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Preservation in Tropical Climate

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IFLA-PAC
Bibliothèque nationale de France
Quai François-Mauriac
75706 Paris cedex 13
France

Director:
Christiane Baryla
Tel: ++ 33 (0) 1 53 79 59 70
Fax: ++ 33 (0) 1 53 79 59 80
E-mail: christiane.baryla@bnf.fr
Editor / Translator
Flore Izart
Tel: ++ 33 (0) 1 53 79 59 71
E-mail: flore.izart@bnf.fr
Spanish Translator: Solange Hernandez
Layout and printing: STIPA, Montreuil

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Preservation in Tropical Climate

The 2011 IFLA congress takes place in Puerto Rico, in the Caribbean, which is particularly affected by the hardness of the tropical climate. It is one of the reasons we chose this topic and its impact on the cultural heritage preservation and conservation.

Museu Casa de Rui Barbosa, Rio de Janeiro, Brazil © Shin Maekawa

Certainly, several works and articles have been published on this theme, such as the annotated bibliography published by René Teygeler in 2001[1], as well as the great number of articles released in *International Preservation News* since its creation in 1992.

So, why dealing with this subject once again? Because, at the global level, the climate change has accelerated; many studies have showed that one of its striking aftermath is that extreme climates are being accentuated. Dryness, hurricanes and tropical rains, natural disasters (earthquake, tsunami, mudslides, landslides) keep increasing regularly. In terms of tropical climate, this phenomenon means also, in everyday life, more humidity, more heat in an often difficult regional economic context, particularly due to still-higher energy costs.

Thus, this issue will offer you different approaches on this topic, starting with a brilliant introduction by John Dean, uncontested specialist of preservation in Asia.

In view of the environmental and economic difficulties known by countries with tropical climate in preserving their heritage, two experts, Shin Maekawa and Vinod Daniel, propose alternatives and low-cost solutions for the climatic control in buildings and pest management. Dietrich Schüller analyzes the case of audiovisual collections, particularly threatened by the tropical climate. Finally, Claude Laroque reminds us how training of preservation staff is important by presenting her experience at the Ecole du Patrimoine Africain in Benin.

As usual, we wish you a good reading and hope to see you again soon for the next issue of *IPN*, which will deal with Energy.

Christiane Baryla
IFLA-PAC Director

1. René Teygeler, with the cooperation of Gerrit de Bruin, Bihanne Wassink and Bert van Zanen. 2011. *Preservation of Archives in Tropical Climates: an annotated bibliography.* Paris: International Council on Archives; The Hague: National Archives of the Netherlands; Jakarta: National Archives of the Republic of Indonesia.

Museu Paraense Emílio Goeldi in Belém, Brazil © Pedro Oliva

Le congrès international de l'IFLA a lieu cette année à Porto Rico, en Caraïbe, région particulièrement touchée par la dureté du climat tropical. C'est une des raisons qui nous ont poussés à choisir ce thème et son impact sur la conservation et la préservation du patrimoine culturel.

Certes, de nombreux ouvrages et articles ont été publiés sur le sujet. On pourra citer la bibliographie annotée publiée par René Teygeler en 2001 ainsi que les nombreux articles qui émaillent l'histoire d'*International Preservation News* , depuis sa création, en 1992.

Si nous avons souhaité aborder une nouvelle fois le sujet, c'est qu'au niveau planétaire le changement climatique s'est accéléré ; de nombreuses études ont montré qu'un des phénomènes marquants liés à cette accélération était l'accentuation des climats extrêmes. La sécheresse, les ouragans et les pluies tropicales, les catastrophes naturelles mêmes (tremblement de terre, tsunami, coulées de boue, effondrements de terrains) vont en augmentant régulièrement. En terme de climat tropical, ce phénomène c'est aussi, au quotidien, plus d'humidité, plus de chaleur dans un contexte économique régional souvent difficile notamment en raison des coûts toujours plus élevés de l'énergie.

C'est donc à un parcours multiple que nous vous invitons avec ce numéro, introduit magistralement par John Dean, spécialiste incontesté de la conservation en Asie.

Face aux difficultés environnementales et économiques des pays à climat tropical pour conserver leur patrimoine, deux experts, Shin Maekawa et Vinod Daniel, proposent des solutions alternatives et à coût réduit pour le contrôle climatique dans les bâtiments et la gestion des nuisibles. Dietrich Schüller analyse le cas des collections audiovisuelles particulièrement mises à mal sous un climat tropical. Enfin, Claude Laroque nous rappelle l'importance capitale de la formation des équipes de conservation en nous présentant son expérience à l'Ecole du Patrimoine Africain au Bénin.

Comme toujours nous vous souhaitons une bonne lecture et nous vous donnons rendez-vous pour notre prochain numéro d'*IPN*, qui aura pour thème l'Energie.

Christiane Baryla
IFLA-PAC Director

Preservation in Tropical Climates: An Overview

by John F. Dean, Preservation and Conservation Consultant,
Former Director of Preservation and Conservation Department, Cornell University, USA

Introduction

What is different about book and paper preservation in countries with temperate climates from preservation in tropical climates? Since quite early times there has been a growing awareness of the effects of heat and humidity on library and archives collections. In 1919 for example, J.A. Chapman demonstrated the rapid deterioration of books stored in the hot and humid regions of Southern India as compared with other copies of the same works stored in Northern India and England (1). Other studies confirmed Chapman's findings and there is now little doubt that high temperatures, high levels of humidity, and air pollution greatly accelerate the degradation of paper. There are many other reasons why collections have been suffering and dwindling in developing tropical countries: poor storage environments, lack of education and training, the onslaught of insect and rodent pests, poor administrative support, unwise reformatting procedures, the effects of natural and man-made disasters, and lack of experience with the treatment of indigenous materials. Many of these issues are dealt with in much more detail later in this work by experts in their respective fields. My more recent work in tropical countries however, has given me cause to be greatly encouraged. There seems now to be greater awareness of preservation issues, and in some cases, there is developing infrastructure to support the establishment of preservation programs. But the ravages of ages past places these incipient programs at a considerable disadvantage, and help will be needed from well-established programs in the temperate zones to ensure that programs in developing countries can begin the long journey to catch-up on the years of neglect and to saving their cultural heritage.

This introductory piece then, is a review of some of the major problems of preservation in tropical climates followed by expert examinations by a range of experts who will greatly enlarge upon them.

Environment

While there is general scientific agreement that high temperatures and fluctuating levels of humidity are damaging to library and archival materials, the question goes a little deeper than that. Most of the world's developing countries lie in tropical zones that have climates that range from hot and dry to hot and very humid. Climate control systems common to richer and more developed countries are either not available to institutions in developing countries for economic reasons or practically ineffective because of unreliable power supplies or inconsistent use. As part of a research project carried out by Cornell University and the (United States) Image Permanence Institute in 2005 (2), twenty-six institutions in ten Southeast Asian countries were monitored for temperature and relative humidity over a one year period. As may be expected, those countries with well funded institutions and the infrastructure and capability to sustain air conditioning systems (such as Singapore, Malaysia, and parts of Hong Kong) had no difficulty in staying within acceptable climate standards, but most of the institutions monitored lacked the ability to fully control climate. In some cases, air conditioning actually exacerbated the problems. At one large institution in a country with a new library building and very high ambient humidity, the cooling effects of air conditioning lasted only as long as electrical power was available resulting in the rapid development of mold as the humidity condensed into moisture on the cool books, causing a serious mold problem that was not known in the original traditional building.

"This does not mean that libraries and archives in tropical climates should give up trying to moderate the effects of high temperature and humidity, but they need to look for more practical alternatives to mechanical climate control systems."

This does not mean that libraries and archives in tropical climates should give up trying to moderate the effects of high temperature and humidity, but they need to look for more practical alternatives to mechanical climate control systems. A great deal of thought has gone into devising natural systems for retrofitting existing library and archival buildings to reduce temperature and improve air flow, and there is some more detailed and valuable discussion of passive climate control systems later in this publication.

The poor environmental conditions and below standard building structures tend also to encourage insect and rodent infestation, yet more careful maintenance both inside and outside the buildings can significantly reduce these pests. Sometimes some leadership in these matters can make all the difference. In one library in which I worked in South Viet Nam, I pointed out to the library director that the unregulated cooking and consuming of food in the library stack storage was encouraging the infestation of insects and rodents. She immediately acted to turn an empty building on the library grounds into a cafeteria that provided free lunch to all library staff, and this novel approach acted to greatly reduce the insect and rodent population. Much more detailed discussion on this topic appears later in this publication.

Brittle Materials and Film Storage

Virtually every report by foreign observers on libraries and archives in tropical regions resulting from fact-finding missions describes run-down and dilapidated facilities, under-trained and under-equipped personnel, minuscule or non-existent funds, and collections that are largely bibliographically and physically inaccessible. While a few cultural gems, well known to Western scholars, seem better protected and available, the majority of library and archive materials are not, and local students and scholars alike struggle painfully but determinedly to try to satisfy their research needs. The large and important legacy of books and archives left behind by colonial powers tend to be concentrated mainly in the nineteenth and the first half of the twentieth century, and thus have the same inherent paper deterioration problems found in libraries and archives throughout the world, but much more severe because of the accelerated aging brought about by poor climate.

Brittle books and archives are, for all practical purposes, beyond the point where conservation treatment alone can significantly render them useful, so for many years the strategy has been to reformat the intellectual content through microfilm - and more recently - digital imaging. But the storage of microform negatives has also proved hazardous in uncontrolled conditions, and has been a significant weakness in the replacement programs that many institutions have tried to launch. Dr. Roger Tol of the University of Leiden, in an important report to the Ford Foundation in 1998 (3), reported that microform negatives are vulnerable when stored in Southeast Asia, and patently, do not last for the five hundred years expected in the West. In fact, most of the film negatives examined by Tol were illegible after only twenty years. Of course, for collections filmed by Western institutions in tropical regions the positive copies of the negatives that are held in Western libraries and archives are in good condition, but to ignore the problems of the deterioration of the original negatives in the countries of origin seems like one of the worst forms of cultural colonialism.

Digital Imaging

In 2007, I spent six weeks working in Afghanistan and that proved to be extremely challenging, as the environment is unfriendly, ranging from quite cold to extremely hot, and the attitude of many of the local people can best be described as unhelpful. The intent of this project was to select unique and scarce books stored at the National Archives, held by individual scholars, and in other institutions, and digitalize them for the benefit of scholars unable or unwilling to travel to Afghanistan. One of the essential features of projects designed to scan or film materials *in situ,* is to ensure that the original materials receive conservation treatment to ensure that they continue to survive in their original format, thus an important part of the project was to establish a full service conservation facility and to train staff in conservation techniques. In other words, this involves considering the original book or archive as an "artifact."

Conservation treatment represents the care of the original artifact in terms both of stabilization and treatment. The definition of an artifact, according to the CLIR *Evidence in Hand: Report of the Task Force on the Artifact in Library Collections* (4) is "an information resource in which the information is recorded on a physical medium, such as a photograph or a book, and in which the information value of the resource adheres not only in the text or content but also in the object itself." For example, the way a book is bound, the materials used in executing the binding, the paper on which the text is printed or written, the form of printing and illustration, the decoration, and so on, are all potentially valuable pieces of information that should be preserved for present and future scholars.

Digitization represents the digital capture of the artifact and this raises a number of issues related to long-term file maintenance, authenticity, copyright, etc. From the conservation standpoint, it is often tempting to regard digital imaging as no different from microfilming or any other analog photography, as all seem to reproduce the artifact. However, the ubiquity of access possible with digital conversion seems to add another dimension, and the special lighting requirements for effective scanning capture, exposure times, and handling concerns, suggest that a different response should be made, especially as many analog reformatting tasks were traditionally the province of preservation departments. Every digital imaging project concerned with the capture of artifacts must involve the preservation of the digital image and the original artifact, and at the very least, digitization should do no harm to the original source document. In fact, it is important to begin conservation work before the artifact is digitally scanned in order to ensure that the entire work has been captured at its best.

When artifacts have been scanned and the work considered complete, some consideration must be given to the stable storage of the original artifact. In some cases, artifacts may be returned to their original storage containers, but in others, new storage containers should be used. Large artifacts that have been unfolded or unrolled will need to be housed in different configurations than before. Folders that are too small or filled with too many other artifacts need to be replaced. In many cases, old folders that may now be acidic and worn should be replaced and discarded. Oversize folders, designed to support storage in steel flat files (map cabinets) should be slightly smaller than the size of the file drawer or exactly half the size of the drawer. In a similar fashion, boxes may be too small, inappropriate, or too acidic and should be replaced. Digitalization projects then should include sufficient funding to ensure that the original artifacts are preserved.

It is also extremely important to ensure that the resultant images are properly "archived," because if the images are not stored it could result in the constant rescanning of artifacts, a practice that should be considered unacceptable. Photographs, art-on-paper, and maps, are especially vulnerable to rescanning. Because file sizes tend to be very large for these objects, a "scan on demand" approach may be adopted that is designed to produce a single printable image without any attempt to save the images and this should be avoided. It is also necessary to ensure that the artifact is scanned in the optimum manner to achieve the desired results as a failure to do so might also result in rescans to improve quality down the road.

Because of the high cost of chemicals and film stock, it has now become the practice in developing countries to replace

microfilming with digital scanning as a preservation reformatting device as it appears to be more economical, but as noted above, ensuring that the image continues to survive is vital. This applies also to the commercial scanning of groups of materials held by developing countries, as it is important to ensure that the commercial scanner will always make the images available for use or better still, will ensure that the library of origin has some means of ensuring that the image continues to live.

Education and Training

As many of the recipients of the *International Preservation News,* I have devoted most of the last twenty five years working in countries with tropical climates on behalf of Cornell University and other institutions: establishing preservation programs, training staff in collections care and conservation treatment, designing facilities, searching for funding, in fact a wide variety of preservation pursuits. In working in other countries and cultures, it is important to recognize that preservation priorities are probably not the same as in the West, that short-term teaching and training alone will not result in viable programs without sustained financial support, preferably secured by librarians *in situ* from national governments and outside foundations, and that the Western response to deteriorating materials and adverse conditions must be learned from experience with the advice and support of the people of the region. In working in tropical regions I have been struck by the steady improvement in preservation development in some countries. In Viet Nam in particular, I have worked in seven different cities since 1990 to the present day, and the rate of improvement in preservation programs has been marked. For example, the conservation staff of the National Library of Viet Nam in Hanoi now work in a well equipped facility, are intelligent, skilful and enthusiastic, and have made remarkable progress since my first encounter with the library and its staff in 1990. But certain imponderables continue to exist.

"In working in other countries and cultures, it is important to recognize that preservation priorities are probably not the same as in the West, that short-term teaching and training alone will not result in viable programs without sustained financial support, preferably secured by librarians *in situ* from national governments and outside foundations..."

Most markedly among these is the fact that very few conservation staff are actually funded to attend overseas training programs, as overseas travel seems to be reserved for administrative staff. Up to a point, this is understandable given that bench staff seem not to have the necessary language skills, but unless this changes, conservation, no matter how well supported locally, will continue to languish in isolation, with few fresh and innovative ideas transmitted to them. Very few conservation staff are able to access the latest published information on preservation, and few have actually seen conservation being practiced in a viable institutional setting. It is most important that staff develop an understanding of the nature of preservation in terms of the tools and technologies available to us and their most appropriate use; developing a sense of priority, understanding that some things are more important than others; developing a sense of local, regional, national, and international preservation needs and solutions; understanding the importance of preserving entire collections rather than individual pieces; understanding that decisions that are made on the physical structure of library buildings, forms of storage, the mechanics of climate control, and the politics of funding priorities, strongly influence the lives or deaths of collections; and developing the ability to assess and articulate the preservation needs of collections.

In Burma, the University's Central Library in Rangoon had a conscientious conservation staff, but their information on conservation was fifty years out of date, having been obtained at the India Office Library and Records of London training program now long defunct. Clearly, there is a need for leaders with the necessary preservation/conservation skills, language ability, and the overall education about libraries to establish programs and effectively lead them. Unfortunately, there seems little incentive for personnel to move to this level as the salaries and conditions are not competitive with other positions in the libraries and archives, and as soon as a person shows promise, they tend to be promoted to administrative positions away from preservation.

Preservation of Indigenous Materials

Beyond the colonial books and documents stored in libraries and archives are those artifacts produced by much older cultures. Bark, papyrus, parchment, palm leaf, traditional paper, silk documents, etc., are revered in most developing countries, but rarely protected or conserved in appropriate fashion and are often hidden away. These materials represent an enormous cultural resource, telling of homeopathic medicine, folk tales, religious narratives, historical tales, and early records of genealogical works. I have been amazed by the large quantities of these documents, and the vast amount of undiscovered knowledge that they contain. Most of the work on indigenous documents that I have been involved with over the years has centered on palm leaf manuscripts and Han-Nom books, the latter represented by a continuing conservation and digitalization program in Viet Nam over the last five years. The conservation treatment of Han-Nom books is a relatively minor part of a project to digitalize and preserve Han-Nom materials at the National Library. The project was based on the pioneering work of four directors of the U.S.-based Vietnamese Nom Preservation Foundation (http://nomfoundation.org):Virginia Jing-yi Shih (bibliographer and project originator), Diem Pham (archivist in charge of the digitalization), John Balaban (translator and then president of the Foundation), and Ngo Trung Viet (vice-president and Vietnam director), as well trained staff in Hanoi. As this is an ongoing project, I will use the following discussion as an example of the conservation work that is going on with indigenous materials.

An early survey of the Han-Nom collection revealed that most of the collection dates from the mid-nineteenth century to hundreds of years ago and consists of stitched bindings with soft paper covers, double-leaves folded at the fore-edge and stitched through the entire text block in a traditional sewing style. The style is simple and effective as it is flexible and the original hand-made paper is usually chemically stable. However, later attempts at remedial treatment of several volumes involved applying lacquer to the spine and over the stitching that must be removed. The work of conservation involves careful cleaning to remove staining, and extensive treatment to fill insect holes and rodent gnawing damage to allow normal use and accurate scanning of the books. Repair of the insect damage is done using three methods: patching, whereby small areas of insect damage are filled using pieces of *tengujo*, a thin Japanese tissue; insertion of support sheets of *gampi* or *do* paper; and the use of a leaf caster, which fills the insect holes and tunnels with a paper pulp through a suction system. To carry out this treatment, the volumes are unstitched and treated as flat unfolded sheets. When the holes have been filled by the leaf caster and the paper de-acidified, the volumes have to be reconstituted by refolding and restitching. Following conservation treatment, a series of clamshell boxes are made from permanent/durable board and covered with archival bookcloth. Each box includes a small envelope containing a simple insect repellent to safeguard the volumes and to repel any possible future infestation. All adhesives used in box construction are internally plasticized polyvinyl acetate, and no starch or protein adhesive is used to avoid attracting insects. Excellent progress has been made on this project because of the leadership of the Foundation and the diligent work of the library staff.

Indigenous collections tend to be the most neglected by local librarians because they are often written in defunct or little known languages or scripts, but the sheer quantities of raw research contained in them begs preservation and wider dissemination. Western scholars have been generally, though somewhat vaguely, aware of these problems for some time, but it is only quite recently that the full breadth and scope of the especially difficult problems facing libraries and archives have become known to a few Western librarians, archivists, and preservation specialists.

Disaster Preparedness, Natural and Man-Made Emergencies

We live in perilous times where the lives of our institutions, libraries, archives, and indeed our family and friends are often at serious risk. The news media seem to thrive on dramatic reports of weather-related catastrophes, and the last century has seen substantial additions to humankind's shameful record of war, terrorism, and civil unrest. In recent times, the wars in Southeast Asia, the former Yugoslavia and Africa have resulted in irredeemable loss to the world's cultural heritage. During the Viet Nam (or American) war, more than two million tons of bombs were dropped on Laos, making it the most heavily bombed country per capita in the history of warfare. In Viet Nam, Hanoi was on the receiving end of more explosive power than was released by all belligerents in the Second World War. The war ended in 1973, but it wasn't until 1992 that the first steps were taken towards the normalization of relations with the United States and other Western countries. History has demonstrated the wisdom of taking precautions prior to events that no-one really wants to happen. This is especially true in the case of war or any other devastating catastrophes likely to affect the entire structure of the institution. In these cases, it is difficult to conceive a situation where ordinary archives or library staff could substantially remedy the effects of a major disaster. However, some forward planning can significantly reduce the loss of unique materials, even when in a state of war.

A good example of this forward planning is the precautions taken by the Vietnamese during the war with America and in the later Chinese War of 1979. Teams of citizens moved large numbers of books, manuscripts, and archives out of the city of Hanoi to a place of relative safety to escape American bombing. In the case of the unique manuscript collections of the Han-Nom Institute in Hanoi, the entire library collection was taken to Dalat, within 300 kilometers of Ho Chi Minh City in anticipation of a Chinese advance or aerial bombing. Clearly, the large-scale evacuation of entire collections is a rare and extraordinary event, and one that would have to be planned with great precision well ahead of a direct threat and actual transportation of materials. The preventative approach here would involve the identification of a place of refuge for the collection, the form and availability of the transportation to be used to move the collections, and the main and alternative routes that must be taken. However, it is important also to consider the principal of proactively storing some materials at a safe remote location for portions of the collection that are already held in duplicate, such as: copies of microfilm. When microfilm is created and processed according to international standards, three generations of film must be produced: a camera or archival negative, a print master negative, and a positive use copy. The camera negative should always be stored in good environmental conditions at a secure location remote from the other generations of film; duplicate copies of other materials should also be stored remotely as a matter of routine. For example, when national libraries receive multiple copies of books through copyright arrangements, it seems sensible not to keep all the copies in one place; dissertations and theses from degree awarding academic institutions that require multiple copies should also have copies stored remotely; electronic records, as archives and libraries are increasingly producing collection records in electronic formats, it must be obvious that the data must be duplicated and stored in other locations or the web to ensure the survival of, for example, bibliographic and collections records.

I have seen very few coherent disaster recovery plans in tropical countries, and no emergency plans to evacuate important portions of the collections when a potential catastrophe threatens. There seems to be a lack of leadership that would result in viable recovery plans, and even the constant threat of occasional water or fire damaged books does seem to have been anticipated.

Conclusion

I have reviewed some of the main issues that have been treated elsewhere in more detail, and hope that my review has not been too pessimistic. I am greatly encouraged by the pioneering work of my colleagues and the extraordinary progress that has been made in the tropical countries in which I have worked. We are all concerned and care passionately about the continued life and availability of our research collections. We care about our traditional manuscripts, our newspapers, photographs, motion picture films, sound recordings, periodicals, and archives. We care about our general collections that are heavily used, carelessly handled, and poorly stored, because they represent the core of all our collections. We care about the cultural treasures that speak so eloquently of the glories and wisdom of our pasts and which we know must inform our future.

References

1. Dean, John F. "The Self-destructing Book". In *Yearbook of Science and the Future: 1989*. Chicago: Encyclopaedia Britannica, Inc., cop.

2. Report to Cornell University Library by the Image Permanence Institute, *Investigation of Hermetic Sealing as a Means of Extending the Life of Film-based Materials*, February 2005.

3. *Acid Irony? Or How to Deal with Negatives Positively: An Evaluation Report of the Microfilming Projects in Indonesia Supported by The Ford Foundation*. Jakarta: The Ford Foundation, 1998.

4. Nichols, Stephen G. and Smith, Abby. *The Evidence in Hand: Report of the Task Force on the Artifact in Library Collections.* Washington: Council on Library and Information Resources, 2001.

Preservación en climas tropicales

¿Qué diferencia la preservación del papel y los libros en los países con climas de temperaturas templadas de la preservación en los climas tropicales? Desde etapas muy tempranas ha existido una preocupación creciente por los efectos del calor y la humedad sobre las colecciones de las bibliotecas y los archivos. En el presente, no cabe mayor duda de que las altas temperaturas, los niveles elevados de humedad y la contaminación del aire aceleran considerablemente la degradación del papel. Sin embargo, existen muchas otras razones por las que las colecciones han estado sufriendo y menguando en los países tropicales en desarrollo, como son los ambientes de almacenamiento inadecuados, la falta de educación y entrenamiento, los ataques violentos de pestes de insectos y roedores, el respaldo administrativo deficiente, los procedimientos de cambio de formato desacertados, los efectos de los desastres naturales o causados por el hombre y la falta de experiencia en el tratamiento con materiales autóctonos. No obstante, parece que actualmente hay una mayor conciencia sobre los problemas de la preservación, y en algunos casos, se está desarrollando una infraestructura de base para el establecimiento de los programas de preservación a fin de recuperar los años de descuido y salvar su patrimonio cultural.

Climate Controls in a Historic House Museum in the Tropics: A Case Study of Collection Care and Human Comfort

by Shin Maekawa, Vincent Beltran, The Getty Conservation Institute, Los Angeles, USA,
Claudia Carvalho, Fundação Casa de Rui Barbosa, Rio de Janeiro, Brazil,
and **Franciza Toledo,** Conservare, Recife, Brazil

Abstract

A climate control strategy that provides an alternative to a standard air-conditioning approach was designed in the library of Casa de Rui Barbosa Museum, a historic house museum located in Rio de Janeiro, Brazil. Based on condition assessments of the building, the collection, and the environment, climate improvement strategies were developed and implemented. The building envelope was repaired and original passive climate designs were restored. A ventilator/dehumidifier-based climate control system was installed in the cellar and attic, primarily for providing collection preservation in the library. Comfort for visitors was addressed through the implementation of a high air-exchange rate of the climate system and high air movement along visitor pathways. Energy conservation was incorporated through full ventilation during dry outside conditions (normally sunny afternoons), full recirculation, and hibernation modes during non-visiting hours. The installed system has maintained a climate of 60 ± 5% RH at 25 ± 3°C with reduced air pollution levels and particulate matters. Although the designed level of air movement was not achieved along visitor pathways due to difficulties encountered during the installation of floor grills, visitors have expressed comfort in the library due to lower humidity, a clean-air sensation, the elimination of direct sunlight, and low noise levels.
Keywords: house museums, historic buildings, energy saving, comfort

Introduction

Cultural institutions have historically used conventional air-conditioning (HVAC) systems as the primary means of climate control. While capable of moderating the environment for both collection preservation and human comfort, using typical HVAC systems can pose significant obstacles. Excessive capital, operational, and maintenance costs, and installation difficulties for historic structures are just some of the major issues. While the ability of a ventilation-dehumidification/conservation heating-based climate control strategy (an alternative to the conventional HVAC approach) to establish and maintain safe environments for collections in hot and humid climates in a technically simple and cost-effective manner has been confirmed through field trials [1, 2, 3], its capability to provide for human comfort while maintaining this environment has remained untested. If this strategy could also satisfy human comfort levels, the potential application of this low-cost, relatively simple and safe strategy, particularly for historic buildings and house museums, could be widely expanded.

1. The Museu Casa de Rui Barbosa.

With ten thousand visitors annually, the Museu Casa de Rui Barbosa (MCRB), an 18th century building with a 19th century interior in the busy Botafogo district of Rio de Janeiro (a nationally important historic building listed by the Instituto do Patrimonio Historico e Artistico Nacional (IPHAN) and designated as Brazil's first house museum in 1930) provided an ideal venue for testing the applicability of the climate control strategy in a setting where human comfort was an important consideration. The Barbosa collection includes artwork, furniture, and several automobiles. However, the library collection—consisting of 37,000 books covering law, humanities, and culture—is considered to be the heart of the museum.

The library of MCRB (Fig. 2), located on the first floor of the 18th century masonry building, consists of five inter-connected rooms: Constitution Room, Civilest Room, Civil Marriage

2. Historic interior of the library of Museu Casa de Rui Barbosa.

Room, Civil Code Room, and Corridor. The five rooms have a total floor area of 165 m^2 with a ceiling height of 3.8 m (approximate total volume of 630 m^3). The rooms contain Rui Barbosa's original book collection in custom-built book cabinets, furniture, and artworks. Therefore, the Fundação Casa de Rui Barbosa (FCRB) considers them to be the most important rooms in the house and selected this area as the focus for the climate improvement project.

In 2004, a project was initiated between the Getty Conservation Institute (GCI) and FCRB with a goal of improving the house's indoor conditions, specifically providing human comfort within a stable and safe environment for the collections. This initiative was a unique climate improvement project for historic houses in Brazil in which the preservation of the collections and the building, visitor comfort, and sustainability were addressed in hot and humid climate regions.

Method

Mechanical deterioration, such as crack and deformation, can be controlled by providing a stable relative humidity environment for limiting their hygrometric dilatations. Chemical degradation, such as aging and oxidation, is considered to be less threatening in these regions, since the process is relatively slow, and the majority of collections have already reached chemically stable stages in stored and displayed environments. However, the process can be slowed by keeping the environment cooler, drier and darker. The biggest threat to collections in hot and humid regions is biodeterioration, and fungal and bacterial attacks. This can be controlled by maintaining the environment at less than 65% relative humidity.

The control of both the temperature and relative humidity is technically difficult and costly, especially in historic buildings in hot and humid regions; therefore, we focused our efforts on maintaining a stable range of relative humidity environment at less than 65% for protecting the collection from biological and mechanical deteriorations while allowing the temperature to vary. This method allows the climate control strategy to be both technologically simple and economically sustainable. Cooling of the library air was limited to only conditions above 28°C, when human comfort became significantly affected, and avoiding the possibility of condensation on the collection and the building.

It was important to maintain the historic ambience in the library, so that original aesthetic of the building (both the exterior and interior) had to remain intact. This meant no alteration of walls and ceilings of the building. Since sustainable preservation environments for collections may produce higher than acceptable temperatures for occupants and visitors, we would provide higher air movements in the space to improve their comfort level.

Thermal comfort of occupants can be estimated based on: 1) metabolic rate; 2) clothing insulation; 3) air temperature; 4) radiant temperature; 5) humidity; and 6) air speed. The predicted mean vote (PMV) can be calculated from the above six parameters. Thermal sensations are defined from +2 (warm) to -2 (cold). Values between -0.5 and +0.5 are considered to be acceptable. [4] Visitors to MCRB typically dress 0.5clo (trouser or knee-length skirt and short-sleeve shirt) and maintain a metabolic rate of about 1.5 met (walking on a flat surface at less than 0.5 m/s or standing). With mean radiant and air temperatures of 25°C and relative humidity at 60%, PMV values are 0.6 with no air movement and 0.1 with an air velocity of 0.5 m/s. Although a threshold air velocity for collection care has not been well established, lower values provide less risk to collections. Therefore, higher air movement needs to be provided only in areas adjacent to visitors while collections remain shielded from the movements.

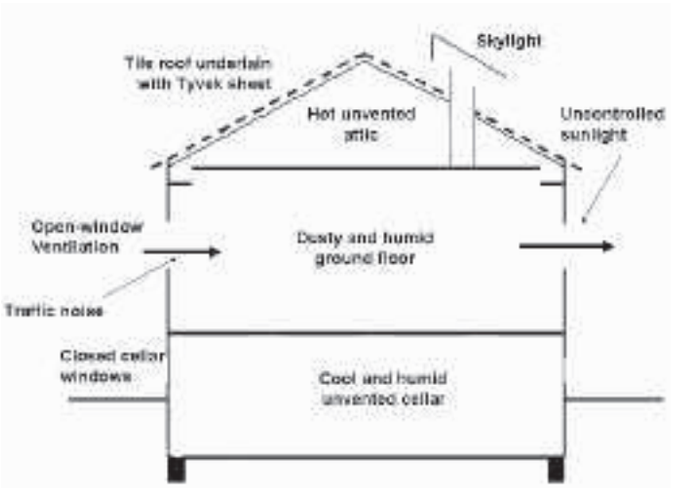
Finally, the building is frequently visited by school children as an important field study of Brazilian history; therefore, adequate amounts of fresh air must be provided in the library for their safety and comfort.

The project consisted of four parts: assessments, strategy development, implementation, monitoring, and improvements. For the first step, condition assessments were conducted in order to document conditions of the building envelope, historic interior, furniture, and books that were in cabinets, as well as the climates in the library and the outside. Based on results of the assessments, climate improvement strategies were developed. These included repairs of the building envelope, cleaning of the building interior and collections, installation of various climate control equipment, and changes to operational procedures of the museum including visitor pathways. Some necessary modifications to the strategies were allowed during the implementation in order to correct oversights during the planning stages. Following the implementation, the building and its environment were monitored for a period of time to verify the improvement as well as to identify needs for future modifications. The last process should be periodically repeated to achieve and maintain the best possible environment in the library as an important procedure of the environmental management strategy.

Condition Assessments

The assessment of the building envelope, conducted by the architect of the FCRB (one of the authors), revealed that many doors and windows had poor closure conditions which allowed the infiltration of large amounts of outside air at all times. They had either misaligned or decayed components that needed to be repaired or replaced. The architect also examined the building's original features for thermal comfort as well as protection against high humidity. Cellar openings, originally designed to naturally ventilate moisture from the space, were closed off with glass windows installed in the 1980s to utilize the space for storage and temporary exhibitions. The building had an original warm-air venting feature consisting of open spaces at the perimeters of the ceilings, the large attic, and loosely stacked roof tiles. However, the recent installation of a Tyvek membrane under the roof tiles (to prevent the infiltration of rainwater and dust in the event of a tile failure) blocked the hot air removal from the attic.

The environmental assessment documented the hot attic and the humid cellar. These spaces are likely impacting the climate in the library. (Fig. 3) The open-window ventilation practice re-



3. Climate conditions in the MCRB identified through initial assessments.

sulted in large fluctuations of both air temperature (22-34°C) and relative humidity (40-90%), as well as high levels of air pollution and particulate matters in the building. However, the climate within the book cabinets was not humid (less than 70% RH) and remained very stable. Furthermore, we found the least amount of oxidizing air pollutants in the cabinets (Fig. 7), indicating that the cabinets were providing a protective microenvironment, shielding books from the poorly maintained library environment.

FCRB's conservators also conducted collection assessments of both furniture and books in the library. The furniture assessment showed that it was generally in good condition. However, many of the book cabinets' doors and covers were either misaligned or warped, resulting in poor closure. Numerous books were affected by the acidification process of typical 19th century papers; some had mechanical damages due to mishandling, past fungal and insect attacks; and many were affected by the accumulation of dust due to a combination of a dusty environment and lack of cleaning.

Conservation Strategies

Recommendations from the above assessments were combined to produce conservation strategies for the library. First, the building envelope needed to be repaired to reduce infiltration, and the original climate control features of the building should be reinstated as much as possible. Climate improvements in the cellar and attic were considered to be especially important. The windows and doors of the library should be kept closed at all times to eliminate infiltration of dusty, polluted and unstable outside air. Books should be cleaned and then returned to the bookcases whose doors had been repaired to close properly. The books would thus be protected from both fluctuations of relative humidity and impacts of air pollution and dusts in the microenvironment of the bookcases.

A climate control system was to be installed in the library cellar to provide filtered clean fresh air and/or conditioned air at 55-65% RH and 22-28°C to the library rooms using ventilation and dehumidification. The supply air, warmer than that of typical air-condition systems, was selected to avoid condensation on supply air ducts and areas surrounding diffuser grills. An exhaust ventilator was to be installed in the attic to reduce heat accumulation. The cellar was to be mechanically ventilated by refitting windows with particle filters to maintain a clean and dry cellar space. As the installation of the climate control system was to be taken place in the cellar and in the attic, it would be hidden from visitors' view and fully reversible.

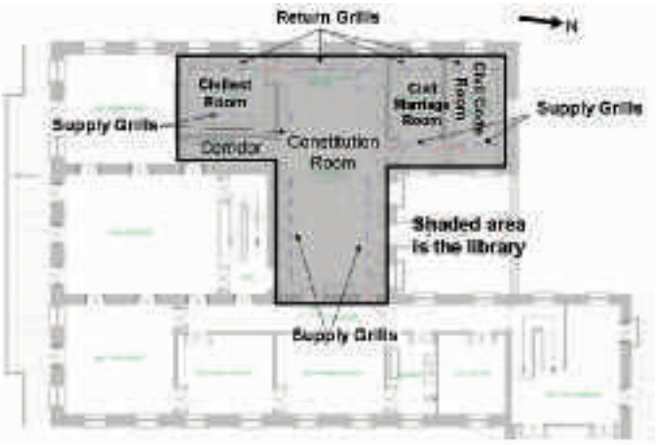
Climate data in Rio de Janeiro from 2001 to 2005 collected by an independent weather station [5] showed that the ventilation mode is viable only 10% of the time if we require conditions of less than 28°C and less than 70% RH. The window for ventilation expands to only 12%, 14%, 15%, and 16%, even if we raise the temperature threshold to 29°C, 30°C, 31°C, and 32°C, respectively. Therefore, we determined that the system would operate mainly in the dehumidification mode.

Adequate amounts of fresh air must be provided for the safety and comfort of both occupants and visitors. From their operational experience, the FCRB staff determined the maximum number of visitors in the library to be 50 based upon the current arrangement of furniture and visitor pathways. The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) recommends fresh air to be provided at the rate of eight litres per second per person. [6] By estimating that the library has an infiltration of outside air at a rate of 1-1.5 air changes per hour (ACHs), we determined that the climate system needs an additional 2 ACHs of fresh air during visiting hours (8 am – 6 pm) in order to limit the carbon dioxide concentration to less than 1000 ppm.

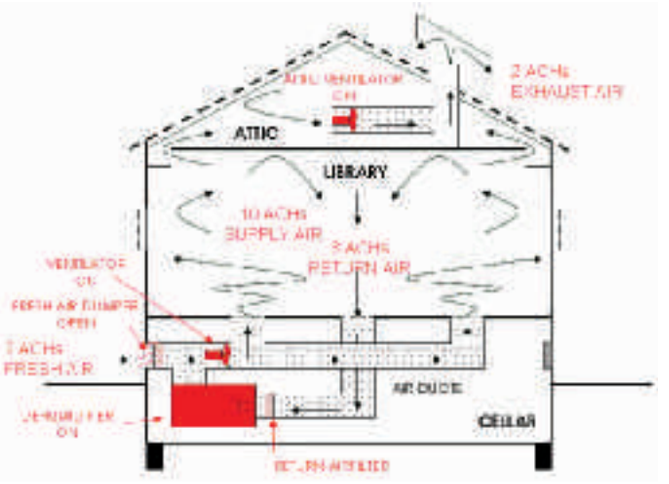
Description of the Climate Control System

A supply and exhaust ventilator system with a split air-conditioning unit and a programmable control unit with two temperature and relative humidity sensors, one in the library and the other outside of the building, are the major components of the climate control system for the library of MCRB. The split unit is designed to always operate in conjunction with the re-heat coil located immediately downstream of the unit to work as an inline dehumidifier. Condensation from the dehumidifier is drained to the outside drain system via a sump pump. With the exception of the attic exhaust ventilator, all other components are installed in the cellar of the library. These pieces of equipment are connected to each other via a series of metal ducts in the cellar as well as in the attic. Both the outside air and recirculated air passes through G3 filters located at the supply and return ends of the dehumidifier, before being gently released into the library through 30 diffuser grills distributed throughout the library floor along visitor paths. (Fig. 4) Spiral type diffusers are used to allow a large airflow with a limited vertical air velocity.

The returning air is taken into duct openings located on the west side of the library floor and ducted to the inlet of the dehumidifier unit. The exhausting air is taken from original ventilation openings at the perimeters of wooden ceilings in the Civil Marriage, Civilest and Civil Code Rooms, as well as the Corridor. (The Constitution Room has a plaster ceiling and therefore does not have ventilation openings at its ceiling.) A large sealed chamber was created in the attic space above the library rooms.



4. Floor plan for the1st floor of MCRB showing the location of the library in shaded area and locations of floor diffusers along visitor pathways.



6. Schematics of the hybrid (dehumidification + ventilation) mode.

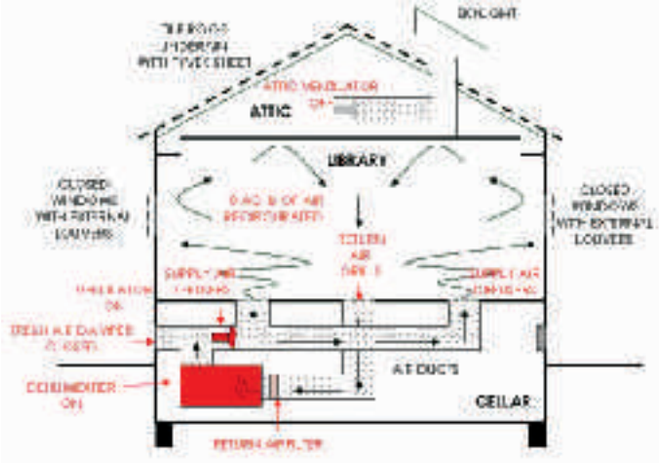
The exhaust ventilator extracts the air from the chamber via a duct and transfers it to the outside through an existing skylight shaft near the library.

A programmable logic control (PLC) unit with a built-in clock, also located in the library's cellar, controls the ventilation and dehumidification equipment. The PLC is programmed to perform the operational sequences described in the following section by controlling the equipment based on climate conditions reported by two air temperature and relative humidity sensors, located outside the building and in the library.

Modes of Operation

Five modes of operation: 1) ventilation; 2) dehumidification; 3) hybrid; 4) cooling; and 5) hibernation were created for the climate control system for the library.

Ventilation: The dehumidifier is turned off (but fans are on), the fresh air damper is opened, and the exhaust ventilator is also turned on. 2 ACHs (1260 m3/h) of fresh air is mixed with 8 ACHs (5040 m3/h) of re-circulated air, and then supplied to the library rooms. 2 ACHs of air are exhausted from the attic. This is an energy saving mode.



5. Schematics of dehumidification mode.

Dehumidification: The dehumidifier and fans are turned on, but the fresh air damper is closed and the exhaust ventilator is turned off. (Fig. 5) The system operates only to recycle the library air through the dehumidifier at the rate of 10 ACHs (6300 m3/h). This is also an energy conservation mode in which no outside air is treated.

Hybrid: This mode combines the ventilation and dehumidification modes. 2 ACHs(1260 m3/h) of the fresh air is mixed with 8 ACHs (5040 m3/h) of the recirculated and conditioned air, and then supplied to the library rooms. And 2 ACHs of the library air are exhausted to the outside through the attic. (Fig. 6)

Cooling: The compressor and air-handler are turned on but reheat coil is turned off. (The dehumidifier is used as a cooler only in this mode.) The system operates as an air conditioner to provide thermal comfort for visitors.

Hibernation: All equipment is turned off except the sensors and the PLC, once the target condition is achieved (less than 28°C and less than 65% RH). This is an energy saving mode. The PLC activates the equipment when either the air temperature exceeds 28°C or the relative humidity exceeds 65% in the library.

Operational Conditions

There are three types of operational conditions that determine the mode of operation; the museum's operating hours, relative humidity, and temperature. The following is a summary of the operational conditions and corresponding operational modes of the system.

Operational Hour: During the museum's hours of operation, the climate system will operate in either ventilation or hybrid mode. In both modes, fresh air is guaranteed in the library to provide visitor safety and comfort. The system can select the dehumidification mode, however, once visiting hours have ended. The library air is completely re-circulated through the dehumidifier until the relative humidity in the library is reduced to 65%.

Relative Humidity: The control system selects the ventilation mode when relative humidity in the library is higher than 65%, and outside relative humidity is lower than 65% at less than 28°C. If outside relative humidity is above 65%, the dehumidi-

fication or hybrid mode is selected depending on the hour of the day.

Temperature: Temperature was added to the system's operational sequence primarily to provide visitors' thermal comfort by limiting the library temperature to less than 28°C. Therefore, it is applicable only during the museum's hours of operation (8 am – 6 pm). When the temperature in the library is higher than 28°C, the climate system will operate in the cooling mode.

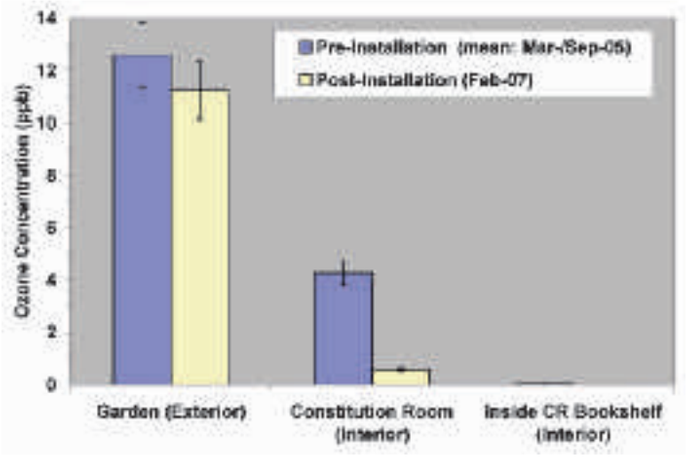
Monitoring and Improvements

After the installation and initial adjustment period of the climate control system, it has produced and maintained 25 ± 3°C at 60 ± 5% RH in the library when the outside condition varied from 35% to 100% RH at 20°C to 38°C. It showed the system's capacity to produce and maintain the targeted climate condition in the library during a typical summer.

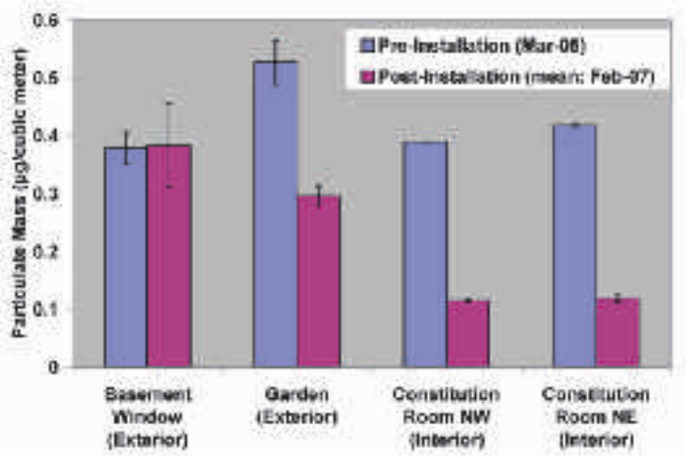
A comparison of air pollution and particulate data collected in the Constitution Room during pre- and post-climate control system installation periods indicated a reduction in concentration for a number of variables examined. Among the pollutants, the highest decrease was observed in ozone, which displayed an 85% reduction in levels relative to values from pre-installation conditions. (Fig. 7) Post-installation nitrogen dioxide concentrations were also decreased by 30% over pre-installation values. However, results of nitric oxide concentrations were inconclusive. Finally, sulphur dioxide levels were negligible both pre- and post-installation.

Two airborne particulate size fractions, 1 to 5 micron and 0.3 to 1 micron, were examined. The larger particles exhibited a 75% to 85% decrease in post-installation Constitution Room concentrations. (Fig. 8) Though the smaller size particles also showed lower post-installation values compared to pre-installation values, the extent of decrease in the Constitution Room was not conclusive.

Air velocities at 50 cm above floor supply grills ranged from 0 to 0.3 m/s with the majority less than 0.1 m/s. We identified several leaks of the supply air at diffuser boxes mounted in new floorboards that were replaced for this project. (Removed original floor boards were stored away with location identifications.) Similar air leaks were identified at return grills resulting in an ingestion of unconditioned basement air into the return duct. Several attempts were made to repair the leaks; however, the thickness difference between the original and replacement floorboards as well as locations of structural members made the repair difficult. In spite of significantly lower air movements at visitor pathways than originally designed for, the majority of visitors indicated the library environment as comfortable. Visitors' comments indicated that the air is noticeably fresher and drier, and the temperature seems cooler, possibly resulting from the filtered and drier air. Closed doors and windows also reduced noise and harsh sunlight, and may have contributed to visitors' comfort.



7. Comparison of ozone concentrations before and after the installation of the climate control system.



8. Comparison of 1-5 micron particulate matter before and after the installation of the climate control system.

Conclusions

A ventilation/dehumidification-based climate control strategy was successfully implemented in a historic house museum in a hot and humid climate. It established and maintained a safe collection environment for both the historic building and its collection, which is a stable relative humidity environment at less than 65% RH while allowing temperature variations between 22°C and 28°C and avoiding condensation or high humidity conditions in or on the building envelope. It has also shown the ability to provide for human comfort. Although the designed level of air movement was not achieved along visitor pathways due to difficulties encountered during the installation of floor

diffusers, visitors have expressed comfort in the library due to lower humidity, a clean-air sensation, the elimination of direct sunlight, and lower noise levels.

The success of the project was attributed to a well-structured project design, execution, and evaluation. Assessments of the building, the collection, and the environment provided essential information for developing an improvement strategy, an integrated approach that combined the building, collection, and the climate control equipment as one environmental system. Monitoring that followed the implementation produced useful information for equipment adjustments and future improvements.

This climate improvement project, which successfully produced an environment for both the collection preservation and human comfort in a historic house museum, paved the way to a wide application of this low-cost, relatively simple climate improvement strategy in cultural institutions in hot and humid climates.

Acknowledgements

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References

1. Maekawa, S., and F. Toledo. 2003. "Sustainable Climate Control for Historic Buildings in Hot and Humid Regions." In *Management of Environmental Quality: An International Journal* Vol. 14, No. 3: 369-382. Also presented at the 18th International Conference on Passive Low Energy Architectures (PLEA), November 2001, Florianópolis, Brazil.

2. Maekawa, S., and M. Garcia Morales. 2006. "Low-Cost Climate Control System for Museum Storage Facility on Tenerife Island." Presented at the 25th International Conference of Passive and Low Energy Architecture (PLEA 2006) in Geneva, Switzerland, September 6–8.

3. Maekawa, S., V. Beltran, and F. Toledo. 2007. "Testing Alternatives to Conventional Air-Conditioning in Coastal Georgia." In *APT Bulletin*, Vol 38, No. 2-3, Association of Preservation Technology International: p3-11. Also presented at the Annual Meeting of APT International, in Atlanta, GA, September 13–16, 2006.

4. ANSI/ASHEAE Standard 55-2004. 2004. *Thermal Environmental Conditions for Human Occupancy*. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., GA.

5. METEONORM Global Meteorological Database, [Online], Available: http://www.meteonorm.com [June 2006].

6. ANSI/ASHEAE Standard 62.2. 2007. *Ventilation for Acceptable Indoor Air Quality*. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., GA.

Insect Control: A Total Approach for Small and Remote Museums in the Tropics

by Vinod Daniel, CEO, IndHeritage Pty Ltd, Australia

This paper is an updated version of the paper that has been published as part of the Proceedings of the Pest Odyssey Conference[1]*, London, October 1-3, 2001 and has been reprinted with the permission of the conference organizers.*

Abstract

Insects are the biggest problem for small cultural institutions in tropical countries. This paper compiles a number of practical preventive steps that can be part of an Integrated Pest Management Plan for small museums. The paper also lists a number of non-toxic and low toxic solutions that can be practically implemented by small museums.

"Insect Pests are a major problem for museums, archives and libraries especially in the tropics."

1. Introduction

Many small museums, archives and libraries in the tropics preserve cultural relics of the past for future generations. The high humidity and temperature of the tropics however brings its own set of conservation problems including insect pests. This combined with bad building maintenance and low budgets make long term preservation of collections a very difficult exercise for heritage professionals.

Insect Pests are a major problem for museums, archives and libraries especially in the tropics. Even with repeated treatments for insect infestation, if an appropriate and safe environment is not provided for its storage or display, the insect problem will reoccur. It is therefore important for museum personnel to device an Integrated Pest Management Plan (IPM) for preventing the insect problems from reoccurring. It could be a number of simple, practical steps to start with, which eventually can be improved.

This report gives a broad overview on practical methods for small museums to prevent insect problems from reoccurring, as well as some non-toxic, and low toxic alternatives for treating collections in case a problem occurs.

2. Integrated Pest Management

It is better to avoid an insect problem than to deal once a problem occurs. An overall integrated pest management (IPM) approach will be the best alternative to prevent problems. An IPM program does not depend solely on pesticides to prevent or control insect problems, but instead involves the implementation of a number of measures including (International Workshop, 1996):

a) Physical Barriers: provision of appropriate physical barriers to make it difficult for insects to reach targeted areas such a storage and display areas. Examples include insect screens seal around doors.

b) Ambient Pest Specific Environmental Controls: understanding what insects prefer such as high humidity, vegetation, etc., and minimizing these in targeted spaces such as storage and display areas.

c) Pesticide control: appropriate selection and least harmful application of pesticides.

d) Monitoring and evaluation of the program for ongoing modifications and improvement.

There are a wide range of insects that can be a problem for collections including beetles, moths, termites, cockroaches, and silverfish. The first line of defence against pest infestation must be the building, then the display case or storage unit. All objects brought into a museum should be carefully inspected to determine whether insects or other pests are present.

Minimising sources of nutrition for insects including dust and moisture is important. As with the building structure, all small gaps in interior fittings, around vents, ducts and piping, etc., should be sealed. Regular inspection and good housekeeping which will remove dust, ensure leaking pipes are fixed quickly, etc., will help to control possible problems. It is also important that food must be kept away from working, storage and exhibition areas (Hadlington and Gerozisis, 1982, Zycherman and Schrock, 1988).

Minimise trees or shrubs close to a building, and use non-flowering plant species. Gravel or paving close to the building avoids the need for watering, which in turn keeps moisture away from the building and in addition it is non-attractive to insects and rodents. Obviously all garden rubbish and garbage from the museum must be kept well away from the building and removed or disposed of as soon as possible. Do not attach lights to a building, as any light will attract insects (Pearson, 1993).

1. Daniel V. 2001. "Insect Control, a total approach for small and remote museums in the tropics." In: Kingsley, H. *et al* (Ed). *Integrated Pest Management for collections. Proceedings of 2001 - a pest odyssey*, James and James, London, 2001. 9-13.

Careful thought given to the layout of the building as regards its different functions makes it possible to build it for insect control. Keep areas attractive to insects away from the collections (including storage and display). The areas that attract insects include kitchens, restaurants, workshops and toilets (source of water).

It is important to have an isolation room where collections are held on arrival at the museum, or after treatment for insect infestation. This should be adjacent to the loading bay. In the quarantine (isolation) room, the doors should be closed as much as possible. Weather strips across the bottoms of doors would also be of benefit. Entrance doors are the other main avenues for insect entry; therefore, they should be kept closed as much as possible (Pearson, 1993).

"It is important for any IPM program to include good inspection as a key aspect. During inspections many insect problems can be identified and controlled before too much damage has occurred."

Insect proof building materials such as brick, stone, concrete or steel minimises should be used as much as possible. Doors should be kept closed at all times when not in use and weather/draft excluders provided, not only to keep out the weather but also to help exclude insects. Windows when closed should fit tightly, and if opened should be screened against insects. From the literature the minimum sizes of holes to prevent entrance by different insect species are as follows (Busvine, 1980, Strang, 1992):

2.3mm	House flies, blowflies
1.15mm	Mosquitoes
0.85mm	Sandflies
0.7-1.7mm	Beetles (depending on the species)

These can be controlled by the common mesh sizes of 10-20 gauge, which have apertures of 2.27-0.853mm respectively.

It is also important to remove bird nests, which can harbour insects. Other insects such as wasps, although themselves are not a problem as regards the collections, their nests, when vacated are again a possible source of insects and they should be removed. Within the building, storage units and exhibition cases should be designed so that they close tightly. Sealing cracks and crevices of internal structures will remove breeding and hiding places for insects. It is particularly important to have good seals between public areas such as exhibition rooms, sales areas, food services, etc., and collection storage (Pearson, 1993).

3. Insect Traps

It is important for any IPM program to include good inspection as a key aspect. During inspections many insect problems can be identified and controlled before too much damage has occurred. Inspections can, however, be time consuming, especially in large collection areas. Use of insect traps could be beneficial in such situations.

Blunder traps are generic traps (not specific to a particular insect), which assist in identifying any insects present within the collection. Insects get trapped largely due to the strategic location and placement of the traps where insects may wander. The traps are often made from a piece of cardboard with a sticky surface for trapping the insects. Trapped insects can be identified using an insect identification kit/book or by contacting the entomology department of a university or museum. Through correct identification it is possible to learn whether or not the insect poses threat to the collection and take any necessary action.

Many insect specific traps incorporate a pheromone. Chemical messengers, similar to hormones within our bodies, which are produced by insects to communicate messages. They tend to attract insects based on their need for a specific food, cue for mating, etc. Several common museum insects have Pheromone traps commercially available including the cigarette beetles, drug store beetles and common clothes moths.

4. Treatment Options

4.1 Chemical Methods

There are a number of chemical treatment options, which would be applicable for small museums. There are many published papers on this topic which small museums can refer to that highlight the range of chemicals from Ethylene Oxide to Permethrins (Story, 1985, Pinniger, 1994).

Insect Growth Regulators (IGR) such as Fenoxycarb, Methoprene and Hydroprene are low toxic chemicals which work specifically on insects by disrupting their life cycles. Commercially they are often mixed with a common fumigant and sold. The idea is for the fumigant to kill the adult insects and the IGR to act on the immature stages by making pupation unsuccessful or preventing the formation of a normal cuticle causing death by dehydration.

4.2 Freezing

Objects are sealed in polythene bags to ensure there is no change in moisture content and to avoid condensation on thawing. They are placed in a freezer and left for one week at below -20°C. These will kill all stages of the insects (eggs, larvae, pupae and adults). Once removed from the freezer, the objects are allowed to acclimatise to room temperature and then removed from their bags (Strang, 1992).

The effect of freezing on museum collections has been an area of many debates. There are two issues that one needs to be careful about:

a) Polymeric materials may become stiffer and more brittle at low temperatures if they go through a glass transition temperature. Drying oil films have a glassy-rubbery transition between –30°C and 0°C. Acrylics used in most paint formulations are glassy below 0°C. Hence it will be most advisable not to use freezing for acrylic and oil paintings. It is therefore important in

freezing that artefacts are not placed on top of each other, and also are handled with care when in a frozen condition.

b) Artefacts to be placed in a freezer needs to be bagged to hold its moisture content constant. For an unbagged material, the moisture content may increase about 5-6%, this would cause a 3% dimensional change, which is dangerously close to the materials elastic limits (Michalski, Strang, 1995).

Freezing is a safe, non-toxic method for pest control for many collections. Here are a few categories where one needs to observe greater caution when freezing:

- Paintings on Canvas
- Ivory
- Ancient and deteriorating glass and glass components
- Waterlogged specimens and artefacts
- Thick powdery and/or mat paints with relatively little binder which have been painted on wood substrates
- Paintings on joined wooden panels
- Objects with wax components or large wax fills. Many wax objects undergoing cycled changes in temperature can produce a polymorphism, resulting in an opaque, powdery wax formation on the surface. Wax components are often brittle and can withstand no dimensional change if they are built up upon a wood or other organic substrate (Kronkright, 1989, 1992).

4.3 High Temperature

Again objects are sealed in polythene bags, but in this case are heated to a temperature of at least + 52°C for 4 hours. This will kill all stages of insects. The objects are allowed to return to room temperature and then removed from the bags. It should be possible to utilise the heat from the sun in tropical countries to provide the energy for this treatment. A black plastic with another clear plastic bag enclosing it (Strang, 1995), or a tin shed in the museum grounds for a collection (Pearson, 2000), may be sufficient. These containers must be fully exposed to the sun, and design specifications include:

- Metal construction with thin materials on the roof and walls facing the sun, and insulated materials with internal heat reflectors on the other walls and the base.
- Shed painted black to promote heating effect of the sun.
- Shed (or Plastic bag) to be raised off the ground to prevent heat loss.
- Means of measuring the temperature inside the shed – thermometer or thermocouple. Ideally the temperature in the centre of the object being treated is where the measurement is required. This is relatively easy for say a collection of textiles but will require a mock object of similar thickness and density for solid objects. Here the temperature is measured from a hole drilled into the centre of the mock object.
- Means of venting and cooling the shed and contents once treatment is over. From calculations of the angles of elevation of the sun it may be possible to use nearby shade or the time of day for this purpose, e.g. heat in the afternoon and allow to cool overnight.

The above thermal treatment methods are appropriate for single objects and collections but it is a different matter when rooms or entire buildings are infested. Although there are companies, which can successfully heat-treat an entire building (Pinniger, 1996), the process is expensive.

As for freezing, unbagged artefacts subject to heating may undergo dimensional changes based on the change in equilibrium moisture content. Hence it will be important that the artefacts be bagged before a heat treatment procedure is followed. The effect of high temperature is an area that is being extensively study at this time, one obvious area where extreme care has to be taken is where materials have a low melting point, for example waxes.

4.4 Low Oxygen Systems

Considerable research has been conducted with the use of modified atmospheres to manage insect pests in stored grains and food. In experiments sponsored by The Getty Conservation Institute (GCI) at the University of California at Riverside, Rust *et al.* evaluated the mortality of all life stages of ten commonly found insect species (webbing clothes moths, furniture carpet beetles, firebrats, cabinet beetles, larder beetles, cigarette beetles, confused flour beetles, cockroaches, powderpost beetles, and western drywood termites) at 55% RH and 25.5°C in a nitrogen atmosphere having less than 0.1% oxygen. The time required for 100% kill varied from three hours for the adult firebrats to 192 hours for the eggs of the cigarette beetle (Rust, 1996). Based on these studies, and other compilation of mortality data in low oxygen environments, it is recommended that the time required for effective treatment in a low oxygen environment (less 0.3% oxygen in nitrogen) at 55 % RH and 25°C is two weeks.

The basic procedure for producing and maintaining a reduced oxygen atmosphere for treating museum objects is to replace air with an inert gas in the bag that encapsulates an infested object. There are three variations in protocol:
(1) *The dynamic system*. An inert gas is used to flush all air out of the bag (or chamber) by an initial high flow rate and then, when a level of less than 0.1% oxygen is reached, the flow is reduced to that required to maintain the low-oxygen atmosphere for a period of the treatment (Daniel *et al.*, 1993).
(2) *The dynamic-static system*. The bag is purged with an inert gas, as in (1), and after the 0.1% oxygen level is reached, a quantity of Ageless™ oxygen scavenger (Daniel and Lambert, 1993, Lambert *et al.*, 1992) is quickly inserted, the gas flow stopped and the bag sealed for the required exposure period (Daniel *et al.*, 1993).
(3) *The static system*. This method is ideal for treating small objects (less than 100 liters). No purging of air in the bag is necessary. A calculated amount of oxygen scavenger needed to absorb the oxygen in the bag and maintain the oxygen concentration at less than 0.1% for the fumigation period is inserted (Daniel *et al.*, 1993).

5. The Big Picture

Small museums have limitations both in terms of financial resources, as well as human resources. Very often they are totally managed by a single staff or volunteer. While it is impossible to totally eradicate insect problems in small cultural institutions,

"In many developing countries there are a number of traditional methods for pest control that have been pursued for generations. Integrated Pest Management programs have to be adapted to use these traditional methods, as well as deal with ethical issues."

the practical steps highlighted in this paper are guidelines that can minimise damage from insects. It is also important to note that damage from insects is more damaging than from any particular treatment, therefore, it is recommended that any affordable pest control treatment option is pursued with necessary cautions rather than debate on which treatment option is better.

In many developing countries there are a number of traditional methods for pest control that have been pursued for generations. Integrated Pest Management programs have to be adapted to use these traditional methods, as well as deal with ethical issues. Examples include the use of leaves from the neem tree in India, and the ceremonial use of tobacco smoke by the American Indians as a pest control option. In countries such as Bhutan, there are ethical issues on killing insects, which have to be managed before pest control is implemented.

It is also important in training personnel from small museums on pest control, that detailed information on availability of supplies locally, as well as procedures for treatment are clearly provided. This would save time for museums to research on suppliers, as well as provide continuity when staff changes occur (especially with volunteers).

Overall insects are the biggest problem for collections in tropical small museum. A cheap, practical low-toxic program developed to minimise damage to cultural collections by insects will greatly assist in preserving the past for future generations.

Vinod Daniel *has worked on collections conservation projects in over 30 countries. He has published and presented over 60 papers especially in Preventive Conservation. He is currently the Chairman of AusHeritage (Australia's International Cultural Heritage Network) and has his own Museum Consultancy Practice working in the Asia Pacific Region. He was the Head of Cultural Heritage and Science Initiatives Branch of the Australian Museum until June 2011 with overall responsibility for conservation, cultural collections, business services and analytical services. Prior to that he worked at the Getty Conservation Institute during the period 1991-95.*

References

Busvine, J.R. 1980. *Insects and Hygiene. The Biology and Control of Insect Pests of Medical and Domestic Importance.* London: Chapman and Hall, 3rd Edition.

Daniel, V. and Lambert, F. L. 1993. "Ageless oxygen scavenger: practical applications." In *WAAC Newsletter*, Vol 15, Number 2, p 12-14.

Daniel, V., Hanlon, G. and Maekawa, S. 1993. "Non-toxic fumigation of large objects." The 21st Annual Meeting of the American Institute of Conservation, Denver, Colorado, May 31-June 6, 1993.

Daniel, V., Hanlon, G., Maekawa, S. and Preusser, F. "Nitrogen fumigation: a viable alternative." International Council of Museums, 14th triennial meeting, Washington D.C.

Florian, M. L. 1986. "The freezing process-effect on insects and artefact materials." In *Leather Conservation News*, Vol 3, Number 1.

Hadlington, P.W. and Gerozisis, J. 1985. *Urban Pest Control in Australia.* Sydney: NSW University Press.

International Workshop on "Pest Control in Museums", Australian Museum, April, 1996.

Kronkrite, D. "Experiences with freezing as a method of insect eradication in museum collections with special emphasis on wooden artifacts." Hawaii: Bishop Museum.

Kronkrite, D. 1989. "Museum artefacts and the deep freeze." In *Bishop Museum Conservation Newsletter*.

Lambert, F. L., Daniel, V., and Preusser, F. D. 1992. "The rate of absorption of oxygen by Ageless; the utility of an oxygen scavenger in sealed cases". In *Studies in Conservation*, Vol 37, p 267-274.

Michalski, S. (Ed). 1992. *A Systematic Approach to the Conservation (Care) of Museum Collections, with Technical Appendices.* Ottawa: Canadian Conservation Institute.

Pearson, C. 1993. "Building out pests." In *AICCM Bulletin,* Vol 19, Nos. 1&2, p 41-55.

Pearson, C. 2000. Personal communication related to recent research at the University of Canberra, Australia.

Pinniger, D. 1994. *Insect Pests in Museums,* London: Archetype Press. 3rd Edition.

Pinniger, D. 1996. "Insect control with the Thermo Lignum Treatment." In *Conservation News,* No.59, p27-29.

Rust, M. K., Kennedy, J. M., Daniel, V., Druzik, J. R., and Preusser, F. D. 1996. "The feasibility of using modified atmospheres to control insect pests in museums." In *Restaurator*.

Story, K.O. 1985. *Approaches to Pest Management in Museums.* Washington D.C.: Smithsonian Institution.

Strang, T.J.K. 1992. "Museum pest management." In S. Michalski (Ed.). *A Systematic Approach to the Conservation (Care) of Museum Collections.* Ottawa: Canadian Conservation Institute.

Strang, T.J.K. 1995. "The effect of thermal methods of pest control on museum collections." In *Preprints of the 3rd International Conference on Biodeterioration of Cultural Property,* Bangkok, July 1995, p 199-219.

Strang, T.J.K. and Dawson, J.E. 1991. "Controlling vertebrate pests in museums." In *Technical Bulletin,* No.13. Ottawa: Canadian Conservation Institute.

Strang, T. "Guidelines for museum pest Control-Low temperature." In *Draft Canadian Conservation Institute notes*.

Strang, T. 1992 "A review of published temperatures for the control of insect pests in museums." In *Collection Forum*, 8(2), p 41-67.

Zycherman, L.A., and Schrock, J.R. 1988. *A Guide to Museum Pest Control.* Washington, D.C.: Foundation of the American Institute for the Conservation of Historic and Artistic Works and the Association of Systematic Collections.

Zycherman, L. A., and Schrock, J. R. (Eds.). 1988. *A guide to museum pest control*. Washington D.C.: Assoc. of Syst. Collections.

A Collection Climate Control System for an Ethnographic Storage of a Museum in North of Brazil

by Shin Maekawa, Ph.D., Senior Scientist, The Getty Conservation Institute, Los Angeles, CA, USA, and **Franciza Toledo,** Ph.D., Conservare, Recife, Brazil

Abstract

This article presents a climate control strategy for the preservation of collections, specially designed for and installed at the Amazonian ethnographic storage of the Museu Paraense Emílio Goeldi in Belem, Brazil. Technologically simple and low cost to install, the system is robust and economical when in operation. It aims to maintain the relative humidity below 60% to prevent the collection from fungal and bacterial attacks while allowing the temperature to vary with the outside climate. The system has maintained the designed preservation environment for the last five years with minimum energy consumption and low maintenance costs. The strategy has also proven its robustness to maintain the conservation environment even during extended power outages common in the region.

1. The Amazonian ethnographic collection of the Museu Goeldi.

Introduction

The greatest threat to museum collections in hot and humid regions is biodeterioration, especially fungal and bacterial attacks. (Agrawal, 1993, Aranyank, 1993) Since tropical climates are characterized by high temperature and relative humidity which promote activities of fungi and bacteria throughout the year, maintaining the collections in a dry environment (less than 70% RH to arrest biological activity) is essential for their preservation. (Brundrett, 1990) Other degradation mechanisms, such as mechanical damage and chemical aging (Michalski, 1993), are considered to be less important when developing environmental improvement strategies for collection preservation in these regions.

An increasing number of cultural institutions have been installing typical air-conditioning systems, which are designed for controlling the temperature for primarily human comfort, rather than as a means of providing preservation environments for their collections. The use of a typical air-conditioning system, however, can present problems for cultural institutions. Both the capital and the operational and maintenance costs are significant. It may require the installation of thermal insulation, vapor barriers and ductwork that can result in damage to the superstructure and/or interior of the building. And often the installation of an air-conditioning system may not guarantee the desired collection environment.

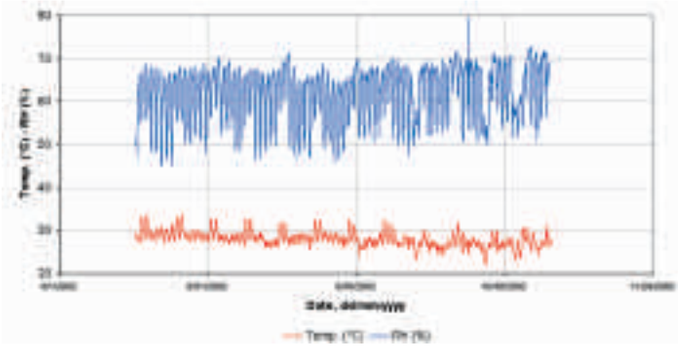
There are serious needs for developing climate control strategies that produce suitable preservation environments that are economical, robust, technologically simple, and require minimal structural modification. Climate control strategies based on the use of ventilation, conservation heating, and dehumidification or any combination of those, which are alternatives to a typical or traditional air-condition based approach, have been successfully tested in cultural institutions in temperate and humid climates. (Kerschner, 1992, Padfield and Jersen, 1990, Stanisforth, Heys and Bullock, 1994, Maekawa and Toledo, 2001 and 2002, Valentín, Garcia, Luis and Maekawa, 1998) These alternative strategies will provide necessary beneficial alternatives to collection managers and conservators in tropical and sub-tropical climates, if they can be successfully tested in the region.

The Museu Pararense Emílio Goeldi (MPEG), located in a northern Brazilian city of Belém and the oldest scientific institution still active in the Amazon region and the second oldest natural history museum in Brazil, has collections of both historical and scientific significance regarding the knowledge of flora and fauna, the physical environment, and social groups that currently dwell or have dwelled in the northern regions of Brazil. The Amazonian ethnographic collection consists of about 15,000 objects from different ethnic groups: objects used in agriculture, fishing and hunting, food processing, ceremonies and celebrations. Classified according to region and tribe, they are mostly basketry, instruments, and ornaments, that are made from plant fibers, woods, seeds and bird feathers.

The climate of Belém is characterized as hot and humid, with annual average air temperature values of 25.8°C in 1931-1960 and 26°C in 1961-1990, relative humidity values of 86% in 1931-1960 and 86.5% in 1961-1990. The relative humidity can reach 100% during the rainy season, but the maximum air temperature never gets higher than 32.5°C in the dry season, the minimum value being 22.5°C in the rainy season (www.inmet.gov.br). The rainy season is from December to May, and

the dry season is from June to November. The annual rain accumulation was 2775 mm in 1931-1960 and 2890 mm in 1961-1990. Because of the high daily evaporation, it is worth noting that it rains on a daily basis in Belém, at the end of the day, with monthly values falling between 50 and 150 mm in the dry period. Solar radiation attains its maximum in July and August (about 270 hours of sun incidence), and its minimum in February and March (about 100 hours). Evaporation is also high in the dry period (about 80mm in July and August).

The majority of MPEG's storage environments are maintained by dual sets of several room (window-mount) air-conditioning units which are utilized in day and night shifts for extended maintenance-free operation of continuous climate control. However, these units are designed to produce low temperatures for human comfort, and these are not to maintain a stable preservation environment for collections. Furthermore, we can often see a large growth of black mold on the building's outside walls due to dew condensation resulting from a combination of poorly insulated walls and low inertia temperatures. Prior to the climate improvement project, the Amazonian ethnographic collection occupied two storage rooms at the Rocinha campus, the MPEG's headquarters near the city center of Belém. These rooms were over-packed, poorly furnished, and climatically unstable due to intermittent operation of room air conditioners, resulting in daily climate ranges of 27.5-32.5°C and 45 -70% RH as shown in Figure 2. There were also drawers full of naphthalene for protection against insects.



2. Temperature and relative humidity in the old Amazonian ethnographic storage at the MPEG in 2002.

MONTH	DAILY CONSUMPTION (kWh)	MONTHLY CONSUMPTION (kWh)	TOTAL COST (R$)
JANUARY	5,675	175,940	36,628.20
FEBRUARY	6,184	173,162	39,697.27
MARCH	4,831	149,746	39,789.05
APRIL	5,685	170,551	43,926.38
MAY	6,156	190,850	46,952.25
JUNE	6,246	187,392	50,123.66
JULY	6,110	189,436	48,703.51
AUGUST	6,037	187,166	58,214.48
SEPTEMBER	6,602	198,088	55,814.51
OCTOBER	5,092	157,857	45,652.57
NOVEMBER	5,855	175,677	42,762.91
DECEMBER	5,064	157,007	37,929.16
TOTAL	69,537	2,112,872	546,193.95

Table 1. The daily and monthly energy consumption at the MPEG in 2002. Source: Electricity bills. R$ is Brazilian Currency, R$1 = $0.475 (US) as of May 8, 2009.

Another issue is that air-conditioning units consume large amounts of power. Table 1 shows the monthly energy consumption at the MPEG in 2002 produced from its monthly electricity bills. Including the daytime use of room air-conditioning units in individual office spaces, the museum spends about 70% of its budget on electricity. Since energy consumption of a particular storage facility cannot be isolated from the museum's energy bill, we estimated the energy cost of the old Amazonian ethnographic storage based on equipment installed in the facility as shown in Table 2. With the nationwide energy crisis in 2001, the Brazilian government mandated its facilities to reduce energy consumption by 30% by 2007. Therefore, the museum has been anxious to reduce its energy use.

Number of units	Equipment	Watts	Hours	Days	Consumption (kWh)
1	AIR COND.	3,900	12	22	1,029.60
1	AIR COND.	3,900	12	22	1,029.60
1	AIR COND.	3,900	12	22	1,029.60
1	AIR COND.	2,070	12	22	546.48
1	AIR COND.	2,070	12	22	546.48
22	Fluorescent light 40W	880	08	22	154.88
				Total	4,336.64

Table 2. Estimated monthly energy consumption in the old ethnographic storage.

In addition, frequent and extended power outages are very common in the region and are another reason for fungal and insect outbreak, despite heavy and broad use of insecticides and fungicides. The museum was therefore searching for an innovative climate control approach that would be low-cost for both installation and operation, technologically robust, and capable of maintaining a stable conservation environment, even in a period of an extended power outage.

New Storage Facility

In 2003, the MPEG gained a new storage space for the Amazonian ethnographic collection at its research campus at the edge of the city. It is located in a typical single-story contemporary urban building and consists of three rooms used for: 1) reception, quarantine and conservation treatments; 2) inventory and study of collections; and 3) the storage itself. The storage area measures 15 m x 18 m (270 m2), has a cement slab floor, a concrete slab ceiling of 3 m high, and the walls are made of fired hollow bricks finished with cement plaster and white water-based paint. The roof is of corrugated metal sheets in two chutes, with a central air gap for passive ventilation of the attic space, with long eaves and a suitable surrounding drainage system.

Conceptual Design for Climate Control

The proposed climate control system for the new storage area consisted of sets of supply and exhaust ventilators and several portable mechanical dehumidifiers, and was to operate based on the output of relative humidity sensors located both inside and outside the buildings. The system was to operate only when the relative humidity rose higher than 70% -- the threshold for microbial activities. The ventilators were to operate when the

outside relative humidity was lower than the value to remove moisture, and the dehumidifiers were to activate when the outside relative humidity was higher than 70%. Therefore, the ventilators could not be used. It was decided to use mechanical dehumidifiers instead of heaters to reduce the rise of already high temperature and conserve energy. The approach would provide relative humidity control to protect the collection from the threat of fungi and bacteria while allowing the temperature to vary, since chemical aging and mechanical damages were not considered to be threatening.

Engineering Design of Climate Control System

The conceptual design of the climate system was forwarded to a local architect and HVAC company for detail design, equipment selection, and installation under the authors' supervision. Figure 3 shows locations of various HVAC equipment for the storage. The system consisted of two large (1620 m3/hr each) centrifugal-type supply fans, four (723 m3/hr each) axial-type exhaust fans, six oscillating fans, four portable mechanical dehumidifiers (300 m3/hr, 390 W each) and two humidistats. The supply air ventilators were placed outside the building, bringing filtered outside air through two centrally located ducts mounted under the ceiling, and distributing air through five diffusers on each side. Each supply fan had an insect net and double banks of G3-type particle filters. The venting air, after flowing through the shelves and drawers, was collected near the floor through two ducts with five return openings each, and along two walls which were parallel to the supply air ducts, and ducted to the exhaust fans located in wall cavities. Gravitational-type shutters were installed on their exhausts to prevent the infiltration of the outside air and insects. Four portable dehumidifiers connected to permanent drains were located near four corners of the storage room. Three oscillating fans mounted near the ceiling on sidewalls operated with the dehumidifiers for mixing the room air. Another three oscillating fans, independently operable, were installed on center columns to provide comfort for staff members and researchers. Two humidistats, with one relative humidity sensor inside the storage and the other outside the building, controlled the operation of ventilators, fans, and dehumidifiers. The climate system operated only when the interior relative humidity exceeded 70%, and deactivated once the relative humidity was reduced to equal or less than 60%. The ventilators (supply and exhaust ventilators) were operated simultaneously when the outside relative humidity was equal or less than 70%. If the outside relative humidity rose higher than 70%, wall fans and mechanical dehumidifiers were activated simultaneously, while ventilators were turned off. Costs of the detailed design, the equipment, and labor for the installation were approximately R$4.33/ft3 (R$153/m3) in 2003, less than one-fifth of a typical climate control system which controlled both temperature and relative humidity.

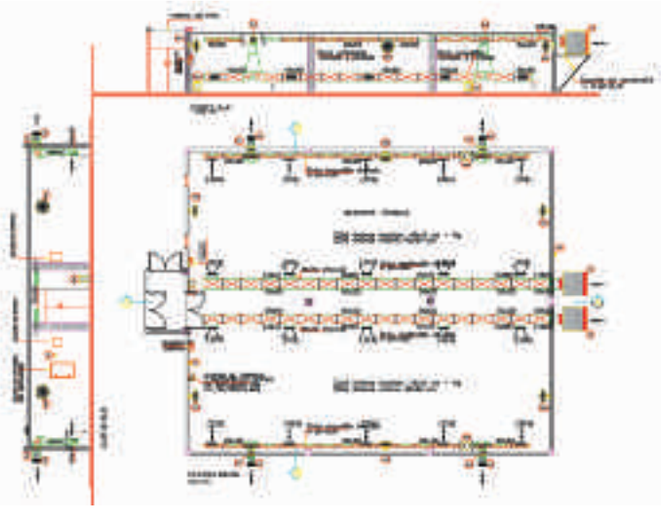
Building Envelope Modifications

For the installation of the climate control system, some architectural modifications were made on the building envelope of the new storage space to improve its air tightness. The modifications included the elimination of a large steel door directly leading to the outside and wall openings for air-conditioners. Some of the wall openings were converted to windows. The ceiling was insulated with 0.10m thick fiberglass panels to minimize the heat transmission from the attic. An area surrounding the storage was paved for improved drainage around the building. Two fireproof metal doors were installed: one at the entrance to access the storage, and the other to access the conservation lab. A vestibule area was created just outside glass entrance doors into the storage surrounded by the two metal doors and a brick internal wall. This area provided a transition space between the storage and non-storage areas of the building for the control of infiltration of the humid outside air, dusts, and insects.

After the envelope modifications and prior to the start up of the climate control system, the climate of the new storage was monitored for several months. Both the temperature and relative humidity reached stable levels at 30-31°C and 80-82%, respectively.

Furniture

Compact shelving systems and chests made of steel with a baked enamel finish were positioned in the storage to provide the maximum use of the space while the ventilating air could circulate through as well as around them. Side panels of the compact shelving system were fabricated with perforated steel sheets to allow air circulation through them even at closed positions. (Figure 4) Drawers of the two chests also had large gaps between them to promote good air circulation, even in the closed position. (Figure 5)

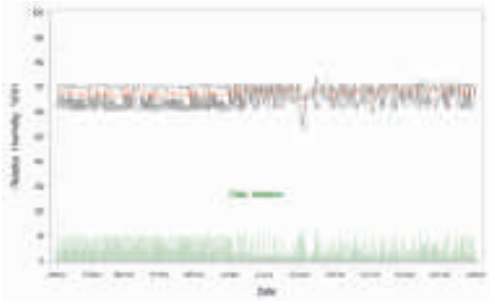


3. Proposed climate control system design for the new Amazonian ethnographic storage at the MPEG.

4. Side panels of compact shelving system are made of perforated plate in order to allow air flow through the panel even in closed positions.

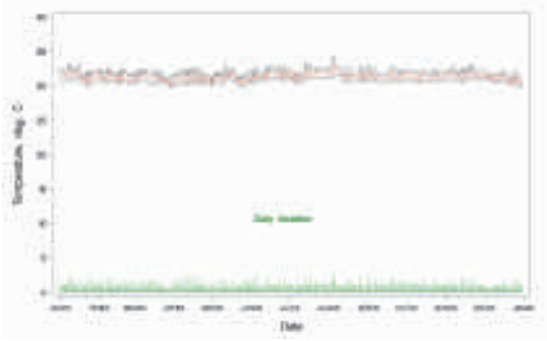
5. Drawers have gaps between drawers in order to allow air flow even in closed conditions.

Results

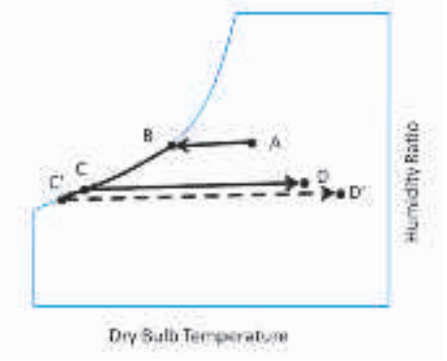


6. Daily maximums, averages, and variation of relative humidity in the new storage in 2005.

The climate in the storage room and the operation of the climate control system has been monitored since its installation late 2003. The system has operated successfully, maintaining the storage at the set relative humidity value of 60-70% RH. (See Figure 6.) The resulting temperature ranged 32-33°C. (See Figure 7.) With the temperature of the uncontrolled storage at 30-31°C, we expected the temperatures of the storage to be 28-32°C with the utilization of ventilators and mechanical dehumidifiers. The higher temperature may be a result of inefficient dehumidifiers. Although the temperature, 30-33°C, was as high as that of a sunny afternoon outside, with the utilization of the installed oscillating fans staff members have been able to work for an extended period of time in the storage. Since the system easily maintained the relative humidity range, we were interested in reducing the set relative humidity to a lower range. However, a decision was made not to lower the set point due to a concern over possible higher temperature values resulting from the system's operation, such as higher outside temperatures for ventilation (Figure 8) and additional heat released by compressors of mechanical dehumidifiers. (Figure 9)



7. Daily maximums, averages, and variation of air temperature in new storage in 2005.



9. Schematics of psychrometric processes of typical mechanical dehumidifiers describing more heat generated for more dehumidification due to the system's inefficiency.

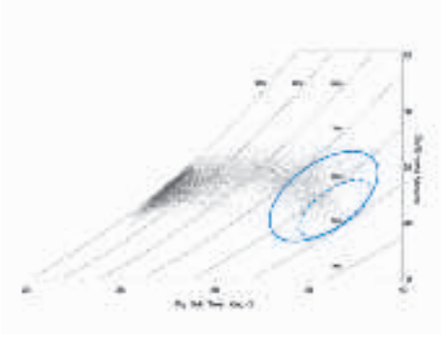
While the climate control system was operational, insect activities were monitored using sticky insect traps distributed throughout the storage. Although less than a 70% RH environment had been maintained we did not observe any fungal activities. We did, however, document an elevated population of psocoptera (booklice, barklice, and barkflies) at the end of 2006. This problem multiplied when the area had several power failure events one after another, and a fungal outbreak occurred. Some of this extended for more than two days. The set point of the system was then reduced to 50-60% RH in order to control the problems. The reduced relative humidity set point immediately controlled both the psocoptera problem and fungal infestation while the temperature remained at 30-33°C. This lower set point resulted in longer continuous operation of mechanical dehumidifiers, allowing them to run more efficiently with no additional heat generation.

The noise level has been less than 52-54 dB with ventilators or 60-61 dB with mechanical dehumidifiers and fans operating. These values were considered to be acceptable, since the space is storage and the staff occupies it only for a limited amount of time. Table 3 shows the resulting measurement of airborne particles conducted in August 2005. The dust level in the storage has been significantly lower than the outside as well as offices and the open corridor in the same building for all particle sizes.

Particle Size, µm	Storage	Outside	Corridor
< 0.3	549,331	1,122,695	1,200,616
< 0.5	29,961	59,532	80,375
< 1.0	4,771	5,459	8,853
< 5.0	68	159	408

Table 3. Number of Airborne Particles.

Through a collection assessment that was conducted one year after the operation of the climate control system, both the curator and conservator of the collection confirmed that they found no new damage to any of the objects in the new storage envi-



8. The outside temperature and relative humidity (15 minute data) of 2005 plotted on a psychrometric chart. The solid circle represents climate conditions for ventilation, if the storage is ventilated to maintain less than 70% RH. The dotted circle represents climate conditions if the storage is ventilated to maintain less than 60% RH.

ronment. Meantime, some staff members noticed that the collections have obtained increased volume and color saturation. In particular, those made of feathers and vegetable fibers seem to have achieved re-hydrated conditions in the new environment with air moisture content similar to the native environment.

Table 4 shows the monthly energy used in the storage during the first 6 months of 2005. The ventilators or dehumidifiers have on the average operated only about four hours daily, mostly during daytime, and the energy use has been approximately one-tenth of that of the old storage. Per unit area, the storage currently expends one-fifth of the average energy use of the rest of the research campus. During the first two years of the continuous operation of the system, the only maintenance needed, other than annual calibration of the humidity sensors and filters replacement, was the replacement of a failed solenoid switch for powering one of the ventilators. This failed component was easily identified and had minimum impact on the climate of the storage. Several events of the extended power failure were recorded during the five-year operation; however, they had minimum impact on the climate in the storage which maintained the designed relative humidity. These events have also proved that the system's operation is robust.

Month	Energy Use (kWh)
January	451
February	559
March	546
April	585
May	490
June	Missing
July	225

Table 4. Energy use of the new storage during the first 6 months of 2005.

Conclusions

A conservation-focused climate control strategy was implemented for the new Amazonian ethnographic storage of MPEG in Belém, a tropical climate region in northern Brazil. The building envelope was tightened to significantly reduce the infiltration of dusty and humid outside air, and the ceiling was thermally insulated to reduce the transfer of heat from the attic. A compact shelving, drawer, and cabinet system with perforated panels and large gaps was installed to allow the maximum air flow through them. A mechanical system was designed to limit the relative humidity to less than 70% (later reduced to 60%) using centrally controlled ventilators and portable dehumidifiers while allowing the temperature to drift with the outside climate. Centrally located ventilators supply filtered outside dry air and peripherally located exhaust ventilators produced a center-to-periphery flow; while they maintained a positive pressure in the storage to limit the infiltration of unfiltered outside air. The climate control strategy has been maintaining the intended conservation climate of 50-60% relative humidity at 30-33°C temperature with the minimum dusts in the storage. The strategy has also proven its robustness to maintain the conservation environment even during extended power outages common in the region. The capital cost of the project was one third of typical air-condition based systems, and the operational cost has been one-tenth of the same system.

The climate control project proved its effectiveness in maintaining safe conditions for the MPEG ethnographic collection with significant saving of equipment, maintenance, and energy costs. The conservation-focused climate strategy can be a beneficial alternative to the traditional air-condition approach for cultural institutions in hot and humid climate regions, especially, with limited resources.

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References

Agrawal, O.P. 1993. "Recent Studies on Biodeterioration of Cultural Property." In *Proceedings of 2nd International Conference on Biodeterioration of Cultural Property* 2, 4-49.

Aranyank, C. 1993. "Biodeterioration of Cultural Materials in Thailand." In *Proceedings of 2nd International Conference on Biodeterioration of Cultural Property* 2, 23-33.

Brundrett, G.W. 1990. *Criteria for moisture control*. London: Butterworth & Co. Ltd.

Kerchner, R. 1992. "A Practical Approach to Environmental Requirements for Collections in Historic Buildings." In *Journal of the American Institute for Conservation*, no. 31: 65-76.

Maekawa, S and F. Toledo. 2001. "A Climate Control System for Hollybourne Cottage, Jekyll Island Historic District, Georgia." ASHRAE Indoor Air Quality Conference, Moisture, Microbes, and Health Effects: Indoor Air Quality and Moisture in Buildings.

Maekawa, S. and F. Toledo. 2002. "Controlled Ventilation and Heating to Preserve Collection in Historic Buildings in Hot and Humid Regions." In *Proceedings of 13th ICOM-CC Triennial Meeting* 1, 58-65.

Michalski, S. 1993. "A Discussion of Correct/Incorret Values." In *Proceedings of 10th ICOM-CC Triennial Meeting*, 614-619.

Padfield T., and P. Jersen. 1990. "Low Energy Climate Control in Museum Stores." In *Proceedings of 9th ICOM-CC Triennial Meeting*, 596-601.

Staniforth, S., B. Hayes, and L. Bullock. 1994. "Appropriate Technologies for Relative Humidity Control for Museum Collections in Historic Buildings." In *Preventive Conservation: Practice, Theory, and Research. Proceedings of IIC Ottawa Congress*, 123-128.

Valentín, N., R. Garcia, O. de Luis, and S. Maekawa. 1998. "Microbial Control in Archives, Libraries and Museums by Ventilation Systems." In *Restaurator* 19, no. 2, 85-107.

Teaching Preventive Conservation Course at the Ecole du Patrimoine Africain

by Claude Laroque, Senior Lecturer, Master in Conservation-Restoration of Cultural Heritage Assets, Paris 1 Panthéon Sorbonne University, France

In 1986 ICCROM[1] launched a new program called "PREMA", Prevention in Museums in sub-Saharan Africa. Gael Guichen, who is behind this initiative, aimed to implement in African museums a concept still very new in Europe at that time, preventive conservation, thus initiating the rescue of African museum collections. Indeed a survey conducted in over forty countries revealed an alarming situation of their collections.

During the first ten years the program developed various actions to create a "network of *African professionals capable of ensuring the conservation of museum collections in sub-Saharan Africa and supporting* the *training of their colleagues*".
The objective is reached in about twelve years: the network gathers over four hundred professionals from museums; around thirty national and international courses were held in which African teachers account for eighty percent; collection rescues and exhibitions to enlight heritage were carried out in various countries in sub-Saharan Africa.

During the early years, ICCROM entered in partnership agreements with two universities, one French-speaking[2] and one English-speaking[3] to help the implementation of the curriculum and issuing diplomas.
Classes are given alternately in French and English, making it accessible to the majority of African countries.

In 1998 ICCROM, in order to relocate PREMA program on the African continent, signed an agreement with the National University of Benin[4] for the creation of the Ecole du Patrimoine Africain (EPA)[5] in Benin's capital, Porto Novo. In Mombasa, in Kenya, is created on the same design for English-speaking counterpart, the Centre for Heritage Development in Africa (CHDA)[6].

EPA is an international nongovernmental organization; it aims to "*contribute to the dignity of the African man through the recognition of the value of his cultural heritage.*"
It defines its objectives according to four main lines:
• Strengthen the network of African professionals able of ensuring the conservation and enhancement of cultural heritage;

1. Ecole du Patrimoine Africain, Porto Novo, Benin.

• Propose to African audiences, programs for the discovery and re-appropriation of their cultural heritage;
• Promote projects of socio-economic development which include the safeguarding and enhancement of cultural heritage;
• Contribute to the publishing and dissemination of publications on African cultural heritage.
The school has two buildings totaling with a floor space of 1,700 square meters. Located in a lush garden, one of the buildings is an Afro-Portuguese old style house, restored at the time of the creation of the school and the other was completed in 2010. Administrative offices, classrooms and workrooms are well equipped to provide a high quality education.

The first mission of EPA was teaching conservation, management and mediation of collections in African museums. It proposed in this framework regional and international courses for a wide range of museum staff that will ensure conservation and enhancement of collections.
Its activities have subsequently diversified, broadening its scope to libraries and archives, architectural heritage and intangible heritage.

Thus, a program for libraries and archives staff was developed in 2004. A first one month course set up in 2005 allowed to evaluate expectations from the institutions. But it was in 2010 that was inaugurated the twelfth edition of the "International Academic Course Professional bachelor degree in Conservation of Heritage", opened to candidates from museums, libraries and archives.

Unlike the previous eleven editions, the course is organized into seven blocks: the first five includes lessons common to *Museums* and *Archives-Libraries* sections, the last two are dedicated to each specialty.

1. International Centre for the Study of the Preservation and Restoration of Cultural Properties – Roma.
2. Université Paris1 Panthéon-Sorbonne.
3. London University.
4. UNB : Université Nationale du Bénin, 02 BP, 647 Gbégamey, Cotonou, Bénin - Tel : (229) 304633.
5. EPA : Ecole du Patrimoine Africain, 01 BP 2205, Porto-Novo – Bénin ; Tél. (229) 20214838, fax. (229) 20212109 ; www.epa-prema.net.
6. CHDA: Centre for Heritage Development in Africa, Old Law Court Building, Nkrumah Road, P.O. BOX 90010 - 80100 Mombasa – Kenya; Tel. (254) 41 2225114; www.heritageinafrica.org.

2. Practical exercises: removal of dust.

3. Protective cloth for books.

Classes, taught in French, include both theoritical and practical modules.
The program focuses on the conservation basics of movable heritage, degradation factors, movement and storage of collections, intervention and management strategies.
All courses include the issue of climatic conditions in tropical areas and specific related issues.

The classes are followed by an internship period after which the student must submit a report which takes the form of a diploma thesis. The year also includes a study tour that allows students to meet colleagues and to visit various African heritage institutions.
Teaching is spread over two academic years, the first is dedicated to the classes in the EPA' building. The internship, usually in the country of the student, individual works and study tour take place in the second year.
The degree is awarded after submission of the internship thesis defended in front of a board of examiners. It is validated by the University of Paris I and University of Abomey-Calavi.

The target audience for this university course includes professional from public museums, archives, libraries having development projects for their institution and who hold at least a baccalaurat or an equivalent degree. The age limit imposed of 40 years old allows recruiting candidates young enough to implement long-term projects. Student involvement is the key to successful programs generated by EPA.
Living together in the same residence for one year, the students share the difficulties associated with their temporary uprooting and distance from their families. Assistance needed to solve problems is then developing in both private and professional life. The solidarity is strengthened by numerous group works in classes, practical works or report writing.
Thus, the initial goal of the Prema program to create a network of professionals has been achieved for many years. Graduates of the EPA keep in touch directly or through school or newsletters. Finally the EPA graduate knows he can rely on the school if necessary.

This success is also due to the applicant selection to access the program. Each country puts forward its candidates; professionals from the network who know both the applicants and the status of their institutions are best capable to choose the best students. EPA will make the final selection.
Determination of the new graduate to implement his project when he returned to his institution is a major element of its success. Without generalizing situations which obviously vary from country to country, there are many obstacles slowing down the change process. The financial aspects are always important but bureaucratic inertia and staff lack of motivation are even more powerful resistances to change. It is therefore important for the project leader to be convinced of the necessity of his work to have enough energy to clear the obstacles.

The education, which takes place not in Rome but on African soil, puts students in real-life situations where problems need local solutions, for example, material supply, execution of works by outside companies, etc. As far as possible, the school provides instruction avoiding the use of imported expensive materials, mostly inaccessible to the graduates returning to their country. A budget is allocated to the purchase of basic equipments such as devices for monitoring temperature, humidity and light. If these equipments are well maintained, they can be used sustainably.

School's teaching team composed mostly of African professionals graduated from the school or those involved in heritage preservation provides a high quality education, adapted to African realities. The team also provides personal coaching and attention to students who can sometimes experience difficult times when their country is subject to armed conflict as it was the case in 2011 in Ivory Coast.

The outcomes of EPA activities in pedagogy are the best indicator of its success since its creation thirteen years ago: the school has trained a total of seven hundred professionals in the heritage field thanks to dozens of programs throughout the continent. It should be noted that the school runs many other activities for which reports are available on its website (www.epa-prema.net), as well as organization of exhibitions and conferences, publication of guidebooks, etc.

L'enseignement de la conservation préventive à l'Ecole du Patrimoine Africain

par Claude Laroque, Maître de conférences, Master Conservation-Restauration des Biens Culturels, Université Paris 1 Panthéon Sorbonne

C'est en 1986 que l'ICCROM[1] inaugure un nouveau programme intitulé « PREMA », Prévention dans les musées d'Afrique subsaharienne. Gaël de Guichen, à l'origine de cette initiative, a pour ambition de développer au sein des musées africains, un concept encore très nouveau à cette époque en Europe, celui de la conservation préventive, amorçant ainsi le sauvetage des collections des musées africains. En effet une enquête réalisée dans plus de quarante pays révélait une situation alarmante de leurs collections.

Les dix premières années le programme va développer diverses actions afin de créer un « *réseau de professionnels africains capables d'assurer la conservation des collections des musées africains au sud du Sahara et de prendre en charge la formation de leurs collègues* ».
L'objectif est atteint en une douzaine d'années : le réseau compte alors plus de quatre cents professionnels de musées ; une trentaine de cours internationaux et nationaux ont été organisés au sein desquels le corps enseignant africain atteint quatre-vingts pourcents; des opérations de sauvetage de collections ainsi que des expositions pour mettre en valeur le patrimoine ont été menées à bien dans divers pays d'Afrique subsaharienne.

Durant les premières années des conventions sont signées entre l'ICCROM et deux universités, l'une francophone[2] et l'autre anglophone[3] pour aider à la mise en place du programme d'enseignement et à la délivrance des diplômes.
L'enseignement est alternativement délivré en français et en anglais, rendant celui-ci accessible à la majeure partie des pays africains.

En 1998 l'ICCROM, afin de transférer PREMA sur le continent africain, signe une convention avec l'Université Nationale du Bénin[4] créant ainsi l'Ecole du Patrimoine Africain (EPA)[5] dans la capitale du Bénin, Porto Novo. A Mombasa au Kenya est créé sur le même modèle pour le volet anglophone, le Centre for Heritage Development in Africa (CHDA)[6].

L'EPA a statut d'organisation internationale non gouvernementale ; elle se donne pour mission de «*contribuer à la dignité de l'Homme africain à travers la reconnaissance de la valeur de son patrimoine culturel* ». Elle définit ses objectifs suivant quatre axes :

- Renforcer le réseau des professionnels africains capables d'assurer la conservation et la mise en valeur du patrimoine culturel.
- Proposer aux publics africains des programmes permettant la découverte et la ré-appropriation de leur patrimoine culturel.
- Promouvoir la réalisation de projets de développement socio-économique qui intègrent la sauvegarde et la mise en valeur du patrimoine culturel.
- Contribuer à l'édition et à la diffusion de publications spécialisées sur le patrimoine culturel africain.

L'école comprend deux bâtiments d'un total de 1700m². Implantés dans un jardin verdoyant, l'un des bâtiments est une ancienne maison de style afro-portugais, réhabilitée au moment de la création de l'école et l'autre a été achevé en 2010. Locaux administratifs, salles de cours et de travail sont bien équipés permettant de dispenser un enseignement de qualité.

La toute première mission de l'EPA était l'enseignement de la conservation, la gestion et la médiation des collections dans les musées africains. Elle a proposé dans ce cadre des enseignements régionaux et internationaux destinés à un large éventail des personnels de musée susceptibles d'assurer conservation et mise en valeur des collections.
Ses activités se sont ensuite diversifiées, élargissant son champ d'action aux bibliothèques et archives, au patrimoine bâti et au patrimoine immatériel.
C'est ainsi qu'un programme destiné aux personnels des bibliothèques et archives fut élaboré en 2004. Un premier cours d'une durée d'un mois, mis en place en 2005, permit d'évaluer les demandes de la part des institutions. Mais c'est en 2010 que fut inaugurée la douzième édition du « Cours universitaire international Licence professionnelle en Conservation du patrimoine », ouvert à des candidats issus des musées, bibliothèques et archives.

A la différence des onze éditions précédentes, le cours est organisé en sept blocs, les cinq premiers regroupant des enseignements communs aux spécialités *Musées* et *Bibliothèques-archives*, les deux derniers destinés à chacune des spécialités.
L'enseignement dispensé en français comprend des modules à la fois théoriques et pratiques.
Le programme s'articule autour des notions de base de la conservation du patrimoine mobilier, des facteurs de dégradation, du mouvement et du stockage des collections, des stratégies d'intervention et de gestion. Tous les cours intègrent la question des conditions climatiques en milieu tropical et des problèmes particuliers qui leur sont liés.

1. Centre international d'études pour la conservation et la restauration des biens culturels – Rome.
2. Université Paris1 Panthéon-Sorbonne.
3. Université de Londres.
4. UNB : Université Nationale du Bénin, 02 BP, 647 Gbégamey, Cotonou, Bénin - Tél : (229) 304633.
5. EPA : Ecole du Patrimoine Africain, 01 BP 2205, Porto-Novo – Bénin ; Tél. (229) 20214838, fax. (229) 20212109 ; www.epa-prema.net.
6. CHDA : Centre for Heritage Development in Africa, Old Law Court Building, Nkrumah Road, P.O. BOX 90010 - 80100 Mombasa – Kenya; Tél. (254) 41 2225114; www.heritageinafrica.org.

Les cours sont suivis d'une période de stage à l'issue de laquelle l'étudiant doit remettre un rapport sous forme de mémoire. L'année comprend également un voyage d'étude qui permet aux étudiants de rencontrer des collègues et de visiter diverses institutions patrimoniales africaines.
L'enseignement s'étale sur deux années académiques, dont la première est occupée par les cours dispensés dans les locaux de l'EPA. Le stage, généralement dans le pays d'origine de l'étudiant, les travaux individuels et le voyage d'études occupent la seconde année.
Le diplôme est sanctionné par la remise du mémoire de stage soutenu devant un jury. Il est validé par l'Université Paris I et l'Université d'Abomey-Calavi.

Le public visé pour le cours universitaire regroupe des professionnels des musées publics, des archives, des bibliothèques ayant des projets de développement pour leur institution et qui sont titulaires au minimum du baccalauréat ou d'un diplôme équivalent. La limite d'âge imposée de quarante ans permet de recruter des candidats suffisamment jeunes pour mettre en œuvre des projets de longue durée. L'engagement des étudiants est la clé de la réussite des programmes générés par l'EPA. Logés dans une même résidence étudiante, ils vont vivre ensemble au quotidien pendant une année, partager les difficultés liées à leur déracinement temporaire et à l'éloignement de leurs familles. L'entraide nécessaire à la résolution des problèmes se développe alors à la fois dans la vie privée et dans la vie professionnelle. Cette solidarité est renforcée par les nombreux travaux de groupe développés dans l'enseignement, travaux pratiques ou rédaction de rapports. Ainsi, l'objectif initial du programme Prema visant à créer un réseau de professionnels est atteint depuis de nombreuses années. Les diplômés de l'EPA conservent des contacts entre eux, directement ou par le biais de l'école, de lettres d'information. Enfin l'«ancien EPA» sait qu'il peut compter sur l'aide de l'école si nécessaire.

Cette réussite tient également à la sélection des candidats à l'entrée du programme. Chaque pays propose ses candidats ; les professionnels issus du réseau connaissant à la fois les postulants et la situation de leurs institutions sont les mieux à même de choisir les meilleurs étudiants. Puis c'est l'EPA qui établira la sélection finale.

La détermination du nouveau diplômé à mettre en œuvre son projet dès son retour dans son établissement est un élément majeur de sa réussite. Sans généraliser les situations qui bien évidemment varient d'un pays à l'autre, les obstacles sont généralement nombreux à la mise en place du changement. Le volet financier est toujours important mais les pesanteurs administratives, la démotivation des personnels sont des freins encore plus puissants. Il importe donc que le chef de projet soit convaincu de la nécessité de son travail et porteur d'une énergie qui l'aidera à franchir les obstacles.

L'enseignement dispensé non plus à Rome mais sur le sol africain place les étudiants dans des situations réelles où les problèmes doivent trouver des solutions locales, par exemple, l'approvisionnement en matériaux, l'exécution de travaux par des sociétés extérieures, etc. Autant qu'il est possible, l'école dispense un enseignement évitant l'utilisation de matériaux d'importation coûteux, la plupart du temps inaccessibles aux diplômés de retour dans leur pays. Un budget est alloué pour l'achat des équipements de base comme par exemple les appareils de mesure de la température, l'humidité et la lumière. Ces matériels, s'ils sont bien entretenus, pourront être utilisés durablement.

L'équipe enseignante composée majoritairement de professionnels africains issus des premières promotions ou d'acteurs engagés dans la sauvegarde du patrimoine dispense un enseignement de qualité, adapté aux réalités africaines. L'équipe assure également un encadrement attentif et personnalisé des étudiants qui peuvent parfois vivre des moments difficiles quand leur pays fait l'objet de conflits armés comme c'était le cas en 2011 pour la Côte d'Ivoire.

Le bilan des activités de l'EPA en matière de pédagogie est le meilleur témoin de sa réussite depuis sa création il y a treize ans : l'école a formé au total sept cents professionnels du patrimoine grâce à plusieurs dizaines de programmes sur tout le continent. Il faut préciser que l'école gère bien d'autres activités dont les rapports sont disponibles sur son site internet (www.epa-prema.net) ou encore l'organisation d'expositions et de colloques, la publication de guides touristiques, etc.

Audio and Video Materials in Tropical Countries

by Dietrich Schüller, Special Preservation Projects, Phonogrammarchiv, Centre for Linguistics and Audiovisual Documentation, Austrian Academy of Sciences, Vienna, Austria

Preamble

Long-term preservation of audio and video recordings can only be achieved by extracting the contents from their original audio and video carriers, by digitising analogue signals, by storing signals as file formats in digital repositories, and by future subsequent migration of digital contents from one digital preservation system to the next (IASA-TC 03 and 04). This methodology, originally developed by European radio sound archives from the early 1990s onward, is meanwhile internationally implemented as the only viable way of audio and video preservation in the long-term. Conservation of traditional original audio and video carriers, however, will remain an important part of general preservation strategies, specifically to retard their deterioration before digital preservation can be organised and financed.

This paper is an updated version of an article published in IPN 21, *May 2000. Emphasizing on the specific risks facing audiovisual materials in tropical countries, it concentrates on heat, humidity and dust. For general guidelines on handling and storage audio and video carriers see Schüller 2008 and IASA-TC 05, currently prepared for publication later in 2011, which also contains a detailed bibliography.*

Beware of high humidity and buy a hygrometer first!

Audiovisual data carriers play an ever-increasing role in the realms of information, communication, cultural documentation and research. With the vast spread of modern technologies, the wide field of the audiovisual domain has become an indispensable factor in every country around the world. In the course of this development, audiovisual collections have mushroomed almost everywhere, with each collection containing irreplaceable documents of unique historical and cultural content.

Beyond the world of modern, «international» entertainment, audiovisual documents are the only suitable records for otherwise undocumentable, orally transmitted cultures and arts. Thus, these documents are indispensable prerequisites for the representation of the world heritage in all its multicultural and multilingual aspects.

It is well known that audiovisual data carriers are prone to decay. Standards have been defined to help slow down the progress of this decay in order to prolong the life of this kind of source material. The parameters of these standards have been defined within the prevailing environmental and economic framework of developed countries with moderate climatic conditions. It is a sad experience, however, that in tropical countries, audiovisual data carriers often have greatly reduced life expectancies. This paper will examine the reasons for this unfavourable situation and suggest measures to overcome at least some of the problems by observing simple, adaptable methods. The views of the author are based on the experience gained from a series of missions to African, Asian, Arabian and Caribbean audiovisual archives.

Before discussing the situation of tropical countries it is advantageous to generally survey the parameters relevant for the stability and integrity of audio and video carriers. Almost all audiovisual carriers (with the exception of the metal parts of mass produced audio or video discs) consist of polymers which are more or less inherently unstable. All preservation measures can be defined as measures to retard decay as a consequence of this inherent instability and to prevent additional risks over what is defined to be «normal» conditions to their chemical, mechanical or - where applicable - magnetic integrity.

The generally accepted recommended storage and handling conditions can be summarized as follows:

1. The maintenance of low and stable temperature and humidity values.
2. The elimination of dust, fingerprints and other kinds of foreign matter.
3. The prevention of mechanical deformations.
4. The control of light and ultra violet radiation.
5. The control of magnetic fields (for magnetic carriers).
6. The use of well maintained replay equipment.

In principle, parameters 3 to 6 are as easy to achieve in tropical as in temperate conditions. This is not the case, however, with temperature, humidity and dust. These parameters will, therefore, be examined more carefully in view of their influence on the stability of audio and video carriers.

Temperature and Relative Humidity

Before dealing with their influence on data carriers it must be explained that temperature and humidity are interrelated. The higher the temperature of the air, the more water it can hold in gaseous form (vapour); the colder the air, the less it can hold. Put another way, the same, absolute amount of water at higher temperatures gives a lower Relative Humidity (RH) and at lower temperatures a higher. When the temperature is lowered, the RH increases until the saturation point (100% RH) is reached. This point is also called the Dew Point because at that, and lower temperatures, water vapour condenses on to the surfaces within the environment. It is important to understand that the Dew Point is reached when, for example, air at 70% RH is cooled, without dehumidification, from 26°C to 20°C.

The speed of chemical processes is temperature dependent: the higher the temperature, the faster the chemical process. Aging is a chemical process and, therefore, in principle, dependent upon the temperature of the environment in which materials

prone to aging are kept: the lower the temperature, the longer the life expectancy; the higher the temperature, the shorter the life expectancy.

Water, omnipresent in the form of humidity or vapour, is - in the case of some polymers - an agent working towards their degradation. Several decay processes are due to hydrolysis, a process whereby the long polymer molecular chains break down thereby altering their chemical and physical properties. Different polymers vary in their susceptibility to hydrolysis and the process is influenced by different factors in different polymers. However, the more water that is available (and the higher the temperature), the stronger is action and, again, the shorter the life expectancy.

The most prominent and widely discussed hydrolytic process is that affecting some types of magnetic layer binders used in some magnetic tapes. The binding properties are reduced and the tape becomes sticky and sheds oxide particles, resulting in clogging of the replay head (colloquially known as the "Sticky Tape" or "Sticky Shed Syndrome"). This causes deterioration or even loss of the playback signal. Most of the affected tapes have been produced during the 1970s and 1980s. Normally, such tapes can be stabilised to make them playable for a short period and, thus, provide sufficient time to be copied. In severe cases the magnetic layer may even shed in flakes of varying size with consequent complete loss of information[1].

Corrosion is another water-related chemical process. In theory, metal particle tape, as used for many video formats and for R-DAT, is prone to corrosion of the magnetic layer. It is noteworthy, however, that so far no significant reports of such corrosion have been received, not even from countries with a very adverse climate. Corrosion also threatens the reflective aluminium layers of optical discs, specifically when protective lacquer layers are mechanically damaged.

Beyond the sphere of chemistry, high levels of relative humidity can cause secondary problems. They support fungus growth, whereby fungus reacts with the surfaces of many audiovisual carriers, especially with the magnetic layer of tapes. In the replay process fungus accumulates on the replay heads of audio and video machines, causing head clogging and thus disturbing, if not hindering the replay process. In severe cases fungus can destroy the magnetic layer. Another unwanted non-chemical humidity problem is condensation on the tape surface if the RH reaches 100%. This can cause severe replay problems, especially with all rotary head formats (video and DAT). It can also lead to adhesion of the tape to the head-drum which may cause damage to the equipment.

Temperature and humidity also have an influence on the dimensions of carriers. Generally, the volume of a carrier increases with higher, and decreases with lower temperature and/or humidity.

1. Another process of polymer decay due to hydrolysis is the so-called "Vinegar Syndrome". It was discovered in the '80s and affects stocks of cellulose acetate films. The decay process produces acetic acid that acts as a catalyst and accelerates the process if trapped in the film can with the film. It has also become evident that the process can affect magnetic tapes with a cellulose acetate base, but not to the same degree as with film.

Finally, higher temperatures result in a faster rate of increase of signal print-through on magnetic tapes[2].

Standards and Compromises

From these facts the following general rule can be derived: for the extension of life expectancy, temperature and humidity should be low. With respect to the mechanical influences of these parameters, in order to prevent, especially with tapes, mechanical deformations caused by stress or undue relaxation, the chosen temperature and humidity level should be kept as stable as possible. Additionally, high levels of RH must be avoided in order to prevent fungus growth and mechanical replay problems.

It must be noted that there is no ideal storage condition per se. Each recommendation is a compromise between:

- the rate of decay of the carriers,
- the frequency of use of the carriers,
- the requirements for health and convenience of the archivists, and
- cost.

Current internationally accepted recommendations propose temperatures around 20°C with maximum (annual) fluctuations of 2-3°C. The recommended humidities have been steadily lowered over the last few decades. As a consequence of magnetic layer binder break down with modern tapes since the 1970s ("Sticky Tape" or "Sticky Shed Syndrome"), humidity recommendations have dropped from a maximum of 60% to 40% RH and lower, with maximum fluctuations of 5-10% RH[3].

These standard recommendations, which are quoted for audio and video carriers, are a typical compromise made from the perspectives of archives in moderate climatic conditions with the need of frequent access to their holdings ("access storage"). They reflect the general climatic conditions as well as a normal working room environment, which is generally accepted by people living in a temperate climatic zone.

Therefore, long-term "archival storage" - as opposed to "access storage" - conditions have been defined with lower and tighter parameters, suggesting 5°C and 30% or lower RH for magnetic tape (Van Bogart). Carriers stored under such conditions are, however, not easily accessible as they will have to be slowly acclimatised to a normal working environment before use.

Turning now to tropical climatic zones, an outdoor temperature range of 25 to 40°C and more can be observed. Humidities may range from extremely (and for most of our carriers, favourable) low values in arid zones - but which then create dust problems - to up to 100% RH in humid zones during the rainy seasons.

2. Print-through is an annoying factor in magnetic recording. But it only affects analogue longitudinal recordings such as audio tapes and the audio tracks mainly of the older two- and one-inch-video formats. It does not affect digital audio formats, nor any analogue or digital video signals. It should be remembered that print-through can be greatly diminished by re-winding the tape several times before replay.

3. Recent research suggests that, in order to retard embrittlement of cellulose acetate tapes and recording layers of lacquer discs, RH for those carriers should be kept between 40 and 50%.

A considerable input of energy and money is necessary to bring down tropical temperatures and humidities and keep them at the values published in our standards. In practice, very few audiovisual archives in tropical areas can afford to keep to these recommendations. The most frequently applied practices are the following:

1. The archivists are unaware of the recommendations, or - for financial reasons - are unable to fulfil them. The audiovisual holdings are kept without any air-conditioning at all.

2. The archivists are aware of the recommendations but have limited funds for air-conditioning. They have cooling equipment running during the day, but they switch it off in the evenings and at weekends in order to save energy.

3. The archivists can afford cooling of the air but, because of lack of awareness and/or insufficient funds, do not effectively dehumidify their environment. Some of them may think that they are, at least, fulfilling 50% of the international recommendations by cooling down to perhaps 20°C but disregarding effective simultaneous dehumidification[4].

In general, it can be stated that of these three mentioned practices the latter is the worst, and of catastrophic consequence if applied in humid areas like the Caribbean and similar regions. As explained above, cooling without effective dehumidification raises relative humidity dramatically. Water condenses in corners without air current, on shelves, and, finally, inside audio and video cassettes. This leads very quickly to fungus growth and to severe replay problems. Video archives employing this method of partial air-conditioning reported that cassettes generally failed to play back after between one and three years only!

Dust

The other factor that creates a greater risk in tropical areas rather than in moderate climatic zones is dust. It is omnipresent in practically all Southern countries. It is less annoying, where occurring, during the rainy seasons. Most aggravating is the fact that airiness is one of the principles of personal well-feeling in these countries. Hence, windows are normally left open. Modern office buildings sometimes do not even have windows in our sense but grids made of bricks to allow a constant air flow. Thus, yellow or red dust covering floors, shelves, and inside everything, including tape boxes and even cassettes, is the standard scene in many archives and collections in these areas.

Dust is one of the greatest enemies of all audiovisual carriers and their equipment. On mechanical carriers, it deviates the stylus from its path, causing clicks and crackles; with magnetic tapes it causes head clogging, and, additionally, scratches on surfaces of tapes, tape heads and tape guides; with CDs it causes, in conjunction with improper handling scratches which may render the discs unreadable[5].

Recommended Practices for Tropical Countries

Ideally, archives in tropical countries should follow the international recommendations for the storage of audio and video materials. For temperature, humidity, and cleanliness in an "access store" this would mean:

- A constant storage temperature around 20°C with fluctuations not exceeding 1°C daily and 2°C annually.
- A relative humidity of 30-40% with minimal fluctuations (5%)[6].
- The absence of dust particles.

Only rich archives are able to follow these recommendations. It must be noted, however, that such low temperatures are considered to be very uncomfortable by local archivists and may, moreover, constitute a considerable health problem. "Archival storage" in Van Bogart's sense would call for even lower and tighter values. In view of the costs that would be incurred, however, their realisation would not happen very frequently.

In order to reach, or to come close, to the above standards, a bundle of measures is necessary. The first and most important is the radical thermal insulation of buildings and rooms housing audiovisual storage areas. Whenever possible, storage areas should be placed in the centre of buildings, their walls should not touch the outside of the house. Indigenous construction materials, e.g. adobe, may be preferable to concrete and the like, additional insulating material is advantageous. Most important is the construction of secondary roofs and facades, with a gap of several feet between the primary and secondary surfaces, to allow for ample air flows around the primary building. This will prevent sunlight from hitting and directly heating the outside surfaces of the primary archival building. This is a simple and inexpensive but most effective measure. The use of underground storage areas may, in principle, help to reduce energy costs, the high risk of flooding must, however, be taken into account. Underground locations are, therefore, only applicable (and still with great caution!) in dry areas. Generally, tropical rains can be abundant, so sufficient measures to prevent flooding of storage areas have to be provided.

In fighting against dust, wrapping audiovisual carriers to individually protect them against dust, e.g. in polyethylene bags, must be critically examined for two reasons, especially in tropical areas:

4. In principle, cooling of the air simultaneously extracts water by condensation. Effective simultaneous cooling and dehumidification of an environment, however, requires specialised equipment and measures. Experience has often shown that standard air-conditioners, as used widely for cooling homes and offices - and also as used in many small, Southern audiovisual archives - do not, in general, work effectively as dehumidifiers. A large part of this ineffectiveness can also be ascribed to improper insulation: any air intake that by-passes the controlled air-conditioning channels will not only counteract cooling but also dehumidification.

5. Scratched tape surfaces often trigger binder degradation. Optical discs, CDs, DVDs and BDs, are also sensitive to scratches. If their lower surface, the polycarbonate body, is scratched, the laser beam is dispersed and may not be able to track the pits. As a consequence, anything between short dropouts and total muting can occur. Scratching the protective varnish of the upper side of CDs will possibly render the reflective layer unstable, leading also to playback problems. All optical discs must, therefore, be handled with utmost care and should never be placed anywhere except in a player or in their cases, the so-called jewel boxes. Placing them on an obviously sandy table may lead to their swift destruction.

6. Except for cellulose acetate tapes and lacquer discs, see footnote 4.

- Several deterioration processes are autocatalytic: the chemical process produces substances that act as catalysts for the further decay, thus exponentially accelerating the process. This is well known with the Vinegar Syndrome that affects cellulose acetate and is also suspected with binder hydrolysis.
- Equally, if not more important, is the danger of creating a microclimate: elevated humidity may be trapped, or accumulated, in closed environments, causing chemical decay and fungus growth with all its disastrous consequences.

The conflicting demands for airy storage[7] and for dust prevention can only be met satisfactorily and simultaneously by providing a good air exchange, using appropriate air-conditioning equipment, in combination with the following radical dust proofing measures:

- tightening windows to ensure a good seal;
- installing air locks at all entrances;
- having terrazzo-type floors. These are easily cleanable and, if dark coloured, make dirt visible and annoying;
- air-conditioners must be equipped with effective dust filters which must be regularly maintained.

What immediate advice could be given, however, if financial funds are lacking to provide ideal conditions?

Thermal insulation and dust proofing can be provided at relatively low cost and have little or no continuing energy requirement. These should, therefore, be at the centre of all endeavours. As to temperature and humidity, it must be mandatory to control both parameters simultaneously. To this end, the availability of a hygrometer is an essential prerequisite[8]. Air-conditioning equipment must be chosen that is able to effectively cool and dehumidify the air. If compromises have to be made, temperature should be kept to a maximum of 25°C, humidity not permanently above 60% RH. If the level of both parameters cannot always be simultaneously achieved, it is more important to keep humidity within the given limits than temperature. A stand-by generator must be provided to ensure a continuing power supply in case of a failure of the public supply. Whatever measures are to be taken, it is imperative that the temperature and RH values be recorded daily (or more frequently) in order to assess the risk and to take appropriate action.

It must be clearly understood, however, that such departures from the standard climatic conditions will inevitably lead to shortened life expectancies for the carriers.

This, however, should be seen pragmatically. The last decade has shown the rapid obsolescence of dedicated audio and video formats, associated with the retreat of manufacturers from production of replay equipment and spare parts as well as maintenance services. Increasingly, audiovisual archives have to search for replay equipment and spare parts on second hand markets, and to maintain their equipment in-house by specialised archive technicians. There is unanimous agreement that the realistic time window to replay dedicated audio and video formats is not longer than 15 years. After that, transfer of audiovisual contents to digital repositories will become an archeological challenge with uncertain results at considerable cost.

Therefore, seen from that point, all efforts should concentrate on the digitisation of audiovisual contents and their transfer into safe digital repositories. Before that can be financed and arranged, carriers should be kept in good playback condition by preventing damage by dust and fungus growth. Temperature and humidity should be kept as low as possible but to those values which can be maintained stable 24 hours a day throughout the entire year.

7. This thought is supported by the observation of Harald Brandes (1992), who reported that even nitrate films seem to survive comparatively well if stored without any air-conditioning, but in a well-aired environment.
8. A simple precision hygrometer, available for perhaps $40, is good enough for this purpose. Electronic wirleless temperature and humidity meters also available at a similar price range.

References

Nota bene: This is select bibliography only. An updated bibliography is under preparation for IASA-TC 05.

Bertram, N. and Eshel A. 1979. *Recording media archival attributes (magnetic)*. Redwood City, Calif.: Ampex Corporation.

Bradley, K. 1992. "Restoration of Tapes with a Polyester Urethane Binder." In *Phonographic Bulletin* 61.

Brandes, H. 1992. "Are There Alternatives to the Traditional Air-Conditioned Film Stores?" In Boston, G. (Ed.), *Archiving the Audio-visual Heritage. Proceedings of the Third Joint Technical Symposium, Ottawa 1990*.

Charles, E. 1992. "Breakdown of Sound and Image Carriers in the Caribbean." In Boston, G. (Ed.), *Archiving the Audio-visual Heritage. Proceedings of the Third Joint Technical Symposium, Ottawa 1990*.

Gilmour, I. and Fumic, V. 1992. "Recent Developments in Decomposition and Preservation of Magnetic Tape." In *Phonographic Bulletin* 61.

Harkness, C. 1988. "Criteria for Air-Conditioning in Audio-Visual Archives." In Orbanz, E. (Ed.), *Archiving the Audio-visual Heritage. Proceedings of the Second Joint Technical Symposium, Berlin 1987*.

IASA Technical Committee: *Standards, Recommended Practices and Strategies*.

IASA-TC 03. *The Safeguarding of the Audio Heritage: Ethics, Principles and Preservation Strategy*, Version 3, December 2005, edited by Dietrich Schüller.
http://www.iasa-web.org/downloads/publications/TC03_English.pdf
Also available in German, French, Swedish, Italian, Spanish and Russian; Chinese forthcoming.

IASA-TC 04. *Guidelines on the Production and Preservation of Digital Audio Objects*, second edition, 2009, edited by Kevin Bradley.
http://www.iasa-web.org/audio-preservation-tc04

IASA-TC 05. *Handling and Storage of Audio and Video Carriers* (working title), edited by Dietrich Schüller and Albrecht Häfner (forthcoming end of 2011).

Schüller, D. 2008. *Audio and video carriers. Recording principles, storage and handling, maintenance of equipment, format and equipment obsolescence.*
http://www.tape-online.net/docs/audio_and_video_carriers.pdf

Schüller, D. 2008. "Socio-technical and Socio-cultural Challenges of Audio and Video Preservation." In *International Preservation News* 46, 5-7.
http://www.ifla.org/VI/4/news/ipnn46.pdf

Van Bogart, J.W.C. 1995. *Magnetic Tape Storage and Handling*. Washington, D.C.: Commission on Preservation and Access.

Preservation of Photograph Collections in Tropical Climate

by Belyamyra Mantilla and **Graciela Mascareño,** Division of Collection Conservation, National Documentary Preservation Centre, National Library of Venezuela, IFLA-PAC Regional Centre for Latin America and the Caribbean

The policy of documentary collection preservation in Latin American countries with a tropical climate requires countless efforts to get results aiming at the protection and maintenance of works. The reality of preservation of the documentary heritage in these countries combines issues related both to the climate itself, and to the financial and economic situations specific to these countries, which result in a high degree of difficulty for the preservation professional to carry out his duties, tasks and activities.

The tropical climate involves the possibility of growth and development of many microorganisms and insects, attracted by the environmental conditions, very generous in humidity and warm temperatures and a flora composed by an abundant variety of plants. In Venezuela's case, the presence of a humid climate, with constant high temperatures and intense sunlight incidence, represent an environment favorable for the growth and development of biological activity. Besides, we find poor storage conditions if we take into consideration that buildings, storage rooms, furniture, artificial lighting, etc., sometimes respond to the economic resources available, to the detriment of collections.

This situation compels conservators to consider a range of action possibilities in accordance with the needs of each collection and the resources available, which in most of the cases are not sufficient to integrally solve the problems that may arise.

Actions range from prevention to detailed treatment. In this sense, the National Documentary Preservation Centre of the National Library of Venezuela approaches documentary preservation from different perspectives, since in many cases the compliance with international standards regarding environmental, storage and handling parameters is impossible, considering the accelerated development of collections, that in many instances are stored in small and inadequate areas, where air conditioning systems are inefficient or obsolete, their pipes and filters are not properly maintained, and the repair and replacement are very expensive. As a consequence, there is an accumulation of dust and pollutants that is aggravated by the increase of external environmental pollution due to, among other factors, the growth in the number of automobiles and the proximity to factories. All the previously described factors have a negative impact on the conservation conditions of the National Library's collections.

What is a priority in this climate?

In its beginnings, the National Document Preservation Centre approached conservation from the need of training in storage, handling and treatment of works. Also, the Centre achieved the installation of workshops, setting of standards, creation of disaster plans and collection assessment in order to determine the type of supports and most common damages. As a result, a policy of collection protection was implemented. However, the fast development of collections and the limited number of specialists in the field of preservation, implied restrictions for the execution of activities, compelling to focus preservation on the collections care, in order to keep them in good condition and prevent future damages.

A preservation policy has been undertaken, focused on the detection of irregularities in collection storage, without ceasing to apply conservation treatments to those items that, for their intrinsic value and historical importance, require them.

Emphasis is made on:

- Measuring and control of environmental parameters (temperature and relative humidity), with special emphasis in obtaining values close to recommended measurements, but above all, trying to keep the least degree of fluctuations;
- Periodical cleaning of collections and storage areas. For this activity, in 2004, the position of conservation worker was created (staff specially trained for the cleaning of collections);
- Generation of a forced air circulation system, by the use of fans and dehumidifiers which, together, prevent the formation of micro-climates favorable to the reproduction of microorganisms that may seriously affect documents;
- Making of protectors of archival quality materials, chemically stable and designed according to the needs and dimensions of each document.

An example: the 19th Century Photograph Collection of the Audiovisual Archive of Venezuela of the National Library

An example that allows to consider a variety of action possibilities, determined by the needs and available resources, is the 19th Century Photographs Collection, owned by the Audiovisual Archive of Venezuela of the National Library.

Photographs are complex structures from a physicochemical point of view, because of the diversity of materials and processes applied. The Audiovisual Archive's collection consists of daguerreotypes, ferrotypes, glass plate negatives, albumin copies, gelatin and collodion copies, and black & white copies of gelatins, albums, among others. This variety of supports makes it very difficult to implement a preservation policy. That is why it is necessary to establish deterioration control measures prioritizing the following parameters:

- Relative humidity;
- Atmospheric pollution;
- Lighting;

1. Storage of the 19th Century Photographs Collection.

- Preventive measure against insects and microorganisms;
- Duplication of originals on other supports that guarantee a greater stability of the information;
- Organizing and cataloging system that gives more access to information, with less handling;
- Periodical and detailed monitoring of storage areas and collections.

This photograph collection is kept in a storage area where the air conditioning system has a series of deficiencies, as described above. For this reason, the greatest challenge faced has been the fluctuations of temperature and relative humidity levels that contribute to the chemical and mechanical changes in the copies, producing alterations and deterioration of their structure, transformation of supports, expansion, contraction and softening of the emulsion.

In order to reduce the impact of these factors, we seek to maintain temperatures between 18 °C y 20°C, values that have not been too hard to reach and keep most of the time.

So as to face the tendency of increasing relative humidity percentages that favor the condensation of water vapor, we rely on: permanent measuring of environmental parameters; use of dehumidifiers; shelving of collections in open metallic shelves placed in the centre of the storage area, in order to facilitate the natural circulation of air and prevent the formation of humid air bags; and storage of items in different protectors and containers.

2. Card catalogs of the 19th Century Photographs Collection.

3. Individual protections.

In addition, to minimize the impact of light radiation, we try to keep the levels of light in storage areas below 100 luxes. Besides, permanent storage of items in boxes or containers avoids their exposure to radiation and protects them from dust.

As a preservation measure, aiming at preventing the excessive handling of the originals, it was decided to make three copies of each item and include in the card catalog a smaller size copy, that allows the user, once he has accessed the catalog, to view the image and choose what really interests him. Besides, images are digitized to create a digital catalog.

For the replacement of the acetate envelops, where negatives are kept, that showed signs of deterioration, sleeves were designed, made of paper with a high content of cellulose, neutral pH, lignine, alkaline reserve and metallic particle free.

4. Passe-partout mounting.

In the case of photographs, single sleeves were made with polyester film (polyethylene terephtalate). The selection of the material was based, first of all, on its chemical stability, since according to some studies, it presents few signs of degradation in time; it guarantees the stability of the items every time they are viewed, because it minimizes the impact of frequent handling, preventing traces of fingerprints, offers mechanical resistance and provides physical support to the item, and at the same time, due to its high level of transparency, allows viewing the image without taking the item out of the protector. These protectors can be made with sheets of polyester film, or with one sheet on top of the picture and a neutral pH cardboard on the back, which is an additional support for very fragile copies.

Another measure that has been gradually applied is the mounting of works on passe-partout, made of chemically stable, 100% rag-content, neutral pH board.

Hard cases for glass plates were built and, in the case of daguerreotypes, their structure was checked to confirm that they were duly sealed, because the most common sign of deterioration is silver sulfuration due to the corrosive action of pollutants, such as sulfhydric acid and sulfur dioxide, which produce degeneration that can cause its total disappearance. Therefore, images should not be submitted to any kind of physical contact and the appropriate way of protecting them is to keep them sealed and covered with glass.

For the protection of ferrotypes, we made cases with a hard neutral board bottom, which work as a support, placing a spacer between the original and the glass to prevent friction.
In the particular case of photo albums, a variety of actions are undertaken depending on the damages they show, such as: use of archival quality board boxes for their storage; insertion of neutral paper leaves as barriers against external harmful agents. In the instances where second supports represent a risk for the photograph, the structure is replaced and a new one is made of archival quality materials.

The manufacture and use of containers must be established as essential, because they work as a protecting medium against external harmful agents. Therefore, it is necessary to analyze previously the nature of each item in order to decide the type of protector to be made, its functionality and the materials to be employed.
Another important aspect is the training of staff in procedures and handling techniques, since a great deal of the deterioration of collections is due to the inadequate handling by staff and users, either by ignorance or neglect.

In order to have a preservation policy it is important for institutions to understand the responsibility for being in charge of the protection of collections, which are an authentic testimony of our history. Thus, there should be a commitment to produce a plan and seek its implementation and compliance.

5. Flexible protective container for photo albums.

La preservación de colecciones documentales en clima tropical

por Belyamyra Mantilla y **Graciela Mascareño,** División de Conservación de Colecciones, Centro Nacional de Preservación Documental, Biblioteca Nacional de Venezuela, Centro Regional IFLA-PAC para América Latina y El Caribe

La política de preservación de colecciones documentales en países de América Latina con clima tropical requiere innumerables esfuerzos a fin de obtener avances orientados a la protección y mantenimiento de las obras. La realidad de la preservación del patrimonio documental en estos casos, entremezcla aspectos relacionados tanto con las condiciones climáticas propiamente dichas, como con aspectos de orden económicos financieros particulares que se presentan en estos países, lo que da como resultado un alto grado de dificultad en el desarrollo de las funciones, tareas y actividades del profesional de la preservación.

El clima tropical trae de manera intrínseca la posibilidad de crecimiento y desarrollo de innumerables microorganismos e insectos, atraídos por unas condiciones ambientales generosas en humedad y temperaturas cálidas y una flora compuesta por una abundante variedad de plantas. En el caso específico de Venezuela, la presencia de un clima húmedo, con niveles constantes de temperaturas elevadas e incidencia de luz solar acentuada, deriva en ambientes propicios para el crecimiento y desarrollo de la actividad biológica, aunado a esto encontramos deficientes condiciones de almacenamiento, tomando en cuenta que las edificaciones, depósitos, mobiliario, iluminación artificial, etc., en ocasiones van en función de los recursos económicos existentes, pero en detrimento de las colecciones.

Esta situación obliga al conservador a pasearse por un amplio abanico de posibilidades de acción en función de las necesidades presentes en las colecciones y los recursos existentes, los cuales en la mayoría de los casos resultan insuficientes para abordar a cabalidad los problemas surgidos.

Las acciones comprenden desde la prevención hasta la atención detallada. En este sentido, el Centro Nacional de Preservación Documental aborda la tarea de preservación de documentos desde diferentes perspectivas, ya que en muchos casos el apego a los estándares internacionales establecidos en cuanto a parámetros ambientales, almacenamiento y manipulación es imposible, si tomamos en cuenta el crecimiento acelerado de las colecciones, las cuales muchas veces son ubicadas en espacios reducidos e inadecuados, donde los sistemas de aire acondicionado presentan deficiencias por obsolescencia, no cuentan con el mantenimiento de la ductería y los filtros y generan elevados costos para su reparación y sustitución, trayendo como consecuencia problemas de acumulación de polvo y agentes contaminantes que se ven favorecidos por el aumento de los niveles de contaminación ambiental externos debido, entre otros factores, al crecimiento del parque automotriz y la cercanía a las industrias. Todos estos factores anteriormente descritos inciden desfavorablemente en el estado de conservación de las colecciones de la Biblioteca Nacional.

¿Qué resulta prioritario en estos climas?

En los inicios del Centro Nacional de Preservación Documental, se abordó la conservación desde la necesidad de capacitación y entrenamiento en almacenamiento, manipulación y tratamiento de obras de manera particular, se logró la instalación de los talleres, el establecimiento de normas, la elaboración de planes de actuación ante siniestros, se analizaron las colecciones a fin de determinar los tipos de soporte y los daños más frecuentes, de esta manera queda establecida la política de resguardo de las colecciones. No obstante, el acelerado crecimiento de las colecciones y el reducido número de especialistas en el área generan limitaciones en el desarrollo de las actividades, lo que obliga a orientar hacia la preservación la atención de las colecciones, a fin de mantenerlas y prevenir futuros daños.

Se asume una política de preservación enfocada en la detección de irregularidades en los depósitos de las colecciones, sin dejar de realizar los tratamientos de conservación a aquellas obras que por su valor e importancia histórica lo requieren.

Se hace hincapié en:
- La medición y control de los parámetros ambientales (temperatura y humedad relativa), con especial énfasis en la obtención de valores que se acerquen a los recomendados, pero sobre todo procurando que exista el menor grado de fluctuación en estos valores;
- La realización de limpiezas periódicas de las colecciones y depósitos, para lo que se crea en el año 2004, la figura de los obreros de conservación, personal entrenado especialmente para la limpieza de las colecciones;
- La generación de un sistema forzado de circulación del aire, mediante el uso de ventiladores y deshumidificadores, lo que en conjunto evita la formación de microclimas favorables a los microorganismos que pueden afectar seriamente los documentos.
- La elaboración de protectores en materiales con calidad de archivo, químicamente estables y desarrollados de acuerdo a la necesidad y dimensiones de cada documento.

Un ejemplo: la Colección Fotográfica del Siglo XIX del Archivo Audiovisual de Venezuela de la Biblioteca Nacional

Un ejemplo que permite pasearnos por un escenario de posibilidades de acción determinadas en función de las necesidades presentes y los recursos existentes, es la Colección Fotográfica del Siglo XIX perteneciente al Archivo Audiovisual de Venezuela de la Biblioteca Nacional.
Las fotografías son estructuras complejas desde el punto de vista físico y químico, ya que son muy diversos los materiales y procesos utilizados en su elaboración. Nuestra colección está

conformada por daguerrotipos, ferrotipos, negativos en placa de vidrio, copias de albúminas, copias de gelatina y colodión, copias en blanco y negro de gelatinas, álbumes, entre otros; de allí la complejidad en la aplicación de la política de preservación, por lo que se hace necesario establecer las medidas para el control de deterioro a través de la atención primordial de los siguientes factores:

- Temperatura.
- Humedad relativa.
- Contaminación atmosférica.
- Luz.
- Mecanismos de prevención contra insectos y microorganismos.
- Duplicación de los originales en otros soportes que garanticen mayor estabilidad de la información.
- Un sistema de organización y catalogación que redunde en mayor acceso a la información y menor manipulación.
- Las revisiones periódicas y detalladas de los depósitos y las colecciones.

Esta colección permanece almacenada en un depósito que cuenta con un sistema de aire acondicionado que presenta una serie de deficiencias relacionadas con las descritas anteriormente, por lo que el mayor reto enfrentado han sido las fluctuaciones en los niveles de temperatura y humedad relativa que favorecen los cambios químicos y mecánicos en los ejemplares, produciendo alteraciones y deterioro en su estructura, sufriendo transformaciones en los soportes, expansión, contracción y reblandecimiento de la emulsión.

Para suavizar el impacto de estos factores, se procura mantener el ambiente con temperaturas entre 18ºC y 20ºC, valores que no han resultado tan difíciles de alcanzar y mantener durante la mayor cantidad de tiempo.

Para enfrentar la tendencia a la elevación de los porcentajes de humedad relativa que favorece la condensación del vapor de agua, nos hemos apoyado en la medición permanente de parámetros ambientales, la utilización de los deshumidificadores, la colocación de la colección en estanterías metálicas abiertas, ubicadas en la zona central del depósito, de manera de favorecer la circulación natural del aire, evitando la formación de bolsas de aire húmedo; así como, el almacenamiento de las obras en diferentes protectores y contenedores.

Para minimizar el impacto de las radiaciones lumínicas, se procura que en los depósitos los niveles de luz no excedan los 100 lux, además de que el almacenamiento permanente de las obras dentro de las cajas o contenedores evita su exposición a los rayos y las protege del polvo.

Como medida de preservación, orientada a evitar la excesiva manipulación de los originales, se decide realizar tres copias de cada ejemplar e incluir en el catálogo una copia de menor tamaño, que permite al usuario, una vez que accede al fichero, visualizar la imagen y seleccionar lo que es de su verdadero interés. Adicionalmente, se digitalizan las imágenes con la finalidad de crear un catálogo digital.

Para sustituir los envoltorios de acetato en los que permanecían almacenados los negativos, los cuales presentaban signos de deterioro, se diseñaron fundas de papel con alto contenido de celulosa, de pH neutro, libres de lignina, de reserva alcalina y de partículas metálicas.

Para las fotografías se diseñaron fundas individuales elaboradas con película de poliéster (tereftalato de polietileno). La selección de este material se basó en primer lugar en su estabilidad química, ya que de acuerdo a estudios realizados presenta pocos signos de degradación con el tiempo; garantiza la estabilidad de los ejemplares cada vez que son consultados, pues minimiza el impacto que crea la constante manipulación, evitando el rastro de huellas, además ofrece resistencia mecánica y provee a cada ejemplar de un soporte físico y al mismo tiempo, al tener un alto nivel de transparencia, permite visualizar la imagen, sin necesidad de que la obra sea retirada del protector. Estos protectores pueden ser realizados bien sea con dos láminas de poliéster o con una lámina de poliéster en el anverso y una cartulina de pH neutro en el reverso, lo cual constituye un soporte adicional para ejemplares muy delicados.

Otra medida que se ha aplicado paulatinamente, es el montaje de las obras en paspartú, elaborados con cartón químicamente estable, 100% trapo y de pH neutro.
Se elaboraron estuches rígidos para las placas de vidrio y en el caso de los daguerrotipos se realizó una revisión de su estructura para constatar que se encontraban debidamente sellados, ya que el signo más común de su deterioro es la sulfuración de la plata debido a la acción corrosiva de agentes contaminantes, tales como el ácido sulfídrico y el dióxido de azufre, produce degeneración, lo que puede ocasionar su completa desaparición, por ende la imagen no debe estar sometida a contacto físico alguno y la manera correcta de resguardarla es mantenerla sellada y protegida con un vidrio.

Para el resguardo de los ferrotipos se diseñaron contenedores con una base rígida de cartón neutro que funciona como soporte y entre el original y el vidrio un espaciador para evitar roces.
En el caso específico de los álbumes se aplican diferentes acciones dependiendo de los daños que presentan, haciendo uso de cajas de cartón con calidad de archivo para su almacenamiento; intercalando hojas de papel neutro que funcionan como barrera ante agentes agresores externos y en aquellos casos en que los segundos soportes representan un riesgo para la fotografía, se toma la decisión de sustituir la estructura y elaborar una nueva con materiales con calidad de archivo.
La confección y utilización de contenedores deben establecerse como una actividad esencial, debido a que estos funcionan como un medio protector ante los agentes de deterioro externos, de allí que previamente se debe analizar la naturaleza de cada obra para decidir el tipo de protector que se va a elaborar, su funcionalidad y los materiales a utilizar.
Otro aspecto esencial es la formación y entrenamiento del personal en procedimientos y técnicas de manipulación, ya que gran parte del deterioro de las colecciones obedecen a la incorrecta manipulación por parte del personal y los usuarios, bien sea por desconocimiento o descuido.
Para que exista una política de preservación es indispensable que las instituciones entiendan la responsabilidad que representa asumir el resguardo de las colecciones, las cuales son testimonios fehacientes de nuestra historia, por lo tanto debe existir el compromiso de generar un plan y velar por la implementación y el respeto de éste.

The Difficulty for Conserving Cultural Heritage in Tropical Countries: the Experience of Rio de Janeiro City

by Antonio Gonçalves da Silva, Conservation Scientist, National Archives of Brazil

Abstract

The cultural assets of a country are the heritage left by the ancients which can testify to the population way of living and have to be conserved for this reason. Nevertheless, their conservation in tropical countries is more difficult due to the inadequate environmental conditions favouring their deterioration, because of the temperature, relative humidity and high level of pollution. This article aims at describing the present difficulties in these countries relying on the case study of Brazil, in general, and of Rio de Janeiro, particularly.

Introduction

Firstly, we are going to describe the tropical region in the world, its climatic diversity and influence on the cultural heritage conservation. Then, after reminding the recommended environmental conditions for the cultural heritage conservation, we are going to deal with the difficulties of countries with tropical climate, showing as an example the actions developed in the city of Rio de Janeiro to conserve its cultural heritage and train professionals.

Climatic Characteristics of Tropical Regions

Tropical area is situated between the Tropic of Capricorn in the southern hemisphere and the Tropic of Cancer in the northern hemisphere. Because of this immense territorial extension, the tropical region occupies various continents such as the Central and Southern America, Africa, Asia, and Oceania, and offers a great climatic diversity.

The climate can be tropical equatorial with characteristics of constant rains with high temperature and humidity. Or dry tropical, characterized at least by a single dry season in the year. This is the most characterized climate in Rio de Janeiro city, having a rainy summer and a dry climate on winter.

The tropical monsoon climate presents in this period of the year copious amount of rain. This occurs mainly in the eastern region of the African continent and in the southern region of India. The tropical climate of altitude has similar temperature to the subtropical one. In Brazil, this climate is common in the southern region and in the mountains in the south-eastern region which is composed of the States of São Paulo, Rio de Janeiro and Minas Gerais.

The climatic conditions of the tropical regions are characterized by high temperature and humidity, with an average annual temperature superior to 25°C and relative humidity superior to 65%. Therefore, some regions have constant rains which put the relative humidity values close to hundred percent, transforming the conditions of conservation of the cultural heritage into a critical problem.

In the environmental conditions of the tropical regions, the cultural heritage, mainly those which are composed of organic material, for instance, synthetic resins, those leathers, and the others derived from lignocelluloses, such as papers and woods, deteriorate easily due to the chemical reactions, mainly the hydrolyses in which water is the environmental element which acts in favour. Similar reaction of degradation also occurs with some metallic inks, formed with the component of iron, due to the instability of the metal containing iron in places with high humidity.

The conservation of cultural heritage in such places with inadequate conditions could be obtain throughout a high financial investment to purchase equipment that controls temperature and relative humidity and hire specialized technicians to manage the adequate conditions for conservation. But, for many tropical countries, the lack of investment is a serious problem.

Rio de Janeiro city presents an annually average temperature of more than 30ºC and a relative humidity of more than 65, which are not ideal for the cultural heritage conservation.

Although the institutions in Rio de Janeiro are worried about the conservation of their collection, most of them don't receive from their leaders enough financial support to adequate their environmental parameters to the ideal conditions of conservation, as described in the following paragraph.

The Ideal Conditions for the Cultural Heritage Conservation

Various technical publications, such as *The Museum Environment*, by Garry Thomson, and *Climate in Museums*, by Gael de Guichen, describe that the ideal environmental conditions for the conservation of the cultural heritage are a temperature of 20 ± 2 °C and a relative humidity of 50 ± 5%. The inadequate environmental conditions are the main causes of the cultural heritage deterioration. The temperature and relative humidity values in tropical countries are generally superior to these ideal indices established for the conservation, which are nearest to values recorded in the regions with moderate climates. The compliance with these standards would oblige the countries localized in the tropical regions to resort to high financial resources to invest in the area of electric energy for maintaining the conservation of their cultural heritage.

In Brazil, the architect Franciza Toledo worked at the Instituto do Patrimonio Artistico Nacional (the Institute of the National Artistic Heritage) for the region of Pernambuco State. She worked in Cuba, where she acquired knowledge on the preservation of the cultural heritage in tropical climate countries. She applied it in the conservation of many materials and documents for museum without using any equipment of refrigeration.

Claudia S. Rodrigues de Carvalho is doctor in architecture, with an environment comfort specialization. She has studied in Brazil and worked at the Casa de Rui Barbosa Foundation (FCRB), the organ of the Ministry of Science and Technology. She developed equipments so that the materials of this House, which shelters the museum, could have the adequate environmental conditions for its conservation without the use of the electric system. This equipment supplies adequate conditions of conservation for the materials throughout the use of ventilation.

The following part presents the various attempts of Brazil to create an institute maintaining the conservation of the cultural heritage of the country.

Creation of the Institute of the National Cultural Heritage in Brazil

Silva (2007) has described that the concerns of the leaders of the country with the preservation of its cultural heritage dated from the middle of the 17th century. Don André de Mello Castro, the vice king of the State of Brazil in 1735 -1749, was the first to be worried about the preservation in Brazil. This preoccupation has been integrated into the country legislation since 1930. In 1934, was created the Inspection for the National Monument (IPM) replaced in 1937 by the Secretariat of the National Artistic Heritage (SPHAN) in charge of protecting and conserving the Brazilian cultural heritage. Lately, in 1970, this organ received its current denomination of Institute of the National Historical and Artistic Heritage (IPHAN).

Brazil, because of its huge territorial extension, has many difficulties to conserve its cultural heritage. In 1994, the Ministry of Cultural Heritage of Brazil and the International Bank of Development (BID) launched a program of preservation of the Brazilian cultural heritage. The program 'Monumenta' came up from this initiative with the financing of BID and the support of UNESCO. At the present moment, about 26 Brazilian cities from different regions of the country are participating to the program. It permitted for instance to restore the historical city of Olinda, in the State of Pernambuco, and Lençois in the States of Bahia.

Regarding the preservation of archives, the concern with the conservation of paper based collections began in 1984 with the creation of a national program of preservation of the historical documents called 'Pro-Documento'. The 1991 law integrated the preservation of the documents into the 1988 constitution and described that "it is the duty of the public authorities to manage and protect the documents of archives, as an instrument supporting the administration and the cultural heritage".

Brazil is the country which has continental dimensions, having also a lot of cultural heritage to be preserved. Although the country has a specific legislation describing this necessity and at the present moment an increasing economy, there's no sufficient financial resources for protecting all the cultural heritage of the country. In some regions, there aren't enough specialized professionals to deal with the cultural heritage conservation, according to the following description of the professionals training.

Training in Conservation and Restoration of Cultural Heritage Assets in Brazil

The training of professionals in the area of conservation and restoration started in the year 1980 when the city of Ouro Preto was registered by UNESCO as World Heritage Site. Before that, persons that had interests in working in this area graduated in other knowledge area and then realized technical internship or post-graduation courses in Europe or North America.
The importance of the city's architecture has been recognized since 1933 when this city was listed as National Monument. And when UNESCO conferred the title of World Heritage to the city, one realized that to keep this title, it was important to preserve its architectural constructions. Nevertheless, there was not enough qualified professional on site to perform the task of the architectural restoration.
The first course to train curators-restorers was offered by the Arts Foundation of Ouro Preto (FAOP) in 1968. This course integrated in its structure the school of arte of Rodrigo Melo Franco de Andrade. Soon, it became an outstanding course in training professionals in the area of conservation and restoration of cultural heritage.
The second course in the area of conservation in Brazil was provided by the Centre of Conservation and Restoration of Movable Cultural Assets (CECOR), a complementary unit of the School of fine arts of the Federal University of the Minas Gerais (UFMG). This unit was created by a convention with the Secretary of Planning of the President of the Republic (SEPLAN). The objective of this course was to provide specialization in the area of restoration and conservation of painting, special easels paintings made of polychrome wood and art works on paper.
In 1980, a group of pioneer curators created the Brazilian Association of Restorers-Curators of Cultural Heritage (ABRACOR). ABRACOR, still existing, is an important institution in Brazil in the area of conservation since it is in charge of the dissemination of information in this field. Furthermore, it organizes courses and an international congress every two years.
The concern that led the professionals of conservation and restoration of cultural heritage to create ABRACOR in the 80´s lasted for the decade and until today. This was due to the necessity to have proper recognition of this profession. Yet, this recognition did not come immediately and is still asked by this professional group. We expect this fight is in its final phase, since the act to recognize the professionals of conservation and restoration is being processed in the Brazilian Congress.
There are other professional associations in the area of conversation and restoration in Brazil, such as the Brazilian Association of Bookbinding and Restoration (ABER). The states in the south of Brazil, such as São Paulo, Paraná, Santa Catarina and Rio Grande do Sul have their own professional association too.
The courses in conservation created in the 70´s by FAOP and in the 80´s by CECOR train technical staff and post-graduates.

The course in the undergraduate level started in the second half of the year 2000 when a private university, University Estacio de Sa, located in the city of Rio de Janeiro, initiated the first undergraduate course in the technology of conservation and restoration of cultural heritage assets.
In the following years, various federal universities launched equivalent courses: the Federal University of Minas Gerais-UFMG in the state of Minas Gerais, then the Federal University of Pelotas-FPEL, in the state of Rio Grande do Sul, and finally, the Federal University of Rio de Janeiro-UFRJ, in the city of Rio de Janeiro in 2005. Before that, various private institutes initiated postgraduation courses in conservation of cultural heritage.
The concentration of the training courses in conservation in the south and south-west region of the country led to a lack of specialized professionals in the north, north-east and centre-west. Consequently, a lot of institutions which are in charge of the preservation of cultural heritage in these regions still lack qualified professionals to take care and ensure the collections are stored in appropriate conditions.

Policy of Conservation of Archival Documents in the City of Rio de Janeiro in the past 40 years

The conservation of paper-based materials in the city of Rio can be divided into three distinct periods, the first one covering the decades of 1970 and 1980. In this period, the materials used in conservation and restoration of the archives were inadequate since they were adapted from the existing national products.
In this period, few procedures and products used in Europe or North America were known. Few imported products reached Rio and were very expensive, which restricted their use in the conservation of cultural heritage documents.
In this period, the principal paper used in Brazil for archives lamination to strengthen the deteriorated paper was the paper Mimo of 25 g/m2, manufactured by the Industrial Company of papers Piray. This paper was manufactured to be used as carbon paper, as paper for copying or typing machines and for casing the filters of cigarettes.
This type of paper was used up to the mid 90´s in foliates of manuscripts with iron gall ink that presented advanced degree of degradation, in attempts to reduce the loss of information of these documents. The same type of paper was employed in the lamination of acid paper that was embrittled.
Regarding the conditioning of the archival documents, alkaline paper was still not available. This explained why these archives were conditioned with acid papers. The alkaline paper only arrived around the beginning of 2000.
In 1970, the institutions of Rio de Janeiro that preserve the archives, such as the Arquivo Nacional do Brazil, FCRB, received the visit of the European curator Françoise Friedler. From this period onwards, the conservation procedures used in the city was modified due to the transmission of the techniques used in Europe, such as the use of Japanese paper and adhesives derived from cellulose (for example, methyl-cellulose) in the documents lamination. Furthermore, there were advances in the clearing and deacidification of papers.
In the 90´s, the National archives of Brazil, located in Rio de Janeiro, received the visit of Helmut Banza, director of Bundesarchiv of Germany. Again, some new procedures of document restoration were transmitted. Particularly, we were studying the technology of dying cellulose fibers to be used in the reconstitution of the missing area in the documents.

Dr. Helmut observed that we were already very advanced and sooner or later, we would find this methodology ourselves. From this visit, we have developed and used the technology in reconstitution of missing areas of archival documents, substituting the fillings from manual grafting by mechanical reintegration. This resulted in more agility in the operations of conservation and increased the amount of archives conserved. In addition, theses techniques solved the problem of having to obtain tons of microfilms of documents.

Policy of Preventive Conservation in the Archival Institutions and Libraries in the City of Rio de Janeiro

From the end of the 90´s, the world policy in massive restoration developed in various countries was replaced by the policy of preventive conservation, launched by the curators of United States of America. The advantage of this methodology relies on the prevention of deterioration of the entire collection. This gives greater visible results than the restoration of isolated items.
The great problem in implementing preventive conservation in countries with tropical climates consists in the lack of methods to handle the deteriorated documents. The handling described in this methodology concerned paper based materials stored in locations where the environmental conditions are appropriate. Furthermore, the policy of preventive conservation does not foresee restoring items that are in advanced state of deterioration.
In particular, in Brazil, the archival documents of various institutions located near the equatorial region are in an advanced state of deterioration. Principally, the states of the region North and North-East experience this problem and unfortunately, as we described it previously, lack curators with experience.
These states have high temperature and relative humidity. Their archives also keep a lot of documents that are constituted mainly of manuscripts from XVIII and XIX centuries, written with iron gall ink.
About three years ago, a study group in preventive conservation was formed by Dr Milagros Vaillante, in the city of Rio de Janeiro, under the name of "Carioca Project". The objective of this project is to study conditions to reduce bio-deterioration of documents in the city of Rio. Professionals that made up this group are from: Arquivo nacional do Brasil; Museu de Astronomia e Ciências Afins- MAST; Arquivo Público do estado do Rio de Janeiro- APERJ; Arquivo Histórico do Exército Brasileiro; Fundação Casa de Rui Barbosa-FCRB; Fundação Bilioteca Nacional do Brasil; Fundação do Instituto Oswaldo Cruz-FIOCRUZ; Centro de Conservação e Preservação de Fotografia e Centro de Documentação da Fundação Nacional de Artes-FUNART.
Last year, another study group was set up gathering curators of the National Archives of Brazil and of Netherlands to examine models of containers for conditioning document archives in tropical countries.

Conclusions

The tropical region includes areas from different continents, so this climate is experienced in many different countries. Their climatic conditions are beyond the standards recommended for the conservation of the cultural heritage assets.

Brazil took almost a century to establish organizations in charge of the cultural heritage conservation. Initially, only architectural constructions were considered as cultural heritage that needed to be conserved. Later on, this concern was extended to all the other cultural heritage assets.

Before the implementation of undergraduate courses in conservation in the universities of Brazil, curators were graduated in other knowledge areas and then trained in educational institutes or made internships in Europe or North America. Now, various undergraduate and post graduate courses in the conservation of cultural heritage assets exist in Brazil. However, these courses are found only in the central-south of the country, whereas the northern region still lacks specialized professionals.

Since 1980, the conservation of cultural heritage documents in the city of Rio de Janeiro has gone through great methodological advances. Currently, preventive conservation to reduce the velocity of the deterioration reactions is the technique most practiced by the institutions that preserve cultural heritage in this city. Important conservation works are in progress.

Acknowledgements

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References

Centro de Conservação e Restauração de Bens Culturais Móveis
http://www.eba.ufmg.br/cecor/ (Access 06/11/2011)

Preservar o patrimônio da cidade é preciso
http://revistaescola.abril.com.br/geografia/pratica-pedagogica/preservar-preciso-426704.shtml (Access 06/11/2011)

Carvalho, Claudia S.R. *O espaço como elemento de preservação dos acervos com suporte em papel.* Fundação Casa de Rui Barbosa.
http://www.casaruibarbosa.gov.br/dados/DOC/artigos/a-j/FCRB_ClaudiaCarvalho_OEspaco_como_elemento_representacao_dosacervos_com_suporte_em_papel.pdf (Access 07/06/2011)

Alarcão, Catarina. *To Prevent in order to preserve the museum heritage*. http://mnmachadodecastro.imc-ip.pt/Data/Documents/Prevenir%20para%20preservar%20o%20patrimonio%20museol%C3%B3gico.pdf

Fundação Getúlio Vargas. Diretrizes do Estado Novo (1937-1945). Serviço do Patrimônio Histórico e Artístico Nacional.
http://cpdoc.fgv.br/producao/dossies/AEraVargas1/anos37-45/EducacaoCulturaPropaganda/SPHAN
(Access 08/06/2011)

Ministério da Cultura. Programa Monsumenta: http://www.monumenta.gov.br/site/?page_id=164>
(Access 08/06/2011)

American Institute for Conservation of Historic and Artistic Works. *Rethinking the Museum Climate*.
http://blog.conservation-us.org/blogpost.cfm?threadid=2227&catid=175
(Access 08/06/2011)

University of Oslo. *KONS2061 - Understanding the indoor climate in museums, galleries and archives.*
http://www.uio.no/studier/emner/hf/iakh/KONS2061/index.xml,
(Access 08/06/2011)

Peralta, L. R.S. 2005. *O SPHAN e o início da presdervação de documentos arquivísticos no Brasil. monografia de curso de graduação*. Rio de Janeiro: Universidade Gama Filho. 63p.

Silva, A.W.A. 2007. *O Pró-Documento e a casa de Oswaldo Cruz. Monografia de curso de graduação*. Rio de Janeiro: Universidade Gama Filho. 83p.

Zuñiga, S.S.G. 2005. *Documentos como objetos de políticas públicas em Preservação e acesso a Informação: o caso das bibliotecas e arquivos*. Rio de Janeiro: Universidade Federal do Rio de Janeiro. 267p.

Hollós, A. L.C. *Entre o passado e o futuro Limites e Possibilidades da Preservação Documental no Arquivo Nacional do Brasil*. Thesis. 105p.

Publication News

Paper and Water: A Guide for Conservators, by Gerhard Banik, National Academy of Fine Arts, Stuttgart, and Irene Bruckle, National Museums in Berlin, Germany, Butterworth-Heinemann Ltd, 2011

This is the first compendium for conservation professionals involved in the preservation of paper artifacts in archives, libraries and fine art museums around the world. The global team of expert authors explain the principal interactions between paper and water, a topic of primary importance for every conservator working with paper artifacts and other cellulose-based materials. Water is present when paper is made. It contributes to its deterioration and serves many essential functions when deteriorated paper is treated by conservators. The work integrates knowledge from the different disciplines of paper engineering, conservation science and conservation practice, and will serve as a textbook in a rapidly expanding profession that has virtually no customized education literature.

Taking its inspiration from undergraduate and graduate science education textbooks, and tested widely through use in workshops with students and specialist professionals in both Europe and USA, this book is highly illustrated to make learning an efficient and pleasurable experience. Visual material exclusively produced for this publication includes video animations, laboratory videos, and key references which appear on an accompanying DVD.

ISBN 10: 0-7506-6831-8
ISBN-13: 978-0750668316

Retirement of Sjoerd Koopman

Our friend, Sjoerd Koopman, is retiring from IFLA. Sjoerd always supported our activity and often helped PAC with good advices and suggestions. He was also strongly involved in Blue Shield activities. Have a lot of good time, Sjoerd! We shall miss you.
Tu seras toujours le bienvenu à Paris!

Events

Announcements

Lasers in the Conservation of Artworks (LACONA) Conference, British Museum and University College London, 7-10 September 2011, London, UK

The ninth conference on Lasers in the Conservation of Artworks (LACONA) will be held in London from 7–10 September 2011. The meeting is being organised by the Department of Conservation and Scientific Research at the British Museum in collaboration with the Centre for Sustainable Heritage at University College London. The 2011 conference will focus not only on the scientific research behind the use of laser technology but also on the application of lasers to the treatment and analysis of cultural heritage in a way that is directly applicable to conservation practice.

The main conference venues will be the British Museum and University College London. The conference language will be English.

A number of major themes will be explored by the conference:

- The uses of laser technologies in conservation treatments for cultural heritage: cleaning; consolidation; materials testing; innovations; case studies; treatment evaluation; health and safety aspects of laser use; new technologies and applications
- Laser-based methods for imaging, 3D documentation and modelling: surveying; measuring; documentation and examination of objects and structures; LIDAR; 3D laser scanning; holography; tomography; interferometry; shearometry; vibrometry; new instrumental and technological developments
- Laser-based techniques for analysis, diagnostics and monitoring: Raman spectroscopy; LA-MS; LIBS; laser-induced fluorescence spectroscopy and fluorescence lifetime imaging; terahertz spectroscopy; new spectroscopic and imaging techniques

More information about registration and programme at: http://www.lacona9.org/

CCI Symposium: "Adhesives and Consolidants for Conservation: Research and Applications", 17-22 October 2011, Ottawa, Canada

Symposium 2011 is being hosted by the Canadian Conservation Institute in partnership with Library and Archives Canada. Adhesives and consolidants are important components of almost every conservation treatment. Symposium 2011 will bring together conservators and scientists from around the world to share their practical and theoretical knowledge about the use of adhesives and consolidants in all areas of conservation. The program will include a mix of lectures, posters, tours, and demonstrations, along with stimulating discussions.

Preliminary programme and registration form are available at:
http://www.cci-icc.gc.ca/symposium/2011/index-eng.aspx

Fees (Canadian dollars):
Early bird (*before Aug. 1, 2011*): $450.00
Regular (*Aug. 1 to Sept. 30, 2011*): $500.00

Contact:
Jane Down
Canadian Conservation Institute
1030 Innes Road, Ottawa, Ontario
K1A 0M5
CANADA
tel: 613-998-3721 or 1-866-998-3721
(toll-free in Canada)
fax: 613-998-4721
e-mail: jane.down@pch.gc.ca

International Conference: "A Pest Odyssey 2011: Ten Years Later", 26-28 October 2011, British Museum, London, UK

"A Pest Odyssey 2011: Ten Years Later" is a follow up to the highly successful conference of the same name held in 2001. The event is being hosted by the British Museum and organised by Icon's Care of Collections Group in partnership with the British Museum and a wide range of other institutions, including English Heritage, The British Museum, the Natural History Museum, Historic Royal Palaces, The V & A, the Museum of London, the Horniman Museum and The Tate.

This new conference will:

- Look at how Integrated Pest Management (IPM) has developed over the past ten years to deal with the increasing threat pest attacks poses to collections and buildings;
- Share new understandings about pest species and the risks they pose;
- Be a platform for showing how successful training programmes have raised the profile of IPM both within the heritage sector and beyond;
- Present cases studies covering a variety of practical control strategies and how these can work in both the traditional museum setting and the wider heritage context;
- Formulate a set of guidelines and priorities for future work and research to make IPM even more effective;
- Enable people to share and discuss their problems and successes.

Speakers are coming from far and wide including Japan, Australia, USA, Europe and include David Pinniger and Tom Strang.
There will be posters galore and the conference proceedings will be published in December in hard copy and as a CD.
Delegates will also be given the opportunity to attend evening events at the prestigious London venues of both Kensington Palace State Apartments and the Natural History Museum.

Registration:
The programme and booking form are available on the conference website.
http://www.pestodyssey.org/
Fees: £270

For other information about the conference, please contact: kerren.harris@hrp.org.uk

Report

Training on Preservation and Restoration of Books and Graphical Documents in Central Asia, June 2011, National Library, Almaty, Kazakhstan

By Thierry Aubry, Expert in Restoration, Department of Conservation, National Library of France

Alma Ata, "the mother of apples[1]" and today known as Almaty, is the former capital[2] of Kazakhstan. Dominated by the snowy summits of Pamir, the city slopes gently downward. We can find our bearings this way: we are either uptown, or downtown. Its orthonormal plan, reminiscent of New York, also facilitates orientation; we always meet at the intersection of two streets. So, the National Library is situated "uptown" on Abaï at the intersection of Abai Street and Abylaikhan Avenue. This is where an introductory course in the preservation and restoration of graphic documents took place over three weeks in June 2011.

The training was intended on one hand for representatives of Kazakhstan's regional libraries coming from 13 of the 14 regions of Kazakhstan, and on the other hand for the members of the National Library. Members of the National Museum, the National Archives and the State University also joined these groups. The participants, to whom I pay tribute here for their enormous motivation, were largely female (with only one student, myself and Atrau Tashutov, our interpreter, representing the male contention). Assengue, for example, travelled more than 3000 km to assist with the seminar, a voyage of not less than 72 hours by train, without air-conditioning of course, and summers are warm in Kazakhstan! But Uzim or Alfiya who live near the Caspian Sea did not travel much less. These endless journeys through the Kazakh steppe are reminiscent of Aitmanof's novel, *The Day That Lasted Longer Than a Century*, the action of which takes place mainly in a rail station isolated in the middle of the Kazakh steppe!
All came from afar, but how could it be otherwise in Kazakhstan whose surface area is four times that of France?

Preservation and restoration are not taught in Kazakhstan and it was the first time that such a training course was held in Almaty. The goal was thus to introduce the foundations of preservation and restoration, in practical as well as theoretical terms. It could indeed serve only as an initiation, because while several chemists work in the National Library, and a recently established restoration workshop there contains five persons[3], many of the regional libraries' representatives often occupying positions not directly linked with preservation had never practised restoration, nor implemented a conservation policy. By the way many books in collection look in very poor condition and it seemed that the diagnostic problems of the very damaged works brought by the trainees are the consequences, above all, of readers' carelessness and poor manipulation on behalf of the library staff as well as the absence of adequate packaging and storage. It was impossible to circulate throughout the whole of this immense country to report on storage conditions (without doubt inferior to the latest western constructions, but certainly as good or varied as in most of the older ones). In any case, the conditions of the BNK seemed suitable: collections are situated in spacious and airy warehouses where temperature differences are insignificant. At the conclusion of this overview, and if plans for deacidification, or building improvements are relevant, it seems that the resolution of problems which could be made only through significant investments, should "take a back seat…". Numerous measures can be implemented on a limited budget.

We thus discussed quite a bit and insisted on the necessity of integrating curative preservation into the context of an overall policy of preservation including all staff and readers. We also insisted on the importance of implementing preliminary evaluations for the various interventions, such as preventive preservation, curative preservation, as well as restoration. The training also had practical aims because these very damaged books are not currently limited in their circulation nor preserved through their transfer to alternative formats, such as digitalization, and only the option to put them back in circulation lies in their curative preservation.

It was thus necessary within the three weeks to respond to the expectations of everyone. That is to say to tackle head-on the conservation treatments for papers from the Arab-Islamic world and those of 19th century case bindings; to make Arab headbands and bindings with flaps, but also to evoke the processes of fabrication and alteration of papers, leathers, iron gall and carbon based ink and envisage the adapted curative preservation treatments for all of the above. It was also necessary to make simple, inexpensive and effective packaging. All of this in the context already mentioned of the absence of initial training, the intensive use of collections, and very restricted means. These last two characteristics are of course among those that stand out most to a western conservator, used to a luxury of means and a high level of ethical and technical standards. So the question of how to practise our profession in these conditions represented one of the most interesting aspects of this seminar.

The lack of equipment and supplies was of course a constant concern throughout the

training and the subject of frequent discussions to devise substitutes for the most costly items. But even this variable does not constitute a major hindrance in the implementation of treatments for curative preservation. Thus the absence during the first half of the training of supplies ordered from Germany (starches, Japanese papers, etc.) led finally to an immersion in the everyday life of the Kazakh conservator and which required of me, a certain adaptability.

We thus made our adhesive with wheat flour and used a lot of filter paper[4], in unlimited supply. However, it seemed surprising to us that it is difficult to procure wheat starch in Kazakhstan. It is indeed a product whose applications are numerous and de facto, although we did not use it to make sausages, which apparently baffled the retailer, the starch reached us rather quickly at a completely reasonable cost for the Kazakh National Library. Thus an important problem was resolved. Nevertheless, it must be said that the adhesive made of flour, correctly cooked, sifted and diluted served as a satisfactory adhesive, even without removing its gluten (a tedious operation to carry out). The resulting collages were flexible, discreet and had a low content of adhesive. Food gelatine being available everywhere, we had two adhesives accessible with which a large range of treatments is possible.

Japanese papers are expensive and difficult to ship (problems with customs, orders, languages, etc.). And while it is difficult to do without them completely, their variety and their quantity can be seriously reduced. The already mentioned filter paper, of a weight of about 50g/m2, made of bleached chemical wood pulp, served a number of uses: in the place of or in addition to vegetable tanned leather (equally expensive and difficult to find), to practise filling in gaps in places not mechanically stressed. It also served for filling in gaps in cardboard or paper. To this end, we sometimes colored it with acrylic paints, glued it with gelatine (in 1 % dilution), and pressed it. So transformed, this paper was very suitable for the preparation of endleaves or in-filling of Arab-Islamic papers.
For linings on taut frames and for repairs of paper tears we used the Japanese papers of low weigh that we had but lacking these, or in complement, it is certainly possible to get some tea bag paper made of hemp or eucalyptus at little cost, although we were not able to confirm it. Used with adhesives like wheat starch, well prepared and diluted, this paper can provide a good lining or repair treatment at a very low cost.
The filling of gaps in paper with the aid of paper-pulp with hemp, hoax and cotton fibres avoids the problems of cost and supply. It's also easy to implement with a little practise with very satisfactory results, even without a suction table[5], as we verified.

We cannot list here all the techniques seen during these three weeks, which were not, however, able to address all the requests of training participants, and I'm sorry about that; their huge interest was often matched by my ubiquitous lack of ability to answer all the questions, often simultaneous, of each of them, from fifteen to thirty during one week! Five more trainers would not have been in excess! The training nevertheless took place in a very pleasant atmosphere, and despite of the high temperatures, concentration and desire to learn remained rigorous, except during the tea break, of course accompanied daily by new pastries and these inenarrable Kazakh candies. This was possible thanks to the precious assistance of the staff of the National Library, the conservation workshop and the laboratory. We also thank the whole administration of the BN of Kazakhstan, and in particular Mrs. Balabekova, the General Director, as well as Mrs. Shaimardanova, Deputy Director and local representative of the IFLA-PAC, the mastermind behind the implementation of this seminar. It is also a pleasure to thank Mrs. Baryla, Director of the IFLA-PAC at the origin of this training and finally of course, UNESCO and its local representative in Almaty, Mr. Karpov for its financing.

It should be emphasized that if such a seminar is an important step in staff training for libraries, archives, or museums, it is at least as important to envisage an assessment of this experience in a near future, which should provide the opportunity for further training. Furthermore, despite the lack of implementation at the national level of such preservation training, we encourage Kazakh institutions to finance the training of several local conservators at a high level, so that they can transmit their skills throughout Kazakhstan.
Personally, in conclusion of this professional experience, I have to emphasize the fruitful character, which this adventure presented. Besides the magnificent horse[6], the symbol of freedom in Kazakhstan, and the magnificent traditional tunic I was offered, it seemed to me, that my greatest satisfaction was that the approach of preservation-restoration we recommend, as well as the methods of treatment and the materials which we used (apart from few exceptions that one can replace) are perfectly transposable in situations that we could consider to be difficult. It was truly delightful to witness that preservation and restoration are not necessarily the privilege of the western world but are rather the fruits of societies' decisions.

1. Just before the first snow grows there a unique variety of apple as big as melon.
2. The new capital, Astana is located more in the middle of the country. Its translation is very simple: "Capital".
3. Two of them recently followed a ten-day conservation-training course in Moscow.
4. This is a kind of blotting paper but thinner and more resistant.
5. Nevertheless, I'll send to participant plan from a very simple and sheep suction table I made many years ago, I still use.
6. In carved wood.

IFLA-PAC Core Activity

PAC (Preservation and Conservation) is one of the six core activities of IFLA, the International Federation of Library Associations and Institutions. Launched in 1986, PAC has been implemented as a network with a focal point based at the National Library of France in Paris and regional centres located in Almaty, Beijing, Canberra, Cape Town, Caracas, Moscow, Port of Spain, Porto Novo, Rio de Janeiro, Santiago, Seoul, Tokyo and Washington. In the future, new sites may be chosen to complement the activities of existing regional centres.
PAC has one major goal: to ensure that library and archive materials, published and unpublished, in all formats, will be preserved in accessible form for as long as possible according to the following principles:

- preservation is essential to the survival and development of culture and scholarship;
- international cooperation is a key principle;
- each country must accept responsibility for the preservation of its own publications.

ACTIVITIES

- Raising awareness among library professionals, the public and the authorities, of the urgent need to preserve our endangered documentary heritage.
- Publishing and translating preservation literature in order to make it accessible to a larger professional audience around the world.
- Disseminating information through printed and on-line publications.
- Organizing training courses, workshops, seminars, etc.
- Promoting research on best preservation practices.
- Fund raising.

TO JOIN US

To join the PAC network or ask for publications, please contact the centre that covers your geographical area or the focal point at the National Library of France in Paris.
The list and contacts of all the PAC regional centres are available in the back cover.
IFLA - PAC Mailing List: pac-list@infoserv.inist.fr

All the information on the IFLA-PAC activities at:
http://www.ifla.org/en/pac

PAC CORE ACTIVITY

USA and CANADA

LIBRARY OF CONGRESS
101 Independence Avenue, S. E.
Washington, D. C. 20540-4500 USA

Director: Dianne L. van der REYDEN
Tel: + 1 202 707 7423
Fax: + 1 202 707 3434
E-mail: Dvan@LOC.gov
http://marvel.loc.gov
http://www.loc.gov/index.html

PAC INTERNATIONAL FOCAL POINT AND REGIONAL CENTRE FOR WESTERN EUROPE, NORTH AFRICA AND MIDDLE EAST

BIBLIOTHÈQUE NATIONALE DE FRANCE
Quai François-Mauriac
75706 Paris cedex 13 - France

Director: Christiane BARYLA
Tel: + 33 (0) 1 53 79 59 70
Fax: + 33 (0) 1 53 79 59 80
E-mail: christiane.baryla@bnf.fr
http://www.ifla.org/en/pac

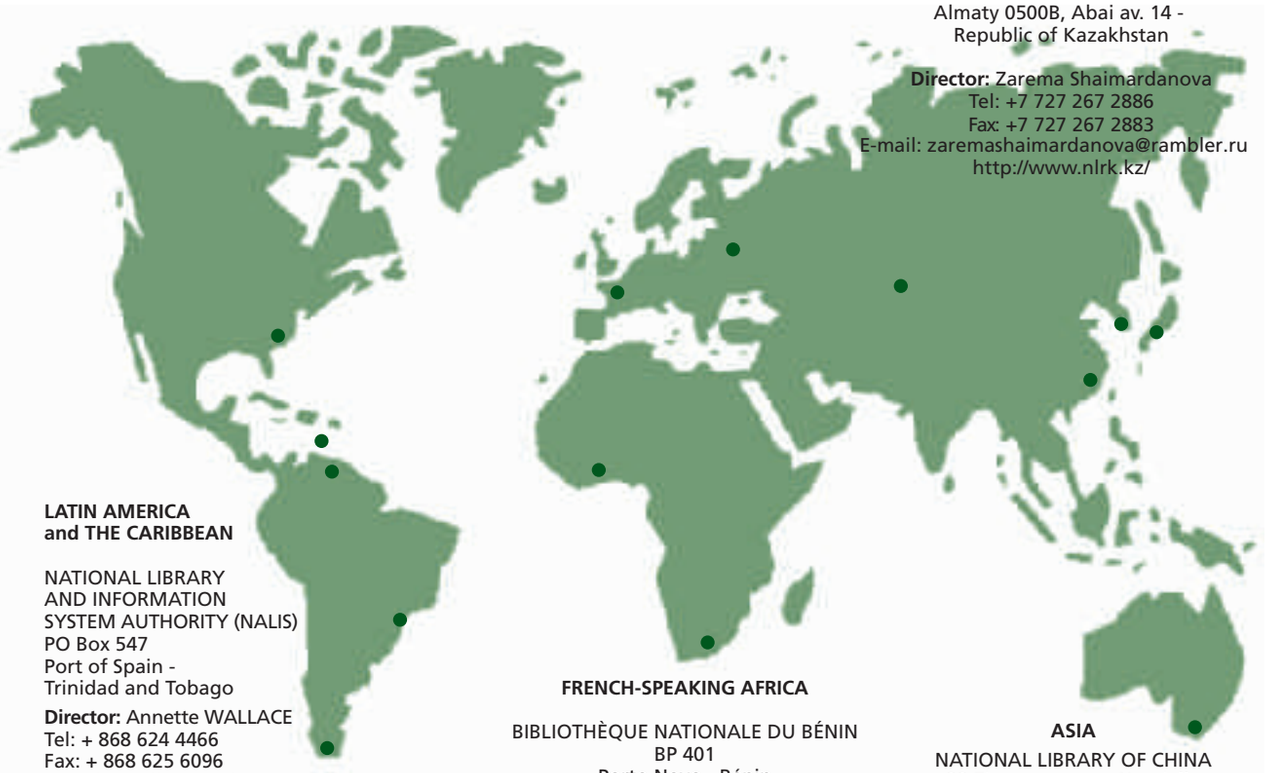
EASTERN EUROPE and THE CIS

LIBRARY FOR FOREIGN LITERATURE
Nikoloyamskaya str. 1
Moscow 109 189 - Russia

Director: Rosa SALNIKOVA
Tel: + 7 495 915 3696
Fax: + 7 495 915 3637
E-mail: rsalnikova@libfl.ru
http://www.libfl.ru/index-eng.shtml

NATIONAL LIBRARY
OF THE REPUBLIC OF KAZAKHSTAN
Almaty 0500B, Abai av. 14 -
Republic of Kazakhstan

Director: Zarema Shaimardanova
Tel: +7 727 267 2886
Fax: +7 727 267 2883
E-mail: zaremashaimardanova@rambler.ru
http://www.nlrk.kz/



LATIN AMERICA and THE CARIBBEAN

NATIONAL LIBRARY
AND INFORMATION
SYSTEM AUTHORITY (NALIS)
PO Box 547
Port of Spain -
Trinidad and Tobago

Director: Annette WALLACE
Tel: + 868 624 4466
Fax: + 868 625 6096
E-mail: awallace@nalis.gov.tt
www.nalis.gov.tt/

BIBLIOTECA NACIONAL
DE VENEZUELA
Apartado Postal 6525
Carmelitas Caracas 1010 - Venezuela

Director: Ramón SIFONTES
Tel: + 58 212 505 90 51
E-mail: ramon87s@hotmail.com
www.bnv.bib.ve/

FUNDAÇAO BIBLIOTECA NACIONAL DE BRASIL
Av. Rio Branco 219/39
20040-0008 Rio de Janeiro - RJ - Brasil

Director: Jayme SPINELLI
Tel: + 55 21 2220 1973
Fax: + 55 21 2544 8596
E-mail: jspinelli@bn.br
www.bn.br

BIBLIOTECA NACIONAL DE CHILE
Av. Libertador Bernardo O'higgins Nº 651
Santiago - Chile

Director: Maria Antonieta PALMA VARAS
Tel: + 56-2 360 52 39
Fax: + 56-2 638 04 61
E-mail: antonieta.palma@bndechile.cl
www.bibliotecanacional.cl/

FRENCH-SPEAKING AFRICA

BIBLIOTHÈQUE NATIONALE DU BÉNIN
BP 401
Porto Novo - Bénin

Director: Francis Marie-José ZOGO
Tel/Fax: + 229 20 22 25 85
E-mail: derosfr@yahoo.fr
www.bj.refer.org/benin_ct

SOUTHERN AFRICA

NATIONAL LIBRARY
OF SOUTH AFRICA
Private Bag X990
Pretoria - South Africa

OCEANIA and SOUTH EAST ASIA

NATIONAL LIBRARY
OF AUSTRALIA
Parkes Place
Canberra Act 2600 - Australia

Director: Pam GATENBY
Tel: + 61 2 6262 1672
Fax: + 61 2 6273 2545
E-mail: pgatenby@nla.gov.au
www.nla.gov.au/

ASIA

NATIONAL LIBRARY OF CHINA
33 Zhongguancun Nandajie
Beijing 100081 - China

Director: Zhang Zhiqing
Fax: + 86 10 6841 9271
E-mail: interco@nlc.gov.cn
http://www.nlc.gov.cn/en/services/iflapac_chinacenter

NATIONAL DIET LIBRARY
10-1, Nagatacho 1-chome,
Chiyoda-ku, Tokyo, 100-8924 - Japan

Director: Noriko NAKAMURA
Tel: + 81 3 3581 2331
Fax: + 81 3 3592 0783
E-mail: pacasia@ndl.go.jp
www.ndl.go.jp/

NATIONAL LIBRARY
OF KOREA
KRILI/Preservation office
Banpo-Ro 664, Seocho-gu
Seoul 137-702 - Korea

Director: Guiwon LEE
Tel: + 82-02-535-4142
E-mail: leegw@mail.nl.go.kr