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SPNHC NEWSLETTER

Society for the Preservation of Natural History Collections

March 2002
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INSIDE...

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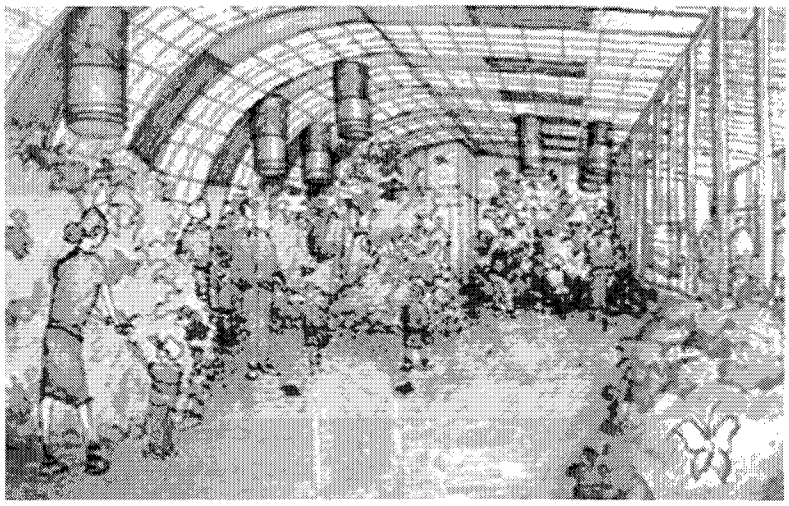
What Do You Know About Butterflies? The Role of Object Conservators in Mounting a Living Butterfly Exhibition.

RACHAEL PERKINS ARENSTEIN, National Museum of the American Indian, 3401Bruckner Boulevard, Bronx, NY 10461. ArensteinR@si.edu



Artist's impression of interior of AMNH butterfly display

In October of 1998, I had the opportunity to bridge the gap between conservator and conservationist when I found myself working on the preparation of a living tropical butterfly exhibition at the American Museum of Natural History in New York. The goal of this paper is to describe the challenges faced in installing the conservatory, which I hope will be useful for those thinking about planning a living exhibit at their institution. The emphasis of this article will not be on the specialized needs of butterflies but on the contributions of some of the people in the project team, focusing on the role of the museum's conservation lab.

In 1997 two institutions, the Milwaukee Public Museum and the Academy of Natural Sciences in Philadelphia, offered AMNH the opportunity to host their exhibitions of living butterflies. After assessing the costs involved in modifying one of the traveling exhibits for the available gallery space, senior museum officials decided that it would be more cost effective to develop a similar exhibit in-house.

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Heritage Health Index Developing Nationwide Survey

Experts across the USA are participating in the Heritage Health Index, a major initiative to measure the condition and needs of the nation's collections. Heritage Preservation is coordinating the Heritage Health Index in partnership with the Institute of Museum and Library Services and with funding from the Getty Grant Program.

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The **Society for the Preservation of Natural History Collections** was formed in 1985 and is recognized as a non-profit organization [501(c)(3)] in the United States. SPNHC members receive *Collection Forum*, a biannual journal of reviewed technical information, and two issues of the *SPNHC Newsletter* each year. The Society for the Preservation of Natural History Collections (SPNHC) is a multidisciplinary organization composed of individuals who are interested in development and preservation of natural history collections. Natural history collections include specimens and supporting documentation, such as audio-visual materials, labels, library materials, field data, and similar archives. The Society actively encourages the participation of individuals involved with all aspects of natural history collections.

The ***SPNHC Newsletter*** (ISSN 1071-2887) is published twice a year, March and September, by the Society for the Preservation of Natural History Collections, c/o Department of Mammalogy, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024-5192, USA. Changes of address should be directed to Lisa Palmer, Treasurer, PO Box 797, Washington, DC 20044-0797; palmer.lisa@nmnh.si.edu.

Submissions are welcome. Please forward announcements, articles and notes to Chris Norris, Newsletter Editor, Department of Mammalogy, American Museum of Natural History, Central Park West @ 79th Street, New York, NY 10024-5192 USA; (212) 769-5475; norris@amnh.org.

Deadline for the next newsletter is August 1, 2002.

Presidential Profile

SUZANNE B. McLAREN
Section of Mammals, Carnegie Museum of Natural History, 5800 Baum Blvd., Pittsburgh PA 15206-3706, USA

Due to the catastrophic events that occurred in the World since our last Newsletter was issued, many of us have undergone a few changes in the way we live and work. We will be experiencing some of the changes in air travel when we go to Montreal for our annual meeting this year. Fewer of us will consider bringing specimens along to facilitate loans with colleagues because of security difficulties. Many of our institutions have experienced substantial, unexpected downturns in donations and endowment earnings. A few events have affected collections directly. These topics, no doubt, will be a focus of discussion at our Annual Meeting.

In the last Newsletter, I reported on my attendance at a meeting of the Preservation Working Group in July. The group met again in October, following a meeting of the Heritage Health Index Task Force. At its core, this Group is still focused upon the "Save America's Treasures" program (SAT). Although those who administer the SAT grants are concerned about the limited time frame for grant application in past years, they were again delayed in initiating the process, due to the fact that funds had not been appropriated by Congress. This is not to say that the program has fallen into disfavor, because even while the current funds had not been appropriated, SAT funding had been included in the Federal budget for 2003. So this year, once again, the application period represents a small window of time, which will close on April 5th. Applicants are encouraged to be in active contact with the administering agencies. They are most anxious to provide input and assist with the application process to assure the quality of submissions. Additionally, funding for several important natural history projects has been approved through the Save America's Treasures program for the current year. It had been hoped that Mrs. Bush, who has taken a special interest in SAT, could publicly announce them. This was considered to be a way to help assure future funding. However, due to security concerns and limits on public appearance by Mrs. Bush, fanfare regarding those grants did not materialize.

The National Task Force on Emergency Response, an initiative of Heritage Preservation and the Federal Emergency Management Agency (FEMA), assisted FEMA in addressing the effect on cultural property of the September 11th attack. Its members are U.S. organizations and agencies concerned with protecting the nation's heritage. Discussion of the involvement of this Task Force at the Preservation Working Group meeting in October led me to inquire about whether a representative of SPNHC could be included on this Task Force. In mid-November, SPNHC was added to the e-mailing list and we were invited to attend their next meeting on 3 December. Cathy Hawks attended that meeting and is now serving as our representative on the Task Force. In January 2002, it was announced that their name would be changed to The Heritage Emergency National Task Force.

In partnership with the Institute of Museum and Library Science, and with major funding from the Getty Grant Program, Heritage Preservation has begun work on the Heritage Health Index (HHI). This project will gather data on the condition of collections in museums, libraries, archives and historical societies every four years. It is felt that this effort will provide a comprehensive picture of the current state of our nation's collections and its

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Suzanne Cowan
1955 - 2001

Suzanne Cowan, Chief Registrar at the New Mexico Museum of Natural History and Science, passed away on October 3, 2001 after a tough and courageous battle with cancer. At the time of her death, she was the outgoing Vice-Chair of RC-MPMA, a board member of RC-AAM, and a member of both the Society of Mineral Museum Professionals and the Society for the Preservation of Natural History Collections. Suzanne's seemingly unending commitment to the museum profession served as an inspiration to many.

Suzanne was preceded in death by her mother, Betty Cowan, of Pierre. She is survived by her Uncle Leo, who helped raise her, and it is common knowledge that Suzanne brought a sparkle to his eye. She had numerous cousins, many of whom live in South Dakota, with others living in all parts of the country.

Born in Pierre, South Dakota on January 31, 1955, Suzanne left South Dakota in her early teens, moving to San Diego, California. She attended San Diego City College and Monterey Peninsula College prior to receiving a BA degree in Anthropology from the University of California at Los Angeles. She received an M.A. in Biological Anthropology from the University of New Mexico, and did coursework for a Ph.D. in Bio-Social Anthropology at the University of New Mexico as well. Prior to her employment at the New Mexico Museum of Natural History and Science, Suzanne worked for the National Park Service as a Museum Technician at Chaco Culture National Historical Park, and for the Maxwell Museum of Anthropology in Albuquerque. She served in the United States Navy and, following active duty, was in the Navy Reserve for several years.

Suzanne was a major fan of the San Francisco 49ers, and she had many other interests, including anthropology, reading mysteries and science fiction, native cultures, and gems and minerals. Her concern and knowledge in mineralogy led to the acquisition of many superior examples for the Natural History Museum's permanent gem and mineral collection. She had an honorable and enviable love of animals, especially Samoyeds, of which she had several during the course of her life. She was especially happy to learn in her final days that her friends had agreed to love and care for her beloved Samoyed Kodiak and her cat Smoky.

As was Suzanne's wish, she was cremated and her remains will be mingled with those of her mother, and then scattered in Monterey, California. Donations in Suzanne's honor can be made to the Gem and Mineral Acquisition Fund, the New Mexico Museum of Natural History and Science Foundation, PO Box 7010, Albuquerque, NM 87194.

New & Reinstated Members

Yvette Harvey
Edith McCandless
Mark A. Sepanski
Dinah J. Houghtaling
Carla Cicero
Amy Halter
William Grewe-Mullins
Mark Kitson
James Macklin
Jim Gardner
Jackie Wilke
Barbara Adams
Robert B. Hole, Jr.
Elizabeth DeRose
Jessica Rosales
Wendy B. Zomlefer
Rachel Delovio
Margaret Rose Ronning
Vicki Gambill
Tamar Danufsky
Darci Mero
James Ladonski
Gregory J. Watkins-Colwell
Michelle New
Amparo R. de Torres
Bridget Beers
Paul Callomon
Stephanie Pau
Shigeru Suzuki
Paul G. Davis
Niccolo Caldararo
Christopher J. Marshall
Sandra L. Swift
Claudia Angle
Andrew W. Froehle
Kent D. Perkins
Gay Hunter
Paul Valentich-Scott
Hollace Hoffman
Christina Wioch
Rolando C. Descalzo
Barbara Hall
Frances Barrow
Tiffany Adrain
Andria Skaff
Christy O'Grady
E.S. McGregor
Barbara A. Brown
Kristof Zyskowski

Life Membership

The SPNHC Life Membership is a special membership category for those interested in the long-term financial stability of our organization. Life membership monies are invested towards the future goals of the Society. SPNHC life memberships are available for $625. The fee is 25 times the Individual Membership rate, currently $25. Life Memberships may be paid in one of three ways:

(1) one-time payment of $625;
(2) two-year installments of $350/1st year and $275/2nd year;
(3) three-year installments of $300/1st year, $200/2nd year and $125/3rd year.

Please contact the Treasurer should you require further information about life memberships.

Lisa F. Palmer, Treasurer
National Museum of Natural History

Conservation Committee Update

Cindy Ramotnik and Janet Waddington continue as co-Chairs of the Resources Subcommittee. Cindy reports that the U.S. Resources Display Unit traveled to the following three venues in 2001: Southwestern Association of Naturalists Annual Meeting in Hays, Kansas; the SPNHC Annual Meeting in San Francisco, California; and the Botany 2001 Conference, Albuquerque, New Mexico. Janet Waddington maintains the Canadian Resource Display Unit and reports that it has not been requested for use since the last newsletter report. The supplies and suppliers lists for both the Canadian and U.S. versions are available on the Conservation link of the SPNHC website.

David von Endt, Chair of the Research Subcommittee, has several items to share with the membership. Research on the care of natural history specimens continues with the addition to David's team of intern Fernando Marte. Fernando is a chemical engineer with a degree from the National University of Cordoba, Argentina. He will be working with David at the Smithsonian Center for Materials Research and Education (SCMRE) for a year on the following three projects: 1) developing a cleaning method for 'greasy' bird and mammal bones prior to accessioning into collections (this is a modification and extension of the research that David presented on at SPNHC 2001 in San Francisco); 2) connecting with proposed partners to investigate adhesives for use with fossils (including investigating the stability/use of cyanoacrylates for this application); and 3) connecting with proposed partners to investigate the use of DMDM-hydantoin as an alternative fluid preparation (this is an extension of the research that Dries Van Dam presented at SPNHC 2001 in San Francisco). Fernando will also take advantage of his time at SCMRE to contact the Anthropology Conservation Laboratory, as well as explore the library and the collection of conservation reprints.

David von Endt and SCMRE Director Lambertus (Bert) van Zelst worked this past fall to gather information on the effects of irradiation on museum specimens. In response to the sending of anthrax spores through the mail that occurred during Fall 2001, the United States Postal Service (USPS) is irradiating mail originating from selected (unspecified) locations throughout the U.S. that is being sent to "sensitive" Zip codes. The U.S. National Museum of Natural History (NMNH) lies within one of these codes. This decision to irradiate could have a significant impact on the ability of museums to exchange specimens and associated documentation through the postal service. To address this concern, NMNH requested information from SCMRE concerning the effect of electron beam irradiation on these materials.

A paper by von Endt and van Zelst was written to provide information about the type of radiation being used, and its effects on museum (especially natural science museum) specimens and documentation materials. While the USPS may expand, or change its irradiation plans, the principles and recommendations described in the paper should remain the same. David contacted SPNHC President Susan McLaren last fall to help distribute the information to the general museum community and the SPNHC membership. We felt it was appropriate to continue that distribution in this SPNHC Newsletter, and a copy of the paper can be found on page 5 of this edition.

Additionally, SCMRE has continued to conduct some experiments with irradiated inks and paper, and has also conducted tests on paper already irradiated by the USPS. A brief description of the results from these studies also appears in this Newsletter, on page 13.

All are encouraged to visit the SCMRE web site, www.si.edu/scrme, for a version of the von Endt and van Zelst paper that has been generalized to accommodate non-natural history museums. In addition, the site contains a more lengthy description of the experiments.

Jude Southward & Lisa Kronthal,
Co-chairs, SPNHC Conservation Committee

Publications Committee Update

SPNHC has been busy on the publications front. *Collection Forum* volumes 16(1&2) and 17(1&2) have been published, bringing the journal up to date for 2001. These were both dedicated proceedings issues, containing papers presented at symposia on the subject of pesticide contamination of collections. In recognition of the mandates of the two meetings, the text of the full papers for *Collection Forum* 16 is now on the SPNHC website, and volume 17 will be posted shortly. The titles and abstracts from all back issues are now on the web as well. Volume 18 is on track as a regular issue and, as usual, SPNHC members are invited (and even urged) to submit manuscripts. We are working to reduce the turnaround time for publication, but that can only be achieved when there are enough manuscripts in hand to ensure regular production. Instructions to Authors are posted on the website.

With this issue of the Newsletter we mark the rejuvenation of the SPNHC Leaflets series, with Rachel Arenstein's informative summary of data loggers that originally appeared in AIC News.

We were pleased to finalize an agreement with University Products, Inc., to store and sell SPNHC books. Please see the SPNHC website for ordering information.

Remember to check the SPNHC website regularly for ongoing news about SPNHC activities and other useful information.

Janet Waddington,
Chair, Publications Committee

The Effects of Electron Beam Irradiation of Mail by USPS on Research Specimens and Museum Collection Items

DAVID VON ENDT and LAMBERTUS VAN ZELST, Smithsonian Center for Materials Research and Education (SCMRE), MRC 534, Smithsonian Institution, Washington DC 20560-0534

1. Proposed radiation technology to be used in sterilization of mail sent by United States Postal Service.

The US Postal Service intends to irradiate government mail using high energy electron irradiation technology. At this time we have no knowledge whether it is the intention to irradiate only incoming or both incoming and outgoing mail. Some information on the methodology was obtained from Mr. Jeff Boeger of the SureBeam Corporation, which manufactures the 150 kW linear electron accelerators that will be used to irradiate mail by the USPS. This equipment produces electrons with an energy of 10 MeV. Electrons of such high energy have a relatively high penetrating power; for example their range in aluminum is about 2 cm. In organic materials, mainly composed of elements with a much lower Z value, this range will be appreciably longer, and for mail (paper, cardboard) it will be approximately 30 cm. The technology is used in the irradiation of food, for purposes of pathogen sterilization, where the packaged food is transported on a conveyor belt through the radiation field. This same technique would be used for the application to USPS mail.

Besides the biocidal application, radiation is also used industrially to initiate specific chemical reactions (such as polymerization of synthetics) or, through the chemical effects, to affect the properties of materials. A few examples of the latter: the plastic coating on virtually all electrical wire is irradiated to render it more resistant to weathering; heat-shrink tubing is irradiated polypropylene; and the non-stick coating of cookware is irradiated Teflon — where the non-reactivity of Teflon is modified so that it will adhere to the metal cookware surface, while still retaining most of its non-stick characteristics.

2. Interaction of radiation and materials.

High energy irradiation causes the deposition of large quantities of energy in the irradiated material, and this in turn causes chemical reactions that are responsible for the desired as well as undesirable effects. The irradiated matter absorbs the energy through ionization. Thus, an electron from the accelerator can hit an atom in the target material, and in this process the former may lose all or part of its energy. The amount of absorbed energy minus that needed to induce the ionization is transmitted to the ionization products; the electron(s) emitted from the atom will move at high energy through the material and induce secondary ionizations. If the original electron did not lose all of its energy in the first interaction with a target atom, the process is repeated, until all its energy has been transferred. The secondary ionization process will continue until all the kinetic energy of the accelerator particle has been used up in ionization processes.

The ions that are formed will eventually recombine with free electrons, but these recombined atoms (and molecules) will be highly energetic and chemically reactive. Free radicals are formed, and many of these may have life times well beyond the time span involved in the initial processes. The number of chemical reactions of a given type that take place will depend on the total amount of energy deposited. This is represented in the concept of radiation "dose", expressed in Grays, notation Gy. The latter unit represents the deposition of 1 Joule of energy per kilogram of irradiated matter. Similarly, the dose rate, a measure for the rate at which the energy is deposited, can be expressed in Gy/min. Obviously, the total dose is a product of the dose rate and the time of irradiation, and the dose rate, in this case of high energy electron irradiation, is a function of the particle energy and the beam intensity. It is of interest to note that the yield rate of a radiation induced chemical reaction often is itself somewhat dependent on the dose rate, but for the purposes of this discussion paper that effect has no great significance.

The induced chemical reactions are the basis of all practical applications of radiation technology. In the biocidal applications, they cause damage that leads to the demise of the organism. The dose needed to induce sufficient damage depends very much on the type of organism. Generally, the lethal dose is inversely related to the complexity of the organism. For example, in highly developed life forms such as humans, a dose of around 1 Gy to the whole body will kill enough cells in vital organs to cause death. For insect control, doses of around 500 Gy are needed for a satisfactory kill rate. Microorganisms, which have no vulnerable cell structures, are killed by major destruction of their DNA, requiring yet much higher radiation doses for eradication, in the order of tens of keys. Food irradiations are typically performed with doses of 1.5 - 3 kGy, while eradication of fungal spores requires doses of around 10 kGy and higher.

The dose to be applied in the USPS mail irradiation for the protection against anthrax spores appears still to be a matter of discussion, but it can safely be assumed to well exceed

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Permitting Session at NSCA Meeting

Four federal permit-granting agencies will be getting together to do a joint program at the June 2002 Annual Meeting of the Natural Science Collections Alliance at the Smithsonian Institution in Washington DC. (June 7-8; opening reception June 6) Representatives from US Fish & Wildlife Service, NOAA, APHIS (USDA) and National Park Service are working together to create an integrated presentation covering all major treaties, acts and do a general permitting overview; followed by a question/answer session; and then "open hours" in the meeting's exhibit area where they will have individual agency displays and time to talk one on one.

A second major part of the program is a Collection Metrics program co-chaired by Sally Shelton and Cheryl Bright, to address collection management in a time of shrinking financial resources and increased costs. The session will focus on setting goals, priorities, and quantifiable methods that measure progress in attaining goals.

Other collections-oriented sessions will address: the collections that underpin genetic, genomic, and proteomic research; economic botany; osteological collections; and herbaria.

The full program can be found on the NSCA web site. To visit go to: http://www.ascoll.org/annualmeeting/2002/2002annlmtg.htm

SPNHC 2002

May 8 - 13, 2002

Redpath Museum / McGill University
Montreal, Canada

For full annoucement, see back page

AAM Accreditation Commission Approves Expectations Regarding Collections Stewardship

At its June 26-27, 2001 meeting, the Accreditation Commission approved a new policy document entitled "The Accreditation Commission's Expectations Regarding Collections Stewardship." This new document is one of an on-going series of Expectations issued by the Accreditation Commission to supplement and further define the existing Accreditation Program eligibility criteria and the *Characteristics of an Accreditable Museum.*

The Commission identified the need for an Expectation on the topic of collections stewardship when it observed, through its review of several hundred institutions during the past five years, that many museums faced challenges with collections, and found it was repeatedly citing concerns—ranging from planning and policies to staff qualifications to environmental conditions and security—in this area. Likewise, it noted a related trend: over the past three years, collections stewardship questions made up the number one category of inquiries received by the AAM Technical Information Service.

Therefore, to help inform the field and guide accredited museums in this area, the new Expectation answers the following five questions:

- Why does the Commission consider collections stewardship important?
- What are the Accreditation Commission's expectations regarding collections stewardship?
- How does the Commission assess whether the institution's collections and/or tangible objects are appropriate to its mission?
- How does the Commission assess whether the institution effectively manages, houses, secures, documents, and conserves its collections and/or tangible objects?
- Does your museum need help with collections stewardship? (The Expectation includes a list of resources.)

Even non-collecting museums need (and are expected) to consider and address stewardship issues related to objects they have in their custody temporarily, and/or the materials they use to carry out the museum's mission. While all accredited museums are expected to meet the standards articulated in the document, non-accredited and developing museums are encouraged to review the document and use it as a tool to shape institutional thinking and guide decision-making about collections stewardship.

Accreditation is a program established and operated by and for the field. The program reflects, reinforces, and promotes

the best practices in museums and the strictest accountability to the public that museums serve. Participation is voluntary, and currently 750 museum have achieved accredited status. Many museums that do not choose to become accredited still use the characteristics, criteria, and expectations developed by the program as benchmarks for performance.

The Accreditation Commission is an independent body appointed by the AAM Board of Directors and it is currently composed of eight museum professionals, who volunteer to serve a maximum of two, six-year terms. They represent the diversity of museum in discipline, geography, and size.

All six Accreditation Commission's Expectations are available at www.aam-us.org/accred.htm or by calling (202) 289-9116.

Elizabeth Merritt
Director, Museum Advancement & Excellence, AAM
SPNHC/RC-AAM Liaison

Natural History Museum of Los Angeles County opens Marine Biodiversity Processing Center

Museums today are being overwhelmed with diverse incoming, unsorted collections resulting from both field work and from institutional donations where storage of these collections is no longer an option. At the same time, there is increasing pressure to make data from these collections available to researchers around the world. To address these problems, the Natural History Museum of Los Angeles County created the Marine Biodiversity Processing Center in early 2001. The Center serves as the clearing house for unsorted incoming invertebrate collections. The Center staff:

- collate historical information about the collections,
- assess the condition of specimens, containers, and labels,
- perform first-level sorting,
- curate specimens and prepare labels as necessary
- database collection and lot information.

Finally, sorted material is turned over to the taxon-specific sections (polychaetes, echinoderms, mollusks, and crustaceans).

More information about our collections and the Center is available at http://collections.nhm.org. A NSF Collections Support Grant received in early 2002 will greatly facilitate the rate at which newly curated, sorted, and databased collections are made available to Museum researchers and the scientific community.

Heritage Health Index *....Continued from page 1*

The Heritage Health Index survey will gather data on collection conditions and preservation needs in the nation's archives, historical societies, libraries, and museums. In addition to providing a national context in which individual institutions may evaluate their progress, the results of the Heritage Health Index will improve long-range planning within the fields of preservation and conservation, inform decision makers and funders on the need for additional resources, and educate the public about the critical work collecting institutions do to preserve our nation's heritage.

Because a sample of collecting institutions across the nation will be asked to complete the survey, involving institutions in its development is essential. Heritage Preservation President Lawrence L. Reger explains, "A survey like the Heritage Health Index is much needed and is long overdue, but to ensure its success we must have the cooperation of as many institutions as possible, and this begins with the survey development."

Even before officially launching the project in summer 2001, Heritage Preservation sought input from leading preservation professionals on planning the initiative. In October 2001, Heritage Preservation convened an Institutional Advisory Group of national associations and federal agencies that advocate for collecting institutions. The meeting of 50 participants represented the diverse universe that the Heritage Health Index will include and provided institutional perspectives on what the survey should capture.

From February to May 2002, Heritage Preservation will assemble nine Working Groups to discuss specific preservation issues that the survey should address. Each group will consist of professionals whose work includes preservation activities, such as administrators, conservators, preservation officers, archivists, curators, librarians, and registrars. Working Group participants will also reflect the diversity of the type, size, and geographical location of institutions to be surveyed. The Working Groups are organized by similar materials and formats and include:

* archaeological and ethnographic objects
* books, manuscripts, records, maps, newspapers
* decorative arts, sculpture, mixed media
* electronic records and digital collections
* furniture, textiles, historical objects
* moving images and recorded sound
* natural science specimens
* paintings, prints, drawings
* photographic materials

Dr. Robert S. Martin, Director of the Institute of Museum and Library Services, said, "The Heritage Health Index partnership

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Mail Irradiation....*Continued from page 5*

the 10 kGy level. Dr. Donald Thayer of the USDA Research Service and Dr. Burrell Smittle of the Florida State Department of Agriculture expressed the opinion that levels of about 25 kGy would be used, while Dr. Steven Seltzer of NIST indicated an anticipated use of significantly higher doses, in the order of 50 - 60 kGy. He also noted that, if mail were to be irradiated from both sides, this dose would be doubled. These very high doses are needed to obtain the sought after "kill ratio", which is in the order of 12-14 decades (in other words, the fraction of surviving spores is intended to be only in the order of 10^{-11} to 10^{-13}).

Ultimately, the deposited energy will be converted to thermal energy, causing a rise in temperature of the irradiated material. For the conditions considered for use by USPS, this effect could amount to a temperature raise in the order of 5 degrees centigrade.

3. Radiation effects on materials.

As mentioned above, the large quantities of energy deposited during irradiation in the target materials leads, through the formation of ions, activated atoms and molecules, and free radicals, to a complex series of chemical reactions, and these can have a very significant effect on the chemical and physical properties of the irradiated compounds. These effects can be even more enhanced if the irradiation takes place in a regular atmospheric environment when reactive species such as ozone, 0* and OH* radicals are formed.

The number of occurrences of a given reaction depends on the dose. Thus, the amount of induced change in material properties can, like the biocidal efficacy, be controlled by the size of the administered dose. Yet, the amount of change that is permissible (or desirable) depends on the nature and use of the irradiated materials and objects: what may be regarded as trivial effects in the context of industrial applications can be unacceptable in the case of museological and archival collection holdings. It is this latter context with which we are concerned here, and the following discussion pertains to material effects on a scale of magnitude that might compromise the value of such collection materials.

The reactions that we are concerned with include the destruction of existing molecules (chain scission and depolymerization, removal of functional groups as in deamination, decarboxylation etc., and oxidation) as well as the formation of new ones (through recombinations and cross-linkages.) While inorganic materials are not immune to radiation induced effects (and later we will discuss some of these as they are of concern), it is the organic materials that are most vulnerable to significant damage. Literature data on damage rates in the ranges that are of concern to museum and archival collections are limited, but a certain amount of work has been done in order to assess the applicability of radiation technology for biodeterioration control in collections. In 1995, SCMRE was the organizing host to a expert consultants meeting on that subject sponsored by the International Atomic Energy Agency (IAEA), attended by experts from Europe and the USA. Generally, most of the information presented at that meeting still represents the current level of knowledge, since in subsequent years the development of alternative, far less aggressive methods for effective biodeterioration control in a museum collections context have made the application of radiation technology for the purpose something of limited, and at best occasional, utility. Additional information can be gathered especially from literature concerned with the sterilization of food, medical supplies and various other industrial commodities.

Of first concern are the polymeric materials, both natural and synthetic. The natural polymers are more vulnerable to significant change than their synthetic counterparts, and of the natural polymers, cellulose is the most vulnerable. The reactions of concern are chain scission, cross linkage, and oxidation. The effects of these various reactions are depolymerization, loss of strength, embrittlement, acidification and discolorations, and a greatly enhanced rate of subsequent aging deterioration. Quite a lot of experimental work has been done on radiation induced damage to cellulosic materials, since it was hoped that this technology could be used to address one of the major problems in the library and archives field i.e. mold growth in collections that have been exposed to water, for instance during the dousing of a fire. Work such as that done in collaborations between the Centre d'études nucléaires de Grenoble and the Central Laboratory of the Netherlands Institute for Cultural Heritage, indicates that, in order to avoid an unacceptable amount of damage to paper, the dose has to be kept below 2 kGy, well below the level necessary for effective microorganism control. At dose levels of around 4 kGy, serious degradation was observed, and at 7 kGy these researchers recorded extensive oxidation and depolymerization. Other cellulosic materials, especially the fibers including cotton, bast fibers, etc., tend to be equally sensitive. Studies on cotton by a Scottish and Greek team of textile scientists indicated, for example, an exponential reduction of tensile fiber strength with dose, where this strength was reduced by ca. 50% at 100 kGy, while early work at Cornell University recorded a 27% reduction in degree of polymerization in cotton cellulose at 6 kGy. While cellulose in wood must be expected to undergo comparable changes, significant mechanical damage to wood, such as investigated in the studies on waterlogged wood from the Mary Rose shipwreck, requires quite high doses, in the order of 100 kGy. Industrial sources tend to regard damages at doses up to 10 kGy as "somewhat trivial" though they concede that color changes occur quite readily at these levels.

The other major group of natural polymers, the proteinaceous ones, tends to be less susceptible to radiation damage than

the cellulosic materials. The major effects result from reactions involving individual amino acids, including deamination, and total disconnection of an individual amino acid from the polymer. There appears to be less susceptibility to chain scission, nor evidence of cross linkage, at the dose levels of the published experiments (up to about 250 kGy). Research on the effects to wool fibers, for instance, showed a loss of about 10% in tensile strength for wool fibers exposed to doses of 20 kGy of gamma radiation, while exposure to accelerated electrons only showed perceptible damage at the 50 kGy level. However, such damage cannot be overlooked when assessing its admissibility in the context of museum collection items, especially since the doses anticipated to be used by the LISPS are in this same range.

Synthetic polymers are generally less vulnerable to radiation damage than their natural counterparts. The most sensitive is Teflon, which is reported to show significant effects at dose levels of 10 kGy. Canadian textile researchers at the University of Manitoba studied radiation effects on a number of nylon fibers, where they found that doses of 10 kGy resulted in about a 5% loss of tensile strength, while 15 kGy induced losses of 10-20%.

A special case is that of DNA molecules. The relatively large size of the DNA molecule results in a high probability of it being hit by one or more radiation particles. It is worth noting that the primary mode of radiation induced eradication of micro-organisms is major destruction of the DNA. Hence, irradiation at the levels intended for anthrax spore extermination will also induce major damage to DNA in research specimens. These effects will include fragmentation of the molecule and, through recombinations, formation of mutations. The mutatiogenic properties of ionizing radiation are, of course, well known, and result from these recombination reactions. While a significant fraction of the original DNA of the specimen irradiated at dose levels of 10-50 kGy may be preserved, the question, which arguably can only be addressed on a case-by-case basis, is to what extent the research value of the specimen is compromised, for the intended or future studies, by the large scale destruction of the specimen's DNA, and formation of significant quantities of mutated varieties and of major concentrations of fragmented DNA.

A class of organic molecules that is especially vulnerable to radiation induced damages is that of the dyestuffs. Complete removal of functional groups such as in the azo-dyes, and the destruction of conjugated double bonds, will result in major fading and color changes at dose levels well below those required for the damages discussed above. In fact, these radiation induced color changes in dyes have been used for purposes of radiation dosimetry. It is not unreasonable to predict that, at the dose levels anticipated to be used by the USPS, dyes in textiles, lake pigments, various ethnographic objects, and scientific specimens (e.g. microscopic slide specimens, flowers, elytra) could undergo extensive color changes or fading. The same holds for color photographs; both color slides and prints should be expected to fade and show color shifts.

In addition to these visual effects that result from destruction of dye molecules, one also must anticipate the occurrence of significant color changes, be it blanching or discolorations, in other organic materials, when chromophore sites are created or destroyed. Color changes are also to be expected in a number of inorganic materials, especially glasses and minerals/gemstones. These effects are due to the population of localized, metastable electron traps at lattice imperfections, by free electrons, resulting from ionizations. Glass can acquire a purple color, while various gemstones acquire a variety of colors. These effects can generally be mitigated by annealing the specimen; however, in the case such as a microscope slide with balsam mounted specimen, heating is not a viable option, and it is not necessarily a recommended practice for mineral specimens either.

It is worth noting that irradiation with 10 MeV electrons will not cause the formation of radioactive isotopes through nuclear reactions, since the thresholds for such reactions would require higher electron energies. In organic materials, with relatively low Z elements, the electrons from the accelerator will loose their energy through interaction with the electrons of the target material's atoms, causing ionizations; with the nuclei their interactions are mainly constricted to scattering, with no consequences for the target material. If the accelerated electrons would hit targets consisting of elements with much higher Z values, increasing amounts of their energy would be lost in the form of "bremsstrahlung", i.e. high energy photons. High energy photons are able to interact with atomic nuclei and induce nuclear reactions; however, the bremsstrahlung from 10 MeV electrons would be below the energy threshold for such reactions.

4. Consequences of the planned electron beam irradiation of USPS mail for the mailing of museum and archival collection items.

As mentioned before, we have no information as to whether all mail, or only incoming mail, will be irradiated. Yet, in the latter case, specimens mailed to the Smithsonian still will be affected. Preliminary information suggests that at this time only irradiation of mail, not of packages, is planned, and this may reduce the concerns to a small fraction of all specimen exchange. Should this situation change, and should USPS start to irradiate packages too, it may be more effective to switch from electron to gamma irradiation, presumably applying a similar size dose. For the purposes of the concerns addressed here, the effects would be largely the same, both qualitative and quantitative.

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Butterfly Display....*Continued from page 1*

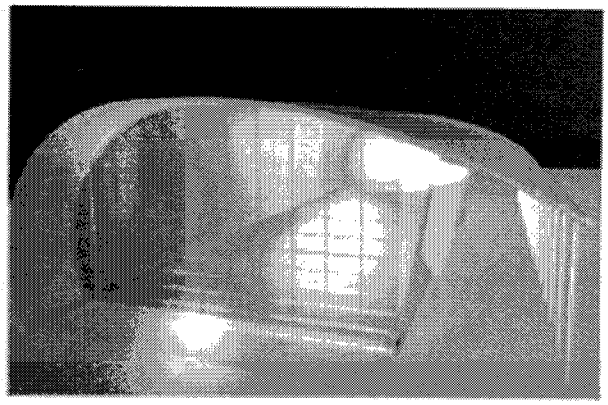
Early in the planning stage, members of the exhibit project team met with the head of conservation in the Museum's Anthropology Department and a preservation consultant who specializes in museum environments. They gave recommendations on construction materials for the vivarium, and suggested ways in which its HVAC and lighting systems could be erected in the Museum's Hall of Oceanic Birds without causing unnecessary damage to the installed permanent collection. Normally the Objects Conservation Lab has a central role in preparing exhibits initiated by the Museum's Anthropology Department. This was not an anthropology exhibit, however, and after this initial meeting there was no further role perceived for conservators and the lab had no more involvement in preparations.

The restrictions and special needs as outlined by the USDA, the entomologists, and conservation were taken into account by Perkins Eastman Architects, P.C. This firm designed the vivarium where, landscaped with appropriate foliage, butterflies were to live and fly freely, interacting with museum visitors. The requirements included the following:

- The structure had to form a continuous, sealed shell.
- There could be no right angles in the flight zone, to prevent the butterflies from getting caught.
- Specifications for appropriate light, temperature, and relative humidity levels had to be maintained.
- The 1,300 square foot structure had to be self-supporting, so that it did not touch the walls or ceiling in the gallery, and it could only bolted to the floor at a few points.
- The vivarium's environmental and lighting systems had to be contained so that they would not affect the hall's murals and dioramas.
- The conservatory had to be easily disassembled, stored, and erected for repeated use each winter.

What was originally conceived as a one-room exhibition space became a complex construction project that had to be completed on a tight budget and even tighter time schedule. Construction planning began in early June with installation to begin about three months later.

In late October, the head of conservation was contacted shortly before the opening date with a request for a conservator to install and monitor dataloggers to provide an independent check that the vivarium's HVAC system was sustaining suitable conditions. After installing the loggers I was told by the exhibits coordinator that they might need additional help as a problem had developed - the first group of butterflies released in the vivarium that morning was already dead.



Artist's impression of exterior of AMNH vivarium

The butterflies' adverse reaction in the conservatory was immediate; within minutes of their release they went into spasms, becoming disoriented and loosing control of their wings. All were dead within one hour. The project's entomologists knew from anecdotal evidence that this type of death was consistent with an environmental contaminant. Staff at other institutions with similar exhibits were clear that butterflies are extremely sensitive to their environment, and that even trace contaminants can lead to death.

We immediately identified three potential sources of contaminants: the make-up air, materials used in constructing the vivarium, and the plants. In conjunction with the entomologists, we devised a series of simple tests to try and pinpoint the problem. Butterflies were placed in either closed containers or plastic bags to force them into proximity with specific construction materials and plant specimens. Tests were conducted both in the conservatory and in the room where the pupae were hatched.

While the tests were carried out, the project contractor and I quickly began to research the vivarium's heating and ventilation systems. In order to maintain 80° Fahrenheit and 80% relative humidity, the HVAC system used only 10% fresh make-up air. The system was designed for 20 air changes per hour, which meant that it was unlikely that an outside contaminant would be able to build to a dangerous level.

Working with the architect, we began to investigate the materials used in constructing the conservatory. Although primarily built of aluminum, fiberglass, and acrylic sheeting, there were several materials, such as the recycled rubber floor, gaskets, and HVAC duct sealant, that could be off-gassing. These materials had not been mentioned in the early planning meeting. The architect and contractors supplied the names of every material used in the vivarium's construction and Material Safety Data Sheets were obtained for each product.

It seemed possible that one of these materials might emit noxious gasses that, in the recycled air, could build to levels

dangerous for the butterflies. Basic air quality tests showed trace amounts of many of the chemicals and solvents listed on the MSDS forms, and a notably high ethanol count. However, tests with the butterflies showed that this was not the immediate problem.

The next most obvious source of the contaminants was the plants. Foliage contaminated with pesticides was the most serious issue mentioned by staff members responsible for butterfly exhibits at other institutions, and several people had related similar experiences involving sudden deaths of their live collections. Unfortunately, the greenhouse that provided the plants used several different growers, making pesticide problems difficult to trace.

Fortunately, the testing quickly narrowed down the suspects. While all the butterflies tested in the vivarium died quickly, showing the same symptoms, in the pupae room the greatest problems occurred with leaves of two *Ficus* trees: butterflies placed in direct contact with leaves from the trees died immediately. Interestingly, even without direct contact death occurred, albeit more slowly. This was a lucky break; the two trees could be traced back to a single grower.

It was discovered that the grower in question had applied a pesticide called Vydate. Armed with this information, I was now able to provide concrete assistance to the exhibit team. The combination of the conservator's background in chemistry, together with our frequent work with a variety of hazardous solvents and chemicals, meant that we were experienced in obtaining information and assessing the risks of materials. Accessing the extensive pesticide databases available on the Internet quickly provided additional information. Vydate, a DuPont product with the active ingredient Oxamyl, is a Class I, restricted-use pesticide, commonly used on ornamental plants. It is applied as a root dip and, as such, becomes systemic. The product literature cites extreme toxicity for birds, fish and bees. We discovered that virtually all growers of ornamentals use pesticides: when the greenhouse promised pesticide-free plants, they assumed that after waiting an appropriate amount of time there would be little residual material of danger – an unfortunate inaccuracy in this particular case.

In project meetings, we realized that the entomologists were having trouble communicating their concerns for the butterflies' safety in the absence of previous experience and hard data. Exhibition staff were equally frustrated by their inability to proceed without guidance. Conservators often find themselves trouble-shooting in the last stages of an exhibition installation and this proved no different. Our important function in these meetings was acting like a translator, supporting the project's lepidopterist with additional data, while helping the Exhibition staff decide how to proceed safely.

With the publicized opening date less than a week away decisions had to be made swiftly. The *Ficus* trees needed to be pulled from the vivarium, but we worried that this alone might not be sufficient, as butterflies showed milder but similar symptomatic deaths with other plants as well. From my conversations with DuPont scientists, I learned that in the extremely humid conditions in the vivarium it was possible for this water-soluble pesticide to become, in effect, airborne. We decided that we would have to pull out the landscaping entirely, wash down the structure, and start over with new, hopefully uncontaminated, foliage.

A new selection of plants was made, based on the pesticide practices of the various growers, and staying away from other plants that had not performed well in the bag tests. Unfortunately none of these plants had the height and coverage of the *Ficus*, and it was thought important to have some taller plants on which the butterflies could find shelter and rest. We visited the manufacture site of one of New York's large suppliers of artificial plants. The materials used in construction, including wood, vinyl coated steel wire, polyester, and hot melt glue, tested well with the butterflies. Two large, artificial *Ficus* trees were purchased, as well as several smaller, bushy plants to fill out the foliage. These were placed at either end of the conservatory, where they would be less visible.

While the landscapers collected the new plants, we worked with the contractors to correct some of the remaining environmental issues that were thought to be placing additional stress on the butterflies. Extra lighting was added to stimulate flight and, more importantly, feeding. The timing of the lights was also coordinated to approximate a day-night cycle, allowing them to rest. Adjustments were made to the HVAC system when, after downloading the data from our loggers, it was discovered that the sensors quickly moved out of calibration in the hot and humid environment. Issues of lighting and environment are common conservation concerns when installing most exhibits and these problems were easily handled.

Having learned our lesson, we started afresh and tried to proceed systematically with the reinstallation, in the hopes that if the problems continued they could be isolated swiftly. The entire interior of the vivarium was washed with a dilute mixture of dishwashing detergent and Chlorox bleach in water. The plants were brought into the Museum in batches and washed by our preparators with the same mixture. As the plants acclimated to their new environment, representative samples were chosen to be bagged with butterflies for further testing. Next, the plants were moved into one side of the vivarium, which was partitioned off with netting, forcing the butterflies into contact with the plants while in the conservatory's environment. These tests ran smoothly and the reinstallation proceeded swiftly to prepare for the revised opening – two weeks after the initial date.

As of the spring of 2001 the Vivarium has attracted over 920,000 visitors in three seasons. There has not been a reccurrence of the problems we had during the first installation possibly because of the implementation of three procedures before the second season.

1. The project's lepidopterist identified which species did well in the conservatory and fine-tuned future ordering to include more of the heartier species.
2. More time was planned for reassembly of the structure, installation of the plants and fine-tuning of the environmental conditions. This has allowed for an earlier initial release of butterflies, and the time to trouble-shoot if necessary.
3. Procedures were set up for early identification and testing of any new materials specified for the vivarium before purchase and installation.

Off-gassing from the rubber floor and one of the HVAC duct sealants, although unproven as contaminants, remained under suspicion. Retesting the air quality at the end of the exhibit's run showed that most of the contaminant levels had decreased slightly; this included the high ethanol count, which was never fully explained. To eliminate the flooring as a factor in the vivarium's second season, alternate materials were investigated. Five months before the start of installation, the architect supplied the Conservation Lab with samples of several materials that were subjected to our standard Oddy Test. This accelerated aging test subjects the sample to high heat and humidity, similar to the conditions in the conservatory. The test is evaluated by assessing the state of three types of metal coupons at the end of thirty days. This was a way to weed out materials that seriously off-gassed. The remaining candidates were also tested with butterflies to ensure that they were suitable.

None of the problems we encountered in setting up our conservatory was unusual. Other institutions experienced with living collections cited the same challenges. What was new to us, however, was the fact that with sensitive species there is no margin for error. In summary, we were able to make several recommendations for those contemplating a living exhibit.

- Allow ample time for information gathering, proper planning, installation and testing - to make sure that problems can be corrected early, and not under pressure.
- Know what you are dealing with. Speak with other institutions or specialists who can provide advice on what challenges to expect.
- Ensure that you have not only the resources, but also the expertise on staff - ideally someone trained with living collections as well as the species' natural history.
- Carefully check all materials used in the environment and test their suitability. If possible, buy the materials in advance to allow them to off-gas safely.
- Use trusted contractors, but do not rely on them to understand the needs of your collection.
- Ensure that the environment is appropriate and stable before introducing the collections.
- And finally, do not expect to be in full control. In natural history museums we have perfected the display of dead and mounted specimens, but there is an element of risk and unpredictability associated with living collections that should not be underestimated.

Conservators are often seen by exhibit staff as an obstacle to displaying an artifact, while the conservators see themselves as advocates for the preservation of the collection. It was not an unreasonable assumption to assume that, after the initial meeting, object conservators had little to offer in staging this kind of exhibit. However, our chemical literacy, the ability to devise methodical testing and our familiarity with environmental problems proved extremely useful. With our help trouble-shooting on this exhibit, conservators were seen not as impediments, but as participants, acting as a liaison between the scientific and exhibition staff. The quick identification of our problems and the solutions for reinstalling the conservatory was possible because everybody had the same mission – to build an environment in which the butterflies could live safely and be enjoyed by the public.

Heritage Health Index....*Continued from page 7*

is a formidable one. The Getty, Heritage Preservation, and the Institute of Museum and Library Services have each contributed a wealth of expertise to help museums achieve the highest standards in conservation. Bringing in a wide group of professionals will help the partnership develop the most comprehensive survey of the nation's collections."

Heritage Preservation has selected Aeffect, Inc. to advise on statistical validity and design of the survey. Based in Deerfield, Illinois, Aeffect, Inc. provides research and consulting services to organizations in the corporate, government, and non-profit sectors. The firm has worked with cultural organizations serving both local and national audiences, including the Norman Rockwell Museum, Museum of Science and Industry, Lake County Discovery Museum, and Shedd Aquarium. Aeffect has also consulted with the Institute of Museum and Library Services to assess the prevalence of museum-library partnerships in the United States and to evaluate the impact of grant programs. Aeffect's research and consultation helps these and other clients better understand and respond to their audiences, refine program offerings, and guide institutional strategic planning.

For more information about Heritage Preservation, the Institute of Museum and Library Services, and the Getty Grant Program go to www.heritagepreservation.org/PROGRAMS/HHIhome.HTM or contact project director Kristen Overbeck Laise at klaise@heritagepreservation.org or 202-634-0033.

Mail Irradiation....*Continued from page 9*

5. Summarizing the information as it pertains to typical collection specimens exchanged by natural history museums and research laboratories and transported by mail, the following concerns emerge.

a. Living specimens (seeds, cuttings, etc.) will be killed by this irradiation.

b. Materials of cellulosic composition, especially plant fibers and paper, will be quite seriously affected. They will lose significant tensile strength and will become more brittle, while the induced chemical changes, chain scission and oxidation, will accelerate their aging processes. Discoloration is also to be expected. Oxidation also will result from interaction with ozone formed in air during the irradiation; while one may expect efficient ventilation at the radiation equipment, ozone also will be formed within the enclosures of the mailed materials, where the concentration could range in the tens of ppm.

c. Materials of proteinaceous composition, while less vulnerable than the cellulosic ones, still can be expected to be affected at the proposed dose levels in terms of physical changes (embrittlement of skin products, loss of fiber strength in wool and hair samples), and in terms of accelerated aging. Again, discolorations are to be expected. Again, ozone production is an additional factor.

d. Samples of interest because of their genetic information can be compromised, to an extent depending on the type of questions being addressed by the research in which they are to be used, because of large scale destruction of DNA molecules, accompanied by recombinations

e. Dyestuffs will fade, resulting in fading and color shifts in textiles, stained specimens, and color photographs. The same effect may result in shifts and fading of the natural colors of specimens.

f. Glass can undergo blue/purple discolorations; this may affect the research value of microscopic slide specimens. While this discoloration of the glass can be removed through annealing, this would not likely be a viable option for mounted specimens because of the effects of the heating on mounting medium and the specimens themselves.

g. Mineral specimens may develop colors and/or change colors; generally these effects are reversible through annealing, though of course the effects of that heating on the specimen depend on its nature.

h. In the case of specimens under alcohol, there is the potential for some radiolysis of the preservation solution, leading to the formation of various ions and free radicals in the solution. These reactions are very complex and can lead to a wide range of reaction products, but the concentrations of the latter should be in the ppm range and do not form a major concern. Additionally, the temperature rise resulting from thermalization of the electron beam energy would raise the pressure in the container somewhat, but this effect is not likely to be of sufficient magnitude to cause failures of the containers unless the integrity of the latter were already seriously compromised.

i. Rubber and plastic stoppers of bottles and vials may become somewhat embrittled, but not to an extent of losing the closure of the containers.

j. Magnetic media (floppy disks, zip disks, audio and video tape) will probably lose significant information content. Undeveloped photographic film will be exposed.

k. Generation of radioactivity in the irradiated samples is, under the proposed conditions, not a concern. It is not practical to try to mitigate the radiation effects through shielding of the samples, e.g. with lead metal. The weight of the shielding required to stop these high energy electrons would be quite high and make the mailing expensive;moreover, the bremsstrahlung generated by interaction of the electrons with the high Z elements of the shielding could still result in appreciable doses to be administered to the material inside. USPS also might have great objections, not only since it presents an attempt to circumvent their preventive actions, but also since this bremsstrahlung could conceivably create other problems at the irradiation facility.

In view of the above, it is strongly suggested that mailing through USPS of vulnerable specimens and collection items, as well as important research information on magnetic media or undeveloped film, be avoided unless it can be arranged for these mailings to be exempted from irradiation.

Recent examination of some irradiated mail

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The response of the Post Office to the anthrax problem has been the electron irradiation of select portions of the mail. The mail is packaged in sealed plastic to a thickness of over 3 inches and irradiated in two passes. Sufficient examples of the irradiated mail have been examined to permit some observations.

The irradiated mail exhibits definite yellowing, and this has been quantified by L*a*b* measurements of irradiated

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DNA Preservation in Fluid Preserved Collections

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Museum collections are now regularly used in microbiological studies and their value is increasingly being recognised by the molecular research community. New techniques, and in particular the advent of the Polymerase Chain Reaction (PCR), have started to open the vast storehouse of genetic information contained in museum collections. As a result, some work is now being carried out to assess how collection and preservation practise affects the condition of the DNA in specimens held in museum collections. Our understanding in this area is gradually improving, and recent years have seen concern for the care and conservation of natural science collections become significantly renewed. Natural science conservators are now actively addressing the many issues involved in the care and conservation of museum natural science collections. The driving aim is to preserved material for *both* morphological and molecular study as cost effectively as possible.

Many potential factors will affect the condition of the DNA in a specimen. These factors include the preservation history and the age of the material. As soon as an organism dies, physiological and cellular control processes are lost and autolytic decay sets in. This causes rapid degradation of DNA molecules from the effects of enzymes and other reactive molecules in the tissues. Autolytic decay processes can be halted by preservation treatments, but these in themselves can have an effect on the condition of the DNA. The DNA can also be affected by environmental factors. The key processes are hydrolysis, oxidation, radiation, and temperature. All these events can cause structural changes to the DNA molecules. Key changes that can occur in the DNA are;

- Denaturation, where the double-stranded DNA (dsDNA) becomes separated into single-stranded DNA, which is more open to chemical attack.

Table 1: summary of the effects of various preservation protocols on invertebrate specimens (after Thomas, 1994; Reiss et al, 1995; Dillon et al, 1996; Quicke et al, 1999)

Mode of Fixation	Subsequent Preservation	External Morphology	Histology	Internal Anatomy	DNA
Cryopreservation	Freezer at -70°C or below	Can be good	Poor	Fair to good	Good
Absolute Ethanol	Absolute Ethanol	Poor to good	Poor to fair	Poor to fair	Good
70-80% IMS	70-80% IMS	Fair to good	Fair to good	Fair to good	Fair to good
70-80% IMS	CPD or HMDS Drying	Good	Poor	Good	Fair to good
70-80% IMS	Air Drying	Good for certain groups	Poor	Variable	Fair
70-80% IMS	Critical Point Drying or HMDS Drying	Good	?	Good	Fair to very good
4% Formaldehyde	70-80% IMS	Fair to Good	Fair	Fair	Poor to fair
4% Formaldehyde	4% Formaldehyde	Good	Fair to good	Good	Poor
Ethyl Acetate	Air Drying	Fair to good	?	Variable	None or very poor
Formaldehyde - based histological	Same	Fair to good	Good	Good	Very poor to none
Mercury - based histological	Same	Fair to good	Good	Good	None or very poor

- Cross-linking reactions, which bond the strands of DNA to each other, or to other molecules such as proteins, making the DNA less accessible.
- Strand breakage or nicks in the sugar phosphate backbone of the DNA molecules, causing fragmentation.
- Chemical modification of nucleotides which carry the genetic coding, through addition, removal, or replacement of chemical groups. This can cause changes in the nucleotide sequence, or alter the way the DNA reacts chemically.

The best method we currently have for the storage of specimens for molecular analysis is to use cryopreservation. This can be done through storage in liquid nitrogen, or through the use of –80°C freezers. Unfortunately cryopreserved collections require constant monitoring, and are expensive to maintain. For these reasons, they are not a practical consideration for many natural history museums. In addition, cryopreservation will not preserve the morphology of a specimen, at least not in a way that makes the specimen accessible. So how do other methods of fixation and preservation used with natural science collections affect the condition of the DNA?

Many of the first published DNA studies using (non-human) museum specimens looked at extinct or rare animals. The material used for these studies was dried muscle, skin, feather, or bone and the studies tended to recover DNA fragments that were around 200-300 base pairs (bp) long. Whilst this DNA is essentially degraded, it has proved usable for cloning, hybridisation and PCR. During this period, workers were also beginning to look at using the DNA stored in archival histopathological material fixed in formaldehyde, or some other fixative, and then paraffin embedded. The use of archival fixed and paraffin embedded material demonstrated that biological material that had been exposed to a whole range of chemical treatments could still have a viable use in DNA studies. This view has been further reinforced from studies with ancient DNA obtained from archaeological and subfossil remains.

The presence of usable DNA in museum specimens that were originally collected for their gross morphological features, rather than their molecular component, has led to the reconsideration of a wide range of museum preserved specimens for molecular work, including fluid-preserved material. As the use of preserved material in DNA studies continued to increase, attention began to be given to the effects of museum preservation treatments on the condition of the DNA, and the reliability of any analysis carried out on this DNA, such as sequencing. The results of some of these studies showed that the DNA extracted from formaldehyde-fixed material tended to be of low molecular weight, whereas ethanol-fixed and preserved material potentially yielded higher molecular weight DNA. As a result, it is generally considered that fixatives such as formaldehyde badly degrade the DNA. Some workers, however, believe that the DNA in formaldehyde specimens is just difficult to extract, rather than highly degraded. Formaldehyde fixation results in the DNA being bound to proteins, forming DNA-protein complexes, making extraction problematic. The development of improved extraction techniques may make it possible to utilise formaldehyde fixed archival samples more widely.

The use of DNA isolation buffers has also been considered. These appear to have the potential to work well, but only if the specimen is homogenised. Examples of buffer solutions used include urea (to preserve fish tissue), sodium chloride – CTAB solutions (to preserve leaves) and guanidium-isothiocyanate (to preserve invertebrate material).

Drying is a widely-used method of preservation in museums. Many different groups of organisms can be preserved in a dry form, and many specimens are dried subsequent to initial fluid preservation. Drying is a particularly useful method for many groups of insects. However, the method by which the specimen is dried can affect the integrity of the DNA. The use by entomologists of ethyl acetate to kill and prepare specimens for dry pinning has been found to adversely affect the preservation of DNA. By contrast, specialised drying techniques such as Critical Point Drying, (CPD), and chemical drying methods such as the use of Hexamethylenedisilazane, (HMDS), potentially give both good morphological and DNA preservation.

Table1 gives a summary of the main effects of a number of fixation and preservation treatments. Whilst our understanding of the effects on DNA of the various fixation and preservation methods used to prepare museum specimens continues to improve, much work needs to be done.

Table 1 references;

Dillon, N., Austin, A.D. and Bartowsky, E. 1996. Comparison of preservation techniques for DNA extraction from hymenopterous insects. *Insect Molecular Biology* 5,1:21-24.

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Mail Irradiation....*Continued from page 13*

material. The color shift is not necessarily immediate and can occur over time. According to postal sources, temperatures of the irradiated materials can reach 130 C. High temperatures have been confirmed, for example, by the extreme distortion of polystyrene slide mounts. The softening temperature of polystyrene is about 110 C. The clear windows of some envelopes are polystyrene and these too have been found to exhibited softening and distortion, in some cases adhering to the printed matter beneath. Certain printed materials have become stuck together, probably due to the softening of the resins in the printing inks or photocopying toner.

Tensile measurements on irradiated paper show that there is a substantial loss in the ability of the paper to be deformed. This loss of extensibility has been as high as 80% and the resulting brittleness is severe. At this point the paper will not sustain being folded over. Analyses of the soluble material in irradiated and unirradiated samples of the same paper show an increase in the amounts of degradation products. The distribution of products is very different from that seen in naturally aged materials. The amount of glucose, especially, is not greatly increased. This shows that the damage is due to reactions other than hydrolysis, which is the primary reaction during the natural aging of cellulose. The relatively small amounts of soluble degradation products probably do not account for the large loss of strength observed, indicating that the changes are most likely due to radiation induced crosslinking. Such reactions have serious implications for the effects of irradiation on biological specimens. For example, crosslinking would severely hinder any DNA analyses.

Campbell Center for Historic Preservation Studies: 2002 Courses

The Campbell Center for Historic Preservation Studies is pleased to announce that the 2002 Preliminary Course Announcement is available on its web site http://campbellcenter.org/courses/prelim.shtml. 2002 Course Catalogues will be available soon and will be posted to http://campbellcenter.org. Collections care core curricula are available in three areas: Historic; Archaeological and Ethnographic; and Natural History. Other courses focus on Historic Preservation and refresher courses for practicing conservators.

Located in Mt. Carroll, Illinois, the Campbell Center for Historic Preservation Studies offers continuing education to meet the training needs of individuals who work to preserve historic landscapes and cultural, historic, and artistic properties. Workshops and courses last from two days to two weeks. Students are housed in dormitories on the campus of the former Shimer College, a group of 14 structures listed on the National Register of Historic Places. Mt. Carroll is in the Northwest corner of Illinois, about 2 ½ hours from Chicago.

Moving Collections: A Request for Information from the Natural History Museum of Los Angeles County

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Last June, at the SPNHC conference at the California Academy in San Francisco, there was an open discussion on moving collections. When the participants were asked "how many of you are currently involved in a collection move, have recently moved your collection, or are planning on moving your collection in the near future?" almost everyone raised their hand. It seems as if institutions everywhere are in the process of renovating current facilities, building new facilities, or a combination of both. And almost any of these building changes involve some type of collection move.

When I started as Chief Registrar at the Natural History Museum of Los Angeles County, there was some talk about a collection move in conjunction with renovation of our current facility, along with possible building additions. I had acted as a Project Manager on a small collection move, of 20,000 objects, in my previous position. That small move seemed like a huge task at the time, requiring at least two years to accomplish, including inventory, packing and re-housing of objects and artifacts. Now we are talking about moving collections of approximately 33 million objects and specimens!

In trying to plan and budget for such a tremendous task such as the Natural History Museum's collection move, we determined that it would be wise to talk to other institutions with similar experiences. Even though every collection move is unique, with its own set of complicated issues, we can all learn from each other's accomplishments, as well as our mistakes. Comparative information is especially helpful for budgeting purposes and in trying to convince people of the real costs associated with handling, packing, and moving collections in a safe and timely manner.

We developed a questionnaire to interview other institutions and gather this comparative information. Almost all institutions that I have interviewed so far have moved their collections from older mostly inadequate storage facilities to newer storage units, and in many cases completely new buildings. One of the good things to come out of many collection moves, is the chance to clean up, re-organize and of course, improve storage methods. I was hoping to be able to publish the results of these interviews, but since we are still in the process of gathering information, this will have to wait until sometime in the future. Since it would be beneficial to continue to receive information from other institutions, it would be great to hear from any and all of you. I have included the questionnaire for those interested in responding, or for those of you who would like to use such a questionnaire for your own collection move.

Natural History Museum of Los Angeles County: Move Questionnaire

Institution:

Contact:

Position:

Date:

What kind of objects/specimens were moved?

How many objects/specimens were moved?

What systems were used? For tracking? Record keeping?

How long did the move take, including planning, inventory, packing, moving and unpacking?

How was the move planned and organized? By whom?

Where were the objects moved? Off site storage? Permanent storage?

What was the distance of the move?

Were the objects moved into new storage units and rehoused?

What kind of packing materials and supplies were used?

What kind of access was available during the move? Was there a loading dock? Freight elevator?

Did you move than once? If so, how many times and why?

Was anything damaged during the move? Could this have been avoided by different moving methods?

What was the state of the collection/s prior to your move?

How much was inventoried?

How much was catalogued? Computer database?

Were additional staff hired? If so, how many? What were their duties?

If available, cost of the move?

Was additional funding, such as grants, sought?

What was the impact on your institution?

Did you close? If so, for how long?

Did you cancel loans (both incoming and outgoing)? If so, for how long?

Did you cancel exhibits? If so, for how long?

Did you cancel research? If so, for how long?

Were collections accessible?

Were collections secure and safely stored during move?

Any specific problems?

Were permits needed (for wet collections), for example?

What about security? Did you hire additional help? Contract? Staff? Special requirements for the move?

What about insurance? Was additional insurance needed? Purchased?

Important additional information:

Return To:

VICKI GAMBILL, Chief Registrar, Natural History Museum of Los Angeles County, 900 Exposition Blvd, Los Angeles, CA 90007.
vgambill@nhm.org

Publications of Interest

This section is from the Conservation Committee and chaired by Paula T. Work of the Citations Subcommittee. Prices and availability are cited when available. Annotations are provided by Diana Dicus {DD}, Jessica Johnson {JJ}, *Rob Waller {RW} and Paula Work {PW}. Contributions and comments may be submitted to Paula Work, Grier Collection Research Center, 1720 Gilbert Avenue, Cincinnati OH 45202; 513-345-8506 (voice); 513-345-8501 (fax); ptwork@cincymuseum.org (email).*

Asma, S. T. 2001. Stuffed Animals and Pickled Heads. The Culture and Evolution of Natural History Museums. Oxford University Press.

Chou, I-Ming, R.R. Seal II, and B.S. Hemingway 2002. *Determination of melanterite-rozenite and chalcanthite-bonattite equilibria by humidity measurements at 0.1 Mpa.* American Mineralogist 87(1): 108-114.

> Provides new measurements of equilibrium relative humidity data for these hydrate transitions at near room temperatures. {RW}

Cordell, L. S. 2000. *Finding the Natural Interface: graduate and public education at one university natural history museum.* Curator: The Museum Journal, 43(2):111-122.

Diamond, J. 2000. *Moving Toward Innovation: informal science education in university natural history museums.* Curator: The Museum Journal, 43(2):93-102.

Krishtalka, L. 2000. *Answering the Aliens: museum biodiversity education.* Curator: The Museum Journal, 43(2):103-110.

Laetsch, W. M. 2000. *Process and Product.* Curator: The Museum Journal, 43(2):83-87.

Lanyon, S. M., G. Murdock, and D. Luce. 2000. *Planning for a Natural History Museum in a University Environment: a case study.* Curator: The Museum Journal, 43(2):88-92.

MacFadden, B. J. and B. D. Camp. 2000. *University Natural History Museums: the public education mission.* Curator: The Museum Journal, 43(2):123-138.

Odegaard, N, S. Carroll, and W. S. Zimmt. 2000. *Material Characterization Tests for Objects of Art and Archaeology.* Archetype Publications, London, England, 230 pp.

> This work has been reviewed; the review will appear in *Collection Forum*

Raphael, T. 1999. *Exhibit Conservation Guidelines.* CD-ROM. Harpers Ferry: National Park Service Publication. Harpers Ferry Historical Association.

> A detailed presentation of conservation-driven exhibition. {DD}

Sachatello-Sawyer, B. and R. Fellenz. 2000. *Coming of Age: a national study of adult museum programs.* Curator: The Museum Journal, 43(2):147-156.

Scotchmoor, J. 2000. *Sharing Science through Technology.* Curator: The Museum Journal, 43(2):139-146.

Tetreault, J. 1999. *TB#21 Coatings for Display and Storage in Museums.* Ottawa: Canadian Conservation Institute.

> This technical bulletin alerts architects, designers, contractors, fabricators, project managers, and museum staff to the damage that coatings might cause to specimens. It provides guidelines for coatings selection that will help minimize risk. Tests that verify coating specifications or monitor emission of volatile compounds are described. Information of substrate surface preparation is provided. Order from CCI. {DD}

Tirrell, P. B. 2000. *A Synopsis and Perspectives of Concerns and Challenges for the International Community of University Museums.* Curator: The Museum Journal, 43(2):157-180.

Natural Hazards Observer. Natural Hazards Research and Applications Information Center. Institute of Behavioral Science #6, University of Colorado at Boulder, 482 UCB, Boulder, Colorado 80309-0482.

> Published bimonthly. The Observer is free to subscribers within the U.S. Subscriptions cost $24.00/year outside of the U.S. Excellent on-going information on hazards and hazardous materials. Much of their information is relevant to collections, institutions, and to our personal circumstances as well. (If we do not take care of ourselves, who will take care of the collections?) {DD}

The Mold Reporter. Published by Abbey Newsletter. $35.00 per year for individuals. Published quarterly.

> If possible, perhaps institutional libraries would be willing to subscribe. Occasionally, a piece of information for which you have been looking. {DD}

Museum Exhibit Lighting. An Interdisciplinary Approach: conservation, design, and technology. Presentations made at a pre-session to the AIC 25th Annual Meeting, San Diego, California, June 9-10, 1997. Presented by the National Park Service and the AIC. Xiii, 324 pp. Supplied 3-hole drilled and shrink-wrapped. $25 + p&h from AIC.

> Information from a variety of presenters. Includes current lighting technology, effects of light on collections and on minimizing light damage, distorted color, fiber optic applications, control of UV, evaluating light damage for window films and light sources, assess objects for exhibition, and exhibit case lighting made simple. {DD}

ACTS FACTS. Monthly newsletter from Arts, Crafts and Theater Safety (ACTS). Subscriptions are $18 US/year. Canada and Mexico add $3. Checks on US Banks only. Monona Rossol, Editor. 181 Thompson Street, #23. New York, New York 10012. 282-777-0062. ACTSNYC@cs.com. http://www.caseweb.com/ACTS.

> ACTS has done outstanding work in reporting on air quality in NYC at ground zero following 9-11-01. Check it out. {DD}

The Mortality and Morbidity Weekly Report *Dinosaur Dig Workers Catch Fungal Pneumonia.* ACTS FACTS, Page 2, Vol. 16, No. 01. From MMWR, 50 (45), 11/16/01, pp. 1011-13; 50 (49), 12/14/01, pp. 1106-7; and 48 (5), 1/12/99, pp. 98-100.

> Archaeologists/Paleontologists will find this particularly relevant. MMWR is *The Mortality and Morbidity Weekly Report* from the Centers for Disease Control and Prevention. {DD}

N-Hexane, Back Again. ACTS FACTS, page 4, Vol. 16, No. 01. From MMWR, (50 (45), 11/16/01, pp. 1011-1013.

> If you use n-hexane, check this out. ACTS has produced a data sheet on Hexane. Send a self-addressed, stamped envelope for a free copy. {DD}

Position Announcements

If you would like to submit job descriptions, please send postings to the Newsletter Editor. See the SPNHC web site, www.spnhc.org, for current postings.

Research Associate Position - GIS Specialist/Post-Doc, University of Colorado Museum of Natural History. The University of Colorado Museum of Natural History - nestled at the foothills of the Rocky Mountains in Boulder - is working with partners across Colorado on a nationally funded project to georeference multiple natural history collections and to link them to environmental data. The ultimate goal is to use distributed museum databases to conduct on-line biodiversity visualizations and analyses. We are seeking an accomplished and independent scientist who will work well with a diverse team of curators, collections managers, informatics staff, graduate students and undergraduates. The successful candidate is a GIS specialist who has experience: 1.) linking databases, especially MS SQL Server, into ArcGIS; 2.) using ArcSDE and especially ArcIMS and; 3.) designing biodiversity-based GIS tools. Demonstrable experience in GIS and programming is required. A PhD or equivalent industry experience is required. Experience working in a museum setting, familiarity with museum data, or previous experience working on biodiversity projects is not required but will be considered. Familiarity with GIS data management over networks also a plus. This Research Associate position has guaranteed funding for two years with annual extensions possible. Starting salary will be $44,000 plus benefits with expected pay increases annually. Applicants should send a curriculum vita, a short (one-page) statement of experience and vision, and the names of the three potential references to Prof. Robert Guralnick, Curator of Invertebrates, CU Museum of Natural History, Boulder, CO 80309-0265, USA by May 1. Starting date for the job is September 1, 2002. Inquiries by email to Dr. Guralnick (guralnic@spot.colorado.edu) or Dr. Paul Murphey (Paul.Murphey@colorado.edu). The University of Colorado at Boulder is committed to diversity and equality in education and employment.

Collection Manager, Entomology Department, The Academy of Natural Sciences, Philadelphia. The Biodiversity Research Group of The Academy of Natural Sciences (Philadelphia) is seeking a Collection Manager (CM) for the Academy's entomological collection. This comprises one of the oldest and most significant collections in the U.S. (approximately 3.5 million specimens) with major holdings including primary types (11,000 specimens), Orthopteroid insects, Hymenoptera, Diptera, Odonata and Apterygota. The CM is responsible for all aspects of caring for the collections, including processing and cataloging incoming material, maintenance of systematic and departmental order, identification, preparation, conservation and preservation of specimens and keeping records of collections usage and growth that facilitate applications for grant funds. The CM will interact with local, national and international scientific and amateur communities through specimen loans, response to inquiries, scheduling and hosting visitors, producing information for internet dissemination (e.g., databasing, imaging) and working to maximize usage and utility of the collections. The CM will also contribute to the growth of the collection through his or her own collecting efforts, supervise curatorial assistant(s), work-study students and volunteers, and participate in the Academy's public programs and other service activities. Starting date for the position is July 1, 2002. A Master's degree or higher in entomology preferred, knowledge of systematic entomology and world geography, familiarity with computers, databases and the Internet in collections activities, and five years experience working with museum collections in a position with similar responsibilities (with proof of sound training in collection management recent graduates will be considered). Candidates should have the ability to identify insects to the species level in one or more major groups. Application material should include a letter of interest, curriculum vitae and names, address and phone numbers of at least three references. These should be sent to Entomology CM Search, c/o Donald Azuma, The Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103. Review of applications will begin Feb. 15, 2002 and continue until a suitable candidate is identified.

Presidential Profile....*Continued from page 2*

preservation needs. SPNHC is cooperating with Heritage Preservation in their effort by serving on the Heritage Health Index Institutional Advisory Committee. I attended the first meeting of the Advisory Committee in late October. In order to pursue this survey, it is planned that several working groups will be set up to advise HHI on the survey design and the formation of questions. The membership of each working group will reflect the diversity of the institutions to be surveyed. Natural Science Collections represent one of the six working groups that have been identified.

Probably the event that has affected natural history collections most directly is the mailing of anthrax tainted letters. While some of the other developments have been limited to activities occurring in the U.S., this one had worldwide implications. Potential irradiation of mail sent shock waves through many institutions whose specimens were somewhere "out there" in the mail system. The potential effects of irradiation on biological materials were of great concern. Fortunately, staff members at the Smithsonian Center for Materials Research and Education (SCMRE) began working to address these questions immediately. David von Endt made sure that information developed by SCMRE to address these concerns was funneled to SPNHC as quickly as possible (see articles by von Endt & van Zelst and von Endt et al in this newsletter). At this point irradiation of the mail is not widespread, but anyone sending specimens to the Smithsonian should contact colleagues at that institution for current advice before preparing shipments.

It will soon be time to come together to conduct Society business once again.The 2002 Host Committee has been actively organizing and planning for nearly a year. This promises to be a meeting not to be missed. I look forward to seeing you in Montreal this May for the 17th Annual Meeting.

Calendar of Events

The Calendar of Events is maintained by Christine Chandler of the Documentation Commitee. Application deadlines, conferences and symposium relevant to collection management, computerization and conservation of natural history collections are listed. Notices may be submitted to Christine at Putnam Museum of History and Natural Science, 1717 West 12th Street, Davenport, IA 52804; (563) 324-1054 ext. 226; email chandler@putnam.org or dinoceras@juno.com.

March 2002

March 1, 2002. **Teaching with Digital Content Collaborations with Cultural Institutions Workshop**, Chicago Public Library, Chicago, Illinois, USA. Free & open to the public. For more information, contact: Nuala A Bennett, Digital Imaging & Media Technology Initiative, University of Illinois at Urbana-Champaign; (217) 333-9046 (phone); (217) 244-7764 (FAX); nabennet@uiuc.edu (email); http://images.library.uiuc.edu/projects/tdc.

March 1, 2002. ***Manuscript submission deadline, Journal of Geoscience Education Special Issue*** *on Research Partnerships in the Geosciences Involving Researchers, K-16 classrooms, & General Public.* Contact: Paul Harnik at pgh3@cornell.edu or Robert Ross at rmr16@cornell.edu. Manuscript guidelines available at http://www.nagt.org/Instructions.htm (website).

March 5 - 7, 2002. **Spring School in New Media**, Dept. of Museum Studies, University of Leicester, Leicester, United Kingdom. Limited to 18 participants. See: http://www.le.ac.uk /museumstudies for further details.

March 6 - 9, 2002. **Art & Soul: Celebrating Indigenous Artisans**, Society of Ethnobiology, University of Connecticut, Storrs, Connecticut, USA.

March 7, 2002. **BRIT Distinguished Lecturer Series, The Role of Natural History Museums in Modern Human Society**, Fort Worth, Texas, USA. Featuring Dr. Gregory Long, President, New York Botanical Garden; sponsored by the Botanical Research Institute of Texas & the Fort Worth Museum of Science & History.

March 11 - 15, 2002. **Microscopy of Protective and Decorative Coatings**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses_2002.html.

March 18 - 19, 2002. **Writing Grants for Conservation Projects**, presented by the Upper Midwest Conservation Association, Minneapolis Institute of Arts, Minneapolis, Minnesota, USA. Contact: Melinda Markell, Field Services Coordinator; (612) 870-3128 (phone); umca@aol.com (email); http://www.preserveart.org (website).

March 18 - 22, 2002. **Museums Australia 2002 National Conference,** Adelaide, Australia.

March 20, 2002. **Identification and Care of Film-Based Materials**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses_2002.html.

March 20 - 22, 2002. **Legal Problems of Museum Administration**, Los Angeles, California, USA. Contact: ALI-ABA, Office of Courses; 1-800-253-6397 ext. 1632 (phone); http:// www.ali-aba.org (website).

March 23, 2002. **Saint Louis Copyright Town Meeting, The Changing Research & Collections Environment: The Information Commons Today**, St. Louis, Missouri, USA. Free of charge & open to the public. See: http://www.ninch.org/copyright/townmeetings01 /stlouis.html.

March 23 - 24, 2002. **The Herpetology Conference 2002, 25th Annual All Florida Conference**, Gainesville, Florida, USA, hosted by the Florida Museum of Natural History. Registration materials available online at http://www.flmnh.ufl.edu/natsci/herpetology/afhc-regist.htm. For additional information, contact: maxn@flmnh.ufl.edu (email); (352) 392-1721 (phone).

March 25, 2002. **Leadership through Diversity Workshop: Building Audiences & Strengthening the Workforce for Tomorrow's Museums**, Mashantucket Pequot Museum, Mashantucket, Connecticut, USA.

March 29, 2002. ***AAM Accreditation Application Deadline.*** Applications are available online at http://www.aam-us.org/accred.htm. Call (202) 289-9116 to obtain a copy by mail.

March 30, 2002. **The Convention on Biological Diversity: A Ten Year Report Card, 7th International Wildlife Law Conference**, Washington, DC, USA.

April 2002

April 4, 2002. **BRIT Distinguished Lecturer Series, The Role of Natural History Museums in Modern Human Society**, Fort Worth, Texas, USA. Featuring Dr. Art Wolf, Director, Museum of Northern Arizona ; sponsored by the Botanical Research Institute of Texas & the Fort Worth Museum of Science & History.

April 8 - 12, 2002. **Practical Wood Anatomy in a Museum Environment**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses_2002.html.

April 10 – 11, 2002. **Biology Collections and Lifelong Learning**, Newcastle University, Newcastle upon Tyne, UK. For information, contact Nick Gordon, New Walk Museum, New Walk, Leicester LE1 7EA, UK, gordn001@leicester.gov.uk (email).

April 10 – 11, 2002. **Biology Curators Group Annual General Meeting**, Newcastle University, Newcastle upon Tyne, UK. For information, contact Nick Gordon, New Walk Museum, New Walk, Leicester LE1 7EA, UK, gordn001@leicester.gov.uk (email).

April 17 - 20, 2002. **Museums on the Web 2002**, Boston, Massachusetts, USA. To register online: http://www.archimuse.com/mw2002/register/index.html. For more information, contact: MW2002@archimuse.com (email).

April 19, 2002. **Keeping in Step: Prioritizing for Archival Preservation**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses_2002.html.

April 25 - 27, 2002. **49th Annual Meeting of the Southwestern Association of Naturalists**, Universidad Autunoma del Estado de Morelos, Cuernavaca, Morelos, Mexico. See: http://www.cib.uaem.mx/swan.htm .

April 24 - 27, 2002. **Northeast Natural History Conference VII**, New York State Museum, Albany, New York, USA.

April 26 - 28, 2002. **3 Day UCLA Extension Course in Document Imaging - Document Management**, Los Angeles World Trade Center, Los Angeles, California, USA. See: http://www.ArchiveBuilders.com for a copy of the course description.

April 27 - 30, 2002. **47th Museum Retail Conference & Expo**, Charlotte,

North Carolina, USA.

April 30 - May 4, 2002. **Canadian Museums Association 2002 Annual Conference**, Calgary, Alberta, Canada. To register: CMA Annual Conference 2002, P.O. Box 62009, Ottawa, Ontario, K1C 7HB; 1-800-221-4443 (phone); (613) 824-1167 (FAX);

May 2002

May 2, 2002. **BRIT Distinguished Lecturer Series, The Role of Natural History Museums in Modern Human Society**, Fort Worth, Texas, USA. Featuring Dr. Doug Sharon, Director, San Diego Museum of Man ; sponsored by the Botanical Research Institute of Texas & the Fort Worth Museum of Science & History.

May 6 - 10, 2002. **History, Technology, & Preservation for Specialty Papers, Archives Materials, & Ephemera**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses_2002.html.

May 8 - 13, 2002. **17Th Annual Meeting of the Society for the Preservation of Natural History Collections**, Redpath Museum, Montreal, Quebec, Canada. Co-organized with the Canadian Museum of Nature. For more information, contact: Ingrid Birker, Redpath Museum, McGill University, 859 Sherbrooke St. West, Montreal, QC H3A 2K6, Canada; (514) 398-4086, ext. 4094 (phone); (514) 398-3185 (FAX); ibirker@hotmail.com (email).

May 12 - 16, 2002. **AAM Annual Meeting, The Community of Museums: Seeking the Common Good**, Dallas, Texas, USA.

May 16 - 18, 2002. **5th European Commission Conference on Research for Protection, Conservation & Enhancement of Cultural Heritage**, Cracow, Poland. Conference website at http://www.heritage.ceti.pl.

June 2002

June 7 - 9, 2002. **Natural Science Collections Alliance (NSCA, formerly ASC) Annual Meeting**, Washington, D.C., USA. Collection-oriented sessions to address tissue collections, economic botany collections, osteological collections, herbaria, etc. Representatives of USF&WS, NOAA, APHIS (USDA), & NPS will present permitting program. For details & updates, log onto http://www.ascoll.org (website) or call (202) 835-9050 (phone).

June 15 - 21, 2002. **Connecting with the K-12 Teaching and Learning Community**, Grindstone Island 2002 Summer Seminar Series, offered by Archives & Museum Informatics. Visit the website at http://www.archimuse.com/grindstone. To receive a brochure, contact: grindstone@archimuse.com.

June 15 - 19, 2002. **American Society of Mammalogists Annual Meeting**, McNeese State University, Lake Charles, Louisiana, USA. Chair: Gale Haigh.

June 23 - 28, 2002. **People & Places: Making Connections**, Assoc. for Living History, Farm, & Agricultural Museums (ALHFAM) 2002 Annual Meeting, Cape Breton, Nova Scotia, Canada.

June 24 - 29, 2002. **World Conference on Educational Multimedia, Hypermedia & Telecommunications**, Denver, Colorado, USA, organized by the Assoc. for the Advancement of Computing in Education (AACE); http://www.aace.org.

June 28, 2002. ***AAM Accreditation Application Deadline.*** Applications are available online at http://www.aam-us.org/accred.htm. Call (202) 289-9116 to obtain a copy by mail.

June 28 - July 2, 2002. **Annual Meeting of the Society for the Study of Evolution**, University of Illinois, Urbana-Champaign, Illinois, USA. Email: scmiller@uiuc.edu.

July 2002

July 3 - 8, 2002. **American Society of Ichthyologists and Herpetologists (ASIH) Annual Meeting**, joint meeting with **SSAR**, Weston Crown Center, Kansas City, Missouri, USA. See: http://www.dce.ksu.edu/dce/cl/2002jointmeeting for information

July 5 - 7, 2002. **Flowers: Diversity, Development and Evolution**, an international conference to be held at the Institute of Systematic Botany, University of Zurich, Zurich, Switzerland. Information is available online at www.sysbot.unizh.ch/flowers (website).

July 6 - 10, 2002. **1st International Palaeontological Congress**, Macquarie University, Sydney, Australia. For further details: http://ipa.geo.ukans.edu/convention.htm.

July 8 - 10, 2002. **Science for Plant Conservation - An International Conference for Botanic Gardens**, Trinity College, Dublin, Ireland. Visit the website for details: http://www.rbg.ca/cbcn/science.

July 8 - 12, 2002. **2nd International Congress on Phthiraptera (Lice),** University of Queensland, Brisbane, Australia. See conference website for further details: http://www.imb.uq.edu.au/ICP2.

July 8 - 12, 2002. **Polarized Light Microscopy - Fundamentals & Applications**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses_2002.html.

July 14 - 26, 2002. **16th Annual Western Archives Institute**, University of Redlands, Redlands, California, USA. *Admission by application only; application deadline is April 1, 2002.* For more information, contact: Administrator, Western Archives Institute, 1020 O St., Sacramento, California 95814 USA; (916) 653-7715 (phone); (916) 653-7134 (FAX); ArchivesWeb@ss.ca.gov (email).

July 23 - 25, 2002. **Enzymes & Their Use in Conservation: A Lecture & Workshop Series for Mid-Career Conservators**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses_2002.html.

July 26 - 28, 2002. **The State of Museums: Memory, Vision, Responsibility..., California Association of Museums 2002 Annual Conference**, Sacramento, California, USA.

July 28 - August 2, 2002. **ICME Conference 2002**, the National Museums Board of Zambia & the International committee for Museums of Ethnography, Lusaka & Livingstone, Zambia. For more information, p.b.rekdal@ukm.uio.no (email).

August 2002

August 7, 2002. **Disaster Mitigation for Document Collections**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses_2002.html.

August 7 - 10, 2002. **Annual Meeting AABGA**, Royal Botanic Garden, Hamilton/Burlington (Greater Toronto Area) Canada.

August 13 - 17, 2002. **Visitor Studies Association (VSA) 2002 Annual Conference**, Cody, Wyoming, USA. Check http://museum.cl.msu.edu/vsa/conferen.htm for details.

August 21, 2002. **Preservation Workshop**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses _2002.html.

September 2002

September 4 - 7, 2002. **Museum Computer Network (MCN) 2002 Conference**, Toronto, Ontario, Canada. See: http://www.mcn.edu for details.

September 11 - 15, 2002. **Descansando Para La Jornada: Resting for the Journey, Western Museums Association 2002 Annual**

Meeting, Tucson, Arizona, USA. Check the website at http://www.westmuse.org.

September 22 – 28, 2002. **ICOM** triennial meeting, Hotel Gloria, Rio de Janeiro, Brazil. http://www.icom_cc.org

September 25 - 28, 2002. **120th Stated Meeting of the American Ornithologists' Union**, in conjunction with the **3rd North American Ornithological Conference**, New Orleans, Louisiana, USA. For more information: http://www.tulane.edu/~naoc-02.

September 29 - October 4, 2002. **5th International Congress of Dipterology**, University of Queensland, Brisbane, Australia. Contact: Sally Brown, Conference Connections at sally.brown@uq.net.au (email); http://www.uq.edu.au/entomology/diperol/diptconf.html.

October 2002

October 2 - 5, 2002. **Mountain-Plains Museums Association & Kansas Museums Association 2002 Annual Conference**, Topeka, Kansas, USA.

October 12 - 15, 2002. **Association of Science-Technology Centers (ASTC) Annual Conference**, Charlotte, North Carolina, USA, hosted by Discovery Place, Inc. Check out http://www.astc.org for more information.

October 16 - 19, 2002. **Southeastern Museums Conference (SEMC) Annual Meeting**, Richmond, Virginia, USA. For more information: (225) 383-5042 (phone); (225) 343-8669 (FAX); SEMCdirect@aol.com (email); http://www.semcdirect.net (website).

October 21 - 25, 2002. **History, Technology, & Preservation of Paper-Based Artifacts**, a Smithsonian Center for Material Research and Education (SCMRE) course. For more information, see: http://www.si.edu/scmre/courses_2002.html.

November 2002

November 13 - 15, 2002. **Education, Enterprise, & Economics: The Value of Museums, New England Museums Association (NEMA) Annual Conference**, Manchester, New Hampshire, USA. For more information: (617) 242-2283 (phone); (617) 241-5797 (FAX); http://www.nemanet.org (website).

November 13 - 15, 2002. **Plant Species-Level Systematics: Patterns, Processes & New Applications**, Leiden, The Netherlands, organized by National Herbarium of the Netherlands, International Assoc. of Plant Taxonomists, and the Linnean Society of London. For further information, visit the symposium website at http://www.nationaalherbarium.nl /symposium2002/home.htm.

November 14 - 16, 2002. **2002 Assoc. of Midwest Museums (AMM) & Minnesota Assoc. of Museums (MAM) Joint Annual Conference**, Minneapolis-St. Paul, Minnesota, USA. Contact: David M. Tanner, (314) 454-3110 (phone) or mmcdirect@aol.com (email); check out the website at http://www.midwestmuseums.org.

December 2002

December 31, 2002. ***AAM Accreditation Application Deadline.*** Applications are available online at http://www.aam-us.org/accred.htm. Call (202) 289-9116 to obtain a copy by mail.

January 2003

January 4 - 8, 2003. **Society for Integrative and Comparative Biology (SICB) Meeting**, Toronto, Ontario, Canada.

July 2003

July 1 - 5, 2001. **Annual Meeting AABGA**, Greater Boston Gardens, Boston, Massachusetts, USA.

August 2003

August 5 - 9, 2003. **121st Stated Meeting of the American Ornithologists' Union**, University of Illinois, Champaign-Urbana, Illinois, USA.

November 2003

November 8 - 11, 2003. **Association of Science-Technology Centers (ASTC) Annual Conference**, St. Paul, Minnesota, USA, hosted by the Science Museum of Minnesota. Check out http://www.astc.org for more information.

September 2004

September 19 - 22, 2004. **Association of Science-Technology Centers (ASTC) Annual Conference**, San Jose, California, USA, hosted by the Tech Museum of Innovation. Check out http://www.astc.org for more information.

October 2005

October 15 - 18, 2005. **Association of Science-Technology Centers (ASTC) Annual Conference**, Richmond, Virginia, USA, hosted by the Science Museum of Virginia. Check out http://www.astc.org for more information.

Request for Information: New England wolves

The Maine Dept. of Inland Fisheries and Wildlife and Dr. Paul Wilson, Trent University, are conducting a study to determine the taxonomic relationship of Maine coyotes to other canid species in the Northeast. They are very interested in obtaining genetic samples from historic wolf specimens collected from any of the New England states. To date, they have only been able to locate one specimen from Maine at the Museum of Comparative Zoology at Harvard University. From the wolf bounty records they have from the turn of the last century, they believe that more specimens may exist, possibly in European collections or even in museums in the western U.S.A.

If your institution holds wolf specimens collected in the New England states, Dr Wally Jakubas of the Maine Department of Inland Fisheries & Wildlife would like to hear from you. His telephone number is (207) 941-4471 and his email is Walter.Jakubas@state.me.us.

Still not paid this year's subscription?

If so, this could be the last SPNHC publication that you receive. Avoid this awful fate by getting your payment to the SPNHC Treasurer, Lisa Palmer, as soon as possible.

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SPNHC 2002

May 8 - 13, 2002

Redpath Museum / McGill University
Montreal, Canada

The 17th Annual Meeting of SPNHC is co-organized with the Canadian Museum of Nature (CMN) and features three days of technical sessions, a keynote speaker and a professional workshop on the topic of *Hazardous Collections and Mitigation.* The Social Programme includes field trips to the Collection Facility of the CMN near Ottawa, a UNESCO Biosphere Reserve, local Ordovician quarries and the world famous Biodome.

Registration and Abstract submission: April 10, 2002.

Please use the Electronic forms available from the SPNHC website at http://www.spnhc.org/2002/ or contact Joan Kaylor, SPNHC 2002,Redpath Museum/ McGill University, 859 Sherbrooke St. West, Montreal, Canada H3X 3R7 or e-mail jkaylor@eps.mcgill.ca