CONSERVATION PERSPECTIVES

THE GCI NEWSLETTER

SPRING 2010

COLLECTIONS RESEARCH

The Getty Conservation Institute

A Note from the Director

Preserving the world's cultural heritage to advance civil society. We rarely emphasize this message, but this is ultimately what the Getty Conservation Institute does. As a private research institute dedicated to advancing conservation practice, we focus our activities on conservation professionals, and the theory, technology, and science that support their efforts. By bringing together a range of international partners—both public and private—the GCI collaborates in a variety of ways to preserve works of art and historic places so that they may continue to inspire, delight, educate, and inform people around the world for generations to come.

This edition of *Conservation Perspectives* emphasizes how science and technology can be used to improve our understanding of cultural heritage and conservation practice. We explore collections research, which—as GCI senior scientist Karen Trentelman discusses in her feature article—can encompass a broad range of museum-based scientific research applied to the study of works of art (see p. 4). Collections research is an important part of the work of GCI Science, and is typically conducted with colleagues at the Getty, as well as with colleagues at other institutions whose objectives and interests integrate well with our own.

Examples of these research partnerships are detailed in two articles in this GCI newsletter. One article describes collective scientific research that the GCI is undertaking with several universities and collecting institutions into late Bronze Age glass from Mesopotamia (see p. 10). The other discusses research into early Renaissance workshop practice—research conducted jointly by the J. Paul Getty Museum and the GCI in preparation for an upcoming Getty Museum exhibition (see p. 13). Both these articles demonstrate the benefit to collections research that comes from bringing a multidisciplinary, and sometimes multi-institutional, team approach to research questions regarding works of art.

A third article in this edition describes the ways the GCI is working to further conservation and cultural heritage research by adapting and transferring technology from other disciplines (see p. 16). The modification or adaptation of existing technologies for use in the conservation laboratory is an effective means of advancing scientific research in the cultural heritage field, and one in which the GCI has been engaged for many years. Also in this edition is a thoughtful discussion (see p. 18) by conservators and conservation scientists—moderated by David Bomford, the Getty Museum's acting director—that examines changes and challenges related to collections research in the museum environment.

Timothy P. Whalen

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ON THE COVER
One of the thirty-eight illustrations in Martín de Murúa's *Historia general del Piru*—from the collection of the J. Paul Getty Museum—being examined with Raman spectroscopy in the Getty Conservation Institute's Collections Research Laboratory. Photo: Dennis Keeley, for the GCI.

COLLECTIONS RESEARCH

A Combined Approach to the Study of Works of Art

BY KAREN TRENTELMAN

Last year the group within the Getty Conservation Institute's Science program responsible for conducting research into works of art in collaboration with the conservation and curatorial staff of the J. Paul Getty Museum and the Getty Research Institute was renamed Collections Research. This renaming grew out of the evolving scope of work being carried out by the GCI scientific team in particular, and by museum-based scientists in general. Historically, museum-based science laboratory names contained the words *services* or *analytical* (as in Museum Services or Conservation Analytical Laboratory), reflecting the sample-based and largely reactive nature of the work. Today scientists increasingly work as part of a multidisciplinary team brought together to bring a more holistic approach to the study of works of art. This proactive, problem-solving approach is suggested in the current names of laboratories, which typically include the words *research* or *scientific* (or both). The evolution in naming is a direct reflection of the changing role of scientists in cultural heritage institutions over the past several decades.

Although *collections research* would not be appropriate to denote scientific work on immovable heritage, such as archaeological sites and historic structures, might the term have broad applicability in describing the activities of museum-based science laboratories?

SCIENTIFIC METHODS APPLIED TO WORKS OF ART

The scientific study of works of art draws from nearly all the established scientific disciplines—chemistry, physics, materials science, biology, and engineering. This is one of the more remarkable and valuable aspects of the field. But research efforts are still largely perceived as specialty applications within one of these established fields. Combining all the scientific aspects of museum-based research under the term *collections research*—emphasizing the subject of the research rather than the approach—might be an important step in helping create a unified, distinct discipline.

The terms currently in most common use to describe the application of scientific methods to the study of works of art in collections are *conservation science*, *technical art history*, and *archaeometry*. Each term carries different connotations with respect to the motivation, methodologies, and expected outcome of the study. Unfortunately, each term has at various times been used to promote one type of research over another—a reflection of politics, not science. These names simply represent different approaches in the application of science to the study of works of art. Whether the instrument of observation is a simple magnifier or a synchrotron radiation source or the objective is the development of a new conservation adhesive or the uncovering of ancient technologies, these approaches are all based on the scientific method: testing a hypothesis through the gathering of data, the interpretation of which may provide answers to the initial questions put forth, suggest further studies, or, in some cases, prompt entirely new research.

Conservation science, often used to describe all aspects of science related to the study of works of art, strictly speaking may be interpreted to refer only to those studies that directly affect the conservation of materials related to art, in terms of either understanding deterioration mechanisms or developing new treatment materials. Examples of conservation science under this definition include work by René de la Rie at the National Gallery of Art in Washington DC, in the development of UV inhibitors in paintings varnishes, and the cellulose degradation studies conducted by Paul Whitmore at Carnegie Mellon University in Pittsburgh. Although motivated by conservation concerns raised in the course of the study and treatment of individual objects or collections of objects, conservation science studies are rarely carried out on the objects themselves. Rather, experiments are carried out on model materials and mock-ups, on which new materials or procedures are thoroughly tested before being introduced into conservation practice.

GCI senior scientist Karen Trentelman removing a small sample from *Figure for Landscape* (1960) by Barbara Hepworth, as part of a study into the coatings and patinas of outdoor sculpture. Sculpture: © Bowness, Hepworth Estate. Collection of the J. Paul Getty Museum, Gift of Fran and Ray Stark. Photo: David Carson, GCI.

Technical art history is generally used to refer to studies that employ scientific and technical methodologies to uncover information regarding the nature of artists' materials and the methods used in the creation of works of art. Such studies also further an understanding of a particular artist's works and their historical context. Examples of technical art history studies include Francesca Bewer's studies on Renaissance bronzes at the Harvard Art Museums and Melanie Gifford's work at the National Gallery of Art characterizing Rembrandt's hand. The first step in technical art history research is developing an understanding of the physical, chemical, and aging characteristics of artists' materials. From information gained through these studies, subsequent research may address art-historical questions such as the development and characteristics of a particular artist's technique, the relationship among artists working concurrently, the influence of earlier artists, or the impact on later artists. Because technical art history studies focus on the physical characteristics of artists' materials, they may serve as a foundation for conservation science studies that seek to develop conservation strategies and establishing appropriate environmental controls for exhibition or storage.

One of the European sculpture and decorative arts galleries at the J. Paul Getty Museum. Photo: Karen Trentelman, GCI.

Archaeometry is in some ways the most general of these three terms. It is also, arguably, the most misunderstood and misused. The journal *Archaeometry* defines itself as "covering the application of the physical and biological sciences to archaeology and the history of art. The topics covered include dating methods, artifact studies, mathematical methods, remote sensing techniques, conservation science, environmental reconstruction, biological anthropology, and archaeological theory." Examples of archaeometric research include the study of arsenical bronze technology by Heather Lechtman of the Massachusetts Institute of Technology and the use of compositional analysis to reconstruct early ceramic technology by Mike Tite of Oxford University. Despite the implications of the name, archaeometric methodologies are not limited to archaeological materials. Regardless of the time period of the object, archaeometric studies (like technical art history studies) begin with an in-depth analysis of the physical, chemical, and material properties of an object or group of objects, the results of which may be interpreted in terms of historical, cultural, or technological context, or may inform subsequent conservation or preservation decisions.

Because archaeometry includes both conservation science and technical art history, some have suggested that the term might be applied to all scientific studies relating to works of art. While this argument has merit, it is unlikely ever to be widely accepted because of the implied bias of the term *archaeometry* toward archaeological materials. However, the narrower definitions of *technical art history* and *conservation science* likewise make them inadequate representations of the broader field. Most museum-based science laboratories engage in a mixture of all three of these approaches—*collections research*.

THE CASE FOR COLLECTIONS RESEARCH

Collections research, as the name implies, is the study of works of art in the collections of museums or other cultural heritage institutions. While this may seem obvious, what may not be self-evident are the implications regarding the particular challenges and opportunities that the term describes. By definition, collections consist of groups of objects that share common artistic, cultural, or historical factors. Collections research not only provides information regarding the material properties of individual objects but also enhances our understanding of their historic and cultural significance. However, perhaps the most distinguishing feature of collections research is that it is defined by the nature of the collection—its size, scope, focus, and condition.

As with all scientific studies, the breadth of the questions that can be addressed by collections research scales directly with the number of available objects. Studies designed around a group of related objects offer the opportunity to explore broad questions, such as defining the influences that led to the development of the working technique of a particular artist or identifying important environmental factors in the aging properties of materials. For example, what began as a relatively routine pigment characterization study of three manuscript illuminations created by the fifteenth-century French artist Jean Bourdichon yielded the intriguing discovery of the presence of the pigment

A small sample being removed from the Getty Museum's red shroud mummy *Herakleides* for a study into the composition of the red pigment. Photo: Marc Walton, GCI.

bismuth black. While interesting, the significance of this finding was unclear until the study was expanded to include works spanning the course of Bourdichon's career. This expanded study provided insight into the development of his palette and technique, identifying Bourdichon as one of the earliest artists to employ bismuth black as a painting pigment.[1] Expansion of the study set to include related objects from other time periods or geographic locations might enable even broader questions to be addressed, such as how the pigment subsequently migrated to Italy, where it has been identified in early sixteenth-century panel paintings by Raphael and Fra Bartolommeo.[2]

Expanding the scope of a research project to include objects in different media (thereby including different conservation and curatorial subdisciplines) similarly creates opportunities for developing broader research questions. For example, for an upcoming Getty exhibition on early Renaissance workshop practices, research into the relationship between manuscript illumination and panel painting techniques is being conducted by a multidisciplinary team consisting of curators, conservators, and scientists (see p. 13). One specific avenue of research is whether the manuscript illuminations, which are in a good state of preservation, might provide information regarding the discoloration and deterioration observed in certain passages in the panel paintings. The results of such studies not only have the potential to impact the preservation of the paintings, but—by possibly providing new insight into the original appearance of the paintings—may also affect their interpretation.

It is important to note that museum-based research is not limited to objects found within a single collection. However, access to objects is important, and thus groups of related objects within a single collection provide a natural starting point for developing research programs. Once preliminary studies have been done, arrangements may be made to include objects from other collections. For example, a collaborative research project between the Getty and several other institutions into early glass technology (see p. 10) was inspired by objects contained within each institution's collection, but it has been enhanced by the combining of efforts.

Collections research may also be defined by the focus of the collection and, by extension, the interests and needs of the conservators and curators. For example, collections of archaeological objects might require research into reconstructing historic craft technology or into evaluating the impact of its burial environment and subsequent excavation—focusing on the archaeometric aspect of collections research. Similarly, a European fine-art collection might inspire research on the techniques of particular artists to strengthen attribution and authorship or to provide additional information in support of the interpretation of the object—focusing on the technical art history aspect of collections research. Finally, a collection of works composed of modern materials might demand research into predicting the aging properties of the materials in order to better assure their preservation—focusing on the conservation science aspect of collections research (see *Conservation Perspectives*, vol. 24, no. 2).

The condition of a collection similarly can influence the nature of the collections research. Collections of objects in poor condition may necessitate more conservation science research, while collections of objects in good condition may support more technical art history or archaeometric studies. Encyclopedic collections perhaps represent the best fit for the term *collections research*, with research being conducted in response to the various needs of the collection—be it in the form of conservation science, technical art history, or archaeometry.

Another aspect of collections research is the adaptation of new technologies for use in the study of cultural heritage materials (see p. 18). Collaboration with university-based scientists may provide an opportunity to evaluate the applicability of the latest advances in technology and to carry out fundamental chemical or materials science research relevant to the study of cultural heritage materials. In an effort to foster the development of academic–cultural heritage collaborations into the study of fundamental scientific phenomena related to cultural heritage materials, new funding opportunities are being offered in the United States by the National Science Foundation (see sidebar).

The designation *collections research* indeed may be a suitable umbrella term for work carried out in museum-based scientific laboratories, highlighting the subject of the research—works of art in collections—rather than the approach. Encompassing those areas described as conservation science, technical art history, and archaeometry, collections research may take on different aspects depending on the needs of the collection and the research interests of its stewards. It may examine the behavior of single materials or complex composites, focus on an individual object or an entire artistic movement, or employ new technologies to rediscover ancient ones. It may be object based or material based. It may concentrate on the commonalities within a collection or explore new relationships among seemingly disparate objects or media. It may help us understand the history of artists and past cultures or anticipate—and prevent—future deterioration.

It is as varied as collections themselves.

Karen Trentelman is a GCI senior scientist; she oversees the Institute's Collections Research Laboratory.

1. K. Trentelman and N. Turner, "Investigation of the painting materials and techniques of the late-15th century manuscript illuminator Jean Bourdichon," *Journal of Raman Spectroscopy* 40 (2009): 577–84; L. Burgio et al., "Spectroscopic investigations of Bourdichon miniatures: Masterpieces of light and color," *Applied Spectroscopy* 63, no. 6 (2009): 611–20.
2. M. Spring, R. Grout, and R. White, "Black earths: A study of unusual black and dark grey pigments used by artists in the sixteenth century," *National Gallery Technical Bulletin* 24 (2003): 96–113 (other references therein).

GCI assistant scientist Catherine Schmidt Patterson and former research laboratory associate Carole Namowicz performing X-ray fluorescence spectroscopy on a panel painting in the galleries of the Getty Museum. Photo: Karen Trentelman, GCI.

Research at the Interface of Science and Art

BY MARCO LEONA

For the scientific study of cultural heritage to grow, it is essential to broaden the base of researchers involved and to foster partnerships among scientists in cultural heritage institutions and those in universities and national laboratories. To create those partnerships in ways that are sustainable, the involvement of funding agencies such as the National Science Foundation (NSF) is crucial.

Over the last decade, conservation scientists, museum and private foundation representatives, and NSF program officers have discussed how such collaborations might be funded and implemented. Two initiatives in particular attracted the attention of the NSF to conservation science and cultural heritage research. In 2005 the Andrew W. Mellon Foundation commissioned a report to the NSF, edited by Paul Whitmore, outlining the state of the field and pinpointing areas for NSF support.[1] In October 2008, a symposium jointly organized by the Art Institute of Chicago and Northwestern University—"Productive Affinities: Successful Collaborations Between Museums and Academia"—further demonstrated that scientific collaborations between universities and national labs on one side and cultural heritage institutions on the other can lead to exciting scientific discoveries, benefit conservation and art-historical research, and have a substantial impact on educational and research training.

Promising as they are, today's collaborations between museum-based and university scientists have not yet fully realized the potential of current advances in scientific research. In order to promote broader partnerships between the cultural heritage worlds and academia, forty chemists and materials scientists from cultural heritage institutions, universities, national laboratories, and industry met in Arlington, Virginia, in July 2009 for a workshop, "Chemistry and Materials Research at the Interface Between Science and Art," jointly sponsored by the NSF and the Andrew W. Mellon Foundation.[2]

The Arlington workshop sought to involve leading chemists and materials scientists in a discussion on cultural heritage research, as well as to stimulate the involvement of the National Science Foundation in order to increase the synergies between cultural heritage institutions and the traditional research world. Materials research and chemistry were selected as the primary research areas—in part because of a need to keep the discussion focused but also because of the demonstrated interest in the field in recent years by materials scientists and chemists.

Workshop participants explored basic scientific questions related to the understanding and preservation of cultural heritage materials, and they discussed near- and long-term priorities for research into the components, structures, and aging processes of cultural heritage. Participants also highlighted the importance of a fundamental understanding, at the molecular and microstructural level, of cultural heritage materials, in order to learn about past cultures and technologies and to enhance our abilities to preserve the world's material culture.

The discussion focused on three main challenges: the fundamental description of complex materials and structures, the understanding of material changes in cultural objects, and the efficient design of effective and safe conservation treatments. Workshop participants identified some promising avenues of research, such as:

- development of analytical probes with high sensitivity and spatial resolution for restricted volume and/or standoff detection of component materials, degradation products, and deterioration markers;
- study of ultra-slow changes in materials, occasionally in severely degraded states or in small populations with unique history;
- compatibility-driven design for multifunctional treatment materials;
- theoretical modeling in materials and structures that includes the complexity of authentic objects on their aging trajectory.

A consensus emerged on the necessity of building broad-based partnerships among researchers to bring advances in sensing technologies, nanoscience, materials design, and theoretical modeling of aging and deterioration processes into the field of cultural heritage research.

Finally, all participants noted the importance of a sustained funding effort on the part of the National Science Foundation. The mechanisms proposed included instrument development grants; initiatives for workforce development; small grants for exploratory research; multiyear research grants; support for workshops, conferences, and Web-based networking initiatives; and the creation of research centers. The enthusiasm demonstrated by academic scientists for the possibilities of scientific research in the field of cultural heritage was one of the key elements of the meeting. The general discussion at the end of the gathering highlighted the clear relevance and impact of the information gained through scientific investigation of cultural heritage materials. Many participants cited the incorporation of cultural heritage research into curricula as a highly effective means to attract and inspire the next generation of scientists.

As a result of the workshop, on February 4, 2010, the NSF issued a new solicitation—NSF 10-534, Chemistry and Materials Research at the Interface Between Science and Art (SCIART)[3]—for proposals between researchers in U.S. museums and academic institutions that aim to address the grand challenges outlined in the workshop.

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1. Paul M. Whitmore (coordinating author), *Conservation Science Research: Activities, Needs, and Funding Opportunities: A Report to the National Science Foundation* (Andrew W. Mellon Foundation, 2005).
2. The workshop report, together with supporting material, can be found at mac.mellon.org/NSF–MellonWorkshop.
3. www.nsf.gov/pubs/2010/nsf10534/nsf10534.htm?org=NSF.

COLLABORATIONS IN ARCHAEOLOGICAL SCIENCE

Analysis of Glass from Nuzi, Mesopotamia

BY KATHERINE EREMIN AND MARC WALTON

IN RECENT YEARS, archaeological research has become a rich, multidisciplinary field that relies on excavation by archaeologists, documentation by art historians, and analysis by physical scientists to tackle the complex process of untangling culture. This collaborative approach to research was certainly not the norm in the early twentieth century, when modern archaeological practices were being established. In those early excavations, more often than not, discovery of small finds such as glass, ornamental metals, and stone objects was of far less interest than the recovery of inscriptions and the uncovering of architecture.

Such was the case with the mound of Yorgan Tepe in present-day Iraq. Excavated by Harvard University between 1925 and 1931, it yielded the late Bronze Age city of Nuzi (fifteenth to fourteenth century BCE). Archaeologists carefully recorded the city's temple and palace complexes as well as scores of cuneiform tablets. However, the myriad small finds of ceramics, stone, metal, and glass were at times only briefly documented in excavation reports.

In 2008 a collaborative project was conceived to reexamine these objects, now housed at Harvard's Semitic Museum, using contemporary archaeological theories and analytical approaches. While all material culture from Nuzi is being investigated under the scope of the project, the glass finds are the emphasis of the initial study. This first in-depth investigation of the glass offered an unparalleled opportunity to increase knowledge and understanding of trade, commerce, and technology of this material in late Bronze Age Mesopotamia and to compare this information with neighboring areas, such as Eighteenth Dynasty Egypt.

STUDYING LATE BRONZE AGE GLASS

Late Bronze Age glasses were prestige materials similar in value to semiprecious stones such as lapis lazuli and turquoise.

Fragments of glass, produced during Kassite rule in Babylonia, now in the University of Pennsylvania Museum collection. Photo: Andrew Shortland, Cranfield University.

Marc Walton, GCI, and Katherine Eremin, Harvard Art Museum, examining glass objects in the storage area of the University of Pennsylvania Museum. Photo: Andrew Shortland, Cranfield University.

However, unlike gemstones, glass was a human-made material produced by tightly administered royal monopolies. By following the extent of glass exchange among cultures in the Bronze Age Mediterranean, the mechanisms of its trade, and the means by which its technology was transferred from one location to another, researchers could provide a window into how these monopolies functioned.

In the past decade, the study of glass from this period has been a popular subject for investigation, resulting in an improved understanding of where primary glass-making workshops may have been located in both Egypt and Mesopotamia. This research has been based on both chemical evidence and archaeological excavation.

A significant development in the study of late Bronze Age glass came in 2007, when a way to discriminate chemically between the main sources of glass from this period was discovered by Andrew Shortland of Cranfield University in Britain and Katherine Eremin of Harvard Art Museum. Using inductively coupled plasma mass spectrometry (ICPMS), Shortland and Eremin established that there are consistent differences in the trace element compositions of Egyptian and Mesopotamian glasses (many of these coming from Nuzi), related to their different materials of manufacture. Shortland and Eremin hoped to expand on their initial findings by undertaking a more comprehensive examination of all the glass finds at Nuzi.

Archaeological research has become so specialized that not all questions can be answered by a single institution. In fact, the key to success in the analysis of archaeological objects is to build a research team that balances in-depth knowledge of the period and material being analyzed with appropriate analytical expertise. This type of multi-institutional and multidisciplinary collaborative approach is now becoming commonplace in archaeological research. It is therefore not surprising that at the start of the Nuzi project, it was recognized that a major scientific reinterpretation of the glass finds would not be possible without active and dynamic interaction among a number of institutions and individuals who would be able to bring different analytical techniques and interpretative ideas to the table.

The international group assembled for the Nuzi project included the Semitic Museum; Cranfield University; Harvard Art Museum; the Catholic University of Leuven in Belgium, which has the premier laboratory for determining radiogenic isotope content in glass; and the Getty Conservation Institute, which owns one of the only laser ablation inductively coupled plasma mass spectrometers (LA-ICPMS) dedicated solely to trace element analysis of museum-based objects.

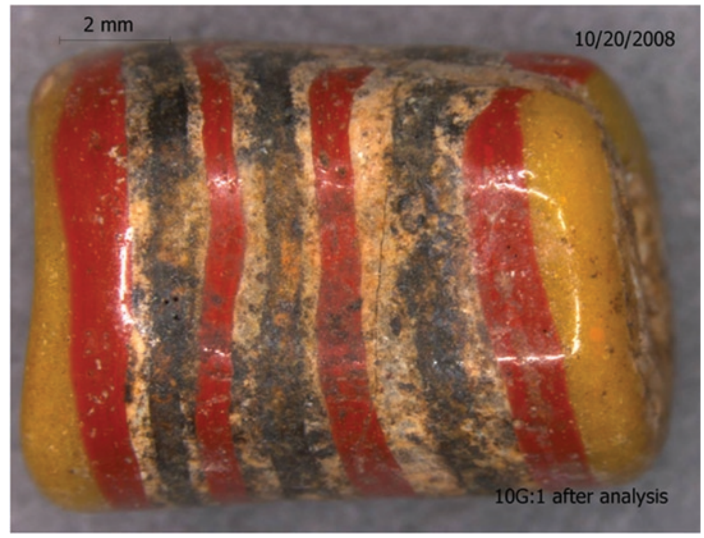
COLLABORATIVE WORK UNDERTAKEN

To date, the comprehensive analysis of the Nuzi glass materials has revealed that there was no significant trade in glass between Egypt and Nuzi. In fact, almost all the glasses found in Egypt have been shown to have an "Egyptian" trace element composition, and likewise, all the glasses from Mesopotamia (Nuzi and other sites) have a unique "Mesopotamian" signature. This finding, based on analysis at Cranfield University and at the GCI, was also corroborated by isotopic data collected at the Catholic University of Leuven. These findings suggest that although the elite may have given one another small gifts of glass, these two major late Bronze Age cultures were not engaged in robust trade. It is more likely that local demand for glass was satisfied by local production. It is therefore interesting that Mycenaean (late Bronze Age Greece) beads from the J. Paul Getty Museum, also analyzed at the GCI as part of this study, were found to have both Egyptian and Mesopotamian signatures. These analyses suggest that there was an active glass trade between Mycenaean Greece and both Egypt and Mesopotamia.

The best-preserved and most colorful beads from Nuzi are on display at the Semitic Museum and could not be sampled using mechanical methods (e.g., by scalpel or saw). In 2008 some of these beads were taken to the GCI for in situ analysis by laser ablation ICPMS. Laser ablation sampling was deemed the least-invasive quantitative measurement technique, since it produces only a discreet 60 µm wide crater that is a mere 50–100 µm deep in the object—and is therefore invisible to the naked eye. Such minimal removal of material was necessary for these glass beads, given their small size, rarity, and use in displays.

The key to success in the analysis of archaeological objects is to build a research team that balances in-depth knowledge of the period and material being analyzed with appropriate analytical expertise.

Analysis showed that this well-preserved glass was extremely unusual for the late Bronze Age. All of the glasses exhibited higher aluminum levels than normally seen in glasses from this period and also showed the presence of lead-tin yellow colorant that was not used in glass until the Roman period (second to third centuries CE). Isotopic data from a single multicolored bead also confirmed that the strontium and neodymium



Multicolor Sassanian-period glass bead from Nuzi. Photo: Marc Walton, GCI.

isotopes did not match other late Bronze Age Near Eastern glasses. Based on the chemical comparison of these glasses, it was found that these beads more closely resembled Byzantine glass than anything from the Bronze Age. Subsequent formal analysis of the beads showed that they indeed matched shapes, colors, and decoration of other beads dating to the Byzantine/Sassanian periods in Iraq (third to fourth centuries CE). We now believe that many of the highly colored glasses in the Nuzi collection are intrusive material from later occupation of the archaeological site and hence cannot provide any information about the Bronze Age culture of interest. They do, however, highlight the dangers of working with collections excavated before modern excavation practices were fully established, as well as the need for careful examination of all objects and records.

WHAT WAS GAINED

Through this collaboration, we have established fundamental analytical evidence for the trade of glass in the late Bronze Age Mediterranean. This would not have been possible without the initial efforts by Shortland and Eremin to establish the compositional fingerprints of the glass and then to apply those fingerprints to the study of a wider body of material. However, a key ingredient to the success of the project has been the diversity of knowledge—in chemistry, geology, and archaeology—brought together in the Nuzi team. This wide-ranging knowledge has resulted in new insights into this late Bronze Age past.

Katherine Eremin is a conservation scientist at the Harvard Art Museum. Marc Walton is an associate scientist at the GCI.

EXAMINING CONNECTIONS

Collaborative Research of Early Renaissance Workshop Practice

Stella Panayotova of the Fitzwilliam Museum and Christine Sciacca of the Getty Museum examining X-ray images of *Laudario of Sant'Agnese* manuscript leaves during a group study day. Photo: Karen Trentelman, GCI.

BY CHRISTINE SCIACCA AND CATHERINE SCHMIDT PATTERSON

MUSEUM-BASED RESEARCH takes myriad forms, from art-historical and archival research on an individual object, artist, or period, to conservation analysis of an object's construction, state of preservation, or long-term care, to scientific evaluation of an object's component materials or physical properties. This complex research requires a pantheon of professionals—curators, conservators, and scientists—to undertake it and, increasingly, to work together on collaborative teams.

Research involving professionals from across an institution benefits from both an expanded knowledge base and a breadth of questions that can be addressed. The advantages of collaboration are evident, for example, in exhibition catalogues, which often contain both art-historical essays by curators and art historians and technical information gathered by conservators and scientists. The work being conducted for the upcoming J. Paul Getty Museum (JPGM) exhibition *Florentine Painting and Illumination in the Time of Giotto* exemplifies the benefits of institutional collaborative research.

EARLY RENAISSANCE PAINTING AND ILLUMINATION

The Getty exhibition explores the community of illuminators and panel painters who contributed to the stunning artistic production in Florence on the eve of the Renaissance. The show's genesis was four remarkable works in the Getty's collection: the important and unusual *Chiarito Tabernacle* by Pacino di Bonaguida and three leaves from the celebrated *Laudario of Sant'Agnese*, a lavish manuscript illuminated by Pacino and a collaborator.

Group study day of *Laudario* leaves from the collections of the Getty Museum, the Fitzwilliam Museum, and Queens' College, Cambridge, held in the Getty Museum painting conservation studio. Photo: Federica Pinna, GCI.

One focus of the exhibition research is Pacino, a prolific manuscript illuminator and panel painter who produced altarpieces and private devotional paintings, as well as luxury copies of manuscripts, which fed the devotional and intellectual demands of his Florentine patrons. A detailed technical analysis of manuscript leaves and panel paintings from Pacino's workshop is under way; this research seeks to elucidate the artist's technique, the effects of material choices on the appearance and aging of his works, and elements of fourteenth-century Florentine workshop practice. For example, did the artist translate traditional illumination techniques into his work on panel, and vice versa? The appearance of many early panel paintings has changed over time because of environmental conditions and restoration; manuscripts, which often maintain their original appearance, may thus reveal important information about the intended appearance of early paintings, influencing both our understanding of these objects and their conservation.

Establishing these links between painting and manuscript illumination, however, requires art-historical insight, conservation observation and evaluation, and a thorough technical investigation of the objects. In short, it requires a collaborative team.

BUILDING A TEAM

This project requires a group of researchers of broad expertise, and a team was assembled from across the Getty. Christine Sciacca, assistant curator in the Department of Manuscripts at the Getty Museum and a specialist in devotional and liturgical art, formulated the scope and themes of the exhibition and identified key works of early trecento Florentine art illustrating the relationship between manuscript illumination and panel painting. Conservator Yvonne Szafran—head of the JPGM Paintings Conservation department, with extensive experience restoring Italian gold-ground paintings, including the *Chiarito Tabernacle*—has been evaluating the condition of Pacino's works on panel and contributing her knowledge of the medium to the ongoing technical research. Conservator Nancy Turner, from the JPGM Paper Conservation department, has similarly contributed her intimate knowledge of the three *Laudario* leaves (which she worked on when they entered the Getty's collection) and her considerable experience with the treatment and analysis of illuminated manuscripts. Bringing to the team her experience of using analytical technologies such as X-ray fluorescence and Raman spectroscopy in the analysis of art, GCI senior scientist Karen Trentelman—along with assistant scientist Catherine Schmidt Patterson and additional staff of the GCI Collections Research Laboratory—has been engaged in the scientific examination of Pacino's materials.

With the members of the research team contributing complementary skills and perspectives to the work, the project was significantly enhanced by the team approach.

A DYNAMIC ENVIRONMENT

Throughout the research, stylistic and material observations have been presented and discussed by the team in a collaborative environment, both to develop broad research objectives on understanding artistic workshop practice and to formulate focused, short-term goals regarding specific analyses. Regular meetings, study days devoted to observation and comparison of the objects, and discussion during the scientific examination have proven critical for generating additional research questions and new approaches to existing challenges. For example, Szafran's suggestion to X-ray the manuscripts—an analysis more common for paintings—has revealed the manuscript's foliation, both confirming and revising curatorial findings.[1] This collaborative process allows the scope and depth of the project to grow organically, drawing on the expertise, professional networks, and institutional resources of each team member. Sciacca, Szafran, and Turner's contacts at museums around the globe have provided opportunities to examine closely a wide variety of early Florentine manuscripts and paintings, enriching the contextual landscape for the ongoing examination. Trentelman's connections with scientists at the Metropolitan Museum of Art and the Art Institute of Chicago and Turner's rapport with conservators at the Pierpont Morgan Library and the curator at the Free Library of Philadelphia facilitated the scientific examination of *Laudario* leaves at those institutions by the Getty research team, providing additional data necessary for understanding the complexities of Florentine workshop practice.

As work has progressed, questions developed and explored in the dynamic group environment are yielding tantalizing results. For example, initial discussions sought ways to identify artists active in Pacino's workshop. The research team selected the faces of figures as a potentially fruitful area of study that each team member was well positioned to address. Close visual analysis by Sciacca, Szafran, and Turner initially suggested that the two artists responsible for the *Laudario* used different painting methods. Detailed scientific examination undertaken by GCI scientists Patterson and Carole Namowicz of several faces in the Getty *Laudario* leaves revealed that Pacino and his collaborator may have used different red pigments to paint flesh tones. The observation that two artists appear to have chosen different materials and methods to produce the flesh tones of a single commission provides an interesting glimpse into the mechanics of artistic collaboration. Through this information, a clearer understanding of fourteenth-century Florentine workshop practice emerges that challenges the expectation that collaborating artists might closely share resources and techniques.

Getty Museum conservator Nancy Turner setting up a *Laudario* leaf—*The Ascension of Christ*, 1340s, tempera and gold leaf on parchment, J. Paul Getty Museum—for examination by Raman spectroscopy. Photo: Karen Trentelman, GCI.

The analysis of faces is, of course, just one of the questions that this research addresses, but it exemplifies the collective working method that has characterized the project. Ongoing work focuses on, for example, comparative analysis of other features, such as underdrawing, the figures' hands, the decoration of halos, the punchwork in gold leaf, pigment layering, and the overall palette of each studied object.

A MORE COMPLEX AND NUANCED PICTURE

The inherently collaborative nature of this project—which includes materials analysis, comparative visual examination, infrared, UV, and multispectral imaging studies, as well as art-historical, archival, and collections research—requires the participation of scientists, conservators, and curators. This diverse team of Getty researchers is working together to develop new questions, to advance scholarship regarding workshop practice, and to disseminate the research to a wide audience at professional conferences,[2] in the exhibition catalogue, and in the exhibition presentation itself. Aspects of technical analysis featured in the gallery will provide a richer context for viewing and studying these beautiful and fascinating objects. Moreover, presenting technical information about the objects may entice new audiences to visit museum exhibitions and encourage regular museumgoers to see art in new ways. This approach will reveal a more complex and nuanced picture of this crucial moment in the history of artistic production in a way that would not have been possible without collaborative research.

Christine Sciacca is an assistant curator in the Department of Manuscripts at the J. Paul Getty Museum. Catherine Schmidt Patterson, an assistant scientist, works in the Collections Research Laboratory at the Getty Conservation Institute.

1. S. Panayotova, "New miniatures by Pacino di Bonaguida in Cambridge," *Burlington Magazine* 151 (2009): 144–48.
2. Y. Szafran, C. Namowicz, C. Schmidt Patterson, C. Sciacca, K. Trentelman, and N. Turner, "Painting on parchment and panel: An exploration of Pacino di Bonaguida's technique," in *Postprints of the National Gallery Technical Bulletin 30th Anniversary Conference "Studying Old Master Paintings—Technology and Practice,"* 16–18 September, 2009, London (in press).

NEW TECHNOLOGIES IN THE SERVICE OF CULTURAL HERITAGE

BY DAVID CARSON AND GIACOMO CHIARI

WORKS OF ART and other cultural heritage objects can be composed of a nearly infinite variety of materials. Each material has a story to tell: how it was made, how it originally appeared, how it has changed over time, how it has been affected by other materials (materials either within the object or used in its preservation), and how it will respond to a new environment. To uncover these stories, scientists rely on observations made using scientific and analytical instrumentation.

It is rare for an instrument to be developed specifically for use in the study and conservation of cultural heritage, and in those few cases where it has been, it is even rarer for the instrument to be commercially viable. For example, in the early 1980s Kevex developed an air-path XRF spectrometer that allowed for the nondestructive collection of elemental information from objects—a tool that was of invaluable benefit to the field—but after the company had sold an instrument to every institution that wanted one, the market evaporated, and production ceased. Similar instruments have recently become commercially available, thanks to the dramatic growth in the number of museum-based science laboratories, and thanks to technological advances that make these instruments marketable to users beyond the cultural heritage community. Another example of a purpose-built instrument for conservation science is the microfadeometer, developed in the 1990s at Carnegie Mellon University by Paul Whitmore. The microfadeometer provides a method for determining the light fading characteristics of material on a very small spot, making it possible to do testing directly on an object. While the microfadeometer has not been marketed commercially, it can be constructed relatively easily from commercially available scientific components, and it has been widely adopted by the cultural heritage community.

TECHNOLOGY TRANSFER AND ADAPTATION

Because of the challenges associated with developing specialized instrumentation for use in the study and conservation of works of art, a more efficient way of advancing the available technology is the transfer of technology from other disciplines. Today's museum-based science laboratory relies on a variety of analytical technologies derived from multiple scientific disciplines, including chemistry, physics, engineering, medicine, biology, and materials science, and, more recently, from communication and imaging technologies. Many analytical instruments can be used in a conservation laboratory with little or no adaptation, including FTIR and Raman spectrometers, GC-MS, HPLC, SEM-EDS, ICP-MS, XRD, and XRF. However, because many of these instruments are invasive, their application is limited by the restricted availability of samples from cultural heritage objects. Therefore, in order to take full advantage of these existing analytical techniques, modification of such instruments may be necessary.

Another example of technology transfer and adaptation is polynomial texture mapping (PTM). PTM—developed by Tom Malzbender at Hewlett Packard (HP) for improving photorealism in three-dimensional rendering products—is a simple technique that provides the ability to look at the surfaces of an object under varying conditions. Requiring only a light source, a camera, and a reflecting sphere, PTM instrumentation records a series of images of an object while light rotates from different directions; the images are then combined and viewed using free software provided by HP.[1] PTM's ability to create a complete, integrated record of an object illuminated under direct and multiple raking light angles has potential for condition reporting and assessing physical changes in appearance over time. This technique has been used by the GCI to record the surface textures of paintings, mosaics, and wall paintings at the ancient site of Herculaneum. It has also been adapted for use with a standard microscope; by rotating the stage instead of the light source, the researcher can image microscopic textures.

WORK AT THE GCI

Transfer of technology and its adaptation for cultural heritage materials is an area the GCI has pursued over the past few years. An example of this is the Institute's development of a computer tomography (CT) scanner to examine bronze sculpture and other dense objects.

CT scanners are in widespread use in medicine, creating a three-dimensional X-ray image from a series of two-dimensional X-ray slices, each of which is generated by the rotation of the X-ray source and detector around the axis of the body. However, medical CT scanners are designed to examine the human body, which is largely composed of water and is of a particular shape. With the exception of their use in the examination of mummies, medical CT scanners have found little application in the study of art. Systems with larger energies and more open architecture are required to examine many of the other objects typically found in a museum collection. Several research groups in Germany and Italy have been at the forefront of applying these types of systems to works of art.

The GCI worked with physicists from the University of Bologna and Lawrence Livermore Laboratories in Berkeley, California, to develop our own CT scanner, applicable to the wide variety of materials and shapes found in works of art. Using the high-power X-ray source already in place at the GCI for conducting X-radiography of bronzes, the team constructed a simple arrangement using an X-ray-sensitive cesium-iodide scintillation screen, a large mirror, an astronomy-grade digital camera, and lots of lead shielding. In this adaptation, the object (rather than the X-ray source) is rotated—a design that vastly simplified the construction. The scanner is currently limited to imaging objects less than 44 cm in width. Nevertheless, it has been applied successfully to the study of a number of small bronze statues, revealing otherwise inaccessible features on the interior, casting flaws, and the structure of repairs.

Another example of the adaptation of an existing technique for use in the examination of cultural heritage materials is the development of a portable XRD/XRF instrument. While portable XRF spectrometers have been readily available from commercial sources for more than ten years, these instruments provide elemental information only; they do not provide the compound-specific information on crystalline material that is most appropriately probed through XRD analysis. Looking at technology developed by the Jet Propulsion Laboratory for the NASA Mars Exploration Rovers that allows the rovers to simultaneously conduct XRD and XRF analysis of rocks on Mars, GCI scientists saw an immediate application for conducting analysis in the field—for example, on wall paintings in remote tombs in China or Egypt. Unfortunately, as designed for the rover, the instrument requires a scoop of finely ground, powdered sample to be placed in a chamber and continuously agitated during analysis—a destructive technique inappropriate for the examination of wall paintings. The GCI modified the original design from a transmitted to a reflective mode, allowing it to operate

GCI senior scientist Giacomo Chiari (background) and former GCI assistant scientist Lionel Keene (foreground) collecting a polynomial texture mapping (PTM) dataset of a wall painting on location in Herculaneum, Italy. Photo: Leslie Rainer, GCI.

completely noninvasively. This new instrument, named the Duetto XRD/XRF, has been used to identify pigments, grounds, and corrosion products in situ on manuscripts, paintings, and sculpture in the collection of the J. Paul Getty Museum. In addition, it has been used to examine paintings in the tomb of King Tutankhamen in Egypt, thus fulfilling its original intention—to allow for noninvasive analysis in the field.

These examples illustrate the importance of looking beyond the original intent of an instrument for opportunities where it may be applied—with some adaptation—to the examination of cultural heritage materials. The cost of developing new technologies will almost always be beyond the ability of most arts organizations to afford, but by looking to other fields and industries, we can enhance the tools used to examine works of art.

Nevertheless, it is important to avoid overestimating the power of emerging technologies; after all, in most cases, adaptations come at the cost of some functionality. While noninvasive and portable techniques are desirable and can be very useful in initial analyses, often the required information may be obtained only through the examination of removed samples, using tried-and-true technologies.

David Carson is the GCI's laboratory manager. Giacomo Chiari is the GCI's chief scientist.

1. www.hpl.hp.com/research/ptm/.

THE SCIENCE IN THE ART

A Discussion about Collections Research

TERRY DRAYMAN-WEISSER is director of Conservation and Technical Research at the Walters Art Museum in Baltimore. She has been involved with training conservators from Iraq, especially in treatment of ancient, flood-damaged Nimrud ivories, and is consulting on a project to establish a conservation training program. She recently received the ICOM-US Service Award for her Iraq work.

MELANIE GIFFORD brings a background in art history and painting conservation to her role as research conservator for painting technology at the National Gallery of Art in Washington, DC. Her research considers the artistic decision-making process, with a particular focus on Dutch and Flemish painters. She also trains conservation students, interns, and postgraduate fellows in microscopy and technical studies.

CHRIS MCGLINCHEY is the Sally and Michael Gordon conservation scientist at the Museum of Modern Art, New York. He works with the conservation staff to provide technical support on the preservation and treatment of the museum's collection. In January he received a 2009 Heritage Preservation Award for Distinction in Scholarship and Conservation from the College Art Association.

They spoke with **DAVID BOMFORD**, associate director for collections at the J. Paul Getty Museum and currently the Museum's acting director, and **KAREN TRENTELMAN**, a senior scientist with the GCI.

DAVID BOMFORD Each of you has worked in science and conservation in different ways. Perhaps we could start by talking about the changes in roles within the museum that you've seen over the years. I recall that when I was a young restorer at the National Gallery in London, we were not supposed to use the library. Curators thought it was their exclusive preserve, and restorers were not expected to actually study books. The exclusivity of the curators in those days was remarkable and certainly not helpful. Those barriers don't exist now, but they certainly were there once upon a time.

MELANIE GIFFORD Many changes are reflected in the administrative structure of museums today. At the National Gallery of Art, conservation is a division parallel to the curatorial division, and both are represented in planning and policy making. More and more often, collaborative teams are assembled at the start of an exhibition or research project, which fosters communication among members of the team. It is essential to bring this collaborative approach into the training of scientists, art historians, and conservators. The more these different specialties develop a common language and work together to develop the questions to be researched, the more fruitful the research will be. At the NGA, our postgraduate fellows in conservation pursue their research with advice from a mentor outside their own department—conservators work with a scientist, science department fellows work with a conservator.

TERRY DRAYMAN-WEISSER I have seen a big change over time. There used to be an accepted division between curator and conservator. The curator had the responsibility for programmatic decisions—exhibitions and loans—and the conservator handled preservation of the collections. Sometimes the conservator would go to the curator with a suggestion for something to include in a show. Today the curator consults with the conservator at the beginning of the planning process for an exhibition or catalogue. It used to be a question as to whether a catalogue would include technical information, but today it's assumed that it will be there in some form.

CHRIS MCGLINCHEY Nowadays conservators and curators work more closely together and utilize some of the same resources. At the Museum of Modern Art in New York, every major exhibition catalogue has included an essay from the conservation department as a separate section, or has information integrated into the body of the text.

GIFFORD It's wonderful that technical essays are included in a great many exhibitions. Even so, I would like to see a day when technical essays aren't segregated—when technical research, like iconographic research or archival research, is simply woven into the fabric of art history. It's part of the whole dialogue.

MCGLINCHEY Exactly. Ann Temkin's catalogue for her exhibition Color Chart—an exhibition that showed how the mass-produced color chart has impacted artists—wove information from the conservation department into the fabric of her text. There was no separate section.

Photo: Michael Palmer

The more each specialist's training involves experience in the other disciplines, the better.

MELANIE GIFFORD

KAREN TRENTELMAN Where do the scientists fit into the hierarchy of curators and conservators? Can we get to the point where scientists have an equal voice at the table?

DRAYMAN-WEISSER It's evolving. There is still a little bit of a silo effect. Eventually the goal is to have projects that interweave everything. Right now we're getting used to each other as equal players. I also want to add in another player—the museum educator. That person is really the connection to the public. We may work with the scientist, we may work with the curator, but then the technical information gets into an exhibition because the educator is saying the public is interested in it. This encourages the museum director and the curator to include a lot of the conservation or scientific information in the public presentation.

GIFFORD In institutions with a science department, the familiarity of colleagues means that scientists can be woven integrally into the research process. This is harder when an outside scientist joins the team. The conservator then takes on the traditional role of mediator—bringing the question from the art historian to the scientist, and then bringing the results back and interpreting them for the art historian—which is a very inefficient process. The more each specialist's training involves experience in the other disciplines, the better. The goal is not to turn us into multitaskers—people who can do mass spectrometry and art history simultaneously. We need the scientist doing mass spectrometry to be familiar with the questions an art historian might ask and to be comfortable phrasing the findings in a way that is meaningful to an art historian. Similarly, an art historian has to have enough experience looking at paint cross sections to ask intelligent questions and perhaps even to debate interpretations.

TRENTELMAN You're talking about the blurring of boundaries for projects that stem from art-historical questions. What about questions driven by treatment or conservation? How does the interaction occur in those projects?

MCGLINCHEY For scientists working in the museum environment, it's best to trust the judgment of the senior conservators in identifying and prioritizing areas of research. These are the people who have identified fundamental problems of conservation materials and techniques. This is as opposed to students trying to master conservation. They have yet to know the difference between their own limitations and the intrinsic limitations of a material. Since senior conservators can articulate these boundaries more succinctly, research can be focused in areas that would benefit the largest audience.

BOMFORD But let's be clear. Whatever question is asked—whether it's art-historical or about authenticity or conservation—it all reduces down to an understanding of the materials and structure of a work of art. That is what we're all trying to discover. Once we understand materials and structure, we begin to answer all those questions.

GIFFORD A new research direction is evolving in which we not only think of the structure and the materials of a work of art—and their inherent characteristics—but also seek to understand that the characteristics of materials change over time, whether through environmental degradation or a natural aging process. When analyzing a material, it's important to recognize where that material is in its life cycle. A specific compound will not always be diagnostic for a specific material. That's a fundamental change in the analytical approach.

DRAYMAN-WEISSER I would divide the scientific work into short-term and long-term. As a conservator doing a treatment, I may have an urgent short-term need. I may need to know if an object contains zinc or whether it's brass or bronze. But in the long term, I may need a new treatment developed, or I may need a broader understanding of something that requires collection of data. These needs begin to conflict when there's one scientist and limited time. I found that once we had an in-house scientist, there were many needs expressed by the conservators for immediate information about objects, as well as for long-term research. The curators—having a scientist in-house—began to think about long-term projects they had put on the back burner. Suddenly we had a scientist with a work list of fifty or sixty items. We had to sit down together and prioritize that list. When we had no in-house scientist, I was the person to develop the research plan for a project and hope that I had made the right decisions bringing in outside scientists to do the work. I was the person who interpreted the data for the curator. Now it's wonderful to have an in-house person who can take some of that role—who, in the most effective way, can help design that project, identify the best people to do it, and share the role of the interpreter of information.

TRENTELMAN Could you each comment on the relative support within your institution for research that is exhibition driven, versus something that would be longer-term, such as developing a new treatment? Is that research adequately supported by your institution—or does it require partnering with universities?

GIFFORD The NGA has a well-established scientific research department that pursues two tracks of research—research into materials and techniques for conservation, and research into the materials and techniques of art objects. But a diverse research program like this isn't possible in most settings: there simply aren't enough staff. In many institutions the best way to pursue fundamental research is in partnership with academic scientists. That said, the needs of the field must be communicated effectively. For an academic program of fundamental research to be relevant, conservators and/or conservation scientists in the museum setting must serve as active research partners and interpreters of the data.

BOMFORD And it's slightly serendipitous, in that what normally drives the process in a museum is an exhibition. Exhibitions concentrate our minds on a specific group of works of art, or on the need for conservation. If you're taking a painting off the wall to conserve it only once in a century, that is the moment you do the analysis and examination. Or you may have a concentrated research project, such as the Rembrandt Research Project, to focus attention on a particular oeuvre or a particular artist. There isn't some great systematic process going on worldwide.

MCGLINCHEY Exhibitions are one driving factor, but we also examine the collection to identify areas of research. For example, resin-coated [RC] prints are difficult to exhibit, and there are no conservation-quality adhesives suitable for mounting them. That's a project useful to anyone needing to display RC prints. And this is where having an in-house scientist helps advance outside collaborations with people in industry and academia. I don't know how efficiently that would proceed with just a photography conservator contacting researchers at other organizations.

DRAYMAN-WEISSER Many of our institutions are public institutions. How do you show that there's public value to what we do? The more we can demonstrate that value, the more support we can get. If you create something that can be presented to the public and the public responds positively, then there is more support from the entire institution for what you're doing. What's regrettable is that sometimes our most urgent needs—developing new techniques for preservation of works of art—sit on the sideline because they're not necessarily viewed as important for the program of the institution, it's often an expensive process, and it often involves bringing in university or industrial scientists. That's when we have to start applying for grants—and then it's a question of competing with other institutional grant priorities.

MCGLINCHEY One thing to consider is how science fits into the administrative structure of each institution. That automatically identifies what hurdles exist. At the Museum of Modern Art, science is embedded in conservation, and that works partly because the staff is not large. Fortunately, the potential problem of feeling unrepresented at higher levels in the administrative structure doesn't apply, because I have a department head and director who both advocate science. I'm frequently called into discussions at the appropriate time. But you can't count on that elsewhere.

BOMFORD We have to acknowledge that the role of conservation across the world is diminishing. Over the last thirty years, conservators were very influential and had a seat at the top table in many museums. Those seats are getting fewer. There are important museums at which conservation is regarded as less and less important. Conservators still do fundamental conservation, but they're not making decisions at the highest level as they used to—and, in some museums, as they still do. In many museums, it's never been important. You have conservation projects in major European museums that are discussed without anyone's even knowing who the conservator is going to be. Conservators are given their orders by the curator, who will tell them exactly what the result should be. This, to me, is very, very disturbing.

GIFFORD And this is why the professional organizations representing the interests and priorities of conservation need to work with organizations like the American Association of Museum Directors [AAMD] and the International Council of Museums [ICOM] to keep those priorities at the top of the list.

DRAYMAN-WEISSER When I was at the London IIC [International Institute for Conservation of Historic and Artistic Works] meeting, several conservators from European museums told me, "We feel that we are being sidelined." It is a frightening trend. In the United States, the American Association of Museums [AAM] and the American Association of Museum Directors need to be convinced to support the inclusion of conservation in decision making. We have to fight hard to ensure that real conservation priorities are included in the AAM accreditation guidelines. Museums will have to strive for high conservation standards or lose their accreditation. Something to remember is that people—and museums—tend to go where the money is, so funding organizations need to be aware of how they can be part of the solution. They can make


Photo: Katherine G. Phillips

As technology and techniques advance, we realize we have more capacity to answer questions than we ever thought possible.
TERRY DRAYMAN–WEISSER

funding available, taking into consideration how a museum deals with conservation needs. I'm thinking specifically about the IMLS [Institute of Museum and Library Services] insisting that there be a conservation survey before funding is requested. Many museums weren't bothering with surveys at all—and all of a sudden, every museum was conducting surveys in order to be able to meet those requirements. It changed entirely how museums operate.

MCGLINCHEY Fortunately, the Andrew W. Mellon Foundation has been steadfast in helping the profession advance by establishing positions for scientists at institutions throughout the nation. Mellon has fostered dialogue among science, curatorial, and conservation communities. The current Mellon-funded project I am involved with focuses on the curatorial, conservation, and scientific examination of the Thomas Walther collection of photographs. The fruits of that comprehensive three-year program will clearly benefit many and will demonstrate to those who have abandoned an integrated approach that they are going down the wrong path.

DRAYMAN-WEISSER I agree completely. And as more institutions have scientists that have been paid for with outside support, the museum sees it as positive—not as a drain on resources. They realize what science can contribute and begin to depend on it. Ironically, at the institutions where positions have been endowed, the scientist has one of the most secure positions in the museum.

BOMFORD With the proliferation of ever-more-sophisticated analytical methods, are we simply answering the same questions in more detail, or are new questions being answered?

MCGLINCHEY When I started at MoMA, I explored portable X-ray fluorescence methods because we were going to be in a series of temporary work spaces during a construction project, and I didn't want to lug around a large XRF. I had known that the handheld technology had advanced and was worth looking into. But it was only after I put the equipment into practice that I got a sense of how useful it was to have something so portable. One could argue the equipment is not as sensitive as other spectroscopic methods, but it is good enough to answer many questions satisfactorily, and being so portable is what makes it so powerful. It really does open up your eyes.

GIFFORD Imaging technology is an area of new research that expands the questions we ask. I particularly appreciate coordination between imaging techniques, where spatial resolution gives information over the entire work of art, and point analysis techniques give detailed results. This supports a trend toward taking samples only when it is essential.

MCGLINCHEY This is a trend that we see more and more—scientific methods dovetailing with one another. We no longer have a single method that someone tries to argue can do everything. That is clearly a myth.

DRAYMAN-WEISSER As technology and techniques advance, we realize we have more capacity to answer questions than we ever thought possible. It also poses new areas for research.

BOMFORD What would each of you have to say regarding the ways in which you see new technologies enhancing future treatments and approaches to conservation?

MCGLINCHEY Today we are closer to identifying the environmental parameter that becomes the Achilles' heel of a particular object. While we might understand the composition of each material in an object, we sometimes neglect to take into account the interaction those materials and method of manufacture have within a work. It is the interaction of these processes that sets up the potential vulnerabilities of these materials. This is where advanced technologies are going to yield a lot of information that helps with issues of preservation.

GIFFORD Yes—the context must inform advanced analytical research. Even experienced scientists who are new to conservation research may not recognize the complex interactions between composite materials and the environment. Research on a pure material taken out of context could identify an irrelevant Achilles' heel and suggest preventive techniques that are not, in fact, appropriate.

An important area of research is degradation processes. One example is the degradation of oil paints and the formation of metal soaps. The exact circumstances under which certain

In order to prioritize, we need to distinguish between the change we can control and the change we can't control.

CHRIS MCGLINCHEY

metal soaps develop aren't yet understood. It's important to understand how degradation products differ from metal soaps that occur naturally as oil paint cures. That means looking at the curing process through the different stages of its history and under different circumstances and identifying analytical protocols for each of these circumstances.

BOMFORD The scientist can discover the fundamental degradation processes, but that has to become part of the decision-making process within an institution and be translated into exhibition, loan, and other curatorial policies. And that's where you might run into conflicts. Interpretation of results is key. The scientist and the conservator need to explain to the museum world the real implications of these things and not be unnecessarily alarmist.

DRAYMAN-WEISSER Because of the economy, most of us are experiencing challenges to our recommendations. We're asked, "Is that really necessary?" and "Can you prove it?" In response, we should continually examine our standards and be able to support what we are saying through scientific research—but there is often resistance in museums, regardless of the findings, due to inconvenience or cost. We have to communicate that this is an evolving process, and we must avoid untested hard-and-fast guidelines—because the first time we alter them, we've lost credibility, creating an excuse for throwing all guidelines out the door.

MCGLINCHEY It's not about throwing out guidelines. It's about revising guidelines. This is the role of science in conservation—providing the data to build new guidelines on. Some, we hope, will be economically advantageous to implement.

GIFFORD As new data comes out, it must be interpreted to the institution's administration: "This is the significance of the new data—and a year from now there will be more data." We need to make clear that science is an ongoing process—always developing new information and perspectives and refining judgments.

TRENTELMAN What needs in conservation science would each of you like to see receive greater attention?

MCGLINCHEY Generally, I would say preventive conservation issues for the storage and exhibition of art. Change is greatest for things that are young, so it's a major issue for contemporary art. In order to prioritize, we need to distinguish between the change we can control and the change we can't control. The fundamental science required to provide that information is large and could spawn several research careers.

DRAYMAN-WEISSER We need more research on preventive conservation for storage. Conservators' recommendations in museums are complicated by the sustainability issues on the horizon, as well as by the current economy. There's a lot of pushback to some of the standards that we use right now, and we really need solid scientific research to understand how already aged and multicomponent materials are going to react. We need reliable data to guide us in putting collection materials into the most cost-effective storage systems that give the best chance for preservation.

GIFFORD An object is usually available for examination for only a short period. It's important to develop widely available examination methods that gather large amounts of data that can continue to be mined in the future. XRF mapping, for example, offers the possibility of storing elemental data so that spectra for specific points on the object can be generated later. Capturing a hyperspectral image set offers the same promise, storing data for later analysis of reflectance spectra. These methods promise spatially resolved analysis over the surface of an object; analysis that gives spatially resolved data for layers below the surface as well will further reduce the need for sampling art objects.

TRENTELMAN That brings up another point. We have to be concerned not only about the preservation of objects but also about the preservation of the knowledge and data that we're generating. We face challenges in preserving that—not from one generation to the next, but from one generation of our computer operating systems to the next. The challenge is to be able to preserve this data in a form that we can go back to, so that we can limit the number of times that we have to return to the object. My wish list would include increased work in statistical analysis and data mining.

BOMFORD In terms of traditional analysis of works of art, with old master paintings, pigments have been the most important thing—but that's because pigments are what we can analyze most straightforwardly. Actually, the medium is equally important but much more difficult to analyze. It's only been in relatively recent times that we've had successful and reliable medium analysis. There's still an awful lot about medium analysis we don't understand. I think there are analytical techniques that we are not yet capable of doing that will yield important information. In imaging techniques alone, we are seeing things now that were simply invisible ten or fifteen years ago.

GIFFORD One issue is that as techniques such as infrared reflectography and XRF become widely available to nonspecialists, we cannot always depend on the results being reliable and comparable. For many research techniques, it is essential to agree on protocols for consistent and validly comparable analyses.

MCGLINCHEY Melanie's point is exactly right about protocols and standardized methods for collection. That's the only way you will be able to go back to old data and reexamine it or apply any type of statistical analysis. It's essential. And with "new media," an art form whose preservation relies heavily on data migration, we have to be sure artistic qualities can be presented in the future by methods that have yet to be developed. I also think education on conservation issues must be integrated into the museum's agenda.

GIFFORD There needs to be overlap in the training of conservators, scientists, and art historians. Conservators need to be able to speak an art-historical language and also to understand how science is carried out. One of the single most important areas that still needs work is the training of conservation scientists. Academic training in a discipline like organic chemistry, combined with a postdoctoral museum fellowship, offers exemplary training for conservation scientists. But the transition from the academic environment—where students rarely focus on art research because of the funding priorities in their labs—to the museum world can be abrupt. If future conservation scientists could partner with museums during their academic training, even for short-term projects, it would open them to the questions we're asking.

DRAYMAN-WEISSER In my experience, if a university receives funds for students to do research relating to art materials, it will be done. If not, it's not likely to happen.

TRENTELMAN Are there other things the conservation community can be doing to broaden the notion of science within art?

GIFFORD Public education initiatives are really important. The more these concerns are translated into easily understood terms for the public, the more they will get out to the administrative levels of museums and become an accepted priority. Not only activities within the museum but also Web-based initiatives are going to be a very important way of reaching a wide audience.

MCGLINCHEY It's difficult, because if we are doing our job well, it is invisible to the public. I want it to be that way when they are looking at an object, but I also want the public to know about our processes at some point. That's a challenge. On an optimistic note, institutions are increasingly aware of the need to go in that direction.

DRAYMAN-WEISSER The Walters is certainly going in that direction. Almost every exhibition has a section that deals with how an object was made, identification of materials, or something relating to conservation. When our educators carried out a survey to determine what parts of an exhibition the public found engaging, the most positive responses related to the conservation part of it. People wanted to see more of the technical and the conservation material. For some people, the conservation or science aspect of an exhibition becomes a window through which they begin to relate to the works of art. We also have a literal window, an open conservation window, where you can visit a conservator. The job of the person in that window is not to work on meeting a deadline, but to talk to the public. We get a steady flow of people, and they stay twenty to thirty minutes because they're fascinated. The Walters Education Division is involved with the Maryland public school system and has a program of integrating the arts, done through our interactive Web site. It's not to learn about art, but rather to learn about other subjects *through* art, such as math, science, language arts, and social studies. Conservation plays a role in the science part of it. For example, looking at analyses of traces of pigments on a stone object from the ancient Near East, the student identifies the colors and then virtually recolors the relief.

GIFFORD Similarly at the National Gallery, we participate in various initiatives, including an annual event for gifted high school students, who tour different agencies in Washington. The tour of our science department always wakes a few students to the possibilities of the field.

MCGLINCHEY MoMA's after-school program, the Art and Science of Conservation, meets weekly for a semester and is often the first opportunity high school juniors and seniors have to use analytical instrumentation. At school they're typically measuring boiling points and crystallization temperatures of materials, but in this class they're analyzing unknown materials in mockups their classmates have made. It's a great opportunity for youth who are technically minded to see how a practicing scientist can work. It may get them thinking about a career in this field—but more fundamentally, it helps them learn how scientific tools can make them better observers of the world around them.

Join the discussion online at
www.getty.edu/conservation/25_1/dialogue.html

Key Resources

Collections Research

ONLINE RESOURCES

AIC Research and Technical Studies Specialty Group
Select "Specialty Groups" at:
American Institute for Conservation of Historic and Artistic Works
www.conservation-us.org/

Archaeometry
www.wiley.com/bw/journal.asp?ref=0003-813X&site=1

Chemistry and Materials Research at the Interface Between Science and Art: Report of a Jointly Sponsored Workshop Between the National Science Foundation and the Andrew W. Mellon Foundation
mac.mellon.org/NSF-MellonWorkshop

Collections Research at the Getty Conservation Institute
www.getty.edu/conservation/science/about/coll_res.html

Conservation and Art Material Encyclopedia Online (CAMEO)
cameo.mfa.org/

e-Preservation Science
www.morana-rtd.com/e-preservationscience/index.html

ICOM-CC Scientific Research Working Group
www.icom-cc.org/37/working-groups/scientific-research/

ICON Heritage Science Group
Select "Heritage Science" at:
The Institute of Conservation
www.icon.org.uk/index.php

Journal of Cultural Heritage
www.sciencedirect.com/science/journal/12962074

UK Science and Heritage Programme
www.heritagescience.ac.uk/

For more information on issues related to collections research, search **AATA Online** at aata.getty.edu/nps/

BOOKS, JOURNALS & CONFERENCE PROCEEDINGS

Artists' Pigments: A Handbook of Their History and Characteristics, volumes 1–4. Washington DC: National Gallery of Art.

British Museum Technical Research Bulletin. www.britishmuseum.org/system_pages/holding_area/technical_research_bulletin.aspx

Conservation Science 2007: Papers from the Conference Held in Milan, Italy, 10–11 May 2007, edited by Joyce H. Townsend, Lucia Toniolo, and Francesca Cappitelli, with editorial assistance from Graham Martin, Gianluca Valentini, and James Tate (2008), London: Archetype Publications.

Materials Issues in Art and Archaeology, a series of conference proceedings of the Materials Research Society. www.mrs.org

National Gallery Technical Bulletin, published by the National Gallery, London.

Painting Materials: A Short Encyclopedia by Rutherford J. Gettens and George L. Stout.

Physical Techniques in the Study of Art, Archaeology and Cultural Heritage, edited by David A. Bradley and D. C. Creagh (2006), Amsterdam and Oxford: Elsevier.

Pigment Compendium: A Dictionary of Historical Pigments by Nicholas Eastaugh, Valentine Walsh, Tracey Chaplin, and Ruth Siddall (2004), Amsterdam: Elsevier Butterworth-Heinemann.

Raman Spectroscopy in Archaeology and Art History, edited by H. G. M. Edwards and J. M. Chalmers (2005), RSC Analytical Chemistry Spectroscopy Monographs, Cambridge: Royal Society of Chemistry.

Scientific Examination for the Investigation of Paintings: A Handbook for Conservator-restorers, edited by Daniela Pinna, Monica Galeotti, and Rocco Mazzeo (2009), Florence: Centro Di.

Scientific Examination of Art: Modern Techniques in Conservation and Analysis (2005), Washington, DC: National Academies Press. www.nap.edu/catalog.php?record_id=11413

Scientific Research on Historic Asian Ceramics: Proceedings of the Fourth Forbes Symposium at the Freer Gallery of Art, edited by Blythe McCarthy et al. (2009), London: Archetype Publications in association with the Freer Gallery of Art, Smithsonian Institution.

Studies in Conservation / Reviews in Conservation
www.iiconservation.org/publications/

GCI News

Project Updates

Detail of an animation cel from the 1937 film *Snow White and the Seven Dwarfs*, exhibiting signs of cellulose plastic deterioration and paint loss. Photo: © Disney Enterprises, Inc.

GCI–DISNEY COLLABORATION

In early 2010 the Getty Conservation Institute began a collaboration with the Disney Animation Research Library (ARL) to improve understanding of the deterioration that can occur in plastics, a material used increasingly by artists over the last sixty years. This joint effort is part of the GCI's long-term Preservation of Plastics project, a key component of the Institute's Modern and Contemporary Art Research initiative, which engages in a range of scientific research to analyze materials in modern and contemporary art, assess their stability, investigate methods to improve knowledge of the effects of conservation treatments, and find technical solutions for decreasing the rates of deterioration.

The Disney ARL is the world's largest archive of animation, housing approximately sixty-five million pieces of animation art created over a period of more than eighty years by Walt Disney Animation Studios. The expansive collection includes original plastic animation cels and backgrounds, as well as conceptual design work, animation drawings, model sheets, layouts, exposure sheets, models, audiotapes and videotapes, reference photographs, and books.

The animation cel collection provides a unique and invaluable source of cellulose nitrate and cellulose acetate, two classes of plastic particularly vulnerable to deterioration. While the ARL's state-of-the-art storage facilities have extended the life of these materials, the exact aging process depends on a number of factors, including the composition of the plastics. A number of cels in the archive are already showing typical signs of cellulose plastic deterioration, such as yellowing, warping, and cracking, as well as the visible pulling away of artists' paint from the plastic support.

The GCI and Disney ARL will together study this collection to better understand the changes that occur in these materials over time and to learn more about the possible causes of these changes, with the ultimate aim of improving ways of preserving not only Disney's animation cels but also any object made from the same types of plastic.

In the initial phase of research, GCI scientists will assess the best methods for the in situ identification and condition monitoring of cels made of cellulose nitrate and acetate; the scientists will also examine their physical and thermal properties in detail.

This Disney-ARL partnership complements the GCI's existing collaborations with the Smithsonian Museum Conservation Institute in Washington DC, and the POPART consortium of European research laboratories, both of which were initiated in recognition of the acute lack of options available to conservators dealing with the rapidly escalating number of plastic objects in museum collections now showing signs of serious deterioration.

More information on the GCI's Preservation of Plastics project can be found on the project Web site at www.getty.edu/conservation/science/plastics/index.html. To learn more about the Modern and Contemporary Art Research initiative, visit the GCI Web site at www.getty.edu/conservation/science/about/macar.html.

CONSENSUS BUILDING WORKSHOP

In December 2009 the GCI's Heritage Values, Stakeholders, and Consensus Building project gathered a small group of conservation professionals for a three-day workshop at the Getty Center, facilitated by the Consensus Building Institute of Cambridge, Massachusetts. This workshop explored the use of consensus building, negotiation, and conflict resolution in the management of cultural heritage places.

The field of public policy consensus building and dispute resolution has been developing and applying strategies in a wide range of international contexts for more than two decades, including extensive work in arenas related to heritage practice, such as environmental and land use disputes, urban planning, international development, community relations, resource management, and public policy making. Remarkably, application of these strategies to the practice of heritage conservation has been limited, despite the fact that such approaches can help conservation professionals deal constructively with the diverse interests and values attributed to heritage, which often conflict.

The GCI workshop aimed to help bridge the practices of the conservation and consensus building fields and built upon the Institute's long-term work in addressing the values of heritage. Topics discussed included typifying the range of issues and challenges in heritage management that require consensus building approaches; reviewing concepts and strategies in the practice of consensus building, negotiation, and conflict resolution; and discussing participant case studies examining related challenges and strategies.

The workshop produced a number of related recommendations, including the development of guidelines for heritage practitioners on working with stakeholders, the inclusion of methods for dealing with stakeholders in heritage training and educational curricula, and the development of related didactic materials. Proceedings from the workshop will be published and posted to the project's Web site.

The Heritage Values, Stakeholders, and Consensus Building project seeks to help heritage practitioners engage more effectively with stakeholders and other authorities in the conservation and management of heritage places and to explore and promote the application of concepts, strategies, and expertise in consensus building, negotiation, and conflict resolution to heritage place conservation and management.

For more information on the Heritage Values, Stakeholders, and Consensus Building project, visit the GCI Web site at www.getty.edu/conservation/field_projects/heritage/.

Robert Ryman in conversation with Francesca Esmay, Dia Art Foundation, and Rachel Rivenc, GCI, at his New York studio, November 2009. Photo: Thomas Learner, GCI.

Workshop participants prioritize recommendations for promoting the application of consensus building methods to the practice of heritage management. Photo: Michael Aronowitz, GCI.

MODERN PAINTS RESEARCH: ROBERT RYMAN

The Modern Paints project, a central component of the GCI's Modern and Contemporary Art Research initiative, addresses questions regarding the character of modern paint materials through the development of analytical techniques for identifying modern paint media and the evaluation of cleaning methods and techniques for modern paintings. In conjunction with this research, the Modern Paints project is undertaking case studies of materials used by a number of important twentieth-century painters and researching the implications of these findings for the long-term preservation of the artists' works.

One study currently under way focuses on American abstract painter Robert Ryman (b. 1930) and is being conducted in collaboration with the Dia Art Foundation and the Solomon R. Guggenheim Museum, both of New York.

Throughout his career, Ryman has been fascinated with materials and their individual behavior, and his interest has prompted him to experiment with a tremendous range of paint types, including those classified as artists' materials, as well as a range of household and industrial paint products, all within the confines of a very limited color palette—white. This combination of an extremely

Ryman donating samples of some of the white paints used in his work for analysis at the GCI.
Photo: Francesca Esmay, Dia.

limited pigment range with wide diversity in binding media presents a unique opportunity to monitor and compare the handling, aesthetic, and aging properties of a broad range of modern binding media. It also provides an opportunity to test if the analytical techniques used or developed at GCI can detect the full range of paint types.

The first part of the case study involved sampling and analyzing eighteen key paintings in the Dia and Guggenheim collections. The results of this work, presented at the 2009 American Institute for Conservation of Historic and Artistic Works conference in Los Angeles, confirmed the extensive diversity of painting media believed to be used by Ryman. In these paintings, at least eleven different binding media were detected, and all were successfully differentiated by use of the analytical methods developed by the GCI during an earlier phase of the Modern Paints project.

In November 2009, staff from the GCI, Dia, and the Guggenheim visited Ryman's studio in New York to discuss the analytical findings and to interview him in detail about the paints he used and the reasons behind his choices.

Two important results emerged from this visit. First, in every case the conclusions from the analysis aligned with Ryman's excellent recollections of the paints he used; in some cases, the analysis could even differentiate between specific brands of the same type of paint—something that impressed Ryman immensely. Second, a range of original paints used by Ryman in earlier works was discovered in his studio, including many paints that are now no longer commercially available (some possibly dating from the 1960s). Samples were obtained to provide additional reference materials for this study. The second phase of the project is now under way; it involves a thorough assessment of how each of the paint types is aging, with a view to quantifying the extent of any yellowing or changes in brittleness, as well as the full dissemination of results.

For more information on the Modern Paints project, visit the project's Web pages at www.getty.edu/conservation/science/modpaints/index.html.

TENTH WORLD CONGRESS OF OWHC HELD

On September 8–11, 2009, nearly five hundred participants from forty-five countries gathered in Quito, Ecuador, for the Tenth World Congress of the Organization of World Heritage Cities. This event, organized by the OWHC in collaboration with the municipality of Quito and the Getty Conservation Institute, marked the third time the GCI has joined with the OWHC and the host city to deliver the biannual congress, following previous collaborations in 2005 (Cusco, Peru) and 2007 (Kazan, Russia).

The World Congress of the OWHC is a unique forum, bringing together politicians and professionals who are committed to the preservation of historic cities, particularly those inscribed on UNESCO's World Heritage List. Since the first world meeting in 1991, this event has enabled participants to discuss topics of common interest, to share experiences, and to learn about new strategies for meeting the challenges associated with the conservation and management of World Heritage cities.

The theme of the 2009 congress was "Revitalization of Historic Centers: How to Involve All Social Actors?" To explore this theme, the GCI and congress organizers developed a dynamic scientific program consisting of various activities, including three keynote presentations, group discussions centered on questions raised by the presentations, a poster session featuring analyses of case studies, a panel on public-private partnerships, and a concluding session that summarized the most relevant ideas presented during the congress.

A pre-congress mayors' workshop, presented by the GCI, provided an opportunity for mayors to discuss common issues and responsibilities faced in the management of World Heritage cities and to utilize the city of Quito as a case study of regeneration efforts that have taken place in some of the city's most important historic neighborhoods.

The GCI's collaboration with the OWHC has been central to the GCI's current work within the Institute's Historic Cities and Urban Settlements Initiative. The initiative's long-term goals are to contribute to the enhancement of practices in the field of conservation and management of historic cities and settlements, and to address critical needs and issues through the implementation of targeted projects ranging from research and education to fieldwork. The initiative will be informed by the results of a survey of practitioners and an experts meeting carried out in 2009. Additional research undertaken thus far has allowed the GCI to identify critical gaps in the existing body of knowledge related to this area of work and will give further direction to the development of appropriate and effective methods and materials for the conservation of historic cities.

For an electronic version of the 2007 Kazan congress proceedings and further information on the GCI's Historic Cities and Urban Settlement Initiative, visit the initiative's Web site at www.getty.edu/conservation/field_projects/historic/.

Proceedings of the 2005 Cusco and 2009 Quito congresses will be available online by June 2010.

The ARTAX micro–XRF spectrometer acquiring element maps from figures in the Getty Museum's *Chiarito Tabernacle*. Photo: Karen Trentelman, GCI.

CLEANING OF ACRYLIC PAINTED SURFACES WORKSHOP HELD

In July 2009 the Getty Conservation Institute organized a weeklong colloquium at the Getty Center entitled "Cleaning of Acrylic Painted Surfaces: Research into Practice." The colloquium was a component of the GCI's Modern Paints project and the Science Workshops Series developed by GCI Education to connect conservation science with conservation practice. It is a first step toward developing an advanced training curriculum for the cleaning of acrylic painted surfaces.

The colloquium, conducted as a trial studio-based workshop in combination with presentations from instructors and discussion sessions, was led by Bronwyn Ormsby (Tate, London), Richard Wolbers (Winterthur Museum/University of Delaware Program in Art Conservation), Chris Stavroudis (independent conservator, Los Angeles), and Tiarna Doherty (J. Paul Getty Museum), with support from GCI scientists Tom Learner and Alan Phenix.

The invited participants included practicing conservators, conservation scientists, and conservation educators from around the world.

The aims of the colloquium were: to explore the features of acrylic artists' paints which can make this material especially difficult to clean; to examine the role of minor additives in acrylic paints and their influence on the effects of cleaning systems; and to assimilate, review, and collectively interpret the scientific research conducted into cleaning these paints—particularly research on the fate of surfactant present in the original paint formulation.

Colloquium instructor Richard Wolbers demonstrating the process of preparing some novel surface cleaning materials. Photo: Sean Charette, GCI.

Insights emerging from the weeklong program included recognition of the fundamental differences of acrylic paints in relation to traditional artists' paint media, and of the crucial influence of ionic species (additives such as dispersing aids) and other water-soluble components (thickeners, surfactants) on the paint's sensitivity to water-based cleaning systems. In addition, reinforced throughout the event was the importance of precise control over the chemistry of aqueous cleaning formulations, especially in relation to pH and conductivity, and the need for balancing the conductivity of aqueous cleaning liquids with the conditions of the paint surface. The practical sessions of the colloquium allowed participants to have hands-on experience in measuring pH and conductivity of surfaces and to explore the influence of these parameters on cleaning performance.

For more information on the colloquium, visit the Science Workshop Series pages on the GCI Web site at www.getty.edu/conservation/education/sci_series/caps.html.

Recent Events

GCI RECEIVES NSF GRANT

The Getty Conservation Institute has been awarded a grant from the National Science Foundation to support the purchase of a mapping micro-X-ray fluorescence (XRF) spectrometer.

The mapping micro-XRF spectrometer is the latest development in XRF technology. Capable of probing on a microscopic scale, this instrument is also able to generate element distribution maps. This capability will facilitate the study of finely detailed objects. For example, the pigments used to paint individual features in the tiny faces frequently found in manuscript illuminations may now be better characterized.

The capabilities provided by this instrument will significantly enhance the ability of scientists in the GCI's Collection Research Laboratory to contribute to an understanding of artists' materials and methods and to assist conservators in developing long-term preservation strategies. Furthermore, because the instrument is portable, it can be taken to local cultural heritage institutions and universities for research and for the training of a diverse range of professionals and students.

Results generated from the use of this instrument will be incorporated into museum gallery displays, exhibition publications, and public lectures, demonstrating how science can increase understanding, appreciation, and enjoyment of art.

Dunhuang Academy director Fan Jinshi (right), deputy director general of SACH, Tong Mingkang (center), and Neville Agnew, GCI (left) with the commemorative plaque presented to the GCI. Photo: Lorinda Wong. GCI.

GCI AND DUNHUANG ACADEMY MARK TWENTY-YEAR COLLABORATION

The spectacular World Heritage site of the Mogao Grottoes, located along the Silk Road near Dunhuang in western China, comprises 492 painted caves, which were excavated into a mile-long cliff face between the fourth and fourteenth centuries. The paintings in these cave temples represent the highest achievements of Buddhist culture and arts and are a crystallization of the integration and exchange between civilizations in ancient China and those to the west along the Silk Road. The GCI and the Dunhuang Academy (DA) have worked together continuously since 1989 to conserve this heritage, with strong support from China's State Administration of Cultural Heritage (SACH).

To celebrate twenty years of collaboration, Dunhuang Academy Director Fan Jinshi presented the GCI with a commemorative plaque at a reception in September 2009. The celebratory event was attended by the deputy director of SACH, Tong Mingkang, and other senior officials from Beijing and Gansu Provincial Cultural Heritage Bureau.

The anniversary of the GCI–Dunhuang Academy collaboration coincided with the sixtieth anniversary celebration of the founding of the People's Republic of China. This presented an occasion for national recognition of Director Fan, who was named by the Chinese government as one of the hundred most influential people in China for her work at the Mogao Grottoes. She was awarded gold medals by President Hu Jintao for her lifelong commitment to the study and preservation of the site.

The strong and effective partnership between the GCI and the Dunhuang Academy is a model of the Institute's approach to working in the field—addressing problems of international relevance in a systematic manner over the long term, fostering professional relationships, and building the capacity of conservation professionals in China, including hosting Dunhuang Academy staff at the GCI for extended periods of study, research, and training.

Recently the seventh-phase agreement (for a period of three years) was signed between the GCI and SACH. Collaboration with the Dunhuang Academy will continue under the agreement in a number of areas, including scientific research on organic colorants. In the first part of 2010, the GCI hosted DA scientist Dr. Fan Yuquan (see below). Later in the year, deputy director Dr. Wang Xudong will visit the GCI for detailed discussions on the direction of joint efforts.

VISITING SCIENTIST

Dr. Fan Yuquan, from the Conservation Institute of the Dunhuang Academy, was a visiting scientist in the GCI Science laboratories from January through April 2010.

Fan Yuquan worked with GCI senior scientist Jim Druzik to learn microfadeometer techniques in relation to the stability of the Mogao wall paintings under light exposure. He also continued Asian organic colorants research with GCI scientist Cecily Grzywacz and Jan Wouters, a conservation scientist from Belgium. His work at the Institute was supported in part by a grant from the Asian Cultural Council and the Friends of Dunhuang.

INTERNATIONAL WORKSHOP HELD AT MOGAO GROTTOES

Tourism to high-profile heritage sites is a worldwide industry of the first magnitude. For tourists to these sites, an enjoyable and enlightening visit is paramount. For custodians of this heritage, hosting visitors, displaying the site's cultural riches, and reaping economic benefits require high levels of integrated planning, management, and conservation, especially if this tourism is to be sustainable while preserving the site's values.

In fall 2009, the GCI coorganized with the Dunhuang Academy (DA) and the Australian Department of Water, Heritage, and the Arts (DEWHA) an international workshop at the Mogao Grottoes, entitled "Advancing Sustainable Tourism at Cultural and Natural Heritage Sites." Designed to offer participants best-practice models for sustainable tourism management, this workshop arose from the long-standing collaboration among the GCI, DA, and DEWHA to develop a master plan (including visitor management) for Mogao, using the *China Principles*—a set of national guidelines for conservation and management of cultural heritage sites in China—as the guiding philosophy. More than one hundred international and Chinese experts in heritage and tourism conservation from twenty-one countries were in attendance to discuss ways to balance the pressures of rapid tourism growth with the need to conserve fragile heritage sites.

Since 1989 the GCI and the Dunhuang Academy have worked to conserve the cave temples at the Mogao Grottoes and to achieve balance between visitor needs and site preservation. The workshop showcased, through a panel session, the GCI and Dunhuang Academy's work to establish a visitor carrying capacity for the site in the context of a comprehensive visitor management plan undertaken by the DA, the GCI, and the DEWHA.

Research on visitation capacity to the site began by identifying the link between visitors to the caves and deterioration of the wall paintings over a number of years. This research has been incorporated into a simulation model and visitor management tool to manage visitors' numbers, movements, and experiences on the site in an integrated way.

The collaborative work at Mogao was identified by workshop participants as an international model of best practice for sustainable tourism management.

The GCI will continue working with the DA in the area of visitor management and site visitation capacity to validate the results of the study after the opening of the new visitor center. Jointly, the DA and the GCI will implement in Cave 85 a visitor interpretation plan, a viewing area, and a safe new lighting system.

For more information on the Institute's work in China, visit the GCI Web site at www.getty.edu/conservation.

Opening of the workshop "Advancing Sustainable Tourism at Cultural and Natural Heritage Sites" at the Mogao Grottoes. Photo: Lorinda Wong, GCI.

Upcoming Events

CONFERENCE ON THE WORK OF JOSEPH NICÉPHORE NIÉPCE

The National Media Museum (NMeM) and the Getty Conservation Institute are pleased to present "Niépce in England," an international conference on recent advances in scientific, art-historical, and conservation research related to photographic plates brought to England in 1827 by pioneering photographer Joseph Nicéphore Niépce.

This two-day conference, to be held October 13–14, 2010, at the National Media Museum in Bradford, United Kingdom, will present results from new, unpublished research and scientific investigations undertaken by the NMeM and the GCI on three Niépce plates in the Royal Photographic Society Collection at the NMeM.

Registration to the conference is limited and will be on a first-come, first-served basis beginning in May 2010. Please contact the National Media Museum (rsvp.nmem@nationalmediamuseum.org.uk) to receive registration information.

This conference is supported by a number of organizations and private individuals, including the Royal Photographic Society, the Wilson Centre for Photography, the University of Bolton, and the National Gallery, London.

Further information on the GCI's Research on the Conservation of Photographs project can be found on the GCI Web site at www.getty.edu/conservation/science/photocon/index.html.

New Publications

Conservation of Ancient Sites on the Silk Road: Proceedings from the Second International Conference on the Conservation of Grotto Sites
Edited by Neville Agnew

The Mogao Grottoes are located along the ancient caravan routes—collectively known as the Silk Road—that once linked China with the West. Founded by Buddhist monks in the late fourth century, Mogao grew gradually over the following millennium, as monks, local rulers, and travelers carved hundreds of cave temples into a mile-long rock cliff and adorned them with vibrant murals portraying Buddhist scripture, Silk Road rulers, and detailed scenes of everyday life.

The sixty-five papers from the Second International Conference on the Conservation of Grotto Sites address such topics as the principles and practices of wall paintings conservation; site and visitor management; scientific research, particularly in the environmental and geotechnical aspects of conservation; and relevant historical and art-historical research.

Neville Agnew is senior principal project specialist at the Getty Conservation Institute and has led its initiative in China since it began in 1989. He is the author of numerous publications, including (with two coauthors) *Cave Temples of Mogao: Art and History on the Silk Road*, and the editor of the proceedings of the first international conference on the conservation of grotto sites, published in 1997.

Issues in the Conservation of Photographs
Edited by Debra Hess Norris and Jennifer Jae Gutierrez

This volume is the first publication to chronicle the emergence and systematic development of photograph conservation as a profession. In seventy-two essential texts from the nineteenth century to the present day, this anthology collects key writings that have influenced both the philosophical and the practical aspects of conserving photographs, including some that have never been published.

Many of the topics have been debated since the introduction of photography. By promoting an understanding of these issues, this volume seeks to advance the education of rising conservation professionals, inspire new scholarship, and contribute to the field's ongoing evolution.

Debra Hess Norris is vice provost for graduate and professional education, chair of the Art Conservation Department, and professor of photograph conservation at the University of Delaware. Jennifer Jae Gutierrez is assistant professor in the Art Conservation Department at the University of Delaware.

Getty Conservation Institute publications can be ordered online at the Getty Bookstore (www.getty.edu/bookstore) or by calling 800-223-3431 (United States) or 310-440-7333 (international).

CONSERVATION PERSPECTIVES
THE GCI NEWSLETTER

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Conservation Perspectives, The GCI Newsletter is distributed free of charge twice a year to professionals in conservation and related fields and to members of the public concerned about conservation. Back issues of the newsletter, as well as additional information regarding the activities of the GCI, can be found in the Conservation section of the Getty's Web site, www.getty.edu/conservation/.

The Getty Conservation Institute works internationally to advance the field of conservation through scientific research, field projects, education and training, and the dissemination of information in various media. In its programs, the GCI focuses on the creation and delivery of knowledge that will benefit the professionals and organizations responsible for the conservation of the visual arts.

The GCI is a program of the J. Paul Getty Trust, an international cultural and philanthropic institution that focuses on the visual arts in all their dimensions.

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CONSERVATION PERSPECTIVES
THE GCI NEWSLETTER

Group study day of *Laudario of Sant'Agnese* manuscript leaves, held in one of the J. Paul Getty Museum's galleries, as part of collaborative research into Renaissance workshop practices. Photo: Karen Trentelman, GCI.

The Getty Conservation Institute