

May 2007

Volume 29 Number 2

## President's Letter

*Camilla Van Vooren*

I begin this letter on a sad note with a memorial to Frederick R. Mayer, one of Denver's most prominent collectors and philanthropists who died on Valentine's Day at the age of 79. Mr. Mayer, an oilman who founded Exeter Drilling Co, was a noted collector of stamps, coins, currency, and art, specifically Spanish Colonial Art. Mayer was passionate in his love and support for museums and collections. He was a member of the Denver Art Museum Board since 1975, including three terms as chairman. Mayer and his wife, Jan, endowed the New World Department

at DAM and have donated hundreds of objects to the art museum, many of which are on view in the New World Galleries. The Mayers sponsor an annual symposium on Spanish Colonial Art at the DAM, which features the work of prominent national and international scholars. Over my sixteen years at WCCFA, I have had the distinct honor of working with Jan and Frederick who always had the utmost concern for the proper conservation of their collection. I will always remember Mr. Mayer's kind and welcoming demeanor; he will be truly missed in Denver's art community.

The 2007 mid-year board meeting took place at the Getty Villa on February 16. In the works: Chris Stavroudis, acting Treasurer, and WAAC's Web Editor, Walter Henry, are working on an online credit card payment system for annual dues, meeting registration, and other WAAC payments by the membership. Among the other issues discussed were vendor displays and vendor sponsorship at the annual meeting. Vendors can have tables with brochures, etc., in the break areas (as the hosting institution permits) free of charge. There are a couple of vendors who have graciously offered to donate funds to help sponsor coffee break costs at this year's meeting. The Board set a minimum of \$300.00 for such sponsorship in the future. These donations will offset registration fees and are greatly appreciated!

It's time again for that perennial favorite: the WAAC election! Nominations for two new members-at-large and a new vice president for 2007/2008 are now being accepted by Vice President, Susanne Friend. Please consider donating some of your time to our fine organization by running for a Board position. See former President Laura Downey Staneff's excellent description of board member duties in her President's Letter from May 2006 (v. 28, No. 2) or feel free to call me or any of the board members if you have any questions. You are welcome to nominate yourself, so don't be shy!

Plans are progressing for the annual meeting in Denver, September 15-17 at the Colorado Historical Society and the Denver Art Museum. Part of the program for Sunday, September 16th, will have the theme of museum expansion. DAM conservators will be on hand to share their experiences with the opening of the Hamilton Wing last fall. I encourage anyone who works for institutions that have undergone expansions or have moved into new buildings to consider joining in this discussion. Conservation, mount-making, moving, storage, public relations, and events coordination are just a few sub-topics that could apply. I hope to end the session with a panel discussion. For the rest of the meeting, talks from all specialties are welcome. (see the Call for Papers on page 3)

This year the annual meeting will again be preceded by a workshop. Yosi Pozeilov, Senior Photographer at the Conservation Center at LACMA, will be offering his popular course on digital photography in a day-long session held at the Colorado Historical Society on Friday, September 14. (see page 2 for details)

I am pleased to announce that the opening reception will be held Friday evening at the Kirkland Museum. Vance Kirkland was an important 20th-century Colorado artist whose home and studio is the oldest commercial art building in Denver. Kirkland was one of Colorado's foremost abstract painters and was instrumental in establishing an art community in Denver. He founded the D.U. School of Art

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President's letter, continued

and was one of the founders of the Denver Art Museum. The museum contains Kirkland's paintings and watercolors and his remarkable collection of decorative arts, said to be the largest on view in the United States. Nearly 3000 objects represent every major 20th-century design style. Hugh Grant, the curator of the museum, has done a remarkable job in keeping the Kirkland Museum in existence. Kirkland was a father figure to him, and he worked as an assistant in Kirkland's studio and is very knowledgeable about the artist's technique. Mr. Grant will be on hand to present a brief overview of the history of the museum. I encourage you not to miss the opportunity for an intimate view of this unique collection.

The annual banquet will be held Sunday night at the Wynkoop Brewery, Colorado's oldest brewery. Housed in the historic J. S. Brown Mercantile Building, the brewery gets its name from Edward W. Wynkoop, the first territorial sheriff of the region. This is a fun place with pool and billiards upstairs and a comedy club downstairs. The bar, restaurant, and the Mercantile Room, the location of the banquet, is on the main floor, the former location of the Show Room of the Mercantile Building. The Wynkoop is located in Denver's Lower Downtown, aka LoDo, a twenty-block area where the origins of the city can be traced back to 1858 when gold was discovered at the confluence of the Platte River and Cherry Creek. In the early days, the area had a notorious reputation for the gambling, drinking, and wild living. Designated a historic district in 1988, it is now one of Denver's most popular areas for galleries, restaurants, shopping, and nightlife.

*Note: Due to the popularity of the new Hamilton Wing of the Denver Art Museum, the annual meeting was scheduled, one year ago, around the single day that Schlessman Hall at the DAM was available for use by WAAC members. I extend my regrets to individuals who will not be able to attend because of religious observances.*

Digital Photography for Conservators Workshop

Friday, September 14, 9:00 a.m. – 5:00 p.m. \$150

Yosi A. R-Pozeilov, Staff Photographer, Los Angeles County Museum of Art Conservation Center

Learn the basics of digital imaging and unique applications that are vital to the conservator's proper documentation of treatments with this popular workshop. Many conservators express the desire to make better use of this relatively new medium to obtain appropriate, accurate records of their work. The workshop specifically addresses issues encountered by the conservator. It will cover the basics of the digital imaging, starting with the identification of proper digital imaging capture devices (i.e. digital cameras, scanners, etc.) and their most efficient methods of use; the importance of knowing the purpose or intended destination of the images generated; some aspects of lighting; image transfer mechanism and preservation; and a brief discussion of image editing software. Note: please e-mail any questions that you would like to see answered in this workshop to: yosipozeilov@yahoo.com.

Yosi A. R-Pozeilov is the Senior Photographer at the Conservation Center of the Los Angeles County Museum of Art (LACMA). Since his return to Los Angeles and to LACMA at the end of 2003, Yosi was given the task to convert the analogue photographic studio into a digital one. Benefiting from the invaluable experience gained during the two years that he worked at the Harvard College Library in Cambridge, MA at the digital imaging studio, as well as his experience at the Museum of Fine Arts (MFA), Boston, Yosi was successful in fully implementing a digital workflow in the Conservation Center. In 2004 he was invited by the AIC to teach his first workshop on digital photography at the annual meeting in Portland, OR. Since then, Yosi has taught his workshop at several venues across the country including the AIC meeting this year.

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

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## Western Association for Art Conservation

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The Western Association for Art Conservation (formerly, the Western Association of Art Conservators), 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 discuss national and international matters of common interest.

### PRESIDENT

Camilla Van Vooren

### VICE PRESIDENT

Susanne Friend

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General Information  
New Memberships  
Publication Orders

Teresa Moreno

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Change of Address  
Payments

Chris Stavroudis

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Donna Williams

Individual Membership in WAAC costs \$35 per year (\$40 Canada, \$45 overseas) and entitles the member to receive the WAAC Newsletter and the annual Membership Directory, attend the Annual Meeting, vote in elections, and stand for office. Institutional Membership costs \$40 per year (\$45 Canada, \$50 overseas) and entitles the institution to receive the WAAC Newsletter and Membership Directory. For membership or subscription, contact the Secretary.

### Internet

Articles and most columns from past issues of WAAC Newsletter are available on-line at the WAAC Website, a part of CoOL (Conservation OnLine) hosted by Stanford University Libraries, at <http://palimpsest.stanford.edu/waac/>.

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## WAAC Annual Meeting Denver, Sept. 15 - 17

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### Call for Papers

If you would like to present a paper, please submit an abstract by completing the form on the inside back cover of this newsletter (or if emailing, please use that format) and submitting it to the appropriate Board member as indicated below. The abstract can be as detailed as you wish; it will be published in the *Newsletter* subsequent to the meeting. It would be very helpful if you could include biographical information to be used in your introduction. It is crucial that you indicate, specifically, what audio/visual equipment you will require, particularly because I will be renting equipment for the days when the meeting will be held at the Colorado Historical Society. All topics and specialties are welcome. Thank you for your participation.

Paintings & Textiles:  
Susanne Friend

Ethnographic & Archaeological Objects:  
Marie Svoboda

Collection Management &  
Professional Practice:  
Scott Carrlee

Science & Technology:  
Chris Stavroudis

Objects, Sculpture, & Furniture:  
Donna Williams

Wall Painting, Architecture, & Sites:  
Leslie Rainer

Book, Paper, Photography, Electronic Media, & all else:  
Camilla Van Vooren

### SILENT AUCTION

The annual meeting Silent Auction will begin the first day of the meeting, September 15 at the Colorado Historical Society and will continue at CHS Monday Morning, September 17, ending at noon. The beneficiary of the Silent Auction funds will be announced in the meeting registration packet. Please bring your donations to CHS, Saturday morning between 8:00 and 8:30 A.M. or send them to me at WCCFA, 1225 Santa Fe Drive, Denver, CO 80204 marked "Silent Auction Donation" with your name, address, telephone number, e-mail, and suggested value of the object included.

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# Denver: logistics and attractions

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## Transportation

### Getting to (not out of, a la Bob Seger) Denver

**by plane:** Denver International Airport (DIA) is 23 miles northeast of downtown, usually a 35- to 45-minute drive. Major national airlines serving Denver include American, America West, Continental, Delta, Frontier, Northwest, Sun Country, JetBlue, United, and US Airways. Regional and commuter airlines include Alaska Airlines, Aspen Air, Mountain Air Express, and three United Express airlines: Air Wisconsin, Great Lakes Aviation, and Mesa. [www.fly-denver.com](http://www.fly-denver.com)

**by car:** The wide open spaces of the west provide ample vistas to enjoy on a road trip to Denver in the fall, but driving distances are long! 1000 miles+ from L.A., 1200+ from Portland or San Francisco, 800+ from Tucson...

**by train:** Amtrak serves Denver via Union Station in LoDo.

### Getting to & from the Airport

A cab ride from the airport to downtown is in the \$30.00-\$50.00 range. Door-to-door service is also available from SuperShuttle @ \$18.00 per person. (tel. 800/525-3177 or 303/370-1300; [www.supershuttledenver.com](http://www.supershuttledenver.com))

The most economical choice is the Denver Regional Transportation Districts (RTD) Sky Ride which will get you to Market Street Station downtown, which is one end of the 16<sup>th</sup> Street Mall Free Shuttle (with stops that are walking distance from the Downtown Courtyard Marriott, the Curtis, and other hotels) for just \$8.00. ([www.rtd-denver.org](http://www.rtd-denver.org))

### Getting Around Denver

Again, if you do not have a car, the RTD 16<sup>th</sup> Street Pedestrian Mall Free Shuttle will get you within walking distance to all the annual meeting events and many downtown hotels. You may want to walk with a buddy to the Kirkland Museum for the opening reception. The Kirkland will provide free parking for the event. The Denver Cultural Complex and the state capitol are walking distance from the Civic Center stop at the other end of the shuttle line.

The RTD Light Rail, at this point in time, serves the metropolitan area and south suburbs and has stops on or near the 16<sup>th</sup> Street Shuttle Line. (Maps available on web page.) Note: The Light Rail doesn't run as frequently on the weekends as during the week so check schedules on the web.

## Accommodations

Two downtown hotels are offering a special rate of \$129/night to WAAC attendees:

September can be a busy month so I encourage you to book soon! Both of these hotels are in the heart of the downtown within a couple of blocks of the 16<sup>th</sup> Street Mall Free Shuttle and LoDo.

Marriott Courtyard Denver Downtown  
(800) 321-2211 or (303) 571-1114  
[marriott.com](http://marriott.com)  
Ask for the WAAC Block  
Cut off date of Monday, 8/20/07

The Curtis  
(800) 525-6651  
[TheCurtis.com](http://TheCurtis.com)  
Ask for the WAAC Block  
Cut off date of Wednesday, 8/15/07

A less expensive option:

The Ramada Denver Midtown  
(303) 433-6677  
[ramada.com](http://ramada.com)

This is near the football stadium, Ocean Journey (the aquarium), Elitch Gardens amusement park, and other midtown attractions. It is less pedestrian friendly but has complimentary shuttle service to downtown attractions and restaurants. \$89/night as of this writing.

Lower rates may also be found in outlying areas and suburbs (such as those on S. Colorado Blvd. and Englewood.) Inquire whether the hotel location is Light Rail-accessible if you won't be driving.

## A Preliminary List of Attractions

Some of my personal favorites...more to come in the registration packet in July. Also check the Denver tourism site: [www.denver.org](http://www.denver.org)

### Red Rocks Amphitheatre

Unfortunately, the concert season will have just finished the weekend before the meeting, but the beauty of the place is well worth the drive. There are great hiking trails, and it sits right next to the quaint mountain town of Morrison. On the way there don't forget to stop at Dinosaur Ridge where geological evidence of the mid-Atlantic seaway can be seen in fossilized sand ripples, and at least three different species of fossilized dinosaur footprints are viewable from the road.

### Garden of the Gods (Colorado Springs)

If you decide to head south to the Springs, this is another group of spectacular rock formations not to miss.

### A Rocky Mountain 14-footer

Mt. Evans is an easy drive from Denver proper, and you can drive all the way to the top if we haven't had snow by that time! If you are rugged enough to climb one of these babies, Long's Peak is near Estes Park and Pikes Peak is in Colorado Springs.

### Rocky Mountain National Park

As I commented in the January *Newsletter*, September is a terrific time to visit this wonderful national park. The entrance fee is per car so I would recommend carpooling with a group for a day trip.

### Molly Brown House

The home of this "unsinkable" Denver matriarch is a tourists' favorite.



### ALASKA

**Ellen Carrlee** is weathering renovations to the conservation lab and collections storage at the Alaska State Museum, surveying totem poles under ASM's care at the Totem Heritage Center in Ketchikan, and finishing the emergency recovery plan for artifacts. Graduate conservation students **Samantha Springer** (Wintertur/Univeristy of Delaware) and **Molly Gleeson** (UCLA/Getty) will be working on a basketry internship project with Ellen and Native Northwest Coast weavers in both Juneau and Sitka this summer.

In February, **Scott Carrlee** traveled to Nome to install Fritz the sled dog in a special micro-climate case that he helped design. Fritz, along with Balto and Togo, was a lead dog for the 1925 serum run which saved the children of Nome from a diphtheria outbreak. This famous event is the basis for the Iditarod sled dog race which ends in Nome every year. Fritz is also the foundation sire for the Siberian Husky breed. So he is a valuable and historic stuffed pooch.

**Emily Ramos** has accepted the position as Museum Scientist/Library Conservator at her alma mater: UC Berkeley. She starts work there in July. She will be missed in Alaska.

**Monica Shah** was hired as the new conservator for the Anchorage Museum at the Rasmuson Center. This is a new position and only the second staff conservation position in Alaska. She is working on upcoming exhibits and starting a lab. She will be presenting information about

conservation and long-term preservation when purchasing contemporary art for the Rasmuson Foundation meetings in Fairbanks.

*Regional Reporter:*  
Scott Carrlee  
Alaska State Museum

### ARIZONA

**Gloria Giffords'** magnum opus will be completed by November! Entitled *Sanctuaries of Earth, Stone and Light* this hefty tome reveals the art, architecture, and furnishings of northern New Spain's churches. **Merideth Milstead**, conservation assistant with Gloria, created the drawings. Gloria and Merideth have also been cleaning and relining five large Spanish Colonial paintings from a private collection. They have consulted with **Chris Stavroudis** on using his modular cleaning system and report that it is working fabulously!

**Linda Morris** recently hired **Rachel Shand** as an assistant. Both are working on a collection of documents and letters. Rachel is also assisting part-time at the Tucson Museum of Art.

**Gretchen Voeks** and **Brynn Bender** continue to work on the conservation of boats at the Grand Canyon. The *Esmeralda II* is a power boat and is presenting

interesting challenges due to the difficulties associated with motors and access to confined spaces. Brynn is also working to bring the National Park Service's Santa Fe collections, totalling over 200,000 objects, to the Tucson facility for storage. Conservation assistant **Audrey Harrison** is repairing beadwork for the Grand Teton NP Vernon collection. **Maggie Kipling** and **Maria Lee** are working on repairing the ceramics from Tuzigoot, NM.

The newly constructed conservation lab at the Arizona State Museum is now up and running. **Nancy Odegaard**, **Teresa Moreno**, and **Chris White** continue to oversee the move of ASM's collection of 20,000 southwestern ceramic vessels into the new storage facility. ASM conservators worked with the museum's curatorial staff to install an exhibit showcasing pieces from the collection in a glass display wall.

Nancy Odegaard traveled to Ethiopia with **Ron Harvey** and **Vicki Cassman** to work as conservation consultants for the Houston Museum of Science on the Lucy Project. Nancy presented at talk, "Sticks, Bones, and Feathers," for the Getty Lecture Series. She is currently working with **David Smith** on a pesticide project with the Winnebago Tribe of Nebraska and on a presentation with **Werner Zimmt** on pesticide mitigation.

Teresa Moreno has been working on the documentation and conservation of objects for various exhibits and loans including an ASM exhibit on Puebloan ceramic tiles, an on-line exhibit of Southwestern Native American silver jewelry,

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### Estes Park

The "Gateway to Rocky Mountain Park" is a scenic town just about an hour's drive from Denver. The Stanley Hotel (of *The Shining* fame) is a beautiful place to sit on the terrace for drinks and dining.

### Colorado State Capitol

The dome has recently been re-opened for tours, and rotunda paintings by the notable regional artist, Allen Tupper True, are based on the theme of water in the west.

### The Brown Palace Hotel

This 115-year-old Victorian, Italian Renaissance style building has hosted princes and presidents. Treat yourself to a break in the atrium lounge, high tea, a tour or, if you really want to indulge, an overnight at this historic Denver landmark.

### Coors Field

The Rockies are scheduled to play the Marlins Sept. 14 -16 and the Dodgers Sept. 18-20.

### U.S. Mint

The free tour of one of the country's four mints is said to be very good; a great stop for kids and walking distance from the museums and hotels.

### Glenwood Springs

The largest and most popular of Colorado's numerous hot springs locations, the drive to Glenwood is gorgeous and only about 3 hours from Denver. Other popular hot springs include Idaho Springs (the closest hot springs to Denver), Strawberry Park Hot Spring (near the town of Steamboat Springs), and Hot Sulphur Springs (near Granby).

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## Regional News, continued

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and a loan for an exhibit on dragons at the Musée de la Civilisation, Québec. She has also been doing some consultation work for the University of Arizona Art Museum.

Chris White is continuing work on the Southwest Pottery Project. The survey, analysis, and treatments are continuing with the help of the staff and volunteers.

**Caitlin O'Grady**, Kress Fellow at ASM, is continuing the research, analysis, and conservation of approximately 1000 organic and inorganic archaeological objects in preparation for the *Journeys of Our Ancestors* exhibit.

**Odile Madden** continues her research developing pesticide-testing protocols using XRF on Smithsonian collections.

*Regional Reporter:*  
Gretchen Voeks

### GREATER LOS ANGELES

*Nineteenth-Century Art in the Norton Simon Museum*, Volume 1, (Yale University Press) was published in December. The catalog by **Richard Bretell** and **Stephen Eisenman** included technical notes by **Joe Fronek**, **Susan Sayre Batton**, and **Roz Westmoreland**. The three conservators spent four years researching and examining 19th-c. paintings and works on paper in the Norton Simon collection prior to publication. Volume 2 is forthcoming and will be entirely devoted to the works of Edgar Degas.

This April, Decorative Art and Sculpture Conservation at the J. Paul Getty Museum completed the installation of the Fran and Ray Stark Collection of 28 outdoor sculptures with the final pieces placed in a newly-constructed garden at the bottom of the hill near the tram entrance.

**Arlen Heginbotham** recently undertook the technical study of a coffer on stand by André-Charles Boulle with London conservator **Yannick Chastang**. The coffer is in the collection of the Lewis-Walpole Library at Yale. The project, partially funded by the Getty Foundation, involves technical study of this important piece at the Getty, followed by treatment at Chastang's studio outside London.

**Frédérique Chantepie**, graduate intern, is researching methods for safely making silicone molds off of plaster sculpture.

**Sharon Shore** of Caring for Textiles has been undertaking two treatments for the department. She is stabilizing the silk fabric on a bergère armchair from the Château de Chanteloup, one of the few pieces of 18th-c. French furniture in the United States with its original upholstery intact.

In addition, Sharon and **Yadin Laro-chette** have been working on the stabilization and treatment of a Beauvais tapestry *Le Mois de Décembre, Le Château de Monceaux*. Although visually in good condition, the tapestry has presented particular challenges due to physical degradation of the silk fibers as well as the presence of an earlier lining glued to the back.

**Victoria Blyth Hill** hosted the South Asian Council of LACMA for a viewing of the large *Yama and Yami* Tibetan thangka she is working on for LACMA. **Soko Furuhata** and **Chail Norton** have also been very involved with the treatment and mounting. In mid-March she attended the gala opening of the Asian Art Fair in New York and also consulted with several collectors and museums. Victoria continues to work with South and East Asian art as well as modern and contemporary western works on paper.

The Natural History Museum is pleased to welcome **Elizabeth Homberger**, a second year Buffalo conservation student, as a summer intern funded by the Samuel H. Kress Foundation. Liz will work with NHMLAC conservator **Tania Collas** on conservation projects spanning several natural and cultural collections in preparation for the museum's planned new permanent exhibits.

The Paintings Conservation Department at the J. Paul Getty Museum has finished work on a multi-year project conserving and restoring two large-scale animal paintings by Jean-Baptiste Oudry culminating in the opening of an exhibition titled *Oudry's Painted Menagerie* which will be up at the Getty through the end of the summer.

A collaborative research project between the J. Paul Getty Museum (**Marie Svoboda** and **Nadia Tsatsouli**) and the Los Angeles County Museum of Art (**Charlotte Eng**) has been initiated in an effort to understand an unusual staining on ceramics caused by aged shellac. The study will focus on what causes the staining and the methods for preventing and/or removing the discoloration. The results of this study will be published.

Department work at the Getty Villa this summer and fall focused on installation of the exhibition *Stories in Stone: Conservation of Mosaics from North Africa* that opened in October. The Getty Villa worked in conjunction with the Getty Conservation Institute and the Institut National du Patrimoine, Tunisia to organize the exhibition that includes mosaic loans from several Tunisian museums.

**Eduardo Sanchez** traveled to Tunisia in May along with representatives of the GCI and Villa curators to assess the condition of the mosaics. 27 were chosen for the exhibition. Some mosaics required limited treatments, and mountmakers **Mackenzie Lowry**, **BJ Farrar**, and **David Armendariz** worked on fabrication of steel support structures for most of the mosaics. The exhibition of these intricate and colorful mosaics (dating from 300 B.C. to 300 AD) ran through April.

The department welcomed Konstantina (Nadia) Tsatsouli as its 2006-2007 intern. Nadia obtained her BSc in Archaeological Conservation from Cardiff University in 2003 and went on to graduate with distinction with a MSc from Cardiff. Since then she has worked as a conservator in various museums in Britain and on archaeological excavations in Egypt and Greece. Since coming to the Antiquities Conservation Department she has

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## Regional News, continued

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worked mainly on mosaics, one of her interests. Nadia also has strong interests in the decay and conservation of metal artifacts and textiles.

The Getty Villa hosted the workshop "Exploring Romano Egyptian Mummies and their Portraits" this fall which brought together curators, archaeologists, historians of art and religion, scientists, medical personnel, and conservators. The workshop was coordinated in part by Marie Svoboda. Participants discussed the diverse aspects of Egyptian mummies from the Roman period in general and the Red Shroud group in particular. **David Mininberg** gave a public lecture on the recent advances in the CAT Scanning of mummies.

**Erik Risser** traveled this summer to the site of Sagallaso, Turkey to continue field conservation work on large-scale sculptures from the site. Erik has worked on conservation at Sagallaso for several seasons, specifically with marble sculpture and architectural elements. He has also been involved in the fabrication of large-scale molds to replicate architectural sections to be incorporated into outdoor structures. Erik is also starting a collaborative project with the Los Angeles County Museum of Art on the re-conservation of the marble sculpture of Hope Hygeia.

Antiquities conservators **Jeffrey Maish** and Marie Svoboda presented papers at the conference "Conserving or Restoring: the Restoration of Greek Vases in Antiquity until Today" at the Antikensammlung, Berlin. Work was presented on two vases from Berlin that were treated at the Getty in preparation for the *Colors of Clay* exhibition at the Villa this past summer.

Soko Furuhashi and Chail Norton organized a wet salvage workshop taught by **M.J. Davis** and **Barbara Moore** directed towards the LACMA staff including conservation, security, collections management, and registration.

**Terry Schaeffer** attended AIC in April and presented a paper titled "Assembled over Time: Analysis of Dyed Yarns in a Victorian Sample Book" to the RATS session. Also, she read the paper by

**Catherine McLean, Frank Preusser, and Mark Gilbert**, "Authenticating an Unknown Anatolian Carpet at LACMA: The Discovery Process," at the Textile session, because none of the authors were able to attend the meeting.

The paper lab at LACMA will have a 4th year intern from the NYU graduate conservation training program for next year, **Erin Jue**. Erin has two undergraduate degrees from the University of California, Berkeley, one in molecular and cell biology and the other in history of art. She has worked on several research projects with the Metropolitan Museum of Art Department of Scientific Research photographing cross-sections for a catalogue of medieval Italian sculpture. In addition, she analyzed pigment samples from the Forbes pigment collections using dispersive Raman spectroscopy to build a database of reference spectra.

*Regional Reporter:*  
Virginia Rasmussen

### NEW MEXICO

**Jamie Hascall** was promoted to Chief Preparator with the Museum of New Mexico in Santa Fe. In January, he also taught a two day mountmaking workshop at the Museum of South Texas History in Edinburg, Texas.

Conservation Solutions, Inc. (CSI) recently completed a conservation treatment of four lead urns located at the Belgian Ambassador's Residence in Washington D.C. and a treatment of Isamu Noguchi's *Slide Mantra* sculpture located in Bayfront Park in Miami, Florida. CSI also completed, in conjunction with local specialists, the assessment of a concrete fountain located at the Breakers Resort in Palm Beach, Florida. CSI's **Joe Sembrat** is working on an assessment in collaboration with **Steven Prins** and Co. of a Zuni mural located in the De Anza Hotel in Albuquerque, New Mexico.

CSI is involved in the start-up of several projects that include: the restoration of eight sets of bronze doors at the EPA Building; the restoration of exterior metals at the US Postal Museum; and the conservation of the immense granite Haupt Memorial Fountain located on the White House grounds. All of these are located in Washington, DC. Additionally, CSI continues work on *Justice* and *Liberty*, two zinc statues from the top of City Hall in Goldsboro, North Carolina; Fort Christian, a 17th-c. fort located on St. Thomas in the US Virgin Islands; and the Ximenez-Fatio House, an 18th-c. structure in Saint Augustine, Florida.

CSI continues to have a presence in the lecture/training circuit. Joe Sembrat and **Patty Miller** recently presented "Applying Museum Conservation Standards to Large Scale Aerospace Artifacts," at the "2007 Mutual Concerns of Air and Space Museums Seminar," hosted by the Smithsonian National Air and Space Museum. In February, **Mark Rabinowitz** conducted a roundtable discussion entitled, "When the Building is the Collection" at "Building Museums 2007," hosted by the Mid-Atlantic American Association of Museums. This May, CSI will be conducting a workshop on the care of outdoor sculpture for Museum Development Associates at the Hacienda de Guru Ram Das, located in Española, New Mexico.

Museum Development Associates continues to work with the Sikh Dharma in Española, New Mexico on their new museum project. **M. Susan Barger** recently gave a training workshop for community members on care of textiles.

The conservation lab for the Department of Cultural Affairs/Museum Resource Division wants to welcome the new Director of Conservation, **Mark MacKenzie**. Mark joined the staff from Saskatoon, Canada where he was head of the conservation department of the Saskatchewan Western Development Museum.

Senior Conservator **Maureen Russell** spent several weeks working at the Egyptian Museum in Cairo as part of a team with two members of the Michael C. Carlos Museum at Emory University and staff from the American University in Cairo in a collaborative project to



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## Regional News, continued

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upgrade and re-install the Predynastic Egyptian display. The project was funded by a grant from the Egyptian Antiquities Project of the American Research Center in Egypt. Maureen is lead conservator for an upcoming traveling exhibition at the Palace of the Governors about Jack Kerouac that will feature the original typed text from "On the Road." She is also working on an Indonesian Shadow Puppet exhibition for the Museum of International Folk Art (MOIFA) and is lead conservator for *Excavating Egypt*, a traveling exhibit from the Petrie Museum of Egyptian Archaeology that will open in August 2007 at the MFA. Maureen and the rest of the lab will be giving a series of workshops on collections care this summer and fall in different parts of New Mexico as part of the lab's Preservation Matters Outreach.

Associate Conservator **Mina Thompson** returned to work part-time in February after her maternity leave. While she catches up, she is treating an elaborate 19th-c. Chinese lacquer and ivory sewing box for *Needles and Pins*, an exhibit of sewing accoutrement from around the world opening at MOIFA in May. She is also continuing to manage the Save Americas Treasures grant awarded jointly with the Palace of the Governors in 2004.

Associate Conservator **Rebecca Tinkham** has started working on a large collection of fans in the Palace of the Governors collection. She is performing necessary stabilization and has designed standardized storage boxes which can be assembled by volunteers leaving her free to complete custom mounting required for each fan. She is also working on textiles to go on exhibit at the Palace and new History Museum and for the exhibit, *Needles and Pins*. Rebecca, with input from many others in the lab, is starting to finalize plans for the auxiliary Conservation Laboratory which will be housed in the New Mexico History Museum slated to open in the spring of 2009. The lab will be able to handle most general conservation needs but will also have specialized equipment for textiles and works of art on paper.

Assistant Conservator **Larry Humetewa** is the lead conservator for the *Needles and Pins* exhibition and has completed a survey of the checklist for the exhibition,

many treatments, and recommendations for mounts, installation, light levels, and RH. In addition, he is working on treatments for an exhibition for the Museum of Fine Arts, *How the West is One*. Larry and Assistant Conservator **Conor McMahon** continue to work with staff at Bandelier National Monument performing soil testing, scientific analysis on original earthen plaster walls, and fill materials used for graffiti mitigation in the cavates at Bandelier. Conor is working on a condition survey of the Kuaua Murals, painted kiva murals, funded by a Getty grant.

Third year intern **Anya McDavis-Conway** traveled to Kingston, Jamaica for two weeks to participate in a conservation program at the National Gallery of Jamaica sponsored by the US Ambassadors Fund. Activities included educational outreach, treatment, survey of collections on view, and general conservation assessment. With the rest of the lab, Anya has been treating objects for the upcoming *Needles and Pins* exhibit. She has also been continuing her research project on the Peruvian retablos in MOIFA's collection. Activities included visible, UV and IR light examination, PLM and FTIR analysis. Anya hopes to travel throughout Peru in June.

*Regional Reporter:*  
M. Susan Barger

### PACIFIC NORTHWEST

**Kristen Kern** has been involved with the installation of the Guild of Book Workers 100th Anniversary Exhibit at the Portland State University Library. The exhibit of traditional to contemporary book structures runs from April 9th to May 20th.

**Sanchita Balachandran** is leaving Vancouver, British Columbia in April and relocating to Baltimore, Maryland. She looks forward to connecting with conservators there. Her article on wall painting fragments from Dunhuang, China, entitled "Object Lessons: The Politics

of Preservation and Museum Building in Western China in the Early Twentieth Century" will be published shortly in *The International Journal of Cultural Property*.

**Jan Cavanaugh** has relocated her private practice in paintings conservation from Eugene to Portland, although she will still be commuting to Eugene during the spring term at the University of Oregon to teach "Art and Conservation," a course offered through the Art History Department dealing with the history, principles, and recent controversies of art conservation.

Among other projects in the studio **Jack Thompson** is treating a mid-18th-c. palm leaf manuscript from southern India and a late 17th-c. Koran. He has volunteers at Ft. Vancouver helping build a two-wheeled ox cart. Jack has an ancestral connection to this type of vehicle. His great-great-great grandfather moved the family from Kentucky to Illinois in 1829 in such a cart! Carrying capacity? About that of a modern pickup truck. Speed? About 3-4 mph, on a good day....

**J. Claire Dean** finished her 2006 field work with trips to Arkansas to do a CAP survey and various field projects in Southern California, Oregon, and Washington. Other than the 10 days she spent at dog sledding school in December, she gave herself a 10 week sabbatical from work over the winter in order to regain her sanity. She thoroughly recommends all conservators in private practice (or any other employ that does not include the possibility of sabbatical time) to work such a break into their schedules. Claire is now back in the field and has projects scheduled in California, Oregon, and Canada.

**Marie Laibinis-Craft** is working on a condition assessment of the Lovejoy Fountain for the city of Portland Water Bureau. The urban concrete fountain was designed by the noted landscape architect Lawrence Halprin in 1966 and has been internationally acclaimed for its design and setting. Marie is also consulting for the water bureau on the analysis, repairs, and restoration of the historic concrete and wrought iron fence that surrounds Mount Tabor Park's Reservoir #1. Built in 1894, the reservoir is one of two res-



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## Regional News, continued

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ervoirs in the park that furnish water to Portland. Both reservoirs' gatehouses bear the patent of a famous concrete craftsman and are examples of some of the earliest reinforced concrete buildings in the nation.

Marie and pre-program intern **Erin Stephenson** have begun research for the conservation treatment of a painted wood sculpture by Donald Judd, (Untitled, Judd #DSS41). Erin recently completed the treatment of three plaster relief panels by Bay Area sculptor, Melvin Earl Cummings (1876-1936). The treatment involved structural and surface repairs of the panels.

**Dana Senge** is enjoying working on several projects with institutions in Washington State. These treatments span from archaeological artifacts, such as steel fragments from the original Tacoma Narrows Bridge (Galloping Gertie) at the Gig Harbor Peninsula Historical Society, to contemporary ceramics for the Tacoma Art Museum.

In early May SAM re-opened following one year of closure for construction of expanded galleries at the downtown museum. This has been a period of intensive activity for SAM conservation staff who began the project with an overhaul of storage facilities at both SAM and Seattle Asian Art Museum. New storage cabinets were installed and new painting racks and compactors were added to four storerooms.

In preparation for expansion SAM conservation surveyed thousands of objects and treated many works of art, with assistance from numerous extraordinary colleagues in private practice and from other institutions.

Major projects included working with the design team on the building plan, testing materials, seismic studies, installing a C16 wood panel room, conserving a ceiling painting and frame by Tiepolo, as well as conservation of works by Cranach, Judd, Flavin, and Giambologna, a Hittite gold crown, and many other pieces from across the collections.

Concurrently, SAM Conservation was heavily involved in preparation, conservation, and maintenance of all of the

art in the new SAM Olympic Sculpture Park on the Seattle waterfront.

One of the inaugural exhibitions in the new museum is *Five Masterpieces of Asian Art: The Story of their Conservation*. A collaboration between SAM conservation and curatorial departments, the show describes recent major conservation projects undertaken on some of the most important paintings from Seattle Asian Art Museum. An international symposium was held on May 20 at SAM downtown.

Volunteers, conservators, installation crews, foundations, scientists, riggers, consultants, and contractors from the region, the nation, and overseas were essential to the realization of these undertakings. Anyone who might be interested in learning more can contact **Nic Dorman** at nicholasd@seattleartmuseum.org or you look at seattleartmuseum.org. The department hopes to describe some of the projects and collaborations in more detail in Denver.

*Regional Reporter:*  
Dana K. Senge

### ROCKY MOUNTAIN REGION

**Laura Staneff** and **Victoria Montana Ryan** have been collaborating on a survey of paintings, art on paper, and archival materials at the Center of Southwest Studies at Fort Lewis College in Durango, CO, under Acting Director **Jeanne Brako**. Laura was also pleased to have **Beth Heller** helping out with treatment for a week in March. Coming up in summer Laura will supervise an intern, **Lisa Duncan**, currently a first-year student at the Delaware/Winterthur program. Laura and Lisa will be working at the Center for Creative Photography on the Ansel Adams collection.

Does the dust ever settle around a new building? Denver Art Museum conservators are still busy with installations and rotations for their 146,000 sq. ft. addition which opened in Oct. 2006. Light-sensitive materials are changing throughout

the museum complex. A very large exhibition schedule includes two that are taking a lot of conservation time, *Artisans and Kings: Selected Treasures from the Louvre* and *Inspiring Impression*.

**Carl Patterson** has recently completed teaching "Introduction to Art Conservation" at the University of Denver. This course, offered in both graduate programs for museum studies in anthropology and art history, is one of the requirements for a BFA in Pre-Conservation. **David Turnbull** and **Kristy Jeffcoat** continue preparing oversized paintings for the move to the new storage facility. The two have also been conserving several paintings by Herbert Bayer for an upcoming exhibit.

**Jessica Fletcher** is currently developing an exhibit with the Native Arts curators on the pottery of Maria and Julian Martinez. DAM contract conservator **Gina Laurin** reports that several hundred pieces of Spanish Colonial silver have been cleaned and reinstalled. Several upgrades to the exhibit case should ensure that the silver remains clean for years to come. She is currently stabilizing a number of Oceanic tapa cloths for rotation.

Third-year intern **Julie Parker** of the Buffalo program has completed articles for publication on her projects which include the conservation of a Chinese Warring States period belt hook and the headdress that once belonged to Chief Iron Tail.

**WCCFA** conservators completed the treatment of murals in the Senate Chambers at the Utah State Capitol earlier this year, in the final stage of their on-site work there. Portraits of the Utah governors will be completed this summer in time for the grand re-opening of the renovated capitol in the fall. Current studio projects include the treatment of six oversized paintings by Colorado abstractionist Vance Kirkland from a private collection

*Regional Reporter:*  
Paulette Reading

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## Regional News, continued

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### SAN FRANCISCO BAY AREA

**Elise Effmann** has joined the staff of the Fine Arts Museums of San Francisco as full-time Associate Paintings Conservator. Prior to taking this position, Elise was Assistant Conservator of paintings at the Kimbell Art museum. Elise graduated in 2000 from New York University with an MA in Art History and Diploma in Conservation, having spent her internship year at the Metropolitan Museum of Art. From 2000 to 2003, she was a Mellon Fellow in paintings conservation at the Philadelphia Museum of Art.

Having treated most of the American paintings collection in preparation for the opening of the new de Young Museum, the Paintings Conservation Department of FAMSF is concentrating on European works from the Legion of Honour. **Carl Grimm**, head of the department, has begun treating a new acquisition, Gustave Courbet's *The Wave*. **Tricia O'Regan** has recently completed work on two 17th-c. Dutch portraits by Maes and is beginning treatment of Carolus-Duran's portrait of his daughter. **Tony Rockwell** has completed treatment of the large *Thunderstorm* by Jan van Goyen and a Guercino, and is presently treating a Flemish panel painting by Jan Brueghel the elder. Elise Effmann has begun work on Fragonard's *Education of the Virgin*.

**Sarah Gates** and **Beth Szuhay** of the Textile Conservation department at the Fine Arts Museums of San Francisco welcome **Yadin Larochette** as a member of the lab on a part-time contract basis. Yadin will be working to conserve a 16th-c. tapestry from the series *Triumph of the Seven Virtues*.

**Bonnie Baskin** will be working again at the Luang Prabang National Museum, Laos, through the sponsorship of the U.S. State Department, beginning in June. In addition to conserving Ramayana dance masks, Dong Son drums, and silver-foil Buddha figures, she will be teaching a four-day workshop on museum basics to representatives of all the national museums and members of the Ministry of Information and Culture.

**Margaret (Meg) Geiss-Mooney**, textile/costume conservator in private practice, conducted a two-day workshop the end of March covering storage of costume

and textile collections. Topics included affordable and available retrofitting and rehousing as well as a hands-on practicum. The Lace Museum (Sunnyvale) graciously served as host.

In November, SFMOMA hosted another collaborative workshop in photograph conservation funded by the Andrew W. Mellon Foundation, entitled, "Contemporary Photography: Digital Prints," organized by photograph conservator **Theresa Andrews** with assistance from **Marie-Chantale Poisson**, IMLS Fellow in Conservation of Contemporary Art. The 14 participants traveled from the U.S., Canada, Europe, Mexico, and Australia. The course material on digital photography was taught by nine lecturers including **Jill Sterrett**, Director of Collections and Head of Conservation at SFMOMA. The very successful event included presentations by artists and practitioners in the field of digital photography and visits to digital printing studios.

SFMOMA hosted an adhesives workshop on April 25th and 26th with lectures and practical sessions taught by **Jane Down**, Senior Conservation Scientist, CCI. The workshop was limited to the enrollment of 13 Bay Area conservators. Topics covered in the workshop included an overview of adhesives and bonding, CCI research on PVAC and acrylic adhesives, CCI research on VAE modifiers, CCI research on tapes, heat-set tissues, and CCI research on epoxy resins for glass repair. Both the PVAC and the VAE lectures were accompanied by a practical session.

Jill Sterrett, was awarded a Fulbright grant as a lecturer to the University of Porto in Portugal from February 1 - April 30, 2007. She returned to SFMOMA on May 7, 2007. **Michelle Barger** served as Acting Head of Conservation as well as continuing to oversee objects conservation.

At Architectural Resources Group and ARG Conservation Services **Glenn David Matthews**, **Kelly Wong**, and **Lisa Kusik** conducted a survey of the Palo Corona Ranch Barn in Carmel Valley for the Monterey Peninsula Regional Park District in mid-March in preparation of a historic structure report for the future use of this historic 1927 barn.

**Katharine Untch** is overseeing interior finishes during the construction phase of the Alameda Theatre, a Timothy Phleuger building constructed just after the Paramount Theatre in Oakland. Katharine Untch, **James Cocks**, **Jason Wright**, **Mary Slater**, and Kelly Wong also documented interior finishes in the Timothy Phleuger lobby of the New Mission Theatre in preparation for renovations and seismic upgrades. In downtown San Francisco, the celebrated 450 Sutter (a.k.a. Medical-Dental) Building, a unique Timothy Phleuger high-rise, is finally gearing up for the construction phase of renovations which is scheduled to begin in August 2007. Kelly Wong is ARG's Project Manager.

James Cocks, **Devlin MacDonald**, and Mary Slater are treating adobe structures at Mission San Juan Capistrano.

Katharine Untch and Mary Slater are conducting a conservation assessment and master preservation plan of interior architecture and collections for the Berkeley City Club, a Julia Morgan building including furnishings designed by the architect.

**David Wessel** and Jason Wright are providing specifications for historic materials preservation during construction at the Contemporary Jewish Museum in San Francisco and the Old Mint that will provide a new home for the San Francisco Museum and Historical Society.

**Molly Lambert** is conducting a condition and treatment priorities plan for the Frank Lloyd Wright Hanna House on the Stanford University campus. She has four interns from the University: **Alisa Chiles**, **Robbie Su**, **Hrysoula Papadakis**, and **Ethan Aumann**. For the San Francisco Arts Commission, Molly and **Sven Atema** will be conserving *The Fire Next Time II*, a large mural by Dewey Crumpler painted on two elevations of the Joseph Lee Recreation Center in the Bayview District. The artist will work with the conservation team to visually reintegrate the lost and faded imagery. Molly happily continues to work with Shangri La (the Doris Duke Foundation for Islamic Art) in Honolulu where **Rob Saarnio** has joined the staff as Deputy Director and the trade winds keep things interesting. **Richard Wolbers** will return

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## Regional News, continued

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to his work at Shangri La supervising Winterthur interns who will spend part of the summer stabilizing the finishes in the Damascus Room.

*Regional Reporter:*  
Beth Szuhay

## TEXAS

Last November, **Jodie Lee Utter** started working at the Amon Carter Museum in Ft. Worth. As Conservator of Works on Paper, she will be working with **Sylvie Pénichon** in the Carter's state-of-the-art paper conservation lab. Jodie has more than 15 years of experience in paper conservation, working for the past six years as sole proprietor of East West Paper Conservation in Memphis, Tenn. She writes that she is now "getting familiar with Ft. Worth and Texas as much as possible."

**Gregory Thomas** recently re-hinged and re-glazed a composite abstract pastel/chalk on black paper art work. The size, 4 foot square, and the unfixed medium required the use of Amiran TN glass from Schott Corp. This water white, laminated (safety glass-like) has non-reflective, anti-splintering, anti-static, and ultraviolet filtering properties, which are ideal for this medium. Greg is also completing the treatments of ten more A.R. Gurrey Hawaiian landscapes and seascapes from the art collection of the Kaua'i Museum.

*Regional Reporter:*  
Ken Grant

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## Health and Safety

### Guest Articles

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*Chris Stavroudis*  
*column editor*

I am pleased to offer two works by others in the *WAAC Newsletter* Health and Safety column.

We have reprinted, with Monona Rossol's permission, the lead article in the May 2007 *Acts Facts* (Vol 21, n. 5). The article is on the listing of our favorite white pigment, titanium dioxide, as a possible carcinogen to humans.

Also, co-opted from *AIC News*, an article by Terry Schaeffer, Conservation Scientist and Safety Officer at LACMA, about new regulations on x-ray usage in the state of California that will have dire consequences to studios that have x-ray imaging equipment.

### TITANIUM DIOXIDE LISTED AS A CARCINOGEN

IARC: Titanium dioxide (IARC Group 2B) Summary of reported data, Feb 2006, up dated, March 10, 2006 & MSDSs of many art and industrial materials.

It's been over a year since the International Agency for Research on Cancer (IARC) updated their standards to include titanium dioxide as a 2B carcinogen, that is, possibly carcinogenic to humans. This IARC determination supports the opinion of the National Institute for Occupational Safety and Health. NIOSH listed TiO<sub>2</sub> as a carcinogen in 1988. As yet, no other major agency or governmental organization has listed it.

The change in IARC's listing came about after the agency reevaluated all of the previous studies, concentrating this time on particle size. Essentially, the differences in the size of the TiO<sub>2</sub> particles used in the experiments explained why some studies showed no lung tumors in animals and others did. There was now enough animal data to support its being a carcinogen when inhaled. And by the same causal mechanisms, IARC says it is a possible human carcinogen.

**SKIN CONTACT.** The good news is that IARC found no evidence that nanoparticle size TiO<sub>2</sub> will absorb through the skin. Instead, studies of sun screens containing ultra fine TiO<sub>2</sub> on healthy skin of human volunteers revealed that the particles only penetrate into the outermost layers of the skin (stratum corneum). This suggests that healthy skin is an effective barrier to titanium dioxide. There are no studies on penetration of TiO<sub>2</sub> on damaged or diseased skin.

**MSDSs.** All material safety data sheets (MSDSs) for paints, clays, cosmetics, sun screens, and other products containing TiO<sub>2</sub> should be updated by this time to include this new status and information. The Occupational Safety and Health Administration (OSHA) requires manufacturers to up date their MSDSs within 3 months after they become aware of any significant new data (29 CFR 1910.1200(g)(5)).

**COMMENT.** TiO<sub>2</sub> is a white pigment found in consumer and art paints, inks, cosmetics, and more. The TiO<sub>2</sub> in these products is not hazardous if it does not get airborne. However, artists should be concerned because the titanium white gessoes are likely to be sanded to create a dust. And clays and glazes containing them always create dust in the studio. Airbrushing or spraying of titanium-containing materials would also be another cause for concern.

The new status also should be the final nail in the coffin for air brushing make-ups. The majority of the ingredients in cosmetics are approved by the Food and Drug Administration only for skin contact. Many are not approved for the skin around the eyes or the lips. And none are approved for inhalation. Now one of these common ingredients is also a possible human carcinogen by inhalation. It's time for the airbrush make-up industry to call it a day.



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## Health and Safety, continued

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### California Proposes New Regulations that Will Affect Conservation X-Radiography

The state of California Department of Health Services has proposed major changes to their regulations governing the conduct of Industrial Radiography. A cover letter requesting commentary states that the new regulations would not have a significant fiscal impact on business in California, but also adds that small businesses would be affected. The cover letter, summary of proposed changes and reasons, and texts of the changes may be found on the California Office of Regulations website at <http://www.applications.dhs.ca.gov/regulations>. Search for R-25-03. The period for submitting commentary on the proposal has closed.

In both the current and the proposed new regulations, Industrial Radiography is defined as the examination of internal structures of materials other than humans and animals by non-destructive methods using radiation. X-radiography of paintings and 3-dimensional art objects as performed in museums is classified as Industrial Radiography.

The proposed regulations include highly specific qualifications for the Radiation Safety Programs of "businesses" undertaking all Industrial Radiography. They describe in great detail the requirements for persons performing the x-radiography at all levels of experience. These requirements appear to be based on the assumption that the radiographer works full time. For example, 2000 documented hours (equivalent to fifty 40-hour weeks) of hands-on experience operating x-radiography equipment - not counting film development and interpretation - will be required in order to be a trainer or supervisor of an "assistant" who is learning the process. Such an assistant must be personally supervised at all times.

In order to serve as Radiation Safety Officer, an experienced radiographer would need twice as much (4000 hours) relevant experience. Without a Radiation Safety Officer to oversee a Radiation Safety program, no x-radiography would be permitted. It would be highly unusual for a conservator or conservation scientist to be able to document this many hours of performing x-radiography. The applicability of other professional qualifications and institutional safety records are not considered in the regulations.

The proposed California regulations do not provide any exceptions to these requirements. They appear to be based on similar regulations in force in the state of Texas. However, the Texas regulations do include an exemption for shielded room radiography performed under circumstances that arts institutions could meet in most cases. Several California museums with conservation departments have filed commentaries calling attention to the professional qualifications and training of conservation staff and the excellent safety records of conservation x-radiography in arts institutions. They have urged consideration of inclusion of a similar exemption in the new California regulations.

It should be noted that OSHA has recently conducted a series of stakeholder meetings on occupational exposures to ionizing radiation. The agendas included consideration of the uses of ionizing radiation, controls utilized to minimize exposures, available exposure data, and training. Currently OSHA allows Agreement States to set their own regulations for the use of ionizing radiation in industrial processes as long as these regulations require adherence to certain federal standards.

Thanks to Scott Fife, Senior Safety Officer, The J Paul Getty Trust, for his invaluable help in evaluating the proposed regulations and writing commentary.

*Terry Schaeffer*

*Chris Stavroudis is a conservator in private practice.*

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## WAAC Publications

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### Handling Guide for Anthropology Collections

Straightforward text is paired with humorous illustrations in 41 pages of "do's and don'ts" of collection handling. A Guide to Handling Anthropological Museum Collections was written by Arizona State Museum conservator Nancy Odegaard and illustrated by conservation technician Grace Katterman. This manual was designed to be used by researchers, docents, volunteers, visitors, students, staff or others who have not received formal training in the handling of museum artifacts. Paperbound and printed on acid-free stock.

**Price, postpaid:**

\$8.85 (\$6.60 per copy for orders >10 copies)

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### 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, postpaid:**

\$12.50

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### 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 per copy**. A discount will be given to libraries seeking to obtain back issues to complete a "run" and for purchases of ten copies or more of an issue.

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### Make your check payable to WAAC. Mail your order to:

Donna Williams

# Generic Hydrocarbon Solvents: a Guide to Nomenclature

All of us, no doubt, have encountered and used generic hydrocarbon solvents from the hardware store or chemical supply house. But how often, as we contemplated our bottle of mineral spirits, naphtha, white spirits, petroleum spirits, turps substitute, mineral turpentine, benzine, petroleum ether, ligroin, or Stoddard Solvent, have we felt that we actually knew what was in it, and what were its properties in terms of solvent power, boiling range, evaporation rate, etc.

Although conservators are becoming increasingly accustomed to proprietary hydrocarbon solvents offered by the larger petrochemical companies – Shell, Exxon Mobil, etc. – and are seeking out particular products with quite specific properties, the traditional generic solvents still arouse some considerable uncertainty regarding composition and properties.

The vagaries of nomenclature of generic hydrocarbon solvents became painfully apparent to me during the course of early work on a book on the use of solvents in conservation which is currently in progress: the situation seemed so unclear to me that I felt it necessary, for my own understanding and peace of mind, to try to untangle some of the web of confusion concerning the identity of all of the kinds of stuff we know of as generic hydrocarbon solvents. The following article is essentially an extract of some of the content of the draft chapter in the book which is concerned with hydrocarbon solvents.

It is perhaps worth mentioning at the outset that the principal ways in which these kinds of product are distinguished are by their boiling/distillation ranges (and, by association, volatility, flash point etc.) and aromatic content; these are the key properties which we should have some idea of when using such liquids. Generally speaking, with regard to aromatic content, generic hydrocarbon solvents fall into two broad groups:

those that are essentially aliphatic (ie. composed largely of linear, branched, and/or cyclic alkanes) and free from aromatic compounds, and

those that contain low to moderate proportions of aromatics, usually less than about 25%.

The presence of a fraction of aromatic compounds in an otherwise aliphatic hydrocarbon solvent will add to its polarity and solvent power, factors which may be desirable for certain purposes, for example dissolving certain polymer resins. The presence of a significant aromatic content in a largely aliphatic hydrocarbon liquid may, however, have some less desirable consequences, such as increased odor or greater degree of harmfulness.

Traditional mineral spirits or white spirits products normally have aromatic contents in the range of about 10-25% w/w. Quite a number of hydrocarbon solvent products will have been actively 'de-aromatized' to remove or chemically convert (by hydrogenation) the aromatic constituents of the original feedstock into saturated compounds, with the result that such grades often contain very few or no aromatics.

matic constituents of the original feedstock into saturated compounds, with the result that such grades often contain very few or no aromatics.

## A note about CAS Registry and EINECS Numbers

When it comes to specifying any chemical substance, a good starting point is the CAS Registry Numbers or, for Europe, the EINECS (European Inventory of Existing Commercial Chemical Substances) number, which is also sometimes called the EC Number.<sup>1</sup> In principle, these registries of chemical substances provide an indexed catalogue of specific chemical compounds: known chemical substances – even different individual isomers of the same substance – are identified by a unique registration number. To take xylene, for example, this substance is covered by four different CAS Registry and EINECS numbers:

	xylene: mixed, or no specific isomers	<i>o</i> -xylene	<i>p</i> -xylene	<i>m</i> -xylene
CAS Registry No.	1330-20-7	95-47-6	106-42-3	108-38-3
EC No.	215-535-7	202-422-2	203-396-5	203-576-3

Hydrocarbon solvents are just one, relatively small, group of products that are the output of petroleum refineries. Like the various fuel products derived from crude petroleum (gasoline, kerosene, fuel oil, etc.) most hydrocarbon solvents are complex mixtures rather than specific individual compounds. So the approach adopted for formal description and differentiation of petroleum refinery products was a series of generic descriptors for different refinery process streams, each with its own CAS Registry Number (and by correlation, now, EC/EINECS Number), based not on chemical composition, but on the process history and final process step. The result is that over 80 CAS Numbers exist which describe different kinds of petroleum refinery output, many of which might apply to commercial solvent products.

The essential point of relevance to solvent products is that CAS Registry Numbers for petroleum refinery products are not necessarily unique descriptors of the chemical substance: refinery products with the same or substantially similar compositions may actually have different CAS numbers; furthermore, more than one CAS Registry Number may apply to any given product. CAS Registry and EC Numbers can be helpful in providing some clarification of the composition of hydrocarbon solvents, but they should

1. A good online source for finding CAS Registry numbers is the ChemIDplus database operated by the US National Library of Medicine. See: <http://chem.sis.nlm.nih.gov/chemidplus>

Similarly, a database of chemical substances searchable by CAS Registry and EINECS numbers is provided by the European Chemical Substances Information System (ESIS) operated by the European Chemicals Bureau; see <http://ecb.jrc.it/esis/>

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## Generic Hydrocarbon Solvents: a Guide to Nomenclature, continued

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be treated with some caution, especially if one is using them to source information on health hazards, etc.. 'Stoddard Solvent' is a good example: Stoddard Solvent has its own CAS Registry No. 8052-41-3, but one may also encounter products called 'Stoddard Solvent' which are assigned other CAS numbers, such as 64742-88-7 which identifies it as *Solvent naphtha, petroleum, medium aliphatic*, as well as several other descriptors.

### Low boiling point, low aromatics (or aromatics-free) generic hydrocarbon solvents: naphthas, petroleum spirit, petroleum benzine, ligroin, petroleum ether, and related products

The terms 'petrol' or 'gasoline' are used in the petroleum industry to describe the broad fraction of volatile hydrocarbons that are distilled from crude oil between 30 and 210°C; but from this very broad fraction a whole variety of sub-fractions can be isolated and/or are marketed as solvents. At the lower end of this boiling range we find liquids that would come under the broad designation of **naphtha** or **petroleum spirits**. These two somewhat over-arching terms correctly describe some of the more volatile liquid fractions of petroleum: naphtha normally applies to refined or partly refined products of distillation of crude oil boiling in the range of approximately 40 to 100°C, or possibly a little higher to around 120°C.

Having said this, however, the term naphtha does, somewhat confusingly, also get used in the names of some petroleum-derived products that have boiling ranges sometimes quite considerably higher than 120°C, as we shall see below.

There is a general convention, then, to call the products that consist of, or contain, an abundance of, lighter, lower boiling point (< ca. 140°C) compounds '**light naphthas**', and to refer to the higher boiling point (> ca. 160°C), more dense products as '**heavy naphthas**'. Some laboratory suppliers may also offer other, higher boiling point, petroleum solvent products with specified boiling ranges under such names as 'Petroleum, Special bp 180-200°C', and while these might be largely aliphatic in composition, the CAS/EC Registry numbers applied to such products (eg. 64742-82-1) suggest these are of the 'white sprits-type' and therefore might contain up to about 20-25% aromatics.

In British usage, the term **petroleum spirits** describes very similar products to those covered by the term naphtha when applied to the more volatile products boiling below 120°C: petroleum spirit finds use commonly among the suppliers of laboratory chemicals to describe, usually, aliphatic (non-aromatic) hydrocarbon solvents within a similar range of boiling points. The English term 'petroleum spirits,' then probably equates best with the German '**Siedegrenzenbenzine**' which term is also usually accompanied with a designation of boiling range. Whilst falling within the rather broad group of products that would come under the general classification of naphtha or petroleum spirits, the very lightest, most volatile liquid hydrocarbon solvents that can be bought from laboratory chemical suppliers may also be offered under the name **petroleum ether**, (the term 'ether'

signifying extreme lightness and volatility), normally with a descriptive suffix giving the boiling range.

Thus, from the leading international laboratory chemicals suppliers it is possible to buy various petroleum ethers with boiling ranges such as 30-50°C, 40-60°C, 50-70°C, 60-80°C, etc. Similar, essentially aliphatic, solvents with specific boiling ranges above 100°C are also available, but these would normally be called, at least in the UK, petroleum spirit, followed by the relevant boiling range, 100-120°C, etc. However, in the United States, laboratory grade aliphatic hydrocarbon solvents with boiling ranges as high as 100-140°C still appear to be called petroleum ether, rather than petroleum spirit. The petroleum ethers will consist mostly of mixed aliphatic hydrocarbons comprising up to about 6 or 7 carbon atoms.

Importantly, some forms of petroleum ether, like other grades of hydrocarbon solvent, are specifically identified as having been 'hydrogen-treated,' which generally means they have been hydrogenated to convert any unsaturated and/or aromatic components to saturated forms; as a rule hydrogen-treated solvents are low in aromatics and other unsaturated compounds. It should be emphasised that the petroleum ethers are extremely volatile, have very low flash points (well below 0°C), and present a significant fire hazard. Petroleum ethers will have similar properties to some of the special (low) boiling point solvents (SBPs) with comparable boiling ranges produced by several of the major petrochemical companies.

Another class of products also available from laboratory chemical suppliers are **ligroins**, which again can be considered as a sub-set of the group of naphthas/petroleum spirits. The term 'ligroin,' again often followed by a specific boiling range, applies to hydrocarbon liquids obtained by fractional distillation of petroleum typically having boiling points between about 60-110°C. Products under the name ligroin can have boiling ranges as low as 60-80°C and may be practically indistinguishable from a petroleum ether with the same boiling range. Ligroin is assigned the CAS Registry Number 8032-32-4, which is also applied to many other products, particularly the lower boiling ones, called petroleum spirit, petroleum ether, and petroleum benzine.

To all intents and purposes **petroleum benzine** appears synonymous with petroleum spirit. 'Naphtha' has the CAS Registry Number 8030-30-6, which also covers petroleum benzine and petroleum ether: that is, the lower boiling point non-aromatic hydrocarbon solvents. Applied to solvents, the terms 'naphtha' and 'benzine' appear essentially synonymous in North American usage. To take a familiar example, the US laboratory chemicals supplier Fisher Scientific offers a product 'Benzine (Petroleum Naphtha)' which is commonly used by conservators. This product is identified by the CAS Registry No. 64742-89-8 which defines the product as *Solvent naphtha (petroleum), light aliphatic*. The boiling range is quoted as 118.5 – 140.5°C, and it is described as consisting substantially of aliphatic hydrocarbons, of which octane and *n*-heptane make up 1.5% and 1.2% respectively;



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## Generic Hydrocarbon Solvents: a Guide to Nomenclature, continued

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aromatic-content is very low, less than about 0.2%. As if to demonstrate perfectly the overlap in the names of these generic hydrocarbon solvents, Fisher's 'Benzine (Petroleum Naphtha)' conforms to the specification for a low-aromatics VM&P Naphtha (see below); indeed this is probably a re-labelled VM&P Naphtha from one of the major US petrochemical companies.<sup>2</sup>

On the whole, the term 'naphtha' is the broadest of all the terms which describe petroleum distillation and refinery products, and apart from the very specific instance of **VM&P Naphtha** (Varnish Makers & Painters' Naphtha), it is perhaps best to avoid this term when referring to solvents.

### **Higher boiling point generic hydrocarbon solvents: mineral spirits, white spirits, Stoddard Solvent, testbenzin etc.**

The various solvents that we know by the common or commercial names above are some of the most difficult to describe and to distinguish. They are probably some of the most widely and frequently used solvents in conservation, but there is often considerable uncertainty in our field, and others, about their identity and composition. This is especially significant since products from this group may vary quite significantly in the magnitude of the health hazard which they present, mostly on account of their aromatic content or other possibly harmful constituents. These solvents are also quite commonly used in operations that involve, in the order of things, relatively large quantities of liquid (applying coatings such as varnishes by brush or spray, dry-cleaning, consolidation etc.), so that potential for actual exposure may be correspondingly increased. But it is not just conservation that uses the various types of white or mineral spirits in quantity: in terms of volume these solvents are probably the most abundantly used around the world.

### **World Health Organization (WHO) 'White Spirit (Stoddard Solvent): health and safety guide,' 1996**

The world-wide health risks associated with the use of white spirits were perceived to be of such magnitude that this product was examined in depth by the World Health Organization (WHO) which published its findings in 1996. The 1996 WHO report and its associated 'Health Criteria' are an excellent starting point for consideration of the general nature and identity of solvents of the type called white spirit or mineral spirits. [1, 2] Many of the observations made in relation to white spirits apply also to the other generic distillation products discussed earlier. However, since the WHO report was published, some significant changes in the specifications of white/mineral spirits and related products have occurred, especially in North America, and it should not now be considered as an absolutely perfect reflection of the current situation.

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<sup>2</sup> Compare, for example, the properties of Fisher 'Benzine (Petroleum Naphtha)' with Marathon Petroleum's VM&P Naphtha in Table 3.

On the basis of the situation in manufacturing before 1996, products coming under the umbrella of the terms mineral spirits or white spirits were described in the WHO report essentially as follows:

White spirit is a clear colorless solvent with very low water solubility and a characteristic odor (odor threshold: 0.5-5 mg/m<sup>3</sup>). It is a petrochemical solvent containing mainly C<sub>7</sub> to C<sub>12</sub> or C<sub>13</sub> aliphatic, alicyclic, and aromatic hydrocarbons with a boiling range of 130-220°C. Different varieties exist which are defined according to different kinds of treatment (hydro- desulphurization, solvent extraction and hydrogenation) that the products have undergone or according to their boiling ranges or flash-points. The content of white spirit can vary, because of differences in the raw material (crude oil) and in the production processes. The different kinds of white spirit are defined, therefore, according to physico-chemical properties rather than exact chemical composition.

Different white spirit products were classified into four main types according to their production process:

#### **Type 1: Naphtha (petroleum), hydrodesulphurized heavy.**

A complex combination of hydrocarbons obtained from a catalytic hydrodesulfurization process. It consists of hydrocarbons having carbon numbers predominantly in the 7-12 range and boiling in the range of approximately 90 to 230°C (194 to 446°F). Aromatics < 25% by weight; Benzene < 0.1% by weight.

#### **Type 2: Naphtha (petroleum), solvent-refined heavy.**

A complex combination of hydrocarbons obtained as the raffinate from a solvent extraction process. It consists predominantly of aliphatic hydrocarbons having carbon numbers predominantly in the 7-12 range and boiling in the range of approximately 90 to 230°C (194 to 446°F). Aromatics < 5 % by weight; Benzene < 0.02 % by weight.

#### **Type 3: Naphtha (petroleum), hydrotreated heavy.**

A complex combination of hydrocarbons obtained by treating a petroleum fraction with hydrogen in the presence of a catalyst. It consists of hydrocarbons having carbon numbers predominantly in the 6-13 range and boiling in the range of approximately 65 to 230°C (149 to 446°F). Aromatics < 1% by weight; Benzene < 0.002% by weight.

#### **Type 0: 'Straight-run' white spirit.**

A distillation fraction subjected to no further treatment beyond distillation, consisting predominantly of saturated C<sub>9</sub>-C<sub>12</sub> hydrocarbons with a boiling range of 140-220°C.

Relevant CAS registry numbers are:

- 8052-41-3 (Stoddard solvent);
- 64742-82-1 (white spirit type 1);
- 64741-92-0 (white spirit type 2);
- 64742-48-9 (white spirit type 3);
- 64742-88-7 (white spirit type 0).

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## Generic Hydrocarbon Solvents: a Guide to Nomenclature, continued

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The naphtha and kerosene fractions from crude petroleum are first subjected to hydrodesulphurization, followed by fractional distillation into the appropriate boiling ranges. In the case of type 3 white spirit, hydrogenation (treatment with hydrogen over a catalyst, also termed hydrotreatment) is carried out on the fraction of hydrodesulphurized white spirit. The sequence of fractionation and hydrogenation may be reversed. Hydrogenation converts the unsaturated aromatics into saturated cycloalkanes. Consequently, hydrogenated white spirit contains straight- and branched-chain aliphatics (n- and iso-alkanes), a relatively large fraction of cycloalkanes (naphthenes), and practically no aromatics. White spirit that has not been treated beyond the process of distillation is termed straight-run white spirit (type 0).

Each of the four types may occur in three different grades: **low flash** grade (flash point: 21-30°C; initial boiling point: 130-144°C), **regular grade** (flash point: 31-54°C; initial boiling point: 145-174°C), and **high flash** grade (flash point: ≥ 55°C; initial boiling point: 175-200°C). The grade is determined by the crude oil used as the starting material and the conditions of distillation.

The most common variety of white spirit is a mixture of saturated aliphatic and alicyclic C<sub>7</sub>-C<sub>12</sub> hydrocarbons with a content of 15-20% (by weight) of aromatic C<sub>7</sub>-C<sub>12</sub> hydrocarbons and a boiling range of 130-230°C. The C<sub>9</sub>-C<sub>11</sub> hydrocarbons (aliphatics, alicyclics, and aromatics) are most abundant, constituting ≥ 80% (by weight) of the total. This ordinary white spirit is designated white spirit, type 1, regular grade, as three different types and three different grades exist. A USA variety of type 1 is called Stoddard Solvent and is a hydrodesulphurized solvent petroleum distillate defined according to its boiling range of 149-204°C and the absence of rancid or objectionable odors.

Here we see one of several different definitions of 'Stoddard Solvent.' It is of interest here to note that the WHO regarded it as a particular form of Type 1 white spirit; that is, one which contains up to 25% aromatics.

### National and International Standards for hydrocarbon solvents

Various national standards which give specifications for mineral spirits solvents are summarized in Table 1. The International Standard ISO 1250: *Mineral solvent for paints - white spirits and related hydrocarbon solvents* was withdrawn in 1985 and no longer applies. That standard was, however, technically identical to the British Standard BS 245:1976 which is still in force and which gives two specifications of white spirit, with low (< 25%) and high (25-50%) aromatic contents respectively.[3]

There is a series of German DIN standards for hydrocarbon solvent products. White spirit is covered in DIN 51632 which is in two parts, each part defining one of two broad classes of white spirit. DIN 51632-1 [4] covers regular white spirit (testbenzene), which is defined as a "refined

gasoline fraction with a minimum flash point of 21°C and a distillation range of 130°C to 220°C;" DIN 51632-2 [5], describes low aromatics white spirits, that is "refined gasoline fraction with a low aromatics content, a minimum flash point of 21°C, and a distillation range of 130°C to 270°C." The aromatics content of regular white spirits falling within DIN 51632-1 is not actually specified, but to comply with the standard products must contain less than 0.1% benzene by weight. Within the broad class of regular white spirit, DIN 51632 - 1 defines four separate sub-types, each having different distillation ranges: Type 1, 130 - 185°C; Type 2, 140 - 200°C; Type 3, 150 - 190°C, and Type 4, 180 - 220°C. According to the standard, a regular (N) white spirits of type 2 would be designated 'White Spirit DIN 51632 - N - 2.'

In the specification for low aromatics white spirit, DIN 51632 - 2, six separate sub-types (1-6) are defined, again according to distillation ranges: Type 1, 130 - 185°C; Type 2, 140 - 200°C; Type 3, 150 - 190°C; Type 4, 180 - 220°C; Type 5, 190 - 250°C, and Type 6, 220 - 270°C. All of these sub-types are specified to have less than 1% w/w aromatics, and for types 1-3 the maximum benzene content is set at 0.1%w/w. According to the standard, a low aromatic (E) white spirits of type 2 would be designated 'White Spirit DIN 51632 - E - 2'.

In addition to the above DIN standards for white spirits, some other hydrocarbon solvent products are specified under German standards. DIN 51630 [6] provides for Petroleum Spirit (also called here Spezialbenzine - Petrolether) which is described as "a special boiling-point spirit commonly used in laboratory applications, having high volatility and low aromatics content." DIN 51631 [7] covers Special-Boiling-Point Spirit (also called Spezialbenzine - Siedegrenzenbenzine) which is described as a "fraction of petroleum naphtha having a narrow distillation range and a flash point below 21°C, specially treated for particular applications." Special-Boiling-Point Spirit according to DIN 51631 is classified into three types: type 1, 2, and 3. (see Table 4.7) A further type of Spezialbenzine is specified in DIN 51635 [8] which applies to FAM Standard Mineral Spirits (FAM-Normalbenzin): this is a low-boiling point product.

An Australian standard for white spirits exists in the form of AS 3530-1988. [9]

### United States standards for generic hydrocarbon solvents

The ASTM standard for mineral spirit that is outlined in Table 1 has undergone considerable revision since it was introduced in 1983 as ASTM D235-83. The current, active version of that standard, ASTM D235-02: *Mineral Spirits and Stoddard Solvent*, [10], came into force in 2002, and it now stands as one of three operational ASTM standards for hydrocarbon solvents, the other two being ASTM D3735-02: *VM&P Naphthas* [11], and ASTM D3734-05: *High Flash Naphthas*. [12] These standards provide an excellent framework for understanding the nature, properties, and range of products that are presently available under these respective generic names.

Table 1. Selected standard specifications pertaining to hydrocarbon solvents

Country	Product and specification reference	Distillation: IBP / FBP <sup>a</sup>	Flash Point	Aromatic content (% v/v) and other compositional specs.
Germany	DIN 51630 Petroleum Spirit (Spezialbenzine – Petrolether)	IBP above 25°C FBP up to 80°C	None specified	Benzene < 0.1% w/w <i>n</i> -hexane <5% w/w
Germany	DIN 51631 Special-Boiling-Point Spirit (Spezialbenzine - Siedegrenzenbenzine)	Type 1 60 min. - 95°C max. Type 2 80 min. - 110°C max. Type 3 100 min. - 140°C max.		Benzene < 0.1% w/w <i>n</i> -hexane <5% w/w Aromatics: Type 1 <0.1% Type 2 <0.2% Type 3 <0.2%
Germany	DIN 51632 – 1 Regular white spirit (Testbenzine)	Overall, 130 – 220°C Four separate sub-types specified: Type 1 130 - 185°C Type 2 140 - 200°C Type 3 150 - 190°C Type 4 180 – 220°C	Overall, 21°C min Type 1 21°C min Type 2 21°C min Type 3 35°C min Type 4 55°C min	Not specified  (benzene < 0.1 g/100g = 0.1% w/w)
Germany	DIN 51632- 2 Low aromatics white spirit (Testbenzine)	Overall, 130 –270°C Six separate types (1-6) specified: Type 1 130 - 185°C Type 2 140 - 200°C Type 3 150 - 190°C Type 4 180 – 220°C Type 5 190 - 250°C Type 6 220 - 270°C	Overall, 21°C min Type 1 21°C Type 2 21°C Type 3 35°C min Type 4 55°C min Type 5 65°C min Type 6 65°C min	Max 1% w/w aromatics  Benzene < 0.1% w/w Benzene < 0.1% w/w Benzene < 0.1% w/w - - -
Germany	DIN 51635 FAM standard mineral spirit (FAM-Normalbenzin)	60 - 95°C 85-95% distilled by 90°C		Benzene < 0.1% w/w <i>n</i> -hexane <5% w/w  Aniline point 59-61
UK	(BS 245: 1976) Mineral solvent (white spirit, type A)	<1% below 130°C; <10% below 145°C; <90% below 200°C; end point not above 220°C	above 32°C	< 25%
UK	BS 245: 1976 Mineral solvent (white spirit, type B)	<1% below 130°C; <10% below 145°C; <90% below 200°C; end point not above 220°C	above 32°C	25-50%
International Standard	Mineral solvent for paints - white spirits and related hydrocarbon solvents. (ISO 1250). Withdrawn 05.01.85	(technically identical to BS 245: 1976)		
Australia	White Spirit <sup>c</sup> AS 3530 - 1988	IBP 145°C min – 155°C max 10% recovered 150°C min – 160°C max 50% recovered 160°C min – 170°C max 95% recovered 180°C min – 190°C max FBP 200°C	31°C	-
USA	(ASTM D235-83) <sup>b</sup> (now obsolete) Mineral spirit type 1 - regular (Stoddard solvent)	149 °C min - 208°C max	38 °C min	-

## Notes:

<sup>a</sup> IBP = initial boiling point; FBP = final boiling point<sup>b</sup> Also includes specifications for high flash-point (60 °C min), odourless (Kauri-butanol value, 29 max) and low dry-point (185 max). This standard now superseded: current specification is D235-02<sup>c</sup> The Australian standards for mineral turpentine and white spirit are almost identical, the only real difference being in the Aniline Point values (mineral turpentine : 20-25°C) and (white spirit : 50-56°C) which suggests that 'mineral turpentine', in Australian usage, is higher in aromatics than white spirit.



## Generic Hydrocarbon Solvents: a Guide to Nomenclature, continued

### ASTM D235-02 Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)

ASTM D235-02 goes some way to clarifying the descriptive terminology of hydrocarbon solvents. By its own description “this specification covers four types of hydrocarbon solvents, normally petroleum distillates, used primarily in the coatings and dry-cleaning industries. ‘Mineral Spirits’ is the most common name for these solvents. They are also called ‘Stoddard Solvents’ when used for dry cleaning.”

It is of interest to note that, at least in the eyes of ASTM, the name ‘Stoddard Solvent’ might be applied to any of the solvents specified in ASTM D235-02.

ASTM D235-02 defines four distinct types of mineral spirits:  
Type I - Full Range.

Type II - High Flash Point.  
Type III - Odorless.  
Type IV - Low Dry Point  
(ie. low final boiling/distillation point).

Each of these four types of Mineral Spirits is then further differentiated according to aromatics content as follows:

Class A - 8 to 22 vol % aromatics.  
Class B - 2 to 8 max vol % aromatics.  
Class C - less than 2 vol % aromatics.

An exception are the ‘Odorless’ grades (Type III): being inherently low in aromatics, these only exist in Class C forms. For Type III ‘Odorless’ solvents, two separate Class C types are specified, C-1 and C-2, which are similar save for the fact that C-2 has a higher Bromine Number and therefore higher olefinic content.

Table 2. Physical and chemical properties of different types of Mineral Spirits according to ASTM D235-02

	Type I Full Range Mineral Spirits			Type II High Flash Point			Type III Odorless <sup>B</sup>		Type IV Low Dry Point			
	Class A	Class B <sup>A</sup>	Class C <sup>A</sup>	Class A	Class B <sup>A</sup>	Class C <sup>A</sup>	C-1 <sup>A</sup>	Class C-2 <sup>A</sup>	Class A	Class B <sup>A</sup>	Class C <sup>A</sup>	
<i>Aromatic Content, range, vol %</i>	8–22	2–8 max	0–2	8-22	2-8 max	0-2	0–0.25	0–0.25	8-22	2-8 max	0-2	
<i>Commercial reference</i>	regular	rule 66	low aromatic	regular	rule 66	low aromatic	odorless	odorless	regular	rule 66	low aromatic	
<i>Appearance</i>	clear and free of suspended matter when observed at 15-25°C											
<i>Flash point, (°C),</i>	38	38	38	61	61	61	38	38	38	38	38	
<i>Color,</i>	Min. not darker than + 25 on Saybolt Scale											
<i>Kauri-Butanol value</i>	<i>min</i>	34	29	28	33	29	28	....	....	34	29	28
	<i>max</i>	43	40	39	43	40	39	29	29	43	41	40
<i>Bromine Number, max</i>	5	1	0.1	5	1	0.1	0.1	5	5	1	0.1	
<i>Distillation, (°C)</i>												
<i>Initial boiling point, min</i>	149	149	149	177	177	177	149	149	149	149	149	
<i>50 % Recovered, max</i>	185	185	185	202	202	202	196	196	174	174	174	
<i>Dry point, max</i>	213	213	213	213	213	213	213	213	185	185	185	
<i>Residue from distillation: Vol %, max</i>	1.5											
<i>Acidity</i>	neutral											
<i>Apparent Specific Gravity (15.6/15.6°C)</i>	<i>min</i>	0.754	0.754	0.754	0.768	0.768	0.768	0.740	0.740	0.754	0.754	0.754
	<i>max</i>	0.820	0.810	0.800	0.820	0.810	0.810	0.775	0.775	0.810	0.800	0.790

**Notes:**

A. Mineral Spirits of Types I, II, III, and IV may be commercially available as Classes B and C to meet certain air pollution regulations (for example, “Rule 66”) which set maximum limits on certain constituents as follows: toluene and ethylbenzene 20 vol %, C8 and higher aromatics 8 vol %, olefins 5 vol %; the sum of all restricted constituents not to exceed 20 vol %.

B. Only products that have a very high isoparaffinic hydrocarbon content, that is, approaching 100 %, are considered to fit the odorless category. Type III Class C-1 is a hydrogenated product; Class C-2 is a distillation fraction.

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## Generic Hydrocarbon Solvents: a Guide to Nomenclature, continued

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In summary, ASTM D235-02 specifies different types of mineral spirits which are designated as follows:

Type IA	Regular Mineral Spirits, 8-22% aromatics; Stoddard Solvent
Type IB	Mineral Spirits, 2-8% aromatics, Rule 66; Stoddard Solvent
Type IC	Mineral Spirits, 0-2% aromatics; Stoddard Solvent
Type IIA	Mineral Spirits, High Flash, 8-22% aromatics; Stoddard Solvent
Type IIB	Mineral Spirits, High Flash, 2-8% aromatics, Rule 66; Stoddard Solvent
Type IIC	Mineral Spirits, High Flash, 0-2% aromatics; Stoddard Solvent
Type III	Mineral Spirits, Odorless
Type IVA	Mineral Spirits, Low Dry Point, 8-22% aromatics; Stoddard Solvent
Type IVB	Mineral Spirits, Low Dry Point, 2-8% aromatics, Rule 66; Stoddard Solvent
Type IVC	Mineral Spirits, Low Dry Point, 0-2% aromatics; Stoddard Solvent.

Key physical and chemical properties of these various types of mineral spirits are summarized in Table 2 which is an abridged version of what is presented in the Standard document itself. Some solvent manufacturers indicate in their technical literature, where appropriate, compliance of particular products with any of the ASTM D-235 mineral spirits types.

### ASTM 3735-02 Standard Specification for VM&P Naphthas

In similar fashion to the specification for mineral spirits described above, ASTM 3735-02 “covers four types of moderately volatile hydrocarbon solvents, mainly aliphatic in composition and normally petroleum distillates. These solvents are used primarily by the coatings industry and are commonly referred to as VM&P naphthas.” ‘VM&P Naphtha,’ then, is generally understood to describe hydrocarbon solvents similar to mineral spirits, but which are somewhat more volatile, having boiling points mostly in the range 120-145°C. The low-aromatics types have much in common with the higher boiling products called ‘petroleum spirits’ described earlier.

ASTM 3735-02 defines four types of VM&P naphtha the physical and chemical properties of which are shown in Table 3:

Type I -	Regular.
Type II -	High flash.
Type III -	Odorless.
Type IV -	Low aromatics

VM&P Naphtha types I and II generally contain a moderate amount of aromatics (<20%), while Types III and IV, by their nature, are very low in aromatics, less than 1% and 2% respectively. Most of the products supplied today under the name VM&P naphtha are generally of the low

aromatics or odourless types. Shell Chemicals presently only produces one product under the general name VM&P Naphtha, namely VM&P Naphtha HT, and the properties of this solvent are included in Table 3 for comparison with the specifications in ASTM D3735. However, until quite recently Shell produced several products with this designation: in the 1990s four different grades of VM&P Naphtha were produced by Shell. Again, the properties of these now obsolete grades are included in Table 3 for comparison purposes. It should be noted that the current Shell product VM&P Naphtha HT has a much narrower, and slightly higher, boiling range than the similarly-named product that was available in 1997.

### A note about Rule 66

It will be noticed that, like CITGO’s Special Naphtholite 66/3, quite a number of solvent products offered by US suppliers include in their names the designation ‘66’ or ‘Rule 66,’ as does the ASTM D 235 classification of mineral spirits (see Tables 2 and 3). This designation serves to indicate compliance with the California’s air pollution control Rule 66 which seeks to regulate emissions of photochemically active volatile organic compounds into the atmosphere.<sup>3</sup> The rule is particularly aimed at commercial or industrial processes which may liberate solvent vapours directly or else combustion products of solvents; and while Rule 66 may not be of immediate relevance to small-scale processes as generally apply in conservation - since the limits for organic emissions are way in excess of what a conservator would normally be using - the rule is significant with regard to specification of solvent composition. For hydrocarbon solvents Rule 66 has a bearing on olefinic and aromatic content. ‘Rule 66’ hydrocarbon solvents, therefore, are those with olefinic contents of less than 5% and, more pertinently,  $\geq$  C8 aromatic contents of less than 8%. According to ASTM D235-02, ‘Rule 66’ solvents are those with aromatics contents between 2 and 8%: solvents with aromatics less than 2% are classed as ‘low aromatic.’

### Stoddard Solvent

It is perhaps appropriate to end this discussion of generic hydrocarbon solvent names with arguably the most indeterminate of the lot: ‘Stoddard Solvent.’ Not only can the term Stoddard Solvent be applied to products having quite different compositions and properties, but it would appear also that the meaning of the term is understood somewhat differently at least, for example, between the United States and the UK. The reader is advised, therefore, to approach and to use the term Stoddard Solvent with some caution: alone, without further qualification, it may not be a very precise descriptor of any given hydrocarbon solvent product.

An obvious starting point for identifying the chemical nature of Stoddard Solvent is the CAS Registry listing. Stoddard Solvent has its own specific entry under CAS Registry Number 8052-41-3 (corresponding to EC/EINECS No. 232-489-3) which identifies the substance as ‘*Low boiling point naphtha – unspecified, Stoddard Solvent.*’

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<sup>3</sup> The full text of Rule 66 can be found, for example, at [www.arb.ca.gov.drdb/sd/curhtml/r66.htm](http://www.arb.ca.gov.drdb/sd/curhtml/r66.htm)

Table 3. Physical and chemical properties of different types of VM&P naphthas according to ASTM 3735-02

	ASTM 3735-02 Specification				Selected Commercial Products						
	Type I <sup>A</sup>	Type II <sup>A</sup>	Type III <sup>B</sup>	Type IV	Current in 2006	Obsolete				Current in 2006	
Commercial reference	regular	high flash	odorless	low aromatic	^Shell VM&P Naphtha HT  (Typical) CAS 64742-89-8	^^Shell VM&P Naphtha HT **  1997 Spec.	^^Shell Super VM&P Naphtha  1997 Spec.	^^Shell VM&P Naphtha EC***  1997 Spec.	^^Shell High Flash VM&P Naphtha  1997 Spec.	Marathon Petroleum VM&P Naphtha  CAS 64742-89-8	Citgo Special Naphthalite 66/3 = ASTM D3735  Type IV VM&P
Appearance	clear and free of suspended matter and undissolved water.										
yBromine number, max	5	5	5	5							
Color	not darker than + 28 on the Saybolt scale, or 10 on the platinum-cobalt scale.				+30	+30	+30	+30	+30		
Aromatics, volume %, max	20	20	1	2	0.2	<0.4	12	7.0	11	<1	0.2
Distillation, (°C)											
Initial boiling point, min	113	138	113	113	131	119	122	121	150	119	130
50 % recovered, max	135	160	135	135	-	125	126	124	161		
Dry point, max	54	177	154	154	144	139	135	134	173	141	142
Flash point, min (°C)	4	23	4	4	20	12.8	11.1	14	34	10	19
Kauri-butanol value											
min	30	30	...	30	36	35	43	38	39	32	36
max	45	45	30	38							
Apparent specific gravity, (15.6/15.6°C)											
min	0.715	0.715	0.715	0.715	0.761	0.746	0.761	0.754	0.774	0.744	0.762
max	0.792	0.792	0.760	0.760							
Apparent specific gravity, (25/25°C)											
min	0.709	0.709	0.709	0.709							
max	0.786	0.786	0.754	0.754							

Notes

A. Type I and Type II may be commercially available to meet certain air pollution regulations that limit C8 and higher aromatics to not more than 8 volume %, total aromatics to not more than 20 volume %, olefins to not more than 5 volume %, and total aromatic plus olefins to not more than 20 volume %.

B. Only products that have a very high isoparaffinic hydrocarbon content, that is, approaching 100 %, are considered to fit the "odorless" category.

<sup>A</sup> from Shell Datasheet 2006

<sup>^^</sup> from Shell product datasheet 1997

<sup>\*\*</sup> VM&P Naphtha HT is a medium evaporating hydrocarbon solvent. It has an increased cycloparaffin content and hence solvency. The high degree of general refining gives this solvent its low level of impurities such as sulphur, olefins, benzene and total aromatics and low odour.

<sup>\*\*\*</sup> VM&P Naphtha EC is a medium evaporating solvent which contains 7% Xylene. High cycloparaffin content gives it a slightly higher solvency than similar products with the same aromatic content.



## Generic Hydrocarbon Solvents: a Guide to Nomenclature, continued

However, insight into North American usage of 'Stoddard Solvent' is given in ASTM D-235 for mineral spirits. As already mentioned above, any of the kinds of mineral spirits covered by ASTM D-235 may also be called Stoddard Solvent when they are used for the purpose of dry-cleaning. (The name Stoddard derives from the name of the inventor of the dry-cleaning process.) Accordingly, by that general definition, 'Stoddard Solvent' could apply to any of a number of products ranging, for example, from more volatile products (the 'Full Range' or 'Low Dry Point' types), possibly with up to 22% aromatics, to odorless or low-aromatics (<2%) types with final boiling points well above 200 °C, and vice versa.

'Stoddard Solvent,' however, appears to be comprehended differently in Europe. In the UK the connection with dry cleaning is often not made: 'Stoddard Solvent' seems more to be understood as laboratory grade white spirits, which may simply reflect the manner in which products called 'Stoddard Solvent' actually reach the small-scale consumer, typically via a laboratory chemicals supplier. Stoddard Solvent from the UK division of VWR International is said to comply both with ASTM D235 Mineral Spirits Type 1 and the British Standard for white spirit BSS 245. 1976: Type A. This appears to tie in with the definition of Stoddard Solvent by the WHO, noted earlier, as a variety of Type 1 white spirit.

A toxicological profile for Stoddard Solvent is the subject of a report by the US Department of Public Health & Human Services, Agency for Toxic Substances and Disease Registry (ATSDR), and this document adds some qualifications to the identification of Stoddard Solvent simply as 'mineral spirits used for dry-cleaning' and helps to distinguish Stoddard Solvent, at least as understood in North America, from some other generic hydrocarbon solvents such as benzene, naphtha, and mineral spirits. [13] Broadly speaking, the report summarizes that "Stoddard Solvent may be considered a subset of mineral spirits."

A final note, the area of proprietary solvents is a huge subject, which will be dealt with at length in the forthcoming book. However, I wanted to give at least a few examples of some familiar solvents. During the 1990s Shell (Americas) offered quite a number of products based on generic names, such as Mineral Spirits or VM&P Naphtha, but just two products retaining these names remain in the current Shell (Americas) product range: VM&P Naphtha HT and Shellsol OMS (Odorless Mineral Spirits). Information on composition and properties of these two solvents is provided here, together with data on two other proprietary Shell solvents which are quite commonly used in conservation.

Table 4. Properties of some selected current Shell (Americas) hydrocarbon solvents. Shell Chemicals now classifies all the various hydrocarbon solvent products it offers worldwide into the following categories:

- Isoparaffins;
- Aliphatic mineral spirits (from fast-evaporating to high flash point mineral spirits);
- White spirits/mineral spirits blends;
- Special (low) boiling point solvents (SBPs); and
- Aromatics and high aromatic blends.

Shell Chemicals classification		Special Boiling Point Solvents	Isoparaffinic Hydrocarbons	White Spirits / Mineral Spirits Blends	Aliphatic Mineral Spirits
Product name		<b>VM&amp;P Naphtha HT</b>	<b>Shellsol OMS (Odorless Mineral Spirits)</b>	<b>Shellsol 7 EC</b>	<b>Shellsol D38</b>
CAS No.		64742-89-8	64741-65-7	-	64742-88-7
<i>Property</i>	<i>Unit</i>				
Distillation, IBP	°C	131	175	160	159
Distillation, DP	°C	144	200	202	181
Relative Evaporation Rate (nBuAc=1)	-	1.0	0.1	0.15	0.21
Composition					
Paraffins	% V	33	96	57	42
Naphthenes (cycloparaffins)	% V	67	4	36	57
Aromatics	%	0.2%	<0.1%	7	<0.2%
Benzene		<0.0002%	<1ppm	<1ppm	<0.5ppm
Flash Point	°C	20	51	43	41
Kauri-Butanol Value	-	36	29	35	34
Aniline Point	°C	60	84	63	66
Hildebrand Solubility Parameter	(cal/cm <sup>3</sup> ) <sup>-1/2</sup>	7.7	7.4	7.6	7.9
Hydrogen Bonding Index	-	-	0	0.4	-
Fractional Polarity	-	-	0	0	-

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## Generic Hydrocarbon Solvents: a Guide to Nomenclature, continued

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### References

1. White Spirit (Stoddard Solvent): health and safety guide. (Health and safety guide no. 103). United Nations Environment Programme, International Labour Organisation. World Health Organization, Geneva 1996. ISBN 92 4 151103 6.
2. White Spirit (Stoddard Solvent) Environmental Health Criteria 187. United Nations Environment Programme, International Labour Organisation. World Health Organization. International Programme On Chemical Safety. Geneva. 1996. ISBN 92 4 157187 X.
3. British Standard BS 245:1976. Specification for mineral solvents (white spirit and related hydrocarbon solvents) for paints and other purposes.
4. DIN 51632-1 Regular white spirit - requirements and testing (Supersedes DIN 51632, 1988).
5. DIN 51632-2 Low aromatics white spirit - Requirements and testing (Supersedes DIN 51632, 1988).
6. DIN 51630 Petroleum Spirit (Spezialbenzine – Petrolether).
7. DIN 51631 Special-Boiling-Point Spirit (Spezialbenzine - Siedegrenzenbenzine) (Supersedes 1988 edition).
8. DIN 51635 FAM standard mineral spirit (FAM-Normalbenzin) (Supersedes 1981 edition).
9. Australian Standard AS 3530-1988. Solvents - Mineral turpentine and white spirit.
10. D235-02 Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent).
11. D3735-02 Standard Specification for VM&P Naphthas.
12. D3734-05 Standard Specification for High-Flash Aromatic Naphthas.
13. Toxicological Profile For Stoddard Solvent. US Department of Public Health & Human Services, Agency for Toxic Substances and Disease Registry, June 1995.

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### A Further Note

Ah, what's in a name...

Adding to the aforementioned complications in nomenclature, there is also the “formerly known as” problem.

In a recent conversation, Scott Blair, of Conservation Support Systems, said that in the 20 years he has been in business, Shell has changed the names of some of its solvents 3 or 4 times. Most recently, designations were changed to reflect flash points, except, of course, when they don't, as in the case of SHELLSOLS A-100, 15, and 7 EC, where they indicate aromatic content.

As we go to press, here are a few name changes that might help.

Cyclo Sol 53 became Cyclo Sol 100 which became **SHELLSOL A 100**

SHELLSOL 71 became **SHELLSOL OMS**

SHELLSOL 140 HT became SHELLSOL 142 HT became **SHELLSOL D 60**

SHELLSOL 340 HT became **SHELLSOL D 38**

Shell MS 135 became **SHELLSOL 15**

Shell MS 145EC became **SHELLSOL 7 EC**

Shell MS 146 HT became **SHELLSOL D 40**

(And then depending on which data sheet you see, it can be either SHELLSOL or ShellSol. Personally, I prefer the latter, but apparently they are using the all caps version lately.)

TS 28, actually a cocktail of solvents, was discontinued. Scott now offers CSS 28 which is made from the original Shell recipe.

Also, Scott has two convenient cocktails, made at the prompting of Jill Whitten and Rob Proctor, which are mineral spirits with a higher aromatic content:

CSS-30 Solvent 30% aromatic

CSS-50 Solvent 50% aromatic.

*Carolyn Tallent*

# A New Approach to Cleaning Iron-Stained Marble Surfaces

## Abstract

The problem of treating iron-stained marble is complex, especially when considering architectural marble that is subject to repeated iron deposition. Care must be taken to ensure that the marble matrix is not harmed during treatment. Theoretical conditions are considered, and a cleaning system is proposed that incorporates N, N, N', N'-tetrakis-(2-pyridylmethyl)ethylenediamine as a chelating agent and electrically conductive conjugated polymers capable of reducing deposited iron species. The proposed treatment system is evaluated using scanning electron microscopy-energy dispersive spectroscopy (SEM-EDS). Directions for future research are suggested.

## INTRODUCTION

From ancient to modern and contemporary, from West to East, from the sacred to the profane, marble surfaces are ubiquitous features of nearly every major city in the world in the form of sculpture, architectural facades, fountains, monuments, and the mundane. As conservators we are charged with the responsible care of these artifacts. As with any treatment, the cleaning of marble should strive to affect an aesthetically desirable surface while being minimally invasive.

The causes and mechanisms of marble deterioration are well known and documented.<sup>1</sup> In the interest of time, they will not be discussed in great detail here. However, it may be helpful quickly to outline these sources to illustrate the idea that the condition of a marble surface depends greatly on a number of interwoven factors. One could easily categorize any cause of deterioration of exposed marble surfaces into four major groups: chemical, environmental, biological, or man-made. Several factors leading to the deterioration of marble surfaces could easily fall into more than one group; acid rain, for example, can be seen as resulting from man-made pollution, wet and dry atmospheric deposition, and subsequent chemical degradation. The development of iron staining on marble surfaces also falls into multiple categories in that the iron source is usually the result of human design, and the iron is transported to the surface by rain or fountain water.

A real-life example of a staining problem, and the impetus for much of this research is the grand fountain at Nemours, the site of a former 300-acre estate of Alfred I. duPont (Figure 1). The fountains are part of the Louis XVI-style garden on the estate just outside of Wilmington, Delaware. Several marble and other stone sculptures and architectural structures are placed throughout the gardens. At the time of this writing, Nemours has embarked upon a two million dollar restoration project that includes the cleaning of the marble fountains, which have been in use since 1911. The original plan was to use commercially available stone cleaning preparations to remove the staining with the intent of returning the fountains to working order soon thereafter.

<sup>1</sup> A quick literature search yields varied resources on marble deterioration. See Carfagni (2003), Spurny (2000), Richardson (2001), and St. Clair and Seaward (2004), for example.

## PREVIOUS APPROACHES TO CLEANING

The problem of removing iron staining satisfactorily, efficiently, and safely has historically proven to be challenging. Looking through a sampling of the conservation literature, one sees a wide range of reagents and pHs used (see Table 1). The majority of published studies follow one or both of two main themes: acidic preparations and the use of strong chelators. In addition, many of the solutions shown here also included high ionic content as part of the driving force to remove the staining. The result of all of these conditions is the removal of iron staining by undercutting the stain – that is, attacking the marble rather than the stain.

Table 1. Some Conservation Preparations for Cleaning Iron-Stained Marble

Reagent	pH	Reference
AB57	10	Mora et al. 1984
Ammonium Thioglycolate	8	Windholz 1983
Ammonium Thiosulphate	*	Stambolov and van Rheeden 1968
Citric Acid	3	MacLeod and North 1979, MacLeod 1987
EDTA	4	Alessandrini et al. 1984, Thorn 1993
EDTA	11	Thorn 1993
Sodium Thiosulphate	*	Stambolov and van Rheeden 1969
Sodium Gluconate	6	Stambolov and van Rheeden 1968, Edos 1990
Sodium Hydrosulfite	9	Merk 1981, Gilberg 1982, Barov 1987
Thioglycolic Acid	*	Stambolov 1968, Edos 1990, Howie 1974
Ammonium Citrate	9	Matero and Tagle 1995
Ammonium Citrate	6.5	Gale 1982
“Bio-Pack” and Hydrofluoric Acid	2.5	Sramek 1991
Versenol (EDTA)	*	Plenderleith 1955
Oxalic Acid, Citrate, and EDTA	*	Rinne 1976
Trisodium Citrate	8	Stambolov and van Rheeden 1968

Figure 1. Iron-stained marble fountains at Nemours



## A New Approach to Cleaning Iron-Stained Marble Surfaces, continued

The same problem exists in industrial applications as well. Although commercial products have been formulated specifically for the cleaning of marble and other carbonate surfaces, there are very few if any products deemed safe that are specifically designed for the removal of iron staining. If one were to clean the marble surfaces of the fountain with these materials and allow thousands of gallons of water to be cycled over the surface, would we be dooming the fountain, whose surfaces remain in a fragile, sugary state after having been cleaned repeatedly over the years and exposed to the elements, to a harmful and expensive cycle of cleaning and staining?

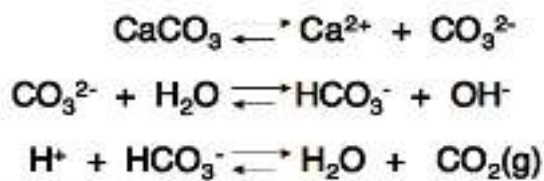
This begs the question - is it possible to define theoretical parameters for a cleaning system that will efficiently remove iron staining without disrupting the marble matrix?

### DESIGNING AN APPROPRIATE CLEANING SYSTEM

There are three main issues that need to be addressed in the formulation of a suitable cleaning solution. Maintaining an appropriate pH is of great importance in achieving the goal of harming the marble substrate as little as possible. Likewise, appropriate use of chelating materials is important. The goal here is to manage the insoluble iron and begin to bring that insoluble material into solution without breaking apart the marble matrix. Finally, the ionic strength of a solution must be considered.

#### pH Considerations

Marble is a considerably complex and diverse material made up of several different carbonates, oxides, hydroxides, and silicates. The primary component, however, is calcium carbonate, typically calcite. Aside from the simple fact that one should probably not drift too far from a pH equal to calcite's  $pK_a$  of 10.33, another factor in the dissolution of calcite should be considered as well. The chemistry of carbonate stones is such that when in contact with water, the dissociation of calcite is driven by two factors: pH and the partial pressure of carbon dioxide in solution.<sup>2</sup> If one were to bring an acidic preparation to a marble surface, the relatively high hydronium ion concentration would drive the dissolution of the marble toward completion. Likewise, dissolution would be favored in an arrangement where carbon dioxide is cut off from the surface, all things being equal.



The consequence of this relation is that if we bring a thin film of cleaning solution to a surface, where the partial pressure of  $\text{CO}_2$  in solution is roughly equal to that of at-

<sup>2</sup> For a discussion of chemical considerations in marble cleaning applications, see Livingston (1992).

mospheric concentrations, the dissolution of the calcite is favored at a pH below about 8.3. However, if a poultice or a gelled preparation is used to clean the surface, the partial pressure of  $\text{CO}_2$  at that surface is reduced. As the partial pressure of  $\text{CO}_2$  decreases, the amount of calcium going into solution reaches a minimum around a pH of 10 (Figure 2). Since using a poultice or gel is probably unavoidable in these situations, working at a pH near 10 should help to minimize the amount of damage possible to the marble surface.

Figure 2a. Calcite saturation as a function of pH and  $P_{\text{CO}_2}$

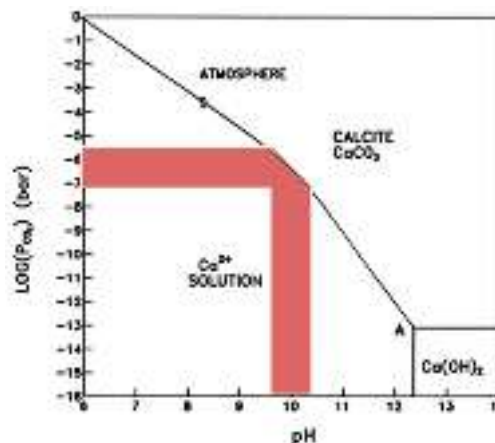
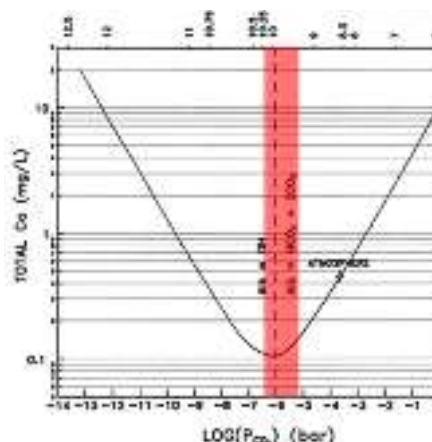


Figure 2b. Calcite saturation vs.  $\text{CO}_2$  pressure. The highlighted regions represent conditions of minimum solubility at decreased carbon dioxide concentration. (Figures adapted from Livingston, 1992.)



#### Chelating Materials

The use of a chelating agent to complex and help remove staining materials is the next factor that will be considered here. While calcium carbonate and other compounds found in and on marble surfaces are relatively insoluble materials by themselves in water, they can begin to be broken up and brought into solution by the introduction of chelating materials. A convenient way to consider the relative strength of a chelating material is to compare its formation constants for the metal ions of various species to the solubility product of



## A New Approach to Cleaning Iron-Stained Marble Surfaces, continued

Table 2. Solubility Product and Formation Constants for Common Species and Chelators

	pK <sub>sp</sub> *	K <sub>f</sub> , Citrate	K <sub>f</sub> , EDTA	K <sub>f</sub> , NTA	K <sub>f</sub> , Oxylate
Ca <sup>2+</sup>	8.35	4.68	11.0	7.6	3.0
Fe <sup>2+</sup>	14.43	3.08	14.33	8.84	5.22
Fe <sup>3+</sup>	37.4	12.5	24.23	15.87	9.4

\*pK<sub>sp</sub> values correspond to prevalent species in the marble matrix and in the iron staining. Data from CRC Handbook.

those species (Table 2). In general, complexation is favored when the formation constant of the complex is greater than the solubility product constant of a given material. The goal, then, is to select chelators that will disassemble iron species and not the marble itself.

Examining formation constants for a few of the more commonly used chelating materials and solubility product constants for bulk materials in marble, a few points of interest arise. First, it is clear that EDTA is far too strong a chelator to use for this application, as calcium will be taken up and brought into solution. And while some chelators like citrate and oxalate should be safe for the marble surface, none of these materials, EDTA included, should be able to efficiently bind the iron species. It should be apparent by looking at these numbers that bringing a strong chelator like EDTA to an iron-stained marble surface will never serve to solubilize the iron staining – instead, the stain would be removed by attacking the marble surface and undercutting, thereby damaging the surface, albeit microscopically. However, repeated cleanings over hundreds of years combined with environmental exposure would leave a surface far removed from the original. Iron(II) complexes, with formation constants on the order of 14, are far more manageable than iron(III). However, this presents two problems: selecting a suitable chelator, and finding a way to efficiently reduce iron(III) to iron(II).

### TPEN:

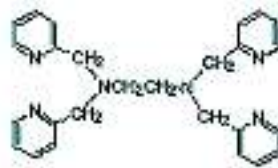
#### N,N,N',N'-tetrakis-(2-pyridylmethyl)ethylenediamine

Looking to other fields, one might be able to find materials suitable for conservation that offer greater specificity than some of the more traditional materials can allow. One promising example is TPEN, N,N,N',N'-tetrakis-(2-pyridylmethyl) ethylenediamine (Figure 3). Several inter- and intra-cellular activities rely heavily on the presence of calcium ions. Fluorescent dyes are used to monitor these biologically active trace amounts of calcium. However, in many cases, the dyes bind readily to heavier metals such as copper, zinc, manganese, and iron, making detection of calcium difficult. TPEN binds strongly to those heavier metals and does not bind well to calcium and magnesium. TPEN, then, is used to mask heavier metals by preventing the fluorescent dyes from binding with them.<sup>3</sup>

<sup>3</sup> See Hofer (2001).

Figure 3. TPEN and its properties as a chelator

#### N,N,N',N'-tetrakis-(2-pyridylmethyl)ethylenediamine



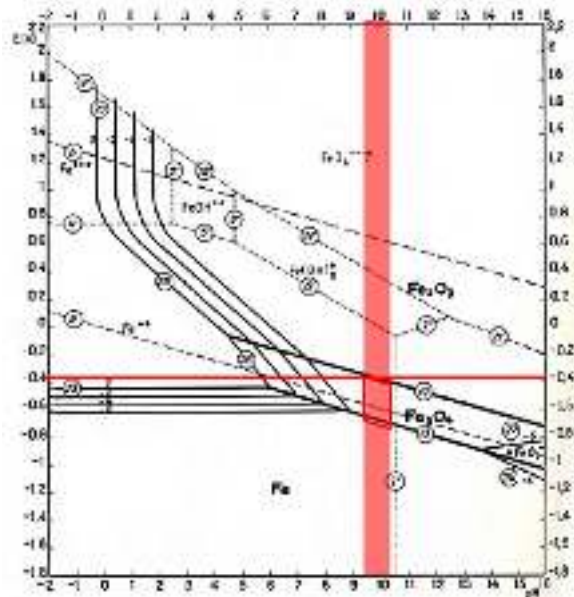
Water soluble  
 pK<sub>a1</sub> = 10.27  
 K<sub>f</sub>, Ca<sup>2+</sup> = 4.4  
 K<sub>f</sub>, Fe<sup>2+</sup> = 14.61  
 High affinity for heavy metals  
 Also binds weakly to magnesium

The binding characteristics and several other properties of TPEN are convenient and novel for the current problem. TPEN is water-soluble. The first pK<sub>a</sub> of TPEN is 10.27, very close to the pK<sub>a</sub> of calcite and our operating pH of 10. TPEN also has a formation constant for iron(II) higher than that of EDTA, and a formation constant for calcium lower than citrate. TPEN's formation constant for calcium is lower than calcite's pK<sub>sp</sub> and the formation constant with iron(II) is almost equal to the pK<sub>sp</sub> of iron(II) hydroxide. This suggests that TPEN should be able to dismantle some iron(II) species without harming the marble matrix.

### Managing Iron(III) Using Conjugated Polymers

Looking at a Pourbaix diagram showing the relationship between speciation, pH, and electrical potential for an iron-water system, it is possible to see how insoluble iron(III) can be reduced to iron(II) (Figure 4). For a solution at a pH of 10 with an oxidation-reduction potential of zero millivolts, the dominant form of iron shown here is Fe<sub>2</sub>O<sub>3</sub>. Given the pH range determined before, if one can get close to providing a reducing potential of 300 to 400 millivolts, we will begin to reduce some of the iron(III) to iron(II).

Figure 4. Pourbaix diagram for an iron-water system. The highlighted region denotes the pH range determined before, and the horizontal line at around -400mV marks the point at which formation of iron(II) species is favored.



## A New Approach to Cleaning Iron-Stained Marble Surfaces, continued

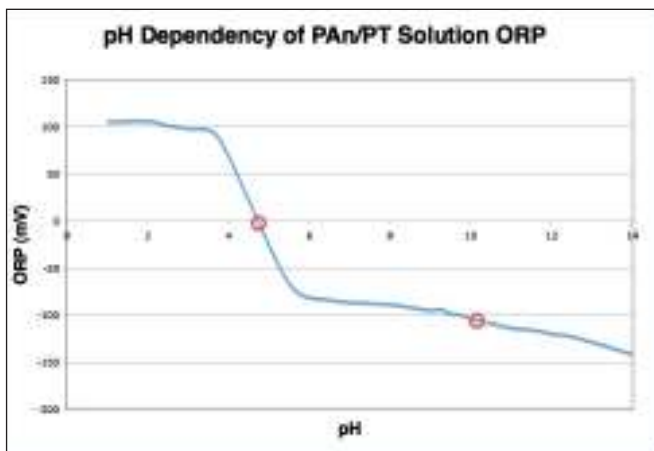
This, of course, does not mean that we should begin hooking batteries up to our marble objects. A more elegant and reasonable solution would be to include materials capable of creating a reducing potential in the cleaning system.

Conjugated polymers are a fairly recent development, with the discovery in 1977 that certain plastics could be made conductive. Conventional wisdom would suggest that polymers and plastics are insulating materials. Yet, within the past five or so years since becoming commercially available, conjugated polymers have been incorporated into organic LEDs, anti-static coatings and films for electronics, and even as corrosion inhibitors in some commercial metal primers.<sup>4</sup>

The conjugated polymer being proposed for use here is a water-soluble sulfonated polyaniline.<sup>5</sup> The conducting nature of the polymer arises from the repeating stretches of alternating single and double bonds, as well as sulfate groups and amine groups that result in a large mass of delocalized electrons, not unlike that in a metal or semiconductor. Most conjugated polymers absorb heavily in the visible and ultraviolet regions of the spectrum, and the promotion and replacement of electrons in the delocalized field allows the polyaniline to conduct and transfer electrons.

A novel approach is to pair different conjugated polymers together to increase efficiency. A water-soluble polythiophene, sodium poly[2-(3-thienyl)ethoxy-4-butylsulfonate], acts a photovoltaic polymer. In a basic solution like the one proposed here, the polythiophene absorbs heavily in the blue and green regions of the visible spectrum as well as in the UV. Conveniently, the resulting fluorescence maximum is very close to one of the absorption maxima of the polyaniline at 566 nm. The polythiophene, then, acts to harness the light energy and feed energy to the polyaniline, increasing the amount of energy transferred by the polyaniline.

Figure 5. pH dependency of PAN/PT Solution ORP



<sup>4</sup> For extensive discussions on electrical characteristics and industrial applications of conjugated polymers, see Salaneck, et al. (1996) and Rupprecht (1999).

<sup>5</sup> ADS650WP available from American Dye Source, Inc. <http://www.adsdyes.com>

The plot in Figure 5 shows the pH dependency of a polyaniline and polythiophene solution's oxidation-reduction potential. Around pH 5, the solution changes from an oxidizing potential to a reducing potential. Also of note is that around a pH of 10, the potential begins to decrease more rapidly. While the ORP of this test solution reached between 100 and 150 millivolts of reducing potential, in final preparations and under UV light as in outdoor conditions on a sunny day, a reducing potential of around 270 millivolts was achieved. While this is shy of the desired value of near 400 millivolts of reducing potential, it should create a condition where some of the available iron(III) would be reduced to iron(II).

### Ionic Strength Considerations

Now that two of the major factors have been considered, it is important to make at least a quick note about the ionic strength of the cleaning solution. The main point to take away here is that having a high ionic content to the cleaning solution creates a large pressure for that ionic material to move into and disrupt the surface of the stone. Another important point is that bringing a large amount of salts to a stone surface increases the chance for salts to diffuse deep into the surface and potentially cause damage upon recrystallization. It would be advantageous, then, not to include a high salt concentration in the cleaning solution if the goal is not to disrupt the stone surface.

While it is true that the conjugated polymers impart a high conductivity to the cleaning solution, it is important to remember that these are high molecular weight polymeric materials that cannot diffuse far into a stone surface, especially in a gelled preparation.

### Cleaning Formulation

Here is a look at the final cleaning formulation. Again, we will be working with an aqueous system as we are dealing with inorganic, ionic materials for the most part here. The conjugated polymers are included to reduce the iron and make it more manageable. TPEN is used as a chelating material to remove iron staining and other salts on the surface. Sodium carbonate is added to set up a carbonate-bicarbonate buffer system to maintain a pH around 10. Finally, Vanzan, a pharmaceutical grade xanthan gum is added as a gelling agent.

- 100 mL Deionized Water
- 1 mg Polyaniline & Polythiophene
- 1 g TPEN
- Sodium Carbonate added to adjust pH to 10
- 1 g Vanzan

This paper was first presented at the 2006 Annual Student Conference of the Association of North American Graduate Programs in the Conservation of Cultural Property, hosted by the University of Delaware/Winterthur Art Conservation Department.

It was also presented at the RATS Specialty Group Session at the 2007 AIC Annual Meeting in Richmond.

## A New Approach to Cleaning Iron-Stained Marble Surfaces, continued

### TEST CLEANING

In testing the cleaning solution, it became clear that the ability to remove staining depended greatly upon the availability of iron and the depth of stain penetration. Where iron is readily available close to the surface, the cleaning system works very well and efficiently, taking on the order of only 1 to 2 minutes for stain removal (Figure 6). The cleaning formulation allows some degree of "tuning" in that a number of variables can be manipulated to achieve the desired effect. Chelator and polymer concentration, duration of application, and exposure to light can all be easily adjusted.

Figure 6. A test cleaning after two minutes of gel application



Remember that some of these surfaces have been stained for several years, and there has been sufficient opportunity for the staining to become deeply entrenched in the marble surface. For very deep stains, the cleaning ability of the solution was slight but noticeable, which is reassuring in that the cleaning preparation is not undercutting deep into the marble surface.

Stained samples of marble were examined before and after cleaning using SEM-EDS (Figure 7). The important features to note here are the differences in the peak height ratios of calcium and iron between the uncleaned and cleaned areas. It is also important to note that the surfaces do not appear to be too morphologically dissimilar in the secondary electron images.

### CONCLUSIONS AND FUTURE RESEARCH

The proposed cleaning system has illustrated possible uses for recently developed materials from research and industry in conservation applications. Preliminary testing suggests that the cleaning system is capable of reducing and chelating iron species while causing minimal damage to the marble surface. Continued research in several areas may help to address related problems and refine the problem at hand.

#### Toward a Water-Reversible Conductive Coating

While the proposed cleaning system is promising, the problem of repeated iron deposition as a result of nearby metal elements, or from cycled water in the case of fountains, needs to be addressed. To that end, attempts have been

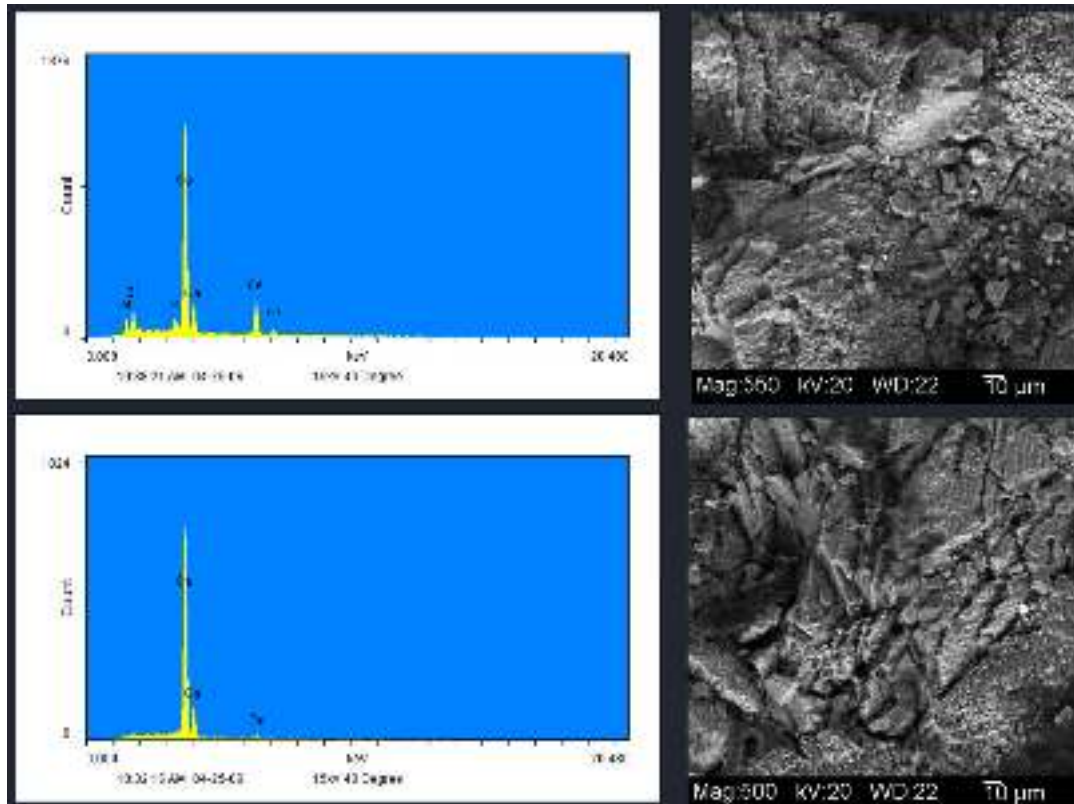


Figure 7. SEM-EDS spectra and secondary electron images for uncleaned (top) and cleaned (bottom) areas of an iron-stained architectural marble fragment

The secondary electron images suggest that little has changed on the marble surface after cleaning other than the removal of small surface particulate and perhaps some minor exfoliation.



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## A New Approach to Cleaning Iron-Stained Marble Surfaces, continued

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made toward creating a coating system that would prevent the marble from becoming stained. This coating would act as a retreatable maintenance coating that ideally would be able to stand up to complete immersion in water over long periods of time. In the interest of brevity, the development and testing of this coating will not be discussed in full here.

However, the desired characteristics of the coating are many and can be discussed briefly. Ideally, the coating should be insoluble in normal rain or fountain water – that is, neutral and acidic pH. Yet, because this would be in an outdoor setting, it might be more environmentally sound and safe for the coating to be reversible in alkaline pHs rather than in organic solvents. For the same reasons, it would be desirable to deliver the coating in a water or alcohol solution. The inclusion of materials capable of producing a reducing potential would be advantageous in that iron would be less likely to settle into the stone as an insoluble material. The coating would also have some anti-static properties in this case that could prevent the deposition of small particulates. Obviously, the coating would need to be stable in a wide range of environmental conditions. And last, but certainly not least, the coating would need to be aesthetically neutral – that is optically clear, not too glossy, etc.

What has been proposed so far is to base the coating on Avalure AC315, a lightly cross-linked poly acrylic acid, which is used in the cosmetics industry for applications such as nail polish that can be removed at relatively high pH (around 10 or 11). As with the cleaning system, polyaniline and polythiophene would be included. And, taking a page out of library and paper conservation, including an alkaline reserve such as Wei-T'OH or some carbonate salts, would serve to maintain the pH of the coating near the equilibrium pH for calcite at reduced CO<sub>2</sub> concentration. The alkaline reserve would also serve as cross-linking agent, allowing the coating greater stability in water. However, more testing needs to be conducted.

### Other Avenues for Future Research

Understanding the cleaning problem at hand would be aided greatly by conducting in-depth comparative studies of marble cleaning preparations and techniques, both past and present. Looking to related fields for selective chelating agents would be advantageous as these materials are being developed in large numbers for specialized applications. Along the same lines, more efficient and longer lasting conjugated polymers and other conductive materials should be pursued and considered. Lastly, it may be useful to examine the benefits of incorporating conductive materials into conservation coatings.

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# Membership

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*Chris Stavroudis, membership secretary*

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## Book Review

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### **Transmaterial**

Compiled and edited by Blaine Brownell, Princeton Architectural Press, 2006, \$29.95.

This book may be only tangential to conservation, but it is really cool. It's a book that will give you ideas.

The seven parameters that the author uses to define transmaterials are: 1) They must be ultraperforming, testing the limits that we normally expect of materials. 2) They are multidimensional. Wall coverings, for example, also can serve as ambient room lighting. 3) They are repurposed, with recycled or nontraditional materials replacing precious raw materials. 4) They are recombinant, using two or more different materials that act in harmony, are esthetically superior, or result in high performance characteristics. 5) They are intelligent. In other words, they can function actively as well as passively. 6) They are transformational, undergoing physical metamorphosis based on environmental stimuli. 7) They are interfacial, providing unprecedented capabilities that create or enhance technologically infused environments.

The entries for each item are short, but give contact information if you need the full specs. The author also has a website, [Transstudio.com](http://Transstudio.com), where more research is published.

*Carolyn Tallent*

**“Keep Artists Away From Their Own Work,”** *The Art Newspaper*, 12/14/2006

Speaking as a conservator and restorer of many years standing, I find it imperative to keep artists away from their own works of art. The involvement of the artist with his work of art should end the moment a work of art leaves the studio. It is no longer the artist’s problem or domain to be involved with his or her work after the artist has stopped the creative process.

This has become very apparent recently with Damien Hirst’s involvement in his famous *The Physical Impossibility of Death in the Mind of Someone Living*, which began to deteriorate so was replaced with another, entirely different shark; namely bypassing the restoration process completely. Does this shark have the same personality? What will happen after the artist’s death when the new shark continues to deteriorate? The restorer will then be thrown into the equation and will have to do something with this object.

The writer is a restorer and a conservator in London

**“Trove of Scholarship,”** *Al Ahrām Weekly*, 12/14-20/2006

The Coptic monastery known as Deir Al-Surian, or the Monastery of the Syrians, in Wadi Natrun, Egypt, contains more than 3,000 books as well as a vast number of texts in Syriac, Aramaic, Coptic, Arabic, and Ethiopic. They date upwards from the fifth century and today, as a result of the revival in Coptic monasticism in recent years, a new generation of educated monks are anxious to safeguard this heritage.

Both Syrian and Coptic monks are engaged in their conservation, as well as restoration of the monastery itself. Members of the conservation team, with the help of volunteers and on a shoestring budget, are surveying, restoring, cataloguing, and storing the Syriac texts in a suitable environment. A digital photographic record of each manuscript will eventually be made to facilitate access for scholars, and appropriate storage for the manuscripts and facilities for visiting scholars is also planned.

Confirmation of Syrian occupation of the monastery comes from an eighth to ninth-century wall painting discovered during recent restoration. It is a

representation of a saint with children on his lap which has proved to be Abraham, Isaac, and Jacob in Paradise.

One part revealed a Syriac text under several layers of plaster which mentions that restoration of the church was completed in the year 992.

**“A Rhino’s Restoration,”** *Los Angeles Times*, 12/5/2007

Like the Mona Lisa or the Venus de Milo, there’s something about French painter Jean-Baptiste Oudry’s life-size, 1749 portrait of Clara — an Indian white rhino imported to Europe by a Dutch sea captain who turned her into an 18th-century superstar by touring her throughout the continent — that invites viewers to be on a first-name basis with art. Mark Leonard, the museum’s head of paintings conservation, says: “She created a sensation everywhere she went. At that time, seeing a rhinoceros was as if today we brought back a creature from Mars.”

Now, for first time in more than 150 years, Clara is on tour again — this time the painting, not the rhinoceros. After languishing in the basement of a German museum for many decades, the Getty Museum is restoring the 10-foot-high, 15-foot-long oil-on-canvas portrait for public view. The public restoration precedes the Getty’s May 1 through Sept. 2 exhibition *Oudry’s Painted Menagerie*.

Images of animals were central to the court of King Louis XV, in part because of the ruler’s obsession with hunting, game, and dogs. Oudry was able to take animal painting to a higher level. In terms of conservation, Oudry was also his own best friend: Leonard says the painter avoided the then-common practice of using sizing, a glue-based material, on canvases to prevent the oil paint from soaking through. “In a lecture he gave in the 18th century, Oudry said: ‘Don’t size your paintings, because it gives a stiffness to the canvas.’” Leonard says. “This may have kept the canvas from cracking.”

**“Salvaged: Restoring The Sirens And Ulysses,”** *Huliq.com*, 12/15/2007

The famous 19th-century artist William Etty considered *The Sirens and Ulysses* to be his greatest achievement. The painting depicts a scene from Homer’s *Odyssey* where the hero, Ulysses, is blindfolded and tied to the mast of his ship to avoid the temptations of the

voluptuous and dangerous Sirens. The condition of the painting has been deteriorating since the middle of the 19th century, and it has not been on public display since the late 1880s because of its poor state of repair. Attention returned to the painting prior to the re-opening of Manchester Art Gallery in 2002, but the sheer scale of the work required prevented the painting from being included in the re-hang. However, the conservation work commenced in the Gallery’s conservation studios in late 2002, and the painting finally moves to Manchester Art Gallery next month.

**“Ancient Techniques Employed to Rescue 5,000 Year Old Egyptian Monument by NYU’s Institute of Fine Arts,”** *Exduco.net*, 01/29/2007

Nearly 5,000 years old, a monument known today as the Shunet el-Zebib, the only surviving example of a series of monumental cultic buildings built by Egypt’s earliest kings at Abydos, has been ravaged by the elements, attacked by animals and insects, and structurally compromised by humans over the millennia; its present day survival seems almost miraculous. In 2001, the experts all agreed that unless steps were taken immediately this massive mud-brick structure would not remain standing much longer.

A conservation and stabilization program was developed, sponsored by New York University’s Institute of Fine Arts, and surprisingly the most suitable methods recommended by the experts for saving the monument turned out not to be highly technical ones of modern construction, but rather those more traditional, and ancient, in nature.

The Shunet el-Zebib is the last and the grandest of the early royal cult enclosures built at Abydos, and it is the only one still standing today. Comprising two concentric enclosure walls, the inner still mostly standing to near its original height of 35 feet and defining a large open ritual space embellished by a substantial mud brick chapel, the monument was built as a setting for King Khasekhemwy’s mortuary cult rituals. He ruled at the end of the Second Dynasty (ca. 2750 BCE) and only some 300 years after the emergence of a politically unified Egyptian state.

After extensive study, the consultants decided that the best means of saving the Shunet el-Zebib was to employ

mud bricks like the ones used to build it. The ancient bricks were scientifically analyzed and new bricks formulated to be technically compatible with the old.

The project's excavations are revealing much about this final stage in the history of the monument. The monks' cells, including traces of both painted decoration and graffiti on the walls, as well as kitchens, storage, and work areas, are all being carefully studied, and many objects from their tenure have been found in the excavations, including items made from cloth, leather, and wood, as well as a few fragments of papyrus and parchment documents.

**"Restoring Penang's Heritage,"** *Malaysia Star*, 12/27/2007

Architect Tan Yeow Wooi's life revolves around conserving and restoring old buildings, especially structures of traditional Chinese architecture. Visiting the office of conservation architect Tan Yeow Wooi, 47, in Penang is a humbling experience for those concerned about the protection and restoration of heritage buildings in Malaysia.

Says Tan, "Penang is a historically important state. It has the highest number of heritage buildings, compared to other states in Malaysia. It still has the largest number of old temples, mosques, churches, association buildings, dwellings, and pre-war shophouses. However, after the repeal of the Rent Control Act in 2000, numerous pre-war buildings have been renovated or re-built beyond recognition or even demolished. In 2006 alone, there were 96 buildings in the city that were either demolished or marred by indiscriminate renovation with 80% of the original structure destroyed."

Tan is on a one-man mission to personally document and convince those in power to restore what's left of the built-heritage of this country. While he is noted for his meticulous work on buildings of Chinese architecture, he is equally concerned about mosques, Hindu temples, and even humble dwellings that are architecturally and historically significant. "But the best form of protection is to educate the public especially property owners on why such heritage buildings ought not to be destroyed. The general public should learn to respect and appreciate heritage buildings. They represent the cultural characteristics of a place which give us a sense of identity."

**"Restored Pulpit Back at Al-Aqsa,"** *Haaretz*, 02/05/2007

Thirty-eight years after his father delivered the last sermon from the grand pulpit of the Al-Aqsa Mosque before the pulpit burned, Sheikh Ikrama Sabri, the head of Jerusalem's Supreme Muslim Council, delivered the first sermon Friday from the now refurbished pulpit.

The original pulpit, or minbar in Arabic, was donated to the mosque over 800 years ago by the Muslim warrior Saladin. It was destroyed in 1969 when a disturbed Australian Christian, Michael Rohan, set fire to the shrine. The restoration of the pulpit, which was carried out in Jordan and other Muslim countries, involved painstaking work and intricate carving of walnut wood.

Its return to the Al-Aqsa Mosque on the Temple Mount in Jerusalem involved political struggles no less intricate. Over the years since the 1969 blaze, the mosque has undergone restoration, and other development, and conservation work has taken place on the Temple Mount and the Dome of the Rock, with the assistance of hundreds of millions of dollars in donations. Only the restoration of the pulpit was delayed. In the Muslim Museum adjacent to Al-Aqsa, a few remains of the burnt pulpit were kept on display in the offices of the director of the Muslim Religious Trust (Waqf), Adnan al-Husseini.

The rumor as to why the pulpit was not restored was that Yasser Arafat was delaying progress on the work because he wanted to be the leader who would bring the pulpit back to the mosque when it was returned from Israeli rule. It was said that Arafat believed the liberation of Jerusalem and Al-Aqsa to be possible and promoted this idea, while at the same time pushing aside the idea of a return of Palestinian refugees, which he believed to be an unattainable goal.

Meanwhile, the Jordanians set up a team of experts from Egypt, Turkey, Indonesia, and European countries to restore the pulpit, led by Dr. Mahmoud al-Balbisi of the department of Islamic art at Al-Balqa Applied University in Salt, Jordan. Ten days ago a caravan of trucks carrying 25 crates containing the parts of the pulpit came from Amman, and the work of putting it back together began.

In his sermon Sheikh Sabri called for a dialogue among Palestinian

factions in order to protect the sanctity of Muslim blood and to safeguard Al-Aqsa from damage by Israel.

**"What Surrounds a Legend? A 3,000-Pound Gilt Frame,"** *New York Times*, 02/19/2007

One of the most complex restoration and reframing projects in the history of the Metropolitan Museum of Art has collided with a 9-foot-3-inch-high doorway. The doorway won.

Emanuel Leutze's heroic and stupendously popular 1851 *Washington Crossing the Delaware*, familiar to generations of schoolchildren, is one of the largest paintings in the museum, measuring 21 feet wide and 12 feet high. It is heavy too, and will be getting heavier, because curators are currently assessing the best way to carve an elaborate new 3,000-pound basswood frame that would replicate the original, missing for more than a century.

After years of detective work, an image of the frame was recently discovered in a 143-year-old Mathew Brady photograph. Since the canvas cannot be removed through the doorway of its home on the second floor of the museum's American Wing, its years-long refurbishment will be carried out within the gallery.

After its conservation the painting is likely to be installed first, attached to steel beams embedded in a grand room of the new galleries. Then the frame will be placed around the canvas, attached to the wall separately. Gilding such an enormous frame will require more than 12,500 3.5-inch square sheets of gold leaves, 1/250,000th of an inch thick, at a cost of more than \$12,000. The Met would not estimate the cost of the total refurbishment, as research and planning are still under way. But some experts said the project could not be accomplished for less than \$500,000.

**"To Freeze or not to Freeze?"** *The Hindu*, 02/16/2007

Opposing views towards conservation can be found in two splendid havelis in Nawalgarh, Rajasthan. Should history be preserved or should it be continued?

This debate finds form in the havelis of Nawalgarh. Situated 250 kms from Delhi in Rajasthan, these havelis are often described as large "open-air art galleries." The cityscape is dotted with



them; some are guarded secrets to be chanced on. Others stand on alleyways like loud announcements.

The two main attractions are the Morarka Haveli Museum and the Dr. Ramnath A. Podar Haveli Museum. Built in 1900, the Morarka Haveli is characterised by its frescoes of religious, mythological, and secular themes. Its touted uniqueness is a fresco of Jesus Christ. Located on the underside of an awning, it can be easily missed.

Dr. Hot Chand, Director (Conservation), passionately explains that the art of frescoes originally passed from the Italians down to the Mughals. The Podar haveli has incorporated a different philosophy toward restoration. The haveli is striking for its profusion of paintings and freshness of colour. Bhairulal Swarnakar, a painter by profession, has chosen to adapt the traditions. Hailing from Bhilwada he has been working here for the last 10 years. Swarnakar has maintained and carried forward the artwork of the haveli, which was built in 1902 by Dr. Ramnath A. Podar. He has painted frescoes in the blank spaces in the 52-room haveli. While using the original natural colours he has adapted the traditional with the contemporary.

**“When Chemistry Meets Culture: Scientists Helping Save Rare Art,”**  
*Stamford Advocate*, 02/24/2007

When white masquerades as yellow and green might actually be blue, a call goes out to Henry DePhillips. DePhillips, a Trinity College chemistry professor, is among a cadre of specialists using cutting-edge science to solve the color mysteries of paintings and other cultural treasures often several centuries old.

Using minuscule samples from the pieces, chemists can now pinpoint the blends of iron oxide, mercury, titanium dioxide, lapis lazuli, and other substances that make up certain colors. The implications go beyond aesthetics to cold cash. For example, the use of pure Prussian blue - the first synthetic color of the Industrial Revolution - can cause a painting's value to skyrocket.

The analysis work has also launched an academic niche that introduces art students to the tenets of chemistry and vice versa. DePhillips, who has been a chemistry professor at Trinity since 1963, has a lengthy waiting list for his class, “Science and Art.” Several

other universities, including Carnegie Mellon in Pittsburgh and Truman State in Missouri, have recently launched similar courses. Educators such as DePhillips say they welcome the new generation of specialists, which they think will benefit the art world as a whole.

**“Put Out More Buckets! - Parish Priest's Solution to the Big Drip,”**  
*Tenerife News*, January 2007

The storm that lashed the Canary Islands over the last weekend of January took its toll on one of Tenerife's oldest and most lovely churches - and one that happens to house a priceless piece of art.

Structurally, the church of Las Nieves in Taganana is in deplorable condition. Last year it celebrated its fifth centenary. The cracks have been evident for more years than anyone can remember, but the recent heavy rains are likely to have caused even more damage to its crumbling fabric, judging by reports that the parish priest of Taganana was obliged to place more than fifty plastic buckets throughout the building to catch the drips that filtered through the ceiling.

Not only that but Father Vicente Spouy had to hold a church service, shouting above the noise of the buckets being filled, drip by damaging drip. He hopes that the publicity gained from the buckety *misa* will bring home the urgency of the situation to the authorities.

The little church's famous art treasure, the Flemish triptych of *The Adoration of the Magi*, attributed to a follower of Van Eyck, is not said to be in immediate danger, but it is obvious that its surroundings are hardly ideal for the conservation of a painting older than the church itself.

**“Entertaining Workplace,”**  
*The Spokesman Review*, 02/25/2007

Beneath five coats of paint inside the men's lounge of Spokane's historic Fox Theater, restoration experts have uncovered murals of a javelin thrower, pool diver, polo player, and other sports figures.

The murals were painted over when the 1931 art deco theater was converted to a triplex movie house in 1975. “We didn't expect to find all of this in this room,” said Michael Carpenter, head of the New York-based paint conservation team Evergreene that is part of the

\$26.5 million renovation of the storied landmark at Sprague and Monroe.

The murals in the men's lounge are a fraction of the dazzling paint schemes, glass, and metalwork being brought back to life in the old Fox. The trick is to modernize the landmark so it can serve as the new home for the Spokane Symphony Orchestra while maintaining its historic luster.

The men's lounge figures, originally finished in painted felt in a technique called fabric appliqué, were scraped off and damaged to the point where they cannot be restored. As a result, Carpenter's crew began tracing outlines of the figures on see-through Mylar sheets from which they will make stencils to replicate the figures, probably on site. All replications will be attached to walls so the underlying remnants will not be damaged. Thus, if new restoration processes develop, what's left of the old murals will remain.

**“Leif Erikson Finally Moved,”**  
*Los Angeles Times*, 03/04/2007

Leif Erikson stood his ground in Seattle's Shilshole Bay Marina, just as he had since 1962 - despite his appointment with makeover artists in Kent, 15 miles to the south, and the efforts of a crew working full time to dislodge the 17-foot bronze Viking.

Workers tried concrete drills and jackhammers, and even tried to lever him out with a crane wielding 20,000 pounds of force. “He's just not going anywhere,” said Kristine Leander, president of the Seattle-based Leif Erikson International Foundation, three days into the effort.

Leander's nonprofit foundation, which formed in 1994 and presented duplicates of the Seattle statue to Norway in 1997 and Greenland in 2000, is working with the Port of Seattle and the local Scandinavian community in a marina renovation to memorialize Scandinavian immigrants. The statue is the centerpiece of the new memorial.

Artech, the company hired to remove the statue, discovered a hatch on the rear of the statue that had been used to pour concrete into the legs, solidly connecting Leif to his 30-foot-high base. “So then we knew we needed to chisel through the base. And we kept finding more and more rebar, which really slows things down.” It didn't help that the work was being done high in the air in wet and windy weather.

Leif Erikson is known as “Leif the Lucky” for, among other feats, reaching North America. “Here in Seattle,” Leander adds, “we’re thinking of changing that nickname to Leif the Stubborn.”

**“Disney to Animate Film by Hand, not Computer,”** *Los Angeles Times*, 03/09/2007

Disney plans to release a 2009 movie that will be animated the old-fashioned way, by hand-drawing the images rather than letting computer wizardry do the job.

Although other Disney animated movies will open between now and then, *The Frog Princess* is the first to be conceived since Disney’s 2006 acquisition of Pixar Animation Studios. So why would Disney return to its roots after spending \$7.4 billion to buy the pioneer of computer animation, which has since become the dominant form for these movies in Hollywood?

*The Frog Princess* will be a musical set in New Orleans, with songs composed by Randy Newman. The central figure, Maddy, will become the first African American among the Disney princesses, the company’s collection of heroines responsible for more than \$3 billion in annual retail sales. Because many of Disney’s animators are computer specialists, the company will have to hire more experts from the old school of hand-drawing. Except in Asia, almost no animated movies are made by hand.

**“Unfurling the Hidden Work of a Lifetime,”** *New York Times*, 03/18/2007

On a recent cloudy day the British art historian David Anfam stood outside a warehouse, a long concrete slab with a steel roof on the outskirts of a nondescript suburb, and confided, “I feel like the archaeologist Howard Carter about to enter Tutankhamen’s tomb.”

The secret cache of art Mr. Anfam had traveled from London to see — 2,393 works, to be exact — has been hidden from public view for decades. Most of it has never been seen by the public at all, thanks to the fierce privacy and bilious contempt for the art world of its creator, the Abstract Expressionist Clyfford Still, who died in 1980 at 75.

He left behind a one-page will, nearly 95 percent of the work he ever made (he sold or gave away only 150 pieces in his lifetime), and a widow de-

termined to follow his final testament to the letter. The demands were these: His estate could be bequeathed only to an American city, one that would build a museum to serve as a temple to his art and to nothing else. No works could ever be sold. No other artist could ever show a single piece alongside his. All Clyfford Still, all the time.

In 2004 his widow, Patricia Still, after decades spent spurning other metropolitan suitors, had chosen Denver as host of a Clyfford Still Museum, largely because of the overtures from the city’s ambitious mayor, John Hickenlooper. According to Barbara Ramsay, the conservator hired to survey the collection, about 10 percent of the paintings she has examined so far have significant conservation problems.

**“1930s School Murals Rise from the Ruins,”** *Chicago Tribune*, 12/16/2007

When a roof leaked and rainwater damaged the plaster walls at Evanston’s Oakton Elementary School several years ago, there was no money to repair the decades-old murals painted by unknown artists. Huge chunks of the paintings that told the story of Charlemagne, the medieval king who conquered Rome, had flaked away, exposing the brick underneath.

Fortunately, members of the Chicago Conservation Center had made tracings of the murals 12 years ago during a previous intervention. “If we had not had those tracings, the murals would have been incredibly difficult to restore,” said Heather Becker, the center’s chief executive officer. “Thank God we thought to do it when we did.”

In September, plasterers fixed the walls, and restoration started. The fresh plaster was covered with the tracings, and the lines of the original paintings were duplicated using a pizza-cutter-like instrument made of a roller and tiny pins. Working in watercolor first, then acrylic, the colors were matched using photographs. Salt residue from the water had corrupted much of the old paint, so much of the old plaster had to be removed.

**“Pakistan’s Ancient Ruins Fast Disappearing,”** *MSNBC*, 03/19/2007

Many Pakistani archaeological sites from its thousands of years of rich history are crumbling away as officials tussle over who should look after them.

A cradle of ancient civilizations and crossroads of Greek, Buddhist, Hindu, and Muslim cultures, Pakistan has a treasure-trove of ruins but many are being built over, pilfered by art thieves and villagers, or succumbing to the elements.

The federal government’s archaeology department has control over most of the country’s main sites but provincial officials argue they should be in charge of looking after their ruins. Only about a third of Pakistan’s sites had been excavated. Villagers often looked after old mosques, but Buddhist and Hindu ruins were often pillaged by thieves supplying artifacts to the international black market, and picked over by people looking for masonry to build their homes.

Another huge problem for whoever is in charge is encroachment. Sites are meant to be protected by a 200-foot buffer zone, but unregulated construction crowds many. The ornate pavilions and fountains of the Shalimar Gardens, built by the Mughal emperor Shah Jahan in 1642, are an island of tranquillity in a traffic-clogged Lahore suburb. Up to now, the garden’s walls have kept out most of the din and fumes and kept at bay the sprawl of concrete and tarmac. But illegal construction up against the thick, white walls is causing flooding and damaging artwork inside the gardens, experts say.

**“Model Captures Never-Built U.K. Church,”** *Happynews.com*, 3/18/2007

A monumental wooden model of a domed cathedral, now on display at the Walker Art Gallery, is the only visible realization of Edwin Lutyens’ vision of an enormous church for the Roman Catholic archdiocese of Liverpool.

Consider that it took 13 years and \$1 million to restore the model, and you get a good idea of why the dream was never translated into stone. The model was not in very good condition when the Walker gallery acquired it in 1975. The 70-year-old model is a snapshot of an evolving dream, because Lutyens’ ideas changed after the model was displayed at the Royal Academy in 1934.

The restoration team worked from surviving drawings to produce a composite of the architect’s intentions, completing and updating the interior in accord with later drawings. The design, commissioned by Archbishop Richard Downey, was a thumping gesture of ec-

clesiastical one-upmanship, designed to dwarf one of the world's largest churches, Liverpool's neo-Gothic Anglican cathedral. The cross atop the dome would have stood 520 feet high, nearly 200 feet higher than the Anglican cathedral, and even taller than the 489-foot dome of the world's biggest church, the Basilica of Our Lady of Peace in Yamoussoukro, Ivory Coast.

Created in the same 1:48 scale as a Lionel toy train, the model soars 12½ feet high and 17 feet long. The cathedral model was damaged during the war when the crypt was used as an air raid shelter. The conservation team replaced missing spires, belfries and a tower, and revived old techniques to create the delicate moldings and friezes to complete the interior. They crafted 175 miniature statues to go with the one statue that had survived; some 900 pieces of wood were used to re-create the lantern atop the dome.

**“A Dilapidated Mies Landmark in Dispute,”** *International Herald Tribune*, 03/22/2007

From the outside, the Tugendhat House doesn't look like one of the most important residential buildings of the 20th century: it's just two white stucco cubes separated by an opening through which a few spiky treetops protrude.

The house, a World Heritage site, was “fundamental to the development of Modern architecture,” according to Barry Bergdoll, the chief curator of architecture and design at the Museum of Modern Art. But it is also growing increasingly dilapidated, or “wasting away,” as *The Prague Post* put it in a recent article.

The house's condition has sparked a battle over who will control its future and ensure its survival: the city of Brno, which owns it, or the heirs of the original owners, Jews who fled Czechoslovakia in 1938.

The house embodies some of Mies van der Rohe's most influential ideas, which went on to become hallmarks of Modernism: free-flowing, open living space; a connection to the outside through transparent walls; the use of a grid of columns instead of load-bearing walls. It was also a project for which Mies designed every detail, from the doorknobs and light fixtures to the Tugendhat and Brno chairs, now classics of 20th-century design produced and sold by Knoll.

**“The Network Group for Composites in Construction Reviews FRP's in Restoration and Conservation,”** *Azom.com (The A to Z of Materials)*, 03/26/2007

The Network Group for Composites in Construction (NGCC) has undertaken a state-of-the-art review of the use of fibre-reinforced polymers (FRP) in restoration and conservation. Experts from UK industry and academia met in London in January 2007 to discuss the latest challenges in the field and present case studies. The workshop identified the significant potential of FRP in the preservation of historical structures.

Much work has already been done to enable their advantages to be exploited in the preservation of historic structures, particularly their high strength, durability, cost effectiveness, and the potential for minimal aesthetic impacts. The workshop findings have led to the production of a new NGCC technical sheet “TS06: FRPs in restoration.” The publication and workshop presentations can be downloaded from the NGCC members' e-library on the NGCC website.

**“Eye Surgeon May Help Restore Munch Works,”** *The Guardian*, 04/11/2007

The theft-damaged Edvard Munch masterpieces *The Scream* and *Madonna* may require treatment by an eye surgeon to remove tiny splinters of glass during their restoration, the Munch Museum director said Wednesday. She said an eye surgeon has skills and equipment for the removal of glass fragments without damaging the surrounding area.

The paintings were recovered by police on Aug. 31, about two years after they were stolen by masked gunmen in a brazen daylight heist at Oslo's Munch Museum. Both were damaged and are being repaired. She said because the frames and glass on both works had been broken during the theft, tiny glass fragments were embedded in the paintings, with *Madonna* being especially hard hit.

**“A Museum with Impeccable Manners,”** *The Times (UK)*, 04/30/2007

There's been quite a hullabaloo in Madrid about the Prado's new building. People have taken to the streets. Questions have been asked in parliament, petitions heard in the supreme court. Spanish

nimbys might call it a “carbuncle on the face of a much loved friend.” But such, says architect Rafael Moneo, “are the perils of building on such a site. It is like all of Spain is watching you.”

But beneath the pomp and circumstance the Prado is a rather weak building, whose illustrious contents and sentimental place in the national consciousness mean that Spaniards overegg its merits and overlook its failings. It is a handsome, solid Neo-Classical building, sure enough. But extending it is not, as one placard blasted, like “scribbling on a Goya.”

In 1998 the trustees bit the bullet, recommending Moneo's plan to build up the slope behind. And that's when the problems really began. For up the slope lay the cloister of the Jerónimos, a 17th-century relic of an old monastery. Being a relatively modern city, Madrid has few 17th-century buildings.

Moneo has returned the slope and built his extension underneath, the natural rise of the hill giving him the volume required for the new temporary exhibition galleries, the auditorium, the conservation department, and storage facilities – increasing the Prado's space by 50 per cent and releasing 40 rooms in the main building for more Goyas. Ascend the escalators and all becomes clear as you emerge, miraculously, in San Jerónimo's cloister, there all along, in its old position too, but meticulously reconstructed, scrubbed up, as the central courtyard for the palazzo.

**“SGPC, Spare a Thought for Heritage,”** *Chandigarh Newslite*, 03/03/2007

In the recently passed budget of the cash-rich Shiromani Gurdwara Parbandhak Committee, not even a penny has been earmarked for preservation and conservation of historic gurdwaras, Sikh art, and creating awareness about heritage buildings.

Angered by this, conservationists, artists, and social workers feel that the religious body managing gurdwaras in northern India must set up a heritage cell so that the history can be preserved and documented. The artists feel that the biggest danger to the Sikh art – comprising paintings, murals, and frescoes decorating walls of the sanctum sanctorum of the Golden Temple – is from its custodian, the SGPC. Recently, the SGPC came under condemnation for damaging



heritage in the name of 'kar sewa' at various gurdwaras as murals were painted white, paintings destroyed, and traditional Nanakshahi bricks were replaced with marble and shining stones.

"They (SGPC) and kar sewa babas have done more harm to the buildings than anyone else. The murals and frescoes at the Golden Temple are peeling off and the restoration at some sections has been improperly done, without taking care of the originality," rued state convener of the Indian National Trust for Art and Cultural Heritage (INTACH) Dr. Sukhdev Singh.

SGPC chief Jathedar Avtar Singh, denying that the SGPC was unconcerned, said he would take up the matter in the executive body meeting, and if decided, they would seek help of the experts.

**"Man Kicks Foot Through Priceless Painting At Milwaukee Museum,"**  
*KSDK St. Louis, MO, 04/09/2007*

A man is in jail after kicking his foot through a priceless painting at the Milwaukee Art Museum. The Ottavio Vannini painting, called *The Triumph of David*, dates back to the 1640s and depicts David holding the severed head of Goliath. A man that museum staffers claim has a history of mental illness destroyed it. He told museum officials the painting disturbed him, and that he didn't like seeing Goliath's severed head.

"This is a very isolated, infrequent type of action," says Chief Curator Joe Ketner. The entire incident was caught on surveillance video and the man could now face felony charges. The museum admits the man had time to destroy the painting before security arrived and now say they are working on a new security plan. The painting is now under lock and key in the museum's conservation area. Experts are deciding the best way to repair it.

**"Fears for Gaudi Masterpiece as Rail Tunnel Approved,"**  
*The Guardian, 04/26/2007*

The chief architect working on the Sagrada Familia in Barcelona yesterday condemned a plan to build a bullet-train tunnel less than two metres from Gaudi's unfinished masterpiece.

Backed by local civic groups, the advisers to Unesco in Spain, and architects and engineers from 50 uni-

versities around the world, Jordi Bonet i Armengol, who has worked on Gaudi's daring church for 40 years, said yesterday: "I am astounded by this brutality. This is an attack on culture of the highest order, something one would only expect of a third-world country."

Last week, the mayor of Barcelona, the Catalan premier, and the public works ministry approved the plan, which awaits an environmental impact review by the national government, according to a city spokesman. The city of Barcelona wants to build the rail tunnel to provide a high-speed link between Madrid and Barcelona, and on to France. The high-speed Ave line is expected to link Madrid and Barcelona by 2007. The tunnel to France is due to be completed by 2009.

**"Museums at War Over a Flying Visit Home for Queen Nefertiti,"**  
*The Times (UK), 04/26/2007*

The exquisite Queen Nefertiti is at the heart of an imminent museum war between Germany and Egypt. The 3,400-year-old bust of the wife of the Sun King Akhenaten has been in German hands since it was dug out of the desert by the archaeologist Ludwig Borchardt in 1912. It was smuggled out of Egypt and became a central part of Berlin's museum collection.

Now the Egyptians want it back, if not for keeps, then at least on loan to mark the opening in 2012 of a new Grand Egyptian Museum, near the Pyramid at Giza. If the Egyptian Museum in Berlin does not agree, says Zahi Hawass, there will be trouble. "We will make the lives of these museums miserable," the secretary-general of the Supreme Council of Antiquities in Egypt said. "It will be a scientific war."

German officials say that the bust is too fragile to travel. Mr. Hawass has sent the Germans an ultimatum: "We will never again organize antiquities exhibitions in Germany if it refuses the request, to be issued this week, to allow the bust to be displayed in Egypt for three months."

Ironically, the only official who ever considered giving it back was Hermann Goering, the Nazi air force chief, who later plundered Europe's art collections. Hitler overruled him: Nefertiti was to be the jewel in the crown, he said, of a redesigned Berlin that was to be called Germania, the capital of the Thousand-Year Reich.

"I really want it back," Mr Hawass says of Nefertiti, and most Egyptians seem to agree. They were as upset as him in 2003, when the Egyptian Museum let two artists place the bust on top of a nearly naked female bronze for a video spectacle. Egyptian cultural officials were so outraged by what they said was the abuse of Nefertiti that they banned further German exploration in their country. "I thought it was disgusting," Mr Hawass said.

On that occasion the Germans backed down, and the video of Nefertiti was not sent, as planned, to the Venice Biennale modern art festival. This time, it seems, the Germans are not prepared to give ground.

**"High Museum Unlocks Gates of Paradise,"**  
*CNN.com, 04/30/2007*

When the artists of Florence, Italy, swung open the doors of the Baptistery of the Duomo now known as the *Gates of Paradise* in 1452, a new world was waiting on the other side. Twenty feet tall and weighing three tons, this single work is considered the gateway to the Italian Renaissance.

And as the High Museum of Art opens its exhibition of three of the doors' 10 gilt panels on Saturday, the conservation effort that brought them here will have lasted 25 years -- just two years less than it took to make the work itself. The panels then will be moved back to Florence to be reassembled in the original doorway for permanent, hermetically sealed display at the Museo dell'Opera del Duomo. They are expected never to travel again.

Exhibition curator Gary Radke of Syracuse University says that the special alloy of bronze developed in the 15th-century workshop of Lorenzo Ghiberti for the doors had resulted in a corrosion that had dulled the dull surfaces of the square relief-sculptures and other gilt ornaments on the doors. However, thanks to a specially developed laser-and-distilled-water technique, what you now can see on display is not a restoration -- not new gold leaf added, or reconstructed bronze modeling -- but the same metals Ghiberti worked with himself. "We found out it wasn't just dirt but was actually chemical reactions between the surfaces of the gold and the bronze."