

President's Letter

Molly Lambert

Save these dates! Make Plans!

Santa Fe, New Mexico
2004 WAAC Annual Meeting
October 1-3 (Fri., Sat., Sun.)

Location: Museum of New Mexico
 – St. Francis Auditorium (downtown)
 and the Folk Art Auditorium
 (on Museum Hill) at the Museum of
 International Folk Art.

Spot Testing Workshop, see p. 2

San Geronimo Feast Day, Taos Pueblo
Sept. 29, San Geronimo Eve Vespers
Sept. 30, San Geronimo Day, Traditional Pole Climbing

(not a WAAC event)

Taos Pueblo is a living Native American community, a UNESCO World Heritage Site, and a National Historic Landmark; it has been continuously inhabited for more than 1000 years.

135 miles from Albuquerque (2:15 drive time)
 300 miles from Denver (4:30 drive time)
 233 miles from Purgatory (3:45 drive time)
 72 miles from Santa Fe (1:15 drive time)

Yes, we're gearing up for the 2004 Annual Meeting, and we mean up. Santa Fe and surrounds range from 5000 to 8000 feet above sea level so leave your water wings at home, steel your lungs, and grab those walking sticks, boots, and water bottles. See page 3 for our Call for Papers, or check the WAAC website (<http://palimpsest.stanford.edu/waac/>) for the Call and for the most current information on the annual meeting. Meanwhile here are lots of tidbits.

Some of our activities will be held downtown Santa Fe where the Museum of New Mexico has their Museum of Fine Arts (including the St. Francis Auditorium) and The Palace of the Governors. Other activities will be held up on Camino Lejo, better known as "Museum Hill" – just a short bus ride, a quick car ride, or a healthy walk from downtown Santa Fe.

There are some very fine cultural institutions on Museum Hill. They are:
 The Museum of Spanish Colonial Art (www.spanishcolonial.org);
 The Museum of Indian Arts & Culture / Lab of Anthropology (www.miacolab.org);
 The Museum of International Folk Art (www.moifa.org);
 The Wheelwright Museum of the American Indian (www.wheelwright.org);
 The School of American Research (www.sarweb.org/ie4.htm);
 ... and, of course, the Museum Hill Café.

Santa Fe is small and very visitor-conscious. There are many options for lodging in the downtown area including a number of well-known historic hotels like La Fonda (505) 982-5511/www.lafondasantafe.com). My favorite place to stay is the Hotel St. Francis (505) 992-6350/www.hotelstfrancis.com) because it is on the edge of downtown (three blocks from the central plaza), is comfortable, has a big front porch and a bar, and is a good price. For a more economical stay, you may want to look into Ghost Ranch Santa Fe: Plaza Resolana (800) 821-5145/www.ghost ranch.org) which is a retreat center offering some B&B/dormitory style rooms, also within three blocks of Santa Fe's central plaza. If you get online you will find many hotels, motels, and Bed & Breakfasts to consider. WAAC will try to secure a discounted group of rooms at one or all three of the hotels listed above, but our group is considered quite small by conference standards so we don't know if such discounts will be available to us yet. You may want to make your arrangements separately for now. Booking early is always a good idea especially with the San Geronimo Fest happening that same weekend, albeit in Taos.

I would encourage you to get a copy of the Santa Fe Visitor's Guide. I know it sounds like one of those awful tourist publications one finds in your hotel room, but this one is actually quite good– and free and easy to get. Request one from the Santa Fe Convention & Visitors Bureau (800) 777-2489/www.santafe.org), which also has listings for hotels, B&B reservation services, weather, camping and family activities – or, the Santa Fe Chamber of Commerce (505) 983-7317/www.santafechamberofcommerce.com). For local events listings, you can use the weekly newspaper *The Santa Fe Reporter* www.sfreporter.com. *continued*

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Spot Testing for Materials Characterization Course

instructors:
Nancy Odegaard
and Scott Carlee

**Volume 26 Number 2
WAAC Newsletter**

Conservators often must characterize the material nature of artifacts, accretions or deposits, and contextual materials as they relate to preservation. Spot tests that do not require expensive instruments or specialists' participation can be particularly useful, provided they are accurate, complete, capable of interpretation, and minimally intrusive. Spots tests are an analytical skill and are based on wet chemistry. This course will combine lecture, discussion, and laboratory sessions for hands-on practice in preparation, testing, and interpretation of results for a representative range of organic and inorganic artifact materials. The successful use of such tests is dependent on the use of the right chemicals, good lab technique, and knowledgeable interpretation of the reactions.

The methodology for the course will use the processes of scientific method combined with safe laboratory practice. The course work will include:

- A variety of micro-sampling techniques, including the electrolysis of minute amounts of sample material onto filter paper.
- Testing of a range of artifact materials, including inorganics such as metals and minerals, and organics such as proteins, cellulose, and plastics.
- Testing of contextual materials, including surface deposits, soils, stains, etc.
- Interpretation results, chemical processes and stages of a reaction, and effects of interference materials.

The tests that are covered are a special selection of Spot Tests drawn from *Material Characterization Tests for Objects of Art and Archaeology* by Odegaard, Carroll, and Zimmt (2000 Archetype Books). At the conclusion of the workshop participants will be able to set up a testing program for their lab. The tentative dates are Sept. 26, 27, 28, 29 (Sun - Wed.). The workshop will be held in the conservation lab of the Museum of New Mexico in the Museum of International Folk Art. The price has not been determined.

President's letter, continued

Walking or the occasional bus ride is the best and most enjoyable way to get around the town of Santa Fe. Side trips usually require a car. If you are without car, you can take an airport shuttle from Albuquerque (there is no commercial airport in Santa Fe). Look into: Santa Fe Shuttle/Herrera Coaches (888) 833-2300 or Sandia Shuttle (888) 775-5696).

It seems likely that you will want to consider visiting a few of the many astounding historic, pre-historic, and natural sites in the Santa Fe or Four Corners area. Just to name a few:

Acoma Pueblo (505) 552-6604 / www.puebloofacoma.org; Bandelier (505) 672-3861 x517 / www.nps.gov/band; Santuario de Chimayo (505) 351-4889 / www.archdiocesasantafe.org/AboutASF/Chimayo.html; Ghost Ranch: Abiquiu (Georgia O'Keefe's former ranch / (800) 821-5145 / www.ghost ranch.org); Chaco Culture National Historical Park (505) 786-7014 / www.nps.gov/chcu/; Mesa Verde National Park, Colorado (970) 529-4465 / www.nps.gov/meve/; Taos Pueblo (505) 758-9593 / www.taospueblo.com).

For those of you interested in some self-indulgence, here are two favorite health spas: Ten Thousand Waves just a few miles outside of Santa Fe (505) 982-9304 / www.tenthousandwaves.com) or Ojo Caliente Hot Springs on the road to Taos (800) 222-9162 or (505) 583-2233 / <http://ojocalientespa.com/>). Or, consider a southwestern cooking class at the Santa Fe School of Cooking (505) 983-4511 / www.santafeschoolofcooking.com).

And lastly, anyone going up towards Mesa Verde in southwestern Colorado may want to know about a public lecture being given by J.J. Brody (cultural resource manager and archaeologist) at the Anasazi Heritage Center (www.co.bsm.gov/ahc) in Dolores, Colorado (near Cortez) on the evening of September 24th. Brody will be speaking on the pre-historic painted plasters of the four corners pueblo cultures.

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To make academic course packets that include articles from WAAC Newsletter, contact the authors of the articles directly.

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Deadline

Contributions for the *May* Newsletter should be received by the Editor before **September 30, 2004**.

Western Association for Art Conservation

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.

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Molly Lambert

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Beverly Perkins

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PUBLICATIONS FULFILLMENTS

Donna Williams

Individual Membership in WAAC costs \$30 per year (\$35 Canada, \$40 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 \$35 per year (\$40 Canada, \$45 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. WAAC's URL is: <http://palimpsest.stanford.edu/waac/>.

Call for Papers - Annual Meeting October 1- 3 Sante Fe, New Mexico

Deadline for Abstracts: August 6, 2004 (working ideas sooner, please).

Presentations can be full length (approx. 20 minutes) or shorter (5-10 minutes) for tip sessions or quick updates. Presentation posters also will be considered.

The first day of talks may concentrate on the conservation of sites and sacred places or Native American collections - not necessarily specific to the American Southwest region. The second two days will focus on the work of our members and affiliates in all categories of material conservation and planning.

While formal abstracts are due in August, we prefer to hear from you now (or as soon as possible) if you are thinking of proposing a presentation. Please send your ideas or abstracts to two members of the WAAC Board - Molly Lambert, President and the person listed below who is covering that topic.

Abstracts submissions should include: your name and the name of any other authors; contact person information (name, phone, email, address); the title of your proposed presentation or paper; length of time you'll need to make the presentation; and what kind of projection or electronic equipment you may need.

Attendance at this meeting is expected to be from 100-150 people. This means that approximately 500 members will have only the abstract you submit to tell them what you talked about when they read the Presentation Summaries in the January 2005 issue of the *Newsletter*. Therefore, your abstract should give the reader basic, useful, and interesting information from your talk. As is custom, some papers will be published in the 2005 *Newsletter*.

All presenters must register for the conference - one-day registration is sufficient. We are also asking you to provide a brief biography so that we can compile introductions for each speaker ahead of time.

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SILENT AUCTION ON VACATION

Contrary to earlier reports in the *Newsletter*, the Silent Auction will be on hiatus during the Santa Fe meetings. We anticipate its return in 2005, so hang on to those precious donations until then.

Thank you,
Beverly Perkins and J. Claire Dean

Regional News

WAAC would like to thank the Regional Reporters for doing such an excellent job at providing all the latest news in their areas. Readers of the *WAAC Newsletters* learn where the action is thanks to these hard working reporters. We encourage WAAC Members to support the Regional Reporters by continuing to submit all the news that's fit to print, and you don't have to wait for them to call you. WAAC sends a special thank you to Paloma Anoveros who did such a fantastic job reporting the news from the San Francisco Bay Area. It is with great appreciation that we greet Charlotte Ameringer who has agreed to take over as San Francisco Bay Area regional reporter.

PACIFIC NORTHWEST

The big news in Alaska is that **Sean Charrette** formerly of the Boston Museum of Fine Arts Conservation Department is now the collections manager at the Museum of the Aleutians in Unalaska. This is a big move for Sean and his wife to a pretty isolated part of the world so we wish them well.

Monica Shah continues to divide her time between private conservation projects in Anchorage and a contract at the University of Alaska Museum in Fairbanks.

Ellen Carrlee is working on the usual projects to get ready for the summer tourist season at the Juneau Douglas City Museum and working for private clients.

In January **Scott Carrlee** helped teach a workshop in Anchorage on Care of Native Collections sponsored by the National Museum of the American Indian and the Smithsonian's Arctic Studies Center.

Seattle Art Museum is currently showing *Renaissance Art in Focus: Neri di Bicci and Devotional Painting in Italy* curated by **Chiyo Ishikawa** and **Nicholas Dorman**. This small exhibition unites Neri di Bicci's large panel, *Madonna and Child with Six Saints* from Seattle's Saint James Cathedral, with late mediaeval and early renaissance works from the SAM permanent collection and some loans. The

exhibition explores technical aspects of these paintings as well as the formal continuity of devotional painting in Italy in the fourteenth and much of the fifteenth centuries.

Conservation of Neri's painting is addressed in the exhibition and catalog which also includes technical findings relating to SAM paintings by Pietro Lorenzetti, Bernardo Daddi, Puccio di Simone, Dalmasio di Jacopo, Luca di Tomme, Lorenzo Monaco, Lo Scheggia, Giovanni di Paolo, and Marco d'Oggiono.

The exhibition gives viewers the first chance to see di Bicci's painting after structural repairs and the removal of extensive overpaint and to compare this work to a stucco, from the same period, that was produced by Antonio Rossellino and painted by Neri. SAM's *St James* by Puccio di Simone has also been reunited with two panels, from a private collection, that were once part of the same altarpiece. The catalog also includes an essay by freelance scholar **Elizabeth Darrow**.

J. Claire Dean and the Local Organizing Committee for the AIC meetings in Portland are busy arranging volunteer schedules and other details for this summer's gathering.

Claire has also been working on rock image related projects in the Portland area, including presenting a paper at the annual North West Anthropological Conference in Eugene, Oregon, on last summer's repatriation of petroglyph boulders along the Columbia River. She is also beginning a big project for the Confederated Tribes of the Umatilla Indian Reservation to update the site records of over 30 rock image sites in south east Washington state by providing condition assessments for each site.

John Kjelland is performing contract work for Montana Historical Society and the National Park Service.

Jan Cavanaugh, Conservator of Paintings, is teaching a course on the history and principles of art conservation at the University of Oregon in Eugene during the upcoming summer term.

In April, **Vina Rust** had an exhibition

of metal sculptural pieces at the Jacob Lawrence Gallery at the University of Washington in Seattle, as part of the 2004 BFA exhibition. A featured piece is *Sprout*, one in a series of three pieces inspired by the botanical illustrations of D.G. Mackean. A neck piece in silver and copper, it incorporates a highly observed seed form in graduating sizes corresponding to sequential stages of germination.

Regional Reporter:
Peter Malarkey

HAWAII

Dawne Steele-Pullman relocated to Singapore in February for a position in a private painting conservation studio. She will be there for at least 5 months.

Rie and Larry Pace, Pace Art Conservation, LLC have been keeping busy with the usual interesting paintings, each of which has even more interesting problems, part and parcel of life in Hawaii, at least for art work. Rie and Larry gave talks to students and professors at the Musashino Art University in Tokyo, Japan in November of 2003 and again in April 2004. They have been introducing various aspects of the conservation of easel paintings to future curators, historians, and artists. Larry will be giving an encore presentation of his October 2003 WAAC Meeting talk, "Dirty Pictures in Paradise" at the Hawaii Museums Association meeting in April on the Big Island.

Regional Reporter:
Laurence A. Pace

GREATER LOS ANGELES

The department of Decorative Arts and Sculpture Conservation at the Getty Museum completed work on the Jean-Antoine Houdon exhibition that displayed over 70 of the artist's sculptures in marble, terracotta, plaster, and bronze.

The mountmakers designed cast bronze prototype clips to facilitate quick seismic mounting during the 3-week installation. A seismic engineer was consulted who designed a spreadsheet to calculate an "Isofactor" number for each of the objects. The results were used to determine which of the sculptures were to be installed on isolated pedestals. The isolators were designed by the Museum's preparations department to absorb seismic shock by allowing vertical and horizontal movement in the event of an earthquake.

In conjunction with the Houdon exhibition, **Jane Bassett** received permission from the lenders to carry out technical examinations of six of the bronze sculptures, the first systematic study of Houdon's casting materials and techniques. She will be reporting her findings in May at a Houdon colloquium at the Chateau de Versailles.

The department has been working hard at writing and compiling the technical entries to be included in the forthcoming *Catalog of French Baroque Decorative Arts in the J. Paul Getty Museum*. The catalog focuses on furniture and gilded bronzes and includes the results of considerable technical analysis conducted over the last several years. The analyses include: microscopic wood identification; x-ray fluorescence analysis of brasses, pewters, and gilding; and paint and polychromy analysis using polarized light microscopy, scanning electron microscopy, Fourier transform-infrared spectrometry, and gas chromatography-mass spectrometry.

Arlen Heginbotham is pursuing a research project in collaboration with the molecular biology department at USC on the use of monoclonal antibodies for the identification of proteinaceous materials in conjunction with cross-section microscopy. This research, which is thus far yielding promising results, offers the possibility of using fluorescent "tags" to visualize and distinguish between artists' materials such as egg white, milk protein, bovine glue, rabbit skin glue, and parchment glue. The specificity of this technique is remarkable; parchment glues could even be separated into those made from sheepskin (predominant in Northern Europe) and goatskin (predominant

in Southern Europe).

Brian Considine collaborated with the Decorative Arts Department to curate the Getty's fourth exhibition on the making of works of art. *The Making of Furniture* seeks to explain the tools and techniques involved in the production of the 18th-century ebenisterie, or veneered furniture in the Getty's collection.

The exhibition is based on a case study of the museum's writing and toilet table by Jean-Francois Oeben of which three copies, each taken to a different stage of completion, were made by Furniture Conservator **Michel Jamet** in Paris, who has worked on many of the Getty's finest pieces of furniture. A photographer documented the creation of the copies, allowing illustration of the use of each of the tools in the exhibition. There are two videos in the exhibition: one on the cutting of marquetry and one on the casting, chasing, and gilding of bronze mounts.

For the second time, the Wooden Artifacts Group of the AIC is organizing a three-week study trip to France for Canadian and American Furniture and Textile Conservators and Curators. The organizers are **Paul Miller**, Curator of the Preservation Society of Newport (Rhode Island), **David Bayne**, Furniture Conservator at Peebles Island, New York, and **Brian Considine**, Conservator of Decorative Arts and Sculpture at the J. Paul Getty Museum.

The goal of the trip is to introduce the group to the collections and people involved in regional as well as Parisian furniture and decorative arts. The group will visit museums, chateaux, and workshops in Paris, Nancy, Bordeaux, Lyon, Grenoble, La Rochelle, and Rennes during the first three weeks of May.

California will be well represented by: **Brian Considine**, **Julie Wolfe**, also of the Decorative Arts and Sculpture Conservation at the Getty, Berkeley Private Furniture Conservator **Mark Harpain-ter**, and **Deborah Hatch**, Curator of Gordon and Anne Getty's Collection.

KCET's (Los Angeles' PBS station, channel 28) news show *Life & Times* aired a segment on "Mural Preservation" (broadcast on March 29th) featuring interviews with **Jerry Podany**,

Nathan Zakheim, **Pat Gomez**, **Donna Williams**, and **Chris Stavroudis**. The seven-minute segment was produced by **Vicki Curry** and discussed the ongoing freeway mural conservation and restoration projects sponsored by the City of Los Angeles Department of Cultural Affairs and Caltrans.

Chris Stavroudis presented an afternoon lecture and demonstration at LACMA in January on his development of the Modular Cleaning Program. The lecture was called "A Novel Approach to Aqueous Cleaning, Using Mixtures of Concentrated Stock Solution and a Database to Arrive at an Optimal Cleaning System." Chris and **Tiarna Doherty** first presented the database project at last October's Verband der Restauratoren Conference, "Surface Cleaning - Materials and Methods," in Dusseldorf. They gave a longer version of the presentation at the GCI in December.

Chris and Tiarna will be debuting the Modular Cleaning Database's newest features, the use of solvent gels and solvents in a paper titled "A Novel Approach to Cleaning II: Extending the Modular Cleaning Program to Solvent Gels and Free Solvents" at the AIC General Session in Portland. They will be presenting the aqueous talk, also given at the WAAC Annual Meeting in Honolulu, for the Paintings Specialty Group.

Will Shank spent a week at LACMA in March with paintings conservators, carrying out preventive treatment on a large Morris Louis painting from the unfurled series, *Beta Ro*. The painting was surface cleaned and then loose-lined with cotton prepared with acrylic gesso to act as a barrier against the migration of wood acids in the stretcher. The project was made possible through a generous grant provided by the Morris Louis Foundation. The Foundation also funded a similar project at LACMA in 2002 for the treatment of Morris Louis' veil painting, *Dalet Heh*.

Marc Walton has been settling into his position of Associate Conservation Scientist at LACMA which he began in December of 2003. Marc has a background in objects conservation having received his Masters Degree in the History of Art with a Certificate in Conservation

Regional News, continued

from New York University. After attending NYU, he went to the University of Oxford to work on his doctorate in Archaeological Science which he plans on submitting for examination in the coming year.

Jennifer Koerner began her new position as Associate Paper Conservator at LACMA last April. Jennifer worked at the Intermuseum Conservation Association for over four years before coming to LACMA.

Batyah Struhm joined LACMA last March as Assistant Objects Conservator. Batyah comes to us from the Getty, where she was taking part in the Getty Graduate Internship Program as an intern in the Antiquities Conservation Department. Batyah is a graduate of the Winterthur program.

Grace Jan arrived at LACMA in April for a Camilla Chandler Frost Summer internship in Paper Conservation. Grace is from the NYU Conservation Program.

Michael Alan Miller will join LACMA in August for a two-month Camilla Chandler Frost Summer Internship. Alan is from the Courthauld Institute. While at LACMA he will be surveying the collection of Latin American art.

Yadin Larochette is completing her third year internship at LACMA. She will return in September as Mellon Fellow. **Natasha Cochran** will be continuing at LACMA next year in the Objects Conservation lab as Mellon Fellow.

Yosi Pozeilov, assisted by **Chail Norton**, will present a workshop at AIC in June on basic techniques of digital imaging, focusing on the documentation needs of conservators. **Terry Schaeffer** and Chail Norton delivered a talk to the book and paper session this year at AIC on a long term project.

Griswold Conservation Associates welcomes **Dave Harvey** as Associate Conservator. Dave is supervising new staff at the GCA North Hollywood studio, including conservation technician **Stephanie Cha-Ramos** and pre-program interns **Laura Beltz** and **Morgan Kibby**, who are currently re-gilding two bronze sculptures for Hearst Castle.

John Griswold is overseeing the conservation treatment of the exterior surfaces and features of the Gamble House in Pasadena, CA and is completing treatment of three early French Gothic limestone windows at the Cloisters Museum for the Metropolitan Museum of Art.

John recently addressed the American Institute of Appraisers and the Getty Conservation Institute Building Materials Research project, and was interviewed on the "Colorado Matters" program of Colorado Public Radio regarding the restoration of the vandalized Ludlow Massacre Memorial Monument. **Stefanie Griswold** is performing cleaning and stabilization treatment of the original Pinocchio concept design marionette for the Disney Feature Animation Archives.

Carolyn Tallent spent three weeks in March on-site at the Yosemite Museum in Yosemite Valley doing minor treatments on paintings. More work is scheduled in October.

Regional Reporter:
Virginia Rasmussen

ROCKY MOUNTAIN REGION

Deborah Uhl, conservation student at the Buffalo program, will do her third year internship at the Western Center for the Conservation of Fine Arts (WC-CFA) in Denver starting in September. The staff at WCCFA is very happy to be able to provide Deborah with this opportunity, and we all look forward to a mutually beneficial year.

Conservators at the Denver Art Museum continue to focus on the planning and installation of art in the new Liebiskind addition which opens in 2006. Thanks to a series of well-timed grants, the majority of the Western American art is nearly ready.

Third-year intern **Paulette Reading** from the conservation program at Buffalo has

taken a leading role organizing African and Oceanic materials for conservation and mounting. Kress Conservation Fellow **Kristy Jeffcoat** recently completed conservation treatments on a number of paintings featured during the run of *Painting a New World, Mexican Art and Life, 1521-1821*.

Assistant Conservator **Jessica Fletcher** continues to prepare Native American materials for publication and reinstallation at the museum. A recent project involved the analysis of resinous materials on the surface of a large Zia pot using FTIR and SEM/EDS to determine if the pot had been used for ceremonial purposes.

Carl Patterson, Chief Conservator, has been coordinating the reframing of nearly 200 Western American paintings to meet conservation standards and writing IPM guidelines for the Collections Services Department.

In conjunction with the "New Deal for the New Deal" organization, Art Care Services Conservator **Victoria Montana Ryan**, has recently completed the conservation treatment of two W.P.A. murals. The murals, one by Archie Musick and the other by Tabor Utley, are in the city auditorium in Colorado Springs. Victoria will also be teaching, along with **Matt Crawford**, the introduction to conservation class at the University of Denver.

Regional Reporter:
Eileen Clancy

NEW MEXICO

Laura Staneff has spent the last few months working part time at the University of New Mexico Art Museum (UNMAM) and continuing to build her private practice, completing projects at the Maxwell Museum at UNM as well as at the University of Arizona Art Museum. Laura and the UNMAM have hosted conservators **Betsy Court** and **Alexis Miller** from the Balboa Art Conservation Center to complete an IMLS-

Regional News, continued

funded survey of the museum's paintings collection. UNMAM is also pleased to welcome **Camille Moore** for a summer conservation internship. Camille has completed her first year as a paper/photograph conservation major at NYU, and will be working on a variety of treatments as well as contributing to ongoing survey and re-housing projects.

Linn Kennedy has moved her textile conservation business to: 2617 Eastridge Drive, NE, Albuquerque, NM 87112. She continues to work with public and private clients. For more information call her at 505-299-3491 or email her at jamelectra@aol.com.

Hillary Kaplan, from the National Archives and Records Center in Washington, DC, presented a workshop for the New Mexico Preservation Alliance in February on collections preservation for libraries and archives.

Regional Reporter:
M. Susan Barger

SAN DIEGO

In March, Paintings Conservator **Betty Engel** attended the 7th Annual American Conference on Oriental Rugs at the Seattle Convention Center. An important exhibition of Turkmen weavings and Kurdish tribal weavings accompanied the conference, which was attended by major rug dealers and collectors from the USA and Europe.

Regional Reporter:
Frances Prichett

SAN FRANCISCO BAY AREA

The Asian Art Museum of San Francisco celebrated its first anniversary in the Civic Center. Most of the conservation staff's time is taken up with preparing light sensitive objects for rotations.

This spring **Donna Strahan** is traveling to Vietnam to assess the condition of selected objects for a future exhibition. She will also plan conservation training and treatments to be performed in Vietnam later this year. Then she will spend one month working in Bangkok at the National Museum preparing objects for the up-coming traveling exhibition *The Kingdom of Siam*.

Mark Fenn's most interesting recent project has been examining two Thai glaives. Now that he has figured out how to get them apart he is looking at all the pieces, trying to determine the sequence of construction and repair.

Debra Fox has developed an economical strategy for the loose mounting of over-sized paintings onto Alupalite™. She is preparing thangkas for exhibit and examining pigments on Southeast Asian paintings.

Meg Geiss-Mooney continues to use her creative side to design textile mounts that are archival, unobtrusive, and still deal with the foibles of the different exhibit spaces and cases (including a two sided case for a hanging Korean bojagi). Meg recently completed the conservation and preparation for exhibit of a large embroidered silk flag for the Society of California Pioneers. The "BEVA eyelash" technique for stabilizing two fracturing silk edges she learned from painting/textile conservator **Nancy Pollack** at last November's NATCC sure was put to good use on this particular project. **Jane Williams** is completing the manuscript for a publication of case studies of treatments of lacquer objects in the museum's collection.

Molly Lambert has received a fellowship from the Attingham Trust to attend the Attingham Summer School in England where participants study first-hand the architecture, landscape architecture, and collections of twenty-five English country homes. Preceding this, Molly will have spent two weeks working on the ceiling of a tomb in the Theban Necropolis, Luxor.

Pam Skiles has been appointed to the WAAC Board of Directors as Secretary and will help coordinate the Annual Meeting in Santa Fe.

Alina Remba has been appointed faculty at the Museum Studies Program at John F. Kennedy University. She will be teaching Preventive Conservation at their new campus in Berkeley.

An exhibition entitled *Finding Sellaio: Conserving and Attributing a Renaissance Painting* will be on view at the Cantor Center from August 4 to November 28, 2004. This case study focuses on the *Virgin and Child with Saint John* (c. 1480-85) and the attribution of the devotional painting to the Florentine artist Jacopo del Sellaio (ca. 1441-1493). The exhibition will explore how this contested attribution has been resolved through data obtained during the conservation process.

On March 27th, the Cantor Arts Center at Stanford University presented an evening focused on conservation, featuring Stanford art history student **Alisa Eagleston**, Fine Arts Museums paintings conservator **Tony Rockwell**, and Stanford Radiology professor **Robert Mindelzun**. Faculty from a cross-section of Stanford departments, conservators, and museum supporters were brought together by **Susan Roberts-Manganelli** of the Cantor Center, with the aim of developing interdepartmental liaisons.

Lesley Bone has returned from travel to Mexico, Guatemala, and Honduras where she helped with the organization, condition-reporting and packing of 176 fragile objects for the exhibit *Courtly Art of the Ancient Maya*, opening first at the National Gallery of Art in Washington, D.C., and then traveling to the Fine Arts Museums of San Francisco, where it opens in September 2004.

Elisabeth Cornu and **Nadina Reusmann**, advanced intern from Argentina in Objects Conservation, have taught a marble conservation course at the San Diego Cemetery in Quito, Ecuador, under the auspices of UNESCO, in January 2004. This course is part of an ongoing series of courses for the Red Latinoamericana de Cementerios Historicos (Latin American Historic Cemetery Association).

In March, **James Bernstein** and **Debra Evans** conducted the workshop "Damaged and Deteriorated Photographic

Regional News, continued

Print Materials: Compensation for Loss” hosted by the Department of Paper Conservation at the J. Paul Getty Museum. The 4-day workshop, funded by the Andrew W. Mellon Foundation, was attended by 16 photographic conservators from a variety of nations: Australia, Brazil, Denmark, England, Holland, Germany, Mexico, New Zealand, and of course the United States.

Marc Harnly was the workshop coordinator, **Debbie Hess Norris** project director, **Nora Kennedy** project coordinator, and **Martin Salazar** workshop assistant. **Bob Aitchison** also provided valuable expertise. The participants also experienced informative visits with Getty Conservation and Research Institute staff, and photography curators from the Getty and Los Angeles County Museum of Art.

At the beginning of the year, Jim Bernstein was called to SFMOMA for the delicate compensation of damaged pigmented surface coatings on three recent, life-sized figural sculptures by Katarina Frisch. Working with **Michelle Barger**, SFMOMA Objects Conservator, Jim devised a treatment and performed the work successfully with invaluable assistance from paintings colleague Alina Remba.

On-Call Paintings Conservator: Jim has had a number of beautiful and challenging conservation projects this winter/spring. These include two powdered ultramarine works by Yves Klein; a four color Alexander Calder mobile with severe paint rejection; damaged encaustic paintings by Anne Appleby; a severely distorted/blistered painting on paper, mounted to hardboard panel by the artist Richard Diebenkorn; as well as works by Andy Warhol, Anselm Kiefer, Sol LeWitt, Gerhard Richter, and others.

From February through April conservators at the paper lab of the Fine Arts Museums of San Francisco were pleased to host intern **Eva Glueck** from the Staatliche Akademie der Bildenden Künste Stuttgart, Germany. Early in February **Janice Schopfer** was joined by paper conservators **Kim Nichols** and **Downey Manoukian** to work on a special project, the treatment of a mid-19th-c. California mining map that consisted of tracing paper that had shattered into thousands

of pieces. The innovative treatment included multiple facings using funori and rayon paper in the Japanese tradition. In March and April paper conservator **Melissa Potter** worked with Janice on another project involving the treatment of numerous mid-19th-c. drawings of California.

Zukor Art Conservation in Oakland has just finished a two-year project for a private library damaged in a fire, doing assessment, conservation, and re-housing for over 500 volumes. The current staff of **Karen Zukor**, **Janice Schopfer**, **Jamye Jamison**, and **Jennifer DiJoseph** now is immersed in the conservation of three large private collections of 20th-century art on paper.

Jamye, a recent graduate of Preservation and Conservation Studies at the University of Texas, Austin, has been at the lab since October, performing both book and paper treatments. Jennifer is completing a one year pre-program internship with Karen. They are aided by the very able **Macy Chadwick**, office manager and book artist. Macy is a recent graduate of the University of the Arts in Philadelphia, and teaches book arts at the Academy of Art University in San Francisco. The entire staff has been seriously pursuing an avocation in the consumption of fine chocolate, becoming quite knowledgeable in the nomenclature, manufacture, and procurement of international cocoa products. Available for consultation.

Regional Reporter:
Charlotte S. Ameringer

ARIZONA

Gretchen Voeks and **Brynn Bender** traveled the Colorado River in February to examine the condition of two wrecked historic river boats and provide the park with recommendations for preservation. Gretchen is also assisting the Dry Tortugas National Park with recommendations on the care and conservation

of a number of large outdoor objects. She recently completed the final treatment of the Channel Islands Fresnel lens. Brynn Bender, with assistance from **Audrey Harrison**, is conserving a collection of 75 prehistoric pots from Joshua Tree National Monument. Brynn taught a session on handling museum objects for the Department of Interior’s “Managing Museum Property” course.

Marilen Pool is working with the Tucson Museum of Art conducting a general preservation assessment of their Latin American collections through an NEH Preservation Assistance Grant.

Nancy Odegaard organized an XRF workshop funded by the NAGPRA Grant Program in January. Staff and students of the lab presented demonstrations at the 3 day Tucson Math and Science FunFest Event for about 5,700 school children. **Werner Zimmt** continues his pesticide mitigation experiments. **Dave Smith** is coordinating the lab’s FTIR research initiative. Intern **Maggie Kipling** worked on the Hopi Mural Project in Flagstaff and intern **Caitlin O’Grady** presented a program on manganese dioxide accretions at the Mata Ortiz! Adult Program.

Teresa Moreno attended the laser workshop at the Conservation Centre, National Museums Liverpool. **Melissa Huber** served as local arrangements coordinator for the BACC sponsored collections care workshops, and Nancy Odegaard and Teresa Moreno taught soft packing. They also gave a presentation on conservation collaboration in archaeology at the Society of American Archaeology meetings in Montreal.

A publication titled, *Textile Care and Preservation: A Manual for Owners and Museums*, written and illustrated by **Nanette Skov**, will be coming out at the end of April.

Regional Reporter:
Gretchen Voeks

WAAC Publications

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. Paper-bound and printed on acid-free stock.

Price, postpaid:
\$8.85 (\$6.60 per copy for orders >10 copies)

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

Nancy Odegaard
Conservation Section
Arizona State Museum
University of Arizona
Tucson, Arizona 85721

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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Site Stewards Help Preserve Arizona's Past

by Melissa J. Huber

The Arizona Site Steward Program developed as a statewide cooperative response to the destruction of fragile and irreplaceable archaeological resources. Formalized in 1988 with an intergovernmental agreement between the public land managers of Arizona and Tribal governments, the program relies almost entirely on the thousands of hours donated by trained volunteers. In 2003 alone, over 800 certified Site Stewards contributed 22,576.5 hours to monitoring approximately 2,000 prehistoric, historic, and paleontological sites.

The majority of Site Stewards are not professional archaeologists. They are concerned citizens who share a respect for the fragility of Arizona's prehistoric and historic resources and an interest in the preservation of cultural heritage. Volunteers are trained and certified by the State Historic Preservation Office and Archaeology Advisory Commission. Instruction takes place in the classroom and field and covers antiquity laws, site and feature recognition, map reading, and identification of looting and vandalism.

The program is designed to function on a local level with regional coordinators organizing Site Steward activities throughout the state. The primary activities of a Site Steward are site monitoring and recording site condition. Stewards agree to visit their assigned site at least quarterly, but many Stewards visit their sites as often as possible throughout the year. As archaeological resources are ever-changing and impermanent by nature, this continual, cyclical monitoring of sites is key to their successful preservation for future study, conservation, and interpretation. If looting, vandalism, or other damage is suspected, Site Stewards are responsible for recording evidence and reporting to the land managers for further investigation. Stewards report about one case a week, on average.

Site Stewards are also encouraged to participate in public education and outreach programs. The goal is to increase awareness of the significance and value of the state's cultural resources and of the damage caused by vandalism, looting, and the sale and trade of antiquities. Heightening public sensitivity to the potential loss of valuable heritage has, in turn, increased advocacy and participation within the community.

Preservation is not merely an end goal for the Arizona State Steward Program, but a means to facilitate cultural understanding at large. By taking a broader understanding of preservation as a systems-oriented process, the program provides an opportunity to involve the community intimately with its cultural heritage. In turn, the process fosters cohesiveness, cultural awareness, and a connection with Arizona's natural and cultural resources.

Since its inception, a number of institutions throughout the Southwest have subsequently modeled stewardship programs after the Arizona Site Steward Program including Los Padres National Forest in California, the Utah Bureau of Land Management, and developing programs in Nevada, New Mexico, and Colorado.

For more information on the Arizona Site Steward Program see www.azstateparks.com.

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Estes, Mary. 2004. Service Hours and Activity Log. Arizona WATCH. 14:1.

Hoffman, Teresa L. 1991. Stewards of the Past: Preserving Arizona's Archaeological Resources Through Positive Public Involvement. Protecting the Past. Southeast Archeological Center. <http://www.cr.nps.gov/seac/>.

Pollutants in the Museum Environment: Practical Strategies for Problem Solving in Design, Exhibition and Storage

The following is an excerpt from the book *Pollutants in the Museum Environment*. The book reviews much of the literature on the subject and includes discussions of: sources of pollutants; methods of testing (the section reprinted here); potential damage; construction materials used in the museum environment, from wood products to plastics; stable materials; protection of objects in enclosures; and the mitigation of pollutants. It is written for those who deal with the challenge of preventive conservation - this includes conservators as well as architects and designers, curators, collections care specialists, and collections managers.

Testing for Pollutants

In order to develop appropriate mitigation strategies, it is crucial first to identify the nature of pollutants present and their sources as well as the sensitivities to those pollutants of the materials found in the collection. A variety of testing methods have been used to identify pollutants in air and pollutants emanating from construction materials, as well as those produced by objects themselves. Numerous pollutants already described are present in the outdoor environment, and may easily find their way into buildings. Many pollutants are also generated within the building itself. Environmental testing is crucial to understanding whether a problem exists, and defining the nature of problems when they arise.

The production of storage, packing, and exhibition environments for works of art and artifacts in the museum community relies on a wide range of commercial materials used in industry. Even when the composition of these materials is known, they must be evaluated on an ongoing basis for their suitability in proximity to works of art, because commercial formulations often change without notice to consumers.

Testing of materials can pinpoint sources of problematic contaminants and prevent their introduction into the environment of works of art. Although testing methods overlap, testing goals can be divided into two broad groups: those that test the environment, and those that test materials. It is important to keep in mind that while volatile pollutants are capable of damaging works of art and artifacts without touching them directly, non-volatile contaminants make many materials unsuitable for direct contact. Some inherently acidic materials may not cause corrosion or other reactions in testing for harmful volatiles, but may cause staining, corrosion, acidification, or other damage on prolonged contact.

Some of the greatest problems encountered in this area concern lack of sophisticated equipment – which assists in pinpointing a problem, duration of sampling time, and difficulty in producing reliable results required for more generalized and less expensive methods such as the Oddy test

Environmental testing methods may be divided into several categories. The most sensitive and precise testing methods involve active sampling of the air, and require sophisticated

analytical methods. These methods are typically quite expensive, and the level of detail they achieve may not be required in many cases.

Active methods (also called dynamic methods), typically used in environmental testing, remove air from an area with a manual or mechanical pump; analysis is conducted in the pump by various methods of instrumentation such as gas chromatography, mass spectrometry, high-performance liquid chromatography (HPLC), and Fourier transform infrared spectroscopy (FTIR). Industrial testing methods for emissions from materials have typically used a closed chamber with a controlled air flow. A method using solid phase micro-extraction and gas chromatography/mass spectrometry has recently been adapted specifically for the detection of formic and acetic acid from construction materials used in conservation (Rhyll-Svendson 2000).

Other methods may collect samples using passive samplers but still require laboratory analysis. These methods require less scientific support, at least during the collection phase, and give precise results, but analyses still tend to be quite expensive, requiring the use of HPLC for example. Other types of passive monitors, such as Draeger tubes, are less sensitive but can be read directly, pollutant levels often indicated by visible color change within a short period of time. These monitors are specific for individual pollutants, so for example, a formaldehyde monitor will not indicate the presence of formic acid. Passive methods rely on the affinity of pollutants to sampling materials and usually require subsequent analysis of trapped contaminants or reaction products such as corrosion, although some passive methods incorporate testing within the device itself.

Accelerated techniques use test materials such as metal coupons or papers, in enclosures with materials at higher than ambient temperature and humidity. Spot tests rely on color change or observation of immediate reactions on samples of materials and often require that a sample of the material be sacrificed for the test. This is significant when considering direct testing of artifact materials.

ENVIRONMENTAL TESTING METHODS

In addition to environmental testing methods specifically designed or adapted for use in larger air spaces, some of the tests presented below for the identification of problematic materials can also be used for testing smaller environments such as display or storage cases, cabinets or rooms. These tests are generally fairly simple and inexpensive to conduct. While they may be able to identify areas in which a problem is present, they can only be used as very general indicators. Specialized methods requiring more sophisticated technologies and training are available for qualitative and quantitative measurements. These methods, of course, require more substantial funding as well.

A variety of environmental testing methods is available to test the levels of pollutants in the air in buildings, storage areas, or even in exhibition cases. A recently developed

method based on analysis of potassium hydroxide-treated diffusion tubes and subsequent analysis by ion-exclusion HPLC, identifies low levels of acetic acid and formic acid as well as formaldehyde (Gibson et al. 1997a: 1). Commercial acetic acid monitors only detect 300 ppb ($743.75 \mu\text{g}/\text{m}^3$) or greater, but more sensitive sampling methods have been developed that can identify formic acid and acetic acid levels as low as $10 \mu\text{g}/\text{m}^3$ (Gibson et al. 1997c).

Passive sampling devices have been used as a more economical alternative to active sampling methods. They use the same technology as active methods, e.g. with one method which uses 2,4-dinitrophenylhydrazine to trap carbonyl compounds, or bisulfite-coated papers which are then returned to the manufacturer for identification, using HPLC or chromatropic acid methods (Grzywacz 1993: 613).

Several atmospheric corrosion monitors have been developed to identify levels of corrosive agents in building environments. Purafil® has developed a product based on the measurement of tarnish layers on silver coupons called the Museum Silver 6 Pak® (see below). The Purafil OnGuard® 2000 Atmospheric Corrosion Monitor is a device which provides real time measurements of the accumulation of corrosion on copper and silver coupons due to pollutant levels.

THERMAL DESORPTION GAS CHROMATOGRAPHY-MASS SPECTROMETRY

In this method, volatiles are concentrated onto sorbent traps such as highly purified carbon. They are subsequently released in the gas chromatograph by the application of heat and separated into individual constituents, and are detected and identified by mass spectrometry (Landry et al. 1991). This highly sensitive method provides identification of the specific compounds emitted from the tested materials.

Headspace gas chromatography (American Society for Testing and Materials, ASTM 4526-85 1991) has also been used to detect volatile substances in polymers (Nicholson and O'Loughlin 1996).

DETECTOR TUBES

Detector tubes are used for the detection of a variety of gases and acids, including volatile acids and aldehydes. Air is forced into the tube by hand or using a pump, subsequent color change indicates ppm measurement of a specific pollutant. Each tube detects only the specific pollutant for which it is engineered, registering a color change in a sorbent inside the tube that reacts with the specific pollutant for which the tube is designed. They are of marginal use in the identification of pollutants in museums because they are designed to detect levels of pollutants significantly higher (on the order of 100 ppm) than those capable of causing damage to works of art. Although they can be used to detect lower levels of pollutants by increasing sampling time, in practice this is found to be impractical.

PASSIVE MONITORING SYSTEMS

Passive monitors rely on the affinity of a given pollutant for a substrate or adsorbent and the subsequent ability to extract, measure or otherwise evaluate the amount of pollutant or reaction product present. Those using sorbents allow gases or vapors to infiltrate the absorbing medium by molecular diffusion. The direct reading devices collect pollutants on adsorbents and results are immediately indicated, usually by a color change, on the detector. These are typically less precise and less sensitive than other methods which require subsequent analysis. These monitors trap vapors for later extraction and identification, and require that samples be sent to a laboratory for analysis.

Commercial direct reading passive monitors are capable of detecting pollutant levels 100 ppm or higher (Grzywacz 1995: 200), levels far higher than the threshold for potential damage to works of art. Some less precise but still informative methods involve the exposure of metal coupons or paper strips to atmospheres and subsequent evaluation of corrosion films or color changes. Some use visual assessment of surface alteration as an indication of pollutants, others use analytical methods such as ion chromatography (Tennent et al. 1993).

Passive monitoring devices have been subjected to extensive evaluation for their use in the field of preservation, and some have been recommended for use with formaldehyde and acetaldehydes (Grzywacz 1995). Recently, passive sampling methods using Palmes™ diffusion tubes have been adapted to monitor levels of acetic acid and formic acid in the museum environment (Gibson et al. 1997a: 1). These test methods are also available for sulfur dioxide, ozone, nitrogen dioxide, hydrogen sulfide, and carbonyl sulfide.

DIRECT READING DEVICES

This classification includes samplers that allow the immediate evaluation of the results of testing without requiring subsequent analysis by the manufacturer. They are available as dosimeter badges, detector, or diffusion tubes.

Dosimeter badges

Dosimeter badges are intended to be worn by individuals working in areas containing pollutants and are geared to indicate exposure levels generally above 100 ppb, because they focus on health effects. They may not be sensitive enough for museum applications, although various ways of increasing their sensitivity have been explored. Some dosimeter badges are direct read, but most require further analysis. In some instances, however, sufficiently sensitive measurements may be taken by modifying methods used with a dosimeter badge (GMD Systems Inc. 570 Series Formaldehyde Dosimeter™). This monitor for formaldehyde was able to identify levels as low as 0.2 ppb ($0.25 \mu\text{g}/\text{m}^3$) formaldehyde for a 24-hour exposure, even though its original range was from 5 ppb ($6.20 \mu\text{g}/\text{m}^3$) to 1500 ppb ($1859.68 \mu\text{g}/\text{m}^3$) formaldehyde (Grzywacz and Stulik 1991). Dosimeter badges require some airflow in order to achieve

Testing for Pollutants, continued

accurate results, and cannot be used in stagnant air spaces (Gibson et al. 1997a: 2).

Dosimeter badges were evaluated for use in detecting low levels of pollutants in the museum environment. These systems were originally designed for detecting higher levels in industrial settings in response to government and organization regulations (OSHA, also ASHRAE), and each detector only identifies a single pollutant. After sample collection, analysis is required, and dosimeters are typically sent back to the company producing them for determination of pollutant levels.

Diffusion tubes

Today, low level diffusion tubes are available for sulfur dioxide, nitrogen dioxide, hydrogen sulfide, ozone, and carbonyl sulfide. Diffusion tubes can be read directly for results, although industrially produced diffusion tubes have high detection limits. They provide a color change upon reaction with specific pollutants, and their sensitivity may be able to be extended by increasing the duration of exposure. Diffusion tubes have been used to identify high levels of sulfur dioxide and volatile acids in enclosed areas (Piechota 1992b). Unlike detector tubes, they do not require a mechanism for pumping air through them, and can be used for detecting lower levels of pollutants than detector tubes (on the order of 80-1200 ppb). They are inexpensive and useful for high level screening, but are problematic because of the potential for inaccurate results in mixed gas atmospheres, the light sensitivity of reactants, their rather wide margin of error, and their inability to register low levels of pollutants (Grzywacz 1995: 202).

A recent adaptation of the Palmes™ diffusion tube, originally designed to sample for nitrogen dioxide, has proven useful in the detection of low levels of acetic acid and formic acid. This method uses a tube sampler containing paper impregnated with 1M potassium hydroxide and 10% v/v (volume per volume) glycerine, which is exposed over a period of 1-2 weeks. Subsequent ion chromatography analysis can detect as little as 44 $\mu\text{g}/\text{m}^3$ acetic acid and 13 $\mu\text{g}/\text{m}^3$ formic acid (Gibson et al. 1997b).

Lower amounts of pollutants are detected by passive sampling methods rather than by active methods, a fact acknowledged by the EPA, which allows for as much as a 20-30% difference between results from the two methods (Grzywacz 1993: 613). Nevertheless, passive monitors that require laboratory analysis can detect much lower levels of pollutants. Direct reading methods are generally not sensitive enough for museum purposes, and the results may be inaccurate because of the sensitivity of the reactants to degradation.

Additional monitoring methods are under development. In one method, results can be obtained in as little as two weeks by exposing lead strips and borax-impregnated silica gel strips to wood products. Although no corrosion is visible to the eye, ion chromatography may be performed on the aque-

ous extracts of these strips, thereby quantifying the effects of formic acid and acetic acid generated from wood products (Tennent et al. 1997).

PURAFIL® SILVER ENVIRONMENTAL CLASSIFICATION COUPONS

One product, the Museum Silver 6 Pak™ was developed for the identification of corrosive agents in building environments based on the measurement of tarnish layers on silver coupons. The coupons, attached to a Plexiglas® support, are installed in areas where problems are suspected and then returned to the company, where the thickness of the corrosion layer is measured and evaluated in comparison to control coupons, using the Equipment Reliability Standard for electronic components (Instrumentation, Systems and Automation Society (ISA) S71.04-1985). Coupons are typically exposed for 90 days, with controls kept at the company headquarters for reference. Differences reported in the degree of corrosion which may be identified range from 7 μm in the control to 23 μm in an open hall, to as much as 178 μm thick after 56 days of exposure (Sease et al 1997: 2).

Interpreting the results of this test method can be problematic, and test coupons placed inside cases should be carefully compared to control coupons from outside the test area, because the equipment reliability standard only identifies the amount of corrosion which would impede the proper functioning of electrical equipment, and does not relate to the long-term or indefinite stability of an artifact. Test results may be returned with a large unknown component, as only limited information is returned to the testing site about the types of corrosion products found. The unknown component may indicate the presence of volatile acids and aldehydes from construction and fabrication materials.

TEST FOR ALKALINE ENVIRONMENT

Simple methods are proposed for the identification of problematic atmospheres in newly constructed buildings, including the use of linseed oil impregnated filter paper which changes color from pale yellow to dark brown on exposure to highly alkaline conditions in newly constructed concrete buildings (Kenjo 1986: 295). Color changes are quantified using a colorimeter. Although the wisdom of introducing even small amounts of drying oils into the environment has been questioned, this method is extremely simple and may identify problems in new construction at a very early stage.

Contaminants can also be monitored in the atmosphere inside buildings using pH-indicating solutions to determine whether acidic or alkaline conditions exist.

TEST FOR ACID OR ALKALINE ENVIRONMENT USING pH INDICATORS (KENJO 1986: 296)

Acid-alkali indicators, also called "color-changing test papers" (Kenjo 1986: 296-7), involve the use of a paper based pH indicator to indicate acid to alkaline conditions in exhi-

Testing for Pollutants, continued

Table 13 Test for acid/alkaline environment using pH indicators (after Kenjo 1986)

Color of strip	Red	Orange	Yellow	Yellow-green	Blue-green	Green	Blue
Ambient conditions	Acidic		Neutral			Alkaline	

bition, storage or enclosed environments. Kenjo states that testing by this method indicates that a newly constructed concrete building takes 18 months to achieve air quality similar to an unpolluted building, and two years to approximate test results of strips reserved in a clean-air environment, and that the linseed oil in paintings became denatured as a result of exposure to the alkaline environment found in a new concrete building (Kenjo 1986: 295).

0.5% glycerol solutions of chlorophenol red, bromothymol blue, bromocresol green, and phenol red are prepared, mixed together, and applied to filter paper. Strips of the paper are hung inside an enclosed space (gallery, display case, storage cabinet) and the color observed after 24 hours (see Table 13).

COLLOIDAL MANGANESE DIOXIDE METHOD FOR MONITORING AIR POLLUTION (LANGWELL 1976)

This extremely simple test is not specific for sulfur dioxide, but a variation on the method has been used to indicate the presence of sulfur dioxide (Hackney 1984: 108). It relies on somewhat subjective assessment of color changes upon comparison with a control sample to identify the presence of pollutants over a period of time. This can provide a graphic visual assessment of conditions for non-technical personnel who want to see evidence of the effects of pollutants in the museum environment. Colorimetric measurements could be taken to quantify results, but the method is relatively non-specific.

Table 14 Colloidal manganese dioxide test

Sample size	not applicable
Reagent preparation	<ul style="list-style-type: none"> • 2g potassium permanganate and 5g potassium acetate dissolved in 100cc distilled or deionized water • 3 dilutions of this solution, one full strength; one diluted by 10x, another by 100x
Procedure	<ul style="list-style-type: none"> • steep separate pieces of Whatman No. 1 filter paper in each solution • brown stain appears on drying • cut samples of each as a control and seal in Mylar envelope; retain in dark • cut samples of each for placement in galleries or enclosed spaces
Result	Most dilute sample will fade in several months; compare results in various air spaces with control over time.

ENVIRONMENT TESTING IN MINERALOGICAL COLLECTIONS

In mineralogical collections, the importance of identifying potential for damage from the interactions of mercury vapor from specimens, reduced sulfur gases and sulfur dioxide produced by pyrite and marcasite oxidation (pyrite decay) has been clearly delineated (Waller 1990: 25-6). Commercial test strips detecting sulfur dioxide (Quantofix sulfite ion test strip), hydrogen sulfide (Machery Nagel lead-acetate paper) and ambient acidity (Machery Nagel pH paper 0-6 pH) have been used. Mercury can also be detected by fabricating an indicating strip made from filter paper impregnated with palladium chloride. To identify low levels of hydrogen sulfide, an indicating strip can be made by soaking commercial lead acetate test paper in an aqueous solution of 1M sodium carbonate (Andrew et al. 1993:14).

MONITORING FOR PARTICULATE MATTER

Fine and total particle sampling devices employing automated scanning electron microscopy have been used to characterize particles in interior spaces (Nazaroff et al. 1993: 22-3). A new technique called helium microwave-induced plasma spectroscopy (He-MIPS) can rapidly examine particles measuring 0.5 μm to 10 μm in diameter. It is used specifically for identifying the source of dust contamination in buildings. Results are available within approximately an hour of sample collection (Anon. 1997b).

MATERIALS TESTING METHODS

Building materials have been tested by industry in a variety of ways since the 1960s when NASA initiated a program of emissions testing for materials considered for use in outer space (Hodgson and Pustinger 1966). Subsequent to this, composite wood products were tested for formaldehyde emissions as the US Department of Housing and Urban Development developed regulations which became standardized by the American Society for Testing and Materials (ASTM). Additional testing programs for carpeting have been developed by the Carpet and Rug Institute (CRI) resulting in "Green Tag" labeling. A modified version of the CRI protocol has been studied for standardizing the determination of emissions from materials and products used indoors (Levin and Hodgson 1996: 380). These methods primarily relate to the establishment of limits for volatile substances found to be harmful to human health, rather than to the sensitivity of works of art in enclosed environments.

The tests commonly used to identify materials which have the potential to react with the materials of art include both accelerated aging tests and tests that identify chemical com-

Testing for Pollutants, continued

pounds by means of a chemical reaction, often producing a change in color (see Table 28). Accelerated aging tests are often conducted at elevated temperatures, and inherently make the assumption that alterations seen at higher temperatures will appear at ambient temperatures after longer periods of time. The temperature at which these tests are usually conducted is 60°C (140°F), as chemical reactions caused at higher temperatures are not prevalent at or below this temperature.

The justification for accelerating test results by applying heat relates to the increase in reaction rates observed when temperature is raised. According to the Arrhenius reaction, a 10°C (50°F) increase in temperature increases many reaction rates by 2 to 6 times, depending on the activation energy of the reaction. Reaction rates have also been increased by adding water to tests involving silver and copper, and water and carbon dioxide to tests on lead coupons (Blackshaw and Daniels 1979: 18). The addition of carbon dioxide as originally proposed by Oddy to enhance corrosion effects on lead was identified as unnecessary in later refinements of the test protocol (Green and Thickett 1995: 147).

TESTING FOR VOLATILE POLLUTANTS

The classic test for detection of potentially harmful volatiles in the museum environment remains the Oddy test (Oddy 1973), spontaneously named for the British Museum's Keeper of Conservation, who adapted it to museum use. Its value lies precisely in its non-specificity, allowing it to identify a wide range of materials which might damage works of art in enclosed spaces.

The test was suggested by W. Andrew Oddy at the British Museum in 1973 as a method for detecting materials which had the potential for damaging works of art and artifacts. It involved sealing cleaned pieces of lead and silver foil in a glass flask for four weeks with the test samples and visual evaluation of changes in the metals when compared to a control. Over the years, the test has been modified to include a source of humidity, and various attempts have been made to standardize the results of the testing procedure.

Its other primary advantages are its simplicity, low cost, and low equipment requirements. Damaging compounds, however, are not specifically identified by this method, and reproducible results have been difficult to achieve. Furthermore, alloyed metals react differently to environmental agents than the pure metals used in this test method - e.g., the inclusion of tin in some leaded alloys was observed to have a protective effect, whereas silver alloys have been observed to corrode more rapidly than purer metals (Blackshaw and Daniels 1979: 18). In general, this phenomenon certainly relates to the position of the metals in question in the electromotive series, but certain materials such as silver, which are high on the electromotive scale, remain more sensitive to some environmental compounds than others.

Numerous modifications of the test method have attempted to deal with the difficulties of visual assessment of the severity of corrosion and to standardize results. In spite of all

of this, the Oddy test continues to be used in conjunction with more sophisticated and specific testing methods because it detects the effects of a wide range of potential hazards to the materials of art and artifacts. Early variations included methods for testing adhesives and paints by applying them to glass rods which rested above a reservoir of water on glass wool in test tubes stoppered with polyethylene (Hodges 1982:58). Also, the purity of the silver (and presumably the other metals used in the test as well) has been the subject of some inquiry. In an effort to standardize the method, the use of AnalaR® metal foils (minimum 99.5% purity) 0.1mm in thickness has been recommended, together with guidelines for sample and test preparation. Some discussion has taken

Table 15 The Oddy test

Sample size	2g
Reagent preparation	10 x 15mm coupon cut from 0.11mm thick silver, copper and lead metal foils of 99.5% purity or greater
Procedure	<ul style="list-style-type: none"> • Abrade surfaces of coupons with glass bristle brush, one brush dedicated to each type of metal, see p. 63 and Stavroudis (1997, 1998) concerning lead hazards • Pierce hole in a corner of metal coupon, suspend coupon from nylon monofilament maximum diameter 0.053 mm • Degrease coupon with acetone • Place 50mm glass in boiling tube with ground glass stopper: the sample and a 0.5ml test tube filled with distilled water and stoppered with cotton wool • Suspend coupon in boiling tube by catching monofilament in ground glass stopper • Seal stopper by wrapping with 15mm heat-shrink tubing shrunk on with hot air blower • Provide control for each type of metal used • Incubate in oven at 60°C for 28 days
Result	Observe and classify corrosion by comparing to control: no change = P (suitable for permanent use); slight discoloration = T (suitable for temporary use); clearly visible corrosion or loss of polish = U (unsuitable)
Problems	<ul style="list-style-type: none"> • Extended time required for testing • Alloys may corrode differently from high purity metals. Relies on subjective visual determination of degree of alteration, and standardized lighting for evaluation; white card held at 60° angle to horizontal test coupon may improve visibility

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place regarding the greater applicability of results using debased alloys such as sterling silver, which might more accurately reflect the composition of museum artifacts (Lee and Thickett 1996; Thickett 1998).

Fine silver contains at least 99.5% silver. Sterling silver 92.5% and 7.5% copper while 800 Alloy contains 80% silver, 20% copper. Typical levels of impurities for 18th- and 19th-century silver average 0.2% gold, 0.3% lead and 0.1% zinc. It is likely that these impurities play a significant role in the sensitivity to corrosion of silver alloy objects and that significant zones of copper appear in less pure modern silver as well as in older artifacts (Lins and McMahon 1993). The reactivity of silver alloys with sulfur seems to peak at about 7.5% copper, the amount present in Sterling silver. The question has been raised as to whether debased silver should be used for such tests in order to more accurately represent the composition of artifacts.

Other methods related to the Oddy test in that they involve exposure of lead to volatile acids include a method which measures the rate of atmospheric corrosion caused by wood products and other potentially corrosive materials in microclimates. Lead coupons suspended from an automatic balance are exposed to volatiles evolved from wood or wood products in enclosed environments at 50°C and 80% RH and the mass of anions and cations formed by corrosion are compared (Bemdt 1990).

The method proposed as a standard by Green and Thickett (1995) forms the basis for the Table 15 description of the Oddy test, although many institutions using their own consistent standards of preparation and materials over a long period of time have created an important body of knowledge relative to the materials tested. The Boston Museum of Fine Art uses a variation of the British Museum standard for the test outlined in Table 15. Three test coupons are suspended from monofilament in each test tube, and Teflon tape is used rather than heat-shrink tubing.

ELECTROCHEMICAL TESTING

Electrochemical testing is used in the manufacturing industry for determining the compatibility of materials considered for use in conjunction with metals. It simulates the corrosion behavior of a metal in association with a test material. This method has the potential to replace the subjective, visual assessment of degree of corrosion associated with the Oddy test in the evaluation of material suitability. Industry has typically used weight change instead to quantify corrosion in similar testing methods (Donovan 1986: 215).

The ability of a metal to resist corrosion in a certain environment is referred to as its polarization resistance. The current flowing between the metal and an electrode is measured and translated into the rate of corrosion of the metal by the test material. This method quantifies the polarization resistance for specific metals as a measure of their corrosion rate in milli-inches (mils) per year. The equipment for this procedure includes a Gamry Instruments Corrosion Measurement System™ consisting of two potentiostatic boards in a

computer attached to a test cell containing the test material, an inert counter electrode and a reference electrode (Reedy et al. 1998). Water extraction of pollutants was the most effective preparation for samples tested, and in general, the degree of corrosion corresponded to that seen in Oddy and other visual tests: highest for lead, then copper, then silver. Corrosion rates are measured in mils per year, and in trials of this technology with commonly used materials ranged from 0.05 mils (Plexiglas®) to 8.16 mils per year for oak. The determination of acceptable standards remains an unsolved issue, however, until corrosion rate scales can be determined for a range of materials.

PHOTOGRAPHIC ACTIVITY TEST

The Photographic Activity Test (PAT) is designed to identify chemical interactions which might occur between materials used for photographic enclosures and the photographic materials themselves. Samples are placed in direct contact with indicators and subjected to accelerated aging to determine whether interactions may occur. The test is an ANSI/NAPM Standard Test (ANSI NAPM IT9.16-1993) and an International Standards Organization Standard (ISO 14523-1999). The Image Permanence Institute (IPI), Rochester Institute of Technology, performs this test.

A-D (ACID DETECTION) STRIPS

A-D (acid detection) strips were developed by the Image Permanence Institute (IPI) for use in the identification of acetate film deterioration. Prior to the introduction of these strips, the only way to detect the deterioration of film was by the characteristic vinegar smell of acetic acid produced in the deterioration of cellulose acetate. Commercially available indicators intended for the detection of the deterioration of acetate-based films were evaluated by the conservation field, including products incorporating pH sensitive dyes on silica gel and paper substrates. These included Dancheck®, which probably uses bromocresol green dispersed in silica gel, and Film Decay Detector®, which uses paper as the substrate (Fischer and Reilly 1995).

This technique was refined for greater sensitivity and developed into the well-known A-D strips for the identification of deterioration of acetate-based films. The developers of this technique won an Academy Award in 1998 for their contribution to the preservation of the history of the motion picture industry. The usefulness of A-D strips for detecting problems with nitrate films seems promising, but the IPI advises caution in relying on results for other materials. Although originally developed as an indicator for the deterioration of acetate films (IPI 1995), A-D strips have been used increasingly because of their simplicity to indicate the presence of a range of volatile gases evolved from display and storage materials (as an indicator of volatile acidity only; different tests are required for materials intended for direct contact with artifacts). The test is considered semi-quantitative, giving only an approximation of the amount of volatile acid released. Although A-D strips provide a very quick method of identification of acidic materials, which should not be enclosed with or in proximity to works of

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art, they do not identify alkaline substances or the presence of other harmful agents such as sulfur. A-D strips can be placed in a closed container or a new heavyweight polyethylene bag with the material to be tested, kept in the dark and monitored for color change; a control (identical container including test strip but without test sample) should always be used for comparison. They should be handled only with clean gloves or tweezers, not with bare hands (Nicholson and O'Loughlin 1996: 83-5).

A-D strips should not be used as indicators of the quality of the environment in a room because the adsorption of atmospheric carbon dioxide will over time produce a false positive result, and exposure to light will fade the strips.

Table 16 A-D strip test for the detection of volatile acetic acid

Sample size	<ul style="list-style-type: none"> • Variable
Reagent preparation	<ul style="list-style-type: none"> • A-D strips, using bromocresol green as an indicator for acetic acid; available from Image Permanence Institute (for in-house indicators, see Materials L distribution list, 17 March 1997, D. Nishimura of IPI) • RH should be about 50% • Color range indicator provided by IPI
Procedure	<ul style="list-style-type: none"> • Place A-D strip in enclosure such as film can, glass vessel or new, heavy weight polyethylene bag • Do not expose to light • Evaluate results in 24 hours • Use control; 2 controls if using bag for testing, one in glass vessel • A-D strip should not touch sample material
Result	Compare results to indicator provided by IPI; blue above pH 5.4 indicates stable material; green below 5.4 indicates change; yellow at 3.8
Problems	<ul style="list-style-type: none"> • Use presently only recommended for evaluation of acetate film products • Light sensitive • Low RH or temperature reduces response time (below 30% RH or below 15°C/60°F) to 4 days; below freezing, requires 1 week • Must be evaluated promptly; strip color reverts to blue soon after removal from confined space • Does not identify alkaline or sulfurous agents

pH PAPER VOLATILE ACID TEST

This test was developed by Walter Hopwood (1979) at the Smithsonian Center for Materials Research and Education (SCMRE) to identify materials that contained volatile acids. An alkaline substance is applied to pH indicator paper and enclosed in a glass test tube with the material to be evaluated at 50°C. If acids are present, the alkaline substance is neutralized and the pH paper indicates their presence.

Table 17 pH paper volatile acid test

Sample size	1g
Reagent preparation	<ul style="list-style-type: none"> • Distilled water boiled to remove CO₂, protected with soda-lime tube while cooling and stored; or keep 2 liters of distilled water in 4 liter bottle with CO₂ absorbing cartridge in stopper • pH indicator paper range 1-11 sprayed with limewater (barely wet); paper indicates pH 10. 2 strips prepared (one for blank)
Procedure	<ul style="list-style-type: none"> • 1ml of the prepared water (pH 6-7) is added to the bottom of test tube • Place small amount of glass wool in tube to prevent sample from sitting in water, then place sample on top of glass wool • Secure indicator strip to glass vial with straight sides fitting loosely in test tube with one end inside glass vial, the other secured by Teflon® tape on the outside • Insert inverted glass vial into test tube, securing it by pressure fit with Teflon® tape • Seal with Teflon® stopper, secured with Teflon® tape • Incubate in 50°C oven over tray of water
Result	pH falls rapidly if volatile acid is present
Problems	<ul style="list-style-type: none"> • Complicated setup • Blank test pH falls to pH 8 in 1 to 5 days, depending on variations in assembly

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GLYCERIN pH TEST FOR VOLATILE ACIDS

This test is intended to identify volatile acids in enclosed environments using pH paper applied with a glycerin (glycerol)/water mixture which will approximate an RH of 50% on the test strip. This hygroscopic mixture will adsorb volatile acids, producing a color change in the pH paper. Narrow range pH papers are recommended for better accuracy; the author recommends pH range of 4-7. pH readings can be calibrated to concentration curves for acetic acid and corresponding zones of deterioration potential: low = pH 7.0-5.0 (< 1000 ppb/2479.16 $\mu\text{g}/\text{m}^3$); moderate = pH 5.0-3.5 (1000-10,000 ppb/2479.16- 24791.60 $\mu\text{g}/\text{m}^3$); high: pH <3.5 (> 10,000 ppb/24791.60 $\mu\text{g}/\text{m}^3$) (Tetreault 1992). Some authors have identified damage at levels far below this, on the order of 100 ppb (249.7 $\mu\text{g}/\text{m}^3$) acetic acid (Brokerhof and van Bommel 1996: 769).

Table 18 Glycerin pH test for volatile acids

Sample size	“Proportional” to size of container
Reagent preparation	<ul style="list-style-type: none"> Mix solution of 20ml deionized or distilled water and 80g glycerin glass container and inert, well sealed top (no cardboard or adhesive)
Procedure	<ul style="list-style-type: none"> Apply glycerin solution to pH indicator paper, preferred range pH 4-7; use two or three strips for each test Suspend indicators in jar over test material; indicators should not touch container or sample Prepare control without sample After 24 hours, observe color change in indicator paper
Result	Read pH value for indicator paper
Problems	<ul style="list-style-type: none"> Glycerin in poorly sealed containers, or old glycerin may not be neutral in pH Neutral pH is rarely indicated because of atmospheric acidification by the presence of carbon dioxide Results are limited to 50% RH pH values achieved must be converted by calibration to concentration; more than one volatile acid may be present Quantification is difficult at low and high levels of volatile acid, or if mixtures of acids are present Readings may be distorted because indicators can be bleached by concentrations of formic acid >5000 ppb (9501.73 $\mu\text{g}/\text{m}^3$).

IODIDE-IODATE TEST FOR VOLATILE ACIDS

The iodide-iodate test was adapted from Feigl (1954). Volatile acids react with iodide and iodate ions to produce a blue iodine solution in the presence of starch (Zhang et al. 1994).

Table 19 Iodide-iodate test for volatile acids

Sample size	2g or larger
Reagent preparation	<ul style="list-style-type: none"> 2% solution of potassium iodide (KI) in distilled water weight by volume (w/v) 4% solution of potassium iodate (KIO₃) in distilled water (w/v) 0.1% solution of soluble starch (w/v)
Procedure	<ul style="list-style-type: none"> Place 2g of sample being tested in bottom of reaction flask Put two drops of each of the solutions into 2mm deep reaction dish Place reaction dish in flask Place stoppered flask in oven at 60°C Examine after 30 minutes.
Result	Blue color of solution indicates positive test for volatile organic acids.
Problems	<ul style="list-style-type: none"> Higher temperature may volatilize acid too quickly for reaction to occur Excessively small sample may not produce acids in sufficient quantity for reaction to occur Potassium iodide solution must be < 2 weeks old; potassium iodate < 8 weeks old, but may gel, requiring redissolution by warming.

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CHROMOTROPIC ACID TEST FOR FORMALDEHYDE

The chromotropic acid test (West and Sen 1956; Zhang et al. 1994) relies on the diffusion of free formaldehyde into a solution of chromotropic acid (1,8-dihydroxynaphthalene-3,6-disulfonic acid), producing a purple solution in the reaction dish. This test is adapted for qualitative use from a quantitative test.

Table 20 Chromotropic acid test for formaldehyde

Sample size	2g or larger
Reagent preparation	<ul style="list-style-type: none"> • 1% solution of chromotropic acid (w/v) in concentrated (97%) H₂SO₄ (w/w) • Store this solution below 4°C and use within 2 days
Procedure	<ul style="list-style-type: none"> • Place 2g of test material in reaction flask • Place 0.2ml (10 drops) chromotropic acid solution in reaction dish • Place reaction flask in 60°C • Examine after 30 minutes
Result	<ul style="list-style-type: none"> • Purple color of solution indicates positive test for formaldehyde
Problems	<ul style="list-style-type: none"> • Dangers of working with concentrated acids • Limited shelf life and special storage conditions for reagents • Chromotropic acid is toxic

SODIUM AZIDE/IODIDE TEST FOR SULFUR

The sodium azide test (Daniels and Ward 1982) identifies the presence of easily reducible sulfur in materials. Sulfur-containing groups cause catalytic decomposition of sodium azide/iodine solution, resulting in the evolution of nitrogen gas bubbles. The rate at which nitrogen gas is evolved indicates the severity of tarnishing which can be expected.

The test does not detect more stable sulfur-containing groups such as sulfates, sulfites or sulfonic acids or their salts (Feigl and Anger 1966). The advantages are that this test can quickly identify materials containing reducible sulfur, but it is recommended in conjunction with the Oddy test because other corrosive compounds may be present which will not be identified with this specific test. This test is done at 40x magnification with transmitted light.

Although this test is extremely useful in the identification of sulfur-containing materials that should not be used in proximity to works of art, problems with false positives were noted in attempts to reliably identify keratinaceous materials under archaeological field conditions (Wellman 1997). These problems were attributed to the highly specific nature of the test, which was designed to identify certain solid or dissolved inorganic sulfur compounds and organic sulfur functional groups, including the disulfide link in keratin.

The reducible sulfur test (ASTM 2001) is specific for sulfur impurities in paper. This and the paper tarnish test (ASTM 1998) are felt to be impractical for conservation needs. For the storage of photographs, the following test is presented for identification of materials selected that can tarnish silver (Collins and Young 1976).

Table 21 Sodium azide/iodide test for sulfur

Sample size	Typically fibers, at least 2mm strands, or 200 micron particles of solid materials
Reagent preparation	<ul style="list-style-type: none"> • 3g sodium azide • 0.05M iodine solution (20g/l potassium iodide plus 12.7g/l iodine) • methylated spirits
Procedure	<ul style="list-style-type: none"> • Dissolve 3g sodium azide in 100ml 0.05M iodine solution • Add 3ml industrial methylated spirit • Let stand 30 minutes before use • Place sample on microscope slide under coverslip • Introduce drop of reagent at edge of coverslip, until sample is saturated • Observe at x20 or greater for 2 minutes
Result	Evolution of nitrogen bubbles indicates the presence of reducible sulfur; No bubbles: suitable for permanent use; Gradual formation of several bubbles: suitable for temporary use only; Immediate and vigorous bubbling: unsuitable (Lee and Thickett 1996 after Daniels and Ward 1982)
Problems	<ul style="list-style-type: none"> • Toxicity of sodium azide • Subjective evaluation of severity of results, especially in "slight" and "negligible" categories

Testing for Pollutants, continued

Table 22 Test for materials that can tarnish silver (after Collings and Young 1976)

Sample size	20 x 20mm
Reagent preparation	0.01M hydrochloric acid
Procedure	<ul style="list-style-type: none"> Polish with alumina a 20 x 50mm strip of plate silver, wash in distilled or deionized water with a little ammonia, rinse with acetone Saturate material to be tested with 0.01M hydrochloric acid and place in direct contact with half of silver strip Place silver and sample on #3 Whatman filter paper in petri dish lid, weighted with 3 microscope slides Place petri dish base in lid and inject 2ml distilled or deionized water Incubate at 75 °C for 8 hours, injecting 2ml distilled or deionized water after 4 hours If no tarnishing after initial test period, continue for 2 additional 8-hr. periods
Result	Tarnishing in vicinity of sample if material is unsafe
Problems	<ul style="list-style-type: none"> Migration of tarnishing chemicals from test sample to blank area; use a test blank to ensure accuracy Problems with use of hydrochloric acid and high temperature Non-specific results - may be a benefit

BEILSTEIN TEST FOR CHLORINE

The Beilstein test (Williams 1986) for chlorine is a burn test, which in the presence of chlorine, produces a characteristic green flame. It is used to identify PVC plastics found in tubing, coin, slide and photo sleeves, and many other products.

Table 23 Beilstein test for chlorine

Sample size	Not significant
Reagent preparation	Heat copper wire until flame is clear, indicating impurities have burned off
Procedure	<ul style="list-style-type: none"> Under low light, heat wire to red heat and touch to test material Immediately return wire to flame and observe color of flame Use caution; cellulose nitrate may burst into flame Variations on this test method to increase sensitivity

Result	Green or blue-green flame indicates the presence of chlorine
Problems	<ul style="list-style-type: none"> False positive result may be obtained due to residues from handling Sample may volatilize too quickly to react with copper wire; see variations on test method (Lee and Thickett 1996: 25)

TESTS FOR CELLULOSE NITRATE

The following two tests for cellulose nitrate are conducted when attempting to identify the presence of cellulose nitrate as a constituent of artifacts, where taking a small sample is possible, or may be used when attempting to characterize materials considered for use in display or storage. The sulphonephthalein test identifies nitrogen dioxide which is released from cellulose nitrate when it deteriorates. This test is particularly useful in the identification of unstable artifacts which may show no visible signs of deterioration.

Table 24 Diphenylamine test for cellulose nitrate (Williams 1988b)

Sample size	Scraping or chip smaller than pinhead; can be microscopic if test conducted under magnification
Reagent preparation	0.5% diphenylamine in 90% sulfuric acid, prepared by slowly adding 90ml concentrated sulfuric acid to 10ml water while stirring, then adding in small portions to 0.5g diphenylamine. TEST SOLUTION IS EXTREMELY CORROSIVE. Store only in polyethylene, polypropylene, or glass containers; other materials will corrode
Procedure	<ul style="list-style-type: none"> Place sample on glass or porcelain slide or spot plate Place single drop of reagent on sample using a dropper Observe color
Result	<ul style="list-style-type: none"> Blue-violet color on sample indicates presence of cellulose nitrate Colors other than blue-violet, or no color indicate negative result
Problems	<ul style="list-style-type: none"> Test reagent is extremely corrosive and dangerous to prepare; take adequate precautions and follow safety rules for handling strong acids Extreme sensitivity of test may give false positives due to presence of traces of coatings or adhesives Inconsistent results have been reported by some researchers, who favor other concentrations of the reagents used (Coxon 1993: 404)

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Table 25 Resorcinol test for cellulose nitrate (Reilly 1991: 157)

Sample size	Scraping or chip smaller than pin head; can be microscopic if test conducted under magnification
Reagent preparation	Concentrated sulfuric acid
Procedure	<ul style="list-style-type: none"> Place sample on glass or porcelain slide or spot plate Digest sample in concentrated sulfuric acid Add small amount resorcinol Observe color
Result	Purplish-blue color indicates presence of cellulose nitrate
Problems	<ul style="list-style-type: none"> Test reagent is extremely corrosive and dangerous to prepare; take adequate precautions and follow safety rules for handling strong acids Extreme sensitivity of test may give false positives due to presence of traces of coatings or adhesives

CRESOL TEST FOR NITROGEN DIOXIDE

Cresol red (o-cresolsulphonophthalein) or Cresol purple indicators are used for the detection of nitrogen dioxide from decomposing cellulose nitrate (Fenn 1995a). Alcohol or water solutions are used to impregnate non-buffered filter paper which is cut into strips and placed in the vicinity of artifacts. The paper registers distinct color changes on exposure to nitrogen dioxide. Other pollutants (including camphor and volatile acids) do not seem to interfere with the results of this test, and the test will identify potential problems with cellulose nitrate objects before signs of deterioration are visible. The dyes appear light stable and can be used on paper-supporting objects adjacent to them to indicate problems over a long period of time.

In one study (Zhang et al. 1994: 50), the combined results of the iodide-iodate test with the chromotropic acid test identified the same range of problematic materials as the Oddy test. The use of these two tests in conjunction with one another will not identify all substances known to cause reactions in the Oddy test, and should not be assumed to be a substitute for broader range assessment.

Certain materials evolving ammonia, or some components of adhesives such as phenol will not produce positive results in either of these two tests, whereas they will be observed to induce changes in samples in the Oddy test (Evans 1937: Oddy 1975). Although the simplicity of the Oddy test has much to recommend it, when severe constraints are placed upon the duration of the test period, the benefits of using these spot tests are undeniable. Nevertheless, the dangers of

working with concentrated acids and the importance of using fresh reagents should not be underestimated. The chromotropic acid will identify materials which do not appear to cause corrosion in Oddy tests.

Table 26 Sulphonophthalein test for nitrogen dioxide

Sample size	Variable
Reagent preparation	<ul style="list-style-type: none"> Aqueous solution (0.04% w/v) of Cresol red or purple OR Alcohol solution (methanol or ethanol denatured with 10% methanol; 0.005% w/v) of Cresol red or purple
Procedure	<ul style="list-style-type: none"> Dip non-buffered filter paper into solution, tapping off excess Paper turns yellow; let dry Place in enclosure with object or sample to be tested; may also be used in storage or display environments Observe color change within approximately 24 hours; response time is shorter for alcohol solution
Result	Color change
pH range Cresol red	0.2 1.8 8.8
Color change Cresol red	pink yellow reddish orange purple
pH range Cresol purple	1.2 2.8 9.0
Color change Cresol red	red yellow purple
Problems	<ul style="list-style-type: none"> No safety information is available about the indicators Toxicity of methanol if using alcohol solution

TEST FOR ACETATES

Table 27 Test for the presence of acetates (Coxon 1993: 406)

Sample size	Shaving or chip
Reagent preparation	<ul style="list-style-type: none"> Solution of 6% potassium hydroxide in methanol (a) Saturated solution of hydroxylamine hydrochloride in methanol (b) Solution of 1 % ferric chloride in water (c) Solution of 10% HCl(d)

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Procedure	<ul style="list-style-type: none"> Place sample in test tube. Add 1ml of solution (a), then 1-2 drops of solution (b). Shake gently and leave to stand for at least 3 minutes Add 1 drop solution (c); shake Add up to 25 drops of solution (d) drop by drop, shaking gently after each addition, until color change is observed
Result	<ul style="list-style-type: none"> Burgundy red color indicates the presence of cellulose acetate or poly-vinyl acetate Pale purple-red is dilute positive, cyanoacrylate, or cellulose nitrate; repeat with smaller quantities of reagents to get strong positive Pale yellow is negative result
Problems	<ul style="list-style-type: none"> Requires preparation and handling of corrosive reagents

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Table 28 Accelerated aging and spot tests use

Chemical species	Test	Method	Duration	Advantages/disadvantages
Volatile acids, sulfur, others	Oddy	accelerated aging, corrosion	28 days	identifies wide range of pollutants/ not specific/ long duration
Volatile acids	iodide-iodate	colorimetric	<1 day	small sample size may give false negative; reagents have limited shelf life
Acetic acid	A-D strips	colorimetric	<1 day to 1 week	light sensitive; sensitive to carbon dioxide
Acetates	potassium hydroxide/ hydroxylamine hydrochloride/ ferric chloride/ HCl	colorimetric	<1 day	corrosive reagents/ complicated
Volatile acids	pH paper test	colorimetric	<1 day	complicated setup
Volatile acids	glycerine pH	colorimetric	24 hours	test limited to 50% RH; CO ₂ interference
Formaldehyde	Chromotropic acid	colorimetric	<1 day	extremely sensitive/ reagents have limited shelf life
Chlorine	Beilstein	flame/ colorimetric	<1 day	sensitive; false positives/ may volatilize too fast
Sulfur	sodium azide	microscope; evolution of bubbles	<1 day	subjective interpretation of low level results; toxicity of reagents
Sulfur/ silver tarnishing materials	Collings and Young test	accelerated aging/ tarnishing	8-24 hours	migration of reagents possible; non-specific
Cellulose nitrate	resorcinol	colorimetric	<1 day	very corrosive; extreme sensitivity may cause false positives
Nitrogen dioxide	sulphonephthalein	colorimetric	24 hours	toxicity?

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Book Review

Gem and Ornamental Materials of Organic Origin

Mary Campbell Pedersen, Elsevier Butterworth-Heinemann, Oxford, 2004

Pedersen presents a useful guide for identifying organic materials that have been used as gems and other forms of ornament. Her book fills a void in the gemological literature, in which materials such as amber, jet, bone, ivory, horn, tortoiseshell, pearl, shell, and coral have been typically underrepresented. Information about these very disparate materials is assembled here in a single source.

The book is organized in encyclopedic format with each chapter dedicated to a different material. The identification methodology is based on visual examination and limited low-tech testing such

as UV exam, hot needle test, and density measurement in a saturated salt solution. Descriptions of the materials' origins and history of use provide further framework for their understanding. Other useful information includes the conservation status of the materials, as many derive from endangered species and are subject to trade restrictions.

Pedersen draws attention to materials that are commonly mistaken for the gems discussed. As many of these materials were not intended to deceive, she uses the term "simulants" rather than "fakes." Early examples include rubber, plastic, and wood-based simulants of jet, including vulcanite, bakelite, and bog oak. Up-to-date descriptions of contemporary methods for simulating amber with plastics or natural resins are a valuable guide for distinguishing fakes.

This is also a rare source for information on more esoteric materials such as rhinoceros horn, insect wings, hornbill ivory, fossilized mollusks, shagreen, gutta percha, and bois durci.

One drawback of the text is the absence of footnotes. However, a bibliography is provided. Also included are a set of Quick Reference Charts for each category of material and a glossary of terms.

This book is a very good introduction to organic gems that is supported by excellent photographs. It is not intended as a scientific resource. No spectra or refractive indices are provided. Rather, the author relies heavily on subjective criteria for identification. This is by no means a negative quality. On the contrary, Pedersen shares information that she has amassed during many years of practical experience. She provides a solid general overview for each material along with peculiar observations that would not be common knowledge for the average reader. It does not claim to be comprehensive or without errors. There is some tendency to anecdote and generalization, particularly in the historical sections, but a degree of this is to be expected in such a concise overview.

A very good reference for the identification of organic gems and an interesting read in its own right. Odile Madden

Articles You May have Missed

Susanne Friend, column editor

“Many Iraq Artifacts Recovered, Many Archaeological Sites Plundered,” *University of Chicago Chronicle*, April 19, 2004.

A year after the Iraq National Museum was looted, many of its artifacts have been recovered. But in terms of archaeological losses, the looting of the museum may well be dwarfed by the continual destruction of archaeological sites all over Iraq by looters.

This looting has touched upon well-known sites such as Nippur, home of an archaeological expedition of the Oriental Institute, Umma, Lagash, and Isin, but many more unexcavated sites are destroyed by the unsystematic onslaught of pick axes used by the looters throughout the country.

The loss in archaeological data is impossible to quantify but clearly has reached disastrous dimensions. Although coalition forces have taken measures to protect some of the key sites in Iraq, archaeologists contend those measures have been inadequate.

“John Kerry’s Share In A Dutch Master,” *Boston Globe*, April 20, 2004.

Senator John Kerry’s biggest source of income after his Senate salary last year was the sale of a Dutch master painting.

Kerry’s wife Teresa Heinz Kerry and her first husband, the late Senator John Heinz, were famous art collectors, specializing in 17th-century Dutch works, primarily still lifes. Kerry, too, has become quite knowledgeable about art during his second marriage.

“He’s fairly intellectual,” one dealer noted, admiringly.

“The French Police Picasso,” *BBC*, April 19, 2004.

French police are releasing their files on Pablo Picasso. Documents show that Picasso was spied on initially as a suspected anarchist, and later over his communist sympathies - before he became a prominent member of France’s Communist Party.

“Science - Unraveling Giorgione’s Mind,” *The Economist*, February 26, 2004.

A group of nine Giorgione paintings have been examined with new scientific techniques reveal much about

how the artist worked. What has become clear with the infra-red discoveries is that Giorgione was a radical modernist when he drew.

Giorgione doodled as he worked out compositions, just like 20th-century artists. But why did Giorgione, “the modernist,” paint such free and fanciful images only to delete them or adapt them into more restrained ones?

“Plan To Double Size Of Uffizi,” *The Guardian (UK)*, February 26, 2004.

Florence plans to double the size of the Uffizi Gallery, and Italy’s culture minister boasts the new gallery will rival the size of the Louvre.

By the time work is completed, visitors to the extensively remodelled Uffizi will be able to see 800 new works, including many now confined to the gallery’s storerooms for lack of space.

“Keep Focused - Tracking Down Looted Iraq Art,” *Christian Science Monitor* February 20, 2004.

Last year Col. Matthew Bogdanos led the US team trying to recover art looted from the Iraq National Museum.

Now, after recovering more than 4,000 stolen artifacts, Bogdanos’s team is in shambles, its members recalled to other projects, or done with their tours of duty. The Marine colonel himself will be returning to civilian life at the end of March.

So this winter he’s touring the world, pleading with government officials, military experts, and antiquities specialists to continue his effort to recover more than 9,000 missing treasures dating back to the birth of city life, the invention of written language, the world’s first laws.

“Iraqi Museum Workers Come To US,” *Washington Post*, February 23, 2004.

A group of Iraqi museum professionals will be coming to the US to study conservation and restoration techniques.

Scholars at the Smithsonian have been discussing for months how to assist their colleagues, especially those at the Iraq National Museum of Antiquities in Baghdad, which was ransacked after the fall of Saddam Hussein’s dictatorship last April.

“The best way is through a practicum, where we can help establish practical methods of conservation, registration, and preservation,” said the museum conservators.

“Debating The Tunnel Through Stonehenge,” *The Guardian (UK)*, February 19, 2004.

The approach to Stonehenge is a miserable affair. So there’s a proposal to dig a tunnel to remove cars from the immediate area. But there’s controversy about the tunnel, so an inquiry’s being held.

Although the proposed tunnel will take the road out of sight of the stones, its entrance portals will still be within the Stonehenge world heritage site, which many archaeologists regard as one vast, man-made, sacred landscape.

The inquiry will pitch the partners in the Stonehenge Project against one another.

“Canadian Art-For-Taxes Scheme Disallowed,” *The Globe & Mail (Canada)*, February 19, 2004.

A Canadian court has disallowed a scheme whereby investors could buy art at a low price, then claim an inflated value by donating it to museums and universities.

It’s been estimated that the scheme, called Art for Education, resulted in tax-credit claims of more than \$65-million.

In December last year, Canada Customs and Revenue announced it was eliminating the tax shelter, saying that henceforth, purchase price would be considered for donations being made for tax purposes.

“Italians Struggle To Return Ancient Obelisk,” *The Observer (UK)*, February 15, 2004.

After years of pressure from the Ethiopians, Italy agreed in 2002 to return a 1,700-year-old obelisk that was stolen by Mussolini and placed near the Coliseum.

So late last year a team of experts carefully dismantled the obelisk, dividing it into three pieces each weighing between 40 and 70 tons. The pieces were wrapped up and stored in a hangar near Rome. But now the Italian authorities have run into a hitch. They say they

cannot find a plane big enough to transport the pieces safely.

“National Gallery Wins Raphael,” *Financial Times*, February 13, 2004.

London’s National Gallery has managed to buy Raphael’s *Madonna of the Pinks* and prevent it from being shipped to America.

A price of £22m has been agreed between the gallery and the Duke of Northumberland.

The Duke agreed to sell the painting to the J. Paul Getty Museum in California for £35m in September 2002.

“A Raphael Forgery, A Caravaggio Copy,” *The Guardian (UK)* February 22, 2004.

On Friday the National Gallery in London learnt that Raphael’s gooey *Madonna of the Pinks* was probably a forgery; meanwhile the National Gallery of Ireland spent the week rebutting accusations that its precious Caravaggio, a moody nocturne representing Christ’s arrest, was a second-hand Flemish copy, inferior to an original unearthed by a dealer in Rome.

The reattribution wounded Irish national pride and the religious conviction that underpins it.

“Baltic Sea - An Archaeological Paradise,” *Los Angeles Times*, February 8, 2004.

Searchers are finding hundreds of beautifully preserved ships in the Baltic Sea, making it an “archeological paradise.”

Politics and nature have conspired to preserve the secrets of the Baltic. The Cold War seriously hindered exploration, and the low salt content of the Baltic waters kept away the shipworms that feast on wooden wrecks.

“The Crumbling Wall Of China,” *The Guardian (UK)*, January 27, 2004.

Thanks to centuries of erosion, decades of tourism, and countless incidents of vandalism, the Great Wall of China is barely a third of its original impressive self.

It is the clearest indication yet that booming China is failing to use its

new wealth to conserve what ought to be a source of national pride.

Renovations that have been carried out have ended with clumsy exploitation, such as at Badaling, where tourists can ride toboggans and cable cars, eat at a KFC outlet and have their picture taken with camels and life-size cutouts of Mao Zedong.

The Badaling section of the wall alone attracts more than 10 million visitors per year.

“Nobody Knows Art Like Customs Inspectors,” *The Telegraph (UK)*, January 24, 2004.

The definition of art is not something that anyone would lightly undertake. Nor would it normally be left to a US customs official to decide. But that is exactly what happened in October 1926, when an extraordinary legal battle erupted over a Constantin Brancusi statue being brought into the U.S.

The point was that ordinary merchandise was subject to duty at 40 per cent, while art was not. And the customs official on duty at the time happened to be an amateur sculptor – just the sort of person to have bumptiously confident views about matters aesthetic.

He took one look at the Brancusi, concluded that it wasn’t art, and levied \$4,000 duty.

“Guilty Or Not, It’s A Damned Creepy Way To Make A Living,” *BBC*, March 10, 2004.

A German scientist who created an exhibition of human corpses has been cleared of allegations that he illegally obtained some of the bodies.

Gunther von Hagens was accused in several press reports last year of using bodies from China and Kyrgyzstan. But prosecutors in Heidelberg, Germany, said the corpses had been sold legally by institutions such as hospitals. Dr von Hagens was allowed to buy the corpses from such institutions because they were legal custodians of the bodies if the relatives of the dead had not claimed them.

“Restorer Rescues Saint John after Koons’ Sculpture is Damaged,” *Seattle Post-Intelligencer*, April 19, 2004.

Saint John the Baptist probably cracked his arm during a short ride

through Seattle from Artech storage to the Wright Exhibition Space. Produced in an edition of three with an artist’s proof, *Saint John* is one of the most prominent pieces from Koons’ celebrated 1988 *Banality* series of large-scale, ceramic sculptures.

Once the sculpture was unwrapped at the Wright Exhibition Space on Feb. 17 and the crack discovered, Artech, the region’s top art handling and storage company, called Patricia Leavengood of Art Conservation Services. Given of the nature of the break – from the palm of the pointing finger down the wrist to just below the elbow where it rings the arm – the crack is never going to disappear, she said.

“It’s a complex piece inherently under a lot of tension. When it cracked, part of it slid forward and can’t be moved back into place. I’m trying to create an illusion of seamlessness, so that the misalignment doesn’t jump out at you.

Porcelain wasn’t meant to exist at this size. My primary task is to stabilize the piece, and that I can do.”

“Craftsmen Shortlisted for Award after Losing their Jobs,” *The Guardian*, April 10, 2004.

The rescue of a stupendous piece of Victorian bombast has been shortlisted for a top conservation award – a week after the English Heritage craftsmen responsible were made redundant.

To add irony to insult, days after their laboratory closed, English Heritage trundled out head conservator Adrian Buckley to celebrate another of his projects, the return of rare Georgian wall paintings to Danson House in south London. He courteously posed beside them without mentioning he had lost his job after 30 years.

In his workshop for the last time on Wednesday, Mr Buckley politely described the news of his nomination for the Pilgrim Trust award, the Oscars of the conservation world, as “not without its ironic aspect.”

Sharon Manitta, a committee member of the United Kingdom Institute for Conservation, said: “There is no substitute for in-house conservation, for the pool of expertise accumulated and the capacity to involve conservators at all stages of a project.”