By the time you receive this September WAAC Newsletter, I hope I will have seen you at the annual meeting in Denver. I extend my sincere appreciation to colleagues who presented papers at the meeting. I encourage all of you to consider sharing an interesting, challenging, or unique project with the WAAC membership at the next annual meeting. The comfortable, friendly, and supportive atmosphere of this gathering of professionals makes it a perfect setting to share our experiences: the good, the bad, and the ugly (and I might add the odd…).

I would like to take this opportunity to thank a number of individuals: Carl Patterson, the entire staff of the Conservation Department of the Denver Art Museum and all of my Denver colleagues for their assistance in planning the meeting, Yosi Poseilov for agreeing to give the workshop on digital photography, Ann Daley and Steve Good for making the tours of the Red House and the Anschutz Collection possible, and Carmen Brian and the Western Center for the Conservation of Fine Arts for hosting the opening reception at the Kirkland Museum. A special thanks, as well, to my fellow WAAC board members, especially my Vice President, Susanne Friend, Treasurer, Membership Secretary and Member-at-Large, Chris Stavroudis, Newsletter Editor, Carolyn Tallent, Webmaster, Walter Henry, and Presidents Emeritus, Laura Downey Stanef, Beverly Perkins, and Molly Lambert for their continued helpfulness, patience, and support during my term. Planning the annual meeting can be, at times, an arduous task. The suggestions, advice, and encouragement of these individuals were invaluable to me. I would also like to recognize vendor donations from Dry Creek Gold Leaf, Inc. of Denver and Terry Dowd, Inc. whose generous contributions helped to defray meeting costs.

Continuing the theme of my previous letters focusing on the art scene in Denver, I will indulge in a discussion of the future of Denver’s dynamic cultural growth. I recently attended a lecture at the Denver Art Museum given by Dean Sobell, the director of the future Clyfford Still Museum to be built by 2010 on Bannock Street, next to the Hamilton Wing of the Denver Art Museum. Sobel’s lecture entitled “Who Is Clyfford Still... And Why Does He Matter” was a prelude to the exhibit at the Denver Art Museum, Clyfford Still, Unveiled: Selections from the Estate which opened July 14. Attendees to the annual meeting will have had the opportunity to see this sampling of the Clyfford Still Museum’s holdings: the thirteen paintings and works of art on paper are a respectable survey of the artist’s œuvre, which includes a striking self-portrait and the black and red-streaked 1944-N No.1 of which Sobel claimed, “I could argue that this is the first work of Abstract Expressionism.”

Despite his early enthusiasm, Still retreated from the movement due to his disenchantment with galleries, the market, and the art world, in general. He went into virtual seclusion from commercial galleries in the 50s, while his contemporaries De Kooning, Pollock, Rothko, Newman, and others went on to further define the movement in a wide variety of styles. Meanwhile, Still left New York to live out his life in Maryland. Despite his reticence, the Met’s exhibit of Still’s work in 1979, the year prior to his death, was the largest body of work by a living artist ever exhibited there.

The artist’s will placed rigid restrictions on the estate (encompassing nearly 95% of the artist’s body of work and his entire archives) including the stipulation that the works could only be exhibited in a gallery built to his specifications. These specifications made various American cities reluctant to take on the responsibility of the estate and resulted in keeping his work from public view since 1980. In 2004, the city of Denver committed to carrying out the artist’s wishes with its proposal to build the Clyfford Still Museum and was awarded with the estate. In
President's letter, continued

2006, architect Brad Cloepfil, who recently completed the expansion of the Seattle Art Museum, won the commission to build the museum.

The Clifford Still Museum will be preceded by the opening of another new cultural institution in Denver, the Museum of Contemporary Art, now under construction and scheduled to open in October. The MCA was founded in 1996 and was first housed in an old fish market in Sakura Square, an Asian market downtown. It moved to the “Temporary Contemporary” across the street from the new building site last year.

The selection process for the new museum took the form of a six-week educational interview during which six architectural designs were presented in lectures attended by graduate students, museum patrons, high school students, and others numbering to 900 per session. Director Sydney Payton says describes the goal of the interview process “...to design a place where architecture supports rather than defines the museum’s mission.” Ghana-born British architect, David Adjaye, was the unanimous choice resulting from the “public interview.”

Adjaye, known for his innovative use of light and symmetry, creates a dynamic interface between the glass-clad exterior and an interior described by the architect as a three volumes wrapped in a translucent skin (polypropylene). The light permeability and insulating properties of the polypropylene as well as the rooftop garden contribute to the structure’s designation as a LEED structure (the first museum in the country with this certification). LEED, Leadership in Energy Environmental Design, is a nationally accepted building rating system which is the standard for the construction and operation of “green” building. LEED certification is based on compliance in five areas: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. The structure will use approximately 40% less energy than a non-LEED building.

Adjaye’s design will house five distinct galleries that will feature works of art on paper, photography, oversized works, new media, and projects. It will be what Payton calls “a flexible space” where a minimalist entryway rises up to a threshold efficiency, materials selection, and indoor environmental quality. The structure will use approximately 40% less energy than a non-LEED building.

I am happy to have been WAAC president at a time that gave me the opportunity to host the annual meeting in Denver when the city is experiencing what could be called a cultural renaissance. I hope that meeting attendees enjoyed both the public and private collections that were available to them as well as other Denver attractions during their visit here, and I hope that they will be encouraged to return to Denver to experience these new institutions in the Mile High City.

Ruslan Heginbotham
(Leon and Arlen)

Carson Carline
(Elle and Scott)

Volume 29 Number 2
WAAC Newsletter

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Deadline
Contributions for the September Newsletter should be received by the Editor before August, 2007.

Conference Pictures by Brian Members - Children are printed in the Newsletter

Chris Stavroudis

WAAC Newsletter Volume 29 Number 3 September 2007

Western Association for Art Conservation

The Western Association for Art Conservation (formerly, the Western Association of Art Conservationists), also known as WAAC, was founded in 1974 to bring together conservators practicing in the western United States to exchange ideas, information, and regional news, and to address local, national, and international matters of common interest.

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Internet
Articles and most columns from previous issues of WAAC Newsletter are available free at the WAAC Website, a part of CoOL (Conservation Online) hosted by Stanford University Libraries, at http://pubsproject.stanford.edu/waac

WAAC welcomes the following new members and late renewals.
Contact information is printed in the 2007 WAAC Membership Directory and the new members are listed here by name only.

Regional News

**ALASKA**

Scott and Ellen Carrlee welcomed a new addition to their household. Carson Orion Carrlee was born on August 20 and weighed 6 lbs, 5 oz. Carson is the daughter of Andrea Hargis Carrlee and B. Woodward Carrlee in Ramona, California. Next year’s Angel Project will be at the B. Woodward Museum in Ramona, organizing volunteer Angels Projects on prehistoric ceramics and textiles from the museum’s collection of Native American items.

Nancy Oedegaard and Teresa Moreno were among an introduction to archaeology and conservation class at the University of Arizona in the Pre-Summer Session. This is the second year that Terence has offered this class, and it has been very successful. Nancy and Scott Carter take their materials characterization class at the Royal Danish Academy of Fine Arts Conservation Program in Copenhagen in June. In July, Nancy worked with Vicki Vohra and the Chichonteras mummies in Chile. After completing her tenure as the Roy Lichtenstein Foundation in New York related to the Getty’s outdoor sculpture program that reports their students participated in a variety of internship projects this past summer. Teresa Moreno is filling in as Acting Head of the Preservation Division at ASM while Nancy is away for the year. This summer, Teresa worked as site conservator for the second season of excavation at the Sanctuary of Zeus at Mt. Lycabettus in Athens, Greece. She is currently working on the conservation of over five hundred objects for an upcoming exhibition titled Set in Stone that will highlight Native American jewelry production and use in the Southwest. This work includes XRF and X-radiography to characterize the materials and technologies.

She worked as a conservation intern at the Smithsonian’s National Museum of the American Indian, Autry National Center in Los Angeles, California, where she will work at Bandelier National Monument as well as exhibitions and loans. Liz Werden will begin her internship with the Getty Conservation Institute’s Field Projects section, focusing on documentation with Adobe and rendering of their datasets as students in the Fall 2007 class: Siska Graubruger, Lauren Horelick, Jiafang Liang, Linda Lin, and Suzanne Morris.

**NEW MEXICO**

David rasch has been promoted to the position of Director of the Santa Fe New Historic Preservation Division within the Land Use Department. He was previously the Historic Preservation Officer for the city. Santa Fe is celebrating its 399th year since the establishment of the colony in 1692. It is the second oldest historic preservation ordinance in the country. Santa Fe will open a new archive on historic preservation, making it the second oldest historic preservation organization in the country. Patricia Morris spent a week in July in Santa Fe to interview with Cuban artists Los Carpinteros has been published in a new book by the Getty Research Center titled “Conversations on Sculpture.” The book, which contains interviews with such seminal figures as Richard Serra, Anthony Gormley, Lynda Benglis, James Turrell, and Maurizio Cattelan, among others, contains valuable information relating to the conservation of these artists’ works. It is available through ICS or from Amazon.

**ARIZONA**

The ‘other WAC’ is no more. The National Park Service’s Western Archeological and Ethnographic Field School in Tarapaca, Chile will soon be folded into the Intermountain Region Museum Services Program. This will hopefully fulfill the common misconception that our conservation labs deal primarily with archaeology.

NPS conservators Gretchen Voeks and Brynn Bender have been working on pesticide testing projects for collections of natural history specimens and NAIP/ACA items. Brynn, Audrey Harrison, and Maria Leskewicz performed treatments for the Grand Teton National Park’s Vernon collection of Native American items.

Maggie Kipling is completing treatments on the Antelope Canyon to prepare for the Grafion III specimen to the Tarzain NM and working on a condition survey of objects from Manzanar NH.

Martha Winslow Grimes continues organizing volunteer Angels Projects for the Costume Society of America. A successful project of processing artifacts for storage was held at May 19 at Jackson Barracks, a military museum in New Orleans, LA. The museum took on 12 feet of water during Hurricane Katrina submerging their artifacts. The museum’s over one thousand artifacts are expected to be on exhibit in May 20th to help out with their military uniform and flags.

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Chris White has recently returned to ASM from Italy where he worked at the site of Poggio Colla on archaeological material. He is returning to the Poya research and is currently focusing on the identification of adhesives and organic residues on the museum’s ceramics collection.

Caitlin O’Grady is completing her Kress Fellowship and will continue working in the ASM Conservation Lab as a New Science Foundation IGERT Fellow in Archaeological Science. She will continue working on her PhD research on the identification of adhesives and organic residues on the museum’s ceramics collection.

René Boitelle, a paintings conservator from the van Gogh Museum in Amsterdam, will work at the Getty Conservation Institute’s Field Projects section on mosaics under the direction of Brian Considine. Molly Galloway will join the Anthropology Conservation Laboratory at the Field Museum of Natural History (NMNH) where her work will focus on a special loan of NMNH Native American collections to the Anchorage Museum and Arctic Studies Center. Allison Lewis will be working on the condition of textiles from GCI’s collections as well as three landscapes by Rousseau which are also in the studio (one of which is a recent Getty acquisition).

Sue Ann Chui, an American jewelry production and use in the southwestern United States. She recently returned to ASM as a permanent staff member. Graduate student Stephanie Nastassova has taken over her duties.

American jewelry production and use in the southwestern United States. She recently returned to ASM as a permanent staff member. Graduate student Stephanie Nastassova has taken over her duties.

Regional Reporter:

**REGIONAL NEWS**

**GREATER LOS ANGELES**

The Natural History Museum is pleased to host Jennifer Kim, a final year conservation graduate student from the NYU program, for a nine-month internship. Starting in September, Jen will be working with conservator Tania Collins and conservation technician Kathleen Olson to preserve and rehouse objects for a new permanent exhibit.

In Decorative Arts and Sculpture Conservation at the J. Paul Getty Museum, Julie Ferguson worked on ancient Vedic artifacts and tablet from the Middle East. She also worked on a basketry conservation project which brought two interns, Molly Galloway and Liz Werden, to begin their internship at the Field Projects section, focusing on documentation with Adobe and rendering of their datasets as students in the Fall 2007 class: Siska Graubruger, Lauren Horelick, Jiafang Liang, Linda Lin, and Suzanne Morris. Rosa Lowinger’s “1999 Sculpture Magazine” interview with Cuban artists Los Car-

**WASHINGTON, D.C.**

Beach, Florida. She has also completed a comparative technical essay on a small painted plaster relief from the Fine Arts Museums of San Francisco, which will be offered this year. Gage Yucán has moved to the University of New Mexico,where she will work on a large survey of ephemeral objects, as well as exhibitions and loans. Liz Werden will begin her internship with the Getty Conservation Institute’s Field Projects section, focusing on documentation with Adobe and rendering of their datasets as students in the Fall 2007 class: Siska Graubruger, Lauren Horelick, Jiafang Liang, Linda Lin, and Suzanne Morris. Rosa Lowinger’s “1999 Sculpture Magazine” interview with Cuban artists Los Car-

**NEW WORLDS**

**REGIONAL OFFICERS**

**NEW MEXICO**

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**PACIFIC NORTHWEST**

The Royal BC Museum has been very fortunate to have Jane Kemp, a conservation intern from the UK. Jane has been a fantastic assistant and occasional artifact replacements in the summer blockbuster exhibits, Titanic: The Artifact Exhibition. She also participated in the condition reporting and mount preparation for GCI’s large in-house exhibition, celebrating BC’s 150th anniversary as a colony. Jane’s greatest potential contribution, however, is her research into PEG impregnation of waterlogged wood for future exhibitions.

Treasures of the Tsimshian currently showing at the Art Gallery of Ontario and soon to be at the Canadian Museum of Civilization will be a fantastic exhibit for which digitized conservation
Regional News, continued
documentation, including digital photography and condition reports, was mastered by RICM staff.
The RICM completed XRF testing for pesticide residues in a collection of First Nations artifacts which may soon be repatriated. Many thanks to the UBC Museum of Anthropology for their support and cooperation on this project. Work continues on the engineering report and cool storage vaults. Construction is scheduled to begin in the new year.

Tania Ainsworth will be joining the RICM this fall as a Sasco Sidney Florence College intern. The RICM also recently welcomed back Jann Stefani, our previous SFU Florence intern, who is assisting in the Archives Lab, with the help of former Archives conservator, Barry Byers, while Betty Walsh is on leave until September.

Susan Lewandowski (from the Seattle Art Museum Conservation Department) and Lina Lazarus (from the Burke Museum, University of Washington) have been interning with Alice Bear Conservation.

Dana Seng of DKS Conservation Services, has been working with the National Park Service for the past few months assisting with stabilization treatments of artifacts from the Gettysburg collection. She has had the pleasure of working with a wide variety of treatment issues as well as the wonderful folks at the Harpers Ferry Conservation Center in West Virginia.

The Washington State Arts Commission’s (WSAC) Art in Public Places Program has hired Adam Novak as Conservation Technician. Adam will be working with the Collections Manager facilitating conservation projects, art handling, preventative conservation, and partner agency training for the care of more than 4600 artworks located throughout the state, making the works accessible to the public.

Kress Fellow Tina Quabeck, on leave from the K20 K21 Museum in Dusseldorf, who has been working on a paper conservator project for the next fiscal year, has recently been named vice-chair for the ACCIPP specialty group. She also gave a presentation at the workshop “The Chemistry of Conservation” held at Colorado College. She attended the Canadian Association for Conservation annual meeting in St. John’s, Newfoundland this past May.

Denver Art Museum conservation staff regret to announce that third-year intern Brian Tinkham, of Paper Conservation, has left for a wonderful job in Omaha NE at the Gerald Ford Conservation Center. She will be missed, but not forgotten. On the other hand, we are pleased to announce that Elizabeth Hamberger from Buffalo State College Conservation is traveling to St. Andrew’s University in Scotland for the Postgraduate Masters course in Museum and Gallery Studies. In September, the SAM conservation department welcomed a new coordinator, Jenny Söderlund.

This fall, SAM conservation and registrators will collaborate with the University of Washington, teaching artists’ techniques to graduate students in the Fine Art Department and teaching the art lab for the Museum Collections Management course of the Museology Masters program.

Jack Thompson has completed CAP surveys for both the World Kite Museum in Long Beach, WA and the Oregon Jewish Museum in Portland, OR. He has also had the pleasure of working on a few family treasures: a family bible that was stolen in 1943 and recovered just last year at a genealogical library in Vancouver, WA and a fiddle and fiddle case belonging to his great-grandfather. The bible has been treated and the family records inside updated. The fiddle case is currently undergoing restoration.

Regional Reporter: Dana K. Senge

ROCKY MOUNTAIN REGION

Camille Moore, who recently graduated from the NYU conservation program, has joined Silverpoint Art Conservation, LLC as Assistant Conservator. She and Laura Zimmerschied are working on a large group of photographers by Edward Curtis.

Victoria Montana Ryan has recently been working on community college galleries around the state, making the works accessible to the public.

Regional News, continued

Regional Reporter: Beth Szahay

The WSAC Art in Public Places Program is also organizing a traveling exhibition of Jacob Lawrence’s series The Legend of John Brown from the State Art Collection. The exhibition tour begins this fall in the Pacific Northwest and continues to community college galleries around the state, making the works accessible to the public.

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Matthew Brack successfully completed his internship in paper conservation at the Asian Art Museum and has returned to complete his degree at Northumbria U.

Melissa Bucsey is joining the Asian Art Museum paper lab this fall as a third year intern for her Masters program.

Denise Migladi will be participating in the North American Textile Conservation Conference in DC this November. Denise will be attending the workshop on “Aqueous Cleaning Methods” taught by Richard Wolbers and “X-radiography for Textiles” by Sonja O’Connor.

Regional Reporter: Beth Szahay

HEAD OF CONSERVATION SEARCH REOPENED

The Asian Art Museum of San Francisco is seeking a Head of Conservation with strong managerial, leadership, and communication skills to supervise and coordinate the staff and operations of the Conservation Laboratory for this world-renowned collection.

Reporting to the Director of Museum Security, the Head of Conservation directs and manages the staff and activities of the Conservation department. The museum’s chief spokesperson on conservation issues, he/she must possess the ability to anticipate the future needs of the institution and to design effective systems for meeting the museum’s obligations with regard to the care and preservation of the collection.

The Head of Conservation supervises and performs highly skilled conservation work including examination, research, treatment, and preparation of works of art for exhibition or storage. The Head of Conservation is responsible for the museum’s chief spokesperson on conservation issues, he/she must possess the ability to anticipate the future needs of the institution and to design effective systems for meeting the museum’s obligations with regard to the care and preservation of the collection.

The ideal candidate will have a significant record of professional achievements that may include publishing and exhibiting, He/She will bring energy, vision, and resourcefulness to this critical position. For the full listing and to apply online, visit our website: www.asianart.org, EOE.
A note about the Hot Air Tool made by Steve Prins was planned for this issue—coincidently, a thread relating to heating tools developed paints. By mixing different pigments and varnishes, a Specialty Group online list. The following is a contribution of collaborations by Steve, Chris Stavroudis, Carol Tomkiewicz, and Rob Proctor, which describe alternatives to standard heated spatulas.

Steve’s Hot Air Tool, pictured below, is the one I can vouch for. I’ve had one for about 10 years and have lent it to several conservators who then get their own if they find it indispensable. It’s a small unit with controls for air flow and temperature, with a range of 35°-350°C (95°-660°F) and a dual speed air pump with a flow valve that permits very low flow for delicate work. It comes with three nozzles 1.5mm, 2mm, and 3mm in diameter. The air hose is an adequate length, but one can opt for the longer size, which makes it more convenient to use, especially for on-site work.

Steve Prins was planned for this issue by Patricia Leavengood. A compilation of the talks comprising the Loss Compensation Symposium Postprints a radiant heat tool attachment (flip from spatula to radiant); the temperature dial in centigrade regulates heating a small area (about 1/2-3/4 inch across) without air flow for cases where displacement with air flow is an issue. The WZ IV of this series also accommodates a sanding/drilling tool. Olaf Unsoeld, furniture conservator, is the liaison in the USA for acquiring the tool and other Engelbrecht products; his e-mail link is: unsoed(at)earthlink.net. If you’d like to see an image of this tool, go to: www.definer-johann.de/. Go to “Technische Geräte,” then to “Heizspachtel und Zubehör” (this European distributor’s web-site is in German). Carolyn Tomkiewicz has used this tool for over 15 years without problems or repairs.

Another recommended tool is the Mini Waxer (model 65999) from Almore Dental www.almore.com, for thread-by-thread tear repair and in situations where a very small spatula tip is needed. You can call the company and order the tip that best suit your needs. Conveniently these tips also fit the Engelbrecht welding needle attachment. The temperature regulation is very good though not indicated by degree on the dial.

And very similar: the Mini Wax cutter available from the Complete Sculptor (www.sculpt.com). It comes with three tips, (others are available) which can be adjusted to suit your needs with emery paper. The tips can be dipped in the stuff made for repairing non-stick pans or low viscosity epoxy like Epotek 30. The former sticks less but the latter will not rub off.

Several kinds of hot tools were mentioned: silicone shaping tools with a variety of shapes, sizes, and hardness (available at many art stores); Teflon tools, in the form of the folder from Hiromi Paper (www.hiromipaper.com, bookbinding section) or a Teflon glove (www.fishersci.com). Saint-Gobain PTFE Policeian. Either can be carved to suit.

Lastly, some useful general comments: Thermoplastic resins set such as wet, and Teflon tools or shrink sheet used with a Teflon tool or silicone shaper work better than tacking irons for more sensitive manipulation of paint, but it’s also important that the tool can be kept in place after the source of heat is removed. Of course these tools can be used following the application of a tacking iron, but this necessitates removing the tool and switching when the tools are switched. Best of all, super sensitive paintings can often be consolided without touching their surfaces by using the hot tip tool in combination with a vacuum line. One can then BEVA. One can then BEVA 110 and a radiant heat tool, but not silicone. (The hot air tool is also good for getting caps of paint tubes or small Kuick touches.)

Carolyn Tallent

Handling Guide for Anthropology Collections Straightforward text is paired with humorous illustrations in 41 pages of “do’s” and “don’ts” of object handling. Written by Nancy Odegaard, this manual was designed to be used by researchers, volunteers, visitors, students, staff or others who have not received formal training in the handling of museum artifacts. Paper-bound and printed on acid-free stock.

Price, prepaid: $8.85 ($6.60/copy for orders >10 copies)

Loss Compensation Symposium Postprints A compilation of the talks comprising the Loss Compensation Panel from the 1993 meeting at the Marconi Conference Center, enhanced by a detailed introduction into the history of loss compensation theory written by Patricia Leavengood.

Price, prepaid: $12.50

Back issues of WAAC Newsletter Back numbers of the Newsletter are available. Issues before 1993 cost $5 per copy; issues from 1993 on cost $10. A discount will be given to libraries seeking to obtain back issues to complete a run and for purchases of ten copies or more.

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WAAC Publications

Technical Exchange

WAAC Newsletter Volume 29 Number 3 September 2007

A Novel Approach to Cleaning II: Extending the Modular Cleaning Program to Solvent Gels and Free Solvents, Part 1 by Chris Stavroudis and Tiarna Doherty

This article has been divided into two parts. This first section deals with principles of solubility and presents the interactive graphical display created to assist one in selecting solvent gels. The second will discuss the formulation of Carbolipol gels and use of the Modular Cleaning Program.

Abstract

The Modular Cleaning Program (MCP) was originally conceived to assist the conservator in the formulation and selection of aqueous cleaning systems. Upon using the system, it became apparent that many of the advantages of the approach could also be applied to both solvent gels and free solvents.

The two overarching principles of the MCP are the use of small amounts of standard stock solutions that can be mixed to make a large number of test cleaning solutions and the use of physical constants as a basis for all calculations. The conservator decides on a cleaning strategy and uses the program to work through variables to determine the optimal cleaning system. The computer takes care of the bookkeeping issues, from creating the most efficient gel to formulating complete mixtures. The software provides a context showing which parameters may be changed in a cleaning, and the conservator chooses the direction of the testing.

Using small volumes of test solutions offers advantages in cost, ecological impact, and health and safety by minimizing exposure and waste. The speed and ease with which test solutions can be formulated allows many more cleaning options to be tested and evaluated than was previously practicable when each test solution had to be made from scratch.

This paper will focus on the design of the solvent and solvent gel capabilities of the program, which will enable a conservator to approach a cleaning using a mixture of free solvents or a set of stock solvent gels that can be mixed together.

The MCP incorporates a new theory for formulating solvent gels: the theory, based on physical observation, postulates physical-chemical structures for Carbopol-based gels. These structures have been used to calculate the gel formations. A group of solvent gels has been integrated into the new graphical display of solvent parameters, allowing the conservator to visualise through the selection of gel combinations. These features are not fully integrated into the current version of the MCP, but are included in the next version. Using the MCP, the user can select any solvent system. The clearance of Carbolipol-based gels will also be addressed within the database. Recommendations for clearance mixtures will be based on the solubility range of the Carbopol/amine present in the gel or gel mixtures and are calculated in Han Sen Solubility Space. As yet, this feature is not incorporated into the database, but research is ongoing.

Introduction

The Modular Cleaning Program evolved as an extension of the Gels Research Project at the Getty Conservation Institute. Valerie Dorge, Dusan Stulik, and Richard Wolbers wished to codify, in the form of a ‘logic tree,’ the thought process that a conservator would follow to arrive at a successful gel cleaning (Dorge 2004).

Using the logic tree concept as a basis, Chris Stavroudis developed the first version of the MCP, which dealt with aqueous cleaning. It incorporated the handling of museum artifacts. Paper-handicrafts, visitors, students, staff or others who have not received formal training in the handling of museum artifacts. Paper-bound and printed on acid-free stock.

A number of methods were tested for quickly preparing a solvent gel of any polarity from pre-mixed components (Appendix B). It was realized that a useful preliminary approach was to use pre-mixed gelled solvents that could be combined with each other. As with the aqueous system, the conservator would use the stock gels to mix a small amount of almost any solvent gel necessary for testing in a matter of minutes.

In an analogy with inpainting, the set of stock gels can be thought of as the palette, and the individual gels are the different paints. By mixing differing amounts of the paints together, the conservator can match any color within the gamut of the inpainting palette. Similarly, by mixing different amounts of solvent gels, one can make a solvent gel set together, a test gel of any intermediate solvent strength can be formulated. The gel sets differs from paints in one significant way, however. While any color can be mixed with any other, regardless of where they fall on the spectrum, gels need to have compatible polarities. Accommodating this requirement meant working with a range of each stock gel's polarity.

The ability to create a gel for a solvent blend depends on the amine used to neutralize the Carbopol and the polarity of the solvent mixture. Typically, Ethoam C/25 (polyethoxylated cocamine), Ethoam C/12 (di ethanol cocamine), or Aquadex 2C (docosamine) are the bases used to react with the polyacrylic acid groups that constitute the Carbopol polymer. The amines are also surfactants and the differences in the hydrophilic and hydrophobic character of each determines the polarity of the Carbopol/amine combination. If the polarity of the Carbopol/amine combination is compatible with that of the solvent mixture, the Carbopol polymer, along with its neutralizing amines, can unravel and impart a three-dimensional network. However if the polarities are incompatible, the gel collapses into a mixture of stickygoo floating in solvent.
Extending the Modular Cleaning Program to Solvent Gels and Free Solvents, Part 1

In order to extend the solubility range, the idea was developed of using two bases to neutralize the Carbopil in a gel. This is the rationale and genesis of the so-called "dual neutralization gel" which will be discussed later. An additional benefit from widening the solubility range of gel is that a wider range of solvent mixtures could be used to clear the gel.

To formulate a gel-based test cleaning system it was necessary that solubility theory be incorporated into the MCP. Providing this information would allow the MCP to be used for solvent-based cleaning as well as serve as a framework for discussing the clearance of solvent gels. For the MCP to support solubility theory, physical constants from various sources had to be added to the database. As will be discussed shortly, these physical constants are used to calculate solubility parameters and predict solvent behavior.

Solubility

Solubility theory can best be considered an extension of the fundamental concept “like dissolves like.” The more a solvent and solute are chemically similar at the molecular level, the better the solvent will dissolve the solute. Of course, solubility is much more complicated than that, which can be seen in the complexity of the numerous solubility theories offered in the literature and the several systems developed to describe the behavior, i.e. solubility parameters, of a solvent.

The single Hildebrand solubility parameter, $\delta$, is an aggregate measure of all intermolecular forces attracting one molecule to another. It is worth mentioning that Hildebrand and Scott proposed an equation (see Appendix A) that gives an estimate of $\delta$ based on the boiling point of a solvent. This serves to further emphasize the relationship between the process of evaporation and solubility. It also means that with minimal information, simply knowing a solvent’s boiling point, molecular weight and density, we can estimate its solubility parameter.

However, the Hildebrand system has limitations, as can be seen when considering two very different solvents like n-propanol and dimethylformamide, which have nearly identical Hildebrand solubility parameters and yet have very different characteristics in cleaning works of art. This means that an aerotrope is lower than either of the component solvents. Unfortunately, hydrogen bonding behaves more like an acid-base reaction than a simple attractive force, and this is a weakness of the Hansen solubility theory. However, in most cases, the Hansen partial solubility parameters work fairly well, and they are used in the solubility calculations in the MCP.

The MCP uses Hansen’s solubility theory as the basis for calculating interactions between components and solvents. Because the MCP enables the conservator to manipulate solvent compositions, it is worthwhile to review the component forces in Hansen, Teas, and other similar theories.

Dispersion forces ($\delta_d$) are the intermolecular forces that attract all molecules to one another. They are commonly weak and are responsible for hydrocarbons like heptane being liquid and larger molecules, like waxes, being solid. Also called London or van der Waals forces, they are explained by quantum mechanics. When molecules are in close proximity, the electron cloud of one molecule induces a distortion in the adjacent molecule’s electron cloud. The distortion causes a net attractive force despite the fact that the electron clouds should really repel one another. Van der Waals forces are related to the surface area of the molecule and function only at close distances. So greater structural similarity between solvent and solute allows molecules to pack closer together and have more area in common, thereby increasing the van der Waals attractive force.

Dipolar forces ($\delta_p$) are often, and incorrectly, referred to as polar forces, as the actual phenomenon of polarity results from a combination of forces. Adding to the confusion, because the subscript ‘p’ is already taken for dispersion forces, they are notated by the subscript ‘\(p\)’. Dipolar forces arise from electrostatic interactions between molecules. They arise from permanent dipoles created by the molecular structure, where partial positive charge is separated in space from partial negative charge. Partial positive charges on one molecule attract to the partial negative charges on an adjacent molecule. Dipoles can also be induced into molecules that don’t normally possess a permanent dipole resulting in a net attractive force between the molecules. Dipolar forces are the predominant intermolecular forces in Hansen space and the solvent mixture being considered (figure 1).

Hydrogen bonding interactions ($\delta_h$) are the strongest of the intermolecular forces. Hydrogen bonds are temporary bonds that form between hydrogen atoms attached to a strongly electronegative atom (O, N, F) in one molecule and another strongly electronegative atom in an adjacent molecule (or, in larger molecules, in the same molecule). This temporary bond forms because the strongly electronegative atom pulls the electron cloud from around the hydrogen molecule, leaving a somewhat exposed proton. If a strongly electronegative atom in an adjacent molecule likewise has pulled the electron clouds from atoms within its molecule, it will have acquired a partial negative charge, and will be attracted to the partial positive charge of the hydrogen proton. Hydrogen bonding is predominant in alcohols. Unfortunately, hydrogen bonds behave more like an acid-base reaction than a simple attractive force, and this is a weakness of the Hansen solubility theory. However, in most cases, the Hansen partial solubility parameters work fairly well, and they are used in the solubility calculations in the MCP.

Various tabulated Hildebrand and Hansen solubility parameters have been entered into the MCP. Where sufficient raw data is available, the MCP also calculates the Hildebrand and Hansen solubility parameters for all components as explained in Appendix 1. The MCP preferentially uses the published, tabulated values from: "Hansen and Beerbower’s 1971 Parameter Handbook for Liquids at 25°C" as published in Barton, Table 11 (1991).

There is one more complication to mention: the formation of aerotropes. An aerotrope is a particular mixture of solvents that has a boiling point minimum (or maximum) lower (or greater) than the starting components. As conservators, we are only interested in aerotropes that show a minimum boiling point. Hildebrand solubility parameter can be calculated from a solvent’s boiling point. The boiling point of an aerotrope is lower than either of the component solvents. This allows an aerotrope of solvents will have an anomalous solubility parameter. This anomaly is not calculated for in the MCP. However, the MCP does alert the conservator of any binary or ternary aerotrope that might exist for the mixture under consideration.

Aging and Solubility

So, after all of the theoretical discussion, one is back to “like dissolves like,” with the proviso that “like” be evaluated on a decidedly chemical basis. Of the many “cleaning” scenarios in conservation, probably the most common is dissolved efflorescence or another where where a complex material was deposited in a “mild” solvent but the coating, adhesive, or paint has changed with time and no longer dissolves in the solvent in which it was deposited. The change in solubility of the second material upon aging is typically caused by any of four possible chemical changes. An organic material can oxidize, form double, often conjugated, or reduce cross-linking, or reduce its molecular weight by chain scission. (Only the first two are of significant interest in this discussion.)

In a very simplistic way, oxidation of paint or varnish can be considered as the addition of acid or ketone groups (or both when forming a carbonylic acid) to the material. To re-dissolve oxidized material, the polarity of the solvent has to increase by moving towards either higher dipolar strength solvents or lower hydrogen bonding solvents. Ultimately, oxidation can require such high polarity solvents that an aqueous cleaning system may be considered.

Similarly, yellowing can be thought of as the addition of unsaturation (double bonds) to the structure. It might be too broad a generalization of “like dissolves like,” but it is a convenient oversimplification to try to re-dissolve yellowed material by increasing the proportions of double bonds by increasing the aerotrope parameter of the solvent.

Applying Solubility Theory

It was necessary to make some adaptations to the original MCP so that it would work with solvents, both free solvents
Extending the Modular Cleaning Program to Solvent Gels and Free Solvents, Part 1

Although tracking down many of the physical constants required referring to a number of different reference sources (Lide 2002; Weast 1972; Budavari 1989; Gemling et al. 2004). Adding the algorithms for working with mixtures of solvents in Hansen space, calculating Teas values and NFPA hazard ratings was more of a challenge. The most difficult task was to come up with an interface that made sense of the numbers generated by the computer and an intuitive means for the conservator to interact with the model.

As always when three variables are interacting, the best way to illustrate it is in three dimensions. Unfortunately, practically speaking this is awkward to display and interpret.

Yet, the most significant change in the MCP is an interactive, graphical display of solvent parameters (figure 2) for working with both solvent mixtures and solvent gels. This display is based on Hansen solubility parameters and a new parameter, which we have called the aromatic/aliphatic index. This diagram does not represent a new solubility theory but is a visualization tool for the conservator. You will notice that a few familiar solvents have been indicated on the diagram.

Examining the polarity triangle one sees that the three axes are labeled dispersion forces, dipolar forces, and hydrogen bonding forces. While this may superficially resemble the Teas Diagram, it is not the same at all. The horizontal line from the left apex represents increasing polarity (in the broader sense of the term) and is the source of the triangle’s name. The increased polarity results from increasing hydrogen bonding forces, dipolar forces, or both. This trend can be thought of corresponding to oxidation in our simple model of the aging of organic materials.

The previous discussion of aging posits that yellowing is attributable to the formation of double bond and that double bonds require aromatic content to solubilize them. From the perspective of the conservator, solubility theory is not entirely satisfying in reflecting the subtlety of differences between aromatic and aliphatic solvents. To demonstrate the influence of the y axis dispersion forces, the vertical axis of the diagram has been detached, as it were, and laid flat.

When the proportions of a solution change, and its inter- and intra-molecular forces change, two dots appear on the new version of the diagram. One, on the triangle, demonstrates its character relative to dipole forces and hydrogen bonding (solution polarity), while dispersion forces are demonstrated on the aromatic/aliphatic bar. (The A/A bar is not an actual measure of the dispersion forces, but reflects the ratio of aromatic to aliphatic in the solution. See Appendix B for a discussion of the aromatic/aliphatic index in detail.) When the proportions change again, these move simultaneously to show the new set of behavior characteristics. (figure 3)

The next installment of this article will present our ad hoc theory of Cabopol based solvent gel formation and will discuss how this empirically derived model is used in the MCP to assist with solvent gel formulation. We will then discuss in further detail how an understanding of solubility theory can suggest approaches to cleaning with solvents and solvent gels and how the MCP can assist with formulating cleaning systems. We will also consider what future research will allow us to determine the solvent mixtures that will most effectively clear a specific solvent gel formulation by using Hansen solubility space calculations to determine how “good” a solvent or solvent mixture will be at keeping a given gel in a happy place, from a solubility perspective.

The MCP is available as freeware. Conservators must register before the software will work in an effort to keep non-professionals from thinking that a computer program can substitute for a professional conservator.

To use the diagram – which, please remember, is designed to be a tool and not a new theory – one selects a solvent to represent each solvent class: aromatic, aliphatic, dipolar, and hydrogen bonding. Then by changing the proportions of these solvents, the database can calculate the polarity and aromaticity of the solvent mixture. In the MCP, the polarity triangle and A/A bar are interactive. As the composition of the test solvent is changed, the position of the dots (one in the polarity triangle and one in the A/A bar) move, providing a visual reference for the conservator.

Figure 2. The graphical display which illustrates solubility space in the MCP. There are two separate but related elements in the diagram: the polarity triangle and the aromatic/aliphatic (A/A) bar.

Figure 3. Three views of the solvent cleaning screen in the MCP, showing n-heptane alone, xylene alone, and a 1:1:1:1 mixture of n-heptane : xylene : isopropanol : acetone.
Appendix A – Soluteility Parameter Calculations

To calculate the Hildebrand solubility parameter of a solvent, one looks up values for the enthalpy of vaporization, its molecular weight and density. The MCP calculates the Hildebrand solubility parameter from the following equation:

\[ \Delta = \left( \frac{\Delta H}{R} - RT \right) \sqrt{\frac{V}{m \cdot \rho}} \]

where \( V \) is the molar volume, \( m \) is the molecular weight and \( \rho \) is the density. The MCP calculates the enthalpy of vaporization from both measured \( \Delta H \) values and the boiling points of the solvents if there are sufficient physical constants in the Handbook of Chemistry and Physics. Further parameters from the above equations and calculate the dispersion parameter by difference. Many of the constants are located in reference sources, but not all information is available for all solvents. Mixed solvents, such as mineral spirits, etc., of course don’t possess these values as we are not privy to the chemical composition of the whole mixture. Analytical methods for the manufacturer often provides the Hildebrand solubility parameter.

Appendix B – The Aromatic/Aliphatic Index

One way to estimate the difference in energy between aromatic and aliphatic compounds is to compare benzene and cyclohexane. Examine the heat of hydrogenation between cyclohexane, cylohexylene, and cyclohexadiene and extrapolating that to a non-existent, non-aromatic, cyclohexane, and then comparing that value to benzene, one finds a resonance energy of 36 kcal from the formation of an aromatic ring. This value is also consistent with the heat of combustion (Morrison and Boyd, 1973, p. 323).

Paralleling the way Hansen originally defined the hydrogen bonding partial solubility parameter (above), we have proposed an aromatic/aliphatic index as the resonance energy of an aromatic ring divided by 6 (for the six carbons in both molecules) times the number of aromatic atoms (FA) in the molecule and then multiplied by the number of aromatic atoms divided by the total number of carbons (FC):

\[ A = \frac{2.0455 \times [36,000 \times (\text{#A}/6) \times (\text{#A}/\text{#C}) / V]}{\text{#A}} \]

where \( A \) is the number of alcohol groups in the molecule (Ahn, 1967, p. 24). In both equations, the factor 2.0455 is the dielectric constant, \( n \) is the index of refraction, and \( \mu \) is the dipole moment of the solvent (Hansen 1967, p. 25).

Likewise, Hansen proposed that the hydrogen bond partial solubility parameter could be calculated for alcohols by dividing the energy of a hydrogen bond (5000 cal., determined from the IR spectra for a typical H—OH hydrogen bond) by the molar volume:

\[ H = \frac{5000 \times A}{V} \]
Protecting Collections in the J. Paul Getty Museum from Earthquake Damage

In 1983 the Getty Museum in Los Angeles, California began efforts to reduce the damaging effects of earthquakes to its collections by:

- Characterizing the overall geology and seismic history of the museum and describing a worst-case seismic event that might occur within a reasonable time frame and at a reasonable risk level,
- Determining the overall response of the museum building to such an event,
- Determining how the contents of the building (collections, display furniture, and fixtures) would respond to the earthquake motions and forces, and
- Developing seismic mitigation approaches to protect the collections.

The four basic methods which were developed to mitigate damage will be discussed in the latter part of this article. They are:

- Lowering the object’s or object assembly’s center of gravity by adding weight to the lower parts of the display assembly.
- Restraining objects by firmly securing them to the floor, pedestals, shelves, wall, and/or supporting mounts.
- Alleviating rocking and sliding forces, and
- Allowing sliding of the display furniture by the use of base isolation mechanisms.

Defining the seismic threat

The mitigation approaches discussed above, particularly base isolation, could only be undertaken when a thorough understanding of how earthquakes affect structures and contents was achieved. The assistance of experienced seismic engineers and seismologists was necessary to establish the characteristics of the worse case scenario earthquake predicted for the area and specific site where the collection is housed.

The duration, strength, frequency content, and potential for displacement of the simulated earthquake, as well as the response of the building (indeed the specific areas of the building) where the collections are housed, give direction to any efforts in developing mitigation approaches. For example, it is more important to know the peak acceleration, velocity, and predominant period of an earthquake (and the building and object response), than it is to know the expected Richter scale magnitude since the former can provide measurable design criteria. Insufficient design can be useless and even make things worse during an earthquake.

In 1984 the Getty Museum commissioned Lindvall, Richter, and Associates to prepare a geologic and seismologic study of the museum site and a geotechnical and structural response study of the Villa museum building.1 Later updated by the URS corporation.2 The museum defined an event with an 80% probability of being exceeded in 50-years (reoccurrence estimated to be every 225 years) as an acceptable risk level.

The study identified two events that would have the most impact upon the museum: an 8.3 Richter scale earthquake on the San Andreas fault, some 67.5 km away from the museum (resulting in a horizontal ground acceleration of 0.2 g at the museum site) and a 6.5 Richter scale earthquake on the Malibu Coast/Santa Monica fault system at a distance of 1.6 km (potentially producing a maximum 0.7g horizontal ground acceleration at the museum site).

Determining the behavior of objects

The conclusions of the Lindvall report provided dynamic data for use in analyzing the behavior of art objects housed at the museum, such as the 1990 research by Aghbalian, Masti, and Negori3 that attempted to predict the seismic response of art works by modeling generic categories that represented groups of similar objects. From these studies basic criteria for stability have evolved. For example, the response of a rigid object to earthquake induced forces and motion can be sliding or, if the friction between the object and the supporting plane is high enough, rocking and eventual overturning. Rocking and overturning are based on the nature of the earthquake and the object’s or object assembly’s geometry and mass distribution.

Figure 1. Rocking stability chart for the Getty villa. Primary horizontal component peak acceleration is 687 cm/sec2 (0.7g) and peak velocity is 3.19 cm/sec. Reprinted from M.S. Aghbalian, et al., Evaluation of Seismic Mitigation Measures for Art Objects, p. 38.

Rocking and sliding will occur when the ratio of the maximum horizontal acceleration is greater than B/H aspect ratio: 2 \( \times \) \( \frac{B}{H} \). Overturning will occur when the relationship of the aspect ratio to velocity of the earthquake is as follows: \( V > \frac{100}{B} \times H \). Whether rocking, sliding, or overturning occurs also depends upon the location of the center of gravity as in figure 2.

Determining the behavior of objects

The term center of gravity (cg) describes a theoretical point within the mass of an object or object assembly where all earthquake forces are focused. The lower the center of gravity is the more stable and resistant to rocking and overturning the object or assembly is. One of the simplest methods of determining the cg is to measure the maximum depth, width, and height of the object and then translate those dimensions into a geometric volume that closely resembles the object’s shape, assuming an even weight distribution throughout the entire volume of the object. The center of gravity will be roughly the same as the calculated center of the geometric volume; see figure 3.

Figure 2. An overturning or sliding response is directly related to the aspect ratio. In a the object will most probably rock and/or overturn, while in b, with a lower center of gravity and a more favorable aspect ratio, the response will be sliding (assuming a sufficiently low coefficient of friction between the object and the support plane).

Alternating the aspect ratio and/or adding weight to the lower sections of the assembly are two ways the center or gravity can be lowered for greater stability. Before this is attempted however, calculating the actual location of the center of gravity of any object or assembly is essential.

Determining the center of gravity

When an object is composed of segments with differing dimensions or densities, each segment can be translated into a geometric shape and the equivalent block determined (figure 4). This method can be advantageous when an object is complex in shape; is made of a variety of segments; has an eccentric distribution of mass; or is part of an assembly (such as a sculpture and pedestal combination). If the separate components cannot be weighed, calculations can be made based on standard material property references.

Determining the Equivalent Block

When an object is composed of segments with differing dimensions or densities, each segment can be translated into a geometric shape and the equivalent block determined (figure 4). This method can be advantageous when an object is complex in shape; is made of a variety of segments; has an eccentric distribution of mass; or is part of an assembly (such as a sculpture and pedestal combination). If the separate components cannot be weighed, calculations can be made based on standard material property references.

Figure 3. A simplified method of determining center of gravity locates the center of a geometric volume. This assumes however that the simplified geometric model accurately reflects the mass of the object and that the density of material is consistent throughout.

Figure 4. Determining the equivalent block of an object assembly, in this case a sculpture and a pedestal combination.

\[
(\text{D1} + \text{W1}) + (\text{D2} + \text{W2}) + (\text{D3} + \text{W3}),
\]

\[
\text{W1} + \text{W2} + \text{W3}
\]

D= Distance from the ground to each section’s cg
W= Each section’s weight
Hcg= Height of the equivalent block

If:
\[
\text{D1} = 146.5 \text{cm and } \text{W1} = 18 \text{ kg},
\]
\[
\text{D2} = 23 \text{ cm and } \text{W2} = 66 \text{ kg},
\]
\[
\text{D3} = 65 \text{ cm and } \text{W3} = 90 \text{ kg}
\]

then:
\[
\text{147.5 x 18} + \text{146.5 x 66} + \text{65 x 90}, \text{or: 16600 = 1072. 18 x 66 = 90} = 174
\]

The equivalent block has a center of gravity at 107 cm and 280 g formula gives us an equivalent block height of 214 cm.

Using the effective aspect ratio formula, \( SB / H^2 \) formula gives us an equivalent block height of 214 cm.

This paper was first presented at the international conference Istanbul 2007: Earthquake Protection of Museums, hosted by the Pera Museum.

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Protecting collections in the J. Paul Getty Museum from Earthquake Damage, continued

Lowering the center of gravity by adjusting the proportions of the exhibition furniture

If a resultant center of gravity is found to be too high, the cg can be lowered using a number of approaches. For example, the object can be fastened to the floor. Although this provides the most stability of any option, the object must be sufficiently sound to withstand the earthquake forces transmitted to it. The base or pedestal can be made wider or weighted for greater stability. An appropriately sized base plate or an enlarged base at the bottom of the pedestal are also options as shown in figure 5.

Calculating the effective aspect ratio of the assembly in figure 5 reveals a more favorable effective aspect ratio. It should be noted that if the height of the plinth/added weight component in figure 5 increases beyond the height of the added weight mass, this case load. Stacking the weight too high will cause the mass to become unstable.

Seismic mount making

The previous discussion assumes that the object is sufficiently robust and rigid to withstand any transmitted earthquake force. Since this is rarely the case, additional strength can be provided by introducing supportive mounts that cradle and restrain the object on display. Effective mount making requires familiarity with diverse materials, including a wide range of metals, woods, plastics, synthetic composites, and fabrics. Mounts should always be made of stable materials that are non-abrasive, non-corrosive, stable, non-staining, and free of corrosive vapors. When designing a mount the contact point between a mount and an object should be sufficiently large; fit as intimately as possible; and always be non-abrasive. Small contact points result in higher point-load forces, thus a larger contact area is used to distribute the forces and provide a more secure mount-to-object connection.

Mounts should be designed in such a manner that the object and mount can be quickly separated if desired. Adhering a mount to an object should be avoided if possible. A safety factor of three is generally considered good practice when choosing the strength of the material from which a mount is made. Dynamic forces due to earthquake motions can increase the total load on a mount by several magnitudes. This might translate into using a hook with an ultimate strength of 68 kg to hang an object weighing 22.68 kg.

Stationary/supportive mounts

While stationary/supportive mounts restrain objects and minimize dynamic loads that might be caused by the impact forces of rocking or falling, it is very important that the mounted object is sufficiently robust in nature to withstand a considerable proportion of the seismic load transferred through the building structure. Protection is dependent upon the object being firmly held to the mount at suitable points and over a suitably large area, and the mount must be securely fastened to the exhibition furniture, the wall, or the floor. The assembly must be rigid and respond as a single unit. Although a number of smaller objects on display at the Getty Museum are restrained using very simple anchoring methods (such as wax or synthetic monofilament), more substantial mounts are the more common approach. These include the following:

Interfaces

Objects which do not sit in a stable and level position, have uneven contact with the supporting plane (floor, pedestal top, or case deck), or have the majority of their weight concentrated on small points (point loaded), require a custom interface to distribute the load evenly over the bottom surface or over the surface on which the object rests (figure 6). Such interfaces are made of high compression strength materials, such as filled epoxies. Prior to casting an interface, the underside of the object’s base should be inspected for undercuts or cavities to avoid any physical “locking” of the interface to the object itself.

To cast an interface a modest amount of thixotropic epoxy is placed on a non-stick surface and covered with a sufficiently thick barrier of thin plastic film (such as the type used in the food service industry). The object is then lowered onto the plastic film and allowed to settle until the desired orientation is achieved and the excess epoxy is displaced. At this point the object should be secured so that it does not shift while the epoxy is curing. Care should be taken to assure that none of the epoxy has come into direct contact with the object. Once the epoxy is fully cured the object is lifted away, the plastic wrap removed and the interface trimmed to the desired shape. In most cases the interface will be secured to the display deck rather than to the object.

Clips

Clips are relatively small point-of-contact mounts that restrain an object’s movement but normally do not provide any support (figure 7).

Figure 7. A typical clip assembly.

A three-point restraint is recommended when using clips to secure objects with round or oval bases. In these cases the clips are spaced as close to 120 degrees apart from each other as possible (figure 8).

Figure 8. Object secured with clips and interface.

For square or rectangular bases clips on all four sides or at each corner are required. The edges of each clip should be slightly rounded and an appropriate felt or padding should be applied to the interior faces to protect the object’s surface.

For objects that are mounted to the wall the clips may also support the object vertically (along the lower edge). In the instance of freestanding objects clips are normally applied to the object’s base or lower edge. Caution must be exercised however since considerable stress will be concentrated at the point where the object is anchored during an earthquake. The taller the object is, and the higher the location of the center of gravity, the greater the forces will be at the anchor (clip) points. Stress failure at the area of load concentration (point loads caused by the clips) or at the area of material weakness is highly likely. Objects must sit flat, and if they do not, casting an appropriate interface is necessary.
Contour mounts

A contour mount is a supportive restraint that closely follows the exterior form of the object, providing complete contact along the object’s profile. A measurement of the object’s profile is attained using a profilometer, plastic contour gauge, or by cutting out and piecing together sections of stiff paper or cardboard as shown in Figure 9.

The material must have the strength and stiffness to support the object as well as withstand the earthquake load. Steel and brass are typically bent and/or welded to attain any given shape, whereas aluminum and acrylic parts are cut and/or adhered together to follow a pre-determined profile. Holes should be drilled through the mount at previously determined locations near the top and bottom where monofilament is inserted to secure the object to the mount as shown in figure 11. The interior surfaces should be felted and exterior surfaces finished. The mount is then secured to the display deck.

In most cases four basic materials are used to fabricate contour mounts; steel (including stainless steel), brass, aluminum, and acrylic (figure 10).

Seismic base isolation (decoupling)

The discussion to this point has been limited to anchoring objects using a variety of support mounts that essentially made the object part of the structure. While this approach has a number of advantages, it also means that the seismic forces transmitted through the building will be fully experienced by the object. It also requires that either the mount be fully visible in the display or that an internal structure (often invasive to the fabric of the object) be introduced. Since this is not always possible and since objects can be too fragile to withstand the seismic load, an alternative approach is base isolation.

Isolation of structures has developed rapidly in the last several decades, but the isolation of building contents, like collections, has lagged behind.

Base isolation remains a new solution to the reduction of seismic forces. In general the isolation mechanisms and materials on which a building or an object rests are designed to absorb the motions and energies of the earthquake. Isolation mechanisms that have some form of restoring force are widely recognized as the most effective.

Decoupling, as an approach to seismic isolation, allows the floor under the object to move during an earthquake without transferring the full force of the earthquake to the object. In a sense the friction between the bottom of the object and the floor is eliminated or dramatically reduced through the introduction of low friction interfaces or mechanisms that provide limited lateral movement between the object and the floor.

There are a number of ways in which an object might be decoupled from the floor. As already described, early efforts to stabilize objects at the Getty Museum included altering the h/b ratios of pedestal/object assemblies to the addition of large steel plates to the bottom of the pedestals. These plates reduced the risk of overturning during an earthquake but did not, necessarily, stop rocking and the resultant dynamic pounding (rocking induced impact) at the lower edges of the pedestal. Teflon pads were added to the underside of the plates to reduce friction. Theoretically these pads allowed the pedestal to slide further reducing the overturning threat and minimizing the degree of rocking. In practice however this decoupling was imperfect since rocking, even overturning, was made even more likely by encounters of the sliding pedestal with imperfections in the floor that dramatically and suddenly, increased friction.

Using a site and building study done by Lindval Richter and Associates in 1984 which identified a maximum probable event (MPE) and then provided a “design earthquake spectra,” it was found that any isolation mechanism being considered by the museum would have to have a period of greater than 0.9 seconds to get any reduction of acceleration input estimated to be 0.7g at its greatest.

The longer the period of the isolator the greater the isolation as long as sufficient room for displacement is provided. However at some point displacement demands would be impractical to accommodate either for reasons of display aesthetics, limited square footage in the galleries, or safety of the visitors.

Based on the data developed from the design earthquake specific to the Getty Villa Museum differing degrees of protection can be achieved for the Getty collections by modifying certain aspects of the base isolator design. To achieve 60% isolation the mechanism must be designed with a 2 second period and to accommodate a minimum of 30.5 cm of displacement. This results in the lower portions of the object being subjected to a peak horizontal acceleration of approximately 0.3g. If the isolator is modified to accommodate 45.7 cm of displacement and designed for a period of 3 seconds, the lower part of the object will experience a peak acceleration of 0.2g which is a 70% isolation. In both cases a 5% damping, introduced by the isolator mechanism itself, is assumed.
Protecting collections in the J. Paul Getty Museum from Earthquake Damage, continued

A design originating in the museum’s antiquities conserva-
tion department was tested at a commercial shake table in
1990 (sine dwell, random dwell, and simulated earthquake)
and indicated that the mechanism had a natural period of 3
seconds, which when combined with an 18 inch (45.7 cm)
displacement capacity provided an almost 70% reduction of
the seismic forces at the top surface of the isolator. The
shake table tests indicated that the isolator had a period of
2.4 Hz (approximately 4 seconds). This provided an accept-
able compromise between displacement demands and size
of the transmitted earthquake force.

The isolator design was fully adapted for the museum ex-
hibits and although numerous alterations and improvements
have been made, it is essentially what is used today at the
Getty Villa Museum (figure 13).

The isolator is a three level de-coupling mechanism that of-
eres relative displacement between the top, middle and bot-
tom platforms. The top and middle platforms are supported
by orthogonal sets of captured linear bearings that travel
along rails. The orthogonal arrangement of these rail-bear-
ing supports prevents torsional movements. Forces arriving
at the isolator from a diagonal orientation are accommodat-
ed by a lateral “scissoring” action of the upper and middle
platforms that travels along an angled ramp, compressing a
series of springs which provide both a predetermine d re-
duction and the lateral displacement and a centering force to
the platforms. Spring rates are pre-determined to provide a
natural period between 1 and 2 seconds, the variation is
determined by the available displacement. A springs-in-se-
dies design provides two specific ranges of resistance to the
lateral motion. A softer set of springs provides a longer pe-
riod with less resistance. As maximum displacement is
approached the stiffer set of springs offers greater resistance
in order to accommodate larger earthquake forces and to avoid
a sudden stop as the maximum displacement is reached.

During the 1990 testing the isolator was attached to a full-
scale mockup of the object being considered for exhibition.
The weight distribution of the model accurately mimicked
that of the original sculpture as did the approach to assem-
bly of the object’s fragments and attachment to the base and
isolator. The 100% design earthquake (maximum probable
event, MPE) motion was filtered to remove periods greater
than 4 seconds to insure that the maximum displacement of
the table would not be exceeded. Although some whipping
at the top of the sculpture-model was experienced, the top of
the雕塑 displaced with a max excusion of 2.5 inches
(6.5 cm). The predicted 0.7 g peak was reduced to 0.1 g
at the top of isolator (a 70% reduction), 0.15 at the top of
pedestal (60% reduction), and 0.3g-0.4g (a 35% - 45 % re-
duction) at the top of the sculpture.

Since the isolator was designed for a full 45.7 cm displace-
ment, ample reserve was provided by the design. Realisti-
ically however this amount of displacement is not always
possible due to the limitations of gallery space, aesthetic
proportions of pedestal to object size, and safety of the visi-
tor should the isolate exceed a 4 second period. The vari-
dation is determined by the available displacement while the
isolator is standing in close proximity.

It should be noted that while isolators absorb a given per-
centage of the seismic forces, they can never elimi-
nate the forces beyond the predicted event while remaining intact
and securely anchored to the building. As a general rule of
thumb designing for a force of 3g (which includes a safety
factor of 3 or more) meets a wide variety of needs.

The design of a case or pedestal structure should provide
direct support under the display surface and artwork (figure
14). This support structure should be rigidly connected to
the structural elements of the case or pedestal. The case-
work structure should include attachment points to either
the building or an isolation system.

Anchoring casework
Anchoring the casework to the floor or wall is always the
best choice, since this fixes the artwork and display furniture
firmly in place resulting in a synchronous movement of the
object with the casework and the casework with the build-
ing. It is important however that these anchoring points
and the hardware used is sufficiently strong to resist the forces
imposed on them during an earthquake.

Conclusions
Many of the suggested solutions outlined in this paper for
the protection of collections from seismic threats have
concentrated on preventing objects from being moved or
shifted during an earthquake. It should be kept in mind that
the majority of many collections are not on dis-
play, but rather placed in storage areas where the threat of
seismic damage can be just as great, if not greater (due to
density) than in the galleries.

The concepts of mitigation presented here worked equally well
for storage facilities, where mitigation efforts can be applied
with less concern for aesthetic presentation. Tying objects to
shelves that have been firmly secured to a wall, placing
large restraining lips or ledges along the length and outer ed-
ges of shelves; and placing soft buffering foam pads between
objects in close proximity or carving individual cavities in
large blocks of ethafoam for storage are all effective ways of
protecting stored collections. None are excessively expen-
sive, nor do they necessarily need extensive engineering stud-
ies to carry out.

The efforts to protect collections from earthquake damage
continually evolve, as do seismology and our understanding
of the nature of earthquakes. It will only be through close
collaboration that we will advance the efforts of reserva-
tion and reduce the number of collections that may suffer
from inevitable earthquakes yet to come.

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3. Aggbabia, M.S., Musti, S.F. and Nigh, R.L. Evaluation of Seismic Mitigation Measures for Art Objects, GCI Scientific Re-

Figure 13. The isolator unit used at the Getty Villa.

Figure 14. An aluminum structure supporting a large sculpture. The frame is then covered with a facing for display.

Helpful References
Pocket Ref, Thomas J. Glover, Abbeon Cal, Inc.
Mechanics Ready Reference, Claus Weingartner, Praunken Publications
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"A Splash of Photo History Comes to Light," *New York Times*, 05/21/2007

The George Eastman House in Rochester, N.Y., is one of the world’s leading photography museums, has received two Edward Steichen autographs. They are the few surviving masterpieces from the earliest days of color photography.

They were taken by Steichen, probably in Buffalo, and are thought to be portraits of Charlotte Spaulding, a friend and student who became his luminous subject for the portraits. As far as any one knows, the photographs were never displayed and were kept in a cupboard or closest for decades. When those autographs had sat for so long out of the light, their colors remained particularly vivid.

Autographs are positive images, made using a complex process in which tiny dried grains of potato starch were spread across a piece of glass and light was passed through them, allowing their colors, which are dim in regular light, to shine through the surface of the glass using a special filter mirror. But prolonged exposure to light can wash out the images. 

"Murals, a Floor-to-Ceiling Fantasy," *Los Angeles Times*, 05/31/2007

Historic artists have been invited to do a walk-on (literally on a light table sometime in October, although a date has not been set.)

"World War II Glider Restoration," WLUC-TV (Michigan), 06/10/2007

A World War II glider that was discovered in Dickinson County, MI three years ago is well on its way to being restored to its original glory. Recovered from the Vernon Anderson Farm in Feldc, the CGAA Glider is now in two different states. Part of the fuselage, the nose section and the center section is down in Wausau, WI. The other half of the glider--the wings and tail end--are being restored in the dry building next to the Cornish Pump in Iron Mountain, MI.


The need to step up efforts to save endangered films has never been greater. Martin Scorsese has given the mission a global thrust. One key development on the sidelines of the recently concluded 00th Cannes Film Festival was the launch of the World Cinema Foundation (WCF) under the chairmanship of filmmaker Martin Scorsese. The mission is to undertake initiatives aimed at the preservation and restoration of the film world’s heritage. It is that involves the work of filmmakers from every continent of the world.

"Paintings from New Orleans Spared by the Storm," *Omaha World-Herald*, 06/10/2007

John Bullard, the director of the New Orleans Museum of Art, was surprised to learn that Katrina hit in August. The day after Katrina, his museum looked only a half of its former self. Much of the museum’s sculpture garden was submerged. The museum’s philosophy is to preserve the figures in their original colors so that whenever possible, Toby is revealing traces of original paint and recording the colors using a multispectral color chart. Old layers of paint are painstakingly scraped away to reveal the original paint and if found to be intact, he is sealed for protection and retained in the same colors.


The carousel in Greenfield Village was built about 1913 by the Herschell-Spillman Company in North Tonawanda, NY. During the early 1900s, the Herschell-Spillman Company made more carousels than any other American factory. The Henry Ford Museum purchased the carousel in 1973. 

The carousel has 40 hand-carved animals; eight of the animals are stationary and 32 are jumpers, animals that move up and down when the carousel is in operation. The carousel includes two stationary chariots, one rocking chariot, and a lovers tub. At the Henry Ford Museum and Greenfield Village purchased the carousel it had been through decades of operation and was in dire need of restoration. Local carousel restorer Tony Orlando was contracted to work on the carousel. Orlando was contracted to work on the carousel again recently in a new restoration program.


The companion, the fragile, $2.43 million scroll was built as a summer residence and hunting lodge for the ruling family of Italy. As for the vast, 250-metre-long fish pond, it had long since dried up under weeds. As for the vast, 250-metre-long fish pond, it had long since dried up and was barely discernible. But yesterday, after eight years of painstaking work worth $5 million, a 25-m (17m) 25.5 hectares of the reconstructed gardens were reopened to the public. The restoration of the grounds is just one aspect of the 200 project to restore the entire complex, including the open parts of the palace, or reggia, itself in September, but the entire scheme is not expected to be completed until 2011.

The Reggia di Venaria Real was built as a summer residence and hunting lodge for the ruling family of Italy. Since 2003, part of its purpose was to inspire awe: the main building alone is bigger than Buckingham Palace.


In return for displaying works by Monet, Picasso, Pollock and more, the Joslyn agreed to give the New Orleans museum $100,000. A private conservator in New Orleans offered to donate his time to repair special works from the museum’s collection. He targeted one of the most important works in the collection, Edgar Degas’ Portrait of Estelle Masson De Gas, which had not left New Orleans for nearly 40 years the museum has owned her.

"That’s where my Buddhism comes in," says Canary. "Some conservators would have walked off. I talked to him about it."


Even after the芨g生命大萧条, motorists in the 1930s, aimed at the preservation and restoration of the film world’s heritage. It is that involves the work of filmmakers from every continent of the world. In return for displaying works by Monet, Picasso, Pollock and more, the Joslyn agreed to give the New Orleans museum $100,000. A private conservator in New Orleans offered to donate his time to repair special works from the museum’s collection. He targeted one of the most important works in the collection, Edgar Degas’ Portrait of Estelle Masson De Gas, which had not left New Orleans for nearly 40 years the museum has owned her.
stopped all work,” Schell said. “They've been right down the street from the Lucille Ball museum.

Construction workers were tearing down the crumbling brick facade of a former hospital that had its last completion in the fall. The billboard for the remaining days for corporate sponsorship once had a dusty sign proclaiming the 40-year-old tunnel in which they were working might collapse.

It’s a very rare artifact.”

The engineering contractors Skanska, who were carrying out structural repairs for English Heritage, pulled its miners off the hill on Monday, fearing that the 40-year-old tunnel in which they were working might collapse.

The plan, now left in chaos by the mound, from the summit where the structure was used as a demonstration of power and wealth - is still guesswork. No original chapter or passage has ever been detected. The site is wreathed in folklore of treasure - and has garnered attention for its power of art. Speaking to French news agency AFP, she said the artist had “left a painting on display in France, has been charged with criminal damage after kissing it.”

“A Painting with a Contested Past in Berlin Street Scene

The painting lies underneath the mound, from the summit where the structure was used as a demonstration of power and wealth - is still guesswork. No original chapter or passage has ever been detected. The site is wreathed in folklore of treasure - and has garnered attention for its power of art. Speaking to French news agency AFP, she said the artist had “left a painting on display in France, has been charged with criminal damage after kissing it.”

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project of recent times in Italy, is to go ahead. After nine years of bitter argument and despite the rage of Florentines including the opera and film director Franco Zeffirelli, the dramatic and imposing new portico at the side of Italy’s most famous art museum was given approval this week.

Its designer is Arata Isozaki, the celebrated avant garde architect from Kyushu. His solution was simple, bold, and arresting: a huge cantilevered canopy fanning out from the gallery, supported by slim rectangular pilasters. There was no attempt to integrate the new work with the Renaissance original: the contrast between old and modern was deliberately stark.

The last large modern building to be erected in Florence is the station, which dates from 1935. But the reaction of conservatives was ferocious. Oriana Fallaci, the Florentine journalist and novelist, called the design “absolutely indecent and unheard of,” and threatened to return to Florence from her home in New York “and tear it to pieces with my bare hands.”

The architect now expects building work to start in the autumn, and for the structure to be completion by 2011. But the project’s opponents will not give up without a fight.

“Ingleswood’s Famed History of Transportation Mural makes a Bold Comeback,” Los Angeles Times, 08/11/2007

Sixty-seven years after it was installed in Inglewood, with great fanfare, and six years after it was removed for restoration, in deplorable condition, Helen Lundeberg’s massive WPA mural The History of Transportation has a new home. The 60-panel, 240-foot-long artwork runs along a curved wall in the new Grevillea Art Park, close to Inglewood City Hall and High School.

This is quite a comeback for the mural, which was badly battered and disfigured before it underwent treatment at Sculpture Conservation Studio in West Los Angeles. Made of petrachrome, a terrazzo-like material composed of crushed rock embedded in tinted mortar, the artwork was built to last. But two panels were destroyed by wayward vehicles; others were cracked, and buried under layers of graffiti.

Lundeberg, a Los Angeles-based artist who died in 1999, at 91, was commissioned to make the mural by the Work Projects Administration’s Federal Art Project. She designed the panoramic view of the evolution of transportation -- from Native Americans on foot to passengers boarding a DC-3 aircraft -- for the entrance to Centinela Park (now Edward Vincent Jr. Park).

Conservation began in 2003 and was finished in a couple of years. Then came the challenges and inevitable delays in installing the work exactly as it was in 1940. Finally on view again, the softly colored parade of people walking and riding into the future can be seen up close with surfaces cleaned, cracks filled, and the two missing panels replaced by facsimiles in colored cement.

“Getty Museum to Give Back Forty Works of Art to Italy,” Agenzia Giornalistica Italiana, 08/13/2007

The deal to return forty works of art was made by the minister of Cultural Activities, Francesco Rutelli, and the director of the J. Getty Museum, Michael Brand. The agreement includes the following points: - The Getty transfers 40 objects to Italy, including the Cult Statue of a Goddess. Technicians from Italy and the Getty Museum will decide on a timeframe for the transfer of the objects in the coming months, with the exception of the statue which will stay in the Getty until the end of 2010.

The parties agree to refer further discussions on the statue of a young victorious athlete to the legal steps in progress in Pesaro. Italy and the Getty agree on a broad cultural collaboration that will include loans of important works of art, joint exhibitions, research and conservation, and restoration projects. Both parties “are pleased that, after long and difficult negotiations, an agreement was reached and now proceed to a new relation of collaboration”.


Housed in the Etruscan Museum of Villa Giulia and originally from Cerveteri, the masterpiece in terracotta is the next goal after the restoration of the Hercules of Veio. Discovered in a tomb of the necropolis of Banditaccia of Cerveteri and dating from around the 6th-5th century B.C., the Sarcophagus of the Married Couple is one of the principal attractions of the museum and one of the most famous examples of Etruscan plastic arts. Witness to a love that has lasted more than two millennia, the cover of the sarcophagus represents a life-size couple reclining on a dining couch in an attitude of tender affection. The conservation is to be sponsored by the Federazione Italiana Tabaccai.

“Restoration Proposed for the “Casiceddhre di Noha’,” Edil One, 08/22/2007

The so-called “Casiceddhre,” or houses of the dwarves, are miniature buildings in polychromed Lecce stone. They are of significant historic, artistic, and cultural importance and may be found in Noha, near the baroque city of Lecce in Puglia, Italy.

The tiny buildings constitute the faithful reproduction in miniature of sixteenth century palaces. Rich in architectural detail, they are considered a rarity among scholars and historians. Cracks in the paving surrounding them and in the building below as well as weeds and roots from nearby pine trees are threatening the tiny buildings. It is not known who constructed these little architectural gems.


A lost sketch by John Constable, never recorded in the catalogues of his work, has tumbled with a cascade of other drawings and letters from volumes which the British Library has owned for almost a century. The library has only just appreciated the scale of its bequest from John Platt, a wealthy textile manufacturer who became a serious art collector, who died in 1902, leaving many of his magnificently bound volumes to the British Museum.

The delicate little pencil drawing of Hyam Church in the artist’s native Suffolk, bought from his grandson 50 years after his death, has been hidden among the pages of one of the books ever since. The Constable, some of the other drawings and documents, and some of the volumes themselves, will now go on display in the library’s Treasures gallery.