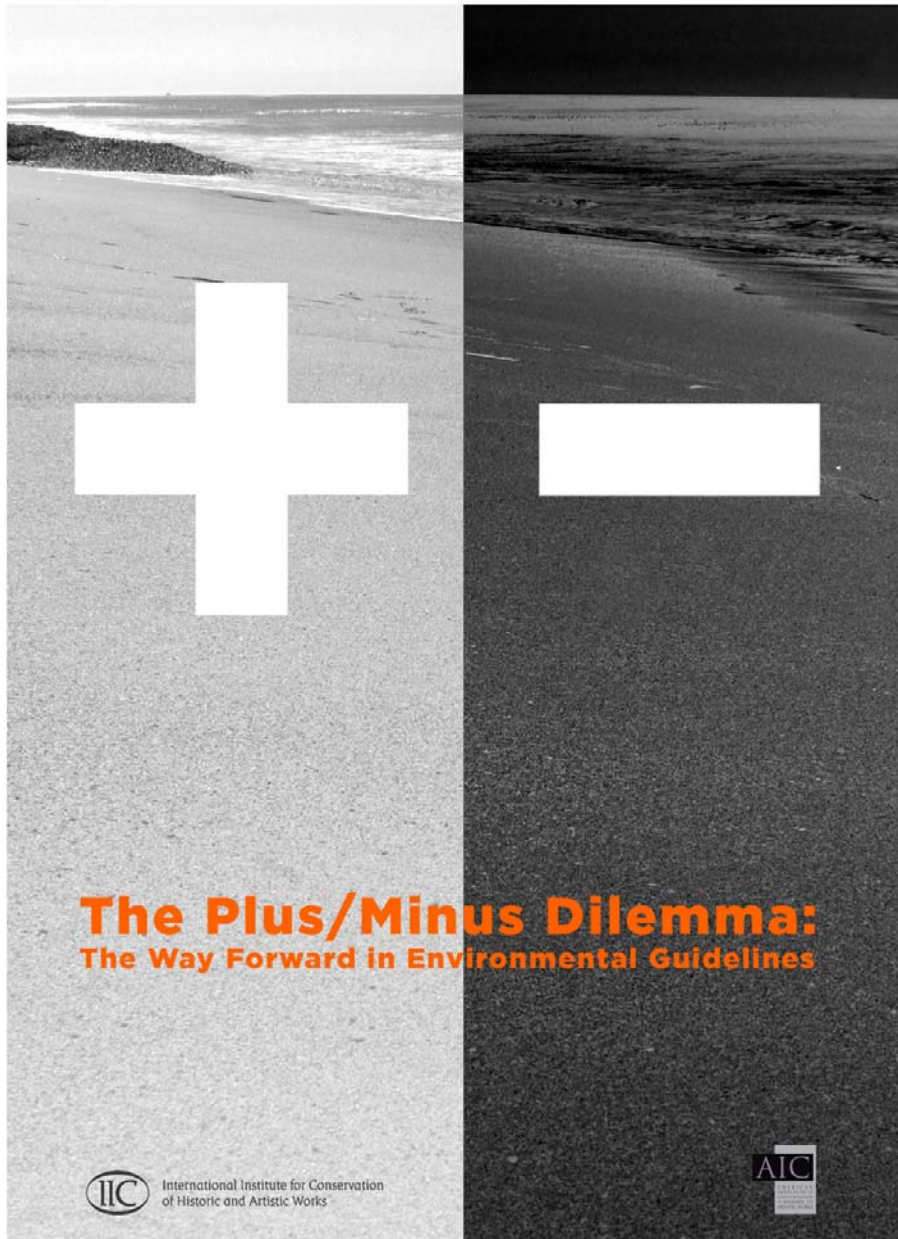





The International Institute for Conservation of Historic and Artistic Works

## *Dialogues for the New Century*

*Discussions on the conservation of cultural heritage in a changing world*



### **The Plus/Minus Dilemma: The Way Forward in Environmental Guidelines**

 International Institute for Conservation  
of Historic and Artistic Works



# The Plus/Minus Dilemma

## A Way Forward in Environmental Guidelines

held on 13 May, 2010 Milwaukee Wisconsin, USA  
in collaboration with the American Institute for Conservation and its annual meeting

Edited transcription with additional comments  
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For over four decades the environmental guidelines for museums and archives have been defined within narrow parameters. While many factors influenced what became *standards*, the narrowest range of conditions and the greatest insistence on them, came when energy was relatively cheap, global climate considerations were not yet mainstream discussions, and the technology of HVAC systems was focused more on control than efficiency.

Given the looming energy crisis, the global economic downturn, and the rising awareness of *green* technology equating to good stewardship of our natural resources, responsible and efficient environmental control has become essential.

For this roundtable the **IIC** was pleased to collaborate with the **AIC** and bring together experts and over 600 conservators, scientists and collections care professionals to explore environmental guidelines, advances in environmental research, and the way forward to solve the *Plus/Minus Dilemma* in collections, archives and libraries. The roundtable members included:

**Maxwell L. Anderson**, The Melvin & Bren Simon Director and CEO, of Indianapolis Museum of Art, Indiana (moderator)

**Nancy Bell**, Head of Collection Care, National Archives, London, and Principle Investigator of the Environmental Guidelines, Opportunities and Risks (EGOR) initiative.

**Cecily M. Grzywacz**, Facilities Scientist, National Gallery of Art Washington D.C. and Chair of the subcommittee responsible for maintaining the chapter "Museums, Galleries, Archives and Libraries" in the *ASHRAE Applications Handbook*.

**Stefan Michalski**, Senior Conservation Scientist, Conservation Research, the Canadian Conservation Institute, Ottawa.

**Karen Colby Stothart**, Deputy Director, Exhibitions and Installations, National Gallery of Canada, Ottawa.

**Terry Drayman-Weisser**, Director of Conservation and Technical Research, Walters Art Museum, Baltimore, Maryland.

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Photo by Brett Rodgers, American Institute for Conservation of Historic and Artistic Works

## INTRODUCTION

Jerry Podany, President IIC

It is my great pleasure to introduce this roundtable on environmental guidelines for collections. This event is part of the IIC initiative, *Dialogues for the New Century* which is meant to encourage discussions and consideration of concerns that reflect the relationship of heritage conservation with the modern world. What guidelines or standards are agreed upon for collections environmental maintenance is certainly a worthy topic.

There are a number of assumed constants in our world. They stand for what we collectively, though perhaps not always unanimously, believe to be the *truth*. Some are based in faith, others are based in scientific research (perhaps a different kind of faith), and still others are so persistent that they impose themselves as inevitable.

It is healthy for us to occasionally verify and question these conventions to see if they are still true or if we can improve upon them. This roundtable had exactly that purpose: to examine what has, in the relatively recent past, been an unassailable standard for collections environments. That is:

**70°F (20° C) +/- and 50% RH +/-**

I think we all have come to understand that this target standard is difficult to consistently meet and indeed is met less often than we might wish. That does not in itself make it wrong. The question is whether it is needed, reasonable, based on solid evidence and fully understood.

The panellists that were invited to this roundtable represent the larger community that will find the *Way Forward*. To have invited everyone whose opinion and expertise is needed would have taken a table significantly larger than the stage. But there should be no doubt that this and future conversations must be broad, the input far ranging and the debate thorough. Resolution will require that scientists and conservators, as well as all collections care professionals, share observations and evidence for the purpose of open discussion and exchange. This event presents far ranging comments, including ones about pragmatic need, responsibility for preservation of not only our cultural heritage but our natural resources, real and significant issues of budget restraints, promising technologies, clear needs for more research, the value of empirical observations and even how the techniques of population studies might just hold the answer to moving us forward.

This discussion could be framed as a conflict between directors and conservators or between scientists and collections care professionals, but that's not going to get us anywhere. Seeing it as a conflict will not move us forward. We are best served by seeing this dialogue as pointing to a series of significant opportunities, the most important of them being this initial discussion and the encouragement of many more such events. It is hoped that these will result in collaborations among many partners and the pairing of observations born from the daily pragmatic challenges of collections care with the results of basic research and technical investigations in laboratories and in museums.

I am so pleased that the IIC and AIC have collaborated to realize this program. And I would like to thank our partners and supporters. First, the AIC president, Meg Craft; the Executive Director, Eryl Wentworth; and the staff of the AIC/FAIC office, especially Eric Pourchot and Ruth Seyler. The IIC could not have asked for better and more supportive partners. I would also like to thank those who have

been generous in supporting the costs of this roundtable: the Institute for Museum and Library Services, the Booth Heritage Foundation, the Samuel Kress Foundation, Julian Hills of Eclipse Advertising, Inc. for designing the wonderful event icon and program, and Tru Vue for their support of the reception that followed the roundtable and where the dialogue continued long after the speakers left the stage.

I also want to thank Amber Kerr and Rose Daley who blogged live from this event; you can read their observations at the IIC news blog <http://www.iiconservation.org/news> (excerpts can also be found at the end of this transcript). A video recording of this event is also available at Art Babble <http://www.artbabble.org> through the generosity of the Indianapolis Museum of Art.

To introduce the program and moderate the discussion I have asked Dr. Maxwell Anderson, director of the Indianapolis Museum of Art. Under the leadership of Dr. Anderson the IMA has taken a significant role in the *greening* of museums and the evaluation of environmental standards. Thank you again to the AIC, to the supporters of the *Plus/Minus Dilemma Roundtable*, and to you, the reader, for joining this discussion on the *Way Forward*.



Photo by Brett Rodgers, American Institute for Conservation of Historic and Artistic Works

### **MAXWELL ANDERSON (moderator)**

I think I was cast in this role of moderator because there may have been some assumptions that as a museum director I might be immune to certain criticisms or controversies, but I assure you that this is not the case and I am not looking for cover from anything that might arise. Although I am not credentialed as

a technical expert in this discussion, those who have worked with me know I am a strong advocate of conservation. For this event I am, in a way, the “straw man” for the *administrator*: that invisible party who often represents a “thud” when matters of aspiration come to the table. I am hoping to convince you in this discussion that the only *Way Forward*, to use Jerry Podany’s term, is to abandon such stereotypes. So I would prefer to be thought of less as an administrator and more as an example of someone, in my case an art historian, who has been pushed into a position to make decisions.

We know that the protagonists for the way forward in the *Plus/Minus Dilemma* include many others besides scientists and conservators. And significant among them are engineers. I say this as a director who works closely with our chief operating officer and the engineers who in turn work with him and who valiantly struggle to do what they are told (which in itself is often a changing scenario). Looking at the ways in which they respond as engineers to the various directives which the director, conservators and scientists give, it seems to me that they always come back with a question asking: “what is the primary currency?”

There are three currencies or arenas in which we talk about the *Plus/Minus Dilemma*. I would suggest that one is the longevity of examples of cultural heritage. That is after all the purpose of what we do, pursue longevity, not necessarily permanent preservation. The second arena is the *pure* currency question; literally the financial and budgetary issues which become a measurable yield of this dilemma. And the third currency is energy (energy efficiency and carbon footprint) as an imperative of a moral dimension that in some people’s eyes trumps the first two. Not in your eyes of course, I would not suggest that, but I am saying that there are those for whom the consumption of energy to achieve longevity and the question of how much the preservation of heritage costs, are completely irrelevant to a larger moral question of the protection and betterment of the natural environment.

We have three things in short supply in this debate. The first is candour. We made a decision at the Indianapolis Museum of Art to display, in real time on the Internet, the relative humidity and temperature

conditions of our special exhibitions gallery <http://dashboard.imamuseum.org> . I log onto it occasionally and see it dancing around, and while I don't take any pleasure in seeing it zig-zag, I am always conscious that we have a limit which our conservators and conservation scientist have given us. I am also aware that like any graph sometimes it can jump around in ways that are unpleasant and discomfiting. But by looking at an actual real-time representation rather than looking, at the end of an exhibition, at a paper printout that is the result of human hair stretched and shrunk, we are in essence wearing a "hair shirt" of a living proportion.

So candour is important when people take doctrinaire positions such as museums MUST do this or they ALWAYS do this or that, when we know that in many instances what museums say they do is not actually what they really always achieve. That is why I implore all of us to be truthful about what we accomplish. In our case it was a simple approach to finding a clinical way of revealing what we actually achieve. Rather than talking about it, we just show it to everyone.

The second needed aspect in short supply is flexibility in the working environment among each other's communities: the conservators, scientists, engineers and administrators. Flexibility in the face of the reality that we cannot, in fact, control our collection environments to the extent we would like to. And the significant challenge within flexibility is to identify that box in which we have to try to live, whether that box be a micro-climate or someone putting on a sweater in a cool house looking to insulate those most vulnerable examples of cultural heritage from degradation.

The last need is for technical capacity. These HVAC systems we discuss were built at a time when human comfort was the ascendant value set and the protection and preservation of a collection was not understood as something that was at the core of a system design. We use systems that were primarily built for human comfort. The extent to which we can tune systems is an important question at hand. The engineers I have spoken with have always said that while these can be made more energy efficient they are not necessarily adaptable to heritage preservation needs.

These are difficult challenges that will take considerable research and collaboration to resolve. And the need for timely resolution is critical. The panellists that have been gathered here today are the very people we need to hear from and engage with to find the way forward in the Plus/Minus dilemma.

**NANCY BELL:**

I am here to provide a brief update of developments in the UK that have given rise to rethinking environmental standards for cultural heritage collections during display, while in storage and while in transit.

The discussion of how to provide sustainable environmental management has very much been in the forefront of a great deal of thinking in the last 18 months in the UK. My comments will build on the first IIC roundtable held in London in 2008 (transcript available at: <http://www.iiconservation.org/dialogues>) and will give an overview of the broader issues and how they are being addressed.

Why now? And what were the catalysts for change? Let me try to put them succinctly into three points:

First was a challenge to the conservation sector following discussion of the Bizot group of museum directors in 2008. Nicholas Serota, director of Tate and Mark Jones director of the Victoria Albert Museum convened a small group of conservation professionals and other stakeholders to review current environmental standards in the age of energy restraint.

The second issue was the introduction of government regulations, which by their very nature focuses one's attention. All UK government departments are required to meet targets for reducing carbon emissions, so the implication for The National Archives (TNA), is a reduction of its energy consumption 13% by 2010-2011. Collection Care has a very good working relationship with the team who manage the estate, nevertheless discussions not only for TNA, but other heritage organizations is to make clear the distinction between energy consumption for the collection and that used for other functions – offices, etc.



The third catalyst was a discreet research funding program (AHRC/EPSRC Science and Heritage Program) to support interdisciplinary science and heritage research. Launched in 2003, this flagship program was designed to support science and heritage and to build conservation science capacity. To achieve this, the Program supported research clusters to develop networks of researchers to address defined questions or themes. I, along with two other investigators from the Centre for Sustainable Heritage and Tate Britain lead a cluster called Environmental Guidelines, Opportunities and Risks (EGOR). This cluster considered the appropriateness of current standards for the buildings, collections and the people who work and visit our collections.

EGOR brought together three working groups, some 67 researchers and practitioners to consider in an age of energy restraint the appropriateness of current environmental guidelines for buildings, collections and the people visiting and working in cultural heritage institutions. The main outcomes were: to identify and prioritize key research priorities or gaps needing to be filled and considered necessary to informing the future development of environmental guidelines for cultural heritage, particularly in areas of material science. For example, it was noted that while we understand the behaviour of some materials subjected to variations in temperature and relative humidity, outstanding questions remain as to how some materials behave at extreme ends of the T and RH scale. In addition, and perhaps more importantly, the participants in the EGOR research cluster strongly recommended that more research be undertaken to understand better the relationship of damage to environmental conditions including working toward defining a vocabulary of damage and developing the tools needed to measure it. The third area of research identified as a priority was the need to better understand how we value cultural heritage, who values it and what are acceptable levels of damage to different communities. That was viewed as necessary to getting us closer to understanding acceptable levels of damage to our collections.

One of the most important aspects related to the topic of environmental control that came from the work of the Bizot group and EGOR was the realization that there was a need for the development of an appropriate environmental standard that reflects new thinking and research over the last ten years, and this standard should be set within an established frame of risk-management protocols. I am pleased to say that the first steering group meeting will be convened for May 26<sup>th</sup> with an anticipated publication date of Spring 2011. This work is currently underway and will feed into the development of other European standards and revisions of British Standard 5454. This will not be a “sector specific” standard, it will cover materials in museums, libraries and archives, and will encompass temperature, relative humidity, pollutants, air ventilation and light. As mentioned the standard will take a risk based approach and will draw on the experience of those having worked on the ASHRAE standards and of course the standards themselves. It will be difficult and complex work which has to be done in 15 months. I am confident we will complete it despite the likelihood that some of it will need revision, but we must start somewhere. I want to leave you with three messages. There is tremendous good will and sharing among conservation professionals and practitioners in the UK supported by co-operative directors who are listening to us. This good relationship will continue, but we need to rise to the challenge put to us, to provide the evidence and tools to support our position.

UK funding in the next three years will provide support for a national strategy for research that aims to address some of the principle materials science questions and other broader questions associated with developing environmental standards such as (mentioned earlier) the relationship of damage to the environment. If we can better understand this element, defining the associated cost of energy required to maintain collections will follow.

We have a tremendous opportunity as a profession to lead this debate; it is an international issue that is not confined just to the USA or Canada or Europe. What a great opportunity to lead, influence and to demonstrate that we can come up with results and agreements that answer questions that have arisen and that will arise.

**KAREN COLBY STOTHART:**

I believe that the perspective that the organizers of this panel wish me to bring to this discussion is that of a senior manager at a major fine arts museum and to introduce a relatively broad field of view into the discussion. As Deputy Director of Exhibitions at the National Gallery of Canada my responsibilities include development, planning and management for the exhibitions and loans program that includes programs at our museum in Ottawa and our fairly large travelling exhibitions program. I should say that as a former conservator by training and practice, I do follow the literature on this topic with interest including the many articles by my colleagues on the panel today. But I am here today to provide an operations perspective. From that perspective I am very impressed with the efforts of the conservation community to recognize and welcome the complexity of this dialogue and to bring an interdisciplinary approach to the discussions at hand. This includes those with direct responsibility for preservation and handling. It also includes the larger global perspective of *greening* of museums and the perspective of managers and directors who are responsible for maintaining viable business operations. This is a very specialized business, sometimes its non-profit, sometimes it is for profit; public or private; but none the less it is a business. At the centre of these businesses are irreplaceable collections and so it's a very complex situation. The age old intersection of preservation, the appropriate use of the collections, and management all come together in this discussion.

I'm going to take a very particular angle, one which is my professional view, of the exhibition program as a driver of this discussion. Exhibitions figure quite prominently in how any museum is perceived, particularly in fine arts museums, and in how we reach our public. This in turn drives revenues across the organization which in principle drives and supports other museum functions. Exhibitions are a very important part of the puzzle that keeps us going. As museum managers seeking to find the right balance between preservation and the appropriate use of museum collections, we spend a great deal of time

assessing our programs and our concepts. We also assess the merits, from an art historical perspective, of loans and projects to decide whether they contribute meaningfully to art history. We also scrutinize these efforts as to whether or not they advance our goals of love and appreciation of the fine arts; if they reach the intended audience; and whether there is a legacy left behind by these exhibitions, such as a publication, etc.

Whether or not art museums in Canada, Europe or the United States succeed in this balance and to what degree we should be building our exhibitions programs into such a large part of our organizations, are different questions and a debate for another day. However the pressures of a special exhibitions program are here to stay. In my 15 years of experience as an exhibitions manager I believe this to be as significant a driver in the *Plus/Minus Dilemma* as any other. It obliges an intelligent discussion of the environmental norms because these norms feature so largely in the loan negotiation and the exhibition production process. The running of these complex and high-value exhibitions usually takes several years to organize. We are planning 2016 and 2017 right now for example. The exhibitions can involve as many as 50 – 60 lending institutions. They require contracts for each work of art and as many, if not double that number, for individual works of art. These are very high insurance values, easily in the 500 million to one or two billion dollar range. It's a big, complex, highly specialized, risky, multi-million dollar business.

For the National Gallery of Canada negotiations of environmental conditions with lenders and borrowers are essential. Monitoring the ability of these venues to deliver on the agreed upon norms, and in many cases trouble shooting and resolving the emerging difficulties with non-compliance can be among the most time consuming and emotionally charged aspects of our day to day activity. Set against this context of exhibition programming, which lies at the core of the National Gallery of Canada's activities alongside preservation and research, the key points that I wanted to present today are:

1. A quick outline of the experience we have at the National Gallery of Canada where we have by necessity been working with a fairly flexible approach that is quite far removed from the old 50% +/-2. We have had this approach in place for over fifteen years.
2. The flexibility and potential that a more nuanced environmental standard presents at an operational level without loss of protection or terrifying increase in loans or exhibitions projects.

To the first point, Canada, with its remote venues, presents long travel distances, inconsistent museum infra structure, and climactic extremes. These have presented us with a sufficiently complex environment to thoroughly test our resolve and the resolve of our conservation department. Our current building is just over 20 years old and provides very precise environmental management. Due to the seasonal extremes of temperature and humidity that are common to Canada and particularly to Ottawa, we have chosen to take advantage of a winter set back strategy. This is fairly common in Canadian museums. We shift our relative humidity set point from 50% RH +/- 3 in the summer to 44% RH +/- 3 in the winter. We have a two month ramping up and down period between seasons. Temperature is maintained at a regular 71°F +/- 2°F (22°C ± 1°C) year around. This has been are practice for almost twenty years. Our observations at this point are that our collections have managed this gradual shifting without harmful effect.

We have a range of storage vault settings but maintain most of our storage at a slightly lower relative humidity setting of 40% RH +/-3% and a temperature of 71°F (22°C). We have some special storage conditions including cool storage at 60°F (15°C) and cold storage at 40°F (4°C), mainly for the photographs and photographic negative collections. We also have a vault especially dedicated to magnetic tape storage which we maintain at a lower 35% RH / 71°F (22°C). We make use of microclimate case solutions as do most art museums and our special exhibition galleries can be isolated into specific zones and adjusted slightly if necessary.

It has really been our special exhibition and loan programs that have shaped our environmental policy over the last 15 years. By virtue of the mandate of the National Gallery of Canada we have to circulate our collections nationally. Our funding is dependent on this and since we have such a vast geography in Canada it presents unique circumstances. Typically we circulate 20 to 25 exhibitions a year outside of our normal programming within the building. In order to render this workable and retain the high quality of the projects our guidelines contain set points which vary depending on the collection types and media. We have also established media specific fluctuation tolerances of +/- 5% for some categories and +/- 10% for other categories. Please bear in mind however that there is always the option of setting very specific, stringent and limited guidelines for particular exhibitions and this option is used. Our experience with this approach over the last decade does underline, and this is a very important point, a very high level of technical understanding on the part of the conservation team and a comfort level in providing a technical assessment of the collections. It is a critical feature in the kind of varied approach I have just described. This approach is both labour and knowledge intensive. But in a context such as ours it provides the flexibility that we really need to prepare a large scale, complex and challenging travelling program.

From a program management and design perspective a clear understanding of the environmental needs of collections and building performance can play very directly into the operational management and program planning. That is to say it affects progress at a management level. Buildings with less precise environmental control can be accommodated during the moderate seasons but not during extreme seasons and high level programming can be developed with some very particular limitations in mind. We have done and will continue to do quite customized projects that meet environmental restrictions depending upon the venue.

Thinking of environmental classification of the venues themselves, the objects and even certain exhibition projects becomes possible if you make use of some of the categories such as the ASHRAE guidelines: AA, A, B, and C. The management possibilities need not be complex, but the potential is easily appreciated.

We are currently in the process of re-writing our loan policy (a process we do every five years) and I am sure this will involve adjustments to some of the categories. We will, however, preserve our flexible and variable approach.

**CECILY M. GRZYWACZ:**

I think what is most important in this discussion is that we realize that there has been no “standard” that has been written down for temperature and relative humidity. We have all assumed that 70°F (20°C) and 50% is a standard that we must abide by. But the reality is that there is no doctrine, no written law that says that. It is just our perception. So we need to look at how we are going to deal with that perception in terms of energy efficiency, sustainability and most importantly the protection and preservation of works of art. As has already been mentioned several times there are many stakeholders and resources in the discussion of where the set points should be. There must be an efficient communication process that includes all of their input. We need to educate each other about our different skills and the different languages that we use. The vocabulary of conservation, of science and of engineering can be different. In the past I have sometimes blamed the conservators for wanting that strict set of standards for relative humidity and temperature, but I have been told several times that it is the requirement of the registrar.

It is my belief that there are no standards that apply uniformly to all collections. The guidelines depend upon the integrity and quality of each collection. So standards and guidelines must be customized to the particular situation and particular collection. I also believe that a lending institution should not require stricter conditions than they themselves can and have applied. Loans are not a “spa-vacation” for our objects.

How do we decide what the best conditions are for our objects? We need to work with the engineers who design the HVAC systems for new museums. We need to recognize that in many existing buildings there can be historic HVAC systems and at some museums, the building itself is historic. But even in that

latter case there is a lot one can do to modify the system and improve its energy efficiency and still provide quite tight controls. For the last decade I have been working with ASHRAE (the American Society of Heating, Refrigerating and Air-Conditioning Engineers – an international organization). As a chemist and conservation scientist it took awhile to learn their language, but I am getting better at it. When I was with the Getty I also worked quite closely with the facilities department at the Getty Center. I learned from these experiences that we can benefit a great deal by working with engineers and including them in our discussions. Engineers work quite hard to give you, the client, what the client wants. We just need to know what we want. And even if what we want changes, the dialogue will provide a way of accommodating those changes. In Conservation we talk about an interdisciplinary approach. The term engineers use is an *integrated building design or integrated project design approach*. Working with other disciplines is not foreign to engineers; during the construction of building they work with a whole range of stakeholders to achieve the best design for a building.

There are no specific numbers and no optimum relative humidity or temperature which we are going to come up with today. It all depends upon your geographic location; the historic and existing conditions for that collection; and the actual material characteristics and response of any particular object. We can learn about a particular material's response to temperature and relative humidity, but we need to understand specific objects, their past treatments and history, and that is where conservators are so important to climate control discussion. The engineering field has been addressing sustainability for a number of years. We need to attach ourselves to those advances and benefit from them. But we must be careful not to compromise the collections or objects to save money or energy. When we acquire a work of art we take on the responsibility of stewardship, which is a long term commitment that goes well beyond the object's treatment and immediate display.

Conservation organizations and museum directors are not the only ones looking at this *Plus/Minus Dilemma*. Facilities managers have been looking at bench marking to try to discover ways of reducing



their costs and to save energy. It is clear that we need to all come together and continue discussions like this so that we can combine expertise and arrive at solutions that are best for the collections.

Preservation of collection includes many factors:

- The building envelop, be it a historic house or purpose-built museum
- Security, meaning the protection from inappropriate handling, ignorance & vandalism
- Natural disasters, like floods, fire or earthquakes
- Physical factors, like wind, rain and salts.
- Biological deterioration, such as pests, mould, fungi or micro-organisms.
- Pollutants, including gases, particles and aerosols.
- Light
- Temperature and relative humidity (T and RH)

For decades people have discussed temperature and relative humidity standards. But there is no standard. There are only suggestions, recommendations, guidelines, and misconceptions. Some say because of loans, Registrars demand strict temperature and relative humidity. Well, you can design for  $70^{\circ} \pm 4^{\circ} \text{F}$  ( $20^{\circ} \pm 2^{\circ} \text{C}$ ) and  $50 \pm 2\% \text{ RH}$ , but that does not mean that you have to operate at those conditions. In other words, install an HVAC system that is capable of maintaining tight T & RH control throughout the zones of the building. But operate the building at  $70^{\circ} \pm 9^{\circ} \text{F}$  ( $20^{\circ} \pm 5^{\circ} \text{C}$ ) and  $50 \pm 5\%$ . Just because you own a car with air-conditioning doesn't mean you have to use the air conditioner every time you drive the car or that you have to use the maximum cooling setting. I myself prefer one click towards warm on my car air conditioner.

What is the best temperature and relative humidity? How can we decide? It depends upon the collection. To the engineers that design HVAC systems for museums, galleries, archives and libraries, I stress that they cannot design a system alone. It is not enough for the engineer, architect, building owner and typical

groups of contractors to decide on temperature and relative humidity. Using their terminology – they need to employ integrated building or project design (we call these approaches “inter-disciplinary”). All of the stakeholders for the collection should be involved: museum administrators, collections managers, curators, conservators, registrars, designers, security, facility managers, and conservation scientists. Ultimately the collection is the client. We build the museum to preserve the collection. We control the climate for the collection. If inappropriate climate control or building systems harms the collection, the design is a failure.

Designing and maintaining appropriate environmental conditions is a process. We need to educate each other, be honest about our failures and successes. To do that we must communicate. We are too small of a field to work independently.

Conservation organizations are discussing the temperature and relative humidity set points for optimum preservation. Museum directors are discussing temperature and relative humidity in order to save money. Facility Managers have been concerned because of the increasing cost of energy. We need to make these decisions together. Hopefully discussions like these will allow us to work together, to provide the best solutions for the preservation and responsible care of our collections.

### **STEFAN MICHALSKI:**

Who am I?

I am a scientist in this area. I have done experiments, but I am primarily a theoretician. I am paid by Canadian taxpayers, so I do feel an obligation to advise them wisely, and cost-effectively.

I did train as a conservator, at the Masters level, but I was offered a job as a scientist (and even in the old days one didn't turn down a good job offer!). Still, I value the wisdom that conservators and I can

accumulate through our fingers and eyes. This is still very much a tactile as well as a visual body of experience, in terms of the effects of the environment.

I am a user of the heritage. I even visit museums on my holidays, not just when I'm working. I remember my teenage daughter rolling her eyes and saying "Dad, you promised not to take any more pictures of cracks." (Because I was holding up the tour).

So I am, then, also a parent. Sustainability is not just global, it's not just local, it's personal.

How do "we" scientists approach the issues?

There is not a cabal of mad conservation scientists who signed a secret manifesto to disagree with you conservators (and anyway, I feel I am a trained conservator). But we are a diverse group who play different variations on shared themes. The themes are familiar to you: biology, chemistry, and physics.

Biology. High RH causes mould. Green and brown stains – bad. No mystery, there, I think.

Chemistry. Twenty years ago, a chemist on a committee for standards in archives, Bill Wilson, called me. He was rather frustrated because the committee was divided on whether chemical issues, which pushed towards low RH and low temperature, or mechanical issues which pushed in the opposite direction, were more important. Bill and (he had discovered) I thought that worrying about a little shrinking and possible cracking of archives was like worrying over a few broken dishes while the Titanic was going down. The consensus did move in favour of chemistry in the last decade for archives. (But it is funny to think that not so long ago wise advisors to archives were not taking cold storage all that seriously.)

I think cold storage is an issue of due diligence for a large portion of 20th century art as well. If we want our grandchildren to understand a few pieces of 1920's celluloid, some constructivists, some Russian stuff, 1980's polyurethane foam (Dali's red sofa is really in sad shape right now, they have a real problem), etc., etc. well...its cold storage or... we pass on profoundly deformed, yellowed, disintegrating, messes. And saying "but we controlled the fluctuations"...I think it will just sound silly.

Inorganic chemistry – minerals, metals, glass – I don't think there's a big mystery there either. Know your materials. Avoid very specific RH thresholds, or your piece might disintegrate in a few hours...or it might not.

So, that's the first three. Finally, the mysterious theme...the reason for this panel, which is the physics.

So, what is the model used by scientists in this area?

The basic model considers a layer of material, attached to some other material. (I think you're all very familiar with this, but I'm just going to review it.) One or both materials want to expand and contract as the fluctuations occur, but there is a mismatch between the two. So mismatch is the key word. Stress develops in each layer. At a certain stress, a material reaches its "yield point". Beyond this, plastic deformation accumulates... and that part's irreversible. So there's the link between our terminology and engineering: yield point equals irreversible. As stress increases further, the material fractures. (We're all clear that fracture is irreversible too!)

So when one uses data such as Mecklenburg's for artist's paints, and he has certainly contributed the largest set of data of use in this model (Note added post panel: for example, <http://www.si.edu/mci/downloads/reports/Mecklenburg-Part1-RH.pdf> and [www.si.edu/mci/downloads/reports/Mecklenburg-Part2-Temp.pdf](http://www.si.edu/mci/downloads/reports/Mecklenburg-Part2-Temp.pdf) . Some data I have used was given as personal communications), or industrial data for wood, the model shows yield does not begin until about 15% humidity fluctuation. In recent work by myself, and colleagues in Europe, the roles of fatigue, on the role of stress relaxation, and hysteresis have been explored. I think it fair to say that the consensus remains among the group that for this model, +/- 10%RH would be a non-damaging fluctuation.

As for temperature fluctuations, they do not begin to even approach the yield threshold until paints are hot enough to be softening, or wood is scorching! On the low side, materials must be dropped well below "freezing" 32°F (0° C) to approach yield. At these conditions, the risk (as I'm sure many of you know) is

not due to shrinkage so much as to the glassiness of the materials, and their greatly increased vulnerability to poor handling.

So, is this model connected to reality?

The model is not representative of all forms of objects. (So, that's truth or dare, it's not entirely representative. Confession!). But it does represent a heck of a lot of acres of objects: paintings on stretchers, paint on wood, gilding on wood, lots of furniture, architectural trim, etc. It does represent the transient response of a single thick layer, which restrains itself. It greatly overestimates the risk to a lot of objects that have little internal restraint, like 99% of works of art on paper, textiles, leather.

So, you will ask, what objects do I think it will underestimate? It underestimates any rigid assembly where the stress "concentrates." (It's an old engineering term before computer modelling of fracture. They talked about stress "concentration.") For example: a paint layer with deep impasto; notched wood elements, such as bas reliefs; paint and gilding over joins, such as the arm joints of polychrome, joints in panel paintings. But...it's fair to say these locations usually cracked a long time ago, they've been restored century after century. And you know it, and I know it.

But, I also know that when these objects need repair, and I think you would agree, it's typically due to events far beyond +/-10% humidity. So, it doesn't get us out of the uncertainty box yet. How do we get a handle on the true sensitivity of these "canaries," because that's what I think we want to know – how many of them, and how do we qualify them.

What do collections tell us?

Mervin Richards of the National Gallery of Art in Washington DC, and Sarah Staniforth of the National Trust, each of whom has been responsible for thousands of objects, in hundreds of exhibitions, have stated (and they can qualify this of course) that they have lived with a de facto range of 40 to 60% humidity for many years, and that they have not seen damage that they would ascribe to humidity or

temperature fluctuations. They've all said that they've seen a lot of handling issues. I would add that they do have qualifications on how one interprets a "40 to 60" range. But at least that's out there on the table.

The British Museum has recently adopted a range of 40-60% as its benchmark for exhibitions and loans and their own works. I don't believe it was based on a hunch, or that they felt pressured. I am sure it was based on admittance that most of their collections are already in that range, or worse...let's not say worse...wider. (Even I slip into old habits and assumptions. They're wider fluctuations, we don't know if they're worse.) And they just don't see a problem. So their reality has been 40 to 60 at least, and it hasn't been an issue before, so why would it be now?

What is my advice, in the end?

When I consider the science plus the evidence of collections, I still reach the same advice that we drafted for ASHRAE 12 years ago. Which is that:

- plus/minus 5%RH means no risk of physical damage, and that
- plus/minus 10%RH means a small risk of physical damage, but only to high susceptibility objects.

We're back around the circle again! Do I think there are many high susceptibility objects? No, I don't, and apparently neither do the people who have seen many collections subjected to these conditions.

One final note: Although most of our attention is focused on acceptable RH fluctuation, I think the bigger benefits for sustainability, for carbon footprint, are in an expanded range of permissible temperatures.

The difficulty for that will be in convincing users to accept warmer summer conditions and colder winter conditions. I don't think the collections will care at all, until people are screaming blue murder.

Thanks.

## **TERRY DRAYMAN-WEISSER:**

As Jerry Podany has noted in the introduction to this roundtable, “The narrow ranges of relative humidity and temperature that we hold as standards today were set when energy was relatively cheap, global climate considerations were not yet common discussions, and the technology of HVAC systems was more concerned with control than with efficiency”. The evaluation of museum climate standards is not new to conservators; in fact, some have already broadened ranges with slow transitions according to the season. However, the *Climate Change and Museum Collections* roundtable (pdf at <http://www.iiconservation.org/dialogues/>) during the 2008 IIC meeting in London and the more recent forum on *Re-thinking the Museum Climate*, at the Museum of Fine Arts, Boston, have again focused our attention on museum climate standards and environmental approaches. Conservators are being asked to consider changes to these standards taking into account the current and future economic and energy crises and the global movement towards *green* technology and sustainability. Most conservators I know are concerned about these large and looming issues but also consider themselves advocates for works of art, today and for future generations. We also know that working toward environmental sustainability and collections care need not be mutually exclusive.

What we need is a way to make informed decisions. I think conservators would agree that in most cases (there are exceptions, e.g. cold storage of certain materials) the existing standards have not led to harm for works of art. And from my own observations I believe that what have been called the “magic numbers” give us a range that is compatible with most of the diverse objects in many of our collections. When the environment has drifted outside of that range I have seen changes and damage to highly sensitive works of art and to many materials that are inherently unstable or that require specific limited RH ranges such as unstable glass/enamel, Asian lacquer, illuminated manuscripts, Asian screens/scrolls, panel paintings, paintings on copper (corrosion at higher RH), archaeological copper alloys/iron, ivory, salt contaminated ceramics/porous stone, among others.



Detail of crizzled surface. Limoges painted enamel on copper, early 16<sup>th</sup> c., *Man of Sorrows*, Walters Art Museum, 44.438. This unstable enamel crizzles below 48% RH and weeps above 52% RH. Photo: Terry Drayman-Weisser

For many years conservators have been aware of the issues surrounding compatible RH for works of art in historic, as well as many modern, structures, and many of us have already moved set points to accommodate seasonal changes to prevent condensation and mould growth. To protect vulnerable objects in those spaces we have made use of climate-controlled vitrines (micro-climates). At the Walters Art Museum we have moved set points in one of our more vulnerable buildings, and as a preventive measure we install less reactive objects during certain seasons and use climate controlled vitrines.

Yet some have suggested that conservators in the United States are stubbornly adhering to outdated standards since scientific testing has demonstrated that no permanent damage occurs in ranges of relative humidity between 40% and 60%. For me a major stumbling block in accepting a broader range in relative humidity is that I am not yet convinced that existing testing of materials and the observations regarding their behaviour within wider RH parameters are applicable to real works of art. The research that supports this broader range meets the highest standards and has produced important data for our consideration. However I am concerned that it cannot model, at this time, the full set of variables that are normally presented by complex objects, especially those that have been through many permutations and



changes over time. I am also concerned that the empirical evidence reported by conservators does not compare with the scientific conclusions. Certainly the recent work reported on the AIC Environmental Guidelines Dist List from the Metropolitan Museum of Art by scientist Dr. Paolo Dionisi Vici convinces me that it is premature to say that we know enough about how actual works of art respond to environmental fluctuations and that we can make informed decisions. We need more research to determine whether permanent damage occurs in hygroscopic materials in the broader ranges being proposed especially with unlimited fluctuations. We also need to evaluate damage due to chemical changes and biological activity within these wider ranges of RH and temperature. For example what happens to works of art at higher RH in the presence of pollutants, insect pests and bio-films.

We recognize that not all objects need to have the same degree of environmental control. In fact, some need no environmental control at all other than preventing mould growth. Collections in storage can be divided and cared for by the level of control needed. On display, micro-climates can be created and maintained for especially reactive materials within galleries with wider ranges of RH. But it must be acknowledged that with expanded general environmental parameters many more objects will need climate controlled cases for long-term preservation. This will create additional expense and demands on staff time. Because of this, even with the best of intentions these special environmental cases may not be regularly maintained. In many instances existing display cases will need to be replaced or reconfigured to become efficient and effective for micro- climate control.

Based on the nature of the collections in my care, our buildings and a desire for a sustainable future I will advocate for a judicious use of wider RH and temperature parameters and seasonal settings wherever possible and practical. I will look to future research to further inform my decisions. Conservators must not feel pressured to abdicate their professional responsibilities but must also be willing to re-evaluate existing or proposed standards based on reliable and realistic data.

## OPEN DISCUSSION

**MA**=Maxwell Anderson, **TW**=Terry Drayman-Weisser, **CG**= Cecily Grzywacz  
**SM**=Stefan Michalski , **NB**=Nancy Bell, **KCS**=Karen Colby Stothart

**MA:** I would like to make a point that I think Stefan raised in an earlier discussion: when we measure RH and temperature where are we doing the measuring? Is it on the wall or is it on the floor? Is it directly measured with a hygrothermograph or is it an average measurement from the return air of the space? It isn't a simple issue and it should be either standardized or revealed and reported.

**TW:** I would like to make a general comment. I think none of us are really that far apart in what we are saying. I am hearing from us all that we need a lot of collaboration among the scientists the conservators and the engineers, the administrators and I think we need to find the mechanisms to do that, some sort of platform. Has AAMD (Association of Art Museum Directors) considered having conservators come to speak to that group?

**MA:** We have in the past, and I think we will again in the future. I think that this is a specific topic we have not focused on before and will be taking it up in far greater detail.

**Audience member Gary Frost:** I have always been a bit confused in relation to the commodity and bulk collections like libraries and archives why we are predicating the monitoring of the condition of the air without correlation of the aspiration of free moisture in and out of these commodities . Because it appears to my experience to be two different rate related phenomena going on.

**SM:** The model we use, and we think it is legitimate, assumes that the books or the commodities are in equilibrium, more or less, with the air. When we speak about these humidity specifications within ASHRAE and other places, I really do think of them as a performance specification at the object. Our responsibility is to say what the object needs, not to interpret that and transform that into 'therefore we think that probably you are using a mechanical system, so probably this is what we should tell the engineer'. That's a separate transformation with its own issues. Sometimes people want to use the same

standards to design a silica gel display case, or they want to use it to measure risk by putting a probe right next to their commodities and saying this is what I am measuring within half a millimeter here of my book. That is what we are talking here, what are the acceptable ranges for the air in equilibrium with the object, which keep them safe.

**Audience member Gary Frost:** Let me put it another way. If we took the commodity out of the library and archives there would be much greater volatility in the fluctuation of the relative humidity in the air. The cellulosic commodity (books, documents, etc) buffers the whole exchange that we're seeing.

**SM:** I agree if you have a library or archive with a mechanical system you essentially have a locomotive with 500 cars full of dead weight and to actually talk about whether the locomotive actually speeds up or slows down the whole train is a complex issue but in the end it does keep moving because the locomotive is going in a particular direction. But you are right the tail on that dog is large and sometimes it does the wagging of the dog. That's a separate issue of the dynamics of the box. You're right, when we're trying to control a big space full of cellulose versus a space not full of cellulose, it has slightly different dynamics.

**NB:** I think this illustrates that we always have to keep in mind what kind of materials and the amount of those materials when we are coming up with an environmental management strategy. In my own collection we have the "box", 187 kilometers of stuff and we have looked at that box or boxes (and the material) and determined the buffering capacity of those boxes and it has helped us be more efficient in managing our energy use. It helps us be more flexible and to use our HVAC system in a more efficient way.

**Audience member, unidentified:** Anecdotally I am hearing a lot about fatigue of materials these days. And due to the narrow range of temperature and RH that has been the standard we are setting up a cyclical flutter rather than a larger but slower adjustment of the material. As a result (we are) causing fatigue of the materials. Would you comment on this? And secondly within the last month or so a group

of folks at ICOMOS have been planning on setting up a Building Systems Working Committee that is looking into the same sorts of parameters of environmental as well as why we seem to think it is acceptable to lose 30% of our building structures every time we do a mechanical upgrade.

**CG:** My first observation is that we have to all be working together. If ICOMOS is attempting this, and IIC and AIC are discussing this, and I'm trying to reflect it in the ASHRAE chapter it creates a problem of us all doing it independently. This is not a large field. We do not have enough research going on and we do not have enough resources. We need to start communicating more effectively. As for the first part of your question, everyone has been giving examples of what they have seen with or without strict environmental parameters and controls and it seems to me that we have to somehow start capturing clear observations and results. And make those available to all of us for evaluation. Maybe it is only 1% of the collection when the parameters are broadened to +/- 10%, or maybe its greater, maybe its 10% of the collection. But until we start capturing the observations, in a way that can be examined and shared we cannot move forward. I do not believe that kind of data is out there.

**Audience member Rachael Arenstein:** I am a conservator in private practice and I deal with institutions of various sizes and a wide range of preventive care projects. I think most institutions have a far greater percentage of the collections in storage than on display. Several of you mentioned tailoring storage environments to the varying needs of the collection. For the most part there is never enough room in storage and with the exception of metals storage or cold storage things are generally grouped by department or object type. So the conversation that in any given museum there is a variety of store rooms and some can retain tighter controls and others cannot and maybe we can organize storage in a different way based on the needs of objects is, to me, a non-starter. So what can we do about organizing storage by environmental need when there is insufficient room and on a practical level seems difficult to consider?

**TW:** You are right of course, but it is sometimes opportunistic. If there is a renovation taking place or a new building being constructed, that is the time for the conservator to begin working with the engineers

and everyone else, to help design and make suggestion about storage facilities. At the Walters we are going through a process right now looking at various spaces and buildings.. We are considering moving parts of the collection that do not require close monitoring and strict standards into a space that has some climate control but is not as strictly controlled as other spaces. Due to storage space needs we are also under pressure to close our library and to dispose of our general reference books and periodicals. Rather than disposing of this material as some suggested, one thought was to put the books from the library around the outside of the most closely controlled storage area for sensitive objects. The mass of books would then have a general, broader climate, but act as a buffer for the storage area, and still be accessible. So you would require less energy to keep the entire storage area stable. I think it is a matter of being creative when you can. Another person who needs to be a part of this conversation is the curator who might be persuaded that objects from different collections could be brought together and separated in storage by their preservation needs rather than by their historical period.

**Audience member Barbara Appelbaum:** I want to describe some turf here. Because we are talking about several different things and not stating them clearly. It seems to me that what we are really talking about here is Art Museums and big fancy art museums,. That's the first thing, and I'm not making a value judgment but a lot of you have said "art" over and over, again and we are talking about things with the greatest value and things that have the most prestige from travelling around. I think from my practice we have been doing the kind of detailed planning that a lot of people have talked about: is it a structure, historic, are the things in vitrines, all of those things. And I think there really is a lot of agreement about looking at the collections, looking at the building, looking at the budget, looking at the climate...whatever. And actually I must say that the only experience I have had with 50/70 (50% RH and 70° F) is when lenders require it and in my practice it has been the most absurd people who require it. Like collections of high fired ceramics. But I think really there is a huge amount of agreement it is just trying to describe it that falsifies what we are saying. So I think that's the box we are in and I am not unhappy with that one. But once we are talking about going *green*, reducing our energy use is not the only way of doing it.

Clearly if we change our energy sources we are in a whole different ball park and from what I know I think Toledo is one of the best examples of that and another slightly less pleasant idea is that international loans are hugely “un-green” by their definition and my guess is that in places, unfortunately not in the United States, in places that have already made rules about reduction, my guess is that emission from the travel of shows don’t end up in calculations of whether you are going *green* or not, which is unfortunately an embarrassing fact.

**MA:** That’s a good provocation, but unfortunately moving half million people somewhere else to see the objects has yet another carbon foot print result and impact.

**Audience member, unidentified:** It seems to me that no one has really addressed the effects of the *green* effects of changing the parameters we are already using or the loosening of the parameters to +/- 10% RH range which many of us do anyway because our systems can’t do any better. A number of years ago Karen (Stothart, published as Karen Colby) published a ranking of light sensitivity and how many lux hours could be tolerated by different material so that we, as helpers in collections care, could talk to curators about what they wanted as an acceptable risk to their collections. I would like to see a component which describes what are we saving, what are we gaining. Will that come out of your group as well or is that yet another separate question.

Because having that data and being able to provide it helps in discussions with chief financial officers, and HVAC engineers, etc.

**NB:** Your priorities are the priorities of other research programs and the questions you ask are really good ones. I don’t think we have at this moment sufficient data on the relationship of energy savings and stewardship. And so that has yet to be explored further.

**Audience member Barbara Mangum:** When I was at the Isabelle Steward Gardner Museum and we undertook a two year climate study looking at both cause and effect. I worked with Nathan Stolow on this and we collected data on temperature humidity and light as well as light mapping. We tried to

determine how a diverse collection in what essentially is a Venetian Palace in Boston. Lots of diverse materials and no climate control except for basic heating for 100 years. The collection was in such poor condition, it had experienced so many different fluctuations. Finally we did get climate control installed and it was seasonally adjusted from 35% to 55%. It was very clear that the parts of the collections that could not handle that kind of variation were things like veneered woods, lacquer, anything that had a soluble salt associated with it, you might get crizzled glass, or stone laden with salt. We saw times when a high temperature and a high relative humidity reacted so quickly with a painting for instance. You could see that it was a very different reaction than your normal humidity temperature thinking. We ended up using a lot of micro climate vitrines. Over that two year period we got to know the collection really well, almost on an individual basis. We monitored in great detail to understand localized climates in small individual areas and we found significant difference between the overall environmental conditions and these localized “pockets”: by a window was very different than by an internal wall. But as we got to know all these things we were able to tailor the use of these specific areas for specific objects, matching the environmental parameters possible to the objects needs. We were able to eliminate a lot of damage. In terms of evaluating the effects of environment of objects, we were doing weight studies and dimensional measurements.

**IIC (added question):** Since we know that even with narrowly set ranges there are considerable variations of RH and temperature within spaces, will we inadvertently venture outside of what may be considered safe when implementing a broader range?

**TW:** The current scientific testing has been interpreted to support the conclusion that the majority of hygroscopic materials will not sustain permanent damage in a fluctuating RH range of 40 to 60%. Assuming that this interpretation is correct, we must then assure that our mechanical systems and other methods of environmental control can actually maintain these parameters. What set points must be selected and what breadth of fluctuations can be tolerated to stay within these expanded guidelines? This

becomes even more of a challenge when we must deal with galleries and storage rooms with imperfect air flow, gradients in RH and temperature from floor to ceiling, corners versus open spaces, intimate or more enclosed areas, etc. It will be the responsibility of every institution to survey and evaluate their facilities and the capabilities of their systems to find their own answers to these questions.

**Audience member JP Brown:** The first thing is that I would like to disagree with Cecily a bit and say that I think it is fine to require more stringent conditions for objects out on loan than one has in one's own museum. If I lend something to someone I want them to be more careful with it than I am.

**CG:** But then the change between the strict conditions you are requiring and those that the object is used to, if they are far apart, may also invite potential damage.

**Audience member JP Brown:** Perhaps, but not necessarily. My second point is that I think we are ignoring the built environment which is where a lot of our energy is being spent. These big atrium spaces for example, controlling the environment in them is very hard. So it is not just about whether you have air conditioning but it's about what kind of building you are putting it into. If we are going to talk about being *green* we need to talk about the building as well as the recurrent energy costs. The third point is that I totally take Stefan's comment about performance based specifications but I do think that when you get on to the ground, helping people with implementation is really important. If you go to an engineer and make a specific request, and they have no idea how to do it, it is important that there are people out there who can give them a starting point and help them work through it.

**CG:** With respect to the building, coming from the engineering side the engineers and many conservators as well look at the building as an "envelope". You cannot control the climate to any effective degree unless you understand the building. There are people out there that do know how to help people understand a building and control the environment. You are absolutely right that we do need to be able to communicate. And that is one of the beauties of ASHRAE: it has all this material available for the



engineer. Yes it can be a little difficult to get and yes it might at first seem foreign to a conservator but that has the information that you need to integrate.

**Audience member JP Brown:** But that was not my point. What I was trying to say is that when we were talking about Gary Thompson's book in the 1990's, one of the concerns was that there wasn't much about actual environmental damage. There was a lot on how to adjust the lighting, but not about the actual damage it caused. That's something we have been rectifying over the last 10 or 15 years but I think sometimes we do lose sight of what the implementation details are. I don't think it is adequate for conservation to keep asking for things that are not achievable. It is important that conservation comes forward, in partnership with engineers, with solutions that actually work.

**Audience member, unidentified :** why not also involve architects who have experience designing museum so that they can, in addition to contributing ideas about structural realities in building design or redesign can also become sensitized early to our concerns.

**CG:** They are often included. It depends on the architect. The engineers working with ASHRAE work a lot with architects. But in the same way conservators have disagreements with registrars and administrators, engineers have disagreements with architects. In the end we will only achieve what we need to achieve when we work together.

**Audience member Richard Kirchner:** This is not a new discussion for those of us who have worked in historic houses. We have been discussing this for the last 15 years and in fact the ASHRAE standards are one of the results of that. As we move forward we should be cautious not to reinvent the wheel. ASHRAE has gone to a lot of work to put together this chapter but unfortunately the guidelines referenced in the ASHRAE Chapter, especially the table created by CCI, are not readily available to those who cannot afford, or have no other reason to subscribe to the ASHRAE Handbook. However a simplified table is available on the CCI website at <http://www.cci-icc.gc.ca/crc/articles/enviro/index-eng.aspx> Information on this topic is out there on the IIC and AIC site. At the Boston meeting we talked

about a different model which is a box of 40%-60%. I think we should stay with the ASHRAE formula of plus or minus, 5% or 10% or 15% and not get confused with a “box” that you cannot step out of.

**CG:** I completely agree that we shouldn't start a new “box”. The work of CCI and the article you cited is already recognized in the field both by Conservation and Engineers (through the ASHRAE chapter). To create a new starting point would not be beneficial and would not help with the consistency that the Directors are looking for. The ASHRAE chapter should be a means to communicate with the engineers and facilities manager. There are several benefits to working within this organization. The Handbook Chapters are revised in print every 4 years and the electronic version is revised every year. ASHRAE has research funds to support its Handbook Chapters. We can submit requests for HVAC/R related research.

**Audience member Merv Richards:** Many of us who have worked with exhibitions and loans over the years are well aware that many of the institutions we deal with in Europe use 55% +/- 5% or 45% +/- 5% so this reference to the fact that many of us have been lending to institutions that do not match exactly our own institutions conditions is absolutely true. It is only anecdotal information that suggests that the amount of damage that has been seen has been minimal, if any at all. That being said, having discussed this topic extensively with many colleagues, I think that when we talk about the issues of 40% to 60% or 60-77°F (16°C to 25°C) the biggest concern is the idea of free-floating between those extremes versus the idea of having more minimal fluctuations like +/- 5 but with some seasonal adjustment, like 45% +/- 5 in the winter and 55% +/- 5% in the summer. So those are certainly some of the concerns being expressed. Max, as a director who is involved in this issue, and as someone who is preparing to discuss it at length at AAMD (Association of Art Museum Directors) what is it that we need to convey to museum directors in America to move forward in agreeing upon an interim specification. And also in terms of discussing what additional research may be done to supplement the good work that has already been completed.

**MA:** I would say consistency is what would help directors. It is exactly the variability of opinion and the diversity of perspectives of people who are highly regarded in the various aspects of this enterprise that

creates confusion for directors. And I know you are not making the assumption that directors are wooden creatures for whom all that matters is the bottom line. We are looking for the best advice that is synthesized from a collective opinion and that is what this very group is capable of arriving at. No one is going to act precipitously and abandon the standards that are generally recognized, but arriving at a more though, reasoned and syncopated result is what the directors need and are looking for.

**Audience member Rob Waller:** In reference to an early exchange I think it would be unethical for an institution to demand more stringent controls for a loan than they are able to accomplish themselves. It seems to me that in any of these attempts at big changes in the field it is helpful if all of us can look in our particular area for “low hanging fruit.” I think most of you have done that. Terry Drayman-Weisser has done that by looking through her collection and identifying those objects that need less stringent control and saving energy accordingly. If at a museum director’s level there were a commitment to not requiring specifications for a loan object that were much stricter than the museum is actually capable of achieving itself, then that would send a strong message that director’s are really behind being consistent and coherent.

**MA:** I agree and that is why I started out by suggesting the need for candour and that is why at my museum (Indianapolis Museum of Art) we are saying to those lenders and borrowers whom we work with around the world “here are our standards, this is what we are achieving, we hope you can meet them”.

**TW:** I think a lot of people assume conservators impose these stringent restrictions on loans in order to turn down requests. But at our museum (Walters Art Museum) when we ask what the environmental parameters are at the borrowing institution, we don’t ask because we want to turn down the loan, rather we ask because we need to know what kind of environment the object is going into. We are dependent upon that institution being honest with us, and to confirm we will ask for charts during that loan period in the previous year to find out what is really going on. We then have something on which to base our

decisions regarding whether that object must be in a climate controlled vitrine or what it might need when it arrives at the venue.

I also want to say that if we all are adapting and accepting these broader parameters it is even more important to know what the environment actually is during the loan period at the borrowing institution. If you have opted for a seasonal set point of 40% and you are sending a work of art somewhere in the world that has opted for a seasonal shift, at that same time, of 60%, you are not going to get just a 10% change but a much broader change.

**Audience member, unidentified:** I think there is something missing. I think defining the range is incomplete. I think a 40%-60% RH fluctuation over two months is vastly different than the same fluctuation over two hours. We are not specifying time. Not what the material is capable of, nor what the space is capable of within a time period. I want you to comment on that.

**SM:** I think you are probably presuming that one of those conditions is universally more dangerous than the other. I can pick an artefact for which one (a fast change) is more dangerous and I can pick another artefact for which the slow change is more dangerous, like a heavy piece of furniture. But you are right, we do have a more detailed understanding of fluctuations than what is contained in the specifications. I am more comfortable myself with the ASHRAE way of formulating the fluctuation. ASHRAE doesn't say you can be between 40% and 60% it says 50% +/-10% is an A classification, and that's not the same as saying you can set your humidistat at 40% sometime in the year and at 60% the other part of the year, plus whatever fluctuations.

**Same audience member:** I would like to know for specific materials what is safe, at what rate can things change within a range. So that then we can design microclimates which I think will ultimately be the more feasible solution, not changing the whole building, but making an enclosure that fits the parameters of the object.

**IIC (added question):** What are the costs for creating micro-environments for works of art with needs very different from a fluctuating 40-60% environment? (Cost of buffering materials, cost of retrofitting cases with better seals and totally inert materials, cost of monitors for cases, staff resources to monitor and reactivate buffering materials—changes will have to be made more often if environment outside of case is markedly different from in case environment).

**TW:** If a 40-60% RH general environmental range is adopted, many more sensitive works of art will need to be displayed within sealed vitrines, and many of these vitrines will require not only buffering from minor fluctuations, but active control of the case environment. This becomes an issue that many curators will want to weigh in on, as their desire for open display will be affected. We also know that the wider the difference in the RH between the gallery space and the interior of the vitrine, the better the case has to be sealed and monitored. The anticipated savings in energy for an institution for expanding the environmental parameters may be seriously eroded by the costs of constructing additional vitrines, retrofitting existing vitrines with better sealing systems and purchasing monitors or dataloggers and large quantities of buffering materials or specialized internal case climate control systems. Another factor that must be considered is the additional staff resources needed to monitor cases and to re-condition or replace buffering materials. One other factor that needs to be considered is that currently there are very few case materials that have been approved for long-term use in a well-sealed display case. This limits options for display design and is an area that needs additional research.

**Audience member Paul Himmelstein:** I am a little confused about what the goal of all this is. If it is to reduce the carbon footprint that's one thing. If it is to reduce the cost of running an institution that's a little different. If it is to go "green" or get LEED® (Leadership in Energy and Environmental Design) certification those are also two different things. I think we are confused about it because we need to also enlist all the other people who are dumping this all in our laps Architects who design buildings that are all made out of glass, where daylight cannot be excluded for half the time when no one is in the building

and thus cause a huge amount of expense for no reason what so ever, that's one problem. If the way the LEED® certification is written you don't get any points, or very few points, for daylight issues, for excluding daylight, and actually for including daylight you get points, which don't help us at all. If the architects are allowed to do anything they want but we can't I think that's not fair. And I would suggest that the visitor and the staff have responsibilities too by turning down the thermostat by 5°F in our part of the country during the winter we could easily raise the humidity without doing any damage to the collection. We could do a lot of good and we could put signs up that warn visitors to keep their sweaters on in the winter. And enlist their responsibility to help preserve their heritage I think if you don't include all the stake holders in an issue like this and it's only up to the conservators, scientists and everything we are only one side of the equation.

**Maxwell Anderson:** I think that's a good note on which we can now bring today's session to a close Thank you to all the panellists for putting so much thought into this and providing us with so much information. We thank the IIC and the AIC for this open discussion on such an important topic.

## SUMMATION STATEMENTS

**Terry Drayman-Weisser:** This roundtable discussion should be viewed as the beginning of a dialog among conservators, scientists, engineers, administrators, and other interested parties on the subject of preserving our cultural heritage and our environment for the future. A pressing need I see as a result of this and other recent meetings is support and funding for further research on a wider range of effects (e.g. chemical, pest, bio-film) on materials in expanded RH and temperature environments. Another significant issue is balancing the savings from broadening parameters against the additional costs of

providing many more local controls for objects that would be adversely affected in an expanded range. Many questions were raised and issues discussed during the session, but what to me is a very positive development is the continuation of the discussion after the meeting in small groups and large, on-line and face-to-face.

**Stefan Michalski:** The same “dilemma” emerges routinely in risk assessment: the discussion is very old, scientific data, models, and field observations are available, but they are limited and disputed. The moral and financial costs of reducing the risk have recently been increased. As the profession claiming expertise on the effects of this risk, we have been asked now to help find a new equilibrium between risk reduction and risk acceptance, between costs and benefits over time. I don’t believe that the community is asking us to define zero risk, although we have certainly sold that false hope in the past. I don’t think new research will remove the fundamental uncertainty about the exact vulnerability of each object in the collection population, but it will uncover its distribution, and probabilities. I think the ASHRAE guidelines are the best linguistic scale of RH fluctuation risk currently available, and they are very conservative. We do have vitrines for all the “precautionaries” among us. Let’s not forget that any collection that has seen a fluctuation X, is not at large risk from any future fluctuation less than X, unless objects are “conserved” incorrectly. That is the real dilemma for our profession.

**Cecily Grzywacz:** We have guidelines;  $70^{\circ} \pm 4^{\circ}\text{F}$  ( $20^{\circ} \pm 2^{\circ}\text{C}$ ) and  $50 \pm 3\%$  RH is not a standard, a code or a law written anywhere. It is the norm because it is presumed to be the best set points to minimize risk for all collections. This is a costly presumption in energy and fiscal resources. Stefan Michalski and CCI’s work on risk management and expanding acceptable fluctuations to  $\pm 5\%$ ,  $\pm 10\%$  or  $\pm 15\%$  provides a strong foundation for relaxing the perceived strict “standards”. This has been incorporated into the ASHRAE *Applications Handbook* chapter, “Museums, Galleries, Archives and Libraries”. Relaxing set points is one discussion. To change the vocabulary to a box of 40-60% could be dangerous. It does not mean  $40 \pm 5\%$  to  $60 \pm 5\%$ , but it could easily be misinterpreted that way. We should continue the

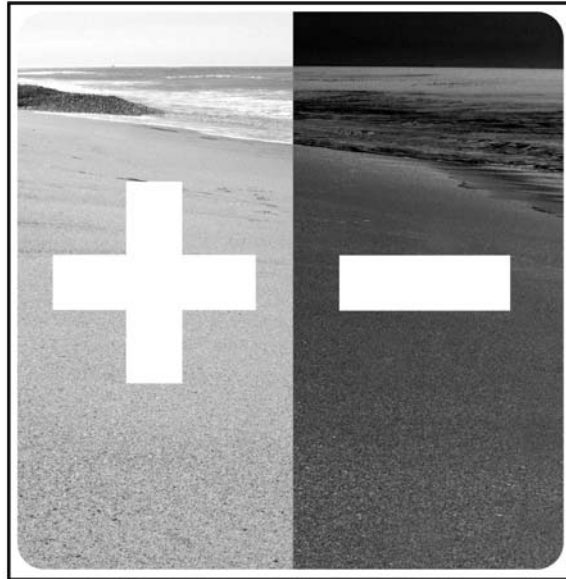
discussion with the same vocabulary. To openly share experiences so that we all benefit from each other's successes and failures. To be honest about reporting climate control and specific about how the measurements were made and where, including time intervals.

The Way Forward must be made with knowledge. We must understand materials; know the history of artefacts especially past treatments; understand acceptable risk and more. This panel discussed the *Plus-Minus Dilemma* with respect to temperature and relative humidity. But in an environment, objects' exposure and risk are a factor of many additional parameters: light, handling, security, open display or behind glass, access and air quality or pollution. We cannot look for the magic answer; we must look for the solution based upon the best knowledge at the time. We should be prepared to modify that solution as we learn more and technology advances.



Photo by Brett Rodgers, American Institute for Conservation of Historic and Artistic Works  
**Panellists from left to right: Stefan Michalski, Terry Drayman-Weisser, Cecily Grzywacz,  
Maxwell Anderson, Nancy Bell, Karen Colby Stothart, Jerry Podany**





## The Way Forward

Each of the roundtable panellists were asked to contribute to some thoughts about the *Way Forward*. The following is what they offered.

- support the continuation of the AIC discussion forum (address?) and the formation of an AIC task force on this topic
- strongly encourage the further education of conservators to allow a more in depth understanding of the environmental needs of various materials (not just a simple adherence to standards).
- encourage the creation of reasonably standardized methods to document observed changes or damage to collections likely due to environmental changes. And then the sharing of this information throughout the field.

- call for more scientific research—collaborations between practicing conservators and scientists; and the encouragement of funding for these efforts.
- support the development of standards for new museum buildings, with an emphasis on building design, construction, and finishing materials selected for promoting a stable environment (rather than asking the conservator to solve the problems created by poorly considered, but often iconic buildings). Such buildings must take preservation needs, sustainability, climate change and future energy costs into account.
- encourage funding agencies to support surveys for and implementation of improvements in passive methods to control the environment such as retrofitting of casework or the replacement of building/finishing materials to make climates more stable with less active control.
- encourage storage of materials by level of environmental needs, rather than period or curatorial area.
- support the use of controlled seasonal drift if appropriate and whenever possible with tightly reduced fluctuations from set targets and the use micro-climates for materials that need a different climate for preservation (focus on preservation of works of art and building).
- support research on and development of inert display case materials so that cases can be safely sealed to create efficient and effective micro-climates.

## IIC NewsBlog comments by Rose Daley and Amber Keller

<http://www.iiconservation.org/news/?p=1026>

### Rose Daley:

**Maxwell L. Anderson**, the Melvin & Bren Simon Director and CEO, of Indianapolis Museum of Art, Indiana moderated the session and he began with comments about how as the director of a museum he stood for administration, but to really move forward in this discussion we need to move past stereotypes and work collaboratively with administrators, scientists, conservators, and building engineers to discuss the longevity of cultural heritage, currency, and energy. Throughout the discussion it was emphasized that the best collective advice should be presented to museum directors so they can make informed decisions about the best practices.

**Nancy Bell**, Head of Conservation Services, National Archives, London, and Principle Investigator of the Environments, Guidelines, Opportunities and Risks (EGOR) initiative, was the first speaker. She introduced recent research in the United Kingdom. The research began after a [2008 meeting](#) of the Bizot group of museums. She discussed research that is being done and emphasized that conservators should make their argument clearly to museum directors to better begin a dialogue.

**Karen Colby Stothart**, Deputy Director, Exhibitions and Installations, National Gallery of Canada, Ottawa followed Nancy. Karen noted that she is an administrator of a museum and she would be speaking with an operational perspective, although she did train and practice as a conservator. She spoke about the importance of exhibitions and how they drive how a museum defines itself and the +/- dilemma. The National Gallery of Canada has a more flexible approach to environmental guidelines, incorporating seasonal changes into the temperature and RH ranges. To have this flexibility requires a high level of technical understanding of the conservation team, and understanding of the collections. This is labor and knowledge intensive but allows for the required flexibility in the National Gallery of Canada.

**Cecily M. Grzywacz**, Conservation scientist specializing in preservation environments and collaborator in the ASHRAE guidelines for museum environments, was the next speaker. Cecily was quick to point out that she was between positions so she could say what she really thought on the +/- dilemma. She began by saying that there is no internationally agreed standard for temperature and humidity parameters and we are currently dealing with the lack of a standard. This is an interdisciplinary communication process that needs to inform and educate each other. She forgave conservators because she pointed out that registrars and loan agreements are where there are requirements for strict standards, and not usually conservators. She rightly pointed out that a loan to a museum should not be a 'spa vacation' for an object, and by requiring more strict parameters for a loaned object could actually be damaging. This reminds me of an article I read earlier by [Jonathan Ashley-Smith](#).

**Stefan Michalski**, Senior Conservation Scientist, Conservation Research, the Canadian Conservation Institute, Ottawa. Stefan is a giant in the field of conservation science, one of those names you study at school and are then amazed that he walks the Earth and looks generally like other human beings. He is also a parent and he spoke about his interest in sustainability from the viewpoint of a parent which is something I have heard from other conservators, "If we are saving collections for our children, then we should also save the world our children will be living in." Stefan went for the facts by stating that the collection environment can destroy materials like plastics and some inorganics but the correct levels, especially for RH have not yet been defined.

He pointed to the [National Trust](#) and the British Museum as institutions using the RH guidelines of 40-60% and this is probably because these collections have been held at these parameters already. He noted that real savings are from adjusting temperature ranges, and changes in temperature are less damaging to collections than changes in humidity.

**Terry Drayman Weisser**, Director of Conservation and Technical Research, Walters Art Museum, Baltimore, Maryland closed the roundtable discussion, with a conservator's perspective about environmental guidelines. She is interested in re-evaluating environmental standards, and embrace green technology and sustainability. She believes that conservators need a way to make informed decisions, using research and realizing that every object may react differently to fluctuations depending on their treatment history. She believes the use of micro-climates and the creative use of exhibition spaces can help keep particularly susceptible collection pieces protected in storage and exhibit spaces.

I left the roundtable thinking that there is a great potential here for interdisciplinary study of the museum environment and how it affects collections, this could be done for individual collections or as research into materials science. Walking out of the ballroom to a song by Journey '[Don't stop believing](#)' I told myself I shouldn't.

## **Amber Keller**

One could sense the significance of this event in the interest and participation levels of the attendees.

Here are few reflection points and questions that I took away from the discussion:

- Transparency and candor in reporting the actual ranges institutions maintain. Max Anderson asked that we be forthright in reporting actual fluctuations in environmental conditions and that we remain flexible when resolving the challenges we face. There are few museums that walk the walk, and talk the talk in this regard, but the IMA's dashboard is setting an example as it displays the museum's daily environmental conditions and energy consumption in real time – visible to all – including those institutions with which they are negotiating exhibitions! (Perhaps transparency will let us all look at the real numbers in order to see what we are truly managing or 'controlling' when it comes to our environments? Perhaps providing this true data will enable us to draw conclusions based on actual conditions and realistic expectations; revealing how much we truly abide to the 'golden standards' we strive for? Have a look at the IMA's dashboard here: <http://dashboard.imamuseum.org/department/Buildings>

- Need for more research and understanding of how changes in environmental conditions will ultimately affect real artefacts – identifying the research gaps needed to develop research projects will be vital. I was encouraged to hear of efforts in UK and EU to address this need for research and will look forward to the learning more about it. Nancy Bell stressed the need to set priorities in material science research and understand the relationship between cultural heritage items and environment damage. This includes understanding who values the cultural heritage items and why they value them, along with determining what the acceptable levels of change are for these items if the proposed parameters are implemented.

- Understanding the canaries in our collections. This was a point brought up by Stefan Mchalski who summed it up when he said that the parameters we operate under should reflect the majority of the materials in our collections. Do we interpret this as providing exception for the canaries; relegating them to specially controlled areas or climate controlled displays, but not basing the entire collections parameters on the canaries? There are many innovative ways we can display, categorize, and care for these items. Reorganizing and managing our collections appropriately can help to preserve artefacts, as well as conserve energy and reduce overhead costs.

- Are 'creature comforts' dictating our environment parameters? If we communicate the importance of these changes to our visitors so they understand the goals for seasonal adjustments in our collection environments, along with the 'greener' benefits of these changes as part of our global responsibility, then perhaps they can 'adjust' to the warmer summer conditions and colder winter conditions. A sacrifice of comfort for sustaining collections and conserving energy.

These are but a few of the points I'm reflecting on since the event. I look forward to the transcripts generated from this and to the summary of Boston event 'Rethinking the Museum Environment' – which I've been told will be released in the coming week and posted (look for it on IIC's Facebook and News blog pages).

Placing these issues on the table opens up the dialogue we need to engage in as a profession, and with other professionals and stakeholders involved in this decision making process. It was clear that the imperative is on participation and collaboration; and although this issue is not new to those who have been in the field for some time (*déjà-vu* for many), looking at something from a different perspective gives greater insight and sometimes a renewed approach. I appreciated the varied perspectives given and remain open to the dialogues and research yet to come.