Conservation

The Getty Conservation Institute Newsletter ■ Volume **19**, Number **1** 2004

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The Getty Conservation Institute (GCI) works internationally to advance conservation and to enhance and encourage the preservation and understanding of the visual arts in all of their dimensions—objects, collections, architecture, and sites. The Institute serves the conservation community through scientific research; education and training; field projects; and the dissemination of the results of both its work and the work of others in the field. In all its endeavors, the Institute is committed to addressing unanswered questions and to promoting the highest possible standards of conservation practice.

The GCI is a program of the J. Paul Getty Trust, an international cultural and philanthropic organization devoted to the visual arts and the humanities that includes an art museum as well as programs for education, scholarship, and conservation.

Conservation, The Getty Conservation Institute Newsletter, is distributed free of charge three times per 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

Front cover: Detail of a French lithograph, *Woman with Prayer Book,* showing pronounced mold growth on the print's surface. Although this work—part of the collection of the Shelburne Museum in Vermont—was stored in a climate-controlled area, the tempered air was not properly circulated. During the summer months, the room's relative humidity reached levels high enough to support mold growth. Following the hiring of a conservator by the museum in 1982, the storage conditions of this and other paper artifacts were modified, and visible mold was removed from this particular print. *Photo:* © Shelburne Museum, Shelburne, VT.

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Effective Preservation

FROM REACTION TO PREDICTION

By Robert Waller and Stefan Michalski

Feature

Consider a day in the life of a museum conservator—we'll call her Carrie—working in the field of preventive conservation (PC).

At 8:00 AM on Monday, Carrie arrives at her office. Before her coat is off she notices several small plastic bags on her desk left by the weekend staff. Each packet contains one or more insects, accompanied by a form showing where they were found. The samples in one of the packets—gathered near a temporary exhibit case containing material loaned from a smaller institution—are live beetle larvae, but not the genus of *Dermestid* commonly seen. Carrie makes a note to identify the pest and examine that display case.

Among Carrie's emails is a request from a curator to raise for three months the temperature in the textile collection room from the normal 17°C to 22°C; an elderly scholar will be visiting and working in the collection. Carrie knows it is possible to predict increased rates of thermal degradation of various fibers and the increment in risk due to pests given a change in temperature, and she recalls that she can call a Canadian colleague who put the prediction model into a spreadsheet. Even so, she will need to speak with the curator and collection manager to determine the benefits of the proposed work and whether alternative locations for the work are possible. Then she will need to consider and communicate the transport and temporary housing risks associated with relocating part of the collection.

Another email message advises of the need to replace the building's main water supply pipe. Carrie replies asking for a meeting with security and facilities staff and lists issues to consider, including flood risk, sprinkler function and fire protection, insurance continuity, and humidification system operation. The phone rings with news that a condensate water leak from an air-conditioning unit has been discovered in the rare book vault. While there is no need to muster the water emergency response team that Carrie assembled last year, she dispatches a conservation technician to assess that situation, ensure cleanup is occurring, take relative humidity readings, and report back. As she sends an email to facilities management asking for a report on the leak's cause and the proposed action to fix the problem, the museum director's personal secretary calls to say that the director would like to see her.

"You recall our exhibit of our six Turner watercolors earlier this year," says the director. "Well, I had dinner with Mr. Smith on Saturday. He's prepared to solicit his corporate board for donations for our new capital project and feels that having those watercolors displayed in his boardroom for six months would help open the pockets of his board members. I know you were keen to get those paintings back in the dark when the exhibit was over, but you must understand how important the capital project is and how much better environmental conditions will be once it's complete. I'd like you to advise us how those Turners can be safely put on display in Smith's boardroom." He turns back to his desk, then pauses. "Oh, and Carrie, I'd like your idea by noon tomorrow."

Back at her desk, Carrie considers the fact that the policy-permitted light dose for the Turner watercolors for the next five years has been used up. She's certain the model that the policy is based upon is reliable, but she also knows that the sensitivity of the paintings was conservatively estimated. Still, what about the much more serious risks of transporting the watercolors and leaving them to the vagaries of a working boardroom—chairs on wheels, food and drinks, preoccupied occupants, nighttime cleaning staff, and ordinary office locks? How can she convey to her director this mix

of certain and uncertain concerns? Her information should support a defensible decision on the loan in a way that identifies and prioritizes each risk, offers ways to mitigate those risks, and gives the cost of those options—but by tomorrow?

As she handles these issues, Carrie knows she must also contribute to the museum's planning cycles and set priorities for improving care among ten major collection units, not to mention the museum's heritage building. A conservation survey exists, but it is more than five years old. Several departments are unhappy with the low priority of their particular collections. Besides, Carrie knows that new knowledge has emerged since the survey, knowledge not reflected in current priorities.

What she needs is a system to do all this—or at least to help her do it.

Challenges for the Conservator

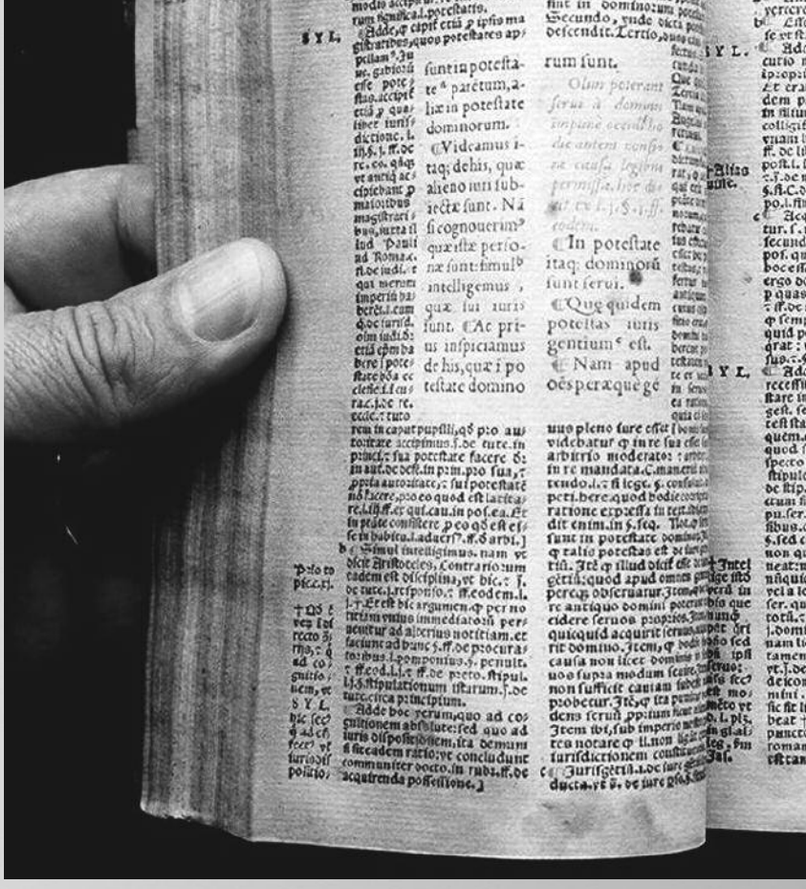
While many professions have become exceedingly narrow, preventive conservation has evolved to become one of the most interdisciplinary fields. It uses knowledge from materials science, building science, chemistry, physics, biology, engineering, systems science, and management, as well as a host of technical fields. In addition, it requires an understanding of multiple value systems within many cultures and an appreciation of how cultural properties deliver value to those groups. Carrie exercises a Renaissance breadth of knowledge in just one working day and, in addition, taps into her personal network of international experts. Not every collection can be so lucky. Today, perhaps none can.

We can consider this breadth of required knowledge for the preventive conservator the "encyclopedia" challenge. Depressingly obvious to Carrie is a further reality of encyclopedias: they need constant revision by experts, and she has no time to read the latest one.

Even if the encyclopedia on collection risks can be organized into a few large themes, each will contain hundreds of independent subentries. In a single decision dilemma, such as the Turner watercolors, Carrie contemplates a multiplicity of entries from her risk encyclopedia: from light damage on several colors, to a dozen or so sources of physical damage, to spillage of alcohol, to fire, and theft. Traditionally, it has been difficult enough to develop sound advice on how to control any one risk, but balancing different risks—finding a single scale to apply to all of them—has not been normal practice. In fact, attempts to do so have been dismissed as "trying to compare apples and oranges."

Even with all the right facts from the encyclopedia at hand (and the problem of comparing apples and oranges somehow solved), the Turner watercolors dilemma becomes a formidable array of contributing factors. Calculated risks and benefits, in turn,

Workers dusting the collection at the National Museum in Cairo (circa 1980). Dusting sculptures, maintaining display case microenvironments, keeping floors clear of pest habitats, and controlling daylight levels can be effective activities when carried out as part of an overall strategy for collection preservation. *Photo:* Stefan Michalski, CCI.



Near right: A 16th-century book penetrated by over two centuries of industrial sulfur, resulting in a brown band that reaches into the text block. *Far right:* A century-old blue dress faded to colorlessness after only 10 years of modern museum display. These are just two examples of the diversity of cumulative risks and related types of damage affecting museum collections. *Photos:* Stefan Michalski, CCI.

need to be balanced against the larger, long-term risks to works in the museum—which is itself a huge array of related factors. If one or two entries in the risk encyclopedia are updated, then all interacting risk estimates need to be recalculated. So even if one reads the whole encyclopedia and also finds a way to compare apples and oranges, redoing this each time the encyclopedia is updated, let alone for every new minicrisis, is impossible.

If preventive conservation is so huge and complex, how has it been done up until now?

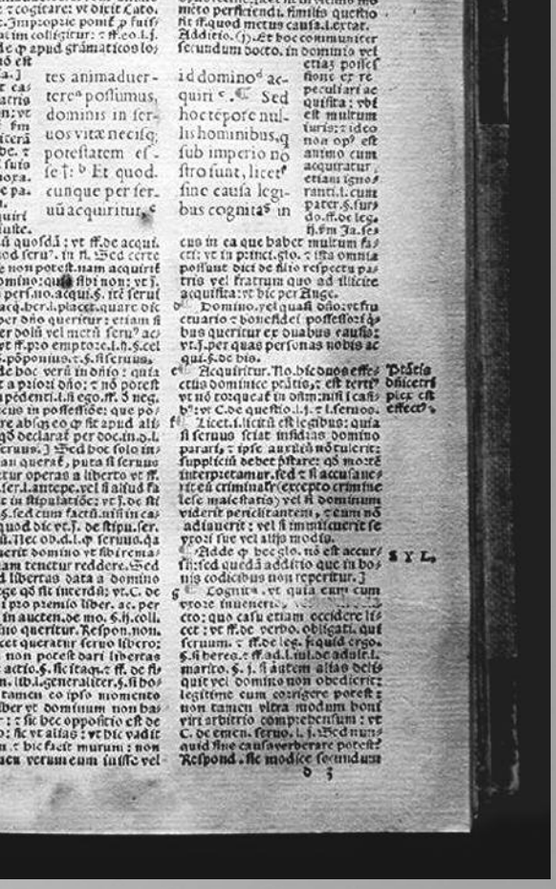
Writing a definition of preventive conservation and its activities, and then writing its history, tends to provoke disputes over the meaning of the term and over the roles of conservators, scientists, curators, housekeepers, and many others in its development. What seems without dispute is that human beings have always kept and cared for those things that are labeled precious. Preservation is an ancient human activity.

Modern philosopher and historian John Ralston Saul proposes that six core qualities allow us to act as reasonable, decent human beings: common sense, memory, intuition, imagination, reason, and ethics. Saul argues that over the last few centuries, and especially in the twentieth, reason has assumed a dangerous dictatorship over the other qualities. This dictatorship of reason has fed, and has been encouraged by, narrow professional specialization, specialized technical languages, and the growth of large institutions.

If we apply Saul's ideas to a history of preservation, it would seem fair to say that from ancient times, memory and common sense provided the preservation encyclopedia, while a mix of common sense, intuition, and reason handled the apples and oranges problem, as well as the complexity problem. Imagination helped with innovative solutions, and ethics tried to keep it all, well, ethical. Although a large amount of practical preventive conservation activity still relies on a balance of these six human qualities, "modern" preservation, or preventive conservation, is very much about the rise of reason, through scientific knowledge and professional expertise. Carrie is stuck trying to use an enormous and highly fractured modern encyclopedia, with no tools other than her own common sense and intuition to solve the problems of apples and oranges and of complexity.

Toward a Risk Management Future

Current practice in preventive conservation involves standard survey methods based on checklists, supplemented by professional judgments and focused investigations. From a decision making perspective, this is a "satisficing" procedure in which the conservator steps through checklists, skipping over topics that she is satisfied are not critically important to preservation. This rational approach, like all approaches to rationality, relies upon bounded rationality. A fully rational approach would require that all possibly relevant information be obtained and used in arriving at a decision or



evaluation. The cost of—and time required for—a fully rational decision is infinite. Instead, a conservator evaluates, using heuristics (simple rules of thumb or intuition), whether there is an advantage in seeking more information before deciding whether a particular issue, such as a risk to a collection, is significant or not.

Checklists give the illusion that the apples-and-oranges problem has been solved. But it has not. For example, there will be questions on fire control and questions on humidity control, among many others, but the relative significance of each item within a group of items, and of each group within the whole survey, remains unknown. Without a formal structure or a common assessment scale for all items, judgments are impossible to evaluate objectively. They can be inconsistent, biased, or both.

German psychologist Dietrich Dorner, in his 1996 book *The Logic of Failure,* wrote, "Methodism is likely to flourish in those situations that provide feedback on the consequences of our actions only rarely or only after a long time. In particular, if our plans apply to a field in which we rarely act, our planning gradually degenerates into the application of ritual." Unfortunately, we too often see ritual in our profession. One example is a tenacious holding to magic numbers for humidity and temperature standards, even in situations where their application is not just wasteful but counter-productive. The major problem is the sparse, slow, or even absent feedback to our actions. Did reducing humidity fluctuations by expensive machinery improve preservation? If so, by how much? And if by that much, was it worth it? The impressive machinery and flat-line humidity data must not be confused with an ultimate goal. They are simply hopeful intermediaries that are easily observed, as are improved facilities in general. They might contribute to the preservation goal but they are not the goal.

The escape from ritual comes from stepping back to conduct a full analysis that embraces real uncertainties in the system—in other words, taking a risk management approach. Preservation is then the cost-effective reduction of the total of all predicted risks. There are three key elements:

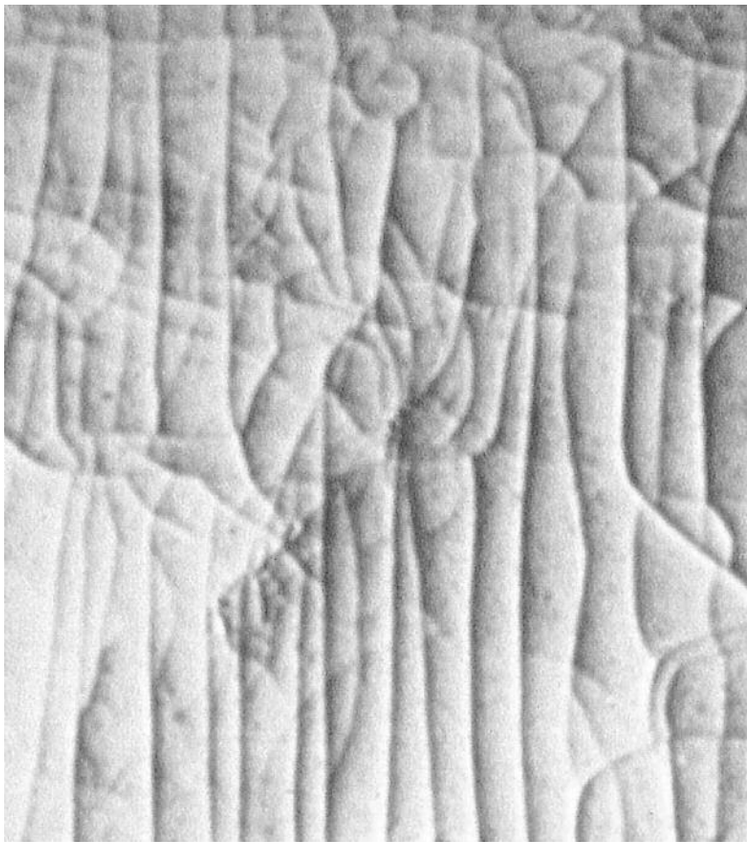
- a common scale for magnitude of all risks, such as fractional loss of value per century, so that we can compare apples and oranges;
- a prediction of the magnitude of each risk if nothing is changed; and,
- a prediction of how these magnitudes will change if certain improvements are made. This reduction in risk is a prediction of expected results, which—uncertain though it is—is the only reasonable guide we can use for our preservation decisions.

A subtle distinction, which we note here briefly, is that uncertainty enters risk assessments in two ways:

Ignorance: Information may be lacking, either in the survey resources or in the encyclopedia of our knowledge. We can reduce this uncertainty, but we would be wise as a profession to focus on significant uncertainties rather than on insignificant ones.

Variability: Some risks occur "by chance," so it is uncertain if Carrie's museum will ever experience them, just as we will never know if we will win a lottery. It is certain, however, that the chances are predictable and changeable—having two tickets doubles our chances at the lottery. In most cases, the expected effect of these by-chance risks can be influenced.

In many parts of the world, new ideas for approaches to preventive conservation are taking hold. Many, if not most, of these involve risk-based strategies. The Risk Map of Cultural Heritage in Italy being developed by the Istituto Centrale per il Restauro is just one example of a national-scale, risk-based PC project. Higher-level degrees in conservation being offered by schools such as the Royal College of Art, University College London, and the Institute of Conservation at the University of Göteborg increasingly involve risk-based preventive conservation research topics.



An Expert System

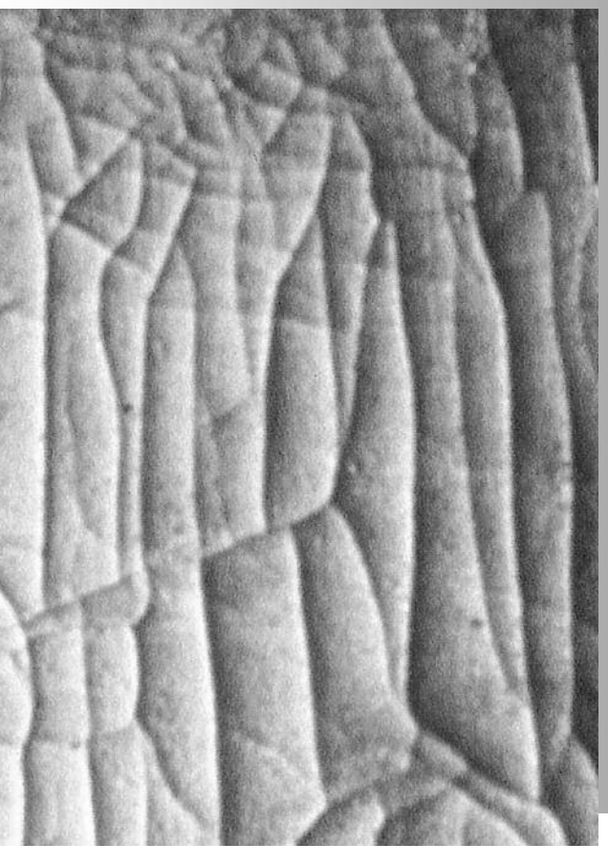
So what about the system that Carrie needs? This system would maintain an up-to-date encyclopedia of knowledge, take advantage of the common risk scale to compare apples and oranges, use a sufficient array of details, and make complex calculations instantaneously. Further, it would allow Carrie to change one or two details (i.e., enter possible improvements) and then recalculate to see the predicted results of the proposed improvement. It would also allow Carrie to explore all the known facts of the Turner watercolor dilemma and evaluate different options. In fact, the system could automatically suggest those factors that contribute most to total risk and that might be addressed first for the most cost-effective risk reduction.

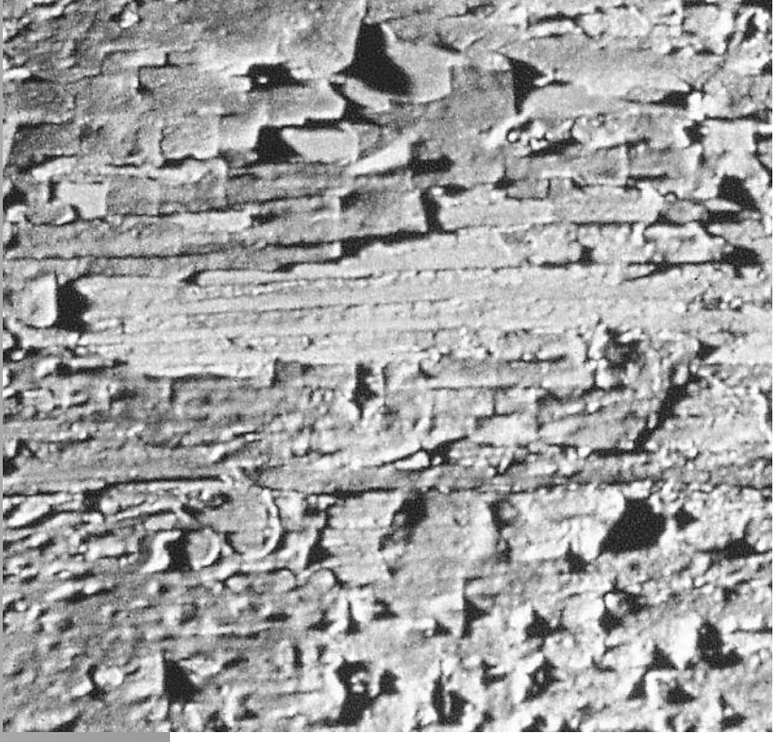
The Canadian Museum of Nature and the Canadian Conservation Institute are working in partnership on such a system. This long-term project builds on the systematic risk assessment approaches that the authors developed over the last decade using computerization, in the manner of what were previously called "expert support systems" but which may now be considered "knowledge-base systems." Internally, the system will build on the checklist approach, but it will allow each question to come with comprehensive lists of options. To each option will be attached either a summary expert opinion of its significance or, where possible, a predictive mathematical model. The system will integrate the effects of buildings, collection rooms, cabinets and boxes, jars or bags. It will also incorporate the influence of museum policy and procedures in reducing risk. The system will ask users questions about their situation. Where are you? What kind of collection do you have? What kind of building is it in? Beyond the first few questions, further questions will be presented according to the likely importance of further information. For a paper-based collection, for example, questions related to water and relative humidity will likely be important. For a gemstone collection, in contrast, questions related to security would be more important and more carefully explored.

It is a large task, but patterns are evident in risk analysis employed in other fields, including the application of the key elements we listed earlier: a common scale for magnitude of all risks, a prediction of the magnitude of each risk if nothing is changed, and a prediction of how these magnitudes will change if certain improvements are made.

During the last two years, we widely explored the field of risk analysis, looking into systems applicable to ecosystems, engineered systems, and marine and aviation transport safety, among others. We are also researching available geo-referenced sources for natural hazard potential and for climate norms; once users enter their geographic location into the system, the system will provide the flood risk, the weather, the frequency of damp days, and so on. Similarly, once users enter their building type or wall fabric, the system will know such things as the fire rating or the time it takes for an expert thief to break through. There is a great deal of relevant knowledge already computer accessible.

There is also a great deal known but not readily available. We therefore need a system that is social, open, and evolving over time. It must be an accessible framework in which PC scientists and practitioners in all disciplines can combine their knowledge, observations, concerns, and best advice. By pooling expertise, the system





Details of two painted objects damaged as a consequence of environmental conditions. In the anonymous folk art painting on the left, the severely cracked surface is a result of widely fluctuating levels of relative humidity (RH). The flaking paint on the mid-19th-century wooden trade sign on the right was caused by low RH in a gallery that was heated but not humidified during the winter; all the flaking paint was readhered during conservation treatment in 1984, and the historic inn where the artifact is exhibited was climate controlled in 1993. *Photos:* Richard Kerschner; © Shelburne Museum, Shelburne, VT.

will both leverage and ratify each expert's advice and will make the advice available according to a user's needs.

Preventive conservation advice offered to a user will be guided by the assessed importance of risks. To some extent, suggesting a range of answers to questions is educational in itself. For example, responding that archives are in: (1) piles on the floor, (2) folders on shelves, or (3) acid-free folders in archive boxes on shelves, then immediately seeing the impact on estimated risks, should be educational.

Basic risk mitigation advice may be offered from a system database. At the very least, the system would generate relevant search terms for any other searchable knowledge bases of conservation publications, via the World Wide Web. Wherever the system identifies large uncertainties in risk caused by missing or uncertain information, it will have identified areas of priority for conservation research.

The Best Available Prediction

The potential for preventive conservation to progress is limited by our ability to surmount three major challenges. The encyclopedia challenge and the complexity challenge are exactly what computers are good at. The apples-and-oranges challenge can be solved by adopting a common scale for all risks, as is normal in any risk-management business. The authors have promoted the scale "fractional loss of value per unit time," as described elsewhere.

John Ralston Saul reminds us to be humble, even cautious, about the power of reason alone. The *Terminator* movies remind us to be cautious about reason and computers combined. We need the equivalents of common sense and intuition in our computer system. Part of those equivalents will be the pooled expert judgments at many levels within the system. These will be the heuristics that constitute the system's bounded rationality. Many of the system's calculations will use tables of expert judgments. The system's outputs, ultimately, will be pieces of advice written by practitioners in the field, as well as by the authors. The system will, in fact, amplify common sense and intuition and imagination by sharing the best examples of each. Ethics will be left to the users themselves, such as Carrie and her director. That will not change. But they will know the implications on preservation much, much better.

The risk management approach does not need a computer system—it will just be much easier with one. What it does need is recognition that effective preservation cannot be measured by easy observables as soon as the money is spent, or even in our lifetimes. It can only be measured by the best available prediction of those effects, however imperfect those predictions might be.

Robert Waller is chief of the Conservation Section of the Canadian Museum of Nature in Ottawa. Stefan Michalski is the manager of the Preventive Conservation Services Division of the Canadian Conservation Institute, also in Ottawa.

Sustainable Access

A Discussion about Implementing Preventive Conservation

The results of conservation research are meaningful to the extent that they can be applied in a practical way. **Conservation** *spoke with three conservators at diverse institutions who have devoted a good deal of time and thought to the application of preventive conservation to objects, collections, buildings, and landscapes.*

Sarah Staniforth *is the head conservator of the National Trust in England. Formerly a member of the Scientific Department at the National Gallery in London, she joined the National Trust in 1985 as advisor on Paintings Conservation and Environmental Control. She is a vice president of the International Institute for the Conservation of Historic and Artistic Works (IIC) and is chair of the United Kingdom Institute for Conservation of Historic and Artistic Works Professional Accreditation of Conservator Restorers Committee.*

Richard Kerschner *is the director of Preservation and Conservation at the Shelburne Museum in Vermont, where he established the conservation department in 1983. He guided the establishment of the Vermont Museum and Gallery Alliance's Collection Care Program and teaches preventive conservation workshops for the American Association for State and Local History. He is a fellow of the IIC and serves as the treasurer of the American Institute for Conservation.*

Jonathan Ashley-Smith *is senior research fellow in Conservation Studies at the Victoria and Albert Museum (V&A) in London and a visiting professor at the Conservation Department of the Royal College of Art. Between 1977 and 2002 he was head of the Conservation Department at the V&A. His book* **Risk Assessment for Object Conservation** *was published in 1999. In January 2003 he was elected secretary general of the IIC.*

They spoke with **James Druzik**, *a senior project specialist in the Science department of the GCI, and* **Jeffrey Levin**, *editor of* **Conservation, The GCI Newsletter.**

Jeffrey Levin: *The vast number and diversity of things that we wish to preserve present a considerable preventive conservation challenge. Is preserving preventively the full gamut of objects and collections, to structures and landscapes, even feasible?*

Sarah Staniforth: The fact that so much heritage has survived until now is evidence of that. The actions taken under the banner of late-20th-century scientific preventive conservation are reworkings of traditional good housekeeping. And I don't mean just good housekeeping of collections but of building maintenance as well. If you look back to William Morris writing in the 19th century, he espoused "little and often," which is what preventive conservation is in the context of building conservation.

Richard Kerschner: I came into preventive conservation about 20 years ago when I became the only conservator at the Shelburne, which is essentially a collection of small museums—we have 40 buildings on 40 acres. Being trained as a treatment conservator, I first built a lab and started treating artifacts. I very quickly realized that working alone I would be lucky to treat 40 artifacts a year. There are approximately 186,000 artifacts in the collection, and I decided that I could not make any progress preserving the collection without preventive conservation. It's just the most efficient way to make sure artifacts last into the future. We now have two conservators—one to do treatment and one to focus essentially on preventive conservation.

Staniforth: Richard, I had exactly the same experience when I was hired by the National Trust to do paintings conservation. I moved

very rapidly into doing preventive conservation. There was no point in putting conserved paintings back into damp houses.

Jonathan Ashley-Smith: The reason that preventive conservation will not disappear under any circumstances is because it's actually so easy to do major good just by putting things in a dry place. It doesn't really require a huge amount to make objects last a great deal longer.

James Druzik: *What research opportunities will drive preventive conservation beyond the intuition and commonsense housekeeping of the 19th century? Jonathan, I once saw a graphic you prepared that showed preventive conservation at a point where you couldn't justify too many more dollars in at least air pollution research. How true is that for all preventive conservation research?*

Ashley-Smith: You can reach a point where you can choose not to put more money into research because you're getting such a small return for it. But museums and organizations are collecting all sorts of new materials, and new technologies in the world outside museums generate new materials. There's always going to be room for trying to understand the way new materials degrade or react with their environment. The general trend lately has been trying to know a lot more about deterioration mechanisms, degradation, and so on. For instance, major European research on paper and leather still hasn't answered all the questions sufficiently to get damage functions or rates of deterioration that help you with usefully predictable outcomes.

Kerschner: I favor research that is pointed toward practical use. Recent U.S. research on safe humidity levels for artifacts has been very important for Shelburne. Under the old guideline of 50% RH plus or minus 2%, we just threw up our arms and said, "We can't do that." The research now indicates that the main damage to artifacts occurs below 25% RH and above 75% RH. This information opens up a whole range of mitigation actions for museums.

Staniforth: The management of all this is really important. It's all very well having the results of research, but if they're not applied wisely, then you may as well not do the research.

Levin: *Can preventive conservation truly be effective in an institution without it being the designated responsibility of a particular individual?*

Staniforth: I wouldn't limit it to a particular individual. Having just one expert is not necessarily the most effective way of dealing with this. If you've got a whole department of conservators, then it's helpful for every conservator to understand that preventive conservation is one of their common responsibilities.

Photo: Nancie Ravenel

—*Richard Kerschner*

"What makes preventive conservation really sustainable at smaller institutions is having a person with the appropriate knowledge directly responsible for it."

Kerschner: I'll extend that to the whole museum staff. Our curators, exhibit designer, protection services personnel, buildings and grounds crews, and collections management staff are all integrally involved in preventive conservation. But without someone like the conservator to champion preventive conservation, integration of preventive conservation actions would not be nearly as effective.

Staniforth: That's nicely put, Richard. The advocacy and champion role of an individual is helpful, along with making it a common responsibility of the whole museum staff.

Druzik: *Isn't it the conservator's role to ensure the accuracy and appropriate application of this information that is now in the hands of other staff members?*

Kerschner: Certainly. I've also found that it's important to take the right approach to do this, and to work with other staff members to establish credibility. If conservators are too precious or indignant, their advice will be ignored. It is important to compromise when necessary, keeping the big picture in focus. If you get along with and respect the opinions of other staff members, they are more likely to value your advice.

Staniforth: I couldn't agree more. It's team working, isn't it?

Kerschner: It's all teamwork.

Ashley-Smith: In the case of the V&A, it's more a matter of expertise being available and also, possibly, one or two people with good judgment being able to say this is—or is not—a battle we can afford to lose. People want us to help them store collections under the right

conditions. I think those are the two sides, the judgment and there being real expertise somewhere in your building—someone who actually knows what you're talking about rather than providing quick answers out of a book.

Levin: *And has that process worked fairly fluidly in your own institution?*

Ashley-Smith: I would say so. None of our storage areas are high tech, but they're all clean, well organized, and the objects are not deteriorating rapidly. And we have things like the integrated pest management system, which involves everybody from curators to cleaning staff.

Levin: *Would you say that the ability to make the concept of preventive conservation a pervasive one is as key to its success as having the knowledge itself?*

Ashley-Smith: Training is essential. Through the conservation department, we've put a lot of effort into getting general concepts over to the people who want to know the answers—curators, collections managers, and so on. Every few years, we have a big push trying to get the latest concepts of conservation over to people.

Druzik: *There's a lot of energy and resources that can go into preserving collections and buildings, but when it is not maintained, it's a wasted effort. How do you sustain it?*

Ashley-Smith: One way is to do what's been done at the V&A for a long time now. Any project that involves the collection automatically has a conservator on the project team. This has two purposes. One is to make sure that if there's a demand for interventive conservation, it is recognized early on, and it gets into the program. The other is to make sure that before individual objects go into storage or display, someone looks at them from the point of view of, "no, don't put them there because that's too light" or "don't put them there because people are going to touch them," and so on.

Kerschner: At a smaller museum like Shelburne, we do the same thing on a more informal basis. The fact that we have a conservator at the senior staff level—and that I can freely communicate with all the other staff members directly involved in a project—is extremely important in promoting preventive conservation actions.

Staniforth: Can I just go back to a word that Jonathan used, which was "project"? One of the things that makes me uneasy is the move away from operational budgeting that pays the salaries of maintenance staff and encourages the "little and often." The budgets for staff salaries are being shifted into big projects as organizations move into this project culture. That is what's happening in the U.K. We do not have the operational budgets to pay for the levels

Photo: National Trust/Nigel Seeley

—*Sarah Staniforth*

> **"It's our responsibility as museum professionals to look at that wider environment and think about our social responsibilities, as well as our responsibilities to the collections."**

of preventive conservation that collections need, and therefore we fund more and more preventive conservation through projects.

Ashley-Smith: I agree. In terms of sustainability of conservation, it's best having people around who know the collections and can be there on a day-to-day basis to do that "little and often" maintenance. Departments such as the one at V&A have people around to make sure things are kept under control. However, in a lot of museums there is a decrease in permanent staff and a decrease in specialized staff, with staffing growing much more out of a contract, project-based environment. This is a real long-term danger.

Kerschner: We've been practicing project-driven preventive conservation for the last 15 years. Much of our preventive conservation money comes as grants from the Institute for Museum and Library Services and the National Endowment for the Humanities. We've implemented projects for fire, security, lighting, and environmental improvements. Without that money, which is significant, we would be nowhere near where we are regarding preventive conservation actions.

Ashley-Smith: In terms of step-by-step improvement, the project is a good way of doing it. But you're not necessarily left with the money to maintain what you've just achieved.

Kerschner: I believe that one of the reasons that we received one large environmental improvement grant is that we recognized that we would have to permanently add a person to the staff to maintain the equipment being installed under the grant, and stated our willingness to do so in the grant application.

Staniforth: It's difficult in the United Kingdom to get endowments for the ongoing maintenance and staff costs. Granting bodies, on the whole, won't give money for endowments. You have to rely on gifts.

Levin: *What I'm hearing here is that at a time when conservation is moving toward preventive conservation—which of course is long term at its foundation—the surrounding culture embraces a short-term perspective.*

Staniforth: It's a real concern. Our lives are driven by the short term, aren't they? If you compare our situation with that of the environmental movement, we face the same challenges that they do, in that no one in government cares what happens in 25 years' time. They're worried about getting elected in the next term. That's probably as true in the States as it is in Europe.

Kerschner: This influences the way we design our projects. We have to look at sustainability very closely, realizing that after we've installed or upgraded equipment, we will have to maintain it on our own budget. We strive to install practical, uncomplicated environmental control, security, or fire protection systems. This may mean adapting commercial equipment to meet our needs rather than purchasing specialized industrial equipment. Such systems are less expensive and can be easily serviced by local contractors.

Ashley-Smith: When we talk about long-term things under the banner of preventive conservation, getting something mechanical maintained probably isn't too difficult. But what about lower-level preventive conservation needs? For example, we have a large library collection. You can keep books from falling apart or tears getting worse with just a low level of maintenance or interventive conservation, which prevents damage. If that sort of thing is project driven, museum administration, when looking at its priorities, will say, "Yes, you can have a conservator for this project." It won't say, "Yes, you can have a conservator sitting here stopping books from falling apart."

Staniforth: In talking about the short-term view in the context of economic sustainability, if you take something as simple as applying UV filters to windows, you're probably not going to see the benefit of them within five years. You're looking at a longer-term benefit. And the accountants aren't very interested in benefits that might be seen in 10 or 25 years.

Druzik: *Those UV filters may have to be replaced several times before the absence of those filters would show up. That means you have replacement procedures with no detectable benefits to the museum director. It takes faith on the part of the director to accept that this needs to be done. That's the kind of sustainability that one fears is threatened.*

Staniforth: It's the sort of cost-benefit research that's interesting to do. With paintings collections, you can look at the rate at which the varnish discolors and therefore needs to be removed and relate that to the frequency with which you need to replace the UV filters, and you start to get a cost-benefit analysis.

Kerschner: It is frustrating. If we do our preventive conservation job well, we prevent the damage to artifacts that ultimately proves our advice was correct. Of course, one can cite past damage to promote preventive conservation actions. Before conservation was established at Shelburne, some dolls had been displayed under fluorescent lights for over 40 years. The staff did the best they could years ago when they set up those cases, but improper lighting damaged the doll costumes. I'm able to point to some of these dolls that were too close to lights and say, "This is what happens, and that's why we have to protect them from excessive light in the future."

Druzik: *Is the conservator in the trenches, who is just trying to keep the environmental conditions stable as he or she sees them, even considering assessing risks more than just stopping imminent catastrophes?*

Ashley-Smith: During my time at the V&A conservation department, I did manage to move the on-the-ground conservators more toward risk assessment and therefore to become less risk averse. Given that some conservators can be a bit dogmatic, if you can get them to use judgment and consider risk assessment, then that's a good thing. If you don't take the most extreme view of the precautionary principle, then risk assessment including cost-benefit analysis—using the precautionary principle as some sort of guide—brings you to a sensibly risk-averse way of dealing with collections. Then you actually end up with a slightly more old-fashioned, but sensible, conservative view about how things ought to be dealt with.

Druzik: *It's really a delicate line to walk, isn't it, because the 50% plus or minus 2% RH is a quintessential risk-aversion position. The idea of assessing risks and allowing those humidity conditions to stray a bit can be terrifying when you consider the potential damage if the sensors are not giving you the information you need to assess that risk carefully.*

Staniforth: There's nothing like a disaster to put those things in perspective. One of the most influential events in my professional life was dealing with a house that burned down. It made me realize where the gains are to be made by good preventive conservation. Of those nine agents of deterioration, dealing with fire, prevention of theft and vandalism, and making sure you've got a sound building are going to get you the greatest cost benefit. I think that helps you to understand the whole concept of risk and to avoid being risk averse.

Druzik: *When you put it that way, Sarah, it seems to boil down to just a lot of common sense. Maybe there's nothing that really distinguishes common sense and preventive conservation.*

Staniforth: The more I do this job, the more I come to that conclusion.

Kerschner: Same here. Common sense is the basis for preventive conservation.

Druzik: *So when you finish reading a new piece of research, do you sit back in your chair and say, "That's what I thought in the first place. I knew that."*

Ashley-Smith: Well, knowing how much faster leather will degrade if there's more sulfur dioxide in the air—those sort of figures are not intuitive. The results follow your intuition, but actual numbers can be useful, and that's what the research is all about—providing the numbers.

Druzik: *In the United States, as well as in some other countries, there is a concept among some manufacturing and engineering firms to document procedures and testing to a rather painful degree of precision, in order to guarantee that the product retains fidelity and quality over the long term. In conservation, we're making a lot of assumptions about the products that we're using. How does one maintain, over several careers, the same qualitative approaches to specifying materials that are used that attain desired results?*

Ashley-Smith: What you've just described is a sort of quality control, but to a standard procedure. It does happen in the museums with which I am familiar, but not in a totally formal way. For example, anytime anyone wants to put new UV film on any windows in the V&A, the product is definitely tested.

Kerschner: At our museum, I am the quality control for preventive conservation actions. If we're going to install a filter, I do the research and find out which filter is best to use. If there were not a well-trained conservator here who knew where to find the information, I'm not sure how well the job would be done.

Druzik: *So in a certain sense, in a small institution, it cannot be sustainable.*

Kerschner: I question whether staff members with primary responsibilities other than conservation will consistently follow preventive conservation standard procedures year after year. What makes preventive conservation really sustainable at smaller institutions is having a person with the appropriate knowledge directly responsible for it. This may not have to be a conservator, but I think it helps if it is.

Ashley-Smith: There is a need for a greater agreement about protocols in all aspects of museum life, but the people whom I speak to are all fairly much against the introduction of universal standards, which is what this sounds like. I think people should have some local judgment and local ability to alter things. If your standards become too rigid and your process automatically enforces those standards, that can be a bad thing in the long term.

Levin: *This whole issue of standards versus guidelines is something that has rumbled around in conservation for quite a while. Are preventive conservation standards the most appropriate approach, or are guidelines more realistic? That seems to be what you're saying, Jonathan.*

Ashley-Smith: I suspect that in the long term no one will be able to distinguish between guidelines and standards, but standards can become easy to use in a dogmatic fashion. In the U.K., with our lottery funding, you must abide by these standards or you won't get the money, even if it turns out that particular standards are not applicable in your local situation. So you can use standards in a bad way.

Kerschner: In my situation, guidelines are exactly what we need. They have to be reasonable and they have to be attainable. I may not eliminate the last bit of UV because I haven't selected exactly the right filter, but what I'm looking at is improving conditions, not necessarily getting to what is the perfect condition under this standard. This "improving conditions" approach has served us very well.

Staniforth: Well, the National Trust manages about 160 registered museums, with 240 houses open to the public and something like 30,000 buildings altogether. We entirely use guidelines, and it's very much related to what's achievable and pragmatic. We definitely go for making things better rather than for perfection.

Druzik: *Do you specify the limits that they can drift within guidelines?*

Staniforth: No. To take an example, the guideline for relative humidity control would be to avoid the extremes above 65% and below 50%. But we would not say to an engineer, "We want the relative humidity to stay between those two levels." The problem with historic buildings is if you give an engineer a tight specification, they will take it literally, and they will put in equipment that will never allow the RH to go above 65% or under 50%. That introduces machinery into a historic building that you just don't want there.

Kerschner: In Vermont, we're happy if we can keep relative humidity below 65 and above 35. We cannot adhere to a standard that's

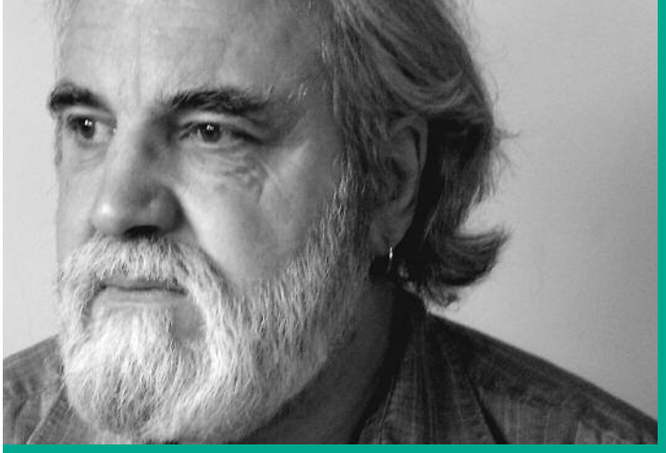


Photo: Diane Ashley-Smith

—*Jonathan Ashley-Smith*

> **If your standards become too rigid and your process automatically enforces those standards, that can be a bad thing in the long term.**

international. It depends on where you are, what your buildings are, whether they are heated, and so many other different factors.

Druzik: *It's certainly true that the use of guidelines is profoundly affected by geography. In Southern California you can spend millions on HVAC equipment and not affect a Santa Ana wind condition, when the outside humidity dips to 2%. There's no machine in the world that can do that outside of a sprinkler system—which for obvious reasons is not very effective for preventive conservation.*

Staniforth: We're inching into talking about the wider environment and global warming. We're having interesting changes in the climate in the UK and, particularly, more extreme weather events, which we're trying to adapt to. We're getting warmer, wetter winters with a lot of heavy downpours, which are affecting buildings. When you put in an environmental control system that copes with more extreme weather, you actually use more energy, which then increases the global warming that is causing the more extreme weather.

Kerschner: It's important that any system one does install works with nature instead of against it. We could heat more of our buildings and install humidifiers to increase humidity during the very cold winters, but that's working against nature globally as well as locally. Instead, we just keep the buildings cold so that the RH stays at a safe level. This certainly affects how people can visit, or even if the buildings can be open in the winter. But that's the type of decision that has to be made.

Staniforth: Actually that's an interesting way of engaging the public, because you can use that as a learning opportunity for visitors. Which brings us right back to the way in which all of these preventive conservation issues relate to our constituency and the way in which the philosophy of preventive conservation leads to sustainability in a much broader sense. Our parents and our grandparents were much more economical with the resources that they used. There are huge lessons to be learned.

When I taught at the GCI preventive conservation course, I talked about the way in which we're controlling RH in the National Trust Historic Houses. We use low levels of heating to bring the humidity down to below the mold threshold, which consumes considerably less energy than comfort heating for people. One or two course participants said that the collections that we look after are so important that the amount of energy we use doesn't matter. I couldn't disagree more. It's our responsibility as museum professionals to look at that wider environment and think about our social responsibilities, as well as our responsibilities to the collections.

Levin: *So when you talk about sustainability, you're not only talking about the cultural institution and its collections, but also about the wider environment in which that institution exists.*

Staniforth: Absolutely. We're in the heritage business, and the whole point of what we do is to pass on our cultural heritage to future generations. What's the point if they're actually going to be much more concerned about their own survival? We have to have an eye towards the wider environment and what's going to happen in a hundred years' time for the sake of our children.

Druzik: *I don't think you have many people saying now that we've got to put all these systems in because our collections are so important. Instead, they're looking for ways to manage money wisely and to use technologies that are sustainable.*

Ashley-Smith: I think the reason that people's minds change is purely the short-term cost benefit of relaxed environmental parameters. It has the benefit possibly of using less energy and therefore not using up resources or destroying the atmosphere. You can use the short-term cost-benefit argument to get what you want, which will have the side effect of being more sustainable.

Kerschner: One of the things that we're looking at is using household air-conditioning systems—not to decrease summer RH levels to 50% or even 55%, but to get down to around 60% RH. That RH level is safe for the artifacts in our historic houses, and it is a significant improvement over present conditions. I agree with Jonathan that it would be nice to be able to say that we're concerned about global warming, but our actions are largely driven by the bottom line. If we can save costs and energy, then that's what makes us do

it. And if our actions are also good for the environment—great. I wish it were the other way around, but I don't think it is.

Druzik: *Another question I have is the potential of expert systems for preventive conservation. This is an area where Rob Waller and Stefan Michalski in Canada have been engaged in research* [see p. 4]. *I'd be interested in what the three of you have to say about the possibility of developing these sorts of systems and their potential for providing a structured way of ensuring quality control.*

Ashley-Smith: I wouldn't advocate any system that stops people doing the thinking themselves, possibly because I like to think these things out myself. However, there are a lot of curators or conservators or people running small institutions who want to be told what to do. Expert systems can tell you what to do in a structured way that takes into account other people's judgments, and that's good in that respect. I personally wouldn't like it if you couldn't see how it works and understand who is saying what and why they're giving you that information. From a brief conversation with Stefan, it sounds as if you can get deeper into the system if you want to. As long as people who want to think for themselves can use it with more judgment, I think it will be good.

Staniforth: I can see how it might be used in a museum with a largely professional staff. But in a very diverse organization with an awful lot of staff who are trained to do what they do, I think it would be a real challenge to put into practice those sort of systems.

Druzik: *I think what you're saying is you wouldn't want to get into a 747 and fly it with an autopilot and have no idea how the thing operates.*

Staniforth: That's what Jonathan was sort of saying. If you've got the ability to understand what it's doing, then it can be a useful tool. In the hands of our managers of historic buildings, I'd probably worry.

Kerschner: I get the best buy-in for preventive conservation actions if everyone on the project team can understand the action and the reason for it. I have found Stefan's preventive conservation work to be very practical and helpful for small museums, so I will seriously consider any system he develops.

Staniforth: I just wanted to say a little bit about the role of the conservator in all of this. I think that *preventive* is a very unfortunate word. At the National Trust we've got some preventive conservation advisors, and some of my colleagues have asked me, "What do they do that prevents conservation?" I like to feel more positive about what we do and that our role, in fact, is to enable sustainable access.

Kerschner: I like the concept of "sustainable access." What I sometimes struggle with is the conflict inherent in improving access to collections and, at the same time, addressing the need to preserve the collection. I believe in more access, but isn't there a point at which that becomes counterproductive?

Staniforth: You have to have a tool kit that looks at that balance between conservation and access. One of the things that we've been developing is a working tool which deals not just with light hours and wear and tear but also with the financial costs of giving more access—and that's in staff time. If you've got more people coming through, you've got more cleaning to do, because they create more dust.

Kerschner: In the United States, the National Endowment for the Humanities has funded many conservation projects out of their Division of Preservation and Access. They do not want to fund the preservation of artifacts that are then hidden in storage. They want collections available to people, and they use their grants to fund preservation actions that encourage responsible access.

Ashley-Smith: When you use the words *sustainable access,* you're also talking about people who don't yet exist. You have to deny some access now for the sake of future generations.

Druzik: *This very quickly gets you into establishing what is acceptable damage over a specified period of time. The instant that that is conceded, you automatically cut out some people.*

Ashley-Smith: With lighting, for instance, you have to accept damage. All light-sensitive objects are being damaged when displayed under light. That's an area where the notion of acceptable damage has become accepted.

Levin: *We live in an age where access is critical for sustaining public awareness of the importance of collections and structures and landscapes, as well as for justifying their preservation. And so the challenge that preventive conservation has to address is, as you put it, sustainable access—sustaining all these things that we've come to treasure as demands increase for them to be accessible to the public.*

Staniforth: Yes, absolutely. The reason we do this is for people. We're not doing it for the objects.

Illuminating Alternatives

Research in Museum Lighting

By James Druzik

The last half of the 20th century saw the widespread acceptance and application of environmental guidelines designed to protect museum collections. In recent decades, these guidelines—which delineate standards for temperature, humidity, lighting, and other environmental factors—have provided unprecedented stability for the environments of many museums, reducing the danger of damage to objects in their collections.

Guidelines exist to enforce consensus, codify experience, and distill large amounts of technical information into general practice, reproducible simplicity, and rational institutional policy. Yet for guidelines to remain vital and useful, they must be periodically scrutinized against evolving knowledge and changing practices. Without regular examination, guidelines suffer from a creeping obsolescence.

Over the past decade, most preventive conservation guidelines—including those that apply to relative humidity (RH), temperature, and air pollution exposure limits—have been reviewed and, gratifyingly, have held up surprisingly well. These periodic reviews have resulted in increased flexibility in building operations and maintenance and in exhibitions display. At the same time, however, they often require greater attention to detail. Single and simple measurements are replaced with precise monitoring and record keeping.

If one chooses to operate near the limits of acceptable environmental standards —or is compelled to operate in this manner because of location in a historical building—the probability of damage to objects increases, making safe control a demanding occupation. Nevertheless, some researchers have developed a theoretical basis for suggesting that the risks can be managed consciously.

The J. Paul Getty Museum exhibition *Michelangelo and Masters of the Renaissance.* For sensitive works on paper—such as the old master drawings in this exhibit—current guidelines recommend limiting gallery illumination levels to 50 lux to optimize the display lifetime of the works. *Photo:* Rebecca Vera-Martinez, courtesy of the J. Paul Getty Museum.

For instance, at one time the limits for RH within a museum's environment were very narrow and ensured that no RH-induced damage was possible—at a significant financial cost, of course. However, theoretical and experimental groundwork has indicated that if the drift is slow enough, reasonable safety might be possible over a much wider RH range, so that a slow seasonal oscillation could replace rigid limits. In other words, while fast change is bad, slow change may not be so bad—it may even be acceptable.

Museum Lighting

Another area where risks can probably be more effectively managed is museum lighting. It has long been clearly understood that, over time, uncontrolled lighting leads to damage, including fading on objects. As a result, the means to control light through restrictive exposures was sought. Not too long ago, the "law" on illumination levels was strict and absolute. These exposure levels were deduced from a paucity of data, starting from about 1930, by several authors whose judgments were later reinforced by subsequent research. In 1961, when Garry Thomson, then scientific advisor at the National Gallery in London, suggested the now well-known illumination limits of 50/150/300 lux for objects of varying light sensitivity, he was actually averaging the recommendations of earlier researchers. In fact, 50 lux—a dark environment indeed—will still fade light-sensitive colorants and effect other color changes if given ample time. Although present at the start, the question of how long 50 lux could be tolerated was not given the same emphasis it gets today. With current ideas of risk management gaining greater interest, conservators and curators have had to think about how much damage over how long a period of time is acceptable. Thus, preventive conservation lighting standards have undergone a slow revolution.

Changes in thinking are also a result of changing technologies. One only needs to recall that fluorescent lamps had been commercially available for just 15 years before they were first suggested—in a 1953 International Council of Museums publication—as possible low-heat alternatives to incandescent lighting in some limited applications. No doubt they had been used before that time. Today we have many more lamp and fixture designs for track lighting, fiberoptics, and, perhaps soon, novel light-emitting diode (LED) alternatives.

Making lighting safer for sensitive artifacts at constant illumination has been the subject of recent study. In a demonstration project published in 2000 in the *Journal of the American Institute for Conservation,* Christopher Cuttle, now at the University of Auckland, used several 50-watt quartz-halogen lamps, filtered to the color-matching functions of the human eye, to approximate the color matching of unfiltered lighting. This research resulted in a major shift in envisioning museum lighting. Using three bands

Nancy Yocco, an associate paper conservator at the J. Paul Getty Museum, and James Druzik of the GCI examining an old master drawing from the Museum's collection. The information a conservation scientist provides on the materials used in old master drawings can inform a conservator's recommendations for exhibition lighting exposure levels for these works. *Photo:* Dennis Keeley.

of colored light instead of one monochromatic light source reduced energy at certain wavelengths not essential for reasonable human visual color matching. As part of Cuttle's research, an assessment by 16 observers noted that the differences between standard quartz-halogen lighting at 50 lux and three-band filtered quartz-halogen at the same illumination were slight, yet the three-band lighting significantly reduced the energy delivered to the surface of the object. This type of lighting will probably inflict less photochemical damage at equal illumination and duration.

Cuttle's promising research helped precipitate a two-day experts meeting on museum lighting at the Getty Center (see *Conservation*, vol.18, no.1). The meeting, hosted by the GCI in October 2002, addressed a series of questions involving the lighting of old master drawings. Participants came from Canada, England, New Zealand, and the United States. They included conservators, conservation scientists, curators, and lighting engineers.

From the discussions at this meeting, it was evident that there were eight major lighting strategies that could improve the display lifetime of works of art on paper, such as old master drawings. Four of these strategies constitute the core of existing guidelines: reduce illumination levels of existing sources; interrupt illumination through the use of switches and motion detectors; remove ultraviolet and infrared radiation; and spread out exhibition display periods over many years, using assumptions about the most fugitive component to set total exposure amounts. (Monitoring actual color change on artifacts could be added to this core group, but it is quite rarely carried out in practice.)

Beyond those four ideas are four other strategies that have thus far received less attention. These strategies include using new light sources such as LEDs with intrinsic three-band character; using filters designed to emulate the three-band concept on existing lamp architecture; investigating further the benefits of anoxic environments on reduced photochemical potential; and increasing the use of risk management methodologies with radiometric rather than photometric monitoring techniques. With input from the Getty Center meeting participants, the GCI decided to pursue these four possibilities as a set of activities that together define a research program.

New Strategies

Shepherding new light sources, such as LEDs, to destinations in museums, libraries, or galleries—along with testing visitor response to new lighting—will be increasingly valuable. Well-designed visitor testing has benefits that include not only the evaluation of aesthetic appropriateness of a new light but also a chance to test sensitive issues like age-reduced viewer visual acuity at low illumination levels. The GCI will begin research and testing in this area at the end of 2004.

A second activity for the research program capitalizes on the fact that the human eye is a poor judge of the relative energy of two equally bright but different sources. While the same object equally illuminated by daylight and incandescent light fades at different rates, the less destructive source may be as acceptable for viewing as the more destructive one. Thus, the strategy of retrofitting hardware like track-installed, quartz-halogen fixtures or fiberoptic illuminators to provide acceptable color rendering for the human eye at reduced overall irradiation (energy) can be pursued on two fronts. One front is to assemble filter packets from available products that achieve the desired goal; the other is to design a single glass filter and manufacture it. The former approach has the benefit of lower initial research costs and the potential for off-the-shelf filters with fewer long-term manufacturing support uncertainties. The latter approach can be more energy efficient and provide a closer match to the spectral reflectance characteristics of illuminated artifacts. The GCI is researching both fronts—one with the Los Angeles County Museum of Art (LACMA), and the other under contract to the University of Texas, El Paso. It is anticipated that for both projects, external groups will verify that the filters achieve a reduction in light damage, all else being equal.

The third strategy to achieve safer, longer display lifetime is to examine oxygen-free microenclosures, assessing their benefits and liabilities. Most, but not all, photochemically damaging processes involve oxygen in one of two fundamental ways. Remove oxygen and those paths are theoretically blocked—and the absorbed energy is dissipated by a safer route. Unfortunately, oxygen is not always needed for photochemically damaging processes, and some important colorants used in artworks have been shown to be susceptible to change even in the absence of oxygen. Such anoxic light-induced change is termed photoreduction, and its extent in museum artifacts is not known. Nor is it known to what extent those photoreducing components can be detected in advance in individual objects, which can then be excluded from such environments. Clearly a large screening study is in order. Also needed are techniques to make the construction of atmosphere-controlled encapsulations practical and inexpensive at the level of individually framed works. Some of these techniques have been worked through at Tate Conservation Department in Britain, with support from the Liverhulme Trust. The GCI is in discussion with other institutions regarding systematic materials screening under anoxic atmospheres.

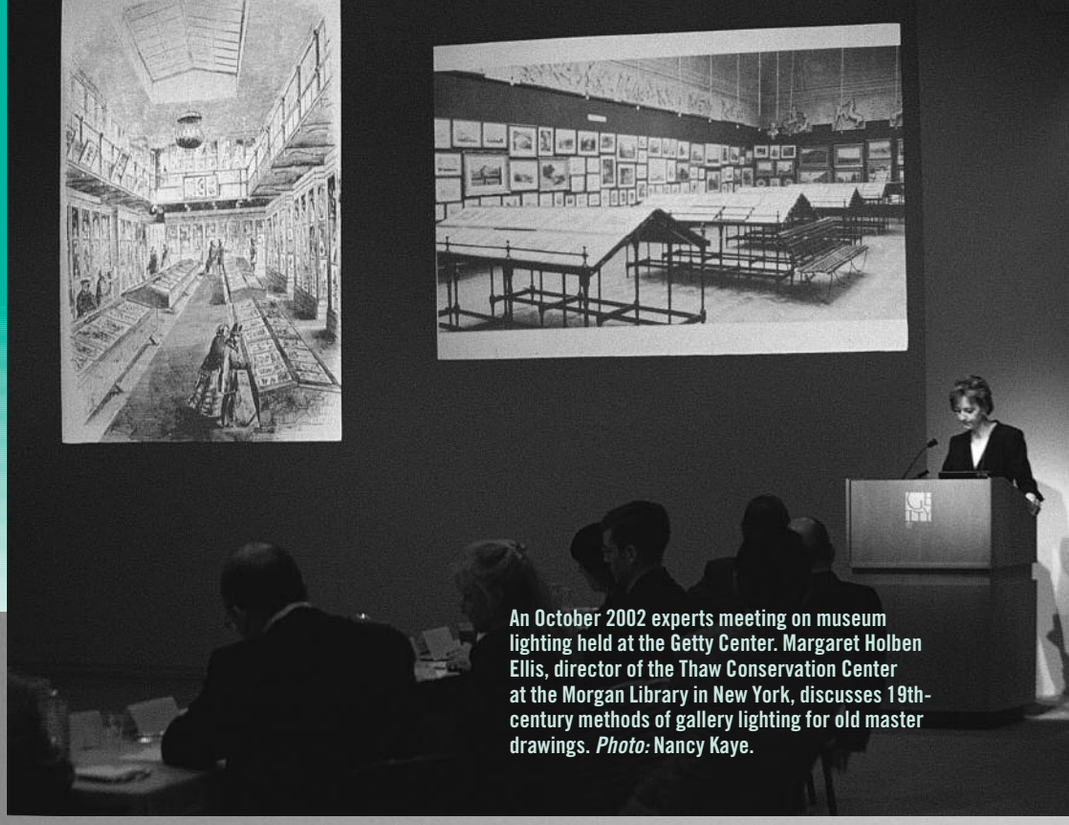
Finally, considering altering the emission spectra of exhibition lighting or adopting new light sources altogether suggests that it is time to improve the basic manner in which light monitoring is carried out. In the past, conservators have been content with measuring lux or footcandles. For a variety of good reasons, this was an acceptable practice. But better management demands better tools. When the spectrum of an incandescent lamp is altered, measuring illumination based upon the human eye's sensitivity loses relevance. It would be best to measure the incident energy for the same perceived level of brightness. Energy units are not new in conservation—specifications based on the number of microwatts per lumen of allowable ultraviolet light have been around for as long as footcandles. But in the absence of a need, or a desire, to measure energy directly, rebuttable presumptions about energy levels have replaced direct measurements. The GCI and LACMA are pursuing this research into monitoring.

With all of these research objectives in mind, the GCI, along with its partners, hopes ultimately to provide museums and libraries greater flexibility in extending the display lifetimes of their light-sensitive artifacts. This achievement, in turn, will better facilitate all the functions of modern museums, whose stewardship calls on them to preserve, display, and educate.

James Druzik is a senior project specialist in the Science department of the Getty Conservation Institute.

Participants in Experts Meeting on Museum Lighting

The Getty Center, October 2002



An October 2002 experts meeting on museum lighting held at the Getty Center. Margaret Holben Ellis, director of the Thaw Conservation Center at the Morgan Library in New York, discusses 19th-century methods of gallery lighting for old master drawings. *Photo:* Nancy Kaye.

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Climate Controls for Historic Buildings

A New Strategy

By Shin Maekawa

and Vincent Beltran

It has long been known that the longevity of cultural collections is directly affected by their surrounding environment. Exposure to elevated temperature and relative humidity (RH) can promote chemical aging, and large fluctuations in those parameters can result in mechanical damage to collections. Studies have also shown that microbial growth can significantly increase during long periods of high RH. For museums, libraries, and archives housed in hot and humid regions, the threat from biological infestation is far greater than the risks posed by chemical aging and mechanical damage.

Many cultural institutions in temperate climates have tried various climate control strategies in an attempt to slow the aging of their collections. In addition to reducing the environmental stress, improving the collection environment can limit bacterial and fungal attacks, and if such improvement is combined with the use of integrated pest management programs, problems associated with pest and microbial activities can be avoided without the use of toxic insecticides or fungicides.

In recent years, increasing numbers of cultural institutions located in hot and humid regions have relied on air-conditioning systems to extend the lifetime of their collections, as well as to provide for the comfort of their visitors and staff. The decision to use air-conditioning, however, can lead to a number of problems.

Proper installation of air-conditioning systems requires the reduction of air infiltration into the building and fittings of thermal

Above: **The 19th-century building that houses the Historic Archive located in Tenerife's La Laguna historic district—a UNESCO World Heritage Site.**
Right: **The climate control system installed in the archive as part of the GCI's Collections in Hot and Humid Environments project. In the foreground are monitoring sensors; at the rear is a window-mounted exhaust fan.**
Photos: **Shin Maekawa.**

Above left: **The Valle de Guerra museum storage facility in Tenerife.** ***Above:*** **A view of the facility's ventilation system. Ducting of the ventilation system was necessary as two walls of the storage area are devoid of windows. Here, two supply ventilators are connected to one ventilation duct to create high-volume airflow into the storage space.** ***Photos:*** **Shin Maekawa.**

insulation and vapor retarder film in the wall and floor. For cultural institutions in temperate climates, the typical environmental standard is a temperature of 68°F, plus or minus 2°F (20°C, plus or minus 1°C), and RH at 50%, plus or minus 5%. For cultural institutions in tropical locations, these conditions may not be practical or even appropriate. Even when preparatory measures have been taken, the installation and operation of air-conditioning systems have repeatedly proven very destructive to the superstructure and interiors of many buildings. Often converted for cultural use, historic structures are particularly susceptible to the loss of much of their original fabric during attempts at air-conditioning installation.

The cost of air-conditioning systems is also significant. The cost of these systems can be prohibitive for cultural institutions, as they are expensive to install, operate, and maintain. Because of the expense of air-conditioning, some institutions have been forced to shut down their systems during off-hours. As a result, museum collections may then be subjected to environmental stresses more severe than those stemming from daily climatic changes.

Combinations of these and other factors—such as improper design and installation—have resulted in unsatisfactory performance by air-conditioning systems, in turn causing many instances of collection damage. Because of these issues, there has been a compelling need to find alternatives that are robust, economically sustainable, and technologically simple to operate.

Ventilation and Heating for Conservation

In 1993 the GCI initiated a study to examine the efficiency of alternative climate control strategies for the conservation of collections in museums and archives housed in historic buildings, particularly those located in hot and humid regions. This study ultimately led to the GCI's Collections in Hot and Humid Environments project (1997–2002). Among the goals of the project were: (a) to develop a locally sustainable climate-control system that would effectively reduce and stabilize levels of RH to avoid fungal and bacterial infestation, and (b) to provide institutions with a feasible alternative to conventional air-conditioning systems.

The project team first conducted extensive background research and developed a number of findings. In tropical and subtropical climates, the daily variation in temperature can have a range of just 5°C (9°F) during the rainy season, to more than 15°C (27°F) in the dry season. Since moisture content of the air remains fairly constant throughout the day, these temperature fluctuations can produce inverse variations of RH. For example, for a parcel of air at 25°C (77°F) and 80% RH, an increase in air temperature of 1°C (1.8°F) will result in an approximately 5% reduction in RH. Moreover, temperatures will cool during periods of fog or rain, even in what may seem a persistently hot and humid tropical climate. A similar scenario occurs within buildings as interior areas of higher RH are typically found in its cooler regions because of this inverse relationship between temperature and RH.

Rather than cooling air below its dew-point temperature in an effort to reduce the moisture content, the proposed climate control approach is to raise the temperature in cooler, more humid areas of the structure, thereby lowering RH. The goal is to maintain RH levels at less than 70%—below the threshold RH of 75%, above which microbial activity significantly increases.

Heating of a building interior can be achieved through space heaters or through the ventilation of warm, dry outside air into the collection space. Since the natural infiltration of outside air is insufficient, mechanical ventilation is typically necessary. Major alterations to the building, however, can be avoided by mounting ventilators in window and/or door openings. To ensure controlled air movement throughout the affected space, it is necessary to install both supply and exhaust fans and to reorganize shelves and cabinets within the interior space.

After the project completed this background research, a series of laboratory and field experiments was conducted to determine how ventilation could be used to arrest fungal and bacterial activities typically found in cultural collections in hot and humid climates. The project also reviewed practical climate control schemes for museums housed in historic buildings and evaluated the performance of several of these approaches. Findings were then applied to the design and implementation of climate control systems at two historical structures located in hot and humid regions. The two study sites were the multiroom Historic Archive in the historical district of La Laguna on the Spanish island of Tenerife, and Hollybourne Cottage, a large residential building in the Jekyll Island Historic District in the state of Georgia, USA. The efficacy of each climate control design was verified by monitoring of the environment before and after installation.

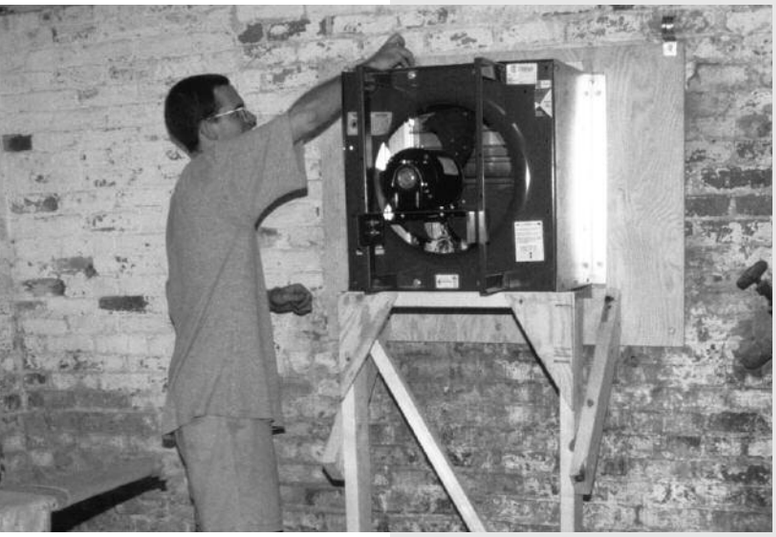
These studies demonstrated a remarkable ability to dramatically improve interior environments using ventilation and heating strategies that, relative to air-conditioning, were significantly less expensive and much simpler to install, operate, and maintain. The results of this research were presented at multiple conferences—including the 2003 ICOM-CC meeting in Rio de Janeiro—and described in articles in several publications. Among these are *Restaurator* (vol. 19, 1998), *Management of Environmental Quality: An International Journal* (vol. 14, no. 3, 2003), and *IAQ 2001—Moisture, Microbes, and Health Effects,* a postconference publication of the American Society of Heating Refrigeration Air-conditioning Engineers.

Alternative Climate Control Project

Following the successes of these two experimental trials, in 2002 the GCI initiated a follow-up project, Alternative Climate Controls for Historic Buildings, to develop case studies with past and present project partners interested in expanding their use of humidistat-controlled ventilation and heating to other facilities. These additional installations have been supported by local resources—including the hiring of local engineers, architects, and contractors and the purchase of equipment. The GCI's follow-up project provides technical support during the design and installation of these new climate control systems, as well as performance monitoring and suggestions for further improvements. Presently, GCI staff members are working at two museum storage facilities and are continuing system monitoring and improvement at Hollybourne Cottage.

The Valle de Guerra museum storage facility for the Autonomous Entity of Museums and Centers of the Island Government of Tenerife, Spain, is housed on the second floor of a contemporary four-story concrete building located on a northeast hillside of the island. The mixed-media collection at this facility includes pottery, baskets, wooden and metal tools, textiles, and modern machines. Occupying approximately 440 square meters with a three-meter ceiling, this storage space is divided into five rooms and contains windows only on two adjacent walls.

The climate control system at Valle de Guerra, installed in August 2002, consists of supply and exhaust fans and convective heaters that are controlled by interior and exterior humidistats.



One of the ventilation system supply fans installed in the basement of Hollybourne Cottage. Since its installation in 2000, the site's climate control system has undergone several programming and equipment modifications. The current configuration consists of humidistat-controlled heaters, supply and exhaust fans, and dehumidifiers in two zones—the basement and the upper floors—each working independently of the other. *Photo:* Shin Maekawa.

Because it was not possible to install additional windows to promote cross ventilation, filtered supply air is taken from windows along the northwest wall and ducted to the southeast end of the space, where it is released. Exhaust ventilators are mounted on existing windows along the northeast wall. Monitored since installation, the climate in the storage facility initially maintained an RH environment of between 50% and 75% and displayed a significant humidity variation between rooms. Minor modifications to the facility's climate control design now produce a narrower RH range of 55% to 65% throughout the year.

The storage facility for the Amazonian Ethnographic collection of the Emilio Goeldi Museum in Belém, Brazil, is the second site of current work. Located on a research campus outside of the city, the facility encompasses part of a contemporary single-story brick building previously used as office space. This facility is approximately 271 square meters with a 3.5-meter-high ceiling, and it houses a collection that includes woods, feathers, animal skins and bones, vegetal seeds and fibers, textiles, and some metals. Due to limited available space, a compact shelving system was also installed. The creation of potentially harmful microclimates within the shelving was avoided through the use of perforated side panels and open-slot drawers.

The climate control system at the Goeldi Museum storage facility, funded by the Vitae Foundation, was installed in July 2003 and is composed of supply and exhaust fans, recirculation fans, and dehumidifiers. The use of dehumidification at this site replaces the heating component and increases the energy efficiency of the system. Humidistats are located at the center of the storage facility and outside the structure control system operation. Positioned outside the building wall, supply fans transfer filtered air into the space through ducts and distribute it along the center axis of the storage room near its ceiling. Exhaust fans, also located outside of the structure, collect air via floor ducts along the east and west walls. Several portable dehumidifiers are positioned along its walls and connected to permanent drains within the room. Although outside dew-point temperature typically ranges from 25°C to 27°C, the climate of the storage space has been maintained between 65% and 70% RH at temperatures of 32°C to 33°C.

Since its installation in June 2000, the climate control system at Hollybourne Cottage on Jekyll Island, Georgia, has undergone multiple phases of refinement. In its fifth phase since May 2003, the current climate control configuration consists of humidistat-controlled heaters, supply and exhaust fans, and dehumidifiers. In addition, steps have been taken to address human comfort issues and improve the system's energy efficiency. This climate control system has remained remarkably maintenance free during its four years of operation.

The GCI will prepare detailed reports on the design, installation, and operation of each site's climate control system for both conference presentation and journal publication. The GCI also plans to consolidate the information produced by this research into a comprehensive publication that will be part of the Institute's Research in Conservation book series. The publication—which will be designed for general use by the museum community—will describe the concepts behind this approach to climate control and provide details regarding the case studies that grew out of the initial research.

Shin Maekawa is a senior scientist and Vincent Beltran is an assistant scientist with the GCI's Science department.

The storage facility of the Amazonian Ethnographic collection of the Emilio Goeldi Museum. The use of perforated side panels and open-slot drawers in the storage area prevents the creation of potentially harmful microclimates within the shelving. *Photo:* Shin Maekawa.

Guidebook on Preservation Incentives

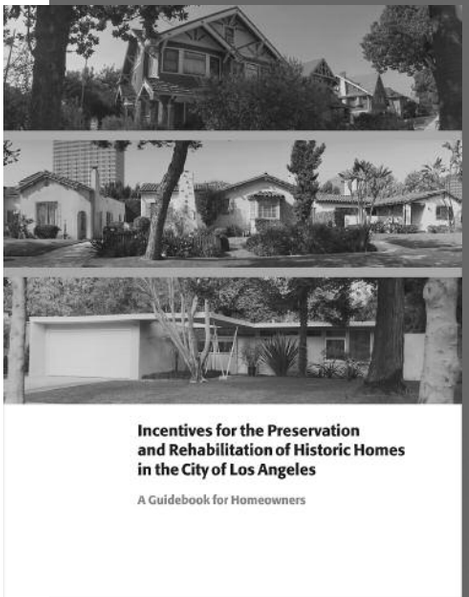
The Getty Conservation Institute has published a guidebook, *Incentives for the Preservation and Rehabilitation of Historic Homes in the City of Los Angeles,* to assist homeowners and prospective owners of older homes in Los Angeles in identifying financial, tax, and regulatory incentives of benefit to owners of older residential properties. It is designed to help property owners to learn whether they might be eligible for such incentives and to understand how to gain access to them. While focused on incentives for homeowners in Los Angeles, the publication contains information and ideas with broader applicability.

In recent years, cities across the United States have created incentives through government sponsorship, foundation initiatives, and local organizations to provide regulatory relief, funding, and technical assistance for owners of properties identified as historic or culturally significant. The GCI's guidebook describes important and useful incentives currently available in Los Angeles which contribute to the pride and benefit of historic home ownership.

The guidebook is a component of the Institute's Los Angeles Historic Resource Survey project. Through this project, the GCI is collaborating with a diverse group of agencies and organizations, including the City of Los Angeles, to develop a comprehensive, citywide historic resource survey—a process by which Los Angeles's historic properties might be identified and incorporated into the community's conservation and revitalization goals.

In addition to the guidebook, the GCI has completed research undertaken as part of its involvement in the Los Angeles survey planning project (see *Conservation*, vol. 18, no. 1). The report on this research is intended to inform decision makers on the development of a historic resource survey. It identifies the elements of a survey process and lays out the framework for a citywide survey that would be developed according to professional standards and that would provide clear, reliable, and accessible information on the range of historic properties and districts throughout Los Angeles. While not making recommendations or intending to limit the city's options or decision making process, the GCI research sets forth the issues that might be considered in the formulation of a comprehensive survey.

Copies of the guidebook, *Incentives for the Preservation and Rehabilitation of Historic Homes in the City of Los Angeles,* are available free of charge in PDF format on the Getty Web site at: www.getty.edu/conservaton/field_projects/lasurvey .



Training in Tunisia

Last fall the second regional group of mosaic maintenance trainees returned to the Roman site of Makhtar, Tunisia, for the third part of their training course in the maintenance of in situ archaeological mosaics. The course is a collaboration between the GCI and the Tunisian Institut National du Patrimoine (INP) to train technicians on stabilization and routine maintenance of in situ archaeological floor mosaics. This campaign continued the technicians' supervised training in stabilization treatments using lime-based mortars, through work on the in situ floor mosaic in the cold room, or frigidarium, of the site's thermal baths.

Due to the variety of colors in the mosaic, which imitates a marble-slab opus sectile pavement, it was necessary for the trainees to learn to create infill mortars that would be visually compatible with lacunae found in different parts of the mosaic. To accomplish this, the trainees procured different-colored fine gravel to mix with lime and sand, and they field-tested a number of mortars of various colors.

The mosaic has suffered loss near its surrounding walls. As a result, the trainees had the opportunity to carry out infilling repairs—not only to the interior of the work but also, on a larger scale, between the external edge of the mosaic and the surrounding walls. The execution of these repairs required the trainees to address the room's floor drainage as well.

During this campaign, the trainees received instruction in basic computer skills—keyboard use, writing, and filing. While their documentation training currently involves learning to record information in hard-copy format, it is hoped that in the future, written and photographic documentation can be conducted and stored digitally.

A fourth and final campaign for this group will be held in spring 2004 in Nabeul. After the completion of their training, the technicians will carry out maintenance of in situ mosaics at archaeological sites in the central region of Tunisia.

The training campaigns are part of a Tunisian national strategy to train a maintenance team for every region of the country. A third group of technicians—these from the coastal region of Sahel, where a number of important mosaic sites are located, including those at the city of El Jemm—will begin their training in fall 2004.

Technicians performing a variety of stabilization treatments, including resetting and marking loose tesserae and infilling small lacunae. *Photo:* Elsa Bourguignon.

Directors' Retreat

The GCI is pleased to announce that the next Directors' Retreat for the Advancement of Conservation Education will be held in partnership with the Centre for Cultural Materials Conservation at the University of Melbourne, Australia, with the involvement of the National Heritage Board in Singapore. Scheduled for July 2004, it will focus on conservation education and training in the Asia-Pacific region.

The retreat will provide a forum for examination and discussion on the future needs and directions for conservation education, explore suitable program models for the region, and allow for the creation of stronger inter-institutional bonds within Asia and the Pacific. Participants will include leaders in conservation education

First Photo Symposium

Pierre-Yves Mahé, founder and CEO of Spéos Paris Photographic Institute, discusses his documentary film on the first systematic investigation of the house where *View from the Window at Le Gras* was made. *Photo:* © Harris Fogel.

from Australia, East Timor, Hong Kong, Malaysia, the Philippines, Singapore, and Thailand.

The July event is the second retreat for leaders in conservation education. Launched in 2002, the Directors' Retreats were initiated as part of the GCI's long-standing commitment to the development and advancement of conservation education. The 2002 retreat, organized in partnership with the American Institute for Conservation, focused on the needs and strategies for expanding a national program for midcareer professional development for conservators.

The Directors' Retreats program seeks to strengthen conservation education by encouraging strategic thinking and action among institutions engaged in conservation education, to increase the exchange of ideas and information, and to promote collaboration and collegiality. The retreats are opportunities for senior-level educators to assemble for reflection, discussion, and renewal in a congenial and quiet setting away from the duties and distractions of everyday work life.

Further information about the program can be found at: www.getty.edu/conservation/education/drsretreat/ .

Last November the GCI and the Harry Ransom Humanities Research Center at the University of Texas at Austin organized an international symposium on research related to *View from the Window at Le Gras* (1826)—the world's first permanent photograph from nature—and the work of its creator, Joseph Nicéphore Niépce.

Attended by more than one hundred participants, the symposium, entitled "At First Light," was held at the Ransom Center. The center's newly renovated exhibition space includes a permanent display of the first photo and a special exhibit of artifacts and rarely seen historical documents related to the work and its rediscovery in 1952 by photo historian Helmut Gernsheim.

During the four-day symposium, a number of new research initiatives and ongoing research projects were presented. The GCI provided results from the first in-depth scientific examination of the first photo, conducted at the Getty Center in July 2002 (see *Conservation*, vol. 17, no. 2). In addition, the Institute gave details of its design of a new, oxygen-free protective enclosure for the photo, which will enhance its long-term conservation and allow for constant monitoring of the enclosure's internal environment. Also discussed was the development of a working hypothesis about visual changes of the photograph due to aging.

Interlaced among the research projects were art historical, historical, scientific, and art conservation presentations related to the first photo. These included presentations on the preservation history of the first photograph, an in-depth investigation of the home where the photo was taken, Niépce's career as an inventor and scientist, Niépce's correspondence and letters, and Niépce's place among early researchers in photography.

The new, official reproduction of the first photo—the first unmanipulated image of the photograph—was also unveiled. It is the result of work by photographers and scientists from the GCI and the J. Paul Getty Museum who utilized classical, ultraviolet, infrared, and digital photography in their effort to capture the image.

The symposium concluded with a panel discussion examining the many unresolved scientific and historical research issues regarding the first photo. Also considered were the needs and direction of future research and scholarship on Niépce and early photography.

Proceedings from the "At First Light" symposium are scheduled to be published by the University of Texas. For more information on *View from the Window at Le Gras,* visit the Ransom Center Web site at www.hrc.utexas.edu/exhibitions/permanent/wfp/ .

GCI Hosts ICOM-CC Board

In January 2004, the GCI hosted the directory board of the International Council of Museums–Committee for Conservation (ICOM-CC). The board represents the 1,400 worldwide members of ICOM-CC—the largest of ICOM's international committees.

While in Los Angeles, the board explored the possibilities for an enhanced ICOM-CC Web site to serve both its membership and the general public. At the board's request, staff from the Institute and the J. Paul Getty Museum spoke regarding the Getty's experiences in serving diverse audiences through the Web. Among the topics discussed were how to understand and assess audience needs and how to disseminate information and foster collaboration via the Web.

Also during its time at the Getty Center, the ICOM-CC directory board gave a roundtable presentation on ICOM-CC related issues for the Los Angeles conservation community.

The GCI's hosting of the ICOM-CC board reflects the Institute's continuing interest in supporting professional organizations that serve the field and in providing opportunities for conservation professionals to meet and exchange thoughts on conservation issues.

ICOM-CC aims to promote the conservation, investigation, and analysis of culturally and historically significant works and to further the goals of the conservation profession. For further information, please visit the ICOM-CC Web site at: icom-cc.icom.museum/Home .

World Archaeological Congress Resolutions

At the Fifth World Archaeological Congress (WAC-5), held last summer in Washington, D.C., the Getty Conservation Institute joined with 10 international organizations, 3 U.S.-based institutions, and 63 professionals to present discussion panels and plenary lectures that addressed a broad range of issues related to the conservation of archaeological sites. Organized under the theme "Of the Past, for the Future: Integrating Archaeology and Conservation," these sessions examined integrated approaches to conservation with the intent of forging closer links between the professions of archaeology and conservation (see *Conservation*, vol. 18, no. 1).

At the close of the congress, nine resolutions were put forward by the organizers of these sessions for consideration by the WAC Executive. These were among the resolutions adopted by the executive branch in December 2003, and they now form part of the organization's statutes. Together with a forthcoming GCI publication that will include the papers presented at the WAC-5 sessions on integrating archaeology and conservation, these resolutions will help foster close working relationships between archaeology and conservation for the benefit of the global archaeological heritage.

Further information on the World Archaeological Congress and a complete listing of all the WAC-5 resolutions can be found at: http://ehlt.flinders.edu.au/wac .

Resolutions Relating to the Theme "Of the Past, for the Future"

Adopted by the WAC Executive in December 2003

To Professionals

Resolution 1: WAC resolves to promote a close working relationship between archaeologists and conservation professionals in order to foster an integrated approach to archaeology that includes research, conservation, management, and the interpretation of archaeological sites and collections.

Resolution 2: It is the responsibility of archaeologists to plan for the conservation of the sites on which they work, the materials they excavate, and the associated records they create over an entire project through the provision of adequate funding and professional expertise, regardless of whether these responsibilities are mandated by law or not.

Resolution 3: Proposed interventions, such as the restoration or reconstruction of sites and artifacts for interpretation and presentation, should be critically assessed beforehand to ensure that authenticity and integrity are not adversely (negatively) impacted.

Resolution 4: It is the responsibility of archaeologists conducting fieldwork to make themselves familiar with, acknowledge, and respect all the cultural values of the sites they are working on, including social and spiritual values, and in turn to share their knowledge about the archaeological significance of the sites with the local communities.

Resolution 5: In cases where the archaeological heritage is impacted by armed conflict, WAC strongly recommends that conservation professionals be included in the initial response teams to assess damage and prepare action plans.

To National Authorities

Resolution 6: Recognizing that partnerships between the public and private sectors can further the goals of conservation, WAC nevertheless calls upon national authorities not to relinquish their responsibilities for the preservation and stewardship of archaeological heritage places and collections.

Resolution 7: WAC urges that decision makers strive for the inclusion of all stakeholder voices in the use, management, and preservation of archaeological places and collections.

To International Organizations

Resolution 8: WAC resolves to recommend to UNESCO that an active program to inventory and document archaeological collections in museums and other repositories be undertaken and that duplicate records be safeguarded elsewhere than at the location of the collections.

Resolution 9: WAC notes that many World Heritage Sites have archaeological values which need protecting, but that management planning provisions do not always recognize archaeological values or provide adequately for their protection, and recommends to the World Heritage Centre that it sponsor workshops on the conservation and management of the archaeological resources of World Heritage Sites, and also that it re-examine the management provisions that need to be met for the nomination and inscription of archaeological sites to the World Heritage List.

Conservation Web Pages Redesigned

In March the redesigned Conservation section of the Getty's Web site (www.getty.edu/conservation/) was launched. The new design features enhanced navigation, which provides users with easier access to the site's approximately 1,800 pages of conservation-related content.

The Getty's Conservation section is now divided into six main areas: "Science," "Field Projects," "Education," "Publications and Videos," "Research Resources," and "Public Programs." Visitors to the site can find information on current and past projects of the Institute—organized by area of work—in the "Science," "Field Projects," and "Education" sections. The "Publications and Videos" section has links to free electronic publications of the Institute, current and back issues of *Conservation, The GCI Newsletter,* and brief online videos highlighting the work of the GCI. "Research Resources" includes links to AATA Online, to a database of bibliographies produced for GCI projects, and to important cultural heritage policy documents. "Public Programs" contains information on upcoming GCI lectures and conferences and on scholar and internship opportunities.

The new "Conservation" section is part of a redesign of the Getty Web site aimed at enhancing public access to the Getty's resources. From the home page of the Getty Web site (www.getty.edu), visitors can access images and descriptions of the collections of the J. Paul Getty Museum, information regarding the Getty Grant Program, and the researching tools of the Research Library at the Getty Research Institute.

To view the redesigned Conservation section, please visit: www.getty.edu/conservation .

Detail of the home page of the redesigned Conservation section of the Getty Web site.

Thomas Roby

Senior Project Specialist, Field Projects

Dennis Keeley

Vincent Beltran

Assistant Scientist, Science

Dennis Keeley

Tom Roby was born and raised in Philadelphia, where he attended a Quaker school that nurtured, among other things, his love of music and his interest in archaeology. This interest, sparked by a trip to Greece organized by his high school history teacher, led to his majoring in classical and Near Eastern archaeology at Bryn Mawr College, while receiving his undergraduate degree from Haverford College. During those years, he worked on summer excavations in Greece and Israel, where he saw for himself the extent to which excavated sites were threatened by deterioration.

After graduation, Tom spent several years with the American Friends Service Committee's Middle East Peace Education Program, before entering the University of Virginia's School of Architecture, where he earned a master's degree in architectural history and a certificate in historic preservation. During his first summer in the program, he did fieldwork in Sicily, which led to his first visit to Rome and a lifelong tie to the city. In 1985 he received a scholarship from the Samuel H. Kress Foundation to attend the University of York Institute of Advanced Architectural Studies; after earning a master's degree in conservation studies, he moved from York to Rome.

For the next four years, several private conservation companies employed Tom as a conservator at archaeological sites and historic monuments throughout Italy; among the sites were Solunto in Sicily and the Arch of Septimius Severus in Rome. In 1991 he began working as an independent conservator, employed directly by academic and conservation institutions on archaeological projects in Italy, Jordan, Egypt, Tunisia, and Lebanon. In 1994 he was awarded a National Endowment for the Arts Fellowship at the American Academy in Rome, during which he evaluated past conservation treatments on marble monuments in Rome.

Also during the 1990s, he attended a GCI course in Cyprus on the conservation of excavated sites. In 2000 he was hired as a consultant by the GCI to develop a training program in Tunisia on the maintenance of in situ archaeological mosaics. Within a year, Tom joined the GCI staff full-time, managing the Tunisian training program and also serving as the senior project conservator on the development of a conservation plan for the hieroglyphic stairway at the Maya site of Copán in Honduras. His responsibilities at the GCI provide him ample opportunity to continue to do what he enjoys most—working on sites out in the field.

A native of Southern California, Vincent Beltran grew up in Long Beach, the son of parents—both originally from the Philippines—working for the U.S. Postal Service. Music and sports were an important part of Vincent's youth; he studied the piano and the saxophone and played on a number of baseball and basketball teams. In high school, his interests in environmental science and oceanography developed, the result of an exceptional chemistry teacher and many weekends spent near the ocean. He majored in chemistry at UCLA but soon realized that he wanted to incorporate more fieldwork into his studies. During college, he served as an intern with the local environmental group Heal the Bay and participated in research at the UCLA Mass Spectrometry Laboratory and at the Bodega Marine Laboratory north of San Francisco.

Following graduation, Vincent worked as a chemist for nearly two years at an industrial chemical company in Los Angeles, preparing and analyzing gas mixtures for use by research institutions. Oceanography remained an interest, and in 1998 he began graduate work in the subject, moving to Honolulu to study at the University of Hawaii at Manoa. His studies there focused primarily on coastal geochemistry, particularly with respect to pollution. For his thesis, he researched the storm-driven transfer of particulate metals from the land to the coastal ocean through several watersheds in Hawaii. In addition to research, he also gave weekly lectures as part of a team-taught undergraduate course on oceanography. Although busy with his studies, he nevertheless found time to train for the Honolulu marathon and to work at the university's radio station, hosting a weekly music show called *Verses from the Abstract,* featuring funk, soul, jazz, and hip-hop.

In the summer of 2002, he applied for a position with the Environmental Studies section of the GCI Science department, and soon thereafter he returned to Los Angeles to join the Institute's staff. Since then, he has worked on several GCI projects, including the development of alternative climate control systems for buildings housing collections in tropical climates; the collection and analysis of macro- and microclimatic data from the environmental monitoring station at the Maya site of Copán; and the design of an oxygen-free display case for the world's first photograph, created by Joseph Nicéphore Niépce.

Vincent continues to enjoy the combination of laboratory and fieldwork that the position affords, as well as the challenging interaction between science and conservation.