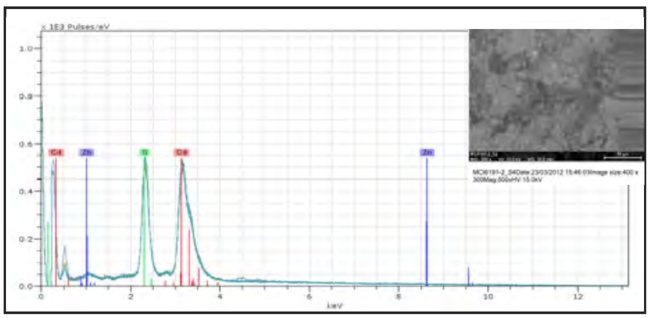
acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: medium orange

sample location: 4.5" from top,
13.0" from right (T 11.4 x R 33.0 cm.)

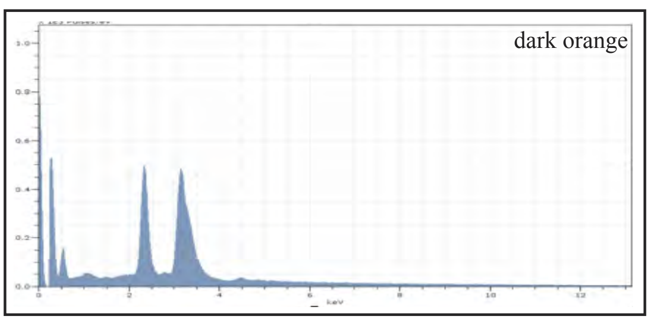
Representative Analysis Compilation—sample S04



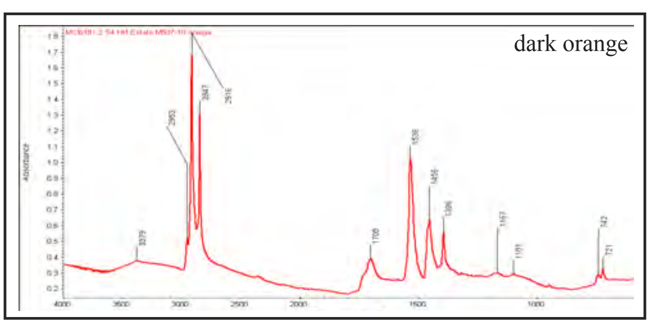
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, dark orange: Cd, S
interpretation: cadmium orange



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	38.77	42.69	15.41	5.69
Sulfur	K-series	13.88	15.28	19.33	0.52
Zinc	K-series	8.16	8.99	5.57	0.34
Potassium	K-series	5.45	6.00	6.22	2.14
Barium	L-series	5.03	5.54	1.64	0.51
Sodium	K-series	2.01	2.21	3.91	1.61
Magnesium	K-series	0.70	0.77	1.28	0.26
Phosphorus	K-series	0.11	0.12	0.15	0.03
Aluminium	K-series	0.08	0.08	0.13	0.08
Silicon	K-series	0.05	0.06	0.08	0.03
Calcium	K-series	0.03	0.03	0.03	0.04
Selenium	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	16.57	18.24	46.25	23.30
	Sum:	90.82	100.00	100.00	

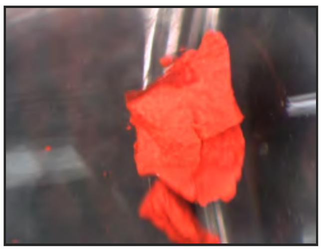


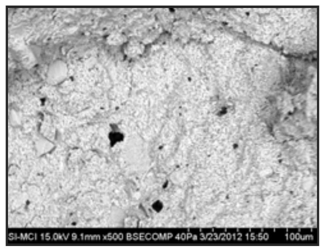
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: orange-red

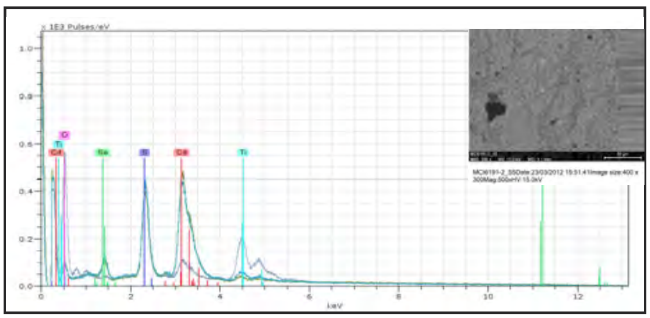
sample location: 1.3" from bottom,
12.0" from right (B 3.3 x R 30.5 cm.)

Representative Analysis Compilation—sample S05

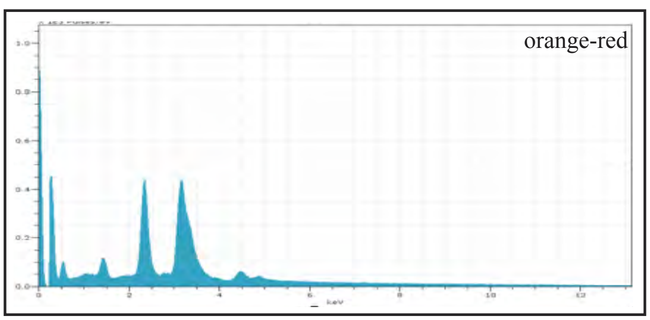




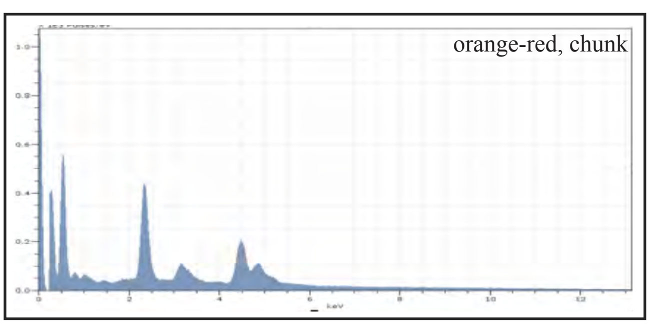
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.1 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.1 mm.
mag: 500x; HV: 15 kV
significant elements, orange-red: Cd, S, Se
interpretation: cadmium red



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	44.35	47.69	18.32	6.63
Sulfur	K-series	15.83	17.02	22.92	0.59
Potassium	K-series	5.74	6.17	6.81	2.42
Selenium	L-series	4.91	5.28	2.89	0.39
Titanium	K-series	2.90	3.12	2.82	0.41
Zinc	K-series	1.69	1.82	1.20	0.11
Barium	L-series	1.45	1.56	0.49	0.70
Sodium	K-series	0.48	0.52	0.98	0.41
Chlorine	K-series	0.45	0.48	0.59	0.06
Calcium	K-series	0.38	0.41	0.44	0.28
Phosphorus	K-series	0.25	0.27	0.38	0.04
Silicon	K-series	0.05	0.06	0.09	0.03
Aluminium	K-series	0.02	0.03	0.04	0.04
Magnesium	K-series	0.02	0.02	0.04	0.04
Oxygen	K-series	14.47	15.56	42.00	23.35
	Sum:	93.00	100.00	100.00	

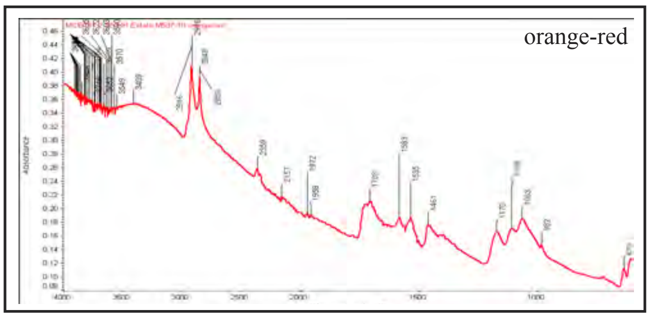


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	41.25	34.18	8.81	2.77
Sulfur	K-series	17.86	14.80	16.33	0.66
Zinc	K-series	13.01	10.78	5.84	0.50
Cadmium	L-series	9.30	7.71	2.43	2.29
Titanium	K-series	1.15	0.95	0.70	0.80
Potassium	K-series	0.92	0.76	0.69	0.64
Sodium	K-series	0.90	0.74	1.14	0.73
Chlorine	K-series	0.88	0.73	0.73	0.07
Phosphorus	K-series	0.69	0.57	0.65	0.06
Silicon	K-series	0.44	0.37	0.46	0.05
Selenium	L-series	0.30	0.25	0.11	0.06
Magnesium	K-series	0.16	0.13	0.20	0.13
Aluminium	K-series	0.12	0.10	0.13	0.11
Calcium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	33.71	27.93	61.78	26.25
	Sum:	120.69	100.00	100.00	

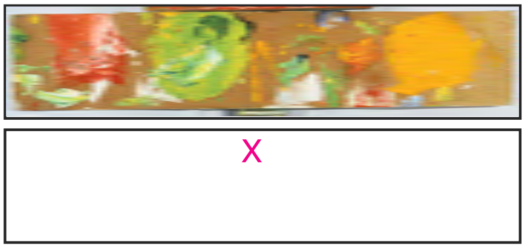
acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: orange-red

sample location: 1.3" from bottom,
12.0" from right (B 3.3 x R 30.5 cm.)

Representative Analysis Compilation—sample S05, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

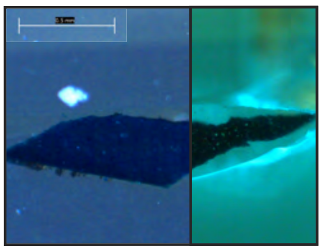


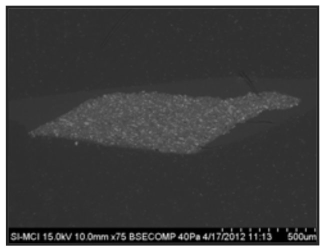
no image available

acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: dark green

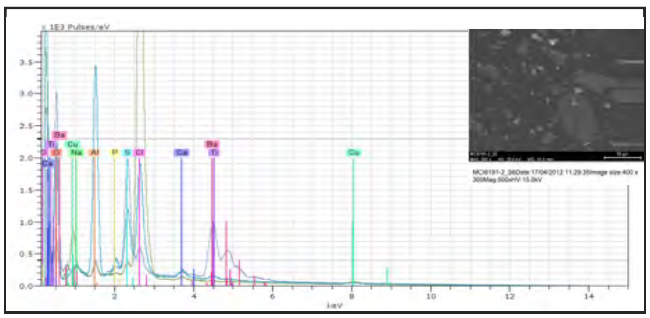
sample location: 1.3" from top,
20.0" from left (T 3.3 x L 50.8 cm.)

Representative Analysis Compilation—sample S06

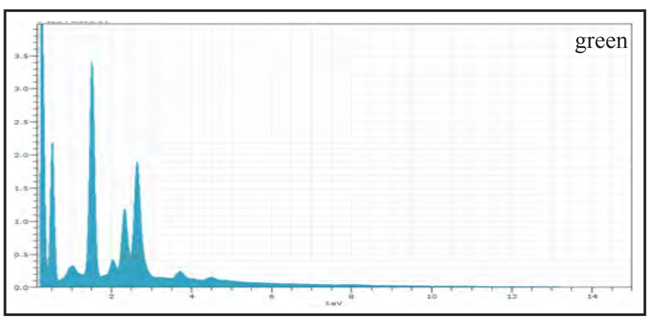




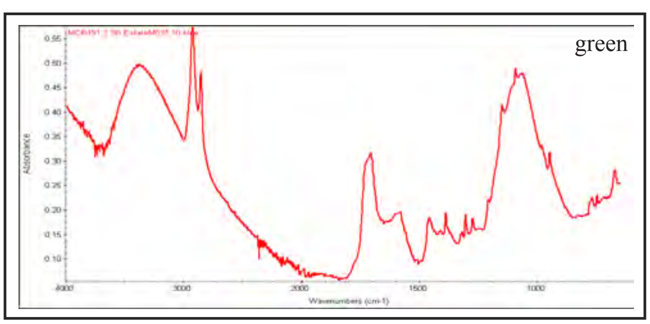
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



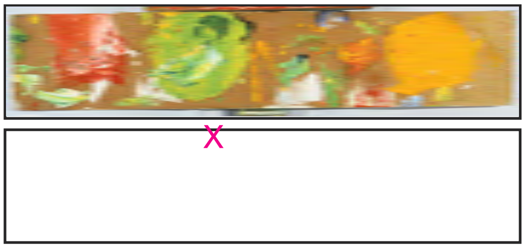
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cl, Cu
interpretation: phthalo green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	12.64	16.19	12.63	0.61
Chlorine	K-series	10.52	13.48	8.00	0.37
Sulfur	K-series	4.78	6.12	4.02	0.19
Copper	K-series	2.91	3.72	1.23	0.12
Barium	L-series	2.06	2.63	0.40	0.17
Phosphorus	K-series	1.08	1.38	0.94	0.07
Calcium	K-series	0.96	1.22	0.64	0.06
Sodium	K-series	0.86	1.10	1.01	0.70
Potassium	K-series	0.07	0.08	0.05	0.03
Titanium	K-series	0.03	0.04	0.02	0.05
Silicon	K-series	0.00	0.00	0.00	0.02
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	42.16	54.01	71.06	17.45
	Sum:	78.06	100.00	100.00	



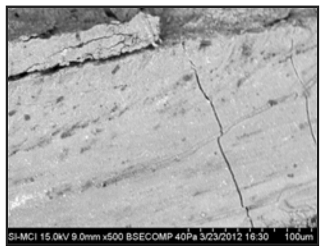
analysis: µFTIR
by: DVR (MCI)
date: 12/21/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7



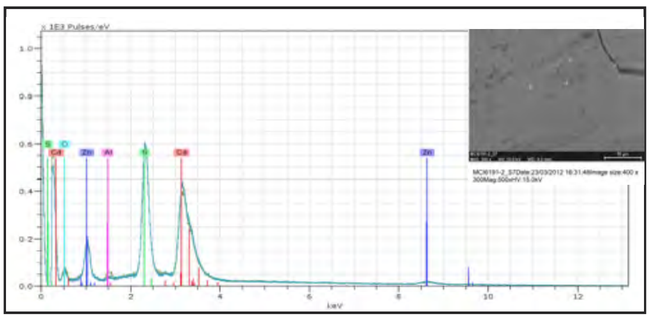
acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: bright green, mixed

sample location: 0.5" from top,
18.0" from left (T 1.3 x L 45.7 cm.)

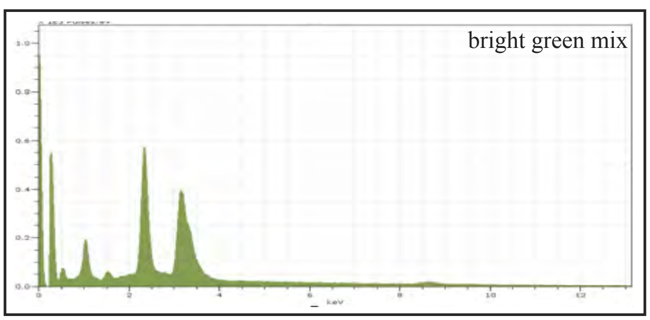
Representative Analysis Compilation—sample S07



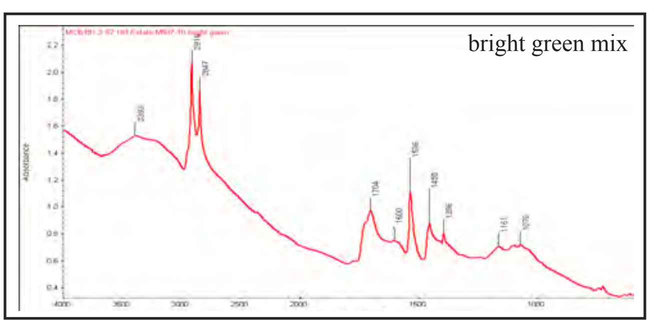
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.0 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.0 mm.
mag: 500x; HV: 15 kV
significant elements, bright green: Cd, S, Na, Zn
interpretation: cadmium green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	51.05	39.68	17.40	7.83
Sulfur	K-series	25.43	19.77	30.38	0.93
Zinc	K-series	24.03	18.68	14.08	0.88
Potassium	K-series	6.53	5.08	6.40	2.89
Sodium	K-series	5.77	4.48	9.61	4.56
Barium	L-series	4.48	3.48	1.25	0.49
Chlorine	K-series	1.98	1.54	2.14	0.12
Aluminium	K-series	1.22	0.95	1.74	0.96
Calcium	K-series	0.93	0.72	0.89	0.42
Phosphorus	K-series	0.68	0.53	0.84	0.06
Magnesium	K-series	0.25	0.19	0.39	0.17
Silicon	K-series	0.19	0.15	0.27	0.04
Selenium	L-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	6.10	4.74	14.61	9.87
	Sum:	128.64	100.00	100.00	

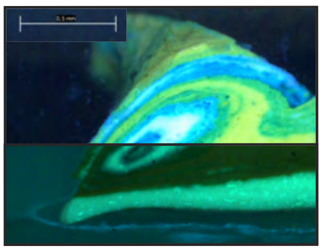


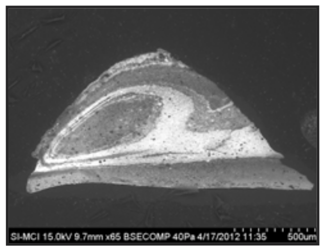
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium inteference

acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: mixing white

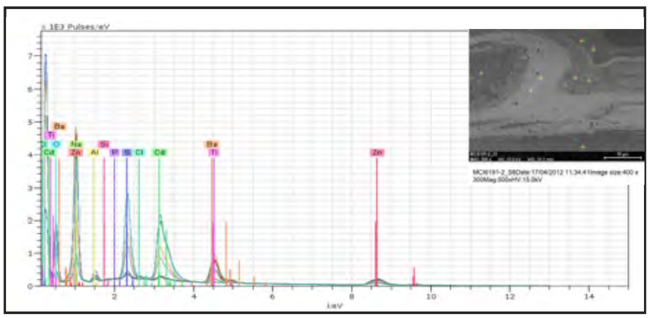
sample location: 2.0" from bottom, 12.0" from left (B 5.1 x L 30.5 cm.)

Representative Analysis Compilation—sample S08

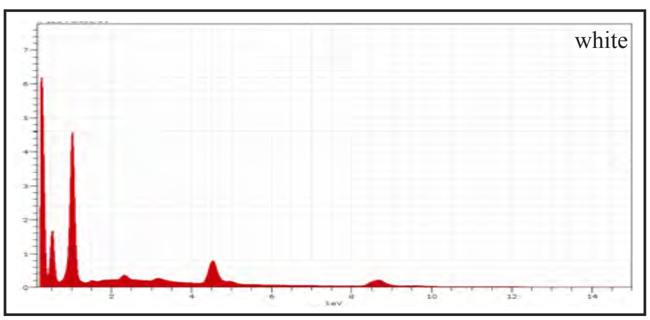




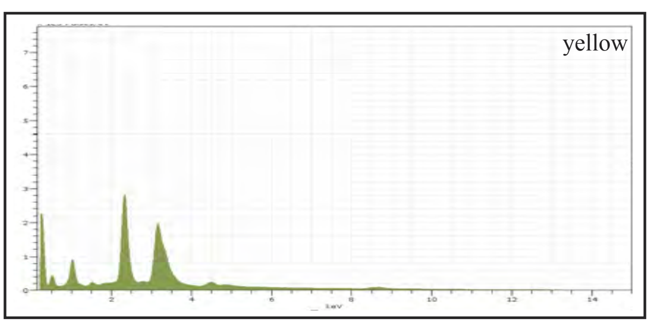
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.7 mm.



analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
significant elements, yellow: Cd, S
significant elements, blue: Na
significant elements, green: Cd, S, Na, Zn
interpretation: ultramarine blue, cadmium yellow, cadmium green, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	60.23	46.91	28.92	2.01
Sodium	K-series	18.03	14.04	24.62	14.21
Titanium	K-series	12.88	10.03	8.45	1.05
Barium	L-series	12.45	9.70	2.85	1.19
Cadmium	L-series	4.68	3.65	1.31	0.88
Sulfur	K-series	2.11	1.64	2.07	0.10
Chlorine	K-series	1.11	0.87	0.99	0.06
Phosphorus	K-series	0.76	0.59	0.77	0.05
Calcium	K-series	0.72	0.56	0.56	0.10
Silicon	K-series	0.35	0.27	0.39	0.04
Aluminium	K-series	0.33	0.26	0.39	0.28
Potassium	K-series	0.15	0.12	0.12	0.13
Magnesium	K-series	0.04	0.03	0.05	0.05
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	14.54	11.32	28.53	6.87
	Sum:	128.39	100.00	100.00	

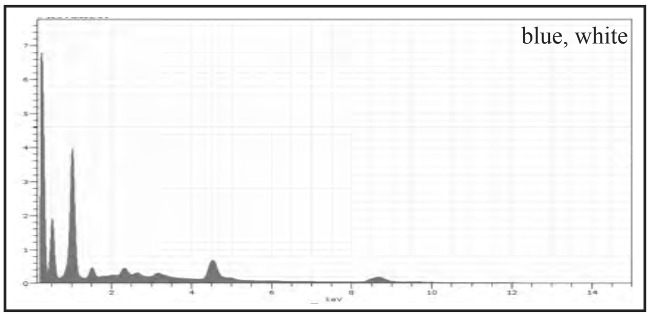


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	18.37	24.10	8.95	1.82
Zinc	K-series	17.21	22.57	14.41	0.60
Sulfur	K-series	14.13	18.52	24.11	0.52
Barium	L-series	6.90	9.05	2.75	0.49
Sodium	K-series	6.79	8.90	16.17	5.37
Potassium	K-series	4.47	5.86	6.26	0.61
Aluminium	K-series	0.60	0.79	1.22	0.48
Magnesium	K-series	0.36	0.47	0.81	0.11
Titanium	K-series	0.02	0.03	0.02	0.04
Silicon	K-series	0.02	0.02	0.03	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	7.39	9.69	25.28	6.36
	Sum:	76.25	100.00	100.00	

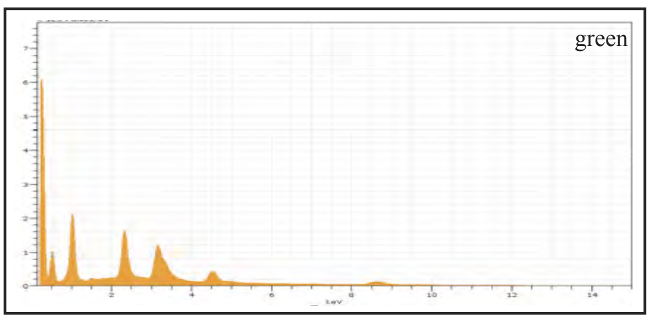
acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: mixing white

sample location: 2.0" from bottom, 12.0" from left (B 5.1 x L 30.5 cm.)

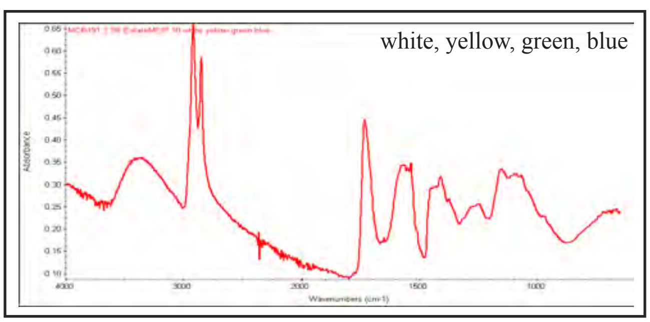
Representative Analysis Compilation—sample S08, continued



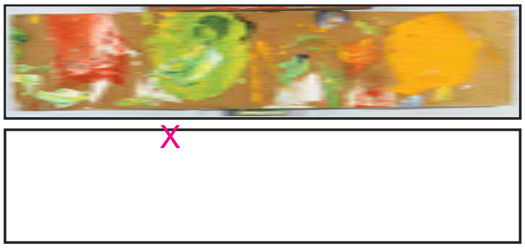
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	50.31	41.37	23.47	1.69
Sodium	K-series	17.65	14.51	23.41	13.91
Titanium	K-series	10.91	8.97	6.95	0.93
Barium	L-series	10.81	8.89	2.40	1.06
Cadmium	L-series	5.09	4.18	1.38	0.95
Sulfur	K-series	2.76	2.27	2.63	0.12
Aluminium	K-series	2.47	2.03	2.79	1.51
Chlorine	K-series	1.98	1.63	1.71	0.09
Phosphorus	K-series	0.78	0.64	0.77	0.06
Calcium	K-series	0.72	0.59	0.55	0.10
Potassium	K-series	0.33	0.27	0.26	0.25
Silicon	K-series	0.32	0.27	0.35	0.04
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	17.47	14.37	33.32	7.82
	Sum:	121.62	100.00	100.00	

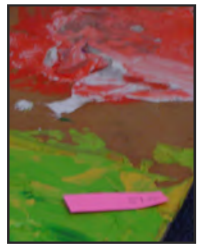


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	22.93	25.47	13.65	0.79
Cadmium	L-series	18.72	20.79	6.48	1.88
Sulfur	K-series	8.72	9.69	10.59	0.33
Sodium	K-series	8.32	9.24	14.09	6.57
Titanium	K-series	5.62	6.24	4.57	0.51
Barium	L-series	3.28	3.64	0.93	0.52
Potassium	K-series	2.43	2.70	2.42	0.69
Chlorine	K-series	0.58	0.64	0.64	0.05
Calcium	K-series	0.22	0.24	0.21	0.12
Aluminium	K-series	0.14	0.15	0.20	0.13
Phosphorus	K-series	0.09	0.09	0.11	0.03
Silicon	K-series	0.08	0.09	0.11	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	18.91	21.00	46.01	11.01
	Sum:	90.03	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 12/21/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

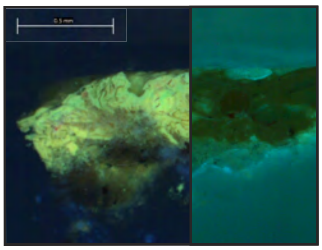


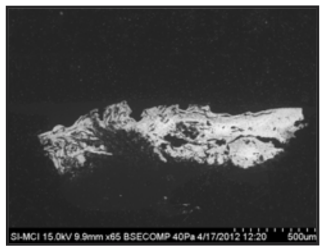


acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: ochre

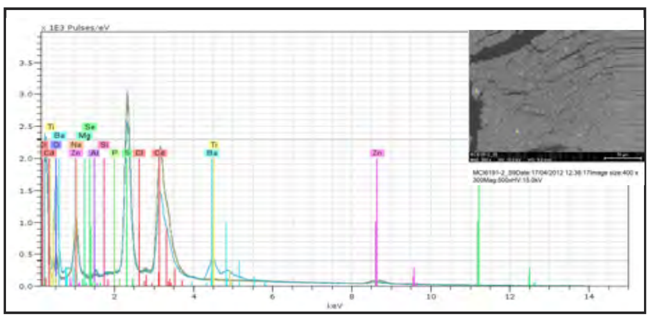
sample location: 0.5" from top,
12.5" from left (T 1.3 x L 31.8 cm.)

Representative Analysis Compilation—sample S09

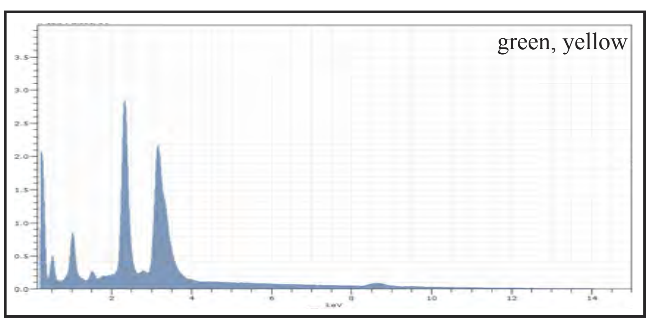




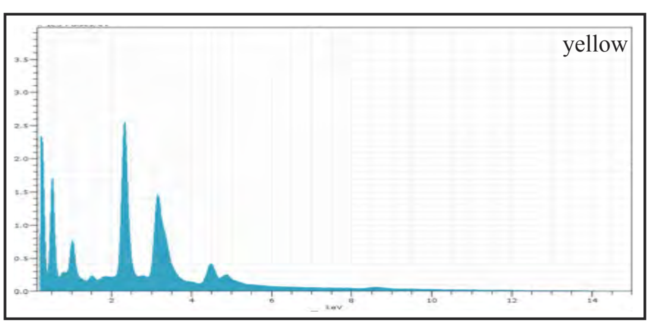
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.9 mm.



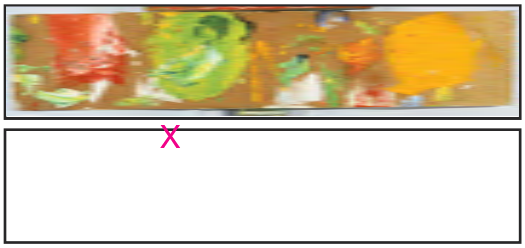
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.8 mm.
mag: 500x; HV: 15 kV
significant elements, green: Cd, S, Na, Zn
significant elements, yellow: Cd, S
significant elements, red: Cd, S
interpretation: cadmium green, cadmium yellow, cadmium red

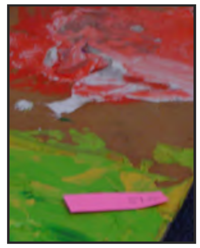


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	50.37	40.99	16.86	3.80
Sulfur	K-series	25.09	20.42	29.44	0.91
Zinc	K-series	20.61	16.77	11.86	0.71
Sodium	K-series	6.65	5.41	10.88	5.26
Potassium	K-series	6.55	5.33	6.30	1.26
Barium	L-series	1.81	1.47	0.50	0.17
Chlorine	K-series	0.99	0.81	1.05	0.07
Aluminium	K-series	0.96	0.78	1.33	0.75
Phosphorus	K-series	0.45	0.37	0.55	0.04
Calcium	K-series	0.35	0.28	0.33	0.21
Silicon	K-series	0.26	0.21	0.35	0.04
Magnesium	K-series	0.19	0.16	0.30	0.08
Selenium	L-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	8.61	7.00	20.24	7.07
	Sum:	122.89	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	22.93	25.47	13.65	0.79
Cadmium	L-series	28.22	26.71	8.72	2.55
Sulfur	K-series	19.02	18.00	20.60	0.70
Barium	L-series	15.32	14.50	3.87	1.02
Zinc	K-series	10.72	10.15	5.70	0.39
Potassium	K-series	3.63	3.43	3.22	0.88
Sodium	K-series	2.64	2.50	3.98	2.10
Titanium	K-series	0.72	0.69	0.53	0.32
Chlorine	K-series	0.59	0.56	0.58	0.05
Phosphorus	K-series	0.36	0.34	0.40	0.04
Aluminium	K-series	0.33	0.31	0.42	0.28
Silicon	K-series	0.25	0.24	0.31	0.04
Magnesium	K-series	0.20	0.19	0.28	0.08
Calcium	K-series	0.01	0.01	0.01	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	23.66	22.39	51.37	11.39
	Sum:	105.66	100.00	100.00	

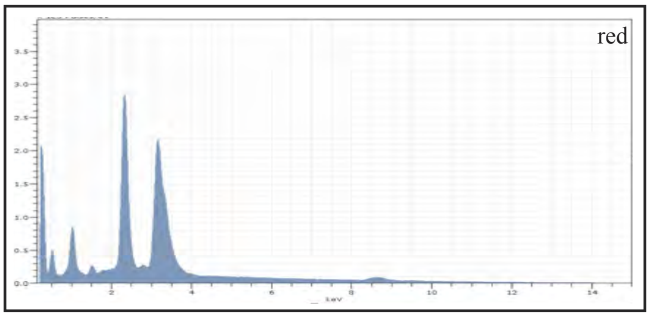




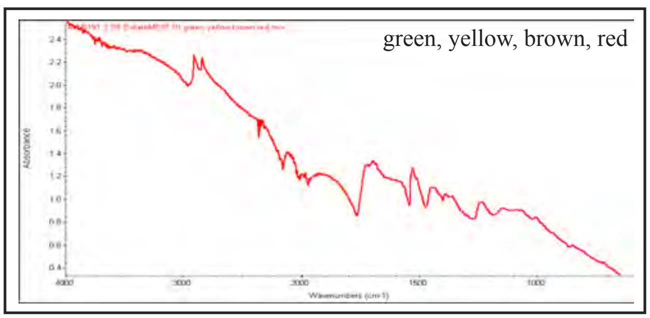
acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: ochre

sample location: 0.5" from top,
12.5" from left (T 1.3 x L 31.8 cm.)

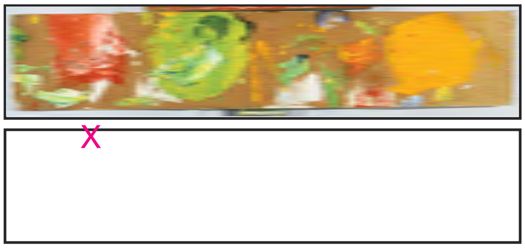
Representative Analysis Compilation—sample S09, continued

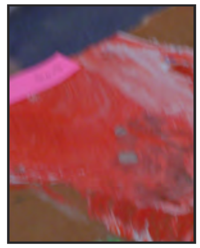


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	52.56	40.39	17.55	3.96
Sulfur	K-series	27.07	20.80	31.69	0.98
Zinc	K-series	24.75	19.02	14.21	0.85
Sodium	K-series	7.81	6.00	12.76	6.17
Potassium	K-series	6.67	5.13	6.41	1.33
Barium	L-series	2.83	2.18	0.77	0.24
Chlorine	K-series	0.97	0.75	1.03	0.07
Calcium	K-series	0.55	0.42	0.51	0.24
Phosphorus	K-series	0.43	0.33	0.52	0.04
Silicon	K-series	0.25	0.19	0.34	0.04
Magnesium	K-series	0.24	0.19	0.37	0.09
Aluminium	K-series	0.23	0.18	0.32	0.20
Selenium	L-series	0.00	0.00	0.00	0.02
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	5.76	4.43	13.52	5.55
	Sum:	130.12	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 12/21/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

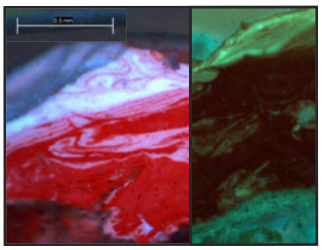


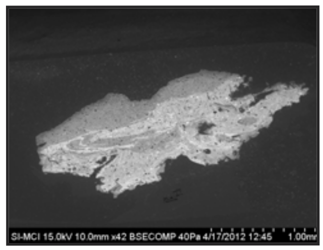


acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: warm red and white

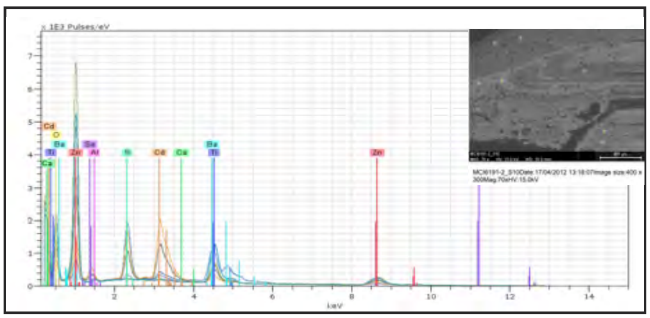
sample location: top edge,
6.5" from left (T 0.0 x L 16.5 cm.)

Representative Analysis Compilation—sample S10

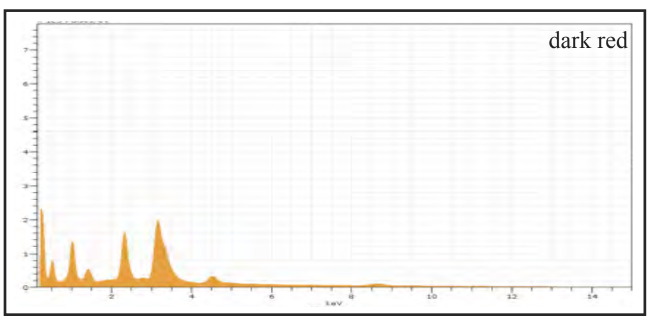




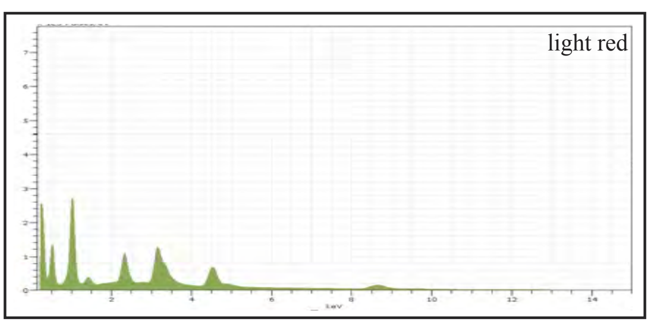
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 10.0 mm.



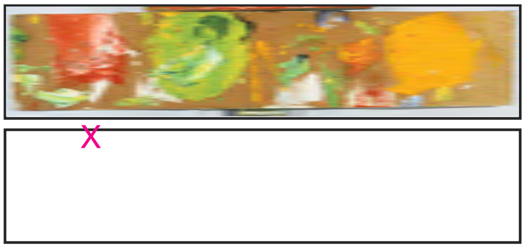
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 10.0 mm.
mag: 70x; HV: 15 kV
significant elements, red: Cd, S, Se
significant elements, white: Zn, Ti
interpretation: cadmium red, Zn/Ti white

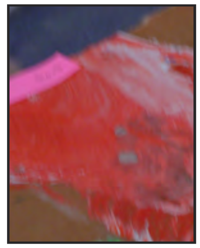


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	27.75	28.31	11.56	2.42
Zinc	K-series	25.81	26.34	18.49	0.88
Barium	L-series	9.00	9.19	3.07	0.68
Sulfur	K-series	8.35	8.52	12.19	0.32
Sodium	K-series	5.74	5.86	11.69	4.54
Potassium	K-series	5.07	5.18	6.08	0.83
Selenium	L-series	2.39	2.44	1.42	0.19
Titanium	K-series	1.95	1.98	1.90	0.33
Aluminium	K-series	0.66	0.68	1.15	0.53
Calcium	K-series	0.20	0.20	0.23	0.16
Phosphorus	K-series	0.12	0.12	0.18	0.03
Silicon	K-series	0.06	0.06	0.09	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Chlorine	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	10.91	11.13	31.93	7.31
	Sum:	98.01	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	55.61	33.89	25.39	1.86
Cadmium	L-series	33.23	20.25	8.83	3.04
Barium	L-series	22.51	13.72	4.89	1.63
Sodium	K-series	10.73	6.54	13.93	8.47
Titanium	K-series	9.82	5.99	6.12	1.10
Sulfur	K-series	9.62	5.86	8.96	0.37
Potassium	K-series	3.55	2.17	2.71	1.13
Selenium	L-series	1.55	0.94	0.58	0.15
Calcium	K-series	1.31	0.80	0.98	0.21
Chlorine	K-series	1.14	0.69	0.96	0.07
Phosphorus	K-series	0.76	0.47	0.74	0.06
Aluminium	K-series	0.69	0.42	0.77	0.55
Silicon	K-series	0.21	0.13	0.22	0.04
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	13.35	8.14	24.92	6.83
	Sum:	164.08	100.00	100.00	

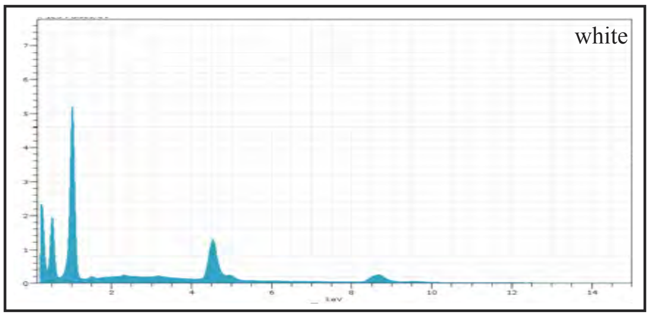




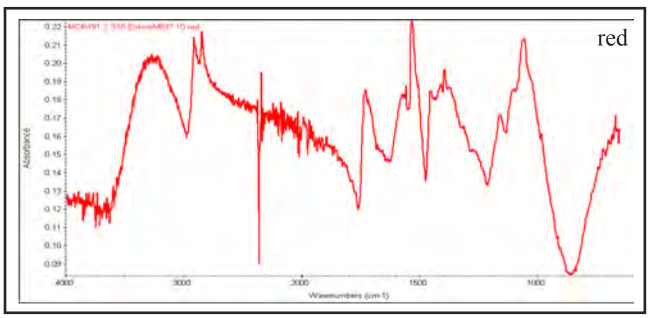
acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: warm red and white

sample location: top edge,
6.5" from left (T 0.0 x L 16.5 cm.)

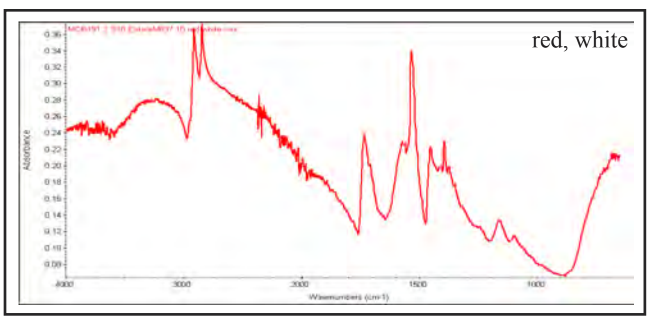
Representative Analysis Compilation—sample S10, continued



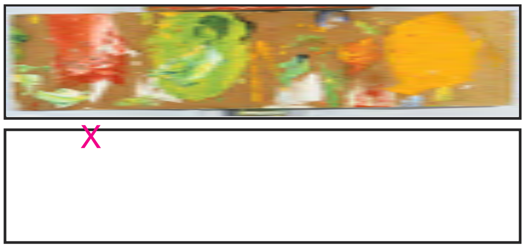
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	45.88	42.40	22.25	1.54
Titanium	K-series	20.38	18.83	13.50	0.84
Sodium	K-series	18.27	16.88	25.20	14.40
Cadmium	L-series	2.03	1.88	0.57	0.52
Sulfur	K-series	0.97	0.90	0.96	0.06
Barium	L-series	0.83	0.76	0.19	0.43
Chlorine	K-series	0.71	0.66	0.64	0.05
Phosphorus	K-series	0.61	0.56	0.62	0.05
Aluminium	K-series	0.44	0.40	0.51	0.36
Silicon	K-series	0.24	0.22	0.27	0.04
Potassium	K-series	0.06	0.05	0.05	0.06
Calcium	K-series	0.04	0.04	0.03	0.04
Selenium	L-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	17.77	16.42	35.22	7.85
	Sum:	108.23	100.00	100.00	

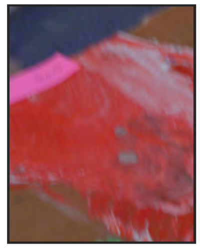


analysis: µFTIR
by: DVR (MCI)
date: 12/21/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



analysis: µFTIR
by: DVR (MCI)
date: 12/21/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

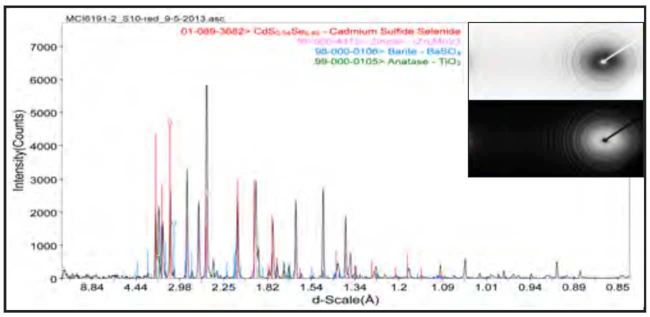




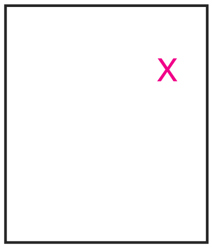
acc. no.: Estate M537-10
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 41.0 x 8.0" (104.1 x 20.3 cm.)
notes: warm red and white

sample location: top edge,
6.5" from left (T 0.0 x L 16.5 cm.)

Representative Analysis Compilation—sample S10, continued



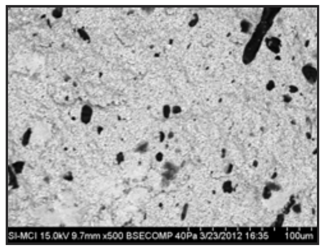
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, oscillate 0-80º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, zincite, barite, anatase titanium
interpretation: cadmium red



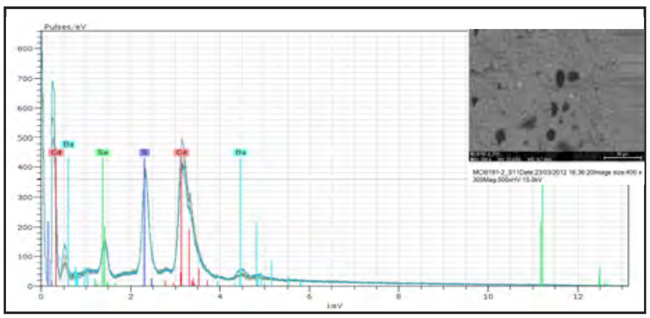
acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: medium red

sample location: 2.0" from top,
1.5" from right (T 5.1 x R 3.8 cm.)

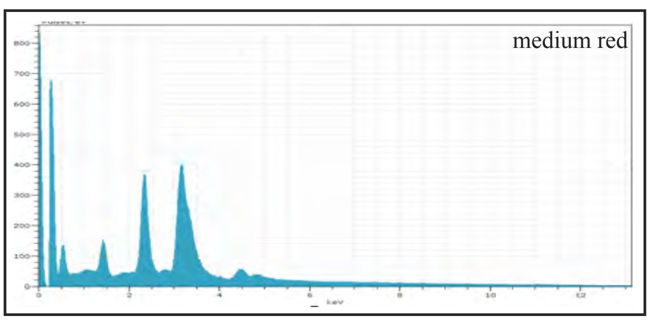
Representative Analysis Compilation—sample S11



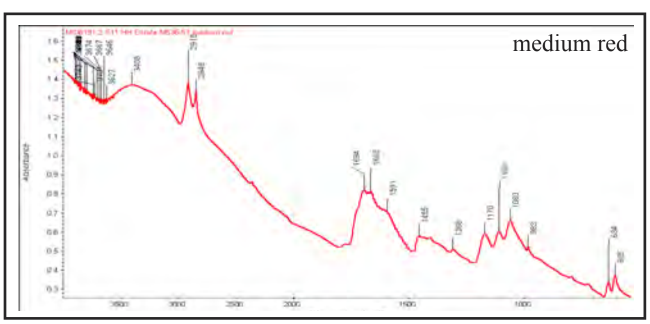
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



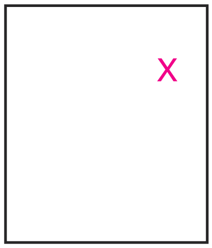
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, medium red: Cd, S, Se, Ba
interpretation: cadmium red mixed with barium sulfate



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	41.73	40.67	17.11	6.44
Sulfur	K-series	14.05	13.69	20.20	0.53
Barium	L-series	10.89	10.61	3.65	0.89
Selenium	L-series	7.83	7.63	4.57	0.62
Zinc	K-series	6.87	6.70	4.84	0.30
Potassium	K-series	5.25	5.11	6.18	2.37
Sodium	K-series	0.55	0.54	1.10	0.46
Chlorine	K-series	0.46	0.45	0.60	0.06
Phosphorus	K-series	0.33	0.33	0.50	0.04
Aluminium	K-series	0.26	0.25	0.45	0.22
Magnesium	K-series	0.18	0.18	0.34	0.16
Calcium	K-series	0.15	0.14	0.17	0.12
Silicon	K-series	0.12	0.12	0.19	0.04
Titanium	K-series	0.03	0.03	0.03	0.05
Oxygen	K-series	13.90	13.55	40.05	20.58
	Sum:	102.61	100.00	100.00	



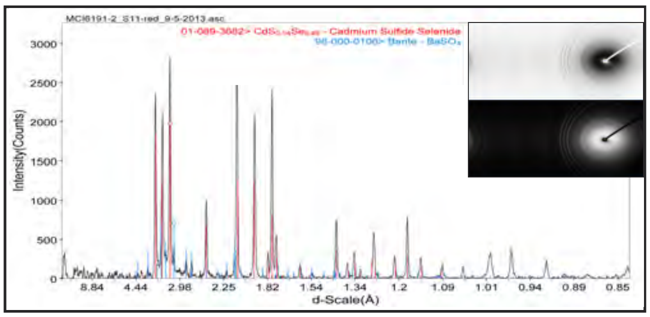
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



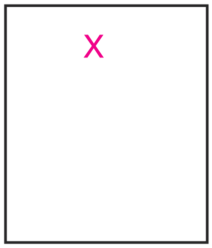
acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: medium red

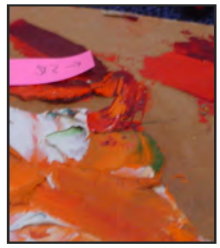
sample location: 2.0" from top,
1.5" from right (T 5.1 x R 3.8 cm.)

Representative Analysis Compilation—sample S11, continued



analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, spin 360º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: cadmium sulfide selenide, barite
interpretation: cadmium red

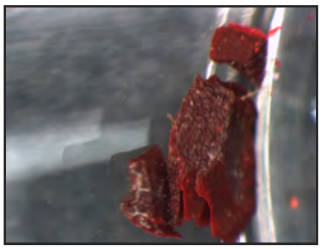
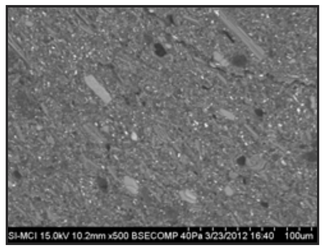





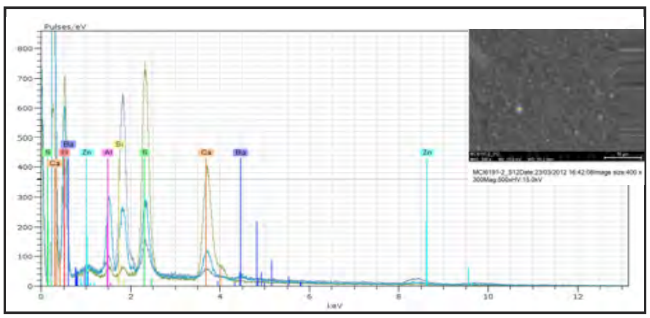
acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: dark red

sample location: 1.8" from top,
3.0" from left (T 4.6 x L 7.6 cm.)

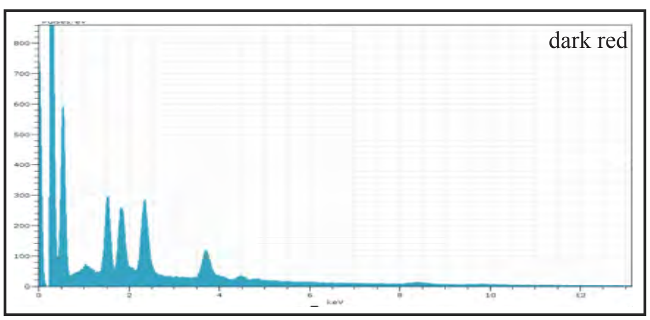
Representative Analysis Compilation—sample S12

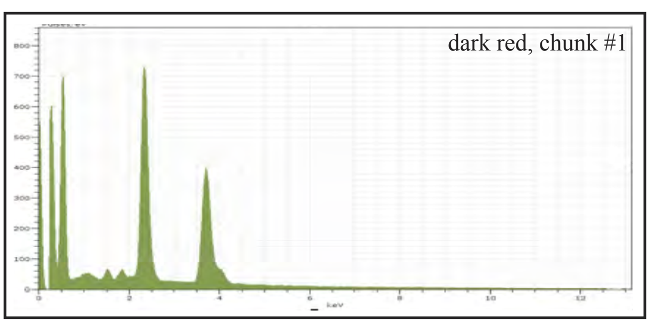
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.2 mm.



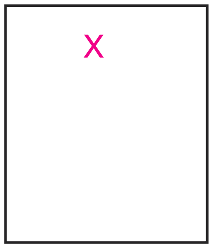
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.2 mm.
mag: 500x; HV: 15 kV
significant elements, dark red: Ca, Al
interpretation: synthetic color

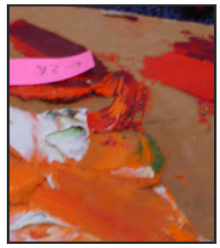


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	8.31	11.82	3.93	0.34
Calcium	K-series	4.05	5.76	3.12	0.26
Aluminium	K-series	4.03	5.73	4.61	2.68
Silicon	K-series	3.82	5.44	4.20	0.19
Sulfur	K-series	3.48	4.95	3.35	0.15
Barium	L-series	2.77	3.94	0.62	0.30
Copper	K-series	2.32	3.29	1.12	0.13
Sodium	K-series	0.84	1.20	1.13	0.69
Phosphorus	K-series	0.49	0.70	0.49	0.05
Magnesium	K-series	0.09	0.12	0.11	0.08
Cadmium	L-series	0.05	0.08	0.02	0.04
Titanium	K-series	0.00	0.00	0.00	0.03
Chlorine	K-series	0.00	0.00	0.00	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	40.05	56.96	77.29	29.05
	Sum:	70.32	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	18.19	21.10	11.19	0.58
Sulfur	K-series	16.27	18.86	12.50	0.60
Zinc	K-series	1.89	2.20	0.71	0.12
Sodium	K-series	0.44	0.51	0.47	0.37
Silicon	K-series	0.42	0.49	0.37	0.05
Aluminium	K-series	0.41	0.48	0.38	0.05
Barium	L-series	0.32	0.37	0.06	0.10
Magnesium	K-series	0.08	0.10	0.09	0.03
Phosphorus	K-series	0.02	0.02	0.02	0.03
Potassium	K-series	0.01	0.01	0.01	0.03
Chlorine	K-series	0.01	0.01	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	48.19	55.87	74.22	32.31
	Sum:	86.25	100.00	100.00	

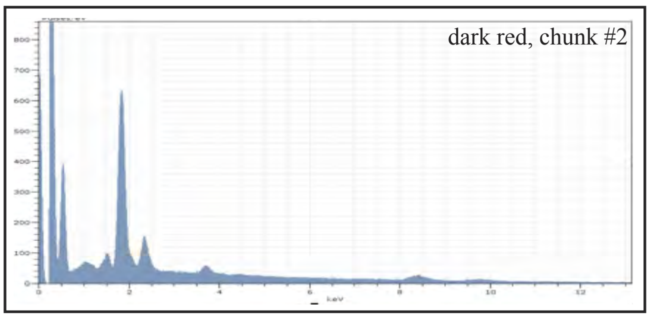




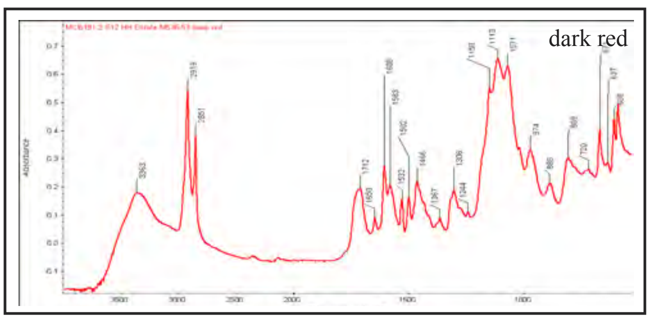
acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: dark red

sample location: 1.8" from top,
3.0" from left (T 4.6 x L 7.6 cm.)

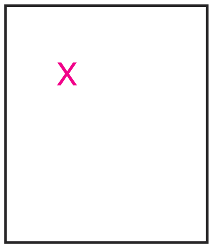
Representative Analysis Compilation—sample S12, continued

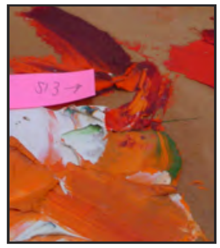


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	22.28	30.05	13.08	0.80
Silicon	K-series	10.38	14.00	14.19	0.46
Copper	K-series	6.24	8.41	3.77	0.25
Barium	L-series	3.08	4.15	0.86	0.33
Sulfur	K-series	2.65	3.58	3.18	0.12
Phosphorus	K-series	2.20	2.97	2.73	0.11
Calcium	K-series	1.41	1.91	1.35	0.08
Sodium	K-series	0.56	0.75	0.93	0.46
Aluminium	K-series	0.44	0.60	0.63	0.05
Chlorine	K-series	0.18	0.25	0.20	0.03
Potassium	K-series	0.13	0.18	0.13	0.04
Magnesium	K-series	0.05	0.07	0.08	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	24.54	33.10	58.89	21.47
	Sum:	74.13	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR81

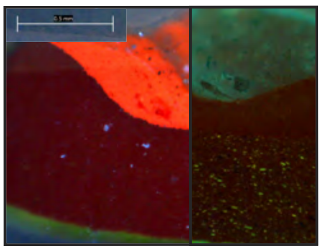


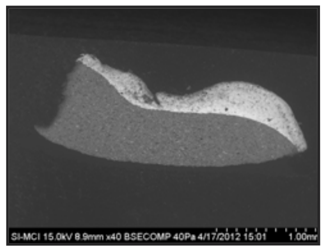


acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: orange from red mix

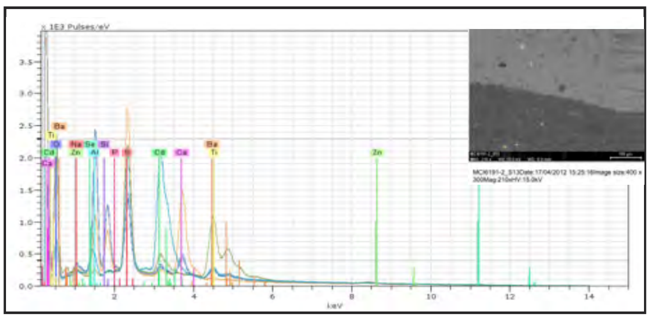
sample location: 2.5" from top,
2.0" from left (T 6.4 x L 5.1 cm.)

Representative Analysis Compilation—sample S13

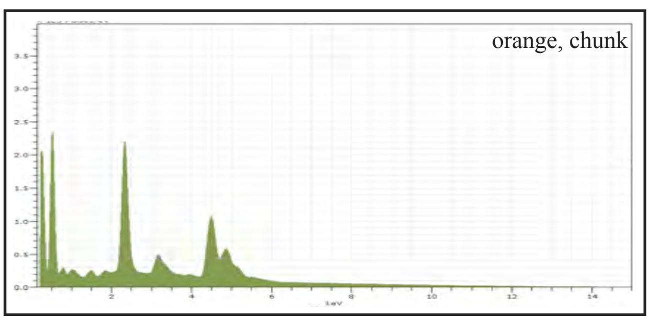




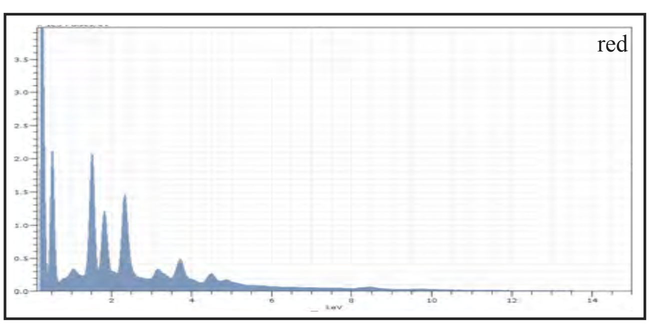
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 8.9 mm.



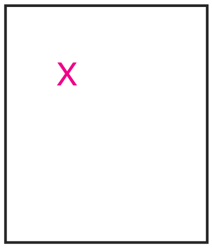
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 8.9 mm.
mag: 210x; HV: 15 kV
significant elements, orange: Cd, S
significant elements, red: Ca, Al
interpretation: cadmium orange, synthetic color

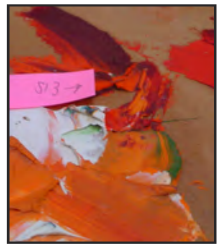


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	29.98	32.00	7.10	1.92
Sulfur	K-series	14.05	15.00	14.26	0.52
Cadmium	L-series	5.36	5.72	1.55	0.89
Zinc	K-series	4.55	4.85	2.26	0.18
Titanium	K-series	2.34	2.50	1.59	0.46
Sodium	K-series	0.64	0.68	0.90	0.53
Aluminium	K-series	0.58	0.62	0.70	0.47
Potassium	K-series	0.57	0.61	0.47	0.31
Chlorine	K-series	0.54	0.57	0.49	0.05
Phosphorus	K-series	0.42	0.45	0.44	0.04
Silicon	K-series	0.34	0.37	0.40	0.04
Calcium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	34.34	36.64	69.82	14.57
	Sum:	93.71	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	9.29	13.61	4.94	0.34
Aluminium	K-series	6.27	9.18	8.07	1.71
Barium	L-series	5.76	8.44	1.46	0.41
Sulfur	K-series	4.58	6.71	4.96	0.19
Silicon	K-series	3.45	5.05	4.26	0.17
Calcium	K-series	2.89	4.24	2.51	0.14
Cadmium	L-series	1.66	2.43	0.51	0.43
Sodium	K-series	0.80	1.18	1.21	0.66
Potassium	K-series	0.33	0.48	0.29	0.18
Phosphorus	K-series	0.25	0.36	0.28	0.03
Titanium	K-series	0.06	0.09	0.05	0.07
Magnesium	K-series	0.01	0.01	0.01	0.03
Chlorine	K-series	0.00	0.00	0.00	0.02
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	32.92	48.22	71.46	14.18
	Sum:	68.26	100.00	100.00	

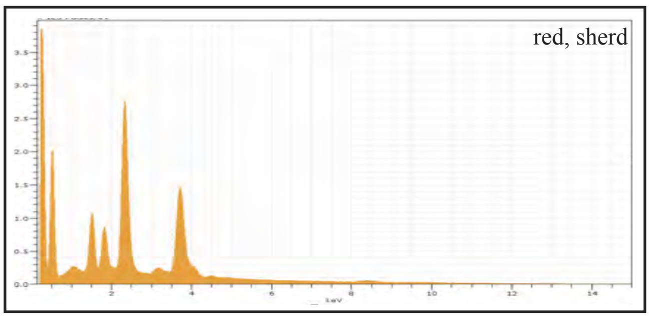




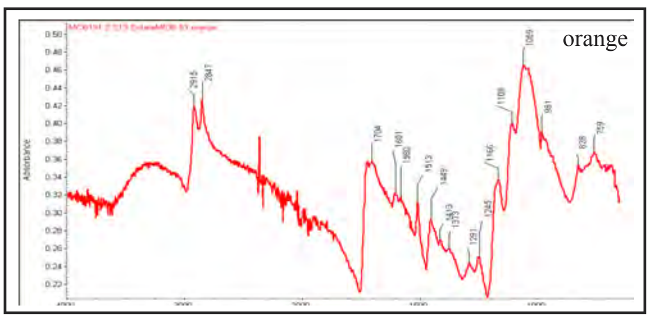
acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: orange from red mix

sample location: 2.5" from top,
2.0" from left (T 6.4 x L 5.1 cm.)

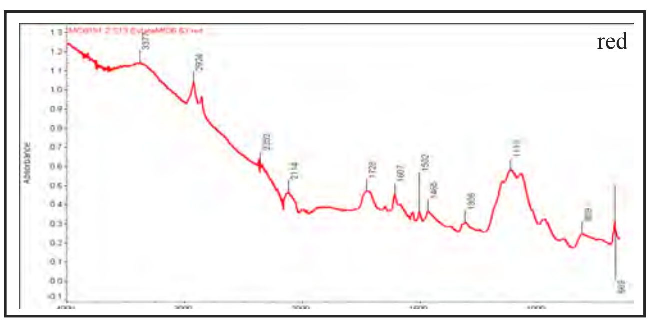
Representative Analysis Compilation—sample S13, continued



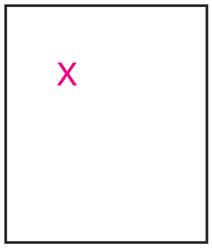
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	12.98	16.60	9.85	0.45
Sulfur	K-series	11.54	14.76	10.94	0.43
Zinc	K-series	6.69	8.55	3.11	0.25
Aluminium	K-series	3.58	4.58	4.03	1.39
Silicon	K-series	2.70	3.45	2.92	0.14
Copper	K-series	1.82	2.33	0.87	0.09
Barium	L-series	1.66	2.12	0.37	0.15
Cadmium	L-series	1.19	1.52	0.32	0.32
Sodium	K-series	0.75	0.96	0.99	0.61
Phosphorus	K-series	0.32	0.41	0.32	0.04
Potassium	K-series	0.13	0.17	0.10	0.11
Magnesium	K-series	0.07	0.09	0.09	0.05
Chlorine	K-series	0.01	0.01	0.01	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	34.76	44.45	66.07	15.09
	Sum:	78.21	100.00	100.00	

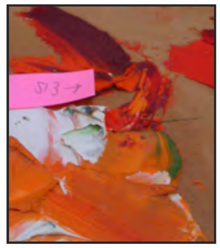


analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR81

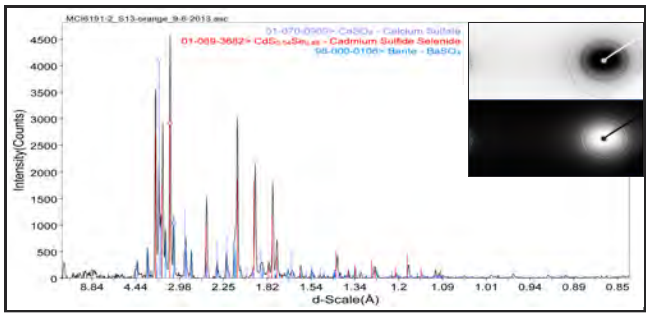





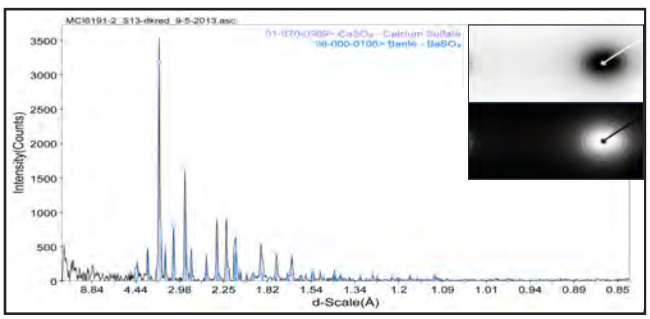
acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: orange from red mix

sample location: 2.5" from top,
2.0" from left (T 6.4 x L 5.1 cm.)

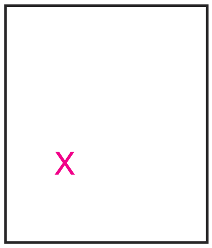
Representative Analysis Compilation—sample S13, continued



analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: fixed at 0º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: calcium sulfate, cadmium sulfide selenide, barite
note: a polymorph match to other cadmium red pigments



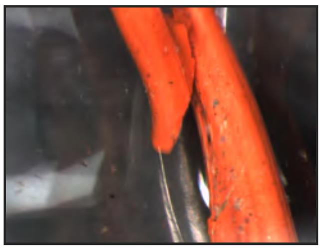
analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, spin 360º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: calcium sulfate, barite
interpretation: inconclusive

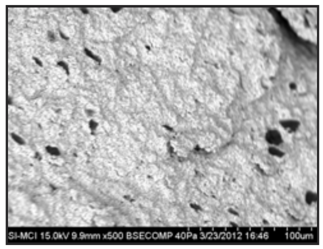


acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: orange from white mix

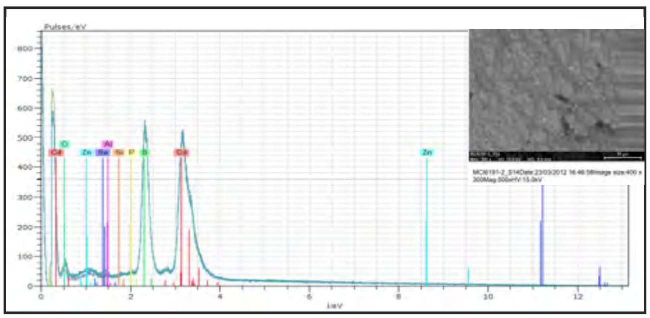
sample location: 3.0" from bottom,
2.0" from right (B 7.6 x L 5.1 cm.)

Representative Analysis Compilation—sample S14

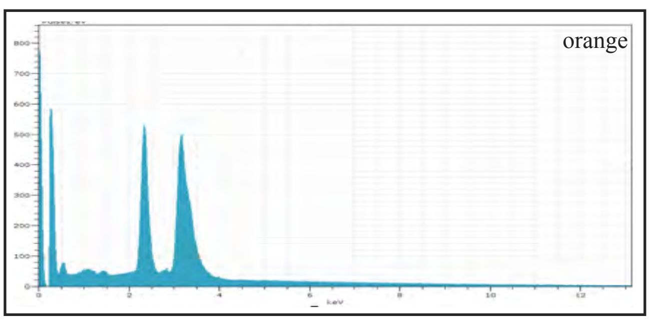




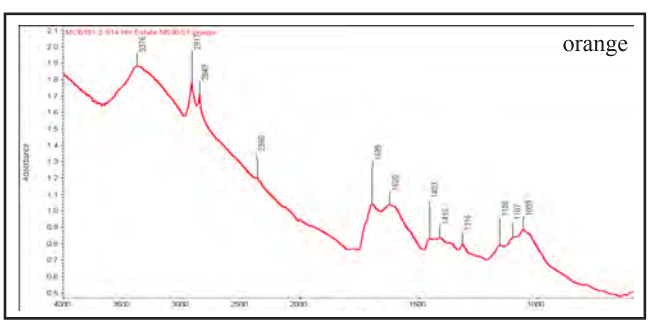
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



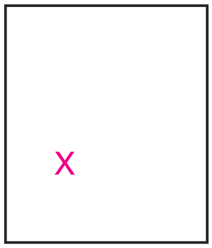
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
interpretation: cadmium orange



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	49.75	53.56	21.75	7.02
Sulfur	K-series	19.67	21.17	30.13	0.72
Potassium	K-series	6.19	6.66	7.78	2.58
Zinc	K-series	3.13	3.37	2.35	0.17
Selenium	L-series	1.02	1.10	0.64	0.11
Magnesium	K-series	0.72	0.77	1.45	0.28
Sodium	K-series	0.56	0.61	1.20	0.47
Barium	L-series	0.27	0.29	0.10	0.11
Phosphorus	K-series	0.25	0.27	0.40	0.04
Chlorine	K-series	0.22	0.24	0.31	0.05
Silicon	K-series	0.09	0.09	0.15	0.03
Aluminium	K-series	0.06	0.07	0.11	0.07
Calcium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	10.95	11.79	33.63	17.72
	Sum:	92.89	100.00	100.00	



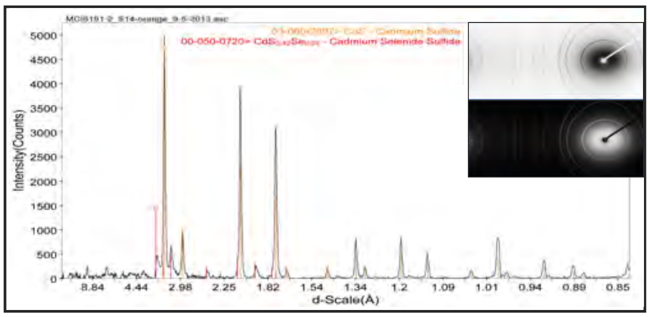
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: cadmium interference

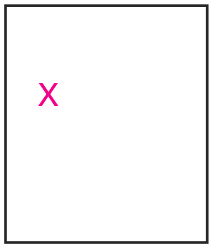
acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: orange from white mix

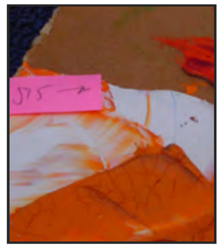
sample location: 3.0" from bottom,
2.0" from right (B 7.6 x L 5.1 cm.)

Representative Analysis Compilation—sample S14, continued



analysis: XRD
by: NL (MCI)
date: 09/05/13
power: 50 kV; 40 mA; 2.00 kW
chi: fixed at 45º; phi: speed 1º/sec, spin 360º;
omega: fixed at 0º; collimator: 0.8 mm
significant compounds: calcium sulfide,
cadmium selenide sulfide
interpretation: cadmium orange

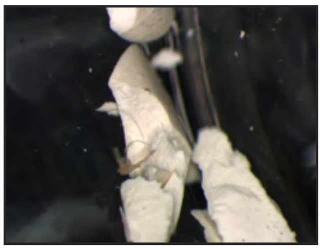


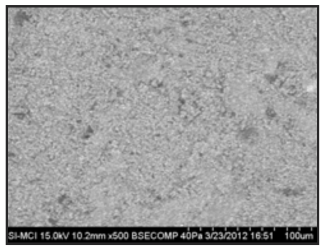


acc. no.: Estate M536-53
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.5 x 8.0" (16.5 x 20.3 cm.)
notes: mixing white

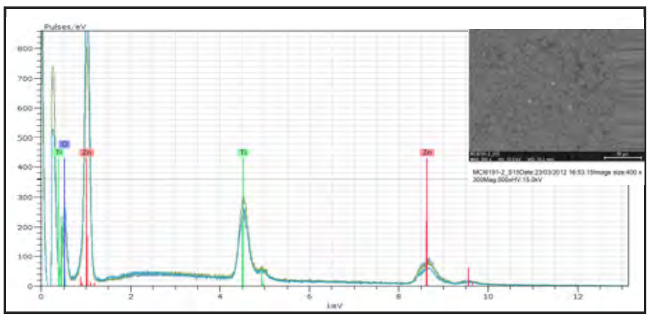
sample location: 3.3" from top,
1.7" from left (T 8.4 x L 4.3 cm.)

Representative Analysis Compilation—sample S15

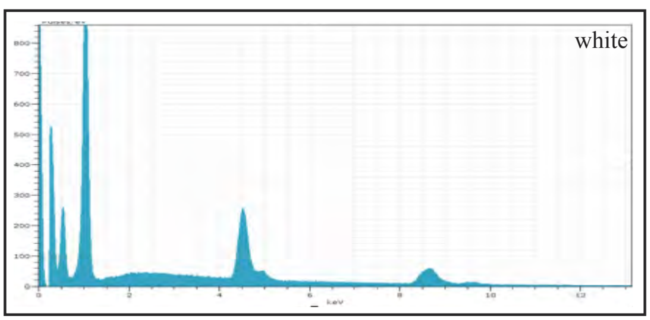




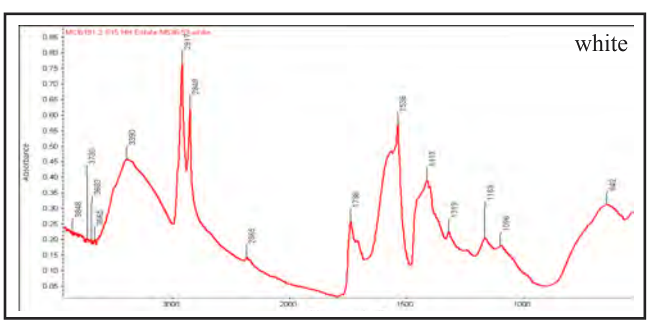
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.2 mm.



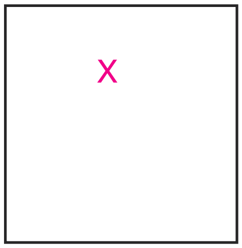
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.2 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white

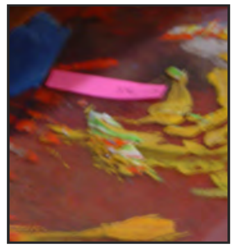


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	49.82	48.82	27.68	1.70
Sodium	K-series	19.48	19.09	30.79	15.36
Titanium	K-series	17.41	17.06	13.21	1.31
Barium	L-series	2.33	2.28	0.62	1.16
Phosphorus	K-series	0.46	0.45	0.54	0.05
Chlorine	K-series	0.34	0.33	0.35	0.04
Sulfur	K-series	0.26	0.26	0.30	0.04
Potassium	K-series	0.19	0.19	0.18	0.04
Aluminium	K-series	0.18	0.17	0.24	0.04
Silicon	K-series	0.12	0.12	0.16	0.03
Calcium	K-series	0.05	0.05	0.05	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	11.40	11.17	25.89	11.65
	Sum:	102.05	100.00	100.00	



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

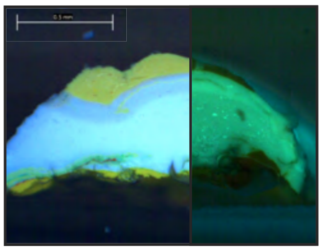


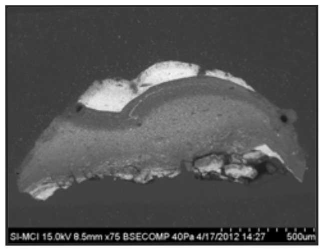


acc. no.: Estate (no number)
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on glass
meas.: 24.0 x 24.0" (61.0 x 61.0 cm.)
notes: bright yellow

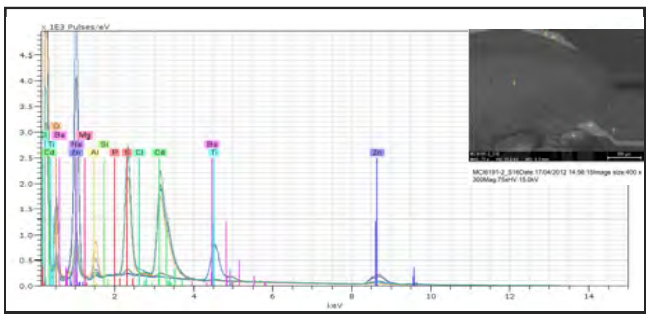
sample location: 8.0" from top,
10.7" from left (T 6.4 x L 3.1 cm.)

Representative Analysis Compilation—sample S16

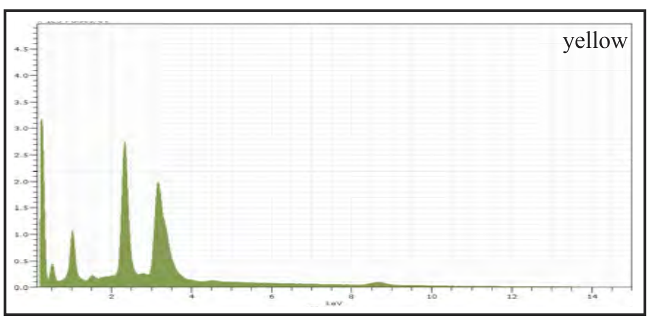




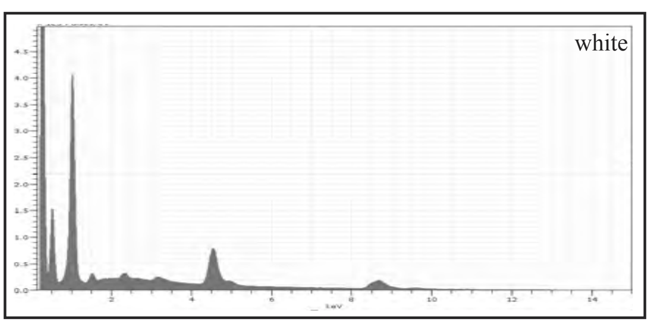
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 8.5 mm.



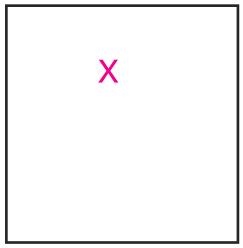
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 8.5 mm.
mag: 75x; HV: 15 kV
significant elements, yellow: Cd, S
significant elements, white: Zn, Ti
interpretation: cadmium yellow, Zn/Ti white

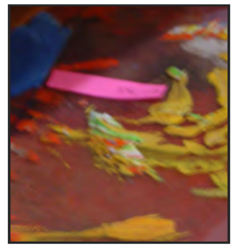


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	41.50	37.84	14.78	3.48
Sulfur	K-series	22.41	20.43	27.98	0.82
Zinc	K-series	17.91	16.33	10.97	0.62
Sodium	K-series	7.79	7.10	13.56	6.15
Potassium	K-series	7.17	6.54	7.34	1.11
Barium	L-series	1.52	1.39	0.44	0.15
Chlorine	K-series	1.14	1.04	1.29	0.07
Aluminium	K-series	0.63	0.57	0.93	0.50
Calcium	K-series	0.38	0.34	0.38	0.20
Phosphorus	K-series	0.34	0.31	0.44	0.04
Magnesium	K-series	0.30	0.27	0.49	0.10
Silicon	K-series	0.13	0.12	0.19	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	8.47	7.72	21.19	7.37
	Sum:	109.68	100.00	100.00	



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	40.56	41.23	21.62	1.36
Sodium	K-series	17.53	17.82	26.57	13.82
Titanium	K-series	12.06	12.26	8.78	0.76
Barium	L-series	5.29	5.38	1.34	0.79
Cadmium	L-series	2.33	2.37	0.72	0.58
Aluminium	K-series	1.15	1.17	1.48	0.90
Sulfur	K-series	1.09	1.11	1.19	0.06
Chlorine	K-series	0.61	0.62	0.60	0.05
Phosphorus	K-series	0.32	0.32	0.36	0.04
Calcium	K-series	0.18	0.18	0.16	0.06
Potassium	K-series	0.16	0.16	0.14	0.13
Magnesium	K-series	0.15	0.15	0.21	0.08
Silicon	K-series	0.10	0.10	0.12	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Oxygen	K-series	16.85	17.13	36.71	8.25
	Sum:	98.37	100.00	100.00	

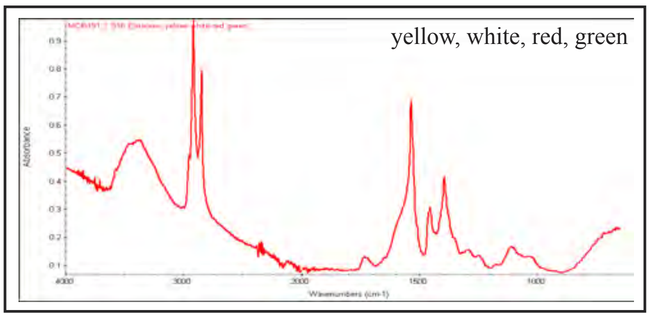




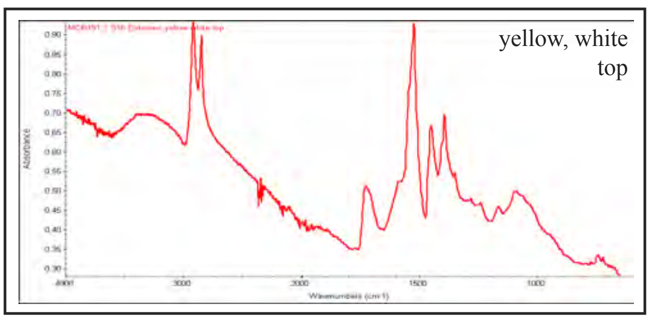
acc. no.: Estate (no number)
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on glass
meas.: 24.0 x 24.0" (61.0 x 61.0 cm.)
notes: bright yellow

sample location: 8.0" from top,
10.7" from left (T 6.4 x L 3.1 cm.)

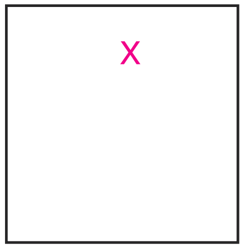
Representative Analysis Compilation—sample S16, continued

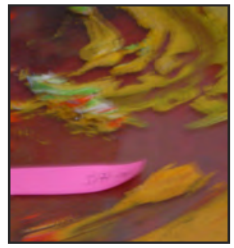


analysis: µFTIR
by: DVR (MCI)
date: 12/21/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil



analysis: µFTIR
by: DVR (MCI)
date: 12/21/12
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

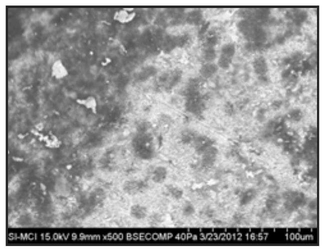




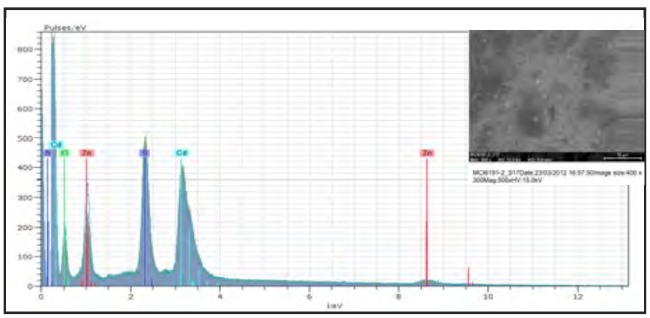
acc. no.: Estate (no number)
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on glass
meas.: 24.0 x 24.0" (61.0 x 61.0 cm.)
notes: bright ochre

sample location: 5.3" from top,
14.0" from left (T 13.5 x L 35.6 cm.)

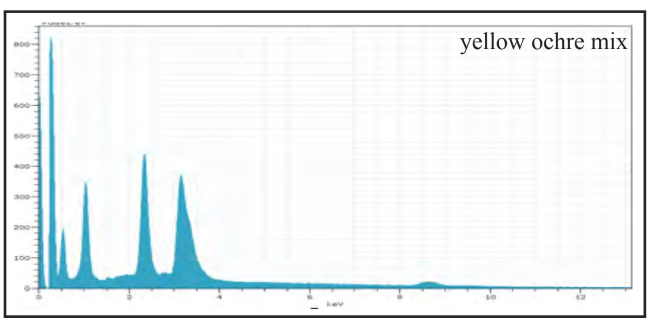
Representative Analysis Compilation—sample S17



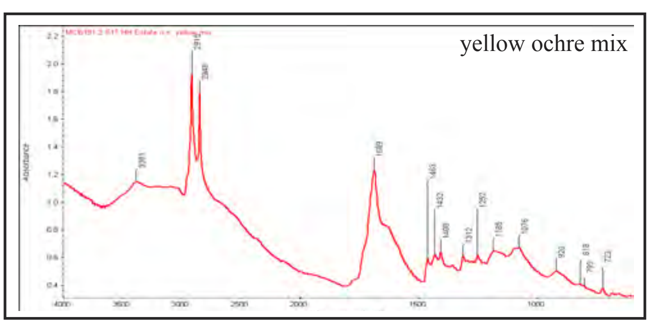
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



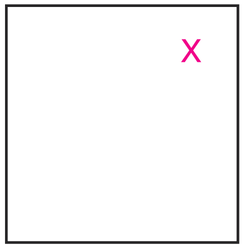
analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, ochre: Cd, S, Fe
interpretation: cadmium yellow, possible yellow ochre



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Cadmium	L-series	20.29	25.04	7.91	3.71
Zinc	K-series	20.08	24.78	13.46	0.73
Sulfur	K-series	11.40	14.06	15.58	0.43
Sodium	K-series	8.59	10.60	16.37	6.78
Potassium	K-series	3.17	3.91	3.55	1.27
Iron	K-series	1.50	1.85	1.18	0.08
Barium	L-series	0.69	0.86	0.22	0.16
Magnesium	K-series	0.17	0.20	0.30	0.13
Phosphorus	K-series	0.05	0.06	0.07	0.03
Silicon	K-series	0.02	0.03	0.04	0.03
Aluminium	K-series	0.01	0.02	0.02	0.04
Chlorine	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Calcium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	15.07	18.59	41.29	18.85
	Sum:	81.04	100.00	100.00	



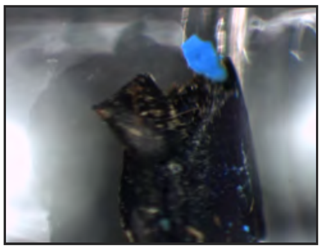
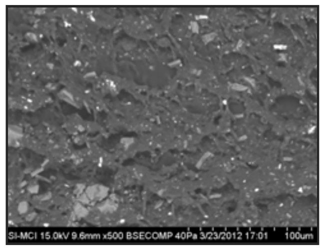
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

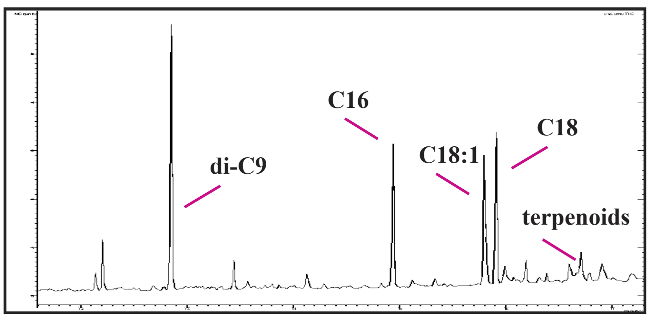
acc. no.: Estate (no number)
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on glass
meas.: 24.0 x 24.0" (61.0 x 61.0 cm.)
notes: warm blue from white mix

sample location: 5.3" from top,
5.3" from right (T 13.5 x R 13.5 cm.)

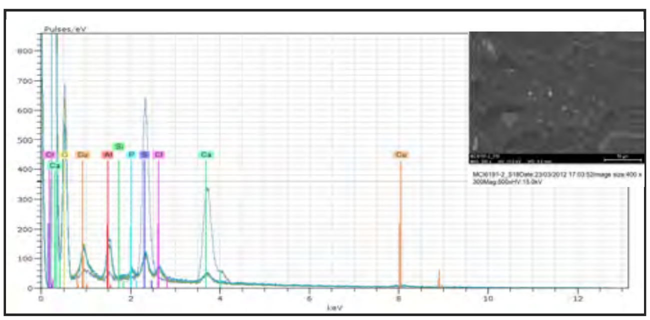
Representative Analysis Compilation—sample S18

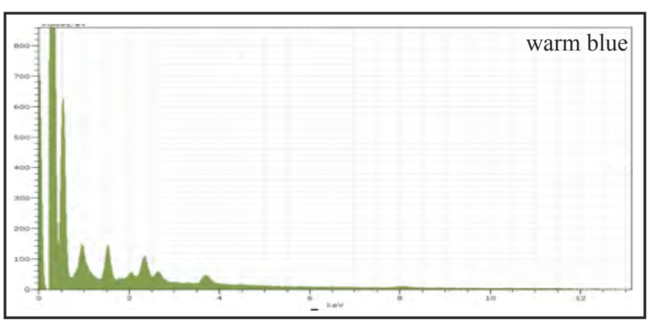
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.6 mm.



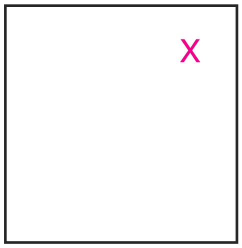
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/03/12
sample weight: 0.277
scan range: 1 - 1467
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.6 mm.
mag: 500x; HV: 15 kV
significant elements, warm blue: Cu
interpretation: phthalo blue



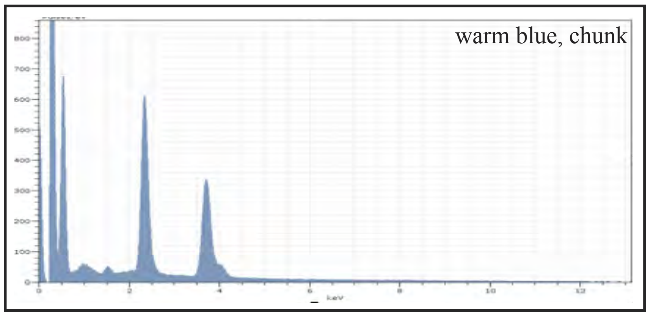
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Copper	K-series	3.47	3.47	0.94	0.16
Aluminium	K-series	1.85	1.85	1.18	0.11
Sulfur	K-series	1.83	1.83	0.98	0.09
Sodium	K-series	1.63	1.63	1.22	1.31
Calcium	K-series	1.39	1.39	0.60	0.95
Chlorine	K-series	0.98	0.98	0.47	0.06
Barium	L-series	0.48	0.48	0.06	0.21
Phosphorus	K-series	0.41	0.41	0.23	0.04
Magnesium	K-series	0.12	0.12	0.08	0.03
Potassium	K-series	0.04	0.04	0.02	0.03
Silicon	K-series	0.00	0.00	0.00	0.03
Tin	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	87.78	87.78	94.22	55.04
	Sum:	100.00	100.00	100.00	

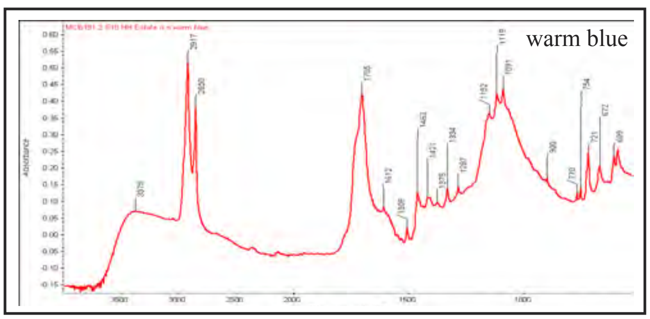
acc. no.: Estate (no number)
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on glass
meas.: 24.0 x 24.0" (61.0 x 61.0 cm.)
notes: warm blue from white mix

sample location: 5.3" from top,
5.3" from right (T 13.5 x R 13.5 cm.)

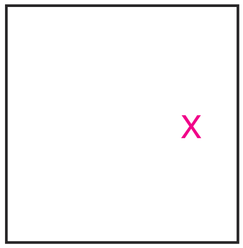
Representative Analysis Compilation—sample S18, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Calcium	K-series	23.12	22.83	12.90	0.73
Sulfur	K-series	20.85	20.59	14.54	0.76
Zinc	K-series	4.36	4.31	1.49	0.22
Barium	L-series	1.20	1.18	0.20	0.22
Chlorine	K-series	0.74	0.73	0.47	0.06
Aluminium	K-series	0.63	0.62	0.52	0.06
Magnesium	K-series	0.32	0.32	0.30	0.05
Phosphorus	K-series	0.23	0.23	0.16	0.04
Potassium	K-series	0.18	0.18	0.10	0.04
Sodium	K-series	0.06	0.06	0.06	0.07
Silicon	K-series	0.04	0.04	0.03	0.03
Titanium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	49.55	48.92	69.24	33.46
	Sum:	101.28	100.00	100.00	



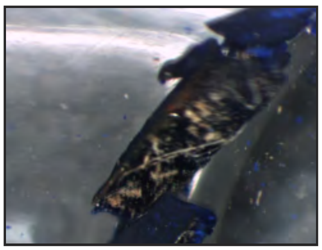
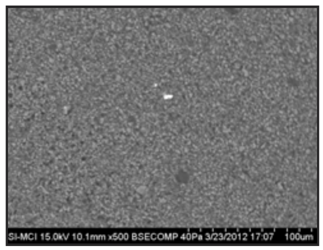
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PB15

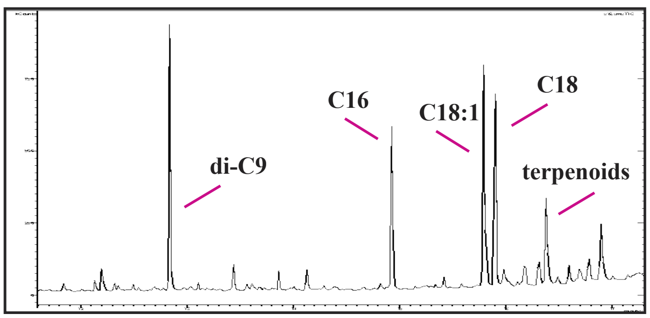
acc. no.: Estate (no number)
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on glass
meas.: 24.0 x 24.0" (61.0 x 61.0 cm.)
notes: cool blue from white mix

sample location: 13.3" from top,
5.3" from right (T 33.8 x R 13.5 cm.)

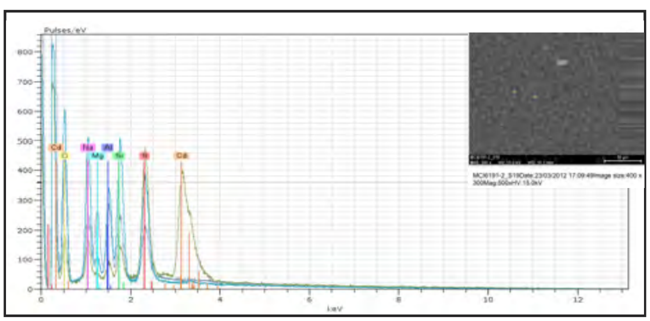
Representative Analysis Compilation—sample S19

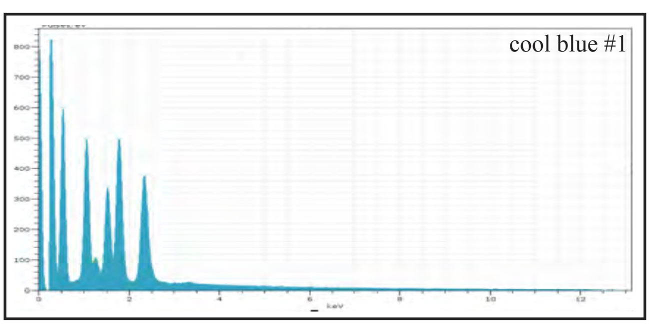
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.1 mm.



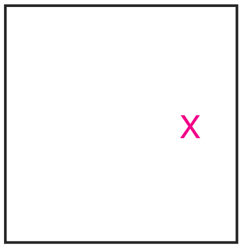
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/03/12
sample weight: 0.045
scan range: 1 - 1494
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.1 mm.
mag: 500x; HV: 15 kV
significant elements, cool blue #1: Na, Si, Al
significant elements, cool blue #2: Cd, S, Na, Zn
interpretation: ultramarine blue, cadmium green



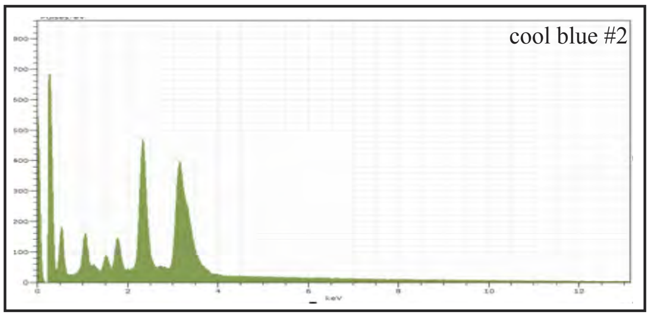
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Sodium	K-series	10.08	12.34	10.53	7.96
Silicon	K-series	8.97	10.97	7.67	0.40
Sulfur	K-series	8.15	9.98	6.10	0.32
Aluminium	K-series	4.65	5.69	4.14	0.24
Zinc	K-series	1.71	2.09	0.63	0.11
Magnesium	K-series	1.10	1.34	1.08	0.09
Barium	L-series	0.42	0.51	0.07	0.11
Potassium	K-series	0.16	0.20	0.10	0.03
Chlorine	K-series	0.04	0.05	0.03	0.03
Calcium	K-series	0.03	0.04	0.02	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	46.39	56.79	69.63	32.61
	Sum:	81.70	100.00	100.00	

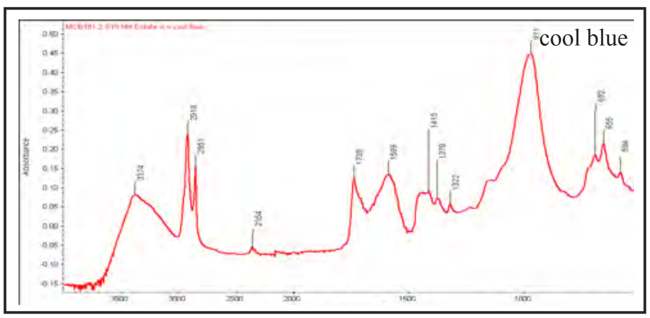
acc. no.: Estate (no number)
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on glass
meas.: 24.0 x 24.0" (61.0 x 61.0 cm.)
notes: cool blue from white mix

sample location: 13.3" from top,
5.3" from right (T 33.8 x R 13.5 cm.)

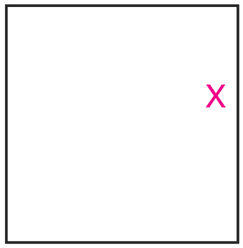
Representative Analysis Compilation—sample S19, continued



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Cadmium	L-series	32.07	31.47	11.20	5.41
Zinc	K-series	17.95	17.62	10.79	0.68
Sulfur	K-series	14.83	14.55	18.17	0.55
Sodium	K-series	6.46	6.34	11.04	5.11
Barium	L-series	5.90	5.79	1.69	0.60
Potassium	K-series	5.14	5.04	5.16	1.87
Silicon	K-series	3.38	3.32	4.73	0.17
Aluminium	K-series	1.34	1.32	1.95	1.05
Magnesium	K-series	0.85	0.83	1.37	0.26
Chlorine	K-series	0.31	0.31	0.35	0.05
Calcium	K-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	13.67	13.41	33.55	17.06
	Sum:	101.90	100.00	100.00	



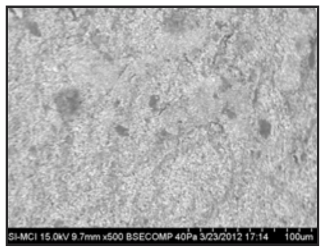
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: fillers



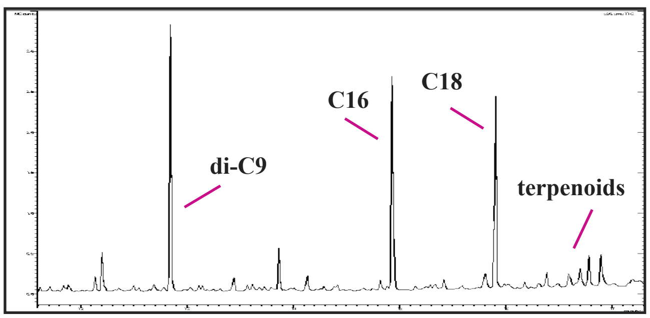
acc. no.: Estate (no number)
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on glass
meas.: 24.0 x 24.0" (61.0 x 61.0 cm.)
notes: mixing white

sample location: 10.0" from top,
2.7" from right (T 2.5 x R 6.9 cm.)

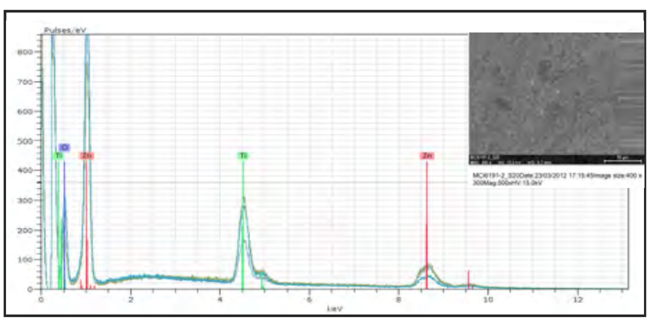
Representative Analysis Compilation—sample S20



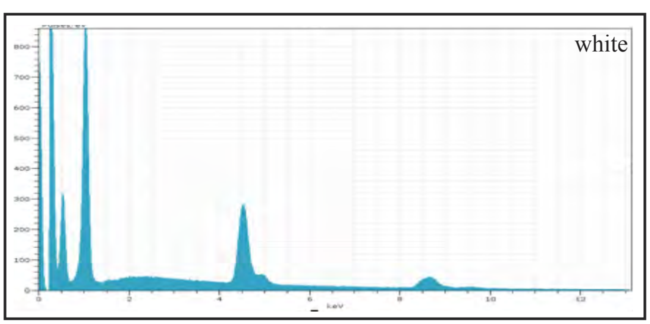
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



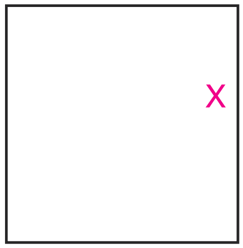
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/03/12
sample weight: 0.158
scan range: 1 - 1489
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18, terpenoids
interpretation: oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



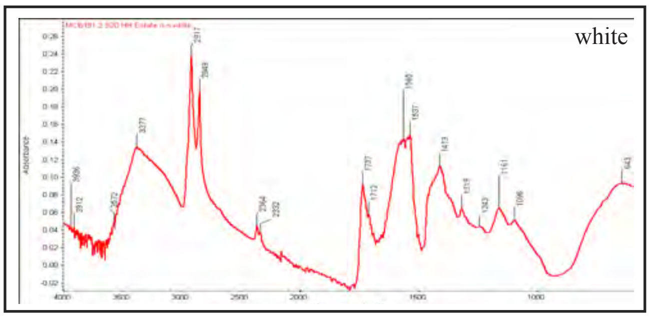
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	37.16	39.33	19.90	1.29
Titanium	K-series	20.25	21.42	14.81	1.43
Sodium	K-series	16.24	17.18	24.74	12.81
Barium	L-series	2.37	2.50	0.60	1.18
Phosphorus	K-series	0.15	0.15	0.16	0.03
Aluminium	K-series	0.14	0.15	0.18	0.04
Potassium	K-series	0.06	0.06	0.05	0.03
Silicon	K-series	0.06	0.06	0.07	0.03
Chlorine	K-series	0.05	0.06	0.05	0.03
Sulfur	K-series	0.05	0.05	0.06	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	17.99	19.03	39.37	16.52
	Sum:	94.51	100.00	100.00	

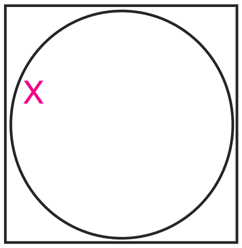
acc. no.: Estate (no number)
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on glass
meas.: 24.0 x 24.0" (61.0 x 61.0 cm.)
notes: mixing white

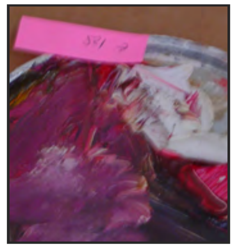
sample location: 10.0" from top,
2.7" from right (T 2.5 x R 6.9 cm.)

Representative Analysis Compilation—sample S20, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

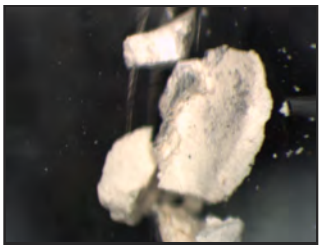
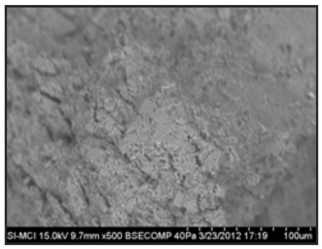





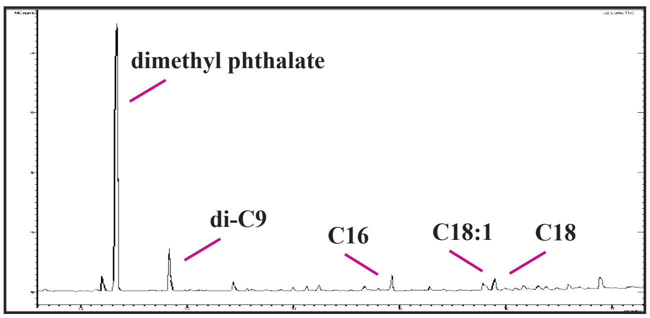
acc. no.: Estate M536-49
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on lid
meas.: 6.0" (15.2 cm.) diameter
notes: white from can

sample location: under lip of lid

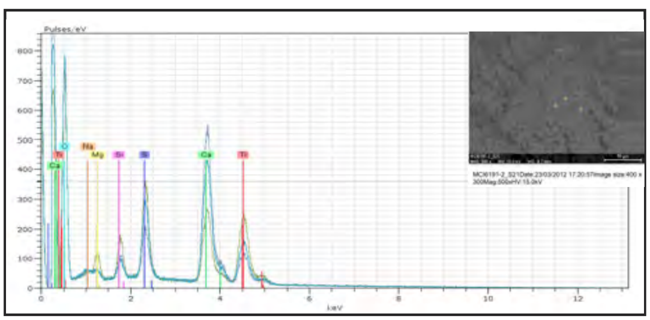
Representative Analysis Compilation—sample S21

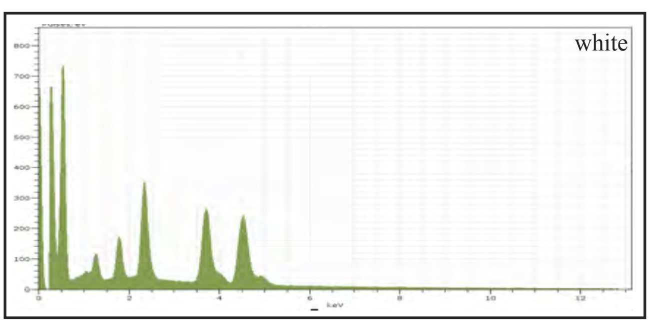
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



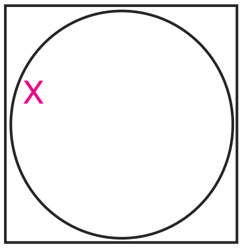
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/03/12
sample weight: 0.194
scan range: 1 - 1492
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18:1, C18
interpretation: alkyd

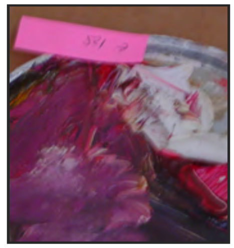


analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, white: Ti
interpretation: titanium white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	23.12	21.71	11.51	1.82
Calcium	K-series	14.81	13.91	8.81	0.48
Sulfur	K-series	10.49	9.86	7.80	0.40
Barium	L-series	4.33	4.07	0.75	2.14
Silicon	K-series	3.89	3.65	3.30	0.19
Zinc	K-series	3.67	3.44	1.34	0.19
Magnesium	K-series	3.19	3.00	3.13	0.20
Chlorine	K-series	0.41	0.38	0.28	0.04
Phosphorus	K-series	0.15	0.14	0.12	0.03
Sodium	K-series	0.14	0.13	0.15	0.14
Potassium	K-series	0.14	0.13	0.08	0.04
Aluminium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	42.14	39.57	62.75	26.68
	Sum:	106.48	100.00	100.00	

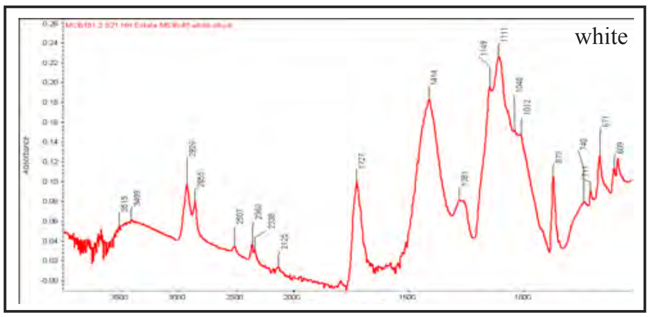




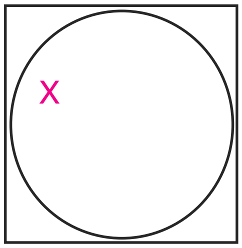
acc. no.: Estate M536-49
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on lid
meas.: 6.0" (15.2 cm.) diameter
notes: white from can

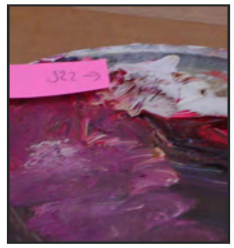
sample location: under lip of lid

Representative Analysis Compilation—sample S21, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

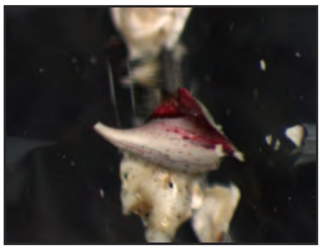


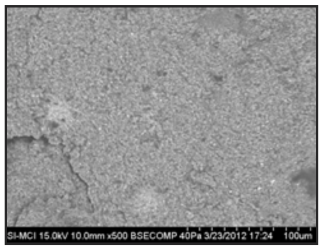


acc. no.: Estate M536-49
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on lid
meas.: 6.0" (15.2 cm.) diameter
notes: mixing white

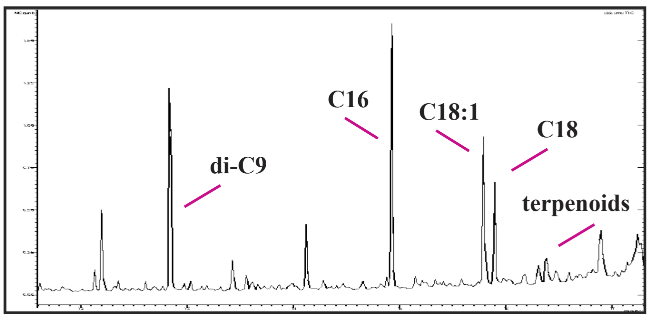
sample location: 0.8" (2.0 cm.) in from edge

Representative Analysis Compilation—sample S22

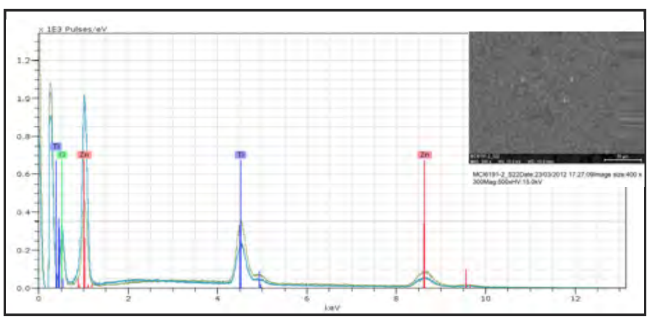




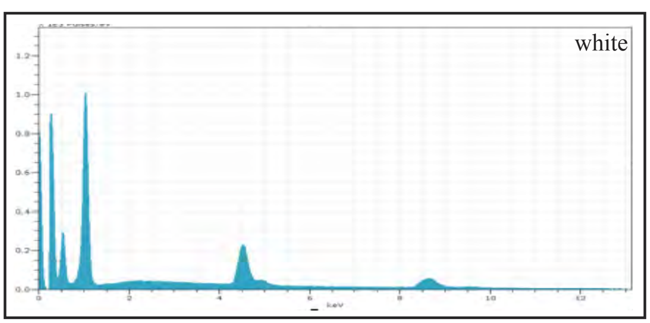
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



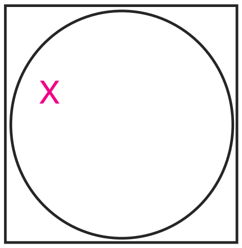
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/03/12
sample weight: 0.271
scan range: 1 - 1489
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: di-C9, C16, C18:1, C18, terpenoids
interpretation: oil

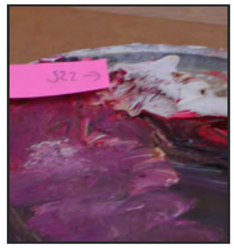


analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, white: Zn, Ti
interpretation: Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	47.69	46.58	25.22	1.63
Sodium	K-series	22.13	21.62	33.28	17.44
Titanium	K-series	16.60	16.21	11.99	1.24
Barium	L-series	1.59	1.56	0.40	0.80
Chlorine	K-series	0.55	0.54	0.54	0.05
Phosphorus	K-series	0.39	0.38	0.44	0.04
Sulfur	K-series	0.38	0.37	0.41	0.04
Potassium	K-series	0.23	0.23	0.21	0.04
Calcium	K-series	0.08	0.08	0.07	0.03
Silicon	K-series	0.04	0.04	0.05	0.03
Aluminium	K-series	0.01	0.00	0.01	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	12.68	12.38	27.40	12.26
	Sum:	102.37	100.00	100.00	

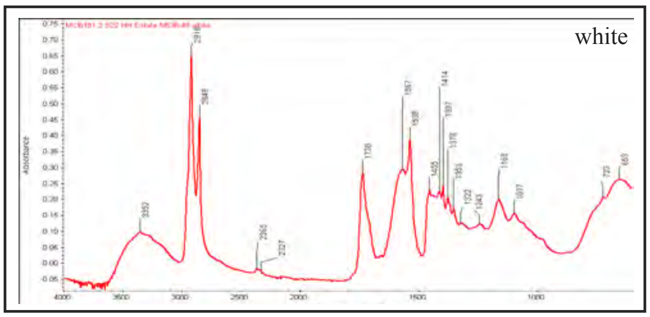




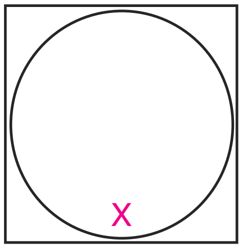
acc. no.: Estate M536-49
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on lid
meas.: 6.0" (15.2 cm.) diameter
notes: mixing white

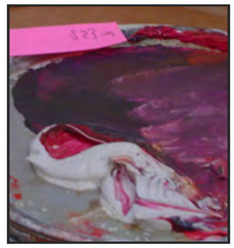
sample location: 0.8" (2.0 cm.) in from edge

Representative Analysis Compilation—sample S22, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

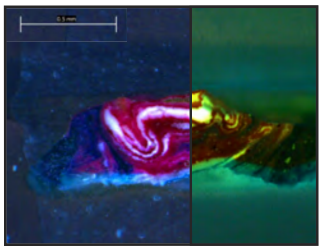
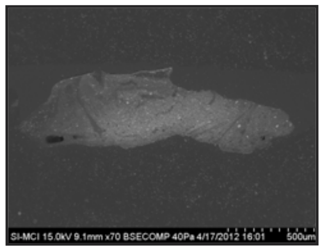





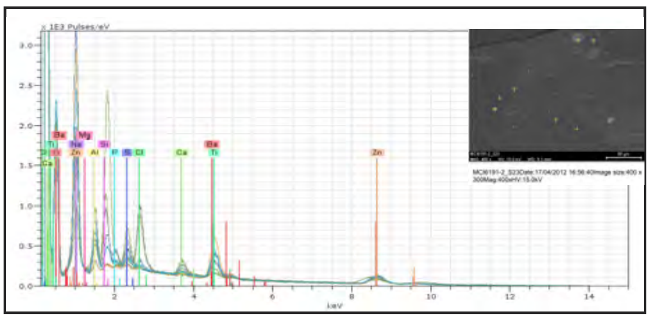
acc. no.: Estate M536-49
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on lid
meas.: 6.0" (15.2 cm.) diameter
notes: purples

sample location: 0.8" (2.0 cm.) in from edge

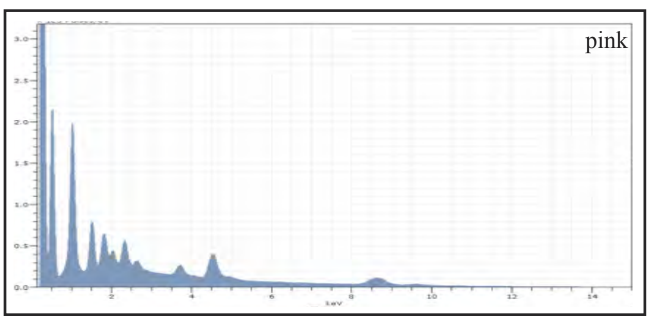
Representative Analysis Compilation—sample S23

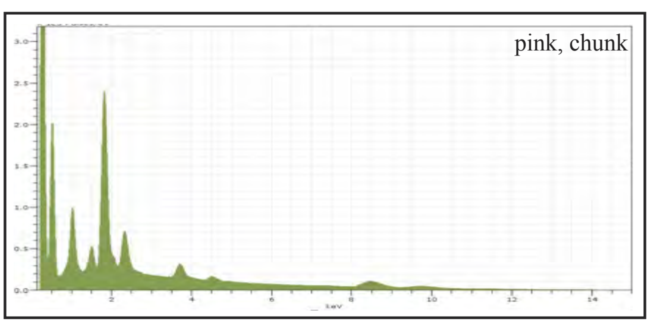
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.1 mm.



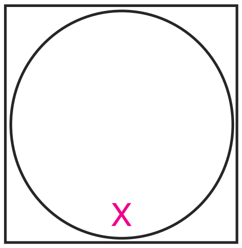
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.1 mm.
mag: 400x; HV: 15 kV
significant elements, pink: Al
significant elements, white: Zn, Ti
significant elements, blue: Na
interpretation: ultramarine blue, Zn/Ti white, synthetic color

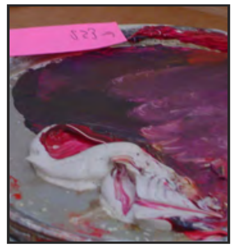


Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	25.89	31.00	13.30	0.88
Sodium	K-series	10.38	12.42	15.16	8.19
Barium	L-series	4.98	5.97	1.22	0.51
Titanium	K-series	3.79	4.53	2.66	0.44
Aluminium	K-series	2.89	3.46	3.60	0.16
Sulfur	K-series	2.30	2.75	2.41	0.11
Silicon	K-series	2.19	2.62	2.62	0.12
Phosphorus	K-series	1.88	2.25	2.03	0.10
Calcium	K-series	1.72	2.06	1.44	0.08
Chlorine	K-series	1.48	1.77	1.40	0.08
Potassium	K-series	0.40	0.48	0.34	0.05
Magnesium	K-series	0.03	0.04	0.05	0.03
Oxygen	K-series	25.60	30.65	53.76	10.79
	Sum:	83.53	100.00	100.00	



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Zinc	K-series	26.67	35.76	14.89	0.91
Silicon	K-series	8.25	11.05	10.72	0.37
Sodium	K-series	3.55	4.76	5.64	2.82
Sulfur	K-series	2.62	3.52	2.99	0.12
Barium	L-series	2.59	3.47	0.69	0.21
Phosphorus	K-series	2.23	2.99	2.63	0.11
Calcium	K-series	1.25	1.68	1.14	0.06
Aluminium	K-series	0.83	1.11	1.12	0.06
Chlorine	K-series	0.32	0.43	0.33	0.04
Potassium	K-series	0.10	0.13	0.09	0.03
Titanium	K-series	0.00	0.01	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	26.18	35.10	59.75	11.31
	Sum:	74.60	100.00	100.00	

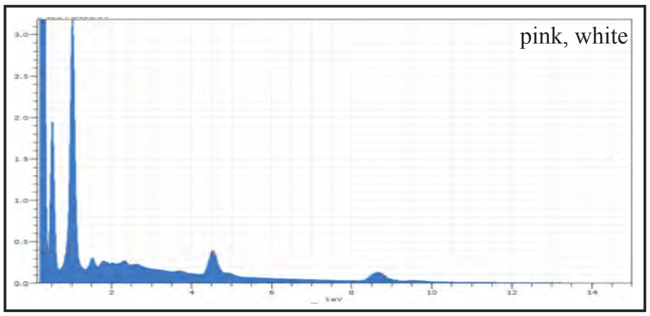




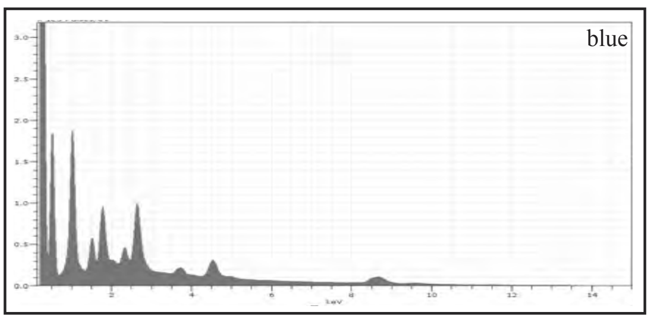
acc. no.: Estate M536-49
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on lid
meas.: 6.0" (15.2 cm.) diameter
notes: purples

sample location: 0.8" (2.0 cm.) in from edge

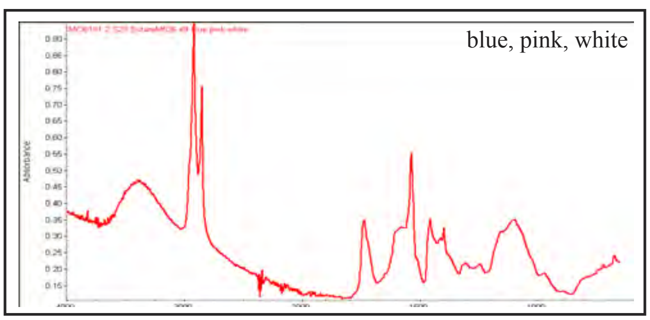
Representative Analysis Compilation—sample S23, continued



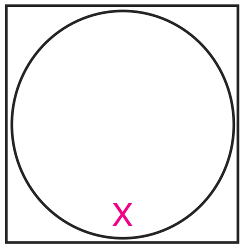
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	24.86	33.49	13.27	0.85
Sodium	K-series	10.49	14.13	15.93	8.28
Titanium	K-series	4.76	6.42	3.47	0.41
Barium	L-series	1.85	2.49	0.47	0.43
Sulfur	K-series	0.58	0.78	0.63	0.05
Chlorine	K-series	0.56	0.75	0.55	0.04
Cadmium	L-series	0.45	0.60	0.14	0.13
Phosphorus	K-series	0.40	0.54	0.45	0.04
Aluminium	K-series	0.37	0.49	0.47	0.30
Calcium	K-series	0.30	0.41	0.26	0.06
Silicon	K-series	0.27	0.37	0.34	0.04
Magnesium	K-series	0.01	0.02	0.02	0.03
Potassium	K-series	0.00	0.00	0.00	0.03
Selenium	L-series	0.00	0.00	0.00	0.02
Oxygen	K-series	29.33	39.51	63.99	13.15
	Sum:	74.23	100.00	100.00	

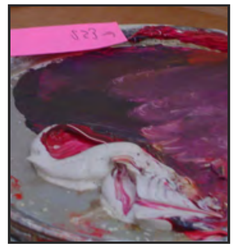


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	20.03	27.13	10.74	0.69
Sodium	K-series	8.54	11.56	13.02	6.74
Chlorine	K-series	5.33	7.22	5.27	0.20
Silicon	K-series	3.50	4.74	4.36	0.17
Titanium	K-series	2.68	3.62	1.96	0.32
Barium	L-series	2.27	3.08	0.58	0.33
Sulfur	K-series	1.28	1.73	1.39	0.07
Aluminium	K-series	1.25	1.69	1.63	0.08
Calcium	K-series	1.05	1.42	0.92	0.06
Phosphorus	K-series	0.68	0.92	0.77	0.05
Potassium	K-series	0.18	0.25	0.17	0.04
Magnesium	K-series	0.10	0.14	0.15	0.03
Oxygen	K-series	26.95	36.50	59.05	12.09
	Sum:	73.85	100.00	100.00	



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: oil

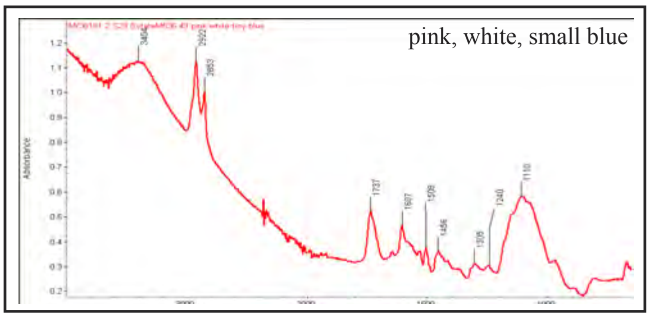




acc. no.: Estate M536-49
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on lid
meas.: 6.0" (15.2 cm.) diameter
notes: purples

sample location: 0.8" (2.0 cm.) in from edge

Representative Analysis Compilation—sample S23, continued

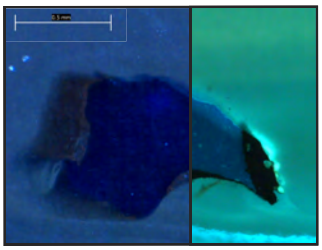
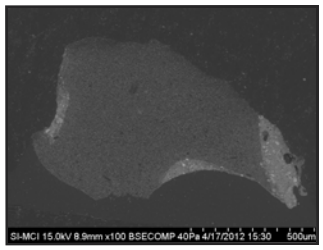


analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR81

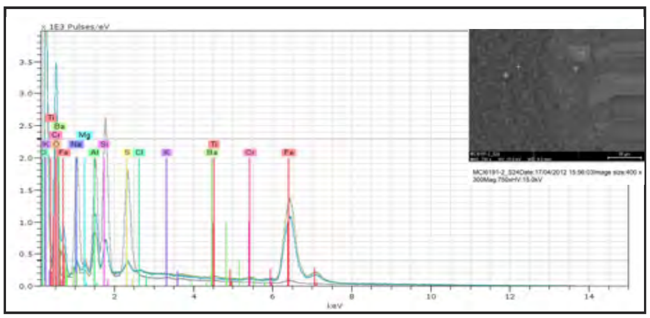

acc. no.: Estate M536-45
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.0 x 11.8" (15.2 x 29.8 cm.)
notes: black

sample location: 3.0" from top,
3.0" from left (T 7.6 x L 7.6 cm.)

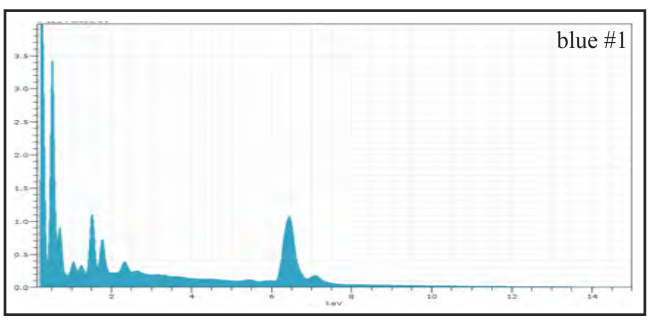
Representative Analysis Compilation—sample S24

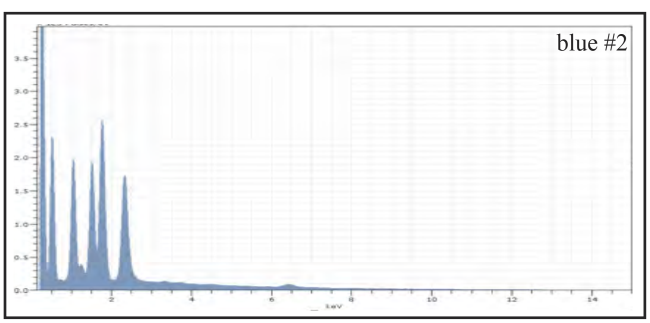
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 8.9 mm.



analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.0 mm.
mag: 750x; HV: 15 kV
significant elements, blue #1: Fe
significant elements, blue #2: Si, Na, Al
interpretation: Prussian blue, ultramarine blue



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Iron	K-series	58.08	61.89	38.75	1.72
Zinc	K-series	4.47	4.76	2.54	0.18
Aluminium	K-series	3.43	3.65	4.73	1.37
Silicon	K-series	2.29	2.44	3.03	0.12
Chromium	K-series	1.35	1.43	0.96	0.07
Sulfur	K-series	1.06	1.13	1.23	0.06
Sodium	K-series	0.99	1.06	1.61	0.81
Barium	L-series	0.94	1.00	0.25	0.12
Cadmium	L-series	0.59	0.63	0.20	0.17
Chlorine	K-series	0.50	0.53	0.53	0.04
Magnesium	K-series	0.29	0.31	0.45	0.08
Calcium	K-series	0.28	0.30	0.26	0.06
Potassium	K-series	0.08	0.08	0.07	0.08
Titanium	K-series	0.04	0.05	0.03	0.05
Selenium	L-series	0.00	0.00	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	19.47	20.74	45.33	31.04
	Sum:	93.86	100.00	100.00	



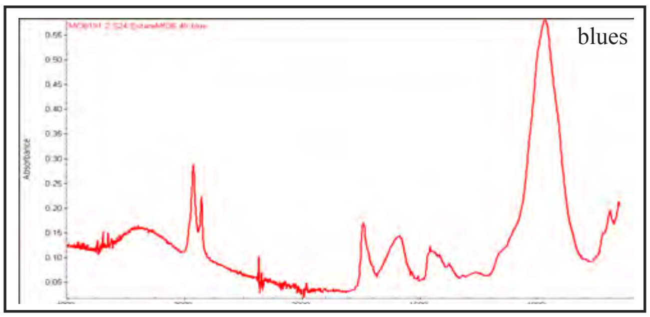
Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Silicon	K-series	8.84	12.56	9.08	0.39
Sodium	K-series	7.62	10.83	9.56	6.02
Sulfur	K-series	7.19	10.22	6.47	0.28
Aluminium	K-series	4.93	7.00	5.27	0.25
Iron	K-series	2.30	3.27	1.19	0.09
Zinc	K-series	1.25	1.77	0.55	0.07
Magnesium	K-series	0.41	0.58	0.48	0.05
Barium	L-series	0.34	0.48	0.07	0.07
Calcium	K-series	0.09	0.12	0.06	0.03
Potassium	K-series	0.08	0.12	0.06	0.03
Chlorine	K-series	0.08	0.12	0.07	0.03
Titanium	K-series	0.01	0.01	0.00	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	37.22	52.91	67.13	15.35
	Sum:	70.35	100.00	100.00	

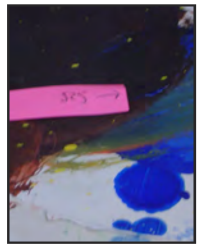
acc. no.: Estate M536-45
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.0 x 11.8" (15.2 x 29.8 cm.)
notes: black

sample location: 3.0" from top,
3.0" from left (T 7.6 x L 7.6 cm.)

Representative Analysis Compilation—sample S24, continued


blues

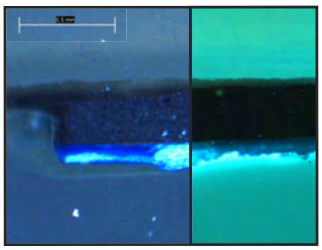
analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: fillers

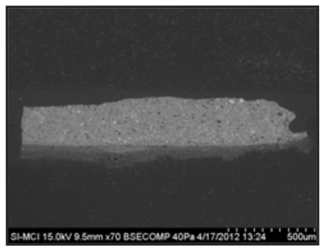


acc. no.: Estate M536-45
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.0 x 11.8" (15.2 x 29.8 cm.)
notes: brown

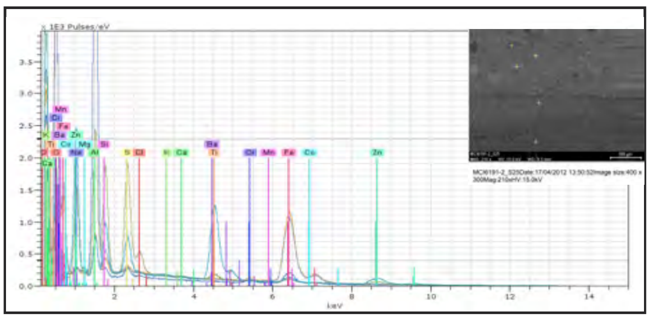
sample location: 3.0" from top,
2.1" from right (T 7.6 x R 5.3 cm.)

Representative Analysis Compilation—sample S25

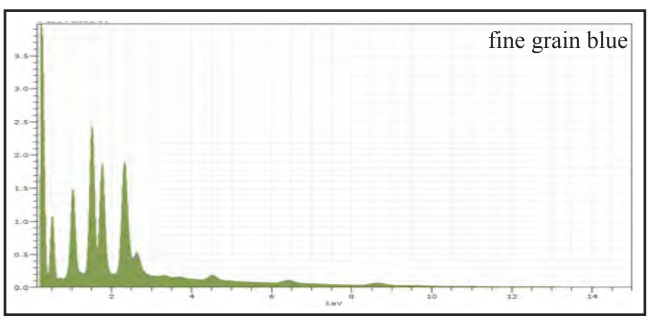




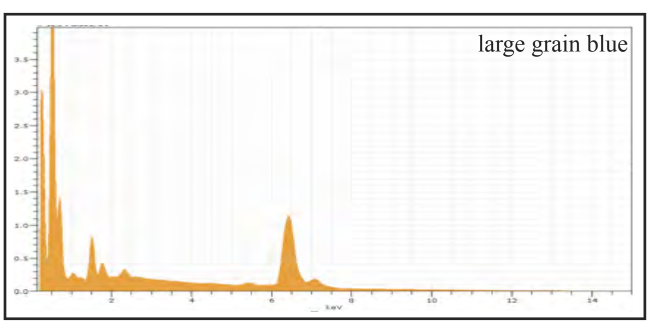
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



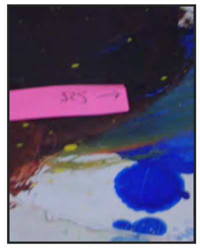
analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.5 mm.
mag: 210x; HV: 15 kV
significant elements, fine blue: Al, Na
significant elements, large blue: Fe
significant elements, white: Zn, Ti
interpretation: ultramarine blue, Prussian blue, Zn/Ti white



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	11.44	15.10	6.62	0.41
Aluminium	K-series	10.12	13.35	14.18	0.49
Sodium	K-series	9.64	12.73	15.87	7.61
Sulfur	K-series	9.36	12.35	11.04	0.36
Silicon	K-series	9.02	11.91	12.15	0.40
Iron	K-series	4.49	5.92	3.04	0.16
Barium	L-series	3.99	5.27	1.10	0.30
Chlorine	K-series	3.09	4.08	3.30	0.13
Potassium	K-series	0.59	0.77	0.57	0.05
Calcium	K-series	0.55	0.72	0.52	0.04
Titanium	K-series	0.18	0.23	0.14	0.13
Magnesium	K-series	0.01	0.01	0.01	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	13.31	17.57	31.47	7.58
	Sum:	75.79	100.00	100.00	



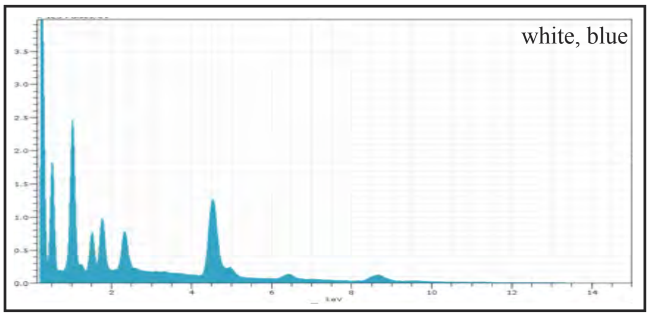
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Iron	K-series	57.16	62.14	35.85	1.69
Aluminium	K-series	3.75	4.07	4.86	0.20
Zinc	K-series	2.32	2.53	1.25	0.11
Silicon	K-series	1.33	1.44	1.65	0.08
Chromium	K-series	1.27	1.38	0.86	0.06
Sulfur	K-series	0.54	0.59	0.59	0.04
Sodium	K-series	0.48	0.52	0.73	0.40
Magnesium	K-series	0.43	0.47	0.62	0.05
Titanium	K-series	0.18	0.19	0.13	0.05
Chlorine	K-series	0.11	0.12	0.10	0.03
Potassium	K-series	0.04	0.04	0.03	0.03
Barium	L-series	0.02	0.02	0.00	0.03
Calcium	K-series	0.01	0.01	0.01	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	24.34	26.47	53.30	38.80
	Sum:	91.97	100.00	100.00	



acc. no.: Estate M536-45
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.0 x 11.8" (15.2 x 29.8 cm.)
notes: brown

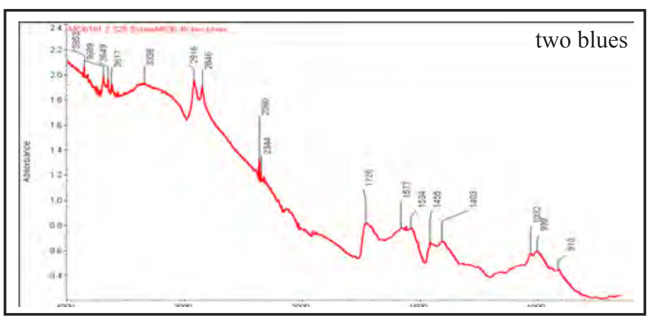
sample location: 3.0" from top,
2.1" from right (T 7.6 x R 5.3 cm.)

Representative Analysis Compilation—sample S25, continued

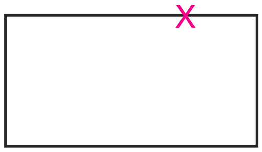


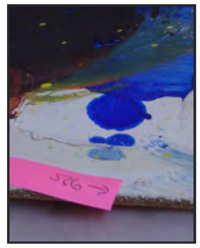
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	23.33	24.50	11.73	0.80
Titanium	K-series	19.72	20.70	13.54	0.91
Sodium	K-series	10.07	10.57	14.40	7.95
Iron	K-series	5.46	5.73	3.21	0.19
Barium	L-series	4.41	4.64	1.06	0.99
Silicon	K-series	3.96	4.16	4.64	0.19
Sulfur	K-series	3.34	3.51	3.42	0.14
Aluminium	K-series	2.38	2.50	2.90	1.21
Cadmium	L-series	0.29	0.31	0.09	0.10
Chlorine	K-series	0.24	0.25	0.22	0.03
Calcium	K-series	0.18	0.19	0.15	0.05
Potassium	K-series	0.16	0.17	0.14	0.11
Magnesium	K-series	0.09	0.09	0.12	0.05
Selenium	L-series	0.00	0.00	0.00	0.02
Phosphorus	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	21.60	22.68	44.38	9.90
	Sum:	95.24	100.00	100.00	

analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: possible iron interference



analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: possible iron interference

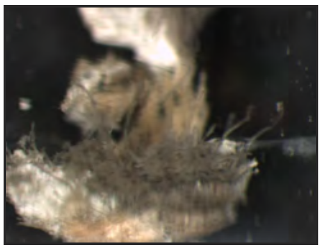


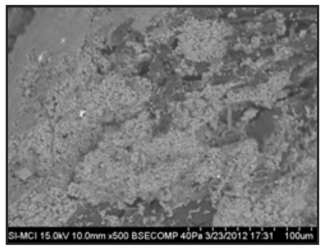


acc. no.: Estate M536-45
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.0 x 11.8" (15.2 x 29.8 cm.)
notes: ground layer

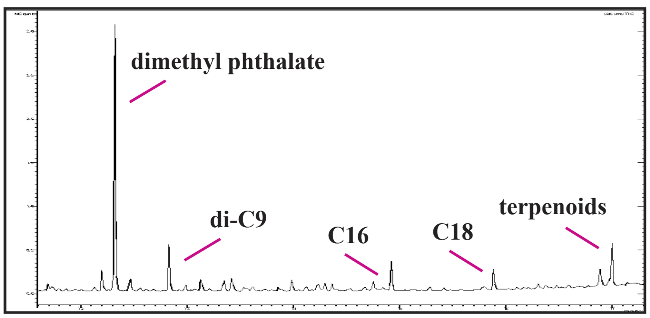
sample location: 3.0" from top,
3.5" from right (T 7.6 x R 8.9 cm.)

Representative Analysis Compilation—sample S26

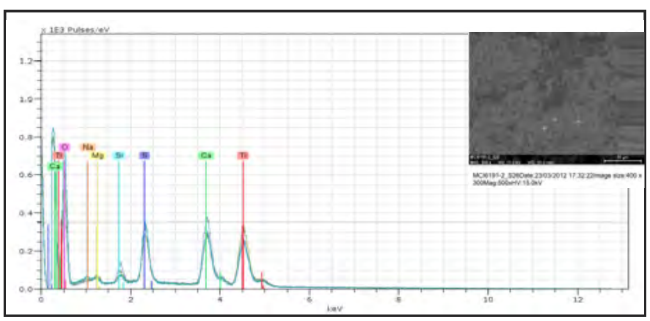




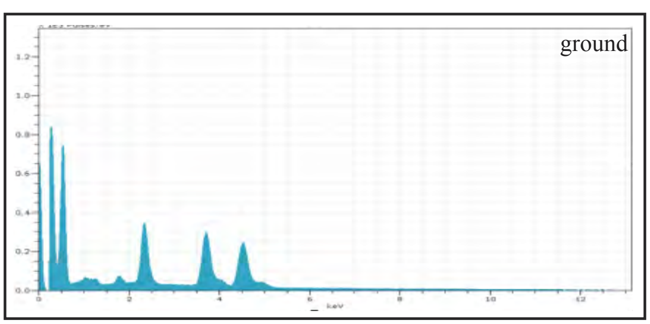
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 10.0 mm.



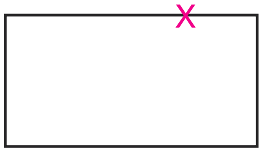
analysis: Py-GC-MS
by: DVR (NGA)
date: 01/04/12
sample weight: 0.147
scan range: 1 - 1487
time range: 0.00 - 23.48 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16,
C18, terpenoids
interpretation: alkyd

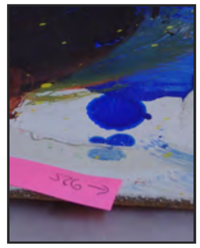


analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 10.0 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti, Ca
interpretation: bulked titanium white



Element	*Series*	*Wt.-%*	*Norm. wt.-%*	*Norm. at.-%*	*Error in %*
Titanium	K-series	27.33	22.19	12.68	2.33
Calcium	K-series	20.64	16.75	11.44	0.65
Sulfur	K-series	11.50	9.33	7.97	0.43
Barium	L-series	8.50	6.90	1.37	2.69
Zinc	K-series	7.22	5.86	2.45	0.32
Silicon	K-series	1.13	0.92	0.89	0.08
Magnesium	K-series	1.06	0.86	0.97	0.09
Sodium	K-series	0.89	0.72	0.86	0.73
Chlorine	K-series	0.70	0.57	0.44	0.05
Potassium	K-series	0.45	0.36	0.26	0.07
Phosphorus	K-series	0.17	0.14	0.12	0.03
Oxygen	K-series	43.61	35.40	60.55	27.49
	Sum:	123.20	100.00	100.00	

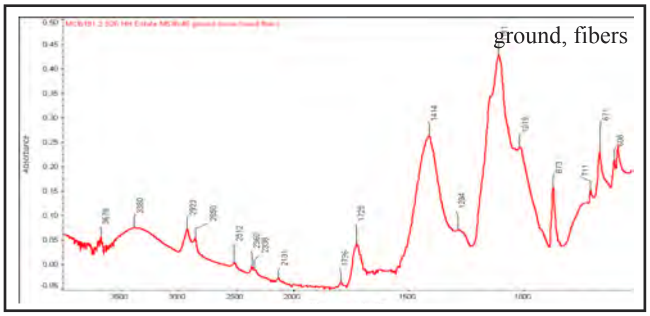





acc. no.: Estate M536-45
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 6.0 x 11.8" (15.2 x 29.8 cm.)
notes: ground layer

sample location: 3.0" from top,
3.5" from right (T 7.6 x R 8.9 cm.)

Representative Analysis Compilation—sample S26, continued

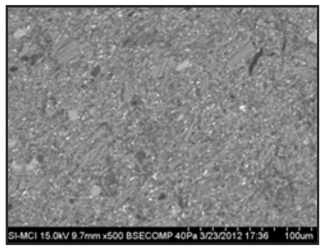


analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, fillers

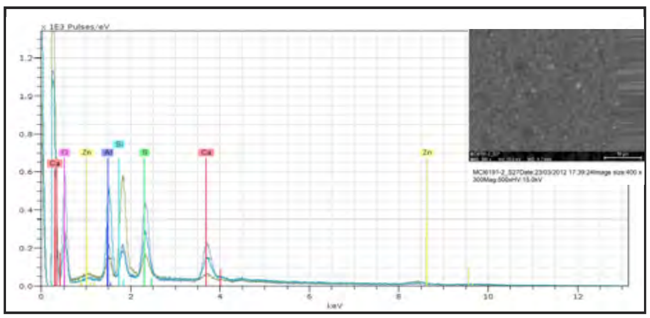
acc. no.: Estate M536-03
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.0 x 11.0" (10.2 x 27.9 cm.)
notes: magenta

sample location: 1.3" from top, 3.3" from left
(T 69.9 x R 58.4 cm.)

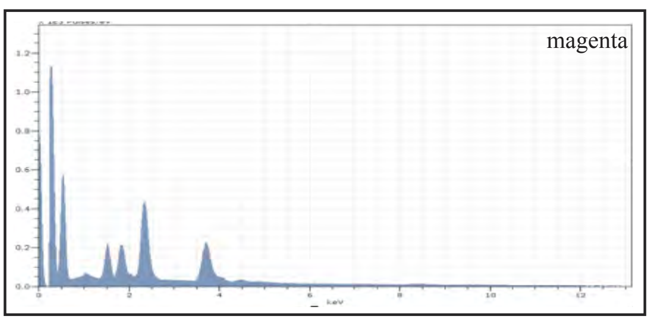
Representative Analysis Compilation—sample S27



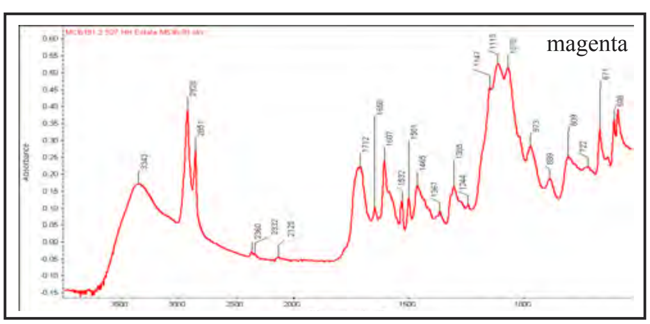
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, magenta: Ba, Al
interpretation: synthetic color



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	14.44	15.89	6.30	0.55
Calcium	K-series	12.88	14.17	9.17	0.42
Sulfur	K-series	12.57	13.83	11.19	0.47
Barium	L-series	6.05	6.65	1.26	0.56
Silicon	K-series	4.47	4.92	4.55	0.21
Aluminium	K-series	3.76	4.13	3.97	0.20
Phosphorus	K-series	1.07	1.18	0.99	0.07
Chlorine	K-series	0.50	0.55	0.40	0.05
Sodium	K-series	0.49	0.54	0.61	0.41
Potassium	K-series	0.29	0.32	0.21	0.05
Magnesium	K-series	0.00	0.00	0.00	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	34.38	37.82	61.34	24.97
	Sum:	90.88	100.00	100.00	



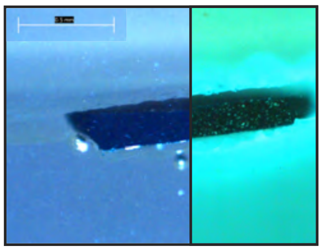
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PR81

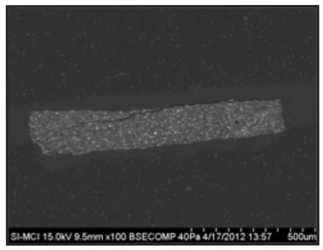
no image available

acc. no.: Estate M536-03
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.0 x 11.0" (10.2 x 27.9 cm.)
notes: teal

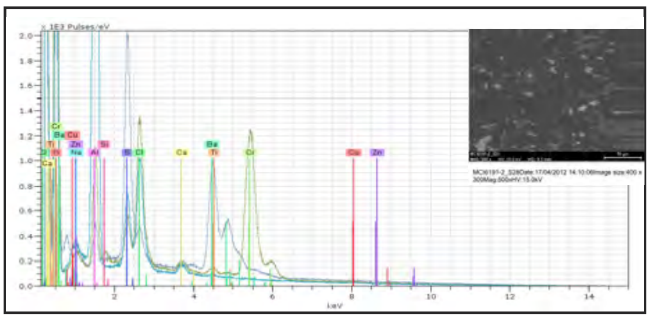
sample location: 1.3" from top, 2.8" from right
(T 69.9 x R 7.1 cm.)

Representative Analysis Compilation—sample S28

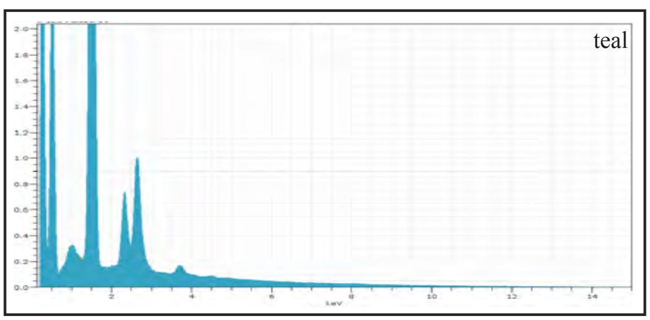




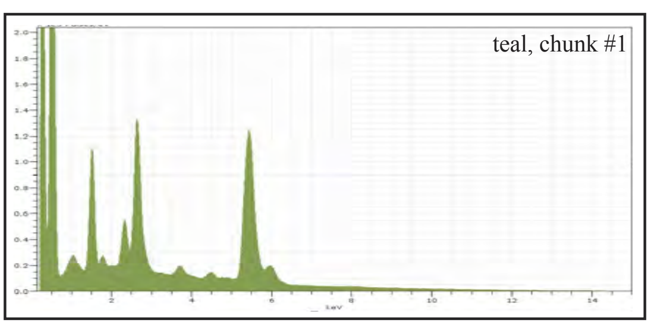
photomicrograph of loose sample:
5x objective, 0.55x tube, 2.79 magnification;
dark field with cover slip, and
ultraviolet illumination (355-425 nm.)
SEM working distance: 9.5 mm.



analysis: EDS
by: DVR (MCI)
date: 04/17/12
working distance: 9.5 mm.
mag: 500x; HV: 15 kV
significant elements, teal: Cl, Cu
interpretation: phthalo green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Aluminium	K-series	20.57	25.65	20.42	0.98
Chlorine	K-series	7.06	8.80	5.33	0.26
Sulfur	K-series	3.25	4.06	2.72	0.14
Zinc	K-series	2.26	2.82	0.93	0.11
Copper	K-series	2.23	2.78	0.94	0.10
Barium	L-series	1.60	2.00	0.31	0.16
Calcium	K-series	1.22	1.52	0.82	0.06
Chromium	K-series	1.03	1.28	0.53	0.06
Sodium	K-series	0.60	0.75	0.70	0.50
Potassium	K-series	0.25	0.31	0.17	0.04
Phosphorus	K-series	0.04	0.05	0.04	0.03
Titanium	K-series	0.01	0.01	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.03
Silicon	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	40.10	49.99	67.10	63.93
	Sum:	80.22	100.00	100.00	



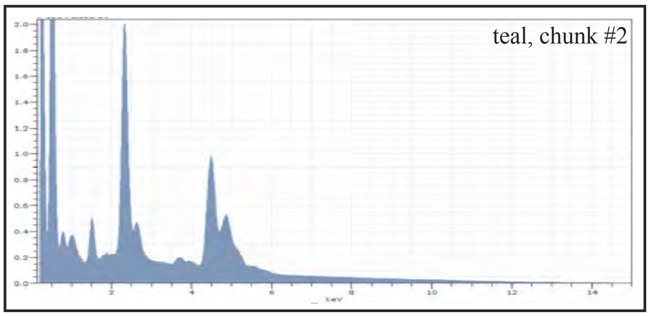
Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Chromium	K-series	39.38	42.38	23.49	1.16
Chlorine	K-series	8.26	8.89	7.23	0.30
Aluminium	K-series	4.81	5.18	5.53	0.25
Zinc	K-series	2.59	2.78	1.23	0.12
Copper	K-series	2.25	2.42	1.10	0.10
Barium	L-series	1.89	2.04	0.43	0.21
Sulfur	K-series	1.72	1.86	1.67	0.09
Sodium	K-series	1.31	1.41	1.77	1.06
Calcium	K-series	0.94	1.02	0.73	0.06
Silicon	K-series	0.39	0.41	0.43	0.04
Titanium	K-series	0.32	0.35	0.21	0.12
Magnesium	K-series	0.07	0.07	0.09	0.03
Potassium	K-series	0.06	0.06	0.05	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	28.93	31.13	56.07	46.10
	Sum:	92.93	100.00	100.00	

no image available

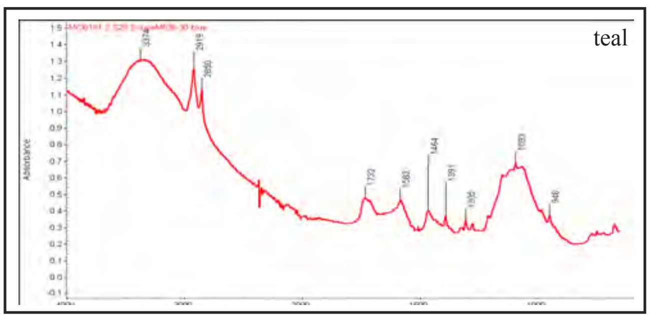
acc. no.: Estate M536-03
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.0 x 11.0" (10.2 x 27.9 cm.)
notes: teal

sample location: 1.3" from top, 2.8" from right
(T 69.9 x R 7.1 cm.)

Representative Analysis Compilation—sample S28, continued



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Barium	L-series	42.66	57.36	25.17	2.58
Sulfur	K-series	16.19	21.76	40.89	0.60
Chlorine	K-series	3.88	5.22	8.87	0.16
Zinc	K-series	3.53	4.75	4.38	0.15
Aluminium	K-series	2.97	4.00	8.93	0.16
Titanium	K-series	2.79	3.76	4.73	0.65
Sodium	K-series	0.90	1.20	3.16	0.73
Phosphorus	K-series	0.40	0.53	1.04	0.04
Silicon	K-series	0.36	0.48	1.03	0.04
Calcium	K-series	0.32	0.43	0.65	0.04
Magnesium	K-series	0.31	0.42	1.03	0.04
Potassium	K-series	0.06	0.08	0.13	0.03
	Sum:	74.37	100.00	100.00	

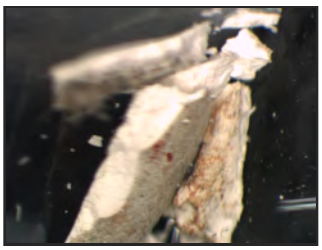
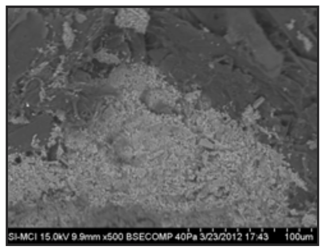


analysis: µFTIR
by: DVR (MCI)
date: 01/11/13
detector: MCT/A
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7

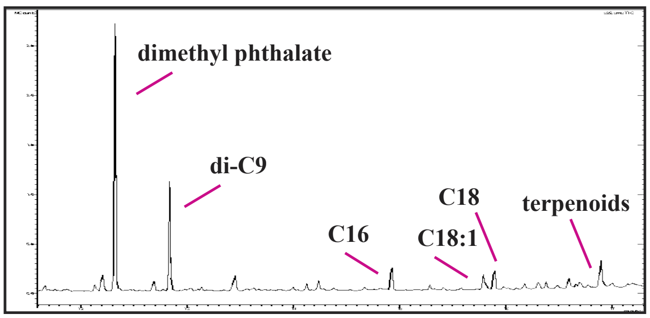

acc. no.: Estate M536-03
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.0 x 11.0" (10.2 x 27.9 cm.)
notes: ground layer

sample location: right edge, 0.5" from top
(T 1.3 x R 0.0 cm.)

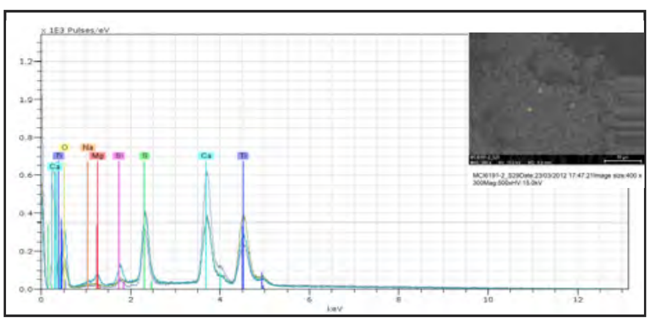
Representative Analysis Compilation—sample S29

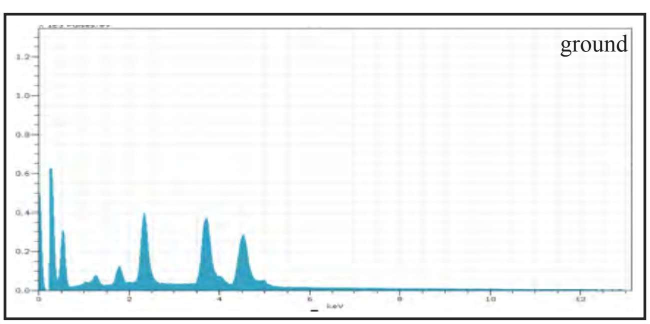
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.9 mm.



analysis: Py-GC-MS
by: DVR (NGA)
date: 01/03/12
sample weight: unknown
scan range: 1 - 1485
time range: 0.00 - 23.47 min.
notes: SS600, TMAH
results: dimethyl phthalate, di-C9, C16, C18:1, C18, terpenoids
interpretation: alkyd, oil



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.9 mm.
mag: 500x; HV: 15 kV
significant elements, ground: Ti, Ca
interpretation: bulked titanium white

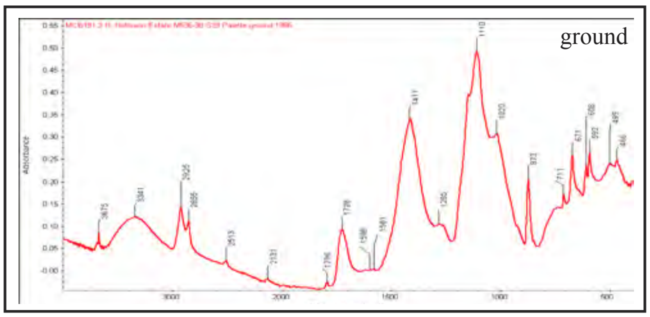


Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Titanium	K-series	22.64	24.83	14.95	1.89
Calcium	K-series	18.88	20.71	14.89	0.60
Sulfur	K-series	9.04	9.91	8.91	0.35
Barium	L-series	7.76	8.51	1.79	2.09
Silicon	K-series	2.86	3.13	3.21	0.15
Magnesium	K-series	2.78	3.05	3.62	0.18
Sodium	K-series	1.30	1.43	1.79	0.32
Potassium	K-series	0.21	0.23	0.17	0.05
Chlorine	K-series	0.12	0.13	0.11	0.03
Phosphorus	K-series	0.00	0.00	0.00	0.03
Oxygen	K-series	25.59	28.06	50.56	23.81
	Sum:	91.18	100.00	100.00	

acc. no.: Estate M536-03
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.0 x 11.0" (10.2 x 27.9 cm.)
notes: ground layer

sample location: right edge, 0.5" from top
(T 1.3 x R 0.0 cm.)

Representative Analysis Compilation—sample S29, continued

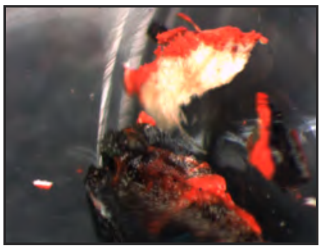


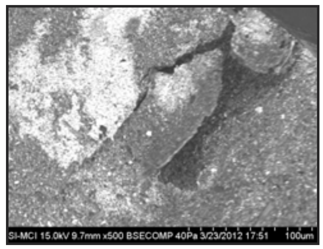
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: low oil, filler

acc. no.: Estate M536-03
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.0 x 11.0" (10.2 x 27.9 cm.)
notes: brown and orange mix

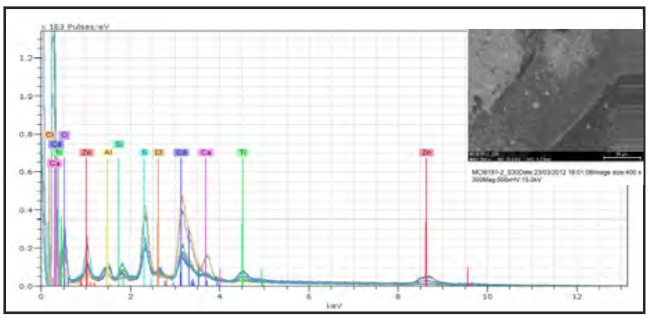
sample location: left edge, 1.0" from bottom
(B 2.5 x L 0.0 cm.)

Representative Analysis Compilation—sample S30

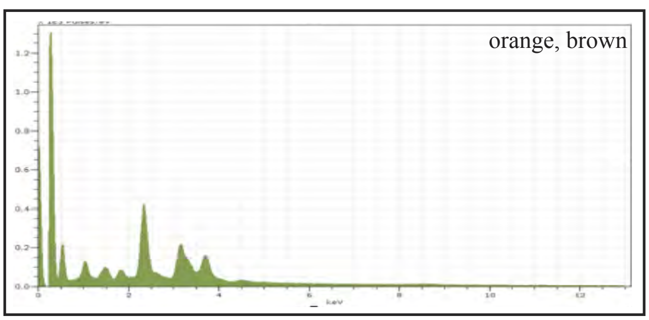




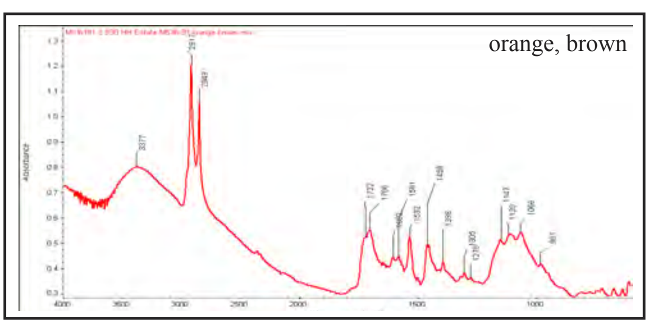
photomicrograph of loose sample:
25x obj, 10x lens, 0.55x tube, 1.40 magnification
SEM working distance: 9.7 mm.



analysis: EDS
by: DVR (MCI)
date: 03/23/12
working distance: 9.7 mm.
mag: 500x; HV: 15 kV
significant elements, orange: Cd, S, Se
significant elements, brown: Cl
interpretation: cadmium orange, phthalo green



Element	Series	Wt.-%	Norm. wt.-%	Norm. at.-%	Error in %
Zinc	K-series	14.68	18.74	8.68	0.56
Cadmium	L-series	11.01	14.06	3.79	2.68
Sulfur	K-series	9.38	11.97	11.31	0.36
Calcium	K-series	7.11	9.07	6.86	0.42
Barium	L-series	4.39	5.61	1.24	0.45
Sodium	K-series	2.01	2.57	3.38	1.61
Aluminium	K-series	1.95	2.49	2.80	1.51
Potassium	K-series	1.82	2.32	1.80	0.95
Silicon	K-series	1.47	1.88	2.02	0.09
Chlorine	K-series	0.45	0.57	0.49	0.05
Selenium	L-series	0.20	0.26	0.10	0.09
Phosphorus	K-series	0.06	0.08	0.08	0.03
Titanium	K-series	0.00	0.00	0.00	0.03
Magnesium	K-series	0.00	0.00	0.00	0.02
Oxygen	K-series	23.78	30.37	57.47	27.70
	Sum:	78.30	100.00	100.00	



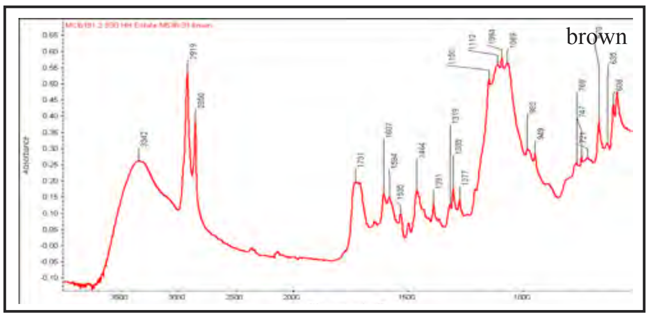
analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: oil

X

acc. no.: Estate M536-03
title, year: *untitled* (palette), 1966
Renate, Hans and Maria Hofmann Trust
medium noted in file: oil paint on board
meas.: 4.0 x 11.0" (10.2 x 27.9 cm.)
notes: brown and orange mix

sample location: left edge, 1.0" from bottom
(B 2.5 x L 0.0 cm.)

Representative Analysis Compilation—sample S30, continued



analysis: ATR-FTIR
by: DVR (MCI)
date: 12/05/12
detector: DTGS
correction: ATR corrected
resolution: 4 cm-1
number of scans: 128
interpretation: consistent with IRUG standard for PG7