

SCMRE

Activity

Report

1996-1998

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DIRECTOR'S REMARKS

It is a great pleasure to introduce this activities report of the Smithsonian Center for Materials Research and Education. Our last report, for FY 1995, covered, like its predecessors, a one-year period. Since then we decided, based on a number of considerations, that included resource requirements but also the fact that many of our programs are of a long-term nature and are better presented in the context of a longer reporting period, on producing multi-year reports. Hence, this report before you represents activities during the period FY 1996-1998.

Much has happened since that last report, not the least of which is our name change, as approved by the Smithsonian Institution's Board of Regents, from the old Conservation Analytical Laboratory to now the Smithsonian Center for Materials Research and Education. This name change, which had been suggested among others by our Advisory Committee after its program review in 1995, represents an acknowledgment of our present mission as opposed to the one under which the laboratory operated for many years in the seventies and early eighties.

During these past few years, new program priorities that were formulated around 1995, have come to fruition with new activities that are reported in this booklet. In research, it is especially worth mentioning the greatly emphasized efforts in the area of the preservation of natural history collection materials, with respect to both the stability of the specimen structure as well as of the biomolecular information contained in the specimens. Another preservation research area in which great progress was made regards the mechanical properties of collection materials, their relation with the chemical properties of materials, and their consequences for the damage potential posed by the collection environment. In the sphere of collection-based research, new inroads into the area of ancient biomolecules, where the newest biochemical research techniques are used to enlighten our understandings in archaeology and paleontology, are especially worth mentioning. All this work adds to the basis of continued outstanding work in the preservation and conservation of more conventional collection materials, and in the provenience attributions and technological studies of archaeological materials.

In education, we have been able to put increased emphasis on outreach toward wider audiences. While traditionally we have directed our educational efforts mainly at professionals in the conservation and related museum fields, we now routinely address the needs of other professional and, of special importance, more general audiences. As a national center, with funding supplied mainly from federal appropriations, we feel it a part of our mandate to address the interests of the general public, including those of traditionally underserved audiences. The great enthusiasm with which such outreach projects as the "*santos*" workshops at SCMRE and in Puerto Rico were received indicates that this program direction indeed answers an existing need.

All these new initiatives had to be implemented with a constant funding base, requiring both internal resource allocations and a greatly increased workload on SCMRE staff. It gives me great pride to reflect on the magnificent job done by these fine professionals, who truly represent the greatest resource of our laboratory.

Finally, I want to acknowledge the outstanding efforts of our program coordinators, Ron Bishop for Research and Don Williams for Education, and of Assistant Director for Operations Melanie Feather, in managing the programs and projects under their responsibility. Not the least of these responsibilities entailed the collections and editing of information in this report. I trust that you will find it both interesting and enjoyable, and look forward to hearing your comments and suggestions.

MISSION STATEMENT

The Smithsonian Center for Materials Research and Education (SCMRE) of the Smithsonian Institution is a specialized unit dedicated to research and education in an interdisciplinary area united the arts and humanities with the physical and natural sciences. The staff represents a wide range of disciplines, the interaction of which achieves a fuller understanding of complex objects, conditions and contexts. Scholarly quality, importance and relevance to the appropriate professional audience nationally and internationally, and concurrence with formulated priorities are principal criteria in program development.

SCMRE's research interests center on collections of cultural or scientific significance and related materials. Within this field, research concentrates in two distinctly different, yet closely interrelated foci: the application of scientific methodology to address questions in archaeology, anthropology, history or art history, and the preservation and conservation of materials in collections. SCMRE's training and education programs are mainly directed at students and professionals in SCMRE's areas of interest and related fields, aiming at an audience with a broad variety of professional training and experience and using a wide range of information delivery mechanisms.

SCMRE's constituency is formed by the community of museums and scholars nationwide and internationally. As part of this constituency, the Smithsonian's museums are primary benefactors of SCMRE's research and education programs. SCMRE's position within the Smithsonian Institution facilitates a mutually beneficial relationship with the Institutional collections, in which the latter may provide research and training materials for SCMRE programs, yet in turn are enriched through collaborative research and training programs and assistance in the form of expert advice services and, within the limits of available resources, direct technical and analytical support.



ORGANIZATIONAL STRUCTURE

SCMRE's present organizational structure was established some 5 years ago, and is intended to reflect the interdisciplinarity of the unit's programming. While it officially reflects the hierarchical framework of federal agencies, in reality it is far more fluid, determined more by programming and projects rather than linear supervisory oversight. In practice, SCMRE employs a matrix structure, in which any staff member may (and usually do) participate in several divergent areas of programming activity.

SCMRE's greatest strength, by far, lies in its staff, which consists of highly skilled and dedicated professionals. Indeed, it must be recognized that the remarkable successes that SCMRE has had in its various program activities and that have earned it a reputation of excellence in several of them, are above all attributable to the staff's great personal involvement, enthusiastic participation and innovative thinking. SCMRE staff, individually and in teams, produce work that is excellent in both quality and quantity. How directed coordination of activities within a functional framework lead to enhancement and multiplication of effect of individual contributions is demonstrated within SCMRE, for example, in the area of the characterization of materials behavior under varying environmental conditions. The synergy of coordinated individual projects in measurement of mechanical properties, modeling of composite structures, chemical and physical properties of photographic materials, chemistry of cellulose degradation, and chemistry of elastomeric polymers, has brought SCMRE researchers to the edge of unparalleled breakthroughs in our understanding of a wide range of materials in collections. It is by coordinating the individual efforts, steering these projects as they go along into mutually reinforcing and complementary directions, that a maximum impact is derived, which would not be realized from fragmented individual projects by themselves.

An organization along functional lines, with the functions representative of SCMRE's mission elements, and in which the organizational/programmatic units closely interact and indeed overlap, with shared resources, including staff, serves SCMRE much better in reaching its goals. A majority of projects, in research or education, require collaboration and co-participation between staff members of different disciplinary background and reporting in different organizational units - conservators, scientists, information specialists. The present structure promotes such cross-overs between units.

SCMRE's functional areas are no longer in conservation, conservation science and archaeometry, as they were until the late 1980's; they are, as defined in the mission statement, in research and education. A functional organization, then, requires a research department and an education department, in addition to a third department that provides the technical infrastructure needed for research and education programs. Such infrastructure support includes provision of access to general use laboratory instrumentation and its operation and maintenance, and technical information assistance. The same department provides technical and information support and collaboration to Smithsonian Institution-wide conservation and curation efforts and appropriate outside constituencies.



SCMRE staff by and large do not restrict their individual activities to one single functional area; most participate in a number of functionally different activities, for example performing both research and training. Hence there is the need for a flexible and somewhat fluid structure, in which organizational units overlap and interact, yet in which coordination within functional areas optimizes the output and efficiency in those areas. Thus we have an organizational structure along the lines described above, with three function areas: (1) research and development, (2) support and collaboration, and (3) training and education.

RESEARCH and DEVELOPMENT

Research at SCMRE is by nature interdisciplinary, combining elements of the arts and humanities with the physical and natural sciences and engineering. It may be pursued by any professional from SCMRE's staff.



In characterization studies or research, methods are developed, adapted and applied for analysis and characterization of cultural materials that can yield information which, in synthesis with the contextual art historical/archaeological information, may enrich our understanding, and knowledge of the artistic, technical, economic, social and political environments in which they originated. Such research can be chiefly developmental in nature or, using fully developed technologies, aim specifically at the actual application.



Preservation research strives to enlarge our understanding of how materials and composite objects deteriorate, to formulate conditions for storage, display or other use which will minimize the deterioration, and to develop and test conservation treatment technologies to stabilize deteriorating collection materials. Studies of deterioration processes require analysis and characterizations of the materials and deterioration products, examining how external and internal factors, such as environmental conditions or chemical composition and physical structure, affect the nature and rate of these alteration mechanisms. While the ultimate goals are

different, both characterization and preservation research consist of analysis of cultural/collection materials and, to a significant degree, share the utilization of the same technology and instrumentation. It may not be too surprising, therefore, that there are already a number of overlaps where, for example, staff members engaging in preservation studies engage in research projects which, by their nature, would be expected to be part of the characterization process. Similarly, technical studies as often done by conservators could equally be construed as belonging within the domain of artifact or material characterization. Rather than differentiating characterization and preservation research as two distinct functional and organizational areas, the SCMRE structure recognizes them as two foci of one functional group: research.



By and large most research at SCMRE is of a strictly applied nature and the transitions where a research project becomes a development project often are extremely vague, especially since the same staff generally is involved with both aspects. Recent work in photographic materials preservation is a good example: after the applied research into the physical response of such materials to changes in environmental conditions, the same scientist then continued to develop a low temperature storage technology for these materials. Especially with SCMRE's relatively small staff, it would then seem quite impractical, if possible at all, to make the distinction between "research" and "development" sufficiently clear and unambiguous that a functional differentiation would be feasible or desirable. Hence, SCMRE combines both into one functional unit: Research and Development.



SUPPORT and COLLABORATION

Both research and education activities at SCMRE require an extensive supporting infrastructure, not only administratively but also technically. While certain instrumentation may be dedicated to specific research programs, and consequently maintained and operated by the project staff, a large fraction of SCMRE research equipment is of general, communal use and requires centralized maintenance and operation. The resources applied to these internal support activities, in terms of staff and facilities, also are involved in the analytical support to conservation and curation efforts in other Smithsonian bureaus.

Access to these resources, for research, educational, or analytical support activities, is planned and coordinated, within a framework of SCMRE priorities, in order to make the most efficient use of them, avoid scheduling conflicts, come to timely completion of commitments, and ensure timely and appropriate maintenance.

Interaction with other bureaus of the Smithsonian Institution range from incidental, relatively small analytical service projects to larger scale, collaborative research or collections care projects on a basis of reviewed proposals. SCMRE analytical staff members are often called to assist with chemical and structural "what is it" questions in support of the research and educational programs of the laboratory. These are usually done as part of a research project or technical study, and the results are often the basis of further study. In addition, because of the SCMRE's advanced analytical instrumentation and staff expertise, other Smithsonian Institution units (and on occasion, other government agencies or museums) will also ask staff members to assist them with their research or conservation projects by performing analyses or consultations.



During FY 1996 through FY 1998 approximately 3225 samples were examined and 7845 analyses run. Approximately 57% were performed for SCMRE projects, 33% for other Smithsonian Institution units, and 10% for outside (non-Smithsonian) organizations.



Scientific instrumentation currently available for such analytical service requests includes fourier transform infrared spectroscopy, gas chromatography, gas chromatography-mass spectroscopy, optical microscopy, scanning electron microscopy with energy dispersive spectroscopy, xeroradiography, x-ray diffraction, x-ray fluorescence, x-ray radiography, and ultraviolet-visible light spectrophotometry.

This equipment enable staff members to help with the chemical and structural characterization of materials, and to try to identify unknown compounds.

TRAINING and EDUCATION

SCMRE has a longstanding tradition of training, especially in the conservation area. During the last ten years the importance of these activities has increased steadily to the point where its importance is recognized in the name of the organization.

The flexibility which SCMRE was allowed in its training program has been, and will continue to be, a key factor to its success. In contrast to, for example, graduate training programs, where the curriculum, staffing, number and type of students, etc. tend to be quite static, fixed for a long period ahead, and hard to modify, SCMRE has been able to quickly create new or adapted educational activities, acting on the needs of the field, as and when perceived. The innovative and highly successful Furniture Conservation Training Program (FCTP) comes to mind first of all, but there are also the dedicated internship programs in archaeological conservation (ACIP) and archival conservation (the latter in turn connected to RELACT, the Smithsonian oriented Research, Libraries and Archives Collections Conservation Taskforce program in conjunction with Smithsonian Institution Libraries and Smithsonian Institution Archives). The long series of professional courses with continuously changing subject matters provides, where appropriate, also repeats of earlier course offerings.

Conservation fellowships and internships have been offered at various levels of expertise and experience (including the highly successful series of pre-program internships), and of course the SCMRE-Johns Hopkins University program in conservation science represented a unique attempt at the training of conservation scientists at the graduate school level. It has become increasingly evident that besides the training of conservation professionals, there exists an increased need for education directed at other museum professionals, such as curators, collection managers, registrars, handlers, exhibit designers, and also administrators and even directors and trustees. This audience needs to be made aware of the needs of the collections with which they are concerned, in terms of physical storage conditions, limitations and options regarding exhibit or research use, in basic and cost effective collections care, in understanding preservation and conservation options, etc. Such educational outreach requires other mechanisms than those used for the specialist training; multimedia and electronic products, seminars and directed publications are other mechanisms that come to mind immediately.



SCMRE's technical information program presently serves two constituencies: a professional audience and the general public. The public information program is a logical commitment for a federally funded operation. SCMRE's partnership in the Conservation Information Network (CIN) and the concomitant participation in its updating, maintenance and promotion put an additional workload on a group which recently has seen a reduction in staffing size due to staff departures and retirements. The fundamental outreach nature of the Information Office suggests its proper role within the Education and Training programming, to which it was transferred from Support and Collaboration near the conclusion of the period covered by this Activity Report.

One need for increased activity which has become very clear is for a SCMRE publication effort. In order to ensure appropriate dissemination for its research achievements, SCMRE's research staff publish its findings in the appropriate peer-reviewed professional press. Also, a major research program may result in a number of sequential professional papers, but the total impact can be made more significant by publication of a monograph synthesizing the collective information over the whole of the subject. At the same time, however, this often is not an efficient way of getting the information about restoration and preservation to the end user.

Especially in the area of public information services, a streamlining through preparation of more easily available reference materials is a first necessity. The growth of SCMRE's presence on the World Wide Web is a reflection of this priority.

In addition to the rich menu of present training offerings, new initiatives may be considered within the context of reprogramming resources allocated to existing activities. This requires an ongoing, periodic review of priorities and activities. Both an internal review process, involving representatives of all professional and functional categories at SCMRE, and an external one, involving representatives of the constituency of the SCMRE Training and Education program, are viewed as essential components in programmatic continuance and development.

Staff and Affiliated Individuals

STAFF MEMBERS



Lambertus van Zelst (LVZ), Director



Harry A. Alden (HAA), Microscopist

Mary T. Baker (MTB), Research Organic Chemist

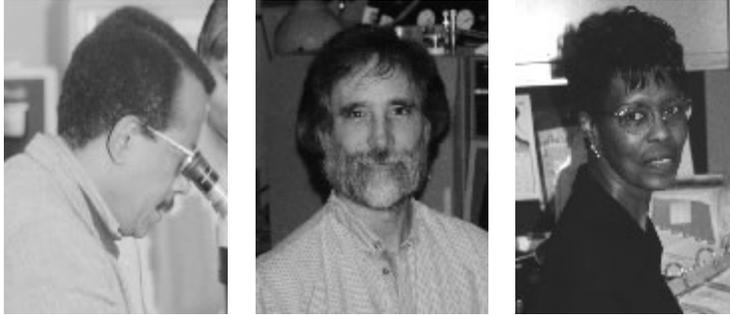
Mary W. Ballard (MWB), Senior Textiles Conservator



Harriet F. (Rae) Beaubien (HFB), Objects Conservator

Ronald L. Bishop (RLB), Coordinator for Research/Senior Research Archaeologist

M. James Blackman (MJB), Senior Research Chemist



Roland H. Cunningham (RHC), Senior Paintings Conservator
W. David Erhardt (WDE), Senior Research Chemist
Loretta Ester-Clark (LEC), Administrative Support Assistant



Melanie E. Feather (MEF), Assistant Director for Operations
Martha Goodway (MG), Metallurgist
Gail L. Goriesky (GLG), Technical Information Specialist



Carol A. Grissom (CAG), Senior Objects Conservator
Walter R. Hopwood (WRH), Organic Chemist
Emile C. Joel (ECJ), Research Chemist



Connie J. Kolman (CJK), Research Biologist
Francine T. Lewis (FTL), Training Program Assistant
Mark McCormick-Goodhart (MMG), Senior Research Photographic Scientist



Marion F. Mecklenburg (MFM), Senior Research Scientist
Ann B. N'Gadi (ABN), Technical Information Specialist
Jill L. Russ (JLR), Biochemist



Jocelyn D. Sellers (JDS), Office Assistant
Beverly M. Smith (BMS), Assistant to the Director
Cheryl D. Sultzer (CDS), Computer Specialist



Camie S. Thompson (CSTh), Analytical Chemist
Fei-wen Tsai (FWT), Archives Conservator
Jia-sun Tsang (JST), Paintings Conservator



Charles S. Tumosa (CST), Senior Research Chemist
Noreen C. Tuross (NCT), Senior Research Biochemist
Dianne van der Reyden (DVR), Senior Paper Conservator

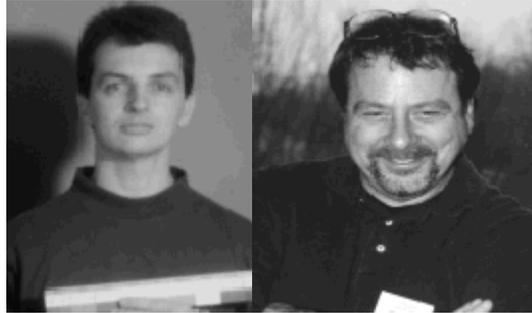


Pamela B. Vandiver (PBV), Senior Research Ceramics Scientist
David von Endt (DVE), Senior Research Organic Chemist
Melvin J. Wachowiak (MJW), Furniture Conservator/FCTP Director



Donald C. Williams (DCW), Coordinator for Education/Sr. Furniture Conservator
Vernetta M. Williams (VMW), Administrative Officer

INTERNS, FELLOWS, and VISITING SCHOLARS



Patrick Albert (PMA), BA Geography, University of Ottawa; Furniture Conservation Training Program (FCTP); 1993-1996

Jane Ballany (JB), PhD University of Strathclyde; research intern in chemistry; 1998 (photo unavailable)

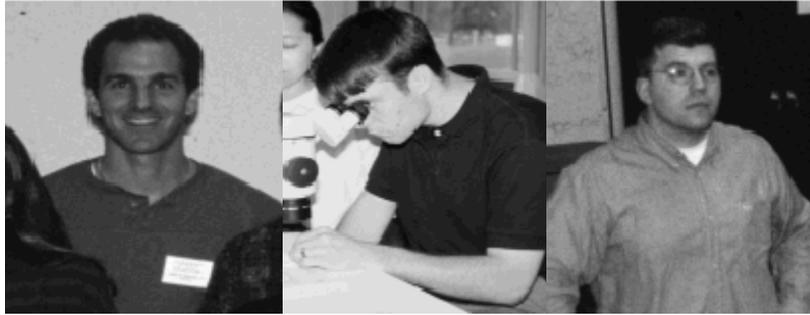
Ron Blank (RSB), BA Comparative Literature, University of North Carolina; Furniture Conservation Training Program (FCTP); 1996-2000



Fabian Goncalves Borrega (FGB), BA Technical Institute of Restoration, Buenos Aires; conservation intern in coatings; Summer 1998

Jon E. Brandon (JEB), MA Education, Michigan State University; Furniture Conservation Training Program (FCTP); 1996-2000

David Chalfoun (DJC), PhD Biochemistry, MIT; post-doctoral fellow in biogeochemistry; 1996-1998 (photo unavailable)



John Courtney (JAC), BS Chemistry, East Carolina University; Furniture Conservation Training Program (FCTP); 1993-1996

Jeff Dunbar (JD), MA Conservation, University of Delaware; intern in paper conservation laboratory; Summer 1997

Tad Fallon (TDF), BA Restoration, Fashion Institute of Technology; Furniture Conservation Training Program (FCTP); 1996-2000



Sean H. Fisher (SHF), BA Art History, Syracuse University, Certificate North Bennett Street School; Furniture Conservation Training Program (FCTP); 1996-2000

Patricia J. Hill (PJH), PhD Chemistry, Arizona State University; professor on sabbatical from Millersville University, PA; 1997

Jennifer J. Hooper (JJH), materials science/ceramics student at Johns Hopkins University; 1998 (photo unavailable)



Stephanie E. Hornbeck (SEH), MA Art Conservation, New York University; graduate intern in archaeological conservation; 1997-1998

Lara Kaplan (LK), BA Art History, Rice University; intern in the coatings laboratory; Summer 1997

Paul Koenig (PHK), BS Engineering, Purdue University; Furniture Conservation Training Program (FCTP); 1993-1996



Kung Yi Kou (KYK), BA Taiwan National College of the Arts; intern in the paper conservation laboratory; Summer 1997 (photo unavailable)

Mark Kutney (MSK), BS Chemistry, Pennsylvania State University; Furniture Conservation Training Program (FCTP); 1993-1996

Eddie C. Lee (ECL), Art student, University of Maryland; FAIC minority intern in the coatings laboratory; Summer 1996 (photo unavailable)



Catherine E. Magee (CEM), MA Art Conservation, University of Delaware; post-graduate fellow in archaeological conservation; 1995-1997

Julie Mancewicz-Arslanoglu (JMA), MS Chemistry, Pennsylvania State University; pre-program intern; 1995-1996

Jennifer Millard (JM), Mechanical Engineering, University of Wyoming; intern in the mechanics laboratory; Summer 1998 (photo unavailable)



Charles Jeffers (Jeff) Moore (CJM), BA Historic Preservation, Roger Williams College; Furniture Conservation Training Program (FCTP); 1993-1996

DucPhong Doan Ngyen (DDN), BA Art History, University of California, Irvine; minority intern in the paper conservation laboratory; Summer 1996

Susan B. Peschken (SBP), MA Art Conservation, Queen's University; post-graduate fellow in archaeological conservation; 1996-1997



Roni Polisar (RP), conservator from Hirshhorn Museum; intern in archives conservation; 1997-1998 (photo unavailable)

Estelle Rebourt (ER), Institut Francais de Restauration des Oeuvres d'Art; intern in photograph preservation; 1995-1996 (photo unavailable)

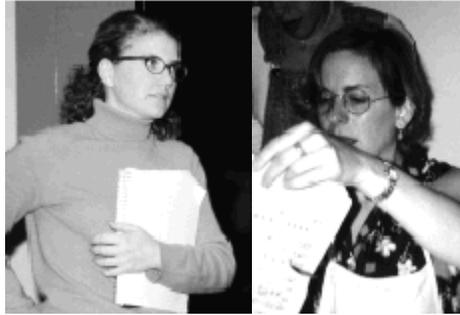
Elizabeth C. Robertson (ECR), MA Art Conservation, Queen's University; post-graduate fellow in archaeological conservation; 1997-1998



Ellen F. Rosenthal (EFR), BSc Archaeological Conservation, University of London; post-graduate fellow in archaeological conservation; 1995-1996

Angel Santiago-Torres (AST), BA Art History/Chemistry, Catholic University of Puerto Rico; Latino Studies fellow; Summer 1998

Erin L. Sears (ELS), BA Archaeology, University of Missouri; minority intern in archaeological characterization; 1996



A. Kate Sheerin (AKS), BA Art History, Tulane University; pre-program intern in the coatings and paper conservation laboratories; 1997-1998

Sarah D. Stauderman (SDS), MA Art Conservation, Buffalo State College; post-graduate fellow in archives preservation; 1997-1998

David E. Taylor (DET), BS Geology, University of South Florida; Furniture Conservation Training Program (FCTP); 1996-2000 (photo unavailable)

Heather Tennison (HT), BA Art History, University of Illinois; pre-program intern in the paper conservation laboratory; 1995-1996 (photo unavailable)

Le Cong Thuan (LCT), visiting chemist on The Rainforest Project, from Vietnam; 1996-1998 (photo unavailable)

Michael Tite (MT), visiting scientist, Laboratory for Archaeometry and History of Art, Oxford University; 1997 (photo unavailable)



Robert P. Tjaden (RPT), BA Theater Education, Augsburg College; Furniture Conservation Training Program (FCTP); 1996-2000

Daniela R. Triadan (DRT), PhD Archaeology, Freie Universitat Berlin; materials science fellow; 1996-1998 (photo unavailable)

C. Mei-An Tsu (CMT), MA Art Conservation, University of Delaware; post-graduate fellow in archaeological conservation; 1996-1997 (photo unavailable)



Randy S. Wilkinson (RSW), BS Electrical Engineering, Bridgeport University;
Furniture Conservation Training Program (FCTP); 1996-2000

Su-fen Yen (SFY), PhD Chemistry, National Taiwan University; visiting scholar in
archives preservation; 1997-1998

VOLUNTEERS



Fred Dieter (photo unavailable)
William L. Philips

RESEARCH ASSOCIATES and PROJECT COLLABORATORS

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Mark Teece, Carnegie Institution of Washington

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PROGRAMMATIC ACTIVITIES

Staff of SCMRE engage in a wide range of projects loosely organized along the lines of the unit structure; in Research and Development, Support and Collaboration, or Education and Training. Any individual staff member, or group of staff, may develop and engage in projects within any of these loose programmatic emphases. Given the multidisciplinary and interdisciplinarity of the staff, programming, and projects any attempt to categorize individual activities within such a fluid and dynamic matrix is, by definition, arbitrary. With that in mind, the 1996-1998 SCMRE Activities Report has been organized not along the lines of unit administrative organization but rather in regard to what our programming is about at the fundamental level - namely the characterization and preservation of collections and their attendant materials, and the transmittal of information vital to those objectives via educational and outreach efforts.



Most individual projects fit legitimately into more than one of these descriptions, and many fit into all three. Appropriate reference is thus rendered in multiple sections of the 1996-1998 Activity Report, but the detailed description may reside in the more dominant area. In compiling this Report, every effort has been made toward completeness of reporting about SCMRE activities, especially those that cross such boundaries. In doing so we have erred on the side of redundancy, so many activities and projects may be rightly included in multiple headings. Such cross-referencing will aid the reader in determining the full scope of any specific activity or project.

ARTIFACT AND MATERIAL CHARACTERIZATION RESEARCH PROJECTS

Specialized Ceramic Technologies of East Asia and Their Changes in Time and Space (PBV)

We have been attempting to develop a regional emphasis on East Asia ceramic technologies. The research highlights of three projects have included characterization of the regional variability in technologies and strategies for developing green glazes in China, Korea, Japan, Cambodia, Thailand and Vietnam using the analytical methods of wavelength dispersive electron beam microprobe analysis for composition and scanning electron microscopy for microstructure. For instance, the highly diverse and creative solutions to the problem of green glaze development in Vietnam are contrasted with the narrow variability of the Thai products. We suggest, because of their similarity to earlier Khmer products, that a continuity of technology exists and that most of the technological development problems were solved with the development of the Khmer brown glazes and merely modified to the solution of the making of green glazes in the later Thai products.

Using Forward Recoil Energy Spectroscopy (FRES) in collaboration with researchers at the Center for Solid State Science at the University of Arizona to study hydrogen reduction firing, first reported in the 1995 Annual Report, we have expanded the time depth and area in which hydrogen reduction is used as a firing technology to include the Neolithic period northern Chinese Lungshan culture, but not the southern Liangzhu, as well as the later Shang dynasty. The area has increased to include Korea and Japan during their periods of state development in the sixth to eighth centuries A.D.

In collaborative research with several institutions in Europe, proton induced x-ray emission (PIXE) was used to demonstrate the transfer of overglaze enamel lead glaze technology from northern Chinese coarsewares to the thirteenth-fourteenth century court wares of Jingdezhen in southern China, Cambodia, Thailand and Vietnam.

Specialized Technologies of the Third Millennium B.C. in Southwest Asia (PBV)

Several crafts that have heretofore been considered distinct are in fact found to be present in Israeli and Jordanian copper smelting furnaces, including glaze, glass, frit and metal technologies. Diverse conditions in localized areas of furnace, once recognized and controlled, lead to transformation of similar raw materials into widely different products. Observation and control of this diversity, we suggest, was developed in the third millennium B.C. as the distinct pyrotechnologies developed. Some new criteria to distinguish details of production have been offered for so-called Egyptian faience. Additionally, some early glass bead production was shown to involve the prefabrication of a pigment that is an intentional mixture of metallic oxides that do not occur together in nature and that would have required prior heat treatment together. Reconstruction of the steps required to produce a variety of glassy products has been carried out as well as structural and compositional analysis of the results and their composition with ancient materials.

Pathways to Pottery: Early Ceramic Technologies of East Asia Compared with Southwest Asia (PBV)

Of the more than 15 sites reporting the presence of pottery prior to 10,000 B.P., all are in East Asia. We have studied three in Siberia, two in China and seven in Japan. People at each of these sites made pottery in the same way, using an unusual method that is no longer in use. Microscopic examination of edge fractures and radiography have allowed us to envision the methods and sequences of manufacture. The widespread patterning of pottery fabrication, in contrast to the variability in decorative or surface impressions, suggests that communication and cultural interaction occurred prior to the Neolithic period and that East Asia was a regional cultural area much earlier than heretofore believed. Current studies are focused on understanding the possible interaction of site deposition processes and weathering of the ceramics with the microstructural pattern that gives us evidence of the reconstructed manufacturing methods.

The contrast of the technological development of East Asian pottery with that in Southwest Asia provides the opportunity to see how people adapt a different resource base with different properties to a similar function. The comparison offers a unique opportunity to study trajectories of technological development. In East Asia, forming and firing technologies show little variability, although selection of suitable sediments in areas of high materials variability, such as the volcanic sediments of Japan, showed the greatest diversity and impacted both the properties of the ceramics to be used as well as their preservation. In Southwest Asia, where sedimentary deposits are impure seabed remains, several difficult materials problems were encountered and plaster technologies developed about 2000 years prior to clay-based pottery. The formulation of a proper clay body required preparation, rather than only selection and collection of clays, and a different way of vessel forming developed; however, the Southwest Asian forming strategies present considerable uniformity across a large region from Egypt to Pakistan and as far north as the Caucasus Mountains.

Paleolithic Pigments and Ceramics (PBV)

Research to characterize the pigments applied to the surfaces of artifacts and cave walls from the Upper Paleolithic period, approximately 32,000 to 12,000 years ago, has resulted in a number of discoveries. At the contemporary sites of Pavlov and Dolni Vestonice in the Czech Republic, for instance, the ceramic technology is unrelated to the pigment technology. However, both are dependent on locally available materials that were not mixed or altered by heat treatment prior to use. The technologies employed at both sites dating to between 28,000 and 23,000 B.P. is very much the same, indicating continuity of cultural patterning of the two separate technologies.

Studies continue on artifacts made of clay in the Paleolithic, especially those that may provide evidence of patterning in Upper Paleolithic soft stone technologies. We have found that all of the technological activities that characterize pottery production in the Holocene were prefigured in the pre-pottery Upper Paleolithic uses of clays, yet pottery vessels were not produced. Even the idea of making a vessel of clay occurred at the site of Kapovaya in the southern Urals for the manufacture of a lamp.

Interregional Interaction at the Southern Frontier of Mesoamerica (RLB, FWL, RHC, ELS)

Drawing upon the breadth and intercomparability of the ceramic compositional data generated by instrumental neutron activation analysis, chemical, technological and stylistic analyses of Maya pottery are ongoing as an aid to understanding the relationship of Mesoamerica to the ancient populations of Honduras and Nicaragua.

The designation Usulután is used to describe a range of loosely related ceramics produced during the Late Preclassic period (approximately 500 B.C. to 300 A.D.) in southeastern Mesoamerica. The pottery is distinctive in having been decorated with a surface finish that appears as light, resist designs against a darker background. Whether or not the general appearance is the result of true resist painting technology, more subtle variations of slipping, or to other techniques, the specific technology used to achieve the required effect is poorly understood and is the subject of scanning electron microscopy (SEM) examination by SCMRE's Roland H. Cunningham. The Usulután resist or negative appearing technique may have had its origins in the western Highlands of El Salvador. The appearance at different sites of pottery decorated with a Usulután technique assists in the alignment of site chronologies and it represents one level of shared information regarding social preferences of ceramic consumption. Outside of its presumed homeland pottery painted with Usulután technique of decoration is generally thought to have been imported. Data obtained through the chemical characterization of the ceramic pastes, however, has demonstrated that a significant percentage of the Usulután pottery found in southern Nicaragua was locally produced. Whether or not there was shared information concerning the very distinctive production technology or if there was local attempts to reproduce the appearance with other methods is the subject of current investigation.

Recent excavations in Managua, Nicaragua by collaborator Frederick Lange (University of Colorado Museum) recovered not only Usulután pottery but also pottery from a later period, painted in a distinctive Ulua-Yoja style commonly associated with sites in Honduras. Neutron activation analysis revealed several vessels to be imported to southern Nicaragua from Honduras. Once again, however, other specimens were determined to have been made using local resources.

The chemical analysis of the Usulután and Ulua-Yoja pottery have provided evidence for far more interregional interaction than was previously documented. The SCMRE research suggests that during at least two different time periods there was demonstrable consumption of northern goods in the area of modern Managua. Beyond this, however, social status associated with the northern pottery was sufficiently high to cause pottery in these styles to be made of local materials. What the particular factors were that resulted in the southern production of the northern pottery are the subject of several ongoing international collaborative investigations.

Production and Distribution of Polychrome Ceramics in the Casas Grandes Region, Chihuahua, Mexico (RLB, MJB, DRT)

The regional patterns of ceramic circulation in the Casas Grandes (Paquimé) region of Chihuahua, Mexico, are investigated through an intensive program of compositional characterization. Casas Grandes Polychromes were distributed in northwestern Chihuahua, parts of eastern Sonora, and southern Arizona and New Mexico during the 13th and 14th centuries A.D. It is commonly believed that these ceramics were produced primarily at Paquimé, the major center in the region, the wide distribution of which seen as evidence for the wide sphere of Paquimé's interaction.

Recent archaeological research has concentrated on defining the nature and intensity of interaction in the Casas Grandes region and the extent of intra-regional social and political organization. Of particular interest is the question of how dominant Paquimé was in the political and economic system. Our project attempts to provide information on the nature and intensity of interaction and exchange between Paquimé and surrounding communities. Ceramics of the Ramos, Babicora and Villa Ahumada Polychrome ceramic types are sampled from collections of several museums, obtained over several decades and from on-going survey and excavation projects in the region.

Compositional data, obtained by instrumental neutron activation analysis, are combined with the analysis and study of whole vessels to seek the extent of correlations in compositional, distribution, typological affiliation, and stylistic expression. A raw material survey will be carried out in the region surrounding Paquimé to assess the geological sources for potting clays and tempering materials. When completed, these data will permit the evaluation of models that describe different systems of production and will establish the directionality and symmetry of exchange. Beyond publication, project findings will serve as the basis for one or more exhibitions planned for the Arizona State Museum and the Museo de las Culturas del Norte in Chihuahua.

Pottery of the Ancient Maya in the Petexbatun Region, Guatemala (RLB)

After seven extensive seasons of archaeological research in the Petexbatun region of Guatemala's Department of El Peten, Guatemala, the focus of recent activity has shifted to artifact analysis and data synthesis. The project, sponsored by Vanderbilt University and co-directed by Arthur Demarest (Vanderbilt) and Juan Antonio Valdéz (Universidad del Valle, Guatemala), focused on issues concerning the causes and nature of the decline of Classic Maya civilization. Ronald Bishop, archaeologist and SCMRE Coordinator for Research, participates as the director of the sub-project concerned with assessing ceramic evidence changes in production and distribution of pottery during the relatively short, four-generational history of the site of Dos Pilas and its neighboring sites in the Petexbatun. The ceramic research, in addition to the detailed form and typological study by Antonia Foias, relied on instrumental neutron activation analysis to characterize the ceramic pastes in order to monitor changes that occurred in ceramic production and to identify probable sources of manufacture for pottery that was imported into the region.

When the ceramic findings are interpreted within the context of other Petexbatun Project data, we find that changes in the economic system followed, rather than preceded, the intensive warfare of the late eighth century. Increasing political rivalry, competition, and warfare during the early to mid-eighth century overwhelmed societal restraints. The disrupted cultural, economic, and ecological systems became major factors that lead to rapid depopulation and general societal collapse.

Future chemically-based research involves supplemental neutron activation analyses to determine possible differences in the production traditions and distributional patterns of different ceramic classes.

Pottery and Power at Calakmul, Campeche (RLB, DRB)

Excavated pottery from the Maya site of Calakmul, Campeche, México is being investigated for what it might reveal concerning patterns of production, distribution and consumption. Research currently is being conducted in collaboration with William J. Folan and Rosario Domeniz of the Universidad Autónoma de Campeche. Critical data for this investigation is obtained through the use of neutron activation analysis to characterize the composition of the ceramic pastes. Specimens sampled for the chemical analysis, numbering more than 500, include both sherd material and whole vessels from tombs discovered inside Structures II, III, IV, and XV during the past two decades. A preliminary synthesis for only slightly more than one-half of the chemical analyses of pottery from the Classic period (A.D. 250-850) provides the present basis for addressing specific questions concerning ceramic typology and stylistic attributions. Together, these data can be used to help answer broader questions of socio-economic exchange and social and political interaction in the region during the Classic period.

Through the cooperation of Mexican archaeologists and museum professionals, thirty-six whole vessels from six elite tombs located in three different structures have been chemically analyzed. The vessels excavated by Dr. William Folan's archaeological investigations at the site were sampled in Museo San Miguel, Campeche, México while the vessels from Structure II, Tomb 4, discovered by Arqlo. Ramón Carrasco, were sampled at the INAH storage facilities Ciudad Campeche, Campeche.

Given that these tomb vessels probably represent specialized production for a specialized (high status) consumer audience, a consistent compositional difference between the chemistry of the elite-use vessels relative to the of general Calakmul pottery exists. This elite production tradition is seemingly in contrast to the clay resources and/or paste recipes utilized by the workshops making non-elite pottery. If this interpretation is correct, we also may conclude that the workshops creating high status pottery were different from those making the more common painted ceramics and utilitarian wares. As the analyses of the pottery continues, special attention will be paid to the potential products of these elite workshops and whether or not their products are can be identified at other Maya sites that were presumably under the control of the powerful Calakmul polity.

Gordion Ceramic Project (MJB)

Chemical characterization of ceramics and other craft products have allowed the detailed examination of changes in production and distribution as related to increasing economic and social complexity in ancient societies. The homogeneity or standardization in the production of an artifact type has been taken to indicate specialist producers. The rise of a class of craft specialists with only indirect links to the subsistence base has been inferred to lend itself to more centralized control over production and/or distribution. The relationship between product standardization and specialist producer and between specialist producer and centralized control, however, remain hypothetical and largely untested.

The Gordion ceramic project has examined ceramic production through chemical characterization at the royal city of Gordion during nine different periods (Middle Bronze through Roman, ca. 1600-100 B.C.). During this span, the site changed in function, size, and the ethnicity of the occupants several times from farming community to city to royal capital and back. With changes in function and size, it was hypothesized that ceramic manufacture would evolve from household production to part time specialist to specialist production and that with changes in the ethnicity different choices in raw materials might be expected as the new occupants explored their environment for clays suited to make their specific type of pottery.

Comparison of ceramics from the Late Bronze Age and Early Phrygian periods has shown that during both periods, the potters of Gordion engaged in large-scale ceramic production. The choice of raw materials was, however quite different. Late Bronze potters relied extensively on locally available calcareous river sediments for most of their clays. Early Phrygian potters, while still using some calcareous clays relied extensively on non-calcareous clays not available in the immediate environs of Gordion.

The chemical characterization studies of ceramics from other periods at the site, while not yet completed, show a similar dichotomy of raw material procurement. The overall trend indicates that the absolute size and formation of the site of Gordion itself is less of a factor than the scale of the regional economy in which it participated.

Medieval Islamic Lusterware Project (MJB)

One current theory on the history of Medieval Islamic ceramic production and distribution holds that the decorative technique of lustering was a highly restricted, proprietary technology and the production of these luxury ceramics was limited to only a few centers in the Islamic world at any given time. Lusterware, where ever found, is said to have been exported from one or another of the centers. A competing theory proposes that the ubiquity of these ceramics at nearly every medieval site regardless of size, points to the wide spread production of lusterware. To test these two hypothesis, the lusterware project focused on excavated ceramics from the small, provincial site of Gritille in Turkey. Gritille, because of its small size, rural agricultural function and short medieval occupation (about 100 years) represents the end of the line in the distribution system.

Luster decoration, a metallic oxide painted on the surface of a glazed ceramic and fixed with reduction firing was most commonly applied to a frit bodied ceramic. The frit body was produced by firing a mixture of 10 parts crushed quartz one part alkali glass (frit) and one part white firing clay (according to medieval texts and modern ethnographic studies from Iran). The chemical characterization of 131 samples of lustered and undecorated glazed ceramics initially revealed a clear distinction between the glass formula used in making Northern Syrian style fritware and Iranian style fritware. The Northern Syrian wares using frit glass with only about 60% of the sodium contained in Iranian wares. Further it was demonstrated that while the Iranian wares may have used the 10:1:1 proportions for mixing the ingredients Northern Syrian wares were made with a formula closer to 6:1:1.

Nine chemically distinct compositional groups were represented in the Gritille fritware ceramic sample and lustered sherds were present in eight of the nine groups. Petrographic thin section analysis of selected subsets of the nine chemical groups revealed seven distinct petrofabrics, five were exclusively associated with their own chemical group and two were associated with two chemical groups each. When the members of the chemical/petrofabrics groups were compared to the stratigraphic levels in which they occurred it was determined that all nine groups were present in the middle three levels of the sequence at Gritille strongly indicating contemporaneous production of luster decorated ceramics in at least nine separate production centers. This project demonstrates that luster technology must have been much more wide spread than previously thought and rather than production being centralized this study shows that production was dispersed among a number of regional and provincial centers.

Hacinebi Sealing Clay Project (MJB)

The characterization of middle eastern administrative artifacts (clay tablets, seal impressed clays, and other unfired clay objects) has sought to monitor administrative activities and the exchange of perishable goods on both the inter and intra site levels. Earlier characterization studies on sealing clays at Tal-e Malyan in the highlands of southwestern Iran and at Tepe Gawra in the Tigris River drainage in northern Iraq demonstrated the ability to track information flow within a single archaeological site, with both sites displaying periods of primarily parochial administrative concentration and other periods of where external contacts proliferated. Characterization studies carried out on tablets from Tell Leilan in the Khabur River drainage in eastern Syria further demonstrated the ability to identify the modern clays of specific drainage systems with tablets from early second millennium B.C. contexts. At Arslantepe in a region of the upper Euphrates River in Turkey, a late 4th millennium B.C. archive was demonstrated to be a local accounting operation with individual specialization in sealing certain types of containers indicated.

The Hacinebi sealing clay project was initiated to examine the apparent use of two different accounting operations at the site of Hacinebi in southern Turkey during the late 4th millennium B.C. period of Uruk colonization from the south. Ceramics of the local Anatolian style predominated in some areas of the site, while in others southern Uruk style ceramics predominated. Further, in the local Anatolian areas the Sealings recovered bore the impressions of local Anatolian stamp seals and Sealings of the Uruk areas were impressed with Uruk style cylinder seals. The two areas were occupied contemporaneously suggesting the presence of an Uruk enclave at the site that controlled the trade in goods moving south to the Uruk heartland. Chemical characterization revealed that the local Anatolian sealing clays were divided among five compositional groups, while Uruk style Sealings fell into four different compositional groups. Four of the five local Anatolian groups were identified as comprised of clays available close to the site by comparison with non portable clay objects. The fifth Anatolian group appears to also be local, although possibly originating at another site in the general area. Two of the Uruk style groups were made of local Hacinebi clays indicating that two separate accounting systems were in simultaneous operation at the site. The remaining two Uruk compositional groups were closely associated with sealing clays analyzed from Susa on the Susiana plain in southern Mesopotamia. The discovery of Uruk tablets and Sealings made of southern Mesopotamian clays in the upper Euphrates River basin provides, for the first time, strong evidence of direct continued contact between the Uruk heartland and its far flung trading colonies and strongly supports iconographic studies that also inferred this direct contact.

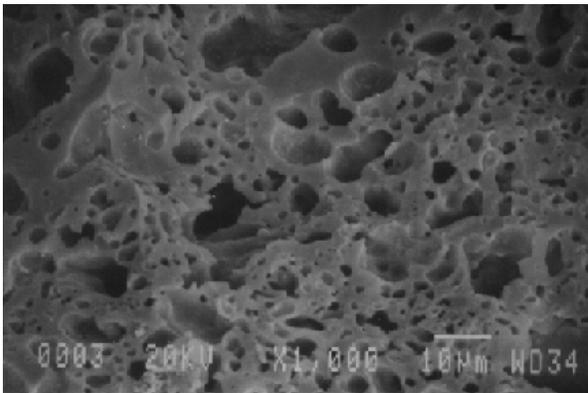
Archaeometallurgy (MG)

The Great Orme Mine near Llandudno, Wales, is a copper mine that has been dated to the Early Bronze Age. Based on its early date and vast extent, the discovery of early mining at this site reversed the accepted direction of the copper trade in northwestern Europe. The Center participated in the initial study of the metal small finds, and, by Emile Joel, the lead isotopic signature of this mine.



Rings and an amulet from a Bronze Age site in Syria, Tel es-Sweyhat, were thought to be silver but upon analysis were found to be lead. Other small metal finds were objects of tin bronze and of arsenical copper alloys, some leaded. Small highly corroded droplets were identified as spillage or waste that in addition to the crucibles found earlier supports the identification of metal working on this site.

The crucible steel traditionally produced in India is called "wootz" and is generally considered to be the steel used in the famed damascus swords. Crucible fragments from the wootz process are being refired to detect the temperature at which microstructural changes that indicate the temperature of the process. Estimates by experts had put this anywhere from 1000EC to 1500EC, but preliminary results showed that the higher temperatures would have caused slumping and bloating of the crucibles. Some crucibles had been used below any of these estimated temperatures. Further work on the replication of this process, of interest to artist blacksmiths, depends upon first determining the processing temperature.

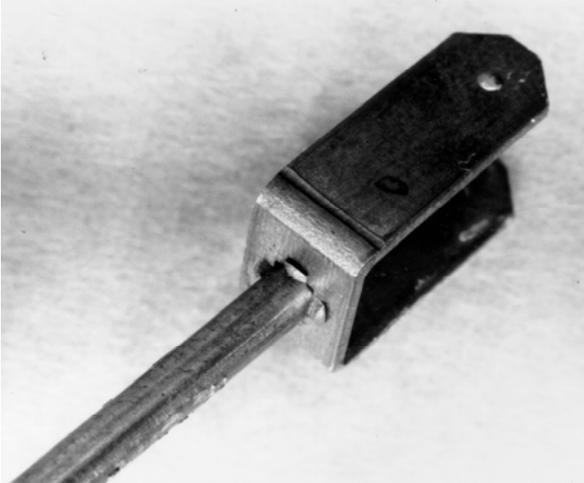


A set of bronze shields, found in pairs in Sweden and known as the Fröslunda shields, were sampled to compare the microstructure of the bronze with that of gongs, whose microstructures had been studied definitively at the Center, to test the excavator's hypotheses that these may have been musical instruments. They proved to be of too low a tin composition to have been similar to gongs or cymbals. However, the sequence of manufacture was determined. A small disk was cast that

was then wrought to size.

Historical Metallurgy (MG)

Very rusty mail links recovered from the site of DeSoto's winter encampment of 1540 in Tallahassee, Florida, were examined for evidence of their manufacture. The iron could not be shown consistently to contain phosphorus, as research done at the Center showed music wire of the 17th and 18th centuries does, but sufficient structure remained in some of the links to indicate that they had been manufactured from iron wire, and one tiny but intact rivet clearly showed how the wire had been fastened to make the links.



Brass parts from early pianos, fortepiano kapsels, were difficult to reproduce using the recommended modern alloy. It was determined that this brass contained lead and that kapsels original to the period (late 18th, early 19th century) were of the same sort of brass but without lead. Also the original parts revealed a very unusual microstructure that was interpreted as the result of unnecessarily high heating during manufacture, an indication of a lack of temperature control at the time.

An abrasive that was observed being used in the Jewellery Quarter of Birmingham (England) had a peculiar color but was identified by the craftsmen only as river sand. A colleague from the Birmingham Museum of Industry, Michael Constable, identified this abrasive as Trent sand. The color was found to be due to chalcopyrite, ordinarily a copper ore and not known as an abrasive. This identification was published as an example of the need to record traditional crafts before they disappear, even in the so called First World, and also as a cautionary example for archaeologists that all finely ground ore may not be intended for the smelting furnace but may be instead an abrasive for a finishing operation.

Molecular Anthropology Sheds Light on the Colonization of the New World (CJK, NCT)

Colonization of the New World is thought to have occurred via one or more migrations of modern *Homo sapiens* traveling from Asia sometime during the last Ice Age or the past 10-50,000 years. These adventurers entered the Americas through Alaska by means of either a land or sea route. Land passage from eastern Siberia to the New World during the last Ice Age was possible through the Bering Land Bridge which was exposed because of the dramatic drop in sea level due to the enormous quantity of water contained in the glaciers. Regarding New World colonization theories, details such as the exact number of migrations, the precise origin of the colonizers, and a more definite time frame for entry to the New World are not known.

Molecular anthropologists are analyzing the molecular diversity of contemporary Native American and indigenous Asian populations in order to establish genetic relationships between these groups and address questions concerning New World colonization. These studies assume that the genetic structure of modern populations is unchanged relative to ancestral populations and that analysis of the modern groups can be used to reconstruct their evolutionary history. However, we know that all New World indigenous populations suffered dramatic population declines at the time of European contact which may have permanently altered their levels of genetic diversity.

Therefore, we are directly studying the molecular diversity of ancestral New World indigenous populations through the analysis of skeletal populations that date from thousands of years ago to contemporary times. Rigorous attention to detail is required for such studies since the passage of time has damaged many of the molecules isolated for these studies. For example, the analysis of ancient DNA is particularly prone to contamination by modern, undamaged DNA, which can be sloughed off as skin cells from researchers in the laboratory or archaeologists at the excavation site. Preliminary results suggest that the genetic link between ancestral and descendant populations is intact and that New World indigenous populations have not undergone dramatic changes in their levels of genetic diversity during their evolutionary history.

Aquilaria Resin Project (WDE, WRH)

Aquilaria trees occur throughout Southeast Asia. When stressed by damage, insects, or fungi, the wood produces a valuable resin used for a number of purposes, including medicines, incense and cosmetics. Resin production is slow, taking decades to produce the highest quality deposits. Resin is restricted to the areas of attack. Because it is impossible to determine where, or if, resin deposits occur in a particular tree, these trees have been extensively cut down and are endangered.

This collaborative project, sponsored by The Rainforest Project, is to develop methods to artificially induce the production of resins at faster rates. Experiments have been conducted primarily in Vietnam, with proposed experiments in other countries with different climates. Collaborator Dr. Robert Blanchette of the University of Minnesota has found a number of fungal species and chemical compounds that induce faster resin growth. We analyze samples using gas chromatography/mass spectrometry to determine if induced resin is comparable to natural samples. A Vietnamese chemist, Le Cong Thuan, spent parts of 1996 and 1997 at SCMRE learning the analytical methods and conducting analyses. He returned for two more months in 1998.

Results are promising, though complicated. The "natural" samples, many acquired from local dealers, are of inconsistent composition. This may be due to adulteration (even wood samples are often treated with cheaper resins) or to changes that occur in resin heated to distill it from the wood. Nevertheless, relatively consistent profiles of the natural wood and resin samples have begun to emerge. Though resin production is still in an early stage, the experimental samples fit within the range of compositions of the natural samples. Results indicate that it should be possible to develop methods that will provide local farmers with a valuable new crop while relieving pressure on the remaining wild trees.

TECHNICAL STUDIES

Characterization and Treatment Technical Studies for Paper-Based Collections (FWT, DVR)

Paper-based collections contain important documents, illustrations and other images that validate object collections, in addition to having their own intrinsic, evidential, and informational value. Libraries, archives and research institutions world-wide recognize the need for research into the degradation and stabilization of these rapidly deteriorating collections. Particularly vulnerable are specialty papers used for scientific illustrations, architectural drawings, chromolithographic prints and bookplates, found in abundance in the Smithsonian Institution's libraries, archives and research collections. On-going technical studies in SCMRE's paper lab characterize such specialty papers (including tracing, pigment-coated, and dyed papers), as well as the effects of conservation treatments upon them. As a result of these published projects, paper lab staff have received requests to design and publish more on these and similar topics. Consequently, three new technical studies were developed. One involves characterizing the effects of traditional and innovative treatments on artists' papers, to be published in conjunction with a chapter on treatments for a book about paper conservation. A second technical study focuses on effects on paper of a highly specialized treatment, aqueous light bleaching. A third study concentrates on characterizing Chinese papers, to be published in conjunction with a special research project about these collections. A fourth study focused on a research collaboration of intern Sarah Stauderman with video research projects by Mary Baker and by Vidipax, on restoration of videotapes, and consulted on creation and production of a CD-ROM on video tape formats and players. This study is discussed under Preservation Studies Research Projects.

Technical Study on the Characterization and Treatment of Paper (DVR, FWT)

To illustrate a chapter about treatment, for a book on conservation of paper to be published by Butterworth-Heinemann, a feasibility study on the comparative effects of traditional and innovative treatments on papers was carried out by Hirshhorn Paper Conservator Roni Polisar with SCMRE paper lab, coatings lab and support staff using SEM imaging, Energy Dispersive Spectroscopy (EDS), ultraviolet (UV) microscopy, fiber analysis and other techniques. Five common papers were characterized: a hand-made white umbria rag paper with Aquapel sizing, a hand-made Bodleian rag with Aquapel sizing, a machine-made white bristol type rag/chemical pulp paper with alum/starch sizing, a machine-made groundwood newsprint with alum sizing, and a commercial gummed label paper of chemical wood with alum/starch sizing. These were selectively treated to compare the effects of 5 treatments using various materials and techniques commonly employed by conservators. The five treatments tested compared the effects (on controls and treated samples) of: surface cleaning, using vinyl cleaners as crumbs or as an electric eraser stick on fibers; sizing removal and deposition techniques, using 20 minute immersion in deionized water/methyl cellulose and air drying; efficacy of wax fixative removal, using benzine on a suction disk; efficacy of adhesive residue removal, using acetone and Fuller's Earth poultice on Hollytex; and efficacy of tape adhesive removal, using xylene applied as vapor through Goretex and as a solvent on a swab and on a suction disk. Preliminary findings confirmed fiber disturbance with an electric eraser applied for 6 seconds; adhesive residue after swabbing; and lateral compression of paper treated with suction disk. The SEM images, showing

some of the problems that can be caused by conservation treatment, are intended to be published in the chapter on treatment for the Butterworth-Heinemann book.

Effects of Washing and Bleaching on Alum-Sized Papers (DVR, FWT)

Many papers become acidic and discolored, and consequently need structural and visual stabilization. This is sometimes done using various deacidification and bleaching treatments. Visiting scholar Terry Schaeffer, research physicist from Los Angeles, completed a collaborative project with the paper and support labs, about the effects of deacidification and aqueous light bleaching. She characterized the effects of two deacidification treatments (immersion in dilute calcium hydroxide or magnesium carbonate deacidification solutions) on two types of paper (Whatman alpha cellulose paper sized with gelatin and alum; mixed pulp paper) to determine changes in two sizing additives (gelatin and alum) using two analytical techniques (SEM/EDS). She found that gelatin diminished in Whatman alpha cellulose paper sized with gelatin and alum that had been deacidified and aqueously light bleached, and this led to the question of whether alum is also lost during these treatments. Samples were analyzed for aluminum by EDS. The results indicate that aluminum is not washed out by immersion in the deacidification solutions of either the gelatin-sized alpha cellulose paper or the mixed pulp paper.

Chinese Paper Technical Study (FWT, DVR)

One class of important and fragile papers found in Smithsonian Institution research collections is that of Chinese papers, used for prints, currency, kites, and many other things. In FY 1997, the Chiang Ching-kuo Scholarly Exchange Foundation funded a two-year project to study and preserve the Chinese paper-based collection in NMNH's Anthropology Department, as a collaboration between the Department and the SCMRE paper conservation lab. The technical study is intended to compile historical research on Chinese papermaking through a literature survey, and characterize selected examples of Chinese paper-based collections in the Anthropology Department. Paper samples for this study come from objects having special use (such as kites, paper money, books, etc.) and/or from fragments in the collection. Five categories of Chinese paper specialty objects have been selected for study: Chinese Kites, Paper Money, Chinese Folk Art (woodblock prints), Books, and Pith Paper. To date, item-level surveys and selection of the types of papers have been completed by the department. This will be followed by characterization of selected paper fibers, and by on-site research at important handmade paper-making facilities in China and Taiwan. The research follows up on a FY 1997 publication on the first part of the project, which was designed to compare the properties affecting the stability and preservation of the major types of papers used by Chinese artists and conservators: Pi paper (made of bast fibers such as paper mulberry, rattan, or blue sandalwood) and Xuan paper (made of mixtures of bast and straw or bamboo fibers, or of blue sandalwood and straw). Twenty-three examples of Chinese paper from seven locations (Anhui, Zhejiang, Hebei, Quansxi, Sichuan, Yunnan, and Taiwan) were compared on the basis of their morphological, chemical, optical and physical properties. Colorimetry measurements (to determine the degree to which such papers might discolor if stored improperly) indicated that two types of papers (from Zhejiang and Yunnan), which contained acidic lignin or were bleached during manufacture, also darkened the most upon accelerated aging. In addition, zero-span tensile testing (for physical strength) and pH (for chemical stability) indicated that as a class the Chinese papers were relatively weak before aging (and therefore they

require special care), although accelerated aging did not appear to weaken them substantially further. Finally, one of the most important findings included the discovery, based on morphological appearance and chemical composition using fiber analysis and SEM imaging and EDS, of a type fiber never before published in the paper conservation literature: a type of rice straw fiber called a phytolith. This fiber was found only in papers from Anhui, which also happened to be one of the weakest papers, despite high alkalinity.

A trip to Mainland China and Taiwan was scheduled from the end of June to the beginning of August, 1998. The purpose of this trip was to collect raw Chinese paper fibers and to document procedures and techniques of handmade Chinese papers in various areas; information of pith paper making was also collected in this trip. Fourteen paper samples in various processing stages were collected. These samples will be mounted and can be used as a reference for future technical studies relating to fiber identification, as well as teaching aids for SCMRE-sponsored courses, such as microscopy. Fiber sampling has been completed for the technical study of Chinese paper in conjunction with the Anthropology Department, NMNH. Fiber identification of selected Chinese paper artefacts in the collection is scheduled for 1999 after the reference samples have been mounted.

Among these raw samples, pith paper samples were used in the Microscopy course in 1998. Because the production of pith paper is dwindling and the information on manufacturing techniques are not widely available, Tsai was asked by the ICOM ethnographic conservation group to contribute an article about the process of manufacturing pith paper.

Technical Studies of Archaeological Artifact Materials (HFB)

Characterization of Artifact Materials from Harappa

In conjunction with on-site conservation activities, technical analyses of unusual materials were carried out at SCMRE by Archaeological Conservation Internship Program (ACIP) participants, assisted by SCMRE staff.

- Gilded bead analysis (SBP, September 25, 1997)
- Technical analysis of an Early Harappan vessel (ECR, Fall 1997)

Characterization of Artifact Materials from Copán

Copán's complex dedicatory caches and funerary deposits have provided materials whose identification is of particular interest to the archaeologists. Linked to on-site conservation activities, technical analyses were carried out at SCMRE by ACIP participants, in conjunction with SCMRE staff as well as with outside resources.

- Charred organic samples from the Rosalila temple, with Ricardo Agurcia (April 2, 1997)
- Offerings from the Structure 26 tomb, including clay coatings, burial material, paints and pigments, and specialized marine offerings (HFB, CAM, SBP, HAA)
- Offerings from the Margarita tomb complex, including paints, pigments, and fibrous materials (HFB, SEH)

Characterization of Glass Beads from the Uluburun Shipwreck

Preparatory to research on appropriate consolidation methods for waterlogged glass, a SCMRE/ACIP participant characterized beads from the Uluburun (Turkey) shipwreck, with the assistance of SCMRE staff (CEM, Fall 1996).

Characterization of Cuneiform Tablets from Anatolian Sites

As part of a research project on appropriate consolidation methods for unfired clay cuneiform tablets, a SCMRE/ACIP participant analyzed samples from several Anatolian sites, with the assistance of SCMRE staff and outside resources. Samples from Kaman Kalehöyük (Turkey) were collected and some treatments tested during on-site conservation work (CMT, Fall 1997).

Characterization of a Coating Applied to a Boli (BMA 77.176.1) in the Collection of the Brooklyn Museum of Art

Identification of constituents in this complex mixture provided an SCMRE/ACIP participant an opportunity to test an analytical methodology that could find useful onsite application (SEH, September 1998).

Technical Study of Pigments (RHC)

Sample preparation and SEM/EDS continued for an ongoing analysis of commercial pigments and acquisition of an EDS pigment reference set, including Winsor and Newton pure ground and mixed powder pigments, and NBS standard pigments. Analyses were done (1) to determine the purity of the compound used as a commercial pigment, (2) to determine those compounds characteristically associated with Winsor and Newton pigments, and (3) to note any compositional changes in these pigment mixtures with time, e.g., a recent addition of previously unused extenders, or the substitution of dyestuffs for inorganic pigments. This reference set has proven useful to those who need to identify inorganic and possibly organic constituents that may now be included in commercially produced powdered pigments.

Microscopy Technical Studies (HAA)

Introduction

During the time covered by this report, the SCMRE microscopy program underwent a major expansion and emphasis, and a reorganization of the microscopy laboratory spaces. Room F2008 and an adjacent alcove were established as the SCMRE Microscopy Laboratory and Sample Preparation Room to be used for material characterizations and for the Optical Microscopy Series of courses. The microscopy lab was organized to include work areas for the Research Microscope (Leica DMRX) and Image Analysis Station (Media Cybernetics, Image-Pro Plus), Metallography Microscope (Leitz Orthoplan), Hardness Tester (Leitz), Polarized Light Microscope (Leitz Laborlux 12), and Photo-microscope (Wild Makroskop M420). Space was designated for reference collections (pigments & particles, wood, natural fibers and plant-based ethnographic materials) and storage of ancillary equipment. The sample preparation room was designed to allow for microtomy (sledge and ultra-microtomy), object examination, sample slicing (Struers AccuMet 50), sample polishing (Buehler Minimet), paraffin and resin microtechniques, isolation of chemical fumes, and chemical storage.

Wood Identification of Samples from a Northern California Ancient Forest

Approximately 600 years ago, a large volcanic event, like the one that happened recently at Mt. St. Helens, occurred at what is now Glass Creek in the Whitewing Mountains (Inyo National Forest) near the skiing resort of Mammoth Lakes in northern California. As in other eruptions, the nearby trees were literally ripped from their stumps and fell leeward, in a parallel orientation in the direction of the blast. In 1993 geneticists with the USDA Forest Service in Berkeley California and foresters in Inyo National Forest, including Constance Miller, contacted Dr. Alden about identifying the tree remains of such a blast from Whitewing Mountains. Microscopic examination allows one to assign a genus and sometimes a species group to unidentified materials. The scientists expected to find pine, fir, cedar and hemlock, based on their visual observations of the logs and from their knowledge of the trees currently growing in the region. To date, over 30 samples have been analyzed, with one hemlock sample and the rest all pines (yellow and white pine groups). At least one of the samples could be sugar pine (*Pinus lambertiana*), a species that does not grow in this ecosystem, and may point to a change in the climate in the last 600 years. Because the forest service is heavily involved in "ecosystem management," one important factor is understanding or reconstructing the past ecosystems of the areas studied. The identification of the arboreal content of this area is essential to the development of an ecosystem management plan based on the reconstruction of past ecosystems.

Copán Marine Organisms

Material provided by Rae Beaubien (SCMRE) was examined using the Leica DMRX and the Wild Makroskop to determine the identity of microscopic and macroscopic materials from a tomb offering from Structure 26 at the Maya center of Copán. All macroscopic samples were photo-archived and microscopic samples were prepared in glycerin-EtOH for examination. The macroscopic material was identified as coming from a marine origin as sea urchin, sea fan, sea star (*Linckia* sp.), brittle star (*Ophiocoma*) and fish spines and vertebrae. Examination of microscopic material showed numerous SiO₂ sponge spicules, some over 2 mm long, and other structures from biological origins. Material and 2x2 slides of these structures were taken to Drs. Bayer and Reutzler (NMNH) for examination, and were identified as siliceous and calcareous spicules from several species of sponges (*Geodia*, *Oxeas* and *Tetractinela*) and sea fans (*Leptogorgia* or *Pacifigorgia* spp.).

Plant Materials from the Lewis and Clark Expedition

Plant material (11 species, all leaves) collected by Lewis and Clark (1805-1806) on their famous expedition was submitted for evaluation as to its state of preservation. Macroscopic and microscopic examination revealed that most of the samples are in pristine condition and that only one or two samples are slightly degraded. External morphology of the leaves (epidermal cells, trichomes, stomata) were examined to determine the state of preservation. All but the Indian Tobacco and one Maple sample showed no damage or degradation to the external structures of the leaves. The Indian Tobacco had very few trichomes still attached to the surface, while the maple had some surface structural damage (analysis still underway). Many of the taxa like Silver Buffalo Berry and Scarlet Globe Mallow are adapted to a xeric environment, where water is scarce during the growing season. These taxa have developed anatomical structures that prevent rapid dehydration in a desert environment. These structures are hairs or trichomes which have branched or shield-like appendages which, when packed close together, shade the leaf and increase the boundary layer, or humid zone surrounding the leaf. Increasing the boundary layer and cooling the leaf prevent rapid loss of water during transpiration. In many plants, surface features like trichomes, glands and bracts are worn off during the course of a season's growth, making the plants a bit "thread-worn" by the end of the growing season. These structures are also the first to degrade and wear off on herbarium specimens. In most of the samples, the external morphology and anatomy are intact and in pristine condition, leading to the conclusion that the material presented for evaluation is in an excellent state of cellular preservation.

ARTIFACT and MATERIAL ANALYSES (Analytical Service Requests)

Examples of analysis projects undertaken by the analytical staff of the SCMRE's Support and Collaboration group are listed below, under the categories SCMRE, Other Smithsonian, and Outside Organizations.

Techniques are abbreviated as follows: fourier transform infrared spectroscopy (FTIR), gas chromatography (GC), gas chromatography-mass spectroscopy (GC-MS), optical microscopy (OM), scanning electron microscopy with energy dispersive spectroscopy (SEM-EDS), xeroradiography (Xero), x-ray diffraction (XRD), x-ray fluorescence (XRF), x-ray radiography (X-ray), and ultraviolet-visible light spectrophotometry (UV-Vis).

SCMRE

Archaeological Conservation/Objects Program

- SEM/EDS on a Harappan silver gilded bead as part of project characterizing artifact materials from Harappa, Pakistan. (SBP, CSTh, PBV)
- SEM of consolidated 'Ain Ghazal plaster; SEM and Xero of 'Ain Ghazal statue torsos and head; Xero of an 'Ain Ghazal head for the television show "Field Trip" Smithsonian: The Nation's Attic. (CAG, HFB, CEM, EFR, RHC, CSTh)
- OM on textile fragments on flint artifacts from the Copán acropolis, Honduras. (HFB, HAA)
- FTIR, SEM/EDS, and XRD on Harappan ceramics desalination parameters project: Harappan salts and Harappan wash bath residue from real-time aging experiment samples. (CMT, CSTh, WRH)
- FTIR, OM, and SEM/EDS on materials from Copán, Honduras, site of Vessel 9, including sponge spicules. (HFB, HAA, RHC, WRH)
- SEM/EDS and XRD on Maya pigments, clay, substrates, tomb samples, adhesives, and black slabby material from the Copán archaeological project. (SEH, SBP, RHC, MEF, CSTh, PBV)
- SEM/EDS, XRD, and XRF on glass beads from the Uluburun shipwreck in Turkey, 14th century B.C. (CEM, CSTh)
- SEM/EDS and XRD on copper sulfide corrosion samples from the Chicago Field Museum. (Holly Lundberg, CSTh)
- FTIR, OM, Sample Preparation, SEM/EDS, and XRD on samples from the burial deposit from the Structure 26 tomb, Copán, Honduras, including microscopic black spheres, red paint, stucco, miscellaneous pigments, fibers, inorganic debris from burial, possible headdress material and gourd material, and quartz for elemental analysis, characterization, and imaging. (CEM, RHC, WRH, CSTh, MJW)
- FTIR, OM, SEM/EDS, Xero, and XRD on Mesopotamian and Anatolian cuneiform tablets, bath residue salts, ceramics, unbaked/unfired clay, and pigment. (CMT, RHC, MEF, WRH, CSTh, MJW)
- OM to assist in the identification of types of wood from Dumbarton Oaks, other organic samples, and samples from Rosalila temple. (HFB, MJW)
- SEM/EDS, Xero, XRD, and X-ray of a Harappan ceramic polychrome vessel and related soil and surface deposits. (HFB, CAG, ECR, RHC, MEF, CSTh, PBV)
- FTIR, OM, SEM, and XRD on coating material from an African boli, including pigment and fired and unfired clay. (SEH, HAA, RHC, WRH, CSTh, MJW)

Biogeochemistry and Natural History Program

- FTIR, OM, and SEM/EDS as part of the study of bone for the tool/blood residue project. (NCT, Aaron Stutz, Andrew Wilson, WRH, CSTh, MJW)
- OM on herbarium specimens as part of project on natural history research. (Mark Teece, HAA)
- OM on fish sections as part of fish storage project. (JLR, MJW)

Ceramics and Glass Characterization

- SEM/EDS and XRD for study of 3rd millennium B.C. refractories including Chinese roof tiles, ceramics, glass, and soils and clays from Pendejo Cave, Feinan, Tumma. (PBV, CSTh)
- Xero on 8 Thai and Chinese ceramics to determine internal structure and method of manufacturer. (PBV, CSTh)
- XRD on soil and soil binder from bird effigy figurines from 13,000 B.P. (PBV, CSTh)
- SEM/EDS, Xero, and XRD as part of a study on hydrogen reduction of Chinese ceramics. Included Chinese Neolithic ceramics, Chinese celadons, Chinese clays, 8000 B.C.-1000 A.D. Chinese pottery, refirings, pigments, replicas, Paleolithic fired ceramics, Czech Republic low-fired ceramics, wood, Korean ceramics, and Sardis glasses. (PBV, RHC, MEF, CSTh)
- SEM/EDS and XRD on Paleolithic pigments and clays from Marsoulas and Cosquer, France and Russia. (PBV, RHC, MEF, CSTh)
- SEM/EDS and Xero of glass and ceramics as part of a study on 14th-15th century Chinese overglaze enamels, including Thai ceramics and Lao green glazes from the Freer/Sackler collection. (PBV, RHC)
- SEM/EDS, Xero, and XRD on Nuzi pigments, clays, and glass to assist in the study of methods of manufacture of ceramics from Nuzi, Iraq. project with James Armstrong (PBV, CSTh)
- Photomicroscopy of 15 samples of ceramic vessel fragments from Northern China, Siberia, and Russia. (PBV, HAA)
- Xero of 4 small pots of various unfired ceramics B2 profiles before firing. (PBV, RHC)
- UV-Vis of roof tile pottery to evaluate the effectiveness of this technique for study of pottery surfaces. (PBV, JLR)
- Xero of pottery sherds from Chernikova and Gromatukha, Russia. (PBV, RHC)
- SEM/EDS on 12 ceramic samples. (JJH, RHC)

Coatings Laboratory

- FTIR on surface coatings from 18th century chest from the Colonial Williamsburg Foundation. (MJW, WRH)
- Sample Preparation, SEM/EDS, XRF, and X-ray of the pigments and structure of a naval painting (George S. Wood Schooner) by James Bard (NMAH collection). (JMA, ECL, RHC, MEF, CSTh)
- FTIR, Reference Sample Preparation, Xero, XRD, XRF, and X-ray were all done on a "training" painting (landscape by H. Frey) to assist a visiting scientist on sabbatical leave from Millersville University, Pennsylvania. She was at SCMRE to learn different techniques using works of art for teaching analytical chemistry to her students. (PH, RHC, MEF, WRH, CSTh)

- FTIR, Xero, and XRF on part of the Teodoro Vidal Collection from NMAH: 8-10 santos and 2 paintings (Three Kings, Virgen de Monserrate). (JST, MEF, WRH, CSTh, with NMAH's Beth Richwine)
- Xero of 8 santos as part of the Imágenes course. (JST, MEF, CSTh)
- SEM for a general overall training session. (JMA, CSTh)
- Synthesis of oil from resin. (JMA, ECL, WRH, JST)
- FTIR of DAP surfacing putty, used in furniture factories. (MJW, WRH)

Furniture Conservation Training Program

- Xero, XRD, XRF, and X-ray on several items including quartz, carbonate, a chair back, and a bed chair as part of demonstrations for the FCTP students. (CSTh)
- SEM/EDS, Xero, and XRF on a variety of items including a chair back, molding, and fitting, and paint cross-sections for the FCTP Analysis course. (RHC, MEF, CSTh)
- SEM/EDS on a cross-section of leaf finish. (PA, CSTh)
- FTIR and SEM on gilded leaf, coatings, and shellac as part of make-up for the Coatings course. (PA, WRH, CSTh)
- FTIR, SEM/EDS, Xero, and XRF on Martha Washington's piano stool from Tudor Place including the fibers and damask cover, and a previously unanalyzed paint sample taken from the object. This object is part of a FCTP student project. (RB, RHC, WRH, CSTh)
- XRF on mahogany strips with dyes. (RB, RHC, MEF, CSTh)
- Xero of a chest of drawers, joint area and leg. (JEB, CSTh)
- Xero of a chair leg. (JEB, CSTh)
- Xero of a crest rail, back, arms, joins, leg, seat rail, and crack of a Gothic chair. (TDF, RHC, CSTh)
- Xero of a rail chair back, middle, and joinery. (TDF, CSTh)
- FTIR on surface coatings from an 18th century American chest of drawers from Colonial Williamsburg Foundation. (MK, WRH)
- FTIR, GC-MS, OM, and SEM/EDS for elemental analysis and imaging of metal foil/flakes from a late 19th century exterior architectural decoration (Isaac Bell House). (CJM, WRH, CSTh, MJW)
- XRF of leaf on bracket clock. (RPT, RHC, MEF, CSTh)

Inorganic Provenance Studies

- SEM/EDS on Guatemalan Mayan pigments (300 B.C.-300 A.D.). (RLB, CSTh)
- Photomicrography in normal and polarized light of petrographic thin sections to produce black and white images for publication. (MJB, MJW)
- Sample preparation for photography and SEM/EDS on Protoclassic Maya ceramic low-fired pottery sherds from Guatemala and Nicaragua, including Tikal, Guatemala (ca.750-800 A.D.) and Naj Tunich (ca.100-200 A.D.). (RLB, RHC)
- SEM/EDS on three Nicaraguan ceramic and clay powder samples, previously studied by neutron activation analysis. (RLB, CSTh)
- SEM/EDS on Benin bronzes used in lead isotope studies. (ECJ, CSTh)
- Xero of pottery sherds, including Mayan, Native American (1500-1800 A.D.), and some from Usulután, Mexico. (RLB, RHC)

Mechanics and Museum Environments

- Differential Scanning Calorimetry, SEM, and Xero on wood samples and paint films for stress/strain studies, including wood density characterization. (CST, MTB, CSTh)
- Xero on ivory as part of mechanical characterization of bone and ivory. (CST, CSTh)

Metals Characterization

- XRD on Trent sand. (MG, CSTh)
- XRF to assist with metallographic analysis on kapsels and metal drops from Tel es-Sweyhat. (MG, RHC, MEF)
- SEM/EDS and XRD on South Asian (Indian) kiln and crucible samples, kiln dust, ceramics, and to assist with wootz temperature determinations. (MG, RHC, CSTh, PBV)

Microscopy

- Wood identification, documentation, and interpretation on the construction of the hull of the 18th century Dutch Navy ship H.M.S. DeBraak. with Charles Fithian of the Delaware State Museums (HAA)

Paper and RELACT Programs

- SEM/EDS for light bleaching project, including imaging of treated and untreated paper samples. (Terri Schaeffer, RHC, MEF, CSTh, DVR)
- OM and SEM/EDS was used to image treated and untreated paper for a chapter in an upcoming Butterworth's book. Hirshhorn paper conservator Roni Polisar participated in this project. (RHC, MEF, CSTh, DVR, MJW)
- OM on Chinese paper fibers. (FWT, HAA)

Support Program

- FTIR, GC-MS, OM, Sample Preparation, SEM/EDS, Xero, XRD, XRF, and X-ray introductions and training sessions were given to new interns and fellows as part of intern orientation on analytical instrumentation available at SCMRE. Diverse items including quartz, carbonate, pots, and a chair back were examined. (HAA, RHC, WDE, MEF, WRH, CSTh, PBV, MJW)
- XRD on Ohio red clay and residual material from acid digestions to help characterize the clay for use in standardization of the ICP-MS. (CSTh)

Textiles Studies

- SEM on archaeological textiles from Jordan and Bahrain. (MWB, CSTh)

Other Smithsonian

Castle

- Xero on 4 virgin santos (including Montserrate, Belen, Delarossa) from the NMAH's Vidal collection for structural information gathering for 3-D photo project for incorporation onto a CD by Symphonics International; for Miguel Bretos and Dennis O'Connor. (MEF, CSTh, JST, with NMAH's Steve Velasquez)
- Consulting and routine object examination; for Peter Muldoon. (MJW)

Freer and Sackler Galleries of Art

- FTIR and SEM/EDS on modern silk and anti-static as part of the Freer/Sackler archaeological silk manuscript project and the study of "add-on" antistatic finishes during aqueous cleaning of natural fiber fabrics. (MWB, CSTh, WRH)
- SEM/EDS and standardless semi-quantitative (SSQ) analysis on ancient Chinese artifacts including bronzes and castings with in-situ corrosion products; for W. Thomas Chase (FGA) and Quanyu Wang (Archaeology Department, Peking University). (RHC, CSTh)
- SEM/EDS/WDS on samples of several Chinese bronzes, Japanese white lead paint samples, samples from the sculpture Durga Victorious Over the Buffalo Demon including stone thin sections, and stone related samples from a sculpture that was possibly "aged" with hydrofluoric acid; for Janet Douglas. (CSTh)
- SEM/EDS on Japanese painting samples, efflorescence, and white lead; for John Winter. (CSTh)
- SEM/EDS on bronze samples and jade cross-sections; for Janet Douglas. (CSTh)
- Wood identification on an Egyptian mask, 1400 B.C.; for Paul Jett. (HAA)

Hirshhorn Museum

- FTIR and OM on a work by Giacomo Balla: film stain from the surface of brown material from building vents; for Susan Lake. (WRH, MJW)
- SEM/EDS on paint cross-sections on an Alexander Calder fish mobile; for Susan Lake. (CSTh)
- SEM/EDS on paint cross-sections on the Gaston Lachaise garden figure The King's Bride for pigment characterization necessary prior to treatment; for Susan Lake. (RHC)
- FTIR of a sticky residue on a paint layer from Untitled, 1961 (paint on metal); for Susan Lake. (WRH)
- SEM/EDS on Magna acrylic resin paint (Magna, Inc.) samples for pigment identification to characterize the inorganic compounds in two unlabeled tubes of yellow paint; for Susan Lake. (RHC)
- FTIR and SEM/EDS for elemental analysis to identify pigments and driers using paint cross-sections of Willem de Kooning's Woman, 1965; for Susan Lake. (RHC, WRH)
- FTIR, GC-MS, and OM/heating stage to look at tallow/wax from the sculpture Erinnerung an mein Jugend im Gebirge; for Susan Lake. (WRH)
- SEM/EDS on inclusions in paint cross-sections of Water Figure by Jackson Pollock, 1948 by Clifford Still, Secretary by Willem de Kooning, and Woman, 1965 by Willem de Kooning; for Susan Lake. (RHC)

- SEM/EDS and XRD on Man Pushing Door bronze casting for chemical analysis of water stain; for Lee Aks. (CSTh)
- FTIR and GC-FID to characterize a discoloration on Red, Orange, Blue; for Susan Lake. (WRH)
- SEM/EDS on Mark Rothko's Red, Blue, Orange paint cross-sections; for Susan Lake. (RHC)

National Air and Space Museum/Paul E. Garber Facility

- Sample preparation, SEM/EDS, and wet chemistry on the Saturn V Rocket: paint, metal, corrosion and delaminating samples; for Bayne Rector, Collections Management. (RHC, CSTh)
- FTIR, OM, and sample preparation for a fiber, weave, and coating analysis of German Horten Ho IIIf and IIIh airplane fabric (coated flax, Reimar & Walter Horten, ca. 1935); for Russell Lee, Aeronautics. (MWB, RHC, WRH, MJW)
- FTIR analysis on Rusteco acidic corrosion remover; for Bayne Rector. (WRH)
- FTIR, GC-MS, Sample Preparation, SEM/EDS, and X-ray for a paint and structural analysis of a Curtiss V-8 motorcycle (Hammondsport, NY, 1907) to be put on exhibit at NASM; for Ed Marshall. (RHC, WRH, CSTh)
- FTIR of Ballistol lubricant; for Bayne Rector. (WRH)
- Fiber identification/weave count, FTIR, and OM on aircraft fabric swatches taken from the Pitcairn PCA autogiro; for Ed McManus. (MWB, WRH)
- OM and sample preparation for wood identification of front of aircraft (Aichi Seiran) instrument panel; for Matt Nazzaro. (HAA, MJW)
- SEM/EDS and XRF for metal (aluminum) and paint analysis of Japanese aircraft (Aichi Seiran float plane) right wing top spar; for Bayne Rector. (RHC, MEF)
- FTIR for constituent determination of fluid from Hurricane fuel tank; for Bayne Rector. (WRH)
- Consulting, OM, Paint Removal, and SEM/EDS because of paint vandalism on Viking Lunar Lander model on display at NASM. The object was intentionally vandalized with red rustoleum and required treatment; for Ed McManus. (MTB, RHC, MJW, AKS)
- FTIR on an accretion from Explorer I transmitter; for Ed McManus. (WRH)

National Museum of African Art

- XRF and X-ray on a silver figure of a man mounted on lion from Fon, Republic of Benin to determine the internal structure of the object and to determine if silver was present; for Dana Moffett. (CSTh)
- XRF on a white metal covering a Baule Côte d'Ivoire Akan shell; for Madeleine Hexter. (CSTh)
- FTIR and OM for identification of a resinous encrustation material on a wooden seated figure from Akan group in Ghana; for Madeleine Hexter. (WRH, MJW)
- OM for identification of fibers found on a quilted tunic (libbeh) from the Tuareg people (Mali); for Madeleine Hexter. (MWB)
- FTIR on the inlay of an ivory tusk with relief carving; for Madeleine Hexter. (WRH)
- SEM/EDS and XRF of metal (aluminum) from two Adire stencils from Yoruba, Nigeria; for Dana Moffett. (RHC, MEF, CSTh)

- FTIR on a surface sample scraped from the surface of a bowl from Olowe of Ise; for Dana Moffett. (WRH)
- FTIR on a Mother and Child figure to find any evidence of a synthetic resin in the sample of the surface transparent coating and any evidence that red material from the base is not original to the figure; for Dana Moffett. (WRH)
- FTIR, SEM/EDS, and XRD for an analysis of a crystalline material from Urban Testament #4; for Dana Moffett. (MEF, WRH)
- OM training for object examination of painted figures; for Madeleine Hexter. (MJW)

National Museum of American Art

- Sample Preparation and SEM/EDS on a sample from American artist T.W. Dewing's Portrait of Frances Houston for inclusion in an exhibition of Dewing's paintings scheduled to open in Boston in 1996; for Helen Ingalls. (RHC)
- SEM/EDS for elemental (especially lead) identification from paint samples from the rear of a Farr mural from the Department of Health, Education, and Welfare; for Stefano Scafetta. (RHC)
- FTIR and Xero on 14 Puerto Rican santos figures from the Vidal Collection. The internal structure of the figures were examined by Xero; for Helen Ingalls. (RHC, MEF, WRH, CSTh)
- OM, Sample Preparation, and SEM/EDS on paint layers of cross-sections from the free-standing, painted plaster sculpture Falling Gladiator by William Rimmer; for Helen Ingalls. (RHC, MJW)

National Museum of American History

- FTIR, GC-MS, OM, SEM/EDS, XRD, XRF, and X-ray on shipwreck artifacts from the wreck of the yacht Ha 'aheo o Hawai'i, originally named Cleopatra's Barge (Hanalei Bay, Kauai, Hawaii), including wood and fiber analysis, concretions, painted wood and leather, lead and copper, red pigment, white accretions, corrosion, and analysis of shipwreck artifacts; for Paul Johnston, Marine History. (HAA, RHC, MEF, WRH, CSTh, MJW)
- OM on samples from the 100,000th Steinway piano, c. 1903, from the White House; for Richard Barden. (MJW)
- FTIR and SEM/EDS on the Star Spangled Banner. Samples, including vacuumed fragments from the flag, fibers, linen yarns, and paint. Other materials of interest have been 2 kinds of wool fabrics, 2 varieties of TYVEK plastic and open-weave plastic screening. This is part of an ongoing analysis for support fabrics and materials for the restoration and mounting of the Star Spangled Banner, with particular interest in the presence of sulfur, lead, and halogens; for Ronald Becker and Suzanne Thomassen-Krauss. (MWB, RHC, WRH, CSTh, CST)
- SEM on Ft. Sumpter and Ft. Hill flags as part of Star Spangled Banner project - wool fragments and fibers - to visually assist in the determination of wool fiber morphology, and to ascertain the extent of fiber deterioration as a possible result of harsh cleaning practices in the past; for Suzanne Thomassen-Krauss. (RHC)
- FTIR, GC-MS, OM, SEM/EDS, Xero, XRD, and XRF for santos (from the Teodoro Vidal Collection) exhibition at NMAH: technical study, pigments of Virgen de Monserrate, etc.; for Beth Richwine. (HAA, MEF, WRH, CSTh, JST, MJW)

- XRD, XRF, and X-ray on shipwreck artifacts from the wreck of the yacht Cleopatra's Barge, about 45 lead sheathing and concretion samples; for Paul Johnston, Marine History. (CSTh)
- OM for wood identification a from Pakistani wooden roller cotton gin; for Tim Grove, Education. (HAA)

National Museum of the American Indian

- FTIR and GC-MS for compositional analysis of decorative material on two canoes; for Leslie Williamson. (WRH)

National Museum of Natural History

- OM for archaeological wood identification for wood from the Frohisher Voyages; for Dusia Laeyendecker, Anthropology Arctic Center. (MJW)
- SEM/EDS on natural and treated carbonate sediments; for Ian McIntyre and Pamela Reid, Paleobiology. (MEF, CSTh, PBV)
- Xero and X-ray was done on anthropological human bone with metal points in order to locate the metal/projectile point and its depth; for Gary Aronson and Pamela Malloy, Repatriation Office. (CSTh)
- Xero on 18 prehistoric human bones with metal/stone points; for Karen Oeh and Doug Owsley, Anthropology. (CSTh)
- FTIR and GC-MS on Aquilaria wood and resin, including collecting, sampling, testing, and analysis; for Henry van Beek, Anthropology/Asian Ethnology. (WDE, WRH)
- FTIR, SEM/EDS, and XRD of crystals on the interior of a wooden vase to assist with the study of crystals on wooden objects; for Natalie Firnhaber, Anthropology Conservation Laboratory. (WRH, CSTh)
- Protein characterization of a wood fragment from a Dorset Eskimo=s spear shaft by amino acid analysis; for William FitzHugh, Anthropology. (JLR, NCT)
- FTIR on white accretion on a pair of Pakistan sandals and on the wood coating on a pair of Vietnamese sandals; for Linda Lennon, Anthropology Conservation Laboratory. (WRH)
- FTIR, SEM/EDS, and XRF on glass, beads, and accretions from a Korean wedding hat and on a Phoenician leaded glass bead; for Linda Lennon, Anthropology Conservation Laboratory. (RHC, MEF, WRH, CSTh)
- FTIR, XRD, and XRF on a blown glass vessel: glass and layer from inside of vessel; for Linda Lennon, Anthropology Conservation Laboratory. (RHC, MEF, CSTh, WRH)
- Xero on a Human calcaneus: foot bone with projectile point; for Allison Willcox, Repatriation Office. (RHC, MEF, CSTh)
- FTIR on Lolo book manuscript for analysis of accretion on paper; for Jayne Holt, Anthropology. (WRH)
- FTIR, SEM/EDS, and XRD for analysis of a deposit formed inside of glass accelerated aging jars during AODdy tests; for Sunae Park Evans, Anthropology Conservation Laboratory. (MEF, WRH)
- SEM/EDS on samples from two stone sculptures of head/bust of figure: identification of white, black, red, and yellowish-red materials; for Natalie Firnhaber and Greta Hansen, Anthropology Conservation Laboratory. (PBV)
- OM on 3 bone artifacts for microphotography of engraved bone with pigmented areas; for Rick Potts, Anthropology. (HAA)

- Conservation treatment, including surface cleaning, mending, filling and matting of a late 19th century dinosaur illustration; for Jann Thompson, Paleobiology. (FWT)
- FTIR to assist with identification of unknown oil from a Korean paper raincoat; for Jayne Holt, Anthropology. (WRH)
- Conservation treatment on a Scelidosaurus Harrisonii drawing; for Mary Parrish, Vertebrate Paleobiology. (SDS, FWT, DVR)

National Portrait Gallery

- FTIR on a discolored coating from the color relief print J.P. Morgan from "Millionaires of America Portfolio;" for Emily Klayman. (WRH)

National Postal Museum

- XRD on a kaolinite standard and possible "china clay" postage stamps; for Joe Geraci and James Burns. (MEF, CSTh)

Office of Protection Services

- Information was sought on the effects pepper spray may have on artifacts in the Smithsonian collections; for Sergeant Fred Mobley. (MEF with SCMRE staff input)

Smithsonian Institution Traveling Exhibition Services

- FTIR, SEM/EDS, and XRD on "color minerals" (blue, red, brown) pigments from Puerto Rico; for Jill Newmark, Registrar. (MEF, WRH)

Visitors' Information and Reception Center

- Textile identification to assist with 150th anniversary banner problems; for Mary Grace Potter. (MWB, WRH)

Outside Organizations

American Institute for Conservation

- FTIR, ICP-MS, OM, and SEM/EDS for a "show and tell" tour for AIC members attending the annual meeting. (HAA, MEF, WRH, CSTh)

Department of Canadian Heritage

- OM, SEM/EDS, and XRD on fossilized wood; for Dr. Charles Gruchy, through Dr. Lambertus van Zelst. (CSTh, NCT, MJW)

Discovery Channel

- SEM/EDS and XRF were done on some teeth and bones provided by the Department of Anthropology's Doug Owsley for a televised special on forensic analysis. (MEF)

Flagler Museum, Florida

- Consulting, FTIR, and SEM/EDS on metallic leaf and gilding from wall of a room; for Sandra Barghini. (WRH, CSTh, MJW)

Folger Library, District of Columbia

- FTIR and XRF on a 1568 book (*Apixionomia*), with the hopes of determining if Shakespeare's signature was on the book, and on a white deposit from microfilm and boxes; for J. Franklin Mowery. (WRH, CSTh)

General Services Administration Property Management

- Consulting on a sculpture located at the Department of State, *The Expanding Universe* with information on bronze copper content, metal porosity, and salt corrosion; for Maurice Spraggins. (MG, CAG)

Getty Conservation Institute

- SEM/EDS analysis of an aluminum SEM sample stub to determine minor elemental impurities that could be detected by SCMRE's system and that may interfere with the analysis of ceramic and glass samples; for Blythe McCarthy, GCI fellow and former Johns Hopkins University student. (MEF)

National Gallery of Art

- Xero on a 15th century terra cotta bust of Giuliano de' Medici by the artist Andrea del Verrocchio; for Susan Orum. (RHC, MEF)

Peabody Museum, Harvard University

- FTIR and OM on coating type on coated leather from seats of three chairs in a guest chamber at Marblehead, a chair in the Nebraska State Capitol, and a carriage in the Lyndhurst National Trust were analyzed; for Elizabeth Lahikainen. (WRH, MJW)

United States Navy

- FTIR, GC, SEM-EDS, and XRD of a Civil War gun pivot and toilet from the sunken wreck of the *CSS Alabama*, including analysis of coatings (gun) and exterior crystals (toilet, possibly calcium carbonate); for Lisa Goldberg, Naval Historical Center. (MEF, WRH)

White House/National Park Service

- OM on coatings and layered samples from a pair of card tables; for John Courtney. (MJW)

PRESERVATION STUDIES AND ACTIVITIES RESEARCH PROJECTS

Paint Solvent Project (WDE, RHC)

This project is designed to examine the effects of solvents on paint films. The initial phase of the project conducted several years ago relied on a limited number of available aged paint samples. New samples of various combinations of oils and pigments (as well as oils processed in various ways) were prepared then. The present phase will involve these newer samples that are now adequately aged. More paint samples also will be prepared when possible.

A number of samples of these paint films have been exposed. A matrix of paint types, solvents, and exposure times has been used. The changes being measured are color, gloss, weight, and the composition of the extracted material. In the initial phase, only low molecular weight materials (up to monomeric fatty acids) in the extract were analyzed. Since then we have tested and implemented newer techniques and methods of analysis in order to characterize the extracts more fully. The new techniques will enable the analysis of whole mono-, di-, and triglycerides as well as fatty acids and smaller compounds. Initial analyses indicate that the higher molecular weight materials are indeed present.

The results will be used in two ways: one, to determine if changes caused by solvents that cannot be seen directly, such as the extraction of material, correlate with visible changes in gloss and color that are used by conservators to judge the effects of solvents; and two, to make recommendations for the selection and use of solvents for the cleaning of paintings that minimize the effects on the paint film.

A large number of samples have been analyzed by gas chromatography. The development of techniques for creating complete profiles of extracted lipids and degradation products has yielded results that are both more complex and more interesting than expected. The data is presently being examined, and further work is being planned. In addition, the techniques and results have proven useful in other ways, including looking at the aging processes of oil paints, including both natural and artificial aging. These results are being integrated with examinations by collaborators (CST, MFM) of the physical properties of paint films (including the effects of solvents).

Cellulose Degradation Project (WDE)

This project is designed to determine the effects of environmental and other factors on the chemical aging processes of cellulose and cellulosic materials. The results are to be used for two primary purposes: one, to determine methods and conditions of accelerated aging that accurately simulate natural aging in order to study the aging of cellulose on a laboratory, as opposed to museum time scale; and two, to develop recommendations for the storage and display of cellulosic materials. Results from studies of other mechanisms of cellulose deterioration will be incorporated into these recommendations. The results for cellulose will be integrated with results for other materials in order to develop recommendations for general museum collections.

Results of aging experiments conducted under a matrix of conditions of temperature and relative humidity on new paper samples indicate that relative humidity is the primary factor in determining the aging process of cellulose. Temperature changes

affect the rate of the process, but have little effect on the nature of the process in the temperature range studied (up to 90oC). Thus, accelerated aging experiments for cellulosic materials should be conducted at relative humidities similar to those of the natural aging conditions they are meant to simulate.

Recommendations for environmental conditions for both cellulosic materials and general collections have been developed. These conditions are being refined as more data become available. Examination of old samples of cellulosic materials (wood and paper) have been or are being examined to see how well the conclusions based on aging experiments on new materials apply to old materials. Results so far are promising, with results falling within a range predicted from experiment. These experiments will be continued in order to further characterize the properties of, and changes in, old and artificially aged cellulosic material.

A number of naturally aged samples of cellulosic materials have been examined and analyzed, and the result compared with those predicted from accelerated aging experiments. Both physical and chemical properties of the naturally aged specimens are as predicted from laboratory experiments. The techniques developed for this work have been adopted for use at other institutions, including the Library of Congress for work on a major project on permanent paper funded by ASTM and the paper industry.

The Star Spangled Banner Program (MFM, CST)

We were requested by the National Museum of American History to establish baseline structural information on the current condition of the Star Spangled Banner (SSB). Various yarn and textile samples were provide by NMAH for mechanical testing. We tested the yarn and textile samples of the Star Spangled Banner, the linen backing, and sewing threads, for several purposes. Mechanical testing provided insight into the remaining strength of the flag and information regarding the degree of chemical degradation of the wool bunting, the linen lining, and the sewing threads. In addition, the mechanical consequences of the chemical degradation were determined. For example, the strength (or tenacity) of the yarns and textiles provided information on the flag=s ability to support its own weight. Testing and determining the yarn and textile samples for elongation to break provided critical information regarding the flag's ability to be rolled, folded or generally handled.

The flag was made around 1812 of dyed wool bunting and sewn with linen threads. The original dimensions of the flag were 30 feet (hoist) x 42 feet (fly). Today, the long dimension of the actual flag is shortened due to the removal of sections used as souvenirs and the present flag dimensions are approximately 30 feet (hoist) x 34 feet (fly). There is a linen lining attached to the reverse of the flag and there is an extension which illustrates the original dimensions of the flag. The linen lining was attached to the flag using extensive linen stitching in 1914. On the reverse of the lining there are attached 2" wide linen tapes on approximately 12 inch centers. These linen tapes are parallel to the stripes of the flag.

While useful information can be gained from the testing of the wool fibers from the flag, it was absolutely necessary to test the actual textile samples and yarns. This is because yarn is not as strong as the sum of the fiber strength making up the yarn. Yarns fail by a combination of factors. There is certainly breakage of the actual fibers, but there is also "pullout," where the fibers slide apart when the yarns fail. To

test fibers and infer the strength of the yarns and textiles can lead to a serious over estimation of the flag's actual strength. Conversely, testing the individual wool fibers provided additional insight into the degree and type of degradation that has occurred to the Star Spangled Banner.

A simple weighing of the materials provided information on the actual weight of the flag and lining as well as allowing the calculation of the maximum forces that are acting on the flag and lining materials. Using this information, it is possible to gain significant insight into the current state of the flag while it is still hanging and determine whether the flag can be safely removed, rolled, and, in general, handled.

After extensive testing of the textiles and yarns of and related to the Star Spangled Banner, reports were written, interpreting the test results and outlining options that were possible for the handling, treatment and re-installation of the flag.

Stone Damage Assessment Project (CAG, MJW)

Cleaning is one of the most commonly performed treatments for both masonry buildings and stone sculpture, its frequency having increased because of air pollution, and recently there have been many new techniques developed and marketed for cleaning. Yet, evaluation of cleaning methods has rarely been objective. The purpose of this research was to evaluate methods of measuring cleaning damage as an aid to the selection of the best cleaning technique. During a preliminary phase of the project, a wide range of instrumental techniques were tested on a limited number of samples. The most promising were selected for further testing on a large set of samples (eight masonry materials) blasted with water or powdered abrasives.

A new technique, reflected light image analysis, was developed for this project in-house, and it proved promising although interpretation of results was complex. Stylus profilometry, the most commonly used tool for measuring roughness in experimental work, produced inconsistent data and could only be used on relatively smooth surfaces. Microdrop absorption testing, a technique requiring minimal resources, was useful in confirming damage induced by the harshest abrasives, but was not applicable in every instance. The most interesting result, however, was that touch and visual evaluation of surfaces were superior overall to instrumental analyses, and it was recommended that such evaluations could be made objective by developing standards, consisting of a range of samples for each type of stone.

Dr. A. Elena Charola, an independent consultant was the principal investigator for the project. Objects Conservator Carol Grissom and previous summer intern Evin Erder prepared samples and performed a number of the tests. Mel Wachowiak developed the reflected light image analysis technique. The project was funded through a cooperative agreement between the National Park Service and the Smithsonian Institution.

Desalination Parameters for Harappan Ceramics (HFB)

Prompted by salinity problems of materials from Harappa, SCMRE/ACIP participants have been carrying out experimental and analytical work to investigate aspects of the desalination process since 1994. Work this year was done in conjunction with SCMRE staff, as well as with outside resources.

- Minimum water usage (SBP, September 25, 1997)
- Analysis of salt residues from real-time aging experiment samples (CMT, September 1997)
- Summary of desalination research at SCMRE (HFB, 1997)



Accelerated Aging Studies Concerning the Stability of Keratin in Natural History Collections Stored in Ethanol and Formalin (DVE, PEH)

The keratins are a closely related family of chemically stable proteins composing mammalian hair, horn, hooves, and avian feather. Sheep hair (wool) has been much studied chemically because of its economic value. To our knowledge, no studies have been conducted on the long-term stability of the other keratins from a museum perspective. Samples of hair for these experiments were taken from horse, guinea pig, cat, dog, rabbit and humans, and feather from two bird species. The stability of these keratins were assessed under simulated aging conditions by heating them dry, in 70% ethanol, and in 70% ethanol plus 1% formalin at 180°C for varying periods of time. At the end of the experiments, the samples remaining were dried, weighed and subjected to amino acid analysis. Feather keratin was approximately 50% less stable than was hair keratin, as evidenced by the amount of amino acids lost from the sample, under those experimental conditions.

The results from these experiments indicate that the keratins are unstable under artificial aging conditions at high temperatures. What is of interest here is the ability to compare the stability of keratin from different sources within a reasonable length of time. If one assumes that the reactions seen at higher temperatures are the same general type that can be observed at lower (room) temperature, the data can be used to adjust museum storage conditions to ensure maximum specimen lifetime.

In summary, when keratins are "stored dry" they last longest. They last less long in 70% ethanol, and least long in 70% ethanol + 1% formalin. These observations imply that even small amounts of formalin promote deterioration reactions in the keratins, seen especially dramatically under the experimental conditions described above. Further, under these experimental conditions, the difference between "longest" and "least long," as seen in the chromatographic data is several orders of magnitude. As a corollary, the amino acid patterns of fresh hair and feather from different species were found to be distinct, and indicative of their originating taxon.

The Effect of Historic Preservation Treatment on Skin Proteins and Nucleic Acid Content in Natural History Collections (DVE, PEH)

A variety of techniques have been used through time to preserve mammal skins in natural history museums. With the advent of molecular genetics, the effect of these techniques on the quantity and quality of extractable nucleic acids, and on the stability of the surrounding protein matrix, is of concern. To investigate these questions, skin from a river otter (*Lutra canadensis*) was divided into 14 sections, and each section treated with a preservative used in the past. Quantitative nucleic acid extractions were performed on one portion of each section to determine how preservation procedures affected the extractability and analyzability of nuclear and mitochondrial nucleic acids. The quality of the nucleic acid extracts was tested by polymerase chain reaction (PCR) amplification of both mitochondrial and nuclear loci. A portion of each section also was analyzed for amino acid composition to determine whether preservation treatment affected skin proteins as indicated by changes in amino acid composition. Further, the portions were analyzed by gas chromatography to determine whether individual amino acid residues had undergone racemization (changes in their stereochemical configuration).

Standard preservation treatments appear to cause degradation (some more than others) of the DNA molecule so that DNA-fingerprinting is probably not possible. The type of preservative also affects the amplifiability of both mitochondrial and nuclear DNA, thus this information can be useful in understanding preferred preservation treatments. Mitochondrial DNA was able to be amplified in 11 of 14 skin samples. Nuclear DNA in otter skin is usable for PCR in eight of 14 treatments. Amino acid analysis (composition) can distinguish degradation in the skin, and indicates stable protein except for three treatments. Amino acid analysis (D/L stereochemistry) also can distinguish degradation in the skin, and indicates unchanged amino acids except for two treatment regimes.

Rates of Change in the Amino Acids of Bone in Natural History Museum Storage Fluids at High Temperatures (DVE, PEH)

Many specimens containing bone are stored in fluids in natural history museum collections. As part of a study to determine the deterioration reactions prevalent in bone stored in fluids, we determined the differences in the rates of deterioration of the individual amino acids composing bone proteins (primarily collagen) under simulated aging conditions. Samples of bone were heated in 70% ethanol, 70% ethanol plus 1% formaldehyde, and 50% 2-propanol, at 120°C, 140°C and 160°C for varying periods of time up to one week. Changes in amino acid stereochemistry (change from L to D, termed racemization) were determined using gas chromatography. Aspartic acid was the most easily racemized of the amino acids detected. This change was most pronounced in the ethanol plus formalin solution. The composition of the amino acids in bone also changed through time: serine and threonine decreased in amounts, aspartic acid decreased in concentration, and ammonia increased. These changes also were most severe in ethanol plus formalin solution. The racemization and compositional data indicate that free formaldehyde in alcohol solutions can destroy the proteins of bone. These data can be connected to the longevity of bone by projecting mathematically the experimental conditions to room temperature "museum" conditions. The racemization data also indicate that these type of reactions may be useful as an indicator of the state of bone preservation in museums, and if bones are stored under the same conditions, may be useful as an indicator of the age of the sample.

Some Nitrogen-Containing Heterocycles Produced at High Temperatures in Bone From Natural History Collections (DVE, PEH)

To follow some of the organic chemical reactions of bone deterioration under conditions of accelerated aging, bone was heated beginning at 45% relative humidity (RH), and at 100% RH for various times at 160°, 190°, and 220°C. At the end of the experiment, the 100% RH bone heated at 220°C and 24 hours had lost about 50% of its weight, and the amino acids of the bone proteins had been altered to varying degrees. As indicated by amino acid analysis using high-performance liquid chromatography, aspartic acid, threonine and serine were partially or completely destroyed, while glutamic acid and glycine were the most stable. Hydrolysis, deamination, and decarboxylation reactions also occurred as evidenced by the production of organic acids and amines. Heating bone beginning at 45% RH (dry) for the same time and temperature produced a 20% loss of weight and less destruction of the protein as evidenced by amino acid patterns. Dry-heated bone also released a series of volatile, nitrogen-containing cyclic deterioration products at all temperatures, as determined by combined gas chromatography/mass spectrometry.

To our knowledge, this is the first time that cyclic compounds have been reported as bone protein deterioration products.

The presence of those compounds in the products formed as a result of heating bone suggests that their presence in other analyses may be used to indicate whether the sample has been subjected to a "heating event." These bone heating experiments also suggest that maceration treatments, especially those using high temperatures, can promote the accelerated aging of specimens. If the activation energy needed for these high-temperature reactions is about the same at lower temperatures, similar deterioration mechanisms could occur under storage conditions of high relative humidity or elevated temperatures. These findings also point to deterioration products that can be investigated in the breakdown of bone under varying treatments and storage conditions.

Spirit Collections: Rates of Change in the Stereochemistry of Amino Acids in Hair Heated in Ethanol, Formalin, and 2-Propanol (DVE)

Keratin, a class of proteins noted for its molecular bonding involving sulfur, is found in the epidermal appendages of vertebrates, and functions as a structural protein. There are many keratinous specimens of scientific and cultural significance that are stored in natural history museum collections, under both dry and wet conditions. The focus of this project is to study any changes in the stereochemistry, and to provide detailed kinetic information concerning the rates at which these changes occur, in individual amino acids (alanine, aspartic acid, and glutamic acid) when hair is preserved in fluids. Using artificial aging techniques, samples of hair were heated in 70% ethanol, 70% ethanol plus 1% formaldehyde, and 50% 2-propanol at 120°C for up to 16 hours, 130°C for up to 8 hours, and 140°C for up to 5 hours. These experiments were designed to simulate the early stages of keratin deterioration. Results indicate that stereochemical changes (change from L to D, termed racemization) in the amino acids of keratin occur at these temperatures when heated in each of the fluids, with the most rapid racemization taking place in aspartic acid. Racemization was significantly less pronounced in 70% ethanol plus 1% formaldehyde, more pronounced in 70% ethanol, and slightly more severe in the 50% 2-propanol solution (compared to ethanol alone). The racemization data indicate that even a stable protein such as keratin is prone to deterioration in alcohol solutions. These data also indicate that racemization of aspartic acid may be useful as an early indicator of the state of keratin preservation.

Spirit Collections: Changes in the Weight and Amino Acid Composition of Hair Heated in Ethanol, Formalin, and 2-Propanol (DVE)

Accelerated aging experiments were conducted that produced changes in the weight and in the amino acid composition of hair. The data indicate that different fluid storage conditions affect weight and stability differently. Hair was heated at 120°C for up to 16 hours, 130°C for up to 7 hours, and 140°C for up to 5 hours in 70% ethanol, in 70% ethanol plus 1% formalin, and in 50% 2-propanol. The results from these experiments indicate that changes in the weight and amino composition of hair samples take place in a complicated fashion, but in general the changes occur most slowly in 70% ethanol, at an intermediate rate in 70% ethanol plus 1% formalin, and fastest in 50% 2-propanol. This project is designed to simulate some of the changes that take place during the later stages of the decomposition of hair, and is related to another, earlier, study. In that study, a slightly different order of stability in the

fluids was reported for changes in the stereochemistry of the amino acids of hair that had been artificially aged in simulated storage fluids to indicate some changes that occur in the earlier stages of decomposition. Both of these studies were conducted because there are many keratin-containing specimens stored in natural history museums in fluids, and they indicate that even a stable protein such as keratin is prone to deterioration in alcohol solutions. In addition, the results from the present study suggests that ethanol be used as a storage fluid for keratin materials, and that they be kept at lower temperatures.

Experimentation in the Preservation of Fish Specimens (CJK, NCT, JLR)

Interest in the isolation and study of macromolecules from archival specimens has increased dramatically over the past decade. Applications range from population genetic studies of extinct or endangered species to the detection of virus and oncogene sequences in human pathology samples. Many studies have now been conducted on a variety of archival tissues with varying success. However, no study has attempted to recreate current and historical fixation and preservation techniques and to correlate different protocols with the quantity and quality of macromolecules extracted from those tissues. Currently, many specimens are subjected to short-term fixation in formalin and long-term preservation in ethanol. Fixation in formalin is thought to stabilize tissue and morphological attributes of the specimen via cross-links between DNA and/or proteins. Although the cross-links are likely to be detrimental to DNA and protein analysis, it is not known how quickly cross-links form or how quickly they render macromolecules useless for genetic study.

We have generated an experimental collection of fish preserved in formalin and/or ethanol that is intended to represent the range of current and historical curatorial practices. We have tested a variety of extraction protocols in order to isolate protein and DNA from the experimental specimens. In our studies, extracted protein is subjected to polyacrylamide gel electrophoresis and amino acid analysis. DNA is assayed for its ability to participate in a chemical amplification reaction known as the polymerase chain reaction and the primary nucleotide sequence of select samples is determined.

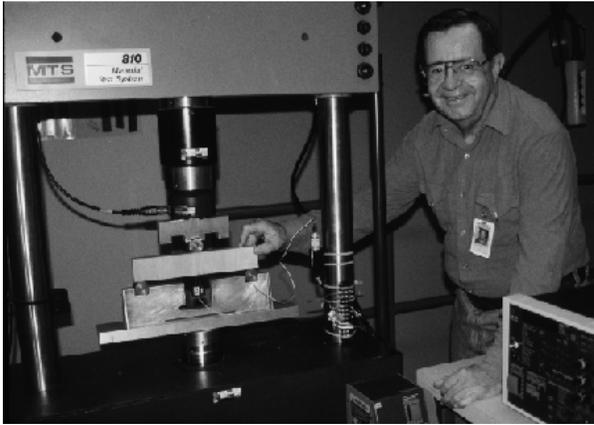
By directly controlling the fixation and preservation procedures and correlating certain protocols with the ability to obtain useful genetic information, we can provide guidelines for researchers interested in initiating studies of archival specimens and also for future curatorial practices. Thus far, we have determined that formalin fixation is highly detrimental to DNA studies while ethanol preservation appears much more benign. Based on these results, we would advise collectors and curators to limit or eliminate formalin fixation of specimens for which future molecular analysis is a possibility.

Natural History Collections as Genetic Repositories (CJK, NCT, JLR)

As natural habitats are destroyed worldwide, increasing numbers of species are attaining endangered and, finally, extinct status. Due to this deteriorating situation, attention has turned to natural history collections as possible genetic repositories for endangered and extinct species. Many studies are currently analyzing a variety of archival material ranging from air-dried bird skins to ethanol-preserved fish specimens. These studies address questions such as the phylogenetic relationship of extant and extinct species, the population history of species prior to their status as endangered or extinct, and the reconstruction of migration and colonization events such as the peopling of the New World. Analysis of DNA and other macromolecules from archival specimens is a highly unpredictable procedure because the passage of time and chemical reaction of preservatives has damaged many of the molecules isolated for these studies. However, no study has attempted to quantitate the "success rate" of DNA analysis from archival specimens in order to ascertain the genetic utility of such collections.

We are currently assessing the utility for genetic studies of fish specimens archived at the National Museum of Natural History at the Smithsonian Institution in Washington, D.C., the Museum of Comparative Zoology at Harvard University in Boston, and the Natural History Museum in London. These specimens represent the range of current and historical curatorial practices in terms of short-term formalin fixation and long-term preservation in ethanol or methylated spirits. Preliminary results suggest that fish preserved in ethanol for over 100 years retain a significant quantity of DNA that can be assayed by current methods. Conversely, specimens that have been fixed in formalin prior to ethanol preservation appear resistant to DNA analysis, especially in materials that have been stored for decades.

Mechanical Properties of Artifact Materials/The Museum Environment (MFM, CST)



It is the condition, that is, the state of deterioration, and not necessarily the age of an artifact that determines its response to environmental factors such as temperature and relative humidity and transit conditions. Knowing the current condition of the materials making up the artifact is essential to making rational decisions about long term exhibition and preservation strategies. One of the most important objectives of SCMRE, then, is the chemical, mechanical, and physical characterization of the materials found

in museum collections. This process leads to developing the types and rates of chemical degradation processes of materials, the magnitude and duration of environmentally induced forces, and the magnitude of environmentally induced dimensional changes. This understanding has already provided us with enough insight that it is possible to reconsider the environmental guidelines for museums, libraries, and other collection sites.

The Smithsonian Institution was the first to undertake a systematic study of the effects of the environment on the mechanical properties of cultural materials and the structural analysis of the objects in the collections. When one couples this information with the chemical response of cultural materials to the environment, a remarkably clear picture of the effects of the museum environment develops. One very obvious conclusion that immediately arises is that even the current recommendations (50% RH \pm 5% RH) for the museum environment represent a major compromise to the chemical stability of the objects. The collections would most likely be better off chemically if they were maintained at around 30% to 35% RH, and at cooler temperatures. Unfortunately this is often structurally, as well as economically, not possible. What is also clear is that if the annual RH mean is to be maintained at around 45% to 55% RH, this also happens to be at the RH range that nearly all hygroscopic materials are the least dimensionally responsive to moisture. In other words the moisture coefficients (the rate at which materials dimensional response to RH) are at a minimum in this range.



It has been well known that when objects in the collections are allowed to freely expand and contract with changes in RH little damage is observed. It is only when they are restrained from moving and subjected to the extreme changes in RH that problems begin. But due to their construction, and the differences in the mechanical and dimensional properties of the materials found in objects, materials are often

restrained from freely expanding and contracting. For those materials restrained and desiccated, clearly tensile stresses and strains develop. For those materials restrained and humidified, compression stresses and strains develop. In this program we have addressed the following questions. What are the magnitudes of cyclic stresses and strains that a cultural material can withstand repeatedly without permanent damage? For restrained materials, what RH or temperature changes correlate to those changes in stresses and strains? Does age of the material affect this behavior? Are there peculiar construction techniques of objects that amplify the environmentally induced structural response? These are the questions we have been answering and there have been some interesting surprises.

One of the answers we found is that while we can clearly establish RH related damage, we found that temperature changes (independent of RH) can also be the source of considerable damage. In fact much of the damage found in painted surfaces (panel and canvas paintings, and painted furniture) and attributed to RH was in fact most probably caused by exposure to low temperature. Understanding this single concept has led us to explore areas that have traditionally been considered by conservators to be of little consequence. Another aspect of the work is that while many artist's materials such as oil paints, tend to strengthen and stiffen with age (several centuries), serious chemical degradation will ultimately cause a loss of strength. So far the research has shown, however, that time alone has no or little affect on the dimensional response of the materials to moisture or on the yield point. This means that the safe reversible RH range is not necessarily affected by an objects age. It is the current condition, or state of degradation, not age of the objects and their materials, that govern their response to the changes in the environment.



The research results suggest that (for the exhibition spaces) a RH range from 35% to 60% is not out of consideration for most museums. For example, a summer environment of 55% RH \pm 5%, 23°C and for the winter time, 40% RH \pm 5%, 20°C. The research also reveals that the rate of change of the environmental conditions is not a factor providing that the object is maintained within the allowable range. Tighter controls that maintain high RH in the wintertime are almost guaranteed to

damage buildings, especially old historic sites. Other factors might require one to tighten this environmental range a bit, but there is substantial evidence suggesting that we have yet to encounter a situation where a nearly flat-line environmental control is necessary or even recommended. These research results are based on a multi-year effort on the effects of the environment on materials and objects in the collections.

Preliminary environmental guidelines were written for nearly all of the museums of the Smithsonian for the Office of Physical Plant. The Smithsonian Institution is already planning to implement expanded environmental ranges for several museums.

The manuscript for the book, *Mechanics and Materials Properties in Museums* is well under way. This book is going to be a summary of the research conducted to date and supplemented with mechanics work from the literature. The book will cover simple topics on how to weight and move objects to more complicated analysis of the stress developed by externally applied loads. The work will also cover in detail how materials and museum objects respond mechanically to changes in temperature, relative humidity, impact, and vibration. There will be sections that will examine the additional considerations when there are pre-existing cracks, flaws, and defects. In general, the materials that will be covered include woods, paints, adhesives, some metals, ceramics, stone etc. that are typically found in cultural objects.

Video Preservation Project (MTB, SDS)

Magnetic media restoration was researched at a private firm, VidiPax, in New York City for two months (summer 1998), resulting in a pictorial history of videotapes on slides and Photo CD. Other areas of research included: videotape cleaning, digitization of collections for access and non-aqueous deacidification.

CONSERVATION and COLLECTIONS CARE

Preservation and Access Resource Center for Paper-Based Collections (DVR, FWT)

When SCMRE's Paper Conservation Laboratory opened in its new space in FY 1996, one third of the area was devoted to a new Paper Preservation and Access Resource Center (PARC), available to all Smithsonian Institution staff, following initial training in its use. The resource center illustrates the principles of an integrated preservation program by exemplifying the space, information, equipment, and supplies necessary for preservation management, environmental control, reformatting, collections maintenance, treatment, research and training. Smithsonian Institution staff is encouraged to contact the lab to schedule orientation and use of equipment ranging from a mat-cutter, board-bender and ultrasonic welder (used for making storage and display enclosures and boxes) to a stage microscope, ultraviolet examination light, and pH meter (for identifying and characterizing prints, drawings, documents, and books). Information is available on how to design and fulfill a strategic plan for preservation and access of paper-based collections, as well as how to write a grant for funding, etc. Limited supplies of folders and document storage boxes are also available upon request. During FY 1996-1998 over a dozen Smithsonian Institution staff members, volunteers, and interns from seven units (Smithsonian Institution Archives, SIA; National Anthropological Archives, NAA; National Postal Museum, NPM; Archives of American Art, AAA; National Air and Space Museum, NASM; National Museum of Natural History Paleobiology Department; National Museum of Natural History Anthropology Department) have used the equipment and facilities to make protective enclosures, window mats, and polyester L-welds and pockets for storage and exhibition of their collections.



On-Site Preventive Paper Conservation Projects (DVR, FWT)

One purpose of the Research, Libraries and Archives Collections Training (RELACT) program is to reach out to the Smithsonian Institution staff without an on-site paper conservator for consultation. In addition to training Smithsonian Institution staff and volunteers on various rehousing projects, SCMRE paper laboratory staff has consulted on different types of surveys, preservation planning, and various treatment and rehousing projects with Smithsonian Institution staff from seven units (NMNH's NAA, and Departments of Paleobiology, Botany, and Entomology; NASM; the National Museum of African Art, NMAfA; and SIA). More than 20 collections of six units have been surveyed during FY 1996-1998. Collections include the American

Indian Art Collections, the C.D. Walcott Invertebrate Illustrations, the O.C. Marsh Dinosaur Illustrations, the Chinese Paper-Based Collections, and Entomology Collections. In addition, there were consultations on the treatment needs of five contemporary African artworks for an exhibition at NMAfA. Under the guidance of the SCMRE paper laboratory staff, paper laboratory interns, such as Heather Tennison, Ducphong Nguen (from George Washington University), Larry Kuo (from Taiwan National College of Art), and Jeff Dunbar (from Winterthur) completed six preservation plans for three units (Anthropology Department, the Botany Department, and the Paleobiology Department). Currently, there are eight ongoing rehousing projects collaborating with the NAA, the Anthropology Department, the Paleobiology Department, and the NASM.

Paper Conservation Treatments (DVR, FWT)

Some paper-based collections cannot be properly accessed or rehoused until certain objects are stabilized by treatment, and so four objects were treated during FY 1996-1998. Jeff Dunbar, SCMRE paper laboratory summer intern, undertook one treatment project for two folded, oversized, black and white Japanese woodblock prints from the NMNH Anthropology Department. The prints were surface cleaned, humidified, unfolded, mended, and stored rolled onto a large diameter archival quality tubing for rehousing. Preprogram intern Heather Tennison undertook the treatment of two damaged American Indian art works from the NMNH's Acee Blue Eagle Collection in the NAA, in collaboration with James Glen, of NAA, and Natalie Firnhaber, of the Anthropology Conservation Laboratory (ACL). These included an ink drawing by Stephen Mopope of a Statue on thin, folded and torn paper (which required the development of innovative mending and flattening techniques), and a seriograph by Stephen Mopope of American Indians Dancing on torn, stained acidic paper (which required stain removal using a suction table, and careful mending to avoid formation of tidelines). NASM's archives member Kristine Kaske, for course credit, was trained in the treatment of a damaged Moissant Family Scrapbook. In addition, there were consultations for projects at NASM for humidification and flattening of rolled plans at Garber Facility. Archives Conservator Fei-wen Tsai, and Intern Sarah Stauderman, examined, treated and housed dinosaur drawings from NMNH.

Archaeological Projects with Preservation Components (HFB)

Archaeological Site of Harappa, Pakistan

- On-site conservation at Harappa, Pakistan

Preservation of materials excavated at the site of Harappa is enhanced by active participation of conservators on the archaeological team. Beginning in 1986, the site conservation laboratory was developed and, since 1990, staffed using SCMRE/ACIP participants under SCMRE conservator supervision. In addition to the treatment of newly excavated materials, materials in collections storage, and occasionally objects destined for display, activities include providing training to Pakistani field school participants through lectures and hands-on opportunities.

1996 field season: Catherine E. Magee and Ellen F. Rosenthal (present February 10-April 15); Harriet F. Beaubien (present February 10-March 1); Conservation laboratory report (CEM and EFR, October 4, 1996)

1997 field season: C. Mei-An Tsu and Susan B. Peschken (present January 21-April 9); Harriet F. Beaubien (present January 21-February 10); Conservation laboratory report (CMT and SBP, September 19, 1997)

1998 field season: Elizabeth C. Robertson (present January 22-May 12); Stephanie E. Hornbeck (present January 22-February 28); Harriet F. Beaubien (present January 22-February 13); Conservation laboratory report (ECR and SEH, September 29, 1998)

- Off-site conservation of artifact materials from Harappa

In conjunction with on-site conservation activities, technical analyses of unusual materials were carried out at SCMRE by ACIP participants, assisted by SCMRE support staff.

A treatment report was written and technical analysis performed on an Early Harappan vessel. (ECR)

Archaeological Site of Copán, Honduras

- On-site conservation at Copán, Honduras - Harvard University project

The conservation laboratory at the site of Copán is staffed during the Harvard University field season using SCMRE/ACIP participants and other interns, under SCMRE conservator supervision. Activities include participation in the field school curriculum through lectures and hands-on training opportunities; stabilization of materials in collections storage (including recently excavated objects), and (in 1997) assistance with special project activities.

1996 field season: Catherine E. Magee (present June 29-August 14); Ellen F. Rosenthal (present June 29-July 10), with Susan B. Peschken (Peabody Museum intern); Harriet F. Beaubien (present June 29-July 10 and July 18-25); Conservation laboratory report (CEM, October 19, 1996)

1997 field season: C. Mei-An Tsu (present June 26-July 27); Susan B. Peschken (present June 26-July 6), with Scott Fulton (Peabody Museum); Harriet F. Beaubien (present June 26-July 6 and July 13-20); Conservation laboratory report (CMT, September 29, 1997)

1998 field season: Elizabeth C. Robertson (present June 26-August 1); Stephanie E. Hornbeck (present June 26-July 5); Harriet F. Beaubien (present June 26-July 5 and July 14-25); Conservation laboratory report (ECR, September 29, 1998)



- On-site conservation at Copán, Honduras - Harvard University Structure 26 tomb project

The completion of excavation, examination and documentation of the funerary deposit in the Structure 26 tomb was carried out by a SCMRE fellow, along with SCMRE/ACIP participants and other interns, under SCMRE conservator supervision.

1996-1997: Catherine E. Magee (September 1996-September 1997; on-site February-March, April-September 1997), with Kelly McHugh (NYU summer intern, present May-August 1997); Conservation report (CEM, October 31, 1997)



- On-site conservation at Copán, Honduras - University of Pennsylvania project (ECAP)

The conservation laboratory is staffed during the archaeological field season by a University Museum conservator and a SCMRE conservator, in order to enhance the recovery and preservation of materials from a royal tomb complex. The work, ongoing since 1993, is carried out both in situ and in the laboratory.

1997 field season: Harriet F. Beaubien (present February 23-March 14); Report on the South Offering Platform (HFB, June 5, 1997)

1998 field season: Harriet F. Beaubien (present March 1-21); Conservation report (HFB, November 18, 1998)



Archaeological Site of Cerén, El Salvador

- On-site conservation at Cerén, El Salvador

Preservation of materials excavated at the site of Cerén is enhanced by active participation of conservators on the archaeological team. Beginning in 1989, the site conservation laboratory was developed and, since 1992, staffed using SCMRE/ACIP participants under SCMRE conservator supervision. In addition to the treatment of newly excavated materials and materials in collections storage, activities include providing training to archaeological team members and Salvadoran colleagues.

1996 field season: Ellen F. Rosenthal (present July 10-August 14); Harriet F. Beaubien (present July 10-18); Conservation laboratory report (EFR, October 10, 1996)

1997 study season: Susan B. Peschken (present July 7-August 2); Harriet F. Beaubien (present July 7-13); Conservation laboratory report (SBP, September 30, 1997)

Archaeological Site of Aguateca, Guatemala

- On-site conservation at Aguateca, Guatemala

Beginning in 1998, a conservation component of the archaeological team was developed, and the laboratory was staffed using SCMRE/ACIP participants under SCMRE conservator supervision. In addition to the treatment of newly excavated materials and materials in collections storage, activities include providing training to archaeological team members and Guatemalan colleagues. Plans for this onsite conservation were developed with Daniela Triadan and Takeshi Inomata.

1998 field season: Harriet F. Beaubien (present May 2-12); Conservation report (HFB, May 19, 1998)

1998 laboratory phase: Stephanie E. Hornbeck (present July 5-August 15); Elizabeth C. Robertson (present August 1-15); Harriet F. Beaubien (present July 5-14); Conservation report (SEH, October 29, 1998)

Archaeological Site of Çatalhöyük, Turkey

- On-site conservation at Çatalhöyük, Turkey

An artifacts conservation laboratory was preliminarily established during the 1998 summer field season, to complement the architectural and mural conservation programs already in place. In addition to some treatment of newly excavated materials and materials in collections storage, activities included developing procedures and protocols and planning for future supplies, staffing, and training opportunities. These plans for onsite conservation were developed with Cassie Myers and Frank Matero.

1998 field season: Harriet F. Beaubien (present August 25-September 11); Artifacts Conservation Program: recommendations for the 1999 field season (HFB, September 1998); Artifacts Conservation Program: workplan for the 1999 field season (HFB, September 1998); Artifact treatment record (HFB, September 1998)

Bluff Great House, Utah

- On-site conservation at Bluff Great House, Utah

In conjunction with an off-site training workshop, preservation issues of newly excavated materials, including artifact recovery and storage methods, were discussed with project staff and archaeological field school students from the University of Colorado. This conservation module was developed following discussions with S. Lekson, C. Cameron, B. Voorhies, L. Cordell, P. Sheets and D. Reents-Budet.

1998 field season: Harriet F. Beaubien (present June 12-20); Conservation report (HFB, November 4, 1998)

Preservation of Nicaraguan ceramics

A condition review of incoming Nicaraguan ceramics material was conducted for an exhibit at the Interamerican Development Bank, "Tierra y Fuego - Ceramics from Nicaragua," on behalf of the National Museum in Managua (May 13, 1996).

The 'Ain Ghazal Statue Project (CAG)



Treatment of lime plaster statues from the 7th millennium B.C. was completed for exhibition at the Smithsonian's Sackler Gallery of Art. Excavated at 'Ain Ghazal, Jordan, the fragmented statues had been too fragile to excavate using conventional methods in the field, and they were brought *en bloque* to the laboratory for excavation and reassembly. Excavation having been completed earlier, the focus was on reassembly during this report period. An internal support system was developed for the statues, and brackets were designed for safely holding them upright during display. Many losses were filled so that the fragments would read as integrated statues without misleading the viewer about the extent of loss. After much discussion, a twin head was fabricated which incorporated a small original fragment so that the statue, clearly two-headed, was more displayable, but the new head was made detachable should a less restored appearance be desired in the future. When reassembly was complete, these unique and rare statues, including three two-headed busts, were fully documented, especially aspects of their construction. The project provided excellent training opportunities for postgraduate archaeological conservation fellows, supervised by Objects Conservators Carol Grissom and Harriet F. Beaubien.



The 'Ain Ghazal statues were featured in two exhibitions. The first, "Preserving Ancient Statues from Jordan" at the Arthur M. Sackler Gallery from July 28, 1996, to April 6, 1997, was devoted wholly to the statues and their conservation at our laboratory. The exhibition attracted a wide audience, in part because of extensive press coverage that compared the appearance of the statues to extra-terrestrial beings. An interactive computer program in the exhibition provided more information than could be placed in the exhibition otherwise. It proved popular with all ages, and a modified version of the program was made available on the World Wide Web. The statues were included in a second exhibition, "Jordanie sur les pas des archaeologue" at the Institut du Monde Arabe in Paris, France, from June 13 to October 5, 1997. The project was also featured in a children's television program "Field Trip: In Search of the Nation's Attic" and a panel discussion was broadcast worldwide on USIA's Worldnet. Innumerable public lectures were given, the most illustrious venue being the Louvre Museum.



Fumigation Activities (MWB)

The necessary licenses were maintained for the Fumigation Room and its operation as an anoxic facility with the state of Maryland. Anoxic treatments were carried out on a group of four mixed media sculptures of The Beatles for the National Portrait Gallery and on a group of 30-40 Puerto Rican santos figures from the Vidal Collection for the National Museum of American Art. Protocols and procedures involved the use of humidified argon gas; oxygen levels were calibrated with an oxygen monitor. This work was carried out under the supervision of Mary Ballard, licensed for fumigation in the state of Maryland, and staff from the respective museums who were trained by Dr. Robert Koestler who developed the treatment parameters.

In association with this work, three additional Smithsonian conservation staff received training from Dr. Koestler in New York during FY 1996-1998: Rosemary Fallon (National Portrait Gallery), Deborah Hashim (National Museum of American History), and Claire Dekle (Smithsonian Institution Libraries). These Smithsonian staff compliment the other conservators already able to carry out anoxic treatments for the minor infestation of objects encountered in Smithsonian museums' collections. All were kept abreast of current issues, conferences, and papers on pest control in the museum context, recent outbreaks in the vicinity of Washington, DC, new technologies, and legislative initiatives by semi-annual meetings of the Pizazz Group. Discussions and hand-outs were distributed to all members.

COLLABORATIONS

Freer/Sackler Archaeological Manuscript Project (MWB)

After a hiatus of sixteen months, the project on the Chu Silk Manuscript II was resumed in October 1995. Some time was required to review the status of the project, each of the hundreds of fragments and their documentation, and the work of various collaborators at the Freer/Sackler and overseas. Mapping and orientation issues were restudied. The need for modern replication of certain chemical and physical aspects of the problem were noted. Fabrication of modern models were developed and examined with SEM/EDS; these were then treated and prepared for experimentation with the assistance of the Far Eastern paintings conservators at the Freer/Sackler. A literature review was expanded, aided by advice from Mark McCormick-Goodhart, former photographic scientist at SCMRE, and from Dr. John Winter, research scientist at the FSG. The work expanded to include experimentation of various factors which might singly or in combination resolve the chemical contradictions encountered in the project, including several series of experiments on microscopic samples. Research on arcane aspects of silk degradation and microbiology, in conjunction with a review of the initial documentation of its excavation, led to some useful inquiries to the editor in chief of International Biodeterioration and to the chief microbiologist at the Armed Forces Institute of Pathology. A new experimental treatment is being developed that may be successful in unlocking the nature of the manuscript(s).

EDUCATION AND OUTREACH PROGRAMMING

The education and outreach activities of SCMRE proceed through a variety of programs and projects utilizing the Center's interdisciplinary strengths and facilities. All SCMRE professional staff can contribute to any of the program's major emphases: internships, formal curriculum training, courses and workshops, and public outreach.



The main thrust of SCMRE's programs is in the areas of preservation and characterization education and training, including technical training for conservation professionals, other museum and related professions, and increasingly the general public.

Educational programs at SCMRE continue to evolve, building on established successes by reaching into new areas of constituents and projects within four major emphases: formal curriculum training, courses and workshops, internships, and public outreach.

Through both long-term programs and short or one-time events, courses provide concrete applications of research implications and the principles of professional practices. Some of our curricula are focused on established preservation professionals, others are available to anyone interested in the topic.

Internships and fellowships at SCMRE span educational levels and academic disciplines reflecting SCMRE programs. Whether the visitor is a postdoctoral fellow in materials science, a graduate student in conservation, or a pre-program or summer intern in conservation, there is a common thread - that the experience benefits the students' understanding of artifact characterization or preservation.

SCMRE staff are extremely active in presenting their work outside SCMRE to both professional and general audiences. In addition, we have undertaken an ongoing series of instructional videos for collection caretakers, and are developing an art/science curriculum for secondary schools.

ONGOING PRESERVATION EDUCATION PROJECTS

SCMRE engages in ongoing curriculum-based teaching and training on many levels, ranging from introductory through advanced professional. Several programs, in archaeological conservation, archives preservation (via RELACT), furniture conservation (via FCTP), and microscopy represent long-term programmatic commitments. A fifth area, in the preservation of *santos*, or Hispanic Catholic veneration art, has evolved into a multi-year project with an international educational impact.

Archaeological Conservation [Internship] Program (HFB)

Many of the projects described below are components of SCMRE's archaeological conservation program, designed to provide specialized training in the preservation of archaeological materials. Advanced-level conservation interns and fellows are trained through supervised staffing of on-site conservation laboratories and through research opportunities pursued at SCMRE using related excavated materials. These activities in turn provide a significant mechanism for enriching our knowledge about the materials being excavated, enhancing collections preservation for the archaeological projects, and carrying out sustained training both of archaeologists and of nationals with limited access to conservation training.

Lectures and Workshops on the Characterization and Preservation of Archaeological Materials

A graduate-level course was developed and offered during the fall 1997 semester (with Rita P. Wright) through New York University's Conservation Center and Anthropology departments. It addressed material culture studies from archaeological, anthropological and conservation perspectives. Conservation and technical studies related to the excavations in which SCMRE participates provided the basis for two lectures:

- Conservation in the field: finds processing issues and practical considerations - for NYU course (November 26, 1996), repeated for SCMRE (December 19, 1997)
- Recognizing a new artifact category: painted gourds from the excavations at Cerén, El Salvador - for NYU course (November 5, 1996), repeated for SCMRE (December 18, 1997)

A conservation module, offered as part of a university-level archaeological field school, was developed and taught to participants in the field school run by the University of Colorado at Boulder in conjunction with excavations at the Bluff Great House, Utah. The training workshop, focusing on conservation principles and techniques as a part of archaeological field methods, took place primarily in the processing laboratory at the Edge of the Cedars, in Blanding (June 15-19, 1998).

Both the Harappa Archaeological Research Project and Harvard University's Copán project include in their research operation a field school for archaeology students and professionals. Lectures and workshop sessions on a wide variety of field conservation issues are a regular part of the curriculum each season. Conservation contributions were made by all SCMRE participants during the 1996, 1997 and 1998 field seasons for the Harappa project and for Harvard's Copán project.

Archaeological conservation workshops for archaeologists were the subject of discussions with J. Johnson (Museum Management Program division) and T. Childs (Archaeology and Ethnography division), to be offered in 1998-99 in collaboration with the National Park Service.

On a regular basis, orientation lectures on field conservation at Harappa, Copán, Cerén and Aguateca were given at SCMRE to program participants and interested others.

Other invited lectures on archaeological conservation issues included:

- Archaeological ceramics: a conservator's perspective - for Material Science of Art and Cultural Objects, Johns Hopkins University's Material Science/Engineering program (April 18, 1996)
- Ordinary things from extraordinary contexts: recent finds from excavations at Cerén (El Salvador) and Copán (Honduras) - for the Pre-Columbian Society of Washington (September 5, 1997) (summarized in Smoke and Mirror, PCSW newsletter, vol. 5 no. 2, October 1997, pp. 2-4); repeated for SCMRE (October 10, 1997).
- Cerén, Copán and SCMRE - as part of the December 4, 1997 (monthly) meeting of the Washington Conservation Guild (summarized in WCG Newsletter, vol. 22, no. 2, p. 3). The featured topic was "Around for World in 80 minutes: Archaeological Conservation at Active Sites."
- The Trappings of Kingship among the classic Maya: Ritual and Identity in a Royal Tomb from Copán - for the 15th Annual Visiting Scholar Conference, held at Southern Illinois University (April 17-18, 1998), organized to address the topic of Fleeting Identities: Perishable Material Culture in Archaeological Research; also repeated for SCMRE (April 15, 1998).
- On-site conservation: Ensuring a Future for Indus Archaeological Collections - for a special session on the Present and Future of Indus Valley Archaeology, at the 27th Annual Conference on South Asia, University of Wisconsin/Madison (October 17, 1998)

The Research, Libraries and Archives Collections Training Program (RELACT) (DVR, FWT)

In this collaborative program with the Smithsonian Institution Archives and the Smithsonian Institution Libraries, Institutional paper-based research collections provide the training grounds and materials while they benefit from special preservation projects and the improvement in their preservation care.

A curriculum of periodic lectures, demonstrations and workshops provides professionals involved in the use and management of these collections with an understanding and appreciation of the applicable principles and practices of preservation and access. An SCMRE-based special resource center provides collection managers trained in the program with the materials and facilities to perform such preservation activities as the preparation of rehousing materials.

RELACT continued to focus on Smithsonian paper-based collections, which are among the largest, most important and distinctly unique in the world, consisting of a wide array of vulnerable materials ranging from Smithsonian's documents to illustrations of extinct species and lost technologies. These collections have incalculable evidential, informational, and research value, much of which is as yet untapped, although their value declines as their materials decay.



RELACT's goal, since its inception in 1992, has been to provide training on how to profit from preservation of paper-based collections. Minimum resources can be maximized through coordinated preservation strategic plans addressing core

preservation responsibilities of management, duplication, maintenance, environmental control, treatment, research and training. Following five successful years, with membership expanding from 50 to 150, RELACT in FY 1996-1998 marked a milestone by redesigning its programs in anticipation of new issues appropriate to the approaching millennium.



RELACT's educational program, initially tailored to a pan-institutional target audience of Smithsonian archivists, librarians, curators and other specialists, has expanded dramatically to include allied professionals and members of the general public concerned with the preservation of their invaluable paper materials. The training, initially achieved through a combination of over three dozen lectures and workshops,

partnerships in grant-writing, and coordination of a resource center with supplies and equipment, expanded to include new initiatives and partnerships. Accordingly, RELACT evolved three programmatic directions: 1) developing an innovated group of Smithsonian Institution-driven programs, 2) millennium-driven programs, and 3) outreach-driven programs.

RELACT's Smithsonian Institution-driven programs for FY 1996-1998 included a new series of lectures and workshops at SCMRE, grants, in-house presentations for museums on the Mall, and participation in over a dozen Smithsonian Institution events, plus concentrated collaborations with the Smithsonian Archives and the NMNH. The workshops included a kick-off introduction to the new SCMRE Paper Conservation Laboratory and Resource Center (in partnership with a Material Culture Forum program on-site); a demonstration of different collection care techniques, such as box making, matting, and humidification (as a prelude to exercises on paper and book-making for the Smithsonian Institution 150th birthday celebration); and a seminar on preservation of photographs (as part of RELACT's Millennium Time Series, described below). The grants included Research Resources grants for staff and collections care, and an outside grant for care of Chinese paper collections. The in-house presentations for museums on the Mall included a disaster preparedness slide show for the Archives Council; a lecture on preventive conservation approaches for the Marsh dinosaur collection in the Paleobiology Department; and demonstrations for the NAA on how to use clam shell boxes and other protective enclosures.

The dozen-plus additional events RELACT participated in included three poster presentations (on Time Capsules, Exhibitions and Courses) for the Smithsonian Institution Council of Scholars Dialog II Meeting on "What about Increase;" a Material Culture Forum meeting held at SCMRE; a Museum Studies Center program on preventive care for paper-based collections; a NASM's Mutual Concerns program on paper documents; the drafting of policy for SD600's Preservation Committee; demonstrations on paper, book and box-making for Smithsonian Institution's Folklife Festival and on research into the technology and preservation of paper-based collections for Smithsonian Institution's Sesquicentennial Birthday Party; and participation with SCMRE's courses for a Violin Workshop, Appraisers Workshop, Furniture Conservation Training Program, and Suitland High School (STATS)

Program. Products developed and distributed for these programs included publications, posters, outlines, bibliographies, guidelines and other handouts, as well as samples of training kits, time capsules, paper, bindings, boxes and other storage systems.

RELACT's Millennium-Driven Programs for FY 1996-1998 focused on developing the *RELACT Millennium Time Series*, starting first with "Marking Time with 'Buried' Treasures: Issues of Preservation and Access" (a program co-sponsored by Smithsonian Institution's Material Culture Forum) with speakers discussing "objects as time capsules," referencing topics as diverse as the "Alp Man," changing interpretations of Cambrian fossils at NMNH from the Burgess Shale of British Columbia, investigations by SCMRE of ancient Jordanian statues, and expressions of rapidly changing contemporary culture as depicted in Time magazine cover illustrations from the NMAA. A summary of the meeting was published in the MCF Grapevine newsletter. This event was followed by a three-day course on "Capturing Time: Preservation Management of Photograph Collections," with speakers from the Image Permanence Institute, Northeast Document Conservation Center, the National Archives, the National Geographical Society, and SCMRE talking about preservation issues for different photograph materials ranging from traditional photographs, films and magnetic tapes, to digital images. "Timeline: Scheduling Strategies for Preservation Collections" focused on preservation activities around the mall. Smithsonian Institution staff collaborators from Mall-based collections delivered lectures covering strategic preservation planning, underground storage issues, and preventive conservation in each department and archives. "Just in Time: Disaster Preparedness for Paper-Based Collections" from September 15 to 16, 1998, was a collaborative project between SCMRE and Smithsonian Institution Libraries (SIL). This program contained one day of lectures with a table top demonstration, followed by a hands-on recovery workshop the next day. The program attracted about 50 participants from ten Smithsonian Institution libraries, eight Smithsonian Institution departments and archives, and seven outside agencies.

The RELACT events audience for FY 1996-1998, composed of Smithsonian Institution and allied professionals as well as members of the general public, numbered 30-50 for each event, with requests for participation, handouts, and course material coming from as far away as Australia and India.

RELACT's Outreach-Driven Programs for FY 1996-1998 extended local and long-distance programs and partnerships. Two local programs for which RELACT lectured were the Capitol Area Network (CAPNET) Seminar on Exhibitions, focusing on how to recognize and preserve photographs, and the National Park Service's School for Scanning course in Washington and New York, covering selection criteria and five-year strategic plans for efficient management of digitization of paper-based materials. Some long-distance partnerships developed in conjunction with lectures at graduate conservation programs at Winterthur (University of Delaware) and Buffalo (New York State University) on conservation of diverse paper-base materials found at the Smithsonian, including scientific illustrations, globes, folding screens, papier-mache furniture, tracing papers, Valentine cards, Chinese papers, etc. Other long-distance programs focus on curriculum development and partnerships with groups working in Latin American and the Orient. These programs have now effectively formed two subcategories of RELACT: the Hispanic Archives Preservation Program (HAP), which has worked to develop courses with ICCROM in Chile and with OAS in Venezuela, and the Asian Archives Preservation Project (AAP), which has worked

with several Chinese cultural organizations to develop programs in Taiwan and research projects on mainland China. These two subgroups are discussed further in a following section. Products for these programs include curricula, guidelines, examples of materials, and publications.

The Furniture Conservation Training Program (FCTP) (MJW, DCW)

The FCTP is a uniquely designed graduate-level program, developed to allow practicing woodworkers and restorers to pursue advanced mid-career development and re-orient their professional activities toward the field of professional, museum quality, furniture conservation. In response to this, and the clear need for a larger professional community of furniture conservators, the FCTP was initiated in 1986. The innovative curriculum is based on three years of intensive course work of four two-week courses per year combined with extensive home study assignments, plus a one-year internship with a recognized furniture conservator. Upon completion of the program, students receive a SCMRE certificate and are eligible for a Master's degree.

The curriculum for the Furniture Conservation Training Program consists of twelve sequential courses followed by a full-year internship. These courses are taught by numerous staff members of the SCMRE and several dozen internationally-recognized specialists in the preservation and materials technology professions.

Program Content

The purpose of the Furniture Conservation Training Program is to integrate craft and technical skills with the ethical and philosophical bases of the profession and enable graduates to contribute toward the preservation of wooden artifacts within this framework. Woodworking is only one of several skills required of a furniture conservator. Other areas include knowledge of material technology, organic, inorganic and physical chemistry, cultural and art history, methods of analysis, written and photodocumentation, in addition to conservation practices. An excellent cabinetmaker can be a poor conservator. The outlook of the conservator is the key attribute which makes the difference - specifically, respect for the integrity of the object, the desire for minimally intrusive actions, and the concern for the long-term stability of the artifact.

Each of the twelve FCTP courses covers a specific furniture conservation subject area. Instruction is by SCMRE staff and visiting faculty. Each course has extensive lecture and laboratory sessions, many of which are interdisciplinary. Taken as a whole, the sequence provides an introduction to furniture conservation, including materials technology, furniture history, scientific analysis, and applied furniture conservation. The lecture component for each course varies from three to six days long, and may be opened to outside attendees. The remainder of each course is a structured laboratory session solely for FCTP students.

Course of Study

1. Wood Technology for Furniture Conservation

Specific subject areas include anatomy, identification, physical, mechanical and chemical properties, biodeterioration and control, and other environmental interactions of wood. Knowledge of these factors as they contribute to deterioration allows the prospective conservator to provide advice about and response to the problems. A session on conservation ethics and philosophy is included in this initial course of the sequence.

2. Furniture History

European, American and some non-Western furniture design, manufacture, and construction is surveyed to provide connoisseurship and an ability to communicate effectively with curators and other furniture caretakers. Specific emphasis is placed on national and regional variations in design, materials, and construction techniques, in addition to chronology and progression of styles. A research paper and oral/visual presentation are required for this course.

3. Examination, Analysis, and Documentation of Furniture

The theory and application of examination, documentation, and analysis techniques is introduced. This includes information obtained from relatively simple techniques as well as sophisticated instrumental methods. Specific areas include photography, documentation reports, microscopy, radiography, and various forms of instrumental analysis modified from other research fields or specifically developed for characterizing museum objects and cultural artifacts.

4. Survey of Non-Wood Materials for Furniture Conservation

The technology, deterioration, and conservation of various materials is addressed - including metals, ceramics, glass, leather, plastics, textiles, upholstery, paper, and others. Applied conservation treatment of these materials is included, providing a basis for effective interaction with specialists in these disciplines.

5. Adhesives for Furniture Conservation

Subject areas include adhesive theory and technology for wood, a survey of adhesives and their properties, adhesives used in conservation, and treatment of adhesive deterioration or failure. Particular emphasis is placed on delamination, e.g. treatment of veneered objects (marquetry, Boulle-work, etc.).

6. Structural Conservation of Furniture

The causes and treatment of structural deterioration is surveyed, including damaged joinery, upholstery substructure, carving, and turning. The technology and practice of consolidating degraded structural materials and the ethical concerns of reconstructing and reproducing objects for interpretation or utility is discussed.

7, 8, 9. Coatings for Furniture Conservation I, II, and III

The history, technology, chemistry, properties, deterioration, and treatment of coating materials and colorants is studied, along with color theory, finishing techniques, treatment and manipulation of existing coatings. The third coatings course emphasizes painted finishes, e.g. polychrome sculpture, decorated furniture finishes, and consolidating and inpainting surfaces.

10. Conservation of Gilt Wood

Topics include history and technology of gilding materials and techniques, and the causes and treatment of deterioration. Fabrication and repair of gilding substrates is emphasized.

11. Exhibition, Storage, and Handling of Furniture

This is primarily a study of collections management for furniture collections, including environmental interaction and control, collections care, and disaster preparedness. Additional discussion focuses on exhibition concerns, storage and handling, and the problems of art in transit.

12. Conservation Administration

This course provides the practical background of administrative procedures in both institutional and private conservation practices. It includes museum philosophy, organization and administration, business management and law, marketing, grants, insurance, and laboratory administration and design.

Internship in a Conservation Laboratory

The information contained in the preceding courses is applied to conserving wooden objects during a year-long full-time internship in the studio or laboratory of an established conservator (with the approval of FCTP staff). Approximately one-fifth of the internship is spent on research which that results in a publishable thesis. The project may address theoretical or technical issues regarding the history and preservation of wooden artifacts.

FCTP Format Change

After 15 years of classroom-based curriculum, the direction of the FCTP will be making a major change in the coming years. Rather than being a somewhat traditional, though still innovative, structure, it will become something else entirely. To announce that change to the professional community, a release with the following text was issued in December, 1997 (emphasis added).

Beginning at the conclusion of studies by the Furniture Conservation Training Program (FCTP) Class of 2000, the Program's format will evolve into an education product with a broader and more far-reaching impact. Starting in 2001 we will begin synthesizing our 15-year experience from the Program into a multi-media educational product for broad distribution to furniture and wooden object caretakers internationally. This transformation is the result of ongoing and continuous evaluations of the Program, and reflects CAL's [sic] programmatic emphases to reach and benefit new audiences interested in preservation of cultural patrimony.

Rather than continue with the status quo of twelve sequential courses over three years, we expect to continue offering two or three furniture or coatings courses a year, specializing in subjects we have thus far been unable to develop more fully due to time constraints. So, on the surface, things may "look" much the same, but the underlying foundation will be different: CAL [sic] will still offer furniture-related courses, but they will be fewer and may be slightly different in focus. At the same time, we will be pursuing a far more efficient vehicle for disseminating the same information.

We are extremely proud of what has been accomplished for the field of education in wooden artifact preservation and restoration via the fifteen remarkable years of the FCTP course-based curriculum. Its eventual success far surpassed our initial hopes, as it has contributed significantly to the definition and recognition of furniture conservation as a specialized professional discipline.

Microscopy (HAA)

SCMRE has begun presenting a coordinated series of educational activities and products on applied optical microscopy for material analysis and identification. This ongoing educational commitment, emerging over the next several years, is focused on microscopy technique as a tool for gathering useful information used in decision-making, emphasizing the practical and theoretical considerations regarding samples and microscopes.

The ultimate vehicles for this commitment include courses, internships and fellowships, definitive reference materials in a variety of media, including practical manuals, atlases, instructional videos, etc. This curriculum will be developed by SCMRE staff led by Microscopist Dr. Harry Alden.

Particular areas of development include: Applied Optical Microscopy; Sample Preparation for Microscopic Investigation; Documentation and Presentation of Results; Analytical Imaging; Image Storage, Archiving, and Manipulation; Microanalytical Techniques; Archaeobotany; and Fiber Analysis. Other topics or techniques will be incorporated as the program evolves.

Courses and reference materials are designed around "real world" conditions found in collections care and related inquiries, i.e. unknown materials and composite artifacts, unknown histories of those materials, sample size limitations, varying states of preservation, etc.

CONSERVATION and PRESERVATION COURSES and WORKSHOPS

Our courses and training events have a variety of emphases. In addition to our two long-term curricula, the Furniture Conservation Training Program (FCTP) and the emerging Research, Libraries, and Archives Conservation Task Force Program (RELACT), there are several individual courses and workshops with a range of constituents and duration, from week-long specialized topic courses for advanced professionals to relatively non-technical introductory and overview courses for collection caretakers. While most SCMRE courses were open to outside audiences, some were particular to the needs of the Smithsonian Institution staff.



SCMRE offered three dozen courses in FY 1996-1998, which were attended by approximately 900 people from wide-ranging personal, geographic, and professional backgrounds. In addition, over 200 Smithsonian Institution colleagues from most bureaus attended, and nearly all SCMRE professional staff participated in teaching, collaborating with more than 80 visiting faculty.

Education Activities Schedule

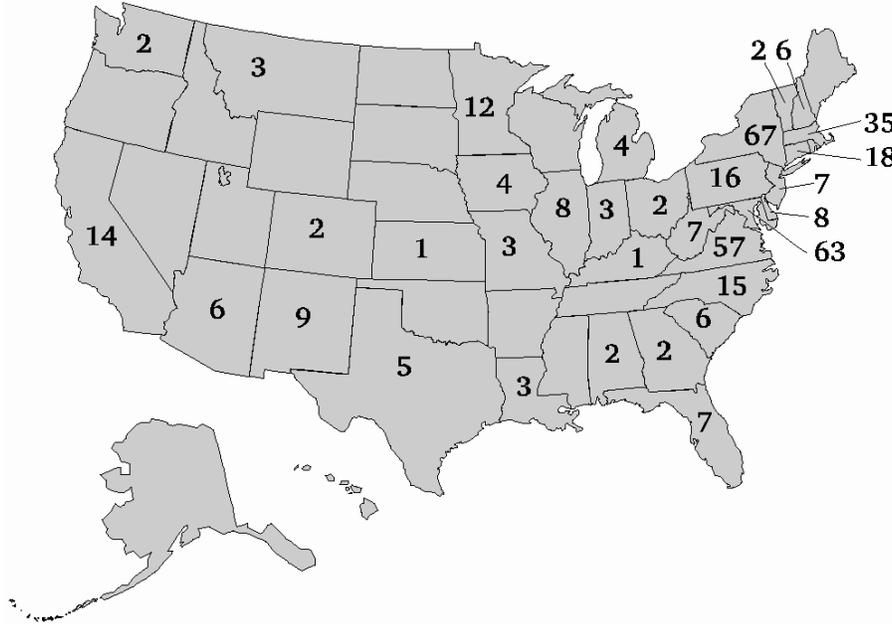
SCMRE event sponsor noted in parentheses.

- Smithsonian Institution Material Culture Forum: May 22, 1996 (DVR)
- Wood Technology for Furniture Conservation: July 22-26, 1996 (MJW)
- Smithsonian Sesquicentennial Celebration: August 9-11, 1996 (DCW)
- Examination, Analysis, and Documentation of Furniture: November 4-8, 1996 (MJW)
- Survey of Non-Wood Materials for Furniture Conservation: February 3-7, 1997 (MJW)
- Furniture History I: May 5-9, 1997 (MJW)
- Furniture History II: May 12-16, 1997 (MJW)
- Four Approaches to Textiles Conservation: May 21-23, 1997 (MWB)
- Nuclear Analytical Techniques in Archaeological Investigations: June 23-27, 1997 (LVZ)
- Technology and Preservation of Artifacts: July 7-11, 1997 (DCW)
- Stain Removal: July 23-25, 1997 (MWB)
- Adhesives for Conservation: August 4-8, 1997 (MJW)
- The Museum Environment: September 3-5, 1997 (LVZ)
- Preservation Management of Photograph Collections: Saving Images for the Digital Age: September 16-18, 1997 (DVR)
- Preservation of Imágenes: Hispanic American Religious Images on Wood: September 23-25, 1997 (JST)
- Structural Conservation of Furniture: November 3-7, 1997 (MJW)
- Preserving Natural History Collections: December 8-12, 1997 (DCW)
- Coatings for Conservation I: February 2-6, 1998 (MJW)

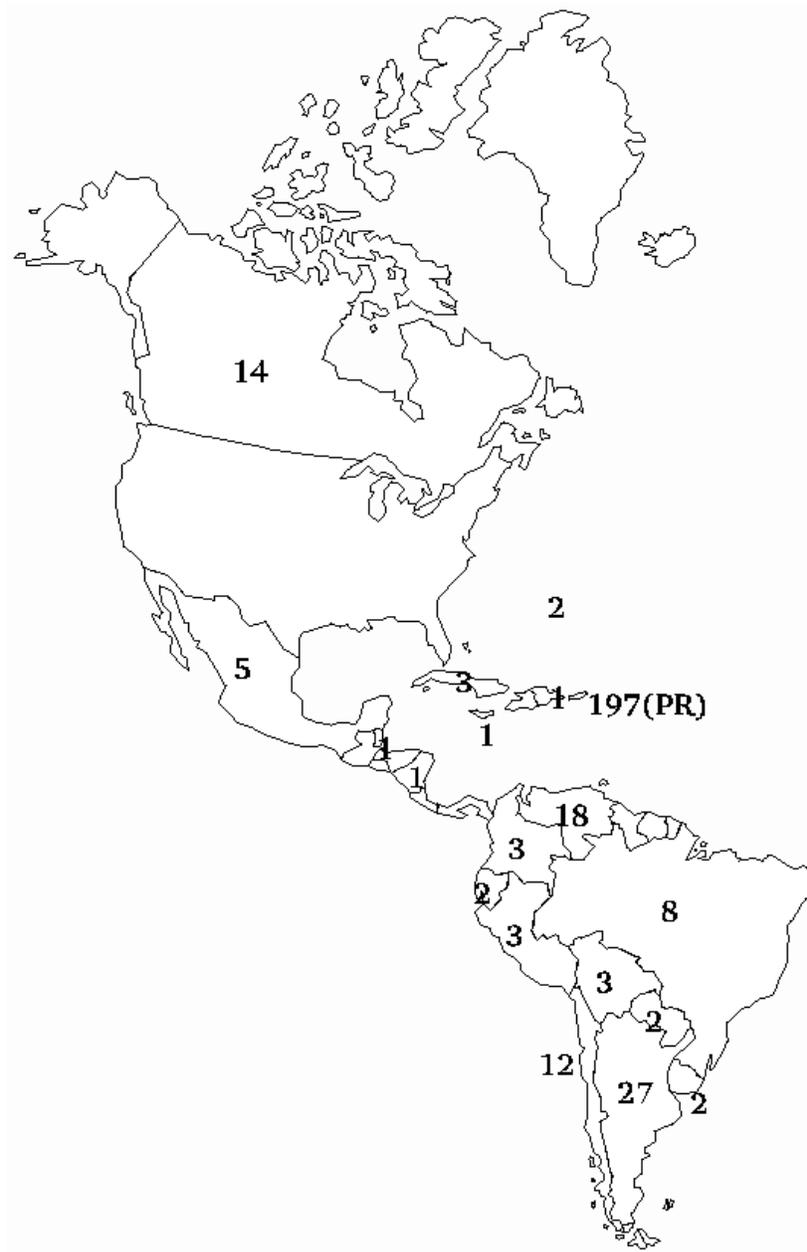
- Stain Removal: April 1-3, 1998 (MWB)
- Coatings for Conservation II: April 27-29, 1998 (MJW)
- Preservation of Santos: May 19-22, 1998 (JST)
- Timeline: Scheduling Strategies for Preservation of Paper-Based Collections: June 23, 1998 (FWT)
- Technology and Preservation of Artifacts I: July 13-17, 1998 (DCW)
- Preservation Fundamentals (MWB)
 - I: Humidity July 20, 1998
 - II: Mold and Mildew July 22, 1998
 - III: Pests July 24, 1998
- Coatings for Furniture Conservation III: August 3-7, 1998 (MJW)
- Just In Time: Disaster Preparedness For Paper-Based Collections: September 15-16, 1998 (FWT)
- Applied Optical Microscopy: September 21-25, 1998 (HAA)
- Patterns and Process - A Symposium in Tribute to Edward V. Sayre: September 21-22, 1998 (RLB)



**GEOGRAPHIC BACKGROUNDS OF ATTENDEES OF
EDUCATIONAL EVENTS
FY 1996-1998
United States of America**



Western Hemisphere



Eastern Hemisphere



Event Descriptions

Smithsonian Institution Material Culture Forum

May 22, 1996 (DVR)

In conjunction with the Smithsonian Institution's Material Culture Forum (MCF), SCMRE's Research, Libraries and Archives Collections Conservation Task Force (RELACT) initiated its millennium-driven programs with the first of its Time Series, entitled "Marking Time with 'Buried'" Treasures: Issues of Preservation and Access." Focusing on the theme of "objects as time-capsules," the joint MCF/RELACT program featured lectures on diverse examples, including the "Alp Man," changing interpretations of Cambrian fossils at NMNH from the Burgess Shale of British Columbia, investigations by SCMRE of ancient Jordanian statues, and expressions of rapidly changing contemporary culture as depicted in Time magazine cover illustrations from the NMAA. The program also included tours of the Museum Support Center conservation laboratories and storage pods. Speakers included SCMRE's Dianne van der Reyden (moderator) and Carol Grissom, as well as Douglas Erwin of the NMNH's Paleobiology Department and Fred Voss of the National Portrait Gallery. About 50 individuals from the Smithsonian Institution and other professional institutions attended. A summary of the meeting was published in the MCF Grapevine newsletter.

Wood Technology for Furniture Conservation

July 22-26, 1996 (MJW)

In this first course of the Furniture Conservation Training Program (FCTP) curriculum, subject areas included anatomy, identification, physical, mechanical and chemical properties, biodeterioration and control, and other environmental interactions of wood. Knowledge of these factors as they contribute to deterioration allows the prospective conservator to provide advice about and response to the problems. A session on conservation ethics and philosophy was included in this initial course of the sequence. Attendance: 12. Faculty: Melvin J. Wachowiak, SCMRE; R. Bruce Hoadley, University of Massachusetts.

Smithsonian Sesquicentennial Celebration

August 9-11, 1996 (DCW)

Like most units of the Smithsonian, SCMRE participated in the three-day extravaganza on the Mall as the Smithsonian Institution celebrated its 150th anniversary with a half-million guests. In a full-sized net pavilion, SCMRE staff demonstrated the projects and programming of the unit. Approximately 25 staff members participated, and an estimated 30,000 people visited the pavilion.



Examination, Analysis, and Documentation of Furniture

November 4-8, 1996 (MJW)

The second course of the FCTP curriculum covered the theory and application of examination, documentation, and analysis techniques on museum artifacts. This included information obtained from relatively simple techniques as well as sophisticated instrumental methods. Specific areas included photography, documentation reports, microscopy, radiography, and various forms of instrumental analysis modified from other research fields or specifically developed for characterizing museum objects and cultural artifacts. Attendance: 11. Faculty: Mary T. Baker, W. David Erhardt, Walter R. Hopwood, Ann B. N'Gadi, Camie S. Thompson, Jia-sun Tsang, Noreen C. Tuross, Melvin J. Wachowiak, Donald C. Williams, SCMRE; Eric Long, Smithsonian Institution Photo Services; Janet Douglas, Freer/Sackler Galleries.



Survey of Non-Wood Materials for Furniture Conservation

February 3-7, 1997 (MJW)

This third course in the FCTP curriculum was a "closed course" open only to the students of the FCTP. The technology, deterioration, and conservation of various materials were addressed - including metals, ceramics, glass, leather, plastics, textiles, upholstery, paper, and others. The course was formulated to integrate lectures and intensive hands-on laboratory exercises to provide a basis for effective interaction between specialists in furniture conservation and these disciplines. Attendance: 7.

Faculty: Mary T. Baker, Harriet F. Beaubien, Carol A. Grissom, Dianne van der Reyden, Melvin J. Wachowiak, Donald C. Williams, SCMRE; Jessie Munn, Library of Congress; Toby Raphael, National Park Service; Betsy Lahikainen, Boston; Don Fennimore, Winterthur Museum; Shelly Sturman, National Gallery of Art.

Furniture History I and Furniture History II

May 5-9, 1997 and May 12-16, 1997 (MJW)

The fourth offering in the FCTP curriculum, these two week-long courses were offered on consecutive weeks at a variety of sites, primarily the Philadelphia Museum of Art and the Winterthur Museum. Course content included a survey of furniture design, manufacture, and construction, to provide connoisseurship and an ability to communicate effectively with curators and other furniture caretakers. Specific emphasis was placed on national and regional variations in design, materials, and construction techniques, in addition to chronology and progression of styles. The first week emphasized American forms, the second week European and some non-Western. By holding the courses in museum collections attendees were provided the opportunity to examine specific forms in person. Course I Attendance: 10. Faculty: Melvin J. Wachowiak, Donald C. Williams, SCMRE; Christian Witt Doerring, Austrian Museum of Applied Arts; David DeMuzio, Philadelphia Museum of Art. Course II Attendance: 16. Faculty: Melvin J. Wachowiak, Donald C. Williams, SCMRE; Wendy Cooper, Nancy Evans, Donald Fennimore, Greg Landrey, Michael Podmaniczky, Winterthur Museum; Phillip Zimmerman, Lancaster, PA.

Four Approaches to Textiles Conservation

May 21-23, 1997 (MWB)

This was a three-day colloquium addressing various conceptual and methodological approaches to preservation, care, restoration, and research on historical textiles for conservators. Four established conservators from around the globe presented and facilitated discussion. Attendance: 20. Faculty: Mary W. Ballard, SCMRE; Margaret Fikioris, formerly Winterthur Museum; Mechtild Flury-Lemberg, Switzerland; Nobuko Kajitani, Metropolitan Museum of New York; Sheila Landi, London.

Nuclear Analytical Techniques in Archaeological Investigations

June 23-27, 1997 (LVZ)

This week-long course focused on interdisciplinary research, especially involving nuclear analytical techniques (e.g. INAA) for characterization of inorganic archaeological materials, and the development of facilities to conduct such investigations in Latin America. This course was fully subsidized by the International Atomic Energy Agency. Attendance: 19. Faculty: Ronald L. Bishop, Lambertus van Zelst, SCMRE.

Technology and Preservation of Artifacts

July 7-11, 1997 (DCW)

Offered through the George Washington University Appraiser's Institute program, this course was a five-afternoon survey of the materials, manufacture, deterioration and preservation of furniture, paintings, paper-based artifacts. The course included lectures and demonstrations by SCMRE conservators, and was intended to inform prospective caretakers and appraisers on the nature of these artifacts. Attendance: 24. Faculty: Jia-sun Tsang, Dianne van der Reyden, Melvin J. Wachowiak, Donald C. Williams, SCMRE.

Stain Removal

July 23-25, 1997 (MWB)

This three-day course was designed for conservators and caretakers of historic textiles with a particular interest in the removal of accidental soiling and staining of porous materials. A review of surfactants, solvent systems, and reagents was followed by a discussion and laboratory exercises on treating the of the most common stains. Attendance: 10. Faculty: Mary W. Ballard, SCMRE; Heasoon Rhee, San Diego.

Adhesives for Conservation

August 4-8, 1997 (MJW)

In the fifth of the FCTP's twelve courses, subject areas included adhesive theory and technology (especially for wood), a survey of adhesives and their properties, adhesives used in conservation, and treatment of adhesive deterioration or failure. Particular emphasis was placed on delamination, e.g treatment of veneered wooden objects (marquetry, Boulle-work, etc.). Attendance: 13. Faculty: Melvin J. Wachowiak, Donald C. Williams, SCMRE; James T. Rice, University of Georgia; Eugene Thordahl, Bjorn Industries.

The Museum Environment

September 3-5, 1997 (LVZ)

A symposium, organized by SCMRE with financial support from the National Center for Preservation Technology and Training (NCPTT), brought 20 invited participants together to evaluate current standards for all aspects of collection environments and to discuss the impact of recent research results. The participants represented a wide spectrum of professionals concerned with collections and the buildings that house them, including conservators, conservation scientists, HVAC engineers, architects, and museum administrators. Discussion topics included the building envelope, HVAC technologies, chemical, biological and mechanical deterioration, relative humidity, temperature and pollution, and energy and cost savings strategies. The symposium covered historic houses, museums, libraries and archives, both in historic structures or in buildings specially designed to house collections. A significant amount of time was devoted to discuss risk assessment and the planning and decision making process. A publication based on the discussions at the symposium is in preparation.

Preservation Management of Photograph Collections - Saving Images for the Digital Age

September 16-18, 1997 (DVR)

This two-day workshop in the RELACT series included introduction by lectures and demonstrations to care and management of photographic materials, identification of photo prints and negatives (workshop), and preservation of special media.

Attendance: 41. Faculty: Dianne van der Reyden, Fei-wen Tsai, Mary T. Baker, SCMRE; Jim Reilly, Image Permanence Institute; Gary Albright, Northeast Document Conservation Center; Robin Siegal, National Geographic Society; Andrew Robb, Washington, DC; Steve Puglia, Library of Congress.



Preservation of Imágenes: Hispanic American Religious Images on Wood
September 23-25, 1997 (JST)

In this three-day conference at SCMRE, Hispanic religious artifacts, *bultos*, and *retablos*, were surveyed including their history, materials, polychrome fabrication and decoration, and preservation and restoration. The conference was comprised of lectures and studio exercises revolving around the examination of artifacts and techniques, enhanced the connoisseurship of scholars, and provided technical information on preservation concerns for conservators, curators, and others. The conference was truly international in scope, and included 17 presenters and 53 attendees.

Structural Conservation of Furniture

November 3-7, 1997 (MJW)

The sixth FCTP course included the causes and treatment of structural deterioration, including damaged joinery, upholstery substructure, carving, and turning. The technology and practice of consolidating degraded structural materials and the ethical concerns of reconstructing and reproducing objects for interpretation or utility was discussed and demonstrated, including workshops on minimally intrusive upholstery and advanced woodcarving. Attendance: 24. Faculty: Melvin J. Wachowiak, Donald C. Williams, SCMRE; Greg Landrey, Mark Anderson, Winterthur Museum; Dr. Audrey Zink, Virginia Polytechnic Institute and University; James Wermuth, Conservation Technology Group, Newport Rhode Island; Wallace Gusler, Colonial Williamsburg Foundation.

Preserving Natural History Collections

December 8-12, 1997 (DCW)

The course was an introduction of the integrated approach to managing and preserving natural history collections, including: risk assessment, categorizing collection specimens, and collection profiling applied to collections care strategic development. The course included a full-scale exercise in Smithsonian Institution collections. Attendance: 12. Faculty: Sylvie Marcil, Barbara Njie, Robert Waller, Canadian Museum of Nature; Ronald McGinley, NMNH, Smithsonian Institution.

Coatings for Conservation I

February 2-6, 1998 (MJW)

The FCTP offered four courses on surface decoration materials, techniques, and preservation. The first of these covered coatings technology, solubility theory and practice, history and technology of natural and synthetic resins, woodfinishing techniques, contemporary woodfinishing materials and techniques, analysis of coatings, deterioration and conservation of coatings, and coating resins used in conservation. Attendance: 22. Faculty: Harry A. Alden, Mary T. Baker, Jia-sun Tsang, Melvin J. Wachowiak, Donald C. Williams, SCMRE; Kathy Makos, Smithsonian Office of Environmental Management and Safety; Robert Mussey, Boston.



Stain Removal

April 1-3, 1998 (MWB)

This three-day course was designed for conservators and caretakers of historic textiles with a particular interest in the removal of accidental soiling and staining of porous materials. A review of surfactants, solvent systems, and reagents was followed by a discussion and laboratory exercises on treating the most common stains. Attendance: 10. Faculty: Mary W. Ballard, SCMRE; Heasoon Rhee, San Diego.

Coatings for Conservation II

April 27-29, 1998 (MJW)

The eighth course in the FCTP series covered the evaluation of color and appearance, toxicity of materials, natural and synthetic dyes used in furniture finishes, synthesis and modification of coating materials, coloring methods used in treatments of transparent coatings, and designing a finishing/finish conservation studio. Attendance: 16. Faculty: Harry A. Alden, Mary T. Baker, Melvin J. Wachowiak, Donald C. Williams, SCMRE; Richard Asplundh, Clemson University; Richard Harold, HunterLab.

Preservation of Santos

May 19-22, 1998 (JST)

This four-day endeavor reprised the earlier three day conference of September 23-25, 1997, transporting the entire event to Universidad del Sagrado Corazón, San Juan, Puerto Rico, plus an additional day in Ponce, PR. It included a survey of the history of polychrome Hispanic religious artifacts, their materials, techniques of fabrication and decoration, and preservation and restoration. Following the three-day workshop, which included intensive lecture and laboratory sessions, a unique one-day free gathering was convened at the Museo de Arte de Ponce, Ponce, PR, for practicing santo makers to engage the presenters in thoughtful discussions of history, materials, and techniques. The conference in San Juan included 17 presenters and 55 attendees; the session in Ponce included seven presenters and an estimated 125 attendees.



Timeline: Scheduling Strategies for Preservation of Paper-Based Collections

June 23, 1998 (FWT)

This half-day meeting in the RELACT program focused on case studies of preventive conservation projects at the Smithsonian Institution. Participants shared current preservation efforts within their divisions, and formulated new directions and strategies with the instructors. Attendance: 19. Faculty: Dianne van der Reyden, Feiwen Tsai, SCMRE; Mary Parrish, Candace Green, NMNH, Smithsonian Institution; Tara Frazier, South Surray, British Columbia.



Technology and Preservation of Artifacts I

July 13-17, 1998 (DCW)

Offered through the George Washington University, this course was a five-afternoon survey of the materials, fabrication, deterioration and preservation of paintings, furniture, and paper. The course included lectures and demonstrations by SCMRE conservators, and was intended to inform prospective caretakers and appraisers on the nature of these artifacts. Attendance: 16. Faculty: Jia-sun Tsang, Dianne van der Reyden, Melvin J. Wachowiak, Donald C. Williams, SCMRE.

Preservation Fundamentals (MWB)

I: Humidity July 20, 1998

II: Mold and Mildew July 22, 1998

III: Pests July 24, 1998

These three courses were grouped around the theme of Preservation Fundamentals and given on alternating days in the summer, so that local staff could easily attend without disruption to their schedules and so that visitors to Washington, DC could also have the opportunity to see exhibitions or to make appointments between classes. Each course dealt in depth with a particular environmental issue that has been highlighted by recent conservation developments in North America. "Humidity" reviewed the measurement of moisture in the air, psychrometric values, and the control of moisture in buildings with and without HVAC [heating ventilating and air conditioning] units. With the instructor, the class toured Smithsonian facilities containing recently installed humidity controls. "Mold and Mildew" divided fungal damage between organic materials in the morning session and inorganic substrates in the afternoon session so participants could gain a broader understanding of the issues and so that the speakers could focus attention on the particular test methods and research associated with specific museum materials. In addition, the head microbiologist at the Armed Forces Institute of Pathology outlined the level of susceptibility for museum staff to potential pathogenic microorganism. His lecture led to a timely discussion of workplace safety and right-to-know laws. The third course was devoted to "Pest Control" in museums. Because of the changes in the regulations of pesticides and of fumigants, as well as the development of alternative treatments, the author of *Approaches to Pest Management in Museums* (CAL, 1985) updated his text with a day-long review of bionomics and treatments. Participants were able to get their copies of the now-classic museum text autographed and to have their particular inquiries answered. Section 1, "Humidity" was taught by Lew Harriman, author (and illustrator) of *The Dehumidification Handbook*. The second day, "Mold and Mildew," was jointly taught by several microbiologists: Dr. Robert Planchette reviewed the microbiology on organic materials; Dr. Robert Koestler, the microbiology of inorganic materials; and Lt. Col. Ted Hatfield from the Armed Forces Institute of Pathology, the pathogenic potential of these organisms. The final session, "Pests," was taught by Keith Story, author of *Approaches to Pest Management in Museums* Attendance Part I: 23; Part I: 41; Part III: 30.

Coatings for Furniture Conservation III

August 3-7, 1998 (MJW)

The specific topics of this FCTP course addressed the subjects of polychrome and paint, particularly on wood, including pigment history, technology and identification; a selected history of painted furniture; deterioration and treatment of panel paintings; history, technology and conservation of urushiol; treatment of painted wooden objects; methods and materials for inpainting; and the craft of painted finishes. Attendance: 21. Faculty: Marion F. Mecklenburg, Melvin J. Wachowiak, SCMRE; Paul Jett, Freer/Sackler Galleries, Smithsonian Institution; Jonathan Thornton, Buffalo State College; James Martin, Williamstown Regional Conservation Center; Frank Jones, Eastern Michigan University; Marylou Davis, Woodstock, CT.



Just In Time: Disaster Preparedness For Paper-Based Collections

September 15-16, 1998 (FWT)

This two-day course in the RELACT program focused on developing a disaster plan, as well as preservation management of collections before, during, and after emergencies. A workshop included a hands-on exercise for rescuing water-damaged documents. Attendance: 39. Faculty: Dianne van der Reyden, Fei-wen Tsai, SCMRE; Janice Ellis, SIL; Carrie Beyer, Library of Congress; Tara Fasier, South Surrey, British Columbia.

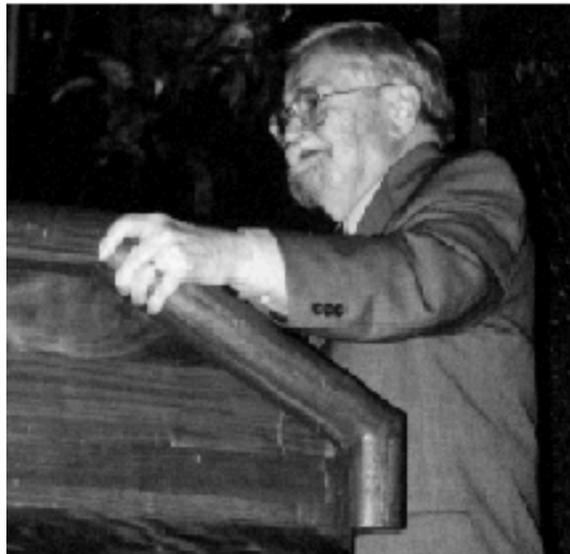


Applied Optical Microscopy
September 21-25, 1998 (HAA)

This course, the first in a series, provided the foundation for advanced optical microscopy applications and training. Subjects addressed included: sample selection and preparation; microscope specifications, selection and set-up; design and layout of microscopy spaces; function and use; imaging and photomicrography; specialized techniques and limits of material identification; documentation and analysis; and introduction to specialized applications, e.g. archaeobotany, coating materials, natural history specimens, etc. Attendance: 10. Faculty: Harry A. Alden, Martha Goodway, Pamela B. Vandiver, SCMRE; Jan Hinsch, Greg Jones, John Ossi, Leica Microsystems; John Russ, Raleigh, NC; James Martin, Williamstown Regional Conservation Center; Randy Wilkinson, Baltic, CT.

Patterns and Process - A Symposium in Tribute to Edward V. Sayre
September 21-22, 1998 (RLB)

A two-day symposium was held September 21 and 22, 1998, to honor the outstanding contributions made at the intersection of science and the humanities by Dr. Edward V. Sayre. Among his many groundbreaking endeavors, which range widely from conservation science to analytical and technical studies of historic and artistic works, his leadership efforts in the area of the characterization of archaeological materials have brought him international acclaim. Not only have his immediate achievements been of exceptional merit, but his accomplishments as both a formal and informal teacher have extended his influence far beyond his own specific research efforts. 28 symposium participants including former colleagues and students from the United States, England, and Greece were joined by numerous attendees. The proceedings from the conference will be published by the Center.



OUTREACH and PUBLIC PROGRAMS

Perhaps no area is more important for SCMRE Education activities than Outreach, or the dissemination of information beyond our own traditional borders. Rather than speaking solely to our company of specialist colleagues, SCMRE strives to reach further, to influence as broad a community of collection-caretakers as possible, and to make them aware of the nature of artifacts and the cause and prevention of their deterioration. SCMRE is taking major steps in this area, working diligently to put knowledge in the hands of audiences thus far under-served by our profession.

To meet emerging needs SCMRE continues developing new avenues for education: a continued emphasis on public presentations to an ever-expanding interested professional and public audience, secondary school outreach, continued specialized and interdisciplinary internships and fellowships, and additional instructional and scholarly videos.

SCMRE staff offered literally hundreds of presentations in FY 1996-1998 ranging from scholarly conferences to the general public. SCMRE has also continued development of a pre-collegiate materials science education program (known as STATS, Science Teaching Art Teaching Science) with Suitland, Maryland, High School for the Visual and Performance Arts (SCVPA). During the three years of this Report, more than 45 visiting scholars, interns, and fellows have worked with SCMRE staff. Finally, the second of SCMRE's instructional videos, "Rescuing Records: Recognizing Value and Problems of Paper-Based Research Collections," was translated into Spanish and made available to the general public. A preliminary cut of a documentary video on the restoration of the 'Ain Ghazal plaster statues was completed. Both "Furniture Care and Maintenance" and "Rescuing Records: Recognizing Value and Problems of Paper-Based Research Collections" are now being distributed.

TECHNICAL INFORMATION OFFICE

The Technical Information Office is the center of SCMRE's public outreach programs. The staff assists SCMRE conservators, scientists, and students, other Smithsonian bureaus, other museums and government agencies, outside professionals (both national and international), and the public in finding technical and professional conservation-related materials and assistance. The Technical Information Office also serves as the public inquiry center for conservation and general scientific information in the Smithsonian.

The Technical Information Office staff member conducts database searches, bibliographic assistance, maintains an up-to-date reprint file, answers questions on conservation-related questions or refers the inquiries to someone who can, and produces and distributes SCMRE publications, including *Approaches to Pest Management in Museums* and *A Primer on Disaster Preparedness, Management, and Response: Paper-Based Materials*. The Technical Information Office is also responsible for the SCMRE World Wide Web (WWW) home page creation and maintenance, and conducts official tours of SCMRE for visiting scholars, professionals, and dignitaries.

Information Assistance (ABN)

The staff of the Technical Information Office answered 2851 inquiries from conservation professionals and the public in FY 1996-1998 (1610 in FY 1996, 595 in FY 1997, and 646 in FY 1998); and, referred 1042 inquiries to SCMRE conservators and scientists (333 in FY 1996, 301 in FY 1997, and 408 in FY 1998).

Such work involves discussing the inquiry with the person initiating it to determine where to route the question, assigning the request, preparing an informational packet to send out, and collecting information from the person initiating the inquiry to make sure his or her needs were met. Technical and public inquiries during FY 1996-1998 included the following topics:

- African drums
- 'Ain Ghazal
- analysis techniques
- animal skulls
- antique barometer
- antique cylindrical slide rule
- antique guns
- antique loom
- antique tools
- antique trunks
- antique weapons
- APOYO
- archaeological, ethnographic, furniture, leather, object, painting, paper, photographic, textile, and wood conservation, preservation, repair, and storage
- artifact authentication
- ballpoint pen ink
- bamboo use in furniture
- barber shop chair

- birchbark
- bison skull
- boar tusks
- burnishing tools
- butterfly collection in wooden box
- card table with painted oilcloth
- carriage
- cave paintings
- cedar dugout canoe
- celluloid hair combs
- child's metal train
- coins
- compo recipe
- 1946 Cushman motor scooter
- daguerreotypes and ambrotypes
- damages from disasters
- deacidification
- die-cast toys
- 1905 Edison Phonograph
- 1900 Edison Victrola and records
- English stick barometer
- environmental concerns for art and archaeological collections and pieces
- ethnic jewelry
- fan corral
- fan restoration
- flags
- Foucault pendulum
- folding card table
- fossils
- framing rattlesnake skin
- frescoes
- fumigation and pest control methods
- gilded gold mirror
- glass globe snowball
- gravestones
- guest lecturer availability
- hanging sculpture in a shopping mall
- harpsichord wires
- horse hair rope
- ink preservation on a baseball
- ivory
- ivory chess set
- lacquer screen
- lacquer silverware
- Lucille Ball's leather boots
- Lucite paperweight
- mannequins
- material properties
- Mayan conch shells
- metal threads
- microclimates
- milk jugs
- mirror re-silvering

- mold and mildew
- mounted zebra rug
- mummy coffin wood
- mural conservation
- museum standards
- Native American objects, textiles, headdresses, and cradle boards
- old tools
- ormolu
- papermaking instructions
- papier-mâché
- pepper spray
- perfume bottle
- pottery, ceramics and porcelain
- procedures for determining appropriate treatments
- publication or guideline requests
- real squash and pumpkins
- referrals to people who would be able to do private conservation work or analysis
- reprint or off print requests
- reverse paintings on glass
- ribbons
- RFK stadium turf
- rope bed
- samovar
- schooner model
- setting up a conservation laboratory
- spectroheliograph
- spyglass
- stabilizing devices for statuary
- steam engine rail road cars
- suit of armor
- suppliers for conservation products and materials
- synthetic resins
- tapa cloth
- tapestries
- taxidermy
- terra cotta figurines
- textiles from mummies and grave garments
- thangkas
- tortoise shell
- tortoise shell flutes
- training opportunities
- Ukrainian egg
- ultrasonic cleaning
- underwater barrel
- vacuum suction table
- wallpaper
- waterlogged wood
- wax carvings
- wooden craft bowls
- wooden masks
- work-related hazards
- World War II aircraft goggles.

The staff of the Technical Information Office completed 230 database searches for conservation professionals and the public in FY 1996-1998 (68 in FY 1996, 93 in FY 1997, and 69 in FY 1998). Databases used in the searches include the Conservation Information Network (CIN), the Museology Bibliography (BMUSE), Smithsonian Institution Research Information System (SIRIS), SCMRE/CAL Archives, and the Internet, in general. Searches during FY 1996-1998 included the following topics:

- acetate salts
- adamantine
- air pollution on brick monuments
- Angor Wat
- anoxic fumigants
- art conservation history
- asbestos
- author bibliographies
- Bakelite
- beads and buttons
- boulle clocks
- bronze disease
- carved polychromy
- casein
- cave paint pigments and binders
- celluloid
- cellulose nitrate
- cement and stone treatment with adhesives or film materials
- chelation
- cleaning of the Sistine Chapel
- clock conservation
- conservation and corrosion of niello
- conservation and deterioration of architectural granite
- conservation assessments, surveys, and long range planning
- conservation of leather
- consolidation and impregnation of waterlogged textiles and rope
- consolidation of burned wood
- consolidation of embrittled silks
- Cor-Ten steel
- criteria for selecting materials for digitalization and microfilming
- daguerreotype cleaning
- designing conservation laboratories
- digitization
- dry-cleaning
- ebonite
- effects of wood storage cabinets on collections
- efflorescent salts
- Egyptian limestone
- electronic speckle pattern interferometry
- ethylene oxide
- exhibit design and techniques
- exvotos
- felt conservation
- french ivory
- fumigation
- fur and feather identification

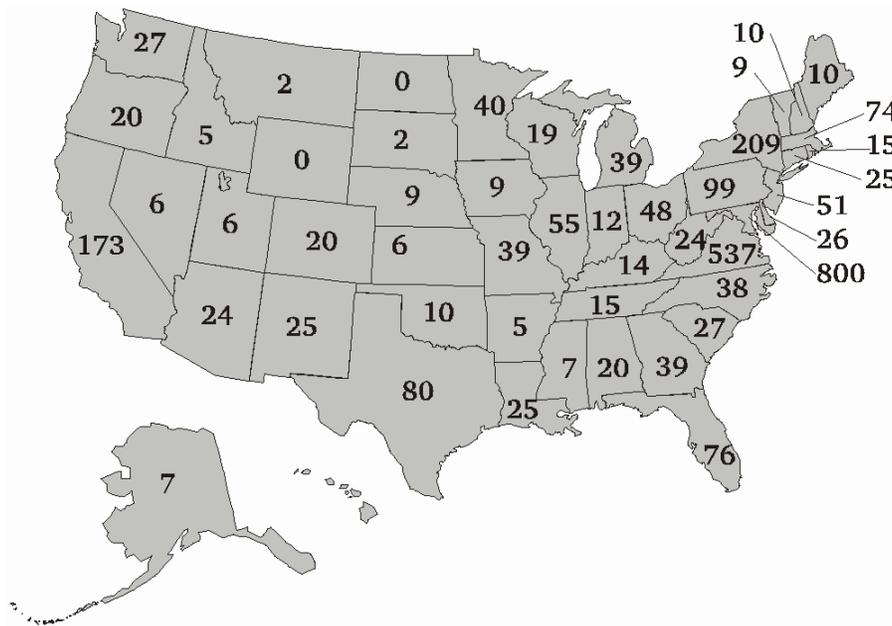
- geotextiles
- glass bead deterioration
- glazing on wool
- graphic techniques on paper
- grave garments
- hair, skin, and leather identification
- history and use of rosin
- history of conservation training in the United States
- hot table fabrication
- icon conservation
- in situ polymerization with consolidants
- infilling objects
- infrared reflectography
- ink
- Islamic manuscripts
- Italian paintings
- ivory, bone, horn, and ethnographic materials
- lamination
- laser cleaning
- laser cleaning of stone
- Limoges
- long-term storage of automobiles
- majolica
- masonry preservation
- Medex
- metal coating and lacquering
- metal polishing
- metal threads in textiles
- mirror resilvering
- molded shellac
- moon rock
- mossbauer spectroscopy
- mounting oversize paper objects
- mummies
- music score notation
- nail production
- natural dyes
- organic residue analysis
- painted or gilt leather
- pallet storage
- paper conservation
- papier-mâché
- pepper spray
- pest control
- phenolics
- photocopier/scanner light intensity
- photograph flattening
- pigment lakes
- pigments
- plaster moulding
- plastic furniture
- plywood
- precipitated dyes

- pressure mounting of textiles
- protein or hide glue
- Puerto Rican art
- pyrite disease
- radiation types
- resin
- Rodin bronzes
- rush seating
- rust removal
- silver lacquering
- silver leaf or pain on Japanese screens
- solvents on leather
- spectroscopy and natural dyes
- stained glass preservation
- storage and maintenance of archaeological collections
- stress and strain in textiles
- sturgeon or fish glue
- synthetic and natural ultramarine blue
- tapa
- textile abrasion resistance
- textile or fabric enzymes
- textile washing
- tortoise shell
- treatment of coatings on microscopes or scientific equipment
- ultrasonic or sonic wet cleaning
- ultraviolet light
- unbaked clays and lowfired ceramics
- ureaformaldehyde
- varnish on 19th century photographs or paintings
- ventilation or air purification systems
- videotape survey
- vulcanite
- wood adhesives
- wood panel paintings.

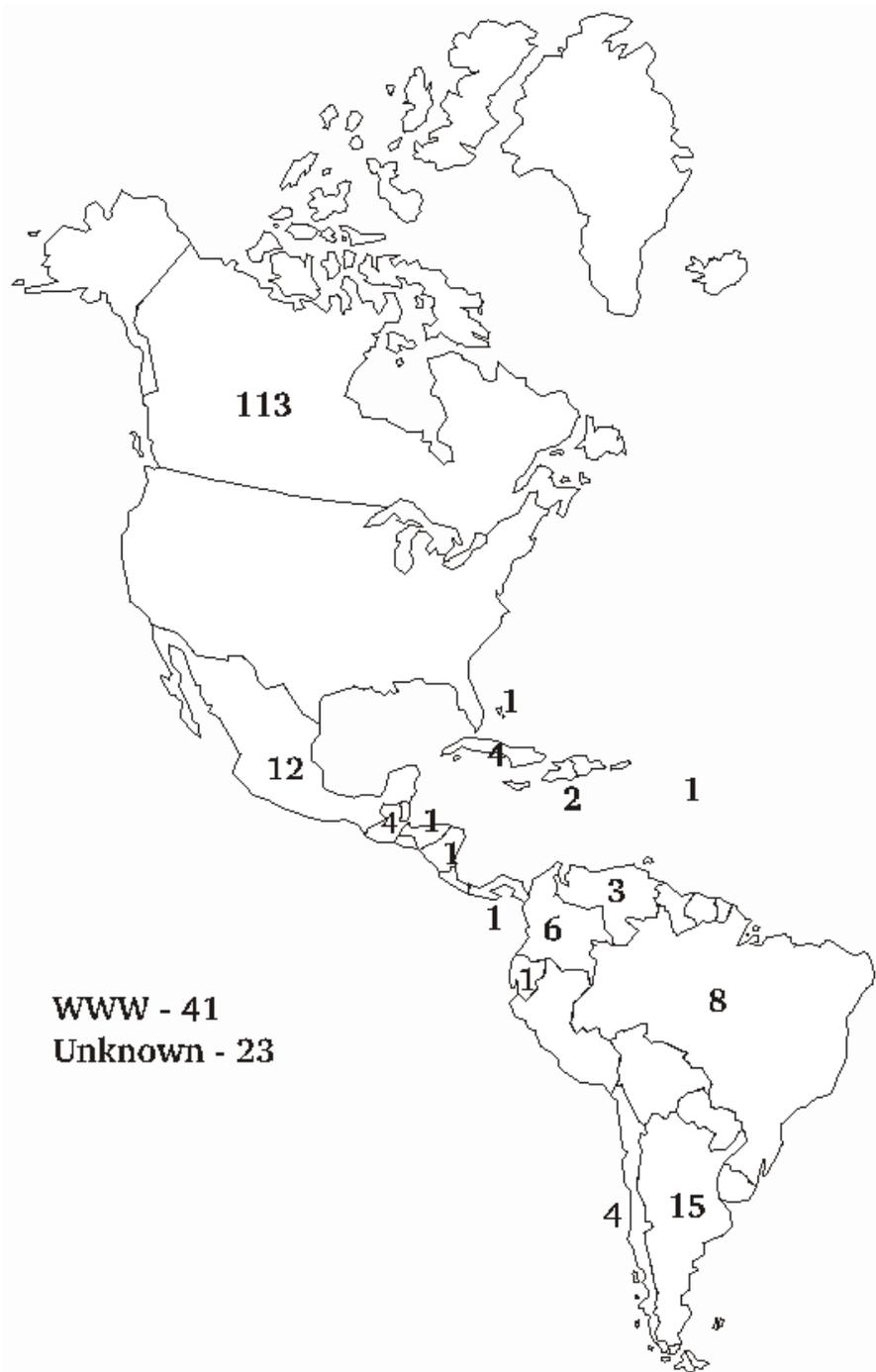
Requests on availability and location of reprints come to SCMRE from throughout the United States and around the world. The SCMRE Technical Information Office is one of the few places where copies of many conservation and conservation-related publications can be found. SCMRE is one of the seven international contributors to the Canadian Heritage Information Network's Conservation Information Network (CIN). The CIN database is a growing and up-to-date resource for conservation professionals, museums and other institutions in the area of conservation, preservation, and the restoration of cultural property. There are over 150,000 citations, including the published volumes of the Art and Archaeology Technical Abstracts, and the combined holdings of the libraries and documentation centers of the contributing institutions: Art and Archaeology Technical Abstracts (AATA), Canadian Conservation Institute (CCI), Getty Conservation Institute Library (GCI), International Centre for the Study of the Conservation and the Restoration of Cultural Property (ICCROM), International Council on Museums and Sites (ICOMOS), Smithsonian Center for Materials Research and Education (SCMRE) [formerly known as the Conservation Analytical Laboratory of the Smithsonian Institution (CAL)], and UNESCO-ICOM Museum Documentation Centre.

The accompanying United States and world maps show where technical and public inquiries, database search requests, and reprint requests originated. Nationally, there was a total of 3536 inquiries and requests from 48 states, the District of Columbia, Puerto Rico, and the US Virgin Islands. Internationally, 523 such inquiries and requests were received from 72 countries (not including the US). The numbers do not add up to 4123 total inquiries because there were 41 answered on WWW with no state or country to put down and, there were also 23 of unknown origin answered. Many of the inquiries came when SCMRE had a tent for the Smithsonian Institution's 150th Birthday Party on the Mall and for the American Folklife Festival 1996.

**TECHNICAL INFORMATION OFFICE INQUIRIES and REQUESTS
FY 1996-1998
United States of America**



Western Hemisphere



WWW - 41

Unknown - 23

Guidelines (ABN)

The Technical Information Office continued to produce, update, and redesign new and existing "Guideline" brochures. Available "Guidelines" include topics on:

- art conservation organizations
- art conservation product suppliers
- art conservation training
- artifact appraisals
- care and handling of ivory objects
- care and handling of paper-based materials
- caring for antique armaments
- caring for antique communication devices: phonographs, radios, telephones, etc
- caring for audiovisual and photographic materials
- caring for clocks and watches
- caring for dolls and toys
- caring for musical boxes
- caring for musical instruments
- caring for old houses
- conservation related addresses
- furniture care and maintenance
- radiocarbon and thermoluminescence dating of artifacts
- time capsules.

EDUCATIONAL OUTREACH

Preservation of Imágenes: Hispanic American Religious Art on Wood (JST)

In September 1997 SCMRE sponsored, hosted and conducted a three day workshop titled "Preservation of Imágenes: Hispanic American Religious Art on Wood." The workshop emerged from the convergence of SCMRE education programming emphasis and expertise, and interests of SCMRE and Smithsonian Institution staff (NMAA, NMAH, NMNH, SOE), combined with the profound enthusiasm from the target audience. The course combined lecture presentations with studio practices in object examination and evaluation, and preservation treatments and strategies. Created to contribute to multiple Institutional initiatives, this programs was in keeping with Smithsonian Institution commitments to public education, national service in the arts, science and history, and specifically the outreach programs for the Hispanic American community.

The over-subscribed workshop was well attended with curators, conservators, historians, preservationists, restorers and *santeros*, makers of wood images of saints. The workshop was underwritten by a grant from the Smithsonian Latino Outreach fund. The course specifically addressed the materials and techniques used to create religious images on wood and the resulting implications for long-term preservation. Nine Smithsonian Institution staff and eight non-Smithsonian Institution scholars - scholars on cultural history, religious history, *santos*, *santo* makers, participated as lecturers for the workshop.



One speaker was Mr. Teodoro Vidal, a Puerto Rican philanthropist, businessman, and art patron, who has donated to the Smithsonian 3,500 objects from his collection. He was particularly impressed by the awareness and commitment regarding conservation issues at the Smithsonian Institution. "We need this awareness in Puerto Rico" he said. In working with the pieces from the Vidal collections, Smithsonian Institution staff found that the main problems were the objects' fragile, deteriorated physical status and the less than professional attempts at restoration to which they had been subjected. This latest information on conserving the *santos* from Puerto Rico along with *santos* from Southwest was included in the workshop.



The workshop served to convene scholars on the subject matter and to introduce the principles of preservation, to introduce the practices of technical examination and materials culture methodology, to demonstrate practical characterization and preservation techniques, to develop of definitive bilingual reference materials, text, video, to serve as the base of future international conferences, and finally to be the cornerstone of scholarship for a generation.

The initial offering on this subject, hosted at SCMRE, was followed in May 1998 with a by-invitation reprise in San Juan, Puerto Rico, hosted by the Universidad del Sagrado Corazon. This time the three day conference, attended by more than fifty, was supplemented by a one-day workshop in Ponce specifically targeted for practicing santeros, of whom over 100 attended. Yet another iteration of this project, in the form of a museum exhibition in Santa Clara, California, is currently under discussion.



The result of this project, which has taken an increasingly prominent role in SCMRE programming, has been to create an increased awareness of the scholarship surrounding *Imágenes*, especially in the area of technical study and material characterization. This has been reflected in the compilation of the reference material notebooks for the conferences, available to all attendees, and a well-received monograph entitled *A Closer Look* created by SCMRE staff, distributed to attendees, and now residing on the SCMRE web page. Additional education materials are in development, including an instructional video for collections caretakers, and transcripts of the conference.

Research, Libraries, and Archives Collections Conservation Task Force (RELACT) (DVR, FWT)

RELACT's outreach-driven programs for FY 1996-1998 extended to three local and five long-distance national programs and partnerships, as well as distance learning curriculum development on the Internet. There were three local programs for which RELACT lectured. For the Capitol Area Network (CAPNET) Seminar on Exhibitions, the topic was how to recognize and preserve photographs. For the National Park Service's "School for Scanning" course in Washington and New York, the topic covered selection criteria and five-year strategic plans for efficient management of digitization of paper-based materials. For the Washington Conservation Guild, the SCMRE archives conservation intern spoke on RELACT preservation projects around the Mall.



Some long-distance partnerships developed in conjunction with lectures at graduate conservation programs at Winterthur (University of Delaware) and Buffalo (New York State University) on conservation of diverse paper-base materials found at the Smithsonian, including scientific illustrations, globes, folding screens, papier-mache furniture, tracing papers, Valentine cards, Chinese papers, etc. Other long-distance programs included "Preserving Memories" for the Memorial Day Weekend Workshop for Military Survivors, sponsored by the Tragedy Assistance Program for Survivors (TAPS), Washington, DC, and "Doubtful Documents, Manipulated Manuscripts, and the Case of the Mysterious Michelangelo," for Museums in Fact and Fiction: Mysterious Stories of Deceit, Deception, and Discovery, Winterthur Museum, Delaware. The SCMRE Archives conservator did a joint presentation with NMNH paleobiology staff on "O.C. Marsh Dinosaur Drawings: Care and Conservation of Historical Scientific Illustrations," for a Dinofest Symposium, sponsored by the Academy of Natural Sciences in Philadelphia, for which a paper will be published.



To better increase and diffuse preservation information for the broadest spectrum of RELACT members, as well as the general public and other professionals, a web curriculum was developed for the Internet. It contains comprehensive information on the preservation of paper-based collections, with over 100 links to other sites, and 50 links to original graphics and text generated by paper laboratory staff. Examples of original material prepared for and loaded onto the site (some with Spanish and Chinese translations) includes an outline, a general introduction based on SCMRE's video script on the problems of preserving paper documents, an article on solutions, survey forms and check lists, an orientation packet for students or course participants at SCMRE, and six new graphics for distribution as guidelines and teaching tools. Examples of topics covered include "Preservation Problems," "Preservation Solutions," "Teaching with Time Capsules," "Teaching with Paper-Making," and "Disaster Mitigation and Recovery, Salvage, and Workshops."

Spanish language captions were prepared and added to the preservation video "Como Rescatar Registros - Como Reconocer Los Problemas De La Conservacion De Documentos En Las Colecciones De Investigacion."

Finally, even longer-distance programs focus on curriculum development and partnerships with groups working in Latin American and the Orient. These programs have now effectively formed two subcategories of RELACT: the Hispanic Archives Preservation Program (HAP), which has worked to develop courses with ICCROM in Chile and with OAS in Venezuela, and the Asian Archives Preservation Program (AAP), which has worked with several Chinese cultural organizations to develop programs in Taiwan and research projects on mainland China. These two subgroups are discussed further below. Products for these programs include curricula, guideline, examples of materials, and publications.

Hispanic Archives Preservation Programs (HAP)

RELACT's preservation efforts aim to respond to the needs of the Smithsonian Institution's diverse constituents both here and abroad. Special efforts have included outreach to the needs of Hispanic communities. This was a result of SCMRE's Senior Paper Conservator Dianne van der Reyden being asked to lecture on preservation both in Spain and Latin America, while at the same time initiating in-house projects including a conference on preventive care in Latin America and the publication of a Spanish language disaster primer. The scope of current and future projects has led to the development of a subcategory under the RELACT umbrella of programs, focusing on Hispanic Archives Preservation Programs (HAP) in order to improve coordinated response to this broad category of needs. RELACT's system of on-going short preservation programs parallels many similar efforts gaining recognition in Latin American libraries, archives, museums, and private collections. The initial sponsor of these efforts was ICCROM, which for two years has invited van der Reyden to teach a two-week course on conservation treatment in Chile for conservators from all over Latin America. Following this she has been invited to design courses for developing future programs in Venezuela and Argentina specifically for paper conservators in those countries. These programs were "Conservation Treatment of Paper Documents," a two-week course for professional conservators, for the "Catedra Miguel Arroyo" preservation program, co-sponsored by the Smithsonian Institution's Voices of Discovery, the United States Information Agency (USIA), the Museo de Bellas Artes, the Galeria de Arte Nacional, and the Biblioteca Nacional, Caracas, Venezuela, and "Preventive Conservation Strategies for Paper-Based Collections" which was a two-week course for Argentinean conservators, sponsored by the Fundación Antorchas, Buenos Aires, Argentina.

Curricula for the four courses follows closely chapters on preservation and treatment of works on paper which van der Reyden prepared for publication by the Society for the Preservation of Natural History Collections (SPNHC) and Butterworth-Heinemann. For instance, the ICCROM course covers theoretical and practical issues of preservation and access. Theoretical issues include conservation ethics, safety, sampling and condition surveys techniques, and selection criteria for digitization, testing and treatment. Practical training includes cleaning, consolidation, removal of adhesives and stains, deacidification, mending, humidification, flattening, and use of solvents and enzymes. Products from these programs include course curricula, guidelines, publications, and a preservation video in English and Spanish. Some of the items will be put online for downloading from SCMRE's web site.

Asian Archives Preservation Programs (AAP)

RELACT programs have attracted interest in the Far East, where preservation awareness is expanding. For example, in Taiwan, the number of museums has grown rapidly since 1994 and the public has realized the need for preserving cultural property. Consequently several preservation efforts, such as public lectures, symposia and workshops, have been organized in Asia in the last few years. SCMRE's Archives Conservator Fei-wen Tsai has been invited to lecture for three of these events, and is currently involved in strategic planning for future efforts. As a result, a subcategory has been formed under RELACT focusing on Asian Archives Preservation Programs (AAP). In FY 1996, Tsai was invited to present "Preventive Conservation and Preservation Responsibilities" to museum colleagues and the public at the National Palace Museum. On a second occasion, she was invited to speak on disaster preparedness for the Symposium on the Conservation and Preservation of Cultural Properties, Taiwan. The symposium, organized by the Hwa Kang Museum at the Chinese Culture University, was funded by the government to raise public awareness of conservation of historical works of art. A third preservation effort in Taiwan aims to establish the National Conservation Center for the Cultural Properties. In early 1997, a lecture introducing SCMRE and its resources was presented to the Project Review Committee of the National Conservation Center, which is studying organizational structures and equipment used in conservation laboratories in the US.

In 1998, Tsai was invited by the Project Planning Office at the National Center for Research and Preservation of Cultural Properties (NCRPCP) to teach a four-day collection survey course (May 6-9). The purpose of this project is to collect museum data in Taiwan for strategic preservation planning in the future. During her visit in May, Tsai was also asked to write an article (in Chinese) about paper preservation. The paper has been submitted for editing to NCRPCP. On July 23, 1998 "Seven Areas of Preservation Responsibilities" was presented at the Kaohsiung Museum of Fine Art, Kaohsiung, Taiwan. A final collaboration involves research of Chinese paper (see Artifact and Material Characterization section). Products from the AAP outreach efforts include publications and handouts in English and Chinese (see publication list), some of which will be modified for downloading from SCMRE's web site.

Preservation Courses in Argentina (MWB, DVR)

In addition to "Preventive Conservation Strategies for Paper-Based Collections," the two-week course for Argentinean conservators, listed in the HAP section above, the textile section of a course for practicing conservators was also organized and taught in Buenos Aires, Argentina for the Fundación Antorchas. After a review of fundamental fiber, yarn and weave properties, the eighteen participants were taught about the interaction of aqueous and nonaqueous systems upon textiles and given practical sessions of increasing complexity in the first week of studies. Subsequently, the participants studied colorimetry, dyes, and light, focusing special attention to dyeing techniques for silk, wool (alpaca), and cotton with a variety of natural dyestuffs and mordants. The class also tested and evaluated their color vision. Classes included some methods of fiber analysis, a demonstration of the latest Hunterlab technology, and visits to the Argentinian textile testing laboratories, a modern weaver, and to a pre-Colombian textile collection. The head of a project to develop guanaco (finer than cashmere) in Patagonia provided a lecture and samples of cotton and vicuna processing methods and terminology in Spanish, as well as notes on the differences among llama, alpaca, vicuna, and guanaco fibers. Two curators, one of ethnographic textiles with specialties in Argentinian and pre-Colombian textiles, lectured on weave structures in Spanish. Classes on pest control issues, storage, and display were also held. Egyptian mummy fragments (private collection) were used to develop a mounting system for archeological textiles. Eighteen conservators participated, including two from Brazil.

Science Teaching Art Teaching Science (STATS) (JST, DVR, DCW)

Science Teaching Art Teaching Science (STATS) is the SCMRE sponsored project to develop an interdisciplinary art/science curriculum suitable for secondary students and faculty. The STATS curriculum uses the interrelation between material science and art as a means to teach both, emphasizing the characterization and use of materials in the creation of artworks both in the past and present. This is a collaborative project in concert with Suitland Center for the Visual and Performance Arts (SCVPA), a Prince George's County, Maryland, Magnet School Program.



The curriculum provides practical explorations of the material technology of art and artifacts, to understand the nature and context of materials and techniques, and to acquire a "feel" for the problems and opportunities of working with a variety of materials. Throughout the course an emphasis will be on "looking at things," that is, the employment of observation and knowledge to understand the character of artifacts: what they are, how they were created, what their condition is, what problems lie in their future.

The Premises

Knowledge in education, particularly technological, has become artificially compartmentalized.



When the artist asks, "How can I accomplish ...?" and the materials researcher asks, "What is it, and how does it behave?" each is asking the same question, but from a different perspective. Materials science research wants to know and understand the nature of things, and the artist wants to use materials to best exploit their properties to express their creative notions.

The program is a series of material technology subject units including lectures, demonstrations, and studio or laboratory exercises covering the nature and properties of specific materials. Each unit focuses on the interrelation between materials' properties and the ability to manipulate those materials for artistic purposes, and to understand more completely the nature of extant artworks and artifacts.

In a normal one-hour-per-day school schedule, each unit will take about three weeks to complete. Ideally, the course will be a team-teaching effort, but the product will include enough information that neither a science nor art teacher is absolutely necessary.



Integral to the project success will be reviewing and combining the material science content with the studio projects into a whole curriculum, making sure that the

information presented is accurate, consistent, and authoritative. To assist SCMRE staff in this endeavor Suitland High School (SHS) chemistry teachers Dr. Mary Kochansky and Mr. Terry Klaser will be increasingly involved with the project development. In addition, Dr. Patricia Hill, Professor of Chemistry, Millersville University, served as a Visiting Scholar on academic sabbatical for the express purpose of collaborating on this project.

Marketing STATS

As the completion of the initial units approaches, SCMRE staff will work in conjunction with the Smithsonian Institution and Prince George's County educators, and other Smithsonian Institution offices (Folklife, Product Development and Licensing, Multimedia Projects, etc.) to begin marketing this product. This effort will include contacting textbook publishers to explore the possibility of linkage to existing or proposed high school and undergraduate textbooks, and cultivating collaboration with professional scientific and education organizations who have already expressed a strong interest in participating in this project (American Chemical Society, American Academy of Arts and Sciences, etc.). Also, there will be continued updates of the project on the WWW, and invitations for field testing participation offered through the SCMRE Web page.



This project, in its entirety, is a multiple component endeavor divided into twelve major units whose completion will be consecutive rather than simultaneous and whose timetable is beyond the time frame of this proposal; this project is an integrated multi-year commitment by SCMRE whose final product(s) will be presented periodically over the next few years until final completion.

The Curriculum

STATS will produce a curriculum available to any secondary instructors who wish to implement an interdisciplinary materials science/art curriculum. It will be a series of ring binders, each containing the following materials for one of the course units:

- Detailed outline and teaching notes
- Written and visual reference materials the teacher can use in preparing for classroom instruction
- Detailed bibliographies to use if participants are interested in going beyond the basic projects
- Written instructions for laboratory or studio exercises
- Instructional video demonstrating the laboratory or studio exercises
- CD-ROM disk/web site containing the Curriculum Units.

Curriculum Units under development include:

Studio Exercise	Science Elements
Painting materials	<i>film formation, polymers, plasticizers, solvents, colorants, appearance</i>
Panel Paintings	<i>wood technology, egg tempera, oil paint, grounds</i>
Molding and casting	<i>ancient and space age casting materials, thermoset polymers</i>
Woodcarving & Woodblock Printing	<i>wood technology, metallurgy, ink and printing</i>
Marquetry	<i>wood technology, metallurgy, adhesive technology, dyes and colorants</i>
Gilding	<i>metal leaf technology, mineralogy, binders</i>
Paper Making	<i>paper chemistry, fiber analysis, microscopy</i>
Electrotyping	<i>electrochemistry, metallurgy, toxicology</i>
Ceramics and Glass	<i>pyrotechnology, glass and ceramic technology</i>
Book Making	<i>leather and binding materials, vellum, etc., traditional craft and materials</i>
Joined Metal	<i>surface patination chemistry, metallurgy</i>

Studio exercises in this project have been conducted over the last three years. It allowed us to experiment with and develop various teaching methods and laboratory exercises, and in turn to focus more effectively our current and future activities.

1996-1997 Syllabus

1. painting media - each medium has unique properties, both working and stability. This emphasized the benefits and drawbacks of traditional contemporary artists' paints, which allowed the student to make better-informed decisions. Material technology topics discussed included mineralogy and organometallic chemistry (pigments), optics, colorimetry, and polymer chemistry (both natural and synthetic).

2. composition ("compo") - this versatile decorative sculptural material gained widespread prominence as an alternative to carved wood or cast plaster ornaments. The exercise included creating molds and castings to be used in the following gilding session. Material technology topics discussed included mineralogy, adhesive and resin technology, space-age synthetics (moldmaking materials), and metallurgy (metal leaf).

3. woodcarving - the craft of woodcarving requires a disparate body of skills and knowledge - what wood is and how it "behaves," what carving tools are and the technology of their manufacture and use, and the methods of combining those two with the skills of the eyes and hands. Material technology topics discussed included wood technology and metallurgy (carving tools).

At the beginning of the 1996-1997 studio sessions, we started a list of material properties and attributes. The students were asked, "What are the characteristics of materials that we might be interested in?" Immediately the responses came. Color. Gloss. Drying process. Toxicity. Plasticity. Transparency. Durability. Hardness. We had an initial list of about fifteen properties, and the students were told we would revisit the list frequently as the sessions progressed. And so we did. By the time of our last gathering, the board was nearly full with over three dozen attributes listed. As each new one was added, we took the opportunity to talk about what caused them, how they could be manipulated (or not) and the consequences for artifact creation and preservation.

The pattern for each session was consistent. On the morning before the students came the video production crew arrived to film the SCMRE staff conducting the demonstrations that comprised the student exercises later that day, and which will become the backbone for the curriculum package. Each session yielded about two hours of raw video tape.

In mid-afternoon the students and three of their SHS teachers arrived for an intense three-hour session. At the beginning of each subject area, and interspersed then throughout, we lectured and held discussions about the materials under scrutiny and the objectives of the studio exercises. The students' enthusiasm was palpable; they worked diligently from the time they arrived until we had to throw them out so we could all go home for supper. It was a grueling but exhilarating time, as we spent up to 10 uninterrupted hours between the set up, filming, and teaching. Even so, in the end we added three additional sessions at the students' request, so that we might truly cover all the areas we had set out to complete. The commitment of the students and their teachers was extremely heartening, as their time with us was

entirely after school; none of them had to participate, but each did fully, enthusiastically completing our assignments, encouraging us continually, and making substantive suggestions and providing insightful feedback at every turn.

1997-1998 Syllabus

As in the previous year, we continued to sharpen the focus and applications of the past year's studio sessions, particularly as we implemented what we learned about the nature of teaching and learning at the secondary level. Much of our project design is a result of observations and suggestions from our SHS colleagues (both teachers and students) and changes brought through our own direct observations.

As recognized by SCMRE staff and our SHS colleagues, we needed to be more aggressive in our presentation of the science aspects of the projects in the classroom. To that end we devoted additional time for lectures and discussions regarding the nature, history, and applications of the materials used. In addition to SCMRE staff presentations, SHS faculty took an active role in making presentations and leading discussions. During 1996-1997, SHS faculty participated in the studio projects and discussions, but did not have an explicit role in presenting the technical information.



The sessions for the 1997-1998 portion of the project focused on the theme "Masks." Beginning with casting plaster face and hand mask molds of the student participants (thus removing the previous requirements of artistic creativity in order to participate fully) we embarked on creating a number of masks using selected materials employed in a variety of manners. In brief, this a general breakdown of the course studio components.





1. Plaster mask molds
2. Fiberglass masks
3. Investment casting mask - bronze
4. Sand cast mask - aluminum
5. Papier mache mask I - cast paper pulp ("wetbroke")
6. Papier mache mask II - laminated paper sheet or strips
7. Chemical colorants - dye and patina technology, specialized pigments



The integrated artwork/artifact theme of "Masks" presented three distinct material science emphases: metallurgy, paper technology, and colorant technology.



- Casting metal masks allowed presentation of not only basic metallurgy through using different metals but also fabrication and manipulation processes (investment vs. sand casting, surface finishing) resulting in fundamentally different materials and artifacts.



- Casting paper masks in distinctly different methods yielded artifacts similar in form and material but dramatically different in technology application, properties, and microstructure. While a foundation of basic paper chemistry and technology is integral to casting masks from paper pulp or strips (onto a single mold) and laminated paper sheet (pressed in two-part molds), the resultant artifacts are decidedly distinct from each other.



- Finally each material technology (metal and paper) was modified even further through the use on chemical colorants acting as dyes, pigments, or patinas. The textile element listed in previous versions of this project has undergone several mutations with the explicit input of the Suitland High faculty, from basic textile chemistry to textile dyes to chemical colorants.) We are now able to explore a much broader scope of material technology, drawing comparisons of chemically induced chromaticity and contrasts of organic dyes saturating porous materials vs. inorganic/organic surface chemistry.



Some Student Comments

"The CAL [sic] program has allowed me to work [in] the arts and science fields and also allowed us to work with materials not available at school.

Through the scientific aspect of the class they [SCMRE instructors] were able to stress the importance of workmanship and the use of... materials. They encouraged us to test the specific properties of a material to be sure that the properties matched the intent of the piece.

CAL [sic] also allowed me to use materials which I could not use in school or gain access to on my own. Classical materials such as oil paint, egg tempera and rabbit skin glue are not available in our art program. CAL [sic] gave us a chance to try new mediums so that we can better appreciate the art work of others."

Matthew Ridgely

"[The SCMRE program] was an enriching and extremely cool experience. I learned a lot about the materials that I work with every day and, as a result, have a better understanding of the art I do. [SCMRE instructors] were wonderful to work with, and it was an especially good idea to involve our science teachers,

CAL [sic] was a good opportunity to work with many different mediums for a substantial period of time, enough to learn about the different tools and processes involved. It is a great idea of a way to present a curriculum, and I look forward to seeing it in schools someday.

Most of all I loved the way I learned so much without knowing it. I've never had such a pleasant and enriching experience while learning so much."

Jennifer Friar

The Sesquicentennial/New Millennium Time Capsule Project (Kit) (MTB, DVR, DCW)

As we approach the millennium, there will be an explosion of interest in preserving personal and corporate histories. One of the primary emphases of this interest will be the use of time capsules. In anticipation of this heightened interest and activity, SCMRE staff, capitalizing on its expertise in providing the public the best means of assembling a time capsule, and through Smithsonian Institution marketing, developed a prototype package of materials for a time capsule.

To foster wider interest and knowledge in material technology and the preservation of cultural patrimony, in 1995-1996 the SCMRE staff created "off the shelf" time capsule kits on two levels: a small, school-aged oriented kit ready for sale immediately, and a set of large family/corporate models that would be ready for sale in time for the millennium. The small kit required no research and development, and little start-up time, making use of available materials; the deluxe kit would require about two years of research and development and involve custom design of materials. Both projects capitalize on the expertise of SCMRE staff, and are educational and practical to the consumer. They would increase public awareness of Smithsonian Institution conservation research and of the Smithsonian Institution's mission, improve the public opinion of the Smithsonian Institution overall, and generate revenue for the Smithsonian Institution.

The purpose of the time capsule packages was to be a product to be marketed through the Smithsonian Institution: on-the-road, in the gift shops, through the catalog, through secondary vendors and outlets. The product would be both educational and practical, complete with SCMRE-created written materials to guide the assembler of the time capsule with information about preservation of all types of materials.

The first phase of the project was intended to be very rapid, linked to the upcoming Smithsonian Institution Sesquicentennial traveling exhibit, and focused on a simple and inexpensive product, "Basic" (\$15-25), encouraging people (especially children) to create "A Museum of My Own" or "A Museum of Me" (both to be trademarked). Public relations was to include 1) SCMRE and other Smithsonian Institution staff working with community leaders; 2) staff presenting seminar/workshops to local history teachers; 3) staff hosting a "clinic day" about what to save and how to save it. Unfortunately, no action was taken on this proposal. Further, no successful efforts followed in garnering interest for the manufacture and distribution of the kit.

The second/third phases would have culminated with larger, more elaborate, comprehensive and expensive "Deluxe" versions to be marketed before the "Christmas shopping season" of 1998, in order to encourage people to keep personal and family mementos generated during 1999. Public relations would include setting up a "preservation hot-line" (phone, e-mail, WWW - a "Time Capsule Page" operated by SCMRE) for people to obtain information, and a "national registry of time capsules" to which people could return an enclosed post-card or submit e-mail messages noting, among other things, the location of their time capsule.

A number of audiences was identified for this project.

1. children
 2. families
 3. neighborhoods
 4. churches
 5. clubs
 6. schools, universities
 7. professional associations
 8. alumni associations
 9. institutions
- etc.

The kit included the following didactic materials:

- Criteria for selecting objects/mementos, and why:
Examples of what to select for the time capsule (basic unit, especially kid's artifacts; the deluxe version would have space for larger items like family bibles, etc.).
- Criteria for rejecting objects/mementos, and why:
Examples of materials that would not last or would be harmful to other objects.
- Criteria for processing objects/mementos:
Examples of how to make a record of what is selected; Guidelines for selecting archival quality housing (Note: the child-oriented "Basic" unit would include everything); Guidelines for selecting environmental controllers (Note: the child-oriented "Basic" unit would include everything); Examples of materials
- Criteria for selecting a "storage" site
Closet versus bank vault, burial versus "cornerstones," etc.

The "Basic Model" included:

- 1 gallon wide-mouth PET jar with polypropylene top and polyethylene shrinkwrap collar
- Ageless oxygen-absorbing packets (8 200-K or the equivalent)
- Corrugated polyethylene outer packaging
- Instructions for assembly
- "How To's" for various objects (coins, paper, hair, etc.)
- Materials to house chosen objects (boxes, bags, tissue paper, polyester film)
- Materials to assist in assembly (blotter paper, gloves)
- Registry Post Card

The above set-up will form and maintain an oxygen-free (less than 0.1%) atmosphere for at least 50 years. It is easy to assemble, yet once the shrink-wrap is placed around the lid and activated with a hair-dryer, the package can not be opened without detection. The outer container will protect the package from light and abrasion/impact (although PET is highly impact-resistant). Pre-market testing would have been necessary to ensure low leak-rate in assembled package (to be farmed out to testing lab; one-two weeks work). Jars are already available; a distributor has obtained several examples and can also bring a custom job on-line in a short time (less than one month). The other materials are also easily obtainable; they will need to be repackaged from bulk.

The "Deluxe Model" would require research and development, but the likely form would be a polycarbonate box inside a rotationally molded carbon-fiber filled crosslinked polyolefin with a Teflon coating. Sufficient metal should be incorporated in the structure to make it findable by a metal detector if buried. A non-burial model could be designed that has no outer box but includes a light barrier (zinc-filled PVC?). All materials would be custom-made and production would take about six months to get on line after final design.

In the end no useful development was pursued given a total dearth of interest in developing the product. Specifications for the basic, child's version was posted on the website for public consumption.

Smithsonian Folklife Festival and 150th Anniversary Celebration (DCW, staff)

The summer of 1996 presented two remarkable opportunities for SCMRE staff to interact directly with the public. The annual July Folklife Festival chose to emphasize the "behind the scenes" aspects of programming at the Institution, and the Sesquicentennial Anniversary Celebration in September began with a huge festival on the Mall, again emphasizing the contributions made to the Smithsonian Institution programs by each unit of the Institution. Since the SCMRE rarely comes into direct contact with the public, it was a challenging and rewarding pair of events.

In both instances, SCMRE occupied a large tent pavilion, in which we set up a variety of stations where we could present our projects. The similarity of the presentations at the two events was such that from a planning and execution standpoint, they were considered Parts 1 and 2 of one event held two months apart. Nevertheless, the logistics of coordinating three dozen staff, spouses and friends, and relocating seven miles to the Mall was a daunting task indeed.

Included in our presentation were demonstrations or discussion stations about:

- 'Ain Ghazal (the paleolithic archaeological site in Jordan)
- Archaeology
- Bookmaking
- Ceramics technology
- Egg tempera painting
- Environments, microclimates, and mechanics
- Marquetry ("painting in wood")
- Metallurgy
- Microscopy
- Molding and casting
- Paper making
- Polymeric materials
- SCMRE Technical Information Office

150th Gallery















International Atomic Energy Agency (IAEA) (LVZ)

From November 6 to 9, 1995, with sponsorship of the International Atomic Energy Agency (IAEA), SCMRE organized an expert meeting on the use of radiation techniques for the control of biodeterioration in cultural materials. This meeting took place in tandem with one on the application of neutron activation analysis in archaeological research. For the biodeterioration meeting, specialists from Canada, Czechoslovakia, France, the United Kingdom, the USA, and IAEA, met to advise IAEA on the potential of such techniques for this application and to identify areas where additional research was needed and useful. Many of the participants had actual experience in the use of gamma radiation to eradicate insect infestations, or were involved in research on the application of such radiation to control microorganisms including molds and bacteria. Others were conservation scientists with experience in the use of alternative methods for biodeterioration control in collections. The meeting included a field trip to a nearby commercial facility for gamma radiation used for the sterilization of foodstuffs and medical supplies.

During the first part of the meeting, participants shared the results of their most recent research and experiences with the use of radiation techniques within the setting of collections of cultural materials, including protocols, success rates, etc. It soon became evident that general agreement existed on the viability, safety and appropriateness of using gamma irradiation to treat insect infested objects, including its superiority over the use of toxic fumigants, although the question of cost effectiveness, in comparison with alternative techniques such placement in anoxic environments, was very much dependent on individual circumstances. One additional concern was that objects, if not returned to improved storage conditions, might easily become reinfected, leading to repeated radiation treatments with ultimately non-negligible radiation damage to more sensitive materials.

On the subject of radiation control of molds and other microorganisms, the participants agreed that the doses needed for effective kill rates, using the usual protocols, were unacceptably high because the radiation damage that could be expected in sensitive organic materials, those most vulnerable to these types of biodeterioration. Recent research by some of the teams represented at the meeting indicates the potential for modified treatment protocols, including pre-radiation sensitization, that may reduce the necessary doses to where they may become more acceptable, but it was generally agreed that much additional research is needed before this application becomes a feasible treatment choice. The group recommended that the IAEA promote and fund such additional research.

Art, Science and Society: The Study of Maya Pictorial Pottery (RLB)

The exquisite painted pottery of the ancient Maya was the subject of an interdisciplinary course "Art, Science and Society: The Study of Maya Pictorial Pottery," taught by Ronald L. Bishop (SCMRE) and Dorie Reents-Budet at the University of Pennsylvania during October 3-24, 1996. Approximately 30 members of the museum-going public enrolled. Combining archaeology, art history, and nuclear chemistry, the course relied on data derived from the chemical analysis of thousands of excavated pottery sherds, providing a background against which the chemical patterns of elaborately painted but nonprovenienced, whole vessels found in many international museums could be compared and attributed to a subregion of the Maya area of southern Mexico, Guatemala, Belize, and Honduras. Once pottery is attributed to a probable region of manufacture, the thematic representations and iconographic styles can be interpreted within a geographic perspective. Individuals or events shown on the pottery are given new significance through their relation to other archaeological or art historical information within a particular subregion of the Maya.

One segment of the course focused on the use of glyphic style to suggest production, or at least painting, by one of the "master painters." Support for such an interpretation was provided by the chemical analysis of vessels that demonstrated virtually identical patterns in the elemental concentrations of the ceramic pastes. Other examples of the benefits of interdisciplinary research were drawn from the multi-venue exhibition and accompanying monograph, *Painting the Maya Universe* by Dorie Reents-Budet, which relied heavily upon data obtained through collaboration with Bishop and SCMRE.

Nuclear Analytical Techniques in Archaeological Investigations (RLB, LVZ, MJB)

The promotion of interdisciplinary research, involving nuclear analytical techniques in archaeological investigations, and the development of facilities for such research at nuclear installations in Latin America is being pursued in cooperation with the International Atomic Energy Agency (IAEA). The project is funded by the IAEA with SCMRE providing instruction and general project coordination. An Advisory Group Meeting was held at SCMRE November 6-9, 1995, bringing together a number of Latin American archaeologists and experts in the application of trace element characterization in archaeological research, to discuss appropriate research designs and sampling protocols, coordination of analytical standards and protocols, and potential application projects. The success of this meeting led to the formation of a three year program of cooperation.

The general goal being pursued was involving regional nuclear scientists and archaeologists to optimize the quality and effectiveness of research through training and coordinated standards for sampling and research design, analytical protocol, data handling, and reference to already existing data in the SCMRE analytical database. The first of three annual meetings was held at SCMRE during June 23 through June 26, 1997. Participants included paired teams of archaeologists and nuclear scientists from Argentina, Brazil, Chile, Cuba, Mexico and Peru. Archaeological participants presented summaries of their proposed research projects and participants associated with the nuclear research facilities gave an overview of their facilities, major research activities, and nature of previous archaeological applications. Formal sessions involved lectures by Ronald Bishop on the chemical characterization of archaeological ceramics, including the objectives of instrumental neutron activation analysis (INAA) application, the natural and cultural basis of ceramic materials, research design and sampling strategies, the role of data analysis and levels of interpretation. Special discussion sessions were led by SCMRE scientists M. James Blackman and Lambertus van Zelst concerning technical aspects of INAA as applied to archaeological ceramics, including radiation/counting configurations and multi sample throughput. Discussion of the use of databases and the sharing of analytical data was led by Peru's Eduardo Montoya. In addition to conducting individual projects, each laboratory will participate in an intercomparison study of a reference material to facilitate data exchange. These data will be presented at the next meeting of the group in Peru in 1999.

FELLOWSHIPS and INTERNSHIPS

The SCMRE offers internships and fellowships at several academic levels, involving a variety of artifact analysis, preservation science, and conservation treatment specialties. All appointments are competitive, and are structured so that the recipient will be ensured of a broad experience reflecting the interdisciplinary nature of the laboratory rather than a sole concentration within a subdisciplinary area.

Summer Internships

SCMRE offers ten-week summer internships applicable to any area of our activities: materials analysis, conservation treatment, and preservation science. The number of appointments varies.

Conservation Internships and Fellowships

One-year appointments may be offered to those preparing for entry into a graduate conservation training program (interdisciplinary pre-program interns).

Archaeological Conservation

Two year-long appointments are offered annually in archaeological conservation, typically one at the post graduate and one at the graduate level, to provide the students with hands-on practice at archaeological excavation projects, supervised by a SCMRE conservator, and on-site conservation project management. The field projects are chosen to expose the students to a variety of geographical and cultural conditions. In addition, studies at SCMRE provide the additional benefit of research and other projects within its interdisciplinary environment.

Archives Preservation

Two year-long appointments may be offered annually, one at the post graduate and one at the graduate level. The emphasis for these interns is on programmatic planning and management of integrated preservation protocols for extremely diverse collections. The SCMRE internships provide a unique opportunity for both the intern and Smithsonian Institution staff to interact as broad-based preservation policies are being formulated and implemented at the Smithsonian Institution. SCMRE interns actively contribute to both the formulation and implementation of preservation standards and in turn gain in-depth knowledge of collection needs from the putative collection caretakers.

Post-Doctoral Fellowships

During the last fifteen years 29 post-doctoral fellows have been in residence at SCMRE. Year-long appointments for post-doctoral fellowships are announced on a laboratory-wide basis, rather than in predefined specialties such as materials analysis or conservation science.

Externally Funded Fellowships and Internships

While the fellowships and internships listed above involve SCMRE-funded stipends, the laboratory receives regular requests for study opportunities from scholars and students, nationally and internationally, with funding from other sources. Such requests are evaluated on the basis of the intrinsic merit of the proposal and concurrence with SCMRE programs and priorities.

Funding sources have included the Fulbright Fellowship program, Organization of American States, various foreign governmental organizations, the Samuel H. Kress Foundation, Smithsonian Trust funds, private sources, and in the case of academic sabbaticals, the scholar's host university.

PUBLICATIONS

Baker, Mary T. "Synthetic Polymers." In *Storage of Natural History Collections: A Preventive Conservation Approach: Volume I*, edited by Carolyn L. Rose, Catharine A. Hawks, and Hugh H. Genoways, pp. 305-323. Washington, DC: Society for the Preservation of Natural History Collections, 1995.

Baker, Mary T. "Thermal History Studies in Ancient and Modern Rubber." *Polymer Preprints: Division of Polymers, American Chemical Society* **39**, no. 2 (1998): 1253-1254.

Baker, Mary T., ed. *Newsletter*. Division of Polymer Chemistry, Inc., American Chemical Society, Spring 1995.

Baker, Mary T., ed. *Preprints of the 4th Pacific Polymer Conference*. Washington, DC: Pacific Polymer Federation, 1995.

Baker, Mary T. and Aniko Bezur. "Micro-ATR Analysis of Polyurethane Binders in Museum Videotape Collections: Natural Aging Reactions in Archive Tapes." *Polymer Preprints* **37**, no. 2 (1996): 180-181.

Ballard, Mary W. "Conference Reports: The Care and Preservation of Modern Materials in Costume Collections." *American Institute for Conservation News* **23**, no. 3 (May 1998): 19.

Ballard, Mary W. "Dead Walter's Clothes." In *Archaeological Conservation and its Consequences: Summaries of the Posters at the Copenhagen Congress, 26-30 August 1996*, p. 1. London: The International Institute for Conservation of Historic and Artistic Works, 1996.

Ballard, Mary W. "Effects of Orvus." *Hali*, no. 88 (September 1996): 65.

Ballard, Mary W. "Hanging Out: Strength, Elongation, and Relative Humidity - Some Physical Properties of Textile Fibers." In *Preprints ICOM Committee for Conservation, Triennial Meeting, Edinburgh*, pp. 665-669. London: James and James (Science Publishers), Ltd., 1996.

Ballard, Mary W. "Hanging out with Tapestries, Carpets, Quilts: The Effect of Textile Properties on Appearance." *Textile Conservation Group Newsletter* **18**, no. 3 (March 1996): 1-4; reprint, *International Tapestry Journal* (Fall 1996): 20-26.

Ballard, Mary W. "Hide Glue: Traditional Advantages and Disadvantages." In *The Conservation of 18th Century Painted Silk Dress*, edited by C. Paulocik and S. Flatery, pp. 134-145. New York: The Costume Institute, Metropolitan Museum of Art, 1995.

Ballard, Mary W. "How Backings Work: The Effect of Textile Properties on Appearance." In *Lining and Backing: The Support of Paintings, Paper and Textiles, The UKIC Conference 7-8 November, 1995*, pp. 14-39. London: The United Kingdom Institute for Conservation, 1995.

Ballard, Mary W. "IIC Conference: A Participant's Viewpoint." *Textile Conservation Group Newsletter* **18**, no. 5 (October 1996): 8.

Ballard, Mary W. "An IPM Checklist for Planning and Implementing Pest Control on Art and Artifact Collections." *American Institute for Conservation News* **22**, no. 3 (May 1997): 3-4; reprint, *Art Hazards News* **20**, no. 3 (1997): 4-6; reprint *Collections Caretaker* **1**, no. 3 (Spring 1998): 4-5.

Ballard, Mary W. "More on Moisture: Cohesive, Temporary, or Permanent Set and Hygral Expansion." *Textile Conservation Newsletter*, no. 32 (Spring 1997): 5-20.

Ballard, Mary W. "Mysteries and Speculations." *Textile Conservation Newsletter*, no. 34 (Spring 1998): 20-21.

Ballard, Mary W. "A Tribute to Kathryn Scott." *Textile Conservation Group Newsletter* **18**, no. 5 (October 1996): 9.

Ballard, Mary W. and Norman Indictor. "Some Attitudes Towards Carbon-14 Dating of Textiles." In *Eastern Analytical Symposium Abstracts*, no. 294. p 105. 1998.

Ballard, Mary W. and Thomas Parker. "Laws and Licensing: Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)." *American Institute for Conservation News* **22**, no. 3 (May 1997): 5; reprint, *Art Hazards News* **20**, no. 3 (1997): 4-6.

Ballard, Mary W. and Thomas Parker. "Take Care to Follow Pesticide Regulations." *American Institute for Conservation News* **22**, no. 3 (May 1997): 5; reprint, *Collections Caretaker* **1**, no. 3 (Spring 1998): 2-3.

Ballard, Mary W. and Heasoon Rhee. "The Effect of Surfactant Residues on Silk." In *SFT Jubilee Silk Conference*. Stockholm, Sweden: September 1997.

Ballard, Mary W. and Irene Skals. "Masking and Misinterpreting Cotton Fibers: Dangers Associated with the Fiber Analysis of Archeological Textiles." In *Archaeological Conservation and its Consequences: Preprints of the Contributions to the Copenhagen Congress, 26-30 August 1996*, edited by Ashok Roy and Perry Smith, pp. 6-10. London: The International Institute for Conservation of Historic and Artistic Works, 1996.

Beaubien, Harriet F. "Field Recovery of Artifacts with Painted Surfaces: Case Studies from Two Mesoamerican Sites." In *Archaeological Conservation and its Consequences: Summaries of the Posters at the Copenhagen Congress, 26-30 August 1996*, p. 2. London: The International Institute for Conservation of Historic and Artistic Works, 1996.

Beaubien, Harriet F., Susan B. Peschken, and C. Mei-An Tsu. "Artifact Conservation during the 1997 Field Season." In *Harappa Archaeological Research Project, Harappa Excavations 1997*, edited by Meadow, Kenoyer, and Wright, pp. 23-29. March 25, 1998.

Becker, Mary A., Y. Magosi, T. Sakai, and **Noreen C. Tuross.** "Chemical and Physical Properties of Old Silk Fabrics." *Studies in Conservation* **42**, no. 1 (1997): 27-37.

Bishop, Ronald L. and **Lambertus van Zelst.** "Chemical Characterization of Archaeological Ceramics at the Conservation Analytical Laboratory." *Techne, Vers une science de l' héritage culturel: quelques exemples de laboratoires étrangers* (Paris, Laboratoire de recherche des musées de France) **5** (1997): 46-53.

Brady, J.E., J.W. Ball, **Ronald L. Bishop**, D.C. Pring, N. Hammond, and R.A. Housley. "The Lowland Maya 'Protoclassic'." *Ancient Mesoamerica* **9**, no. 1 (1998): 17-38.

Charola, A. Elena, **Carol A. Grissom**, Evin Erder, **Melvin J. Wachowiak, Jr.**, and Douglas Oursler. "Measuring Surface Roughness: Three Techniques." In *Proceedings, 8th International Congress on Deterioration and Conservation of Stone*, edited by Josef Riederer, pp. 1421-1434. Berlin, Germany: 1996.

Chase, W. Thomas, I.L. Barnes, and **Emile C. Joel.** "Lead Isotope Ratios." In *Eastern Zhou Ritual Bronzes in the Arthur M. Sackler Collections*, authored by Jenny So, Appendix 4, pp. 489-491. *Ancient Chinese Bronzes in the Arthur M. Sackler Collections*, vol. 3. Washington, DC: Arthur M. Sackler Foundation and Cambridge, MA: Arthur M. Sackler Museum, Harvard University, 1995.

Cockburn, E. and **Mary W. Ballard.** "Cotton in Ancient Egypt: A Unique Find" In *Proceedings of the First World Congress on Mummy Studies*, pp. 625-631. Puerto de la Cruz, Tenerife, Canary Islands, February 1992. 1996.

Collins, Stephen, **Marion F. Mecklenburg**, and **Mary W. Ballard.** "Fabric Selection and its Relationship to Dimensional Changes in Support Systems for Constrained Fabric Mounting Devices." In *So Many Countries So Many Customs: Different Approaches to Textile Conservation*. International Conference of the ICOM Conservation Committee Working Group on Textiles, Budapest, Hungary, September 11-15, 1995. London: Academic Projects, 1996.

Demarest, Arthur, **Erin L. Sears**, and Coral Rasmussen. "Investigaciones de Los Sistemas Defensivos de Punta de Chimino: Suboperaciones PC13A y PC19A." In *Proyecto Arqueologico Regional Petexbatun Informe Preliminar #6*, edited by Arthur A. Demarest, Juan Antonio Valdes, and Hector Escobedo, Chapter 41-1. Vanderbilt University, 1996.

Ellis, G.L., G.A. Goodfriend, J.T. Abbott, **P. Edward Hare**, and **David W. von Endt.** "Assessment of the Integrity and Geochronology of Archeological Sites Using Amino Acid Racemization in Land Snail Shells: Examples from Central Texas." *Geological Archeology* **11** (1996): 189-211.

Erhardt, W. David. "Drying Oils: Their Chemistry and Properties." In *Painted Wood: History and Conservation*, edited by V. Dorge and F.C. Howlett, pp. 17-32. Los Angeles: The Getty Conservation Institute, 1998.

Erhardt, W. David. "Relative Humidity: Its Role in Collections Maintenance." *The FACTS Report* (first quarter 1997): 1-8.

Erhardt, W. David, Marion F. Mecklenburg, Charles S. Tumosa, and Mark H. McCormick-Goodhart. "The Determination of Appropriate Museum Environments." In *The Interface Between Science and Conservation*. British Museum Occasional Paper no. 116, edited by S. Bradley, pp. 153-163. London: The British Museum, 1997.

Erhardt, W. David, Marion F. Mecklenburg, Charles S. Tumosa, and Tone M. Olstad. "New vs. Old Wood: Differences and Similarities in Physical, Mechanical, and Chemical Properties." In *ICOM Committee for Conservation Preprints 1996, Volume II*, pp. 903-910. London: James and James, 1996.

Evershed, Richard P. and **Noreen C. Tuross.** "Proteinaceous Material from Potsherds and Associated Soils." *Journal of Archaeological Science* **23**, no. 3 (1996): 429-436.

Fain, S.R., **David W. Von Endt**, and **P. Edward Hare.** "The Relationship Between Preservation Treatment, Nucleic Acid Content, and Amino Acid Racemization in Otter Skin." In *Society for the Preservation of Natural History Collections, 12th Annual Meeting Program and Abstracts*, p. 14. 1997.

Fogel, Marilyn L., Noreen C. Tuross, B.J. Johnson, and G. Miller. "Biogeochemical Record of Ancient Humans." *Organic Geochemistry* **27**, no. 5-6 (1997): 275-287.

Goodway, Martha. "Fortepiano Capsules, Old and New." *Harpsichord and Fortepiano* **6**, no. 1 (1997): 13-16.

Goodway, Martha. "Mail Links from the DeSoto *entrada* of 1540." *Historical Metallurgy* **29** (1995): 89-93.

Goodway, Martha. "Metals in Antiquity." Report of the International Symposium at Harvard, 10-13 September 1997. *Society for Archaeological Sciences Bulletin* **20**, no. 3/4 (July-December 1997): 16-18.

Goodway, Martha. "News of Archaeometallurgy." *Society for Archaeological Sciences Bulletin* **18**, no. 3 (July-September 1995): 2.

Goodway, Martha. "News of Archaeometallurgy." *Society for Archaeological Sciences Bulletin* **18**, no. 4 (October-December 1995): 1-3.

Goodway, Martha. "News of Archaeometallurgy." *Society for Archaeological Sciences Bulletin* **19**, no. 1/2 (January-June 1996): 2-3.

Goodway, Martha. "News of Archaeometallurgy." *Society for Archaeological Sciences Bulletin* **20**, no. 1/2 (January-June 1997): 9-10.

Goodway, Martha. "News of Archaeometallurgy." *Society for Archaeological Sciences Bulletin* **20**, no. 3/4 (July-December 1997).

Goodway, Martha. "News of Archaeometallurgy." *Society for Archaeological Sciences Bulletin* **21**, no. 1/2 (January-June 1998): 14-15.

Goodway, Martha. "News of Archaeometallurgy." *Society for Archaeological Sciences Bulletin* **21**, no. 3/4 (July-December 1998): 8.

Goodway, Martha. "News of Archaeometallurgy from Martha Goodway, Smithsonian Institution." *ICOM Committee for Conservation Metals Working Group Newsletter*, no. 15 (December 1995): 3-4.

Goodway, Martha. "Tetsu bunmei no gijitsu kankyo wo tensho suru (The Exhibition of Iron in Washington)." In *1994 Shinpojium Ikiteiru Tetsu Hokokusho Zaidan Hojin Tetsu no Rekishi Mura Chiiku Shinko Jigyodan*, pp. 39-56. Tatara, Japan: Tatara Historical Village, 1995.

Goodway, Martha. "An Unusual Microstructure in a- β Brass." *The Journal of the Historical Metallurgy Society* **30** (1996): 47-49.

Goodway, Martha. "Review of In Quest of Mineral Wealth: Aboriginal and Colonial Mining and Metallurgy in Spanish America, edited by Alan C. Craig and Robert C. West." *The Journal of the Historical Metallurgy Society* **29**, no. 1 (1995): 52-53.

Goodway, Martha and Yuyan Chen. "The Fröslunda Shields: Cymbals or Symbols?" *Laborative Arkeologi, The Journal of Nordic Archaeological Science*, University of Stockholm. **9** (1996): 49-52.

Goodway, Martha and Michael A. Constable. "'Trent Sand': Chalcopyrite as an Abrasive." *The Journal of the Historical Metallurgy Society* **29**, no. 1 (1995): 46-50.

Griffin, Patricia S., Mark R. Fenn, and **Harriet F. Beaubien.** "Preventive Conservation Case Study: The Stabilization of Ceramic Vessels at Harappa, Pakistan." *Pakistan Archaeology* **28** (1993): 253-272.

Grissom, Carol A. "Conservation of Neolithic Lime Plaster Statues from >Ain Ghazal." In *Archaeological Conservation and its Consequences: Preprints of the Contributions to the Copenhagen Congress, 26-30 August 1996*, edited by Ashok Roy and Perry Smith, pp. 70-75. London: The International Institute for Conservation of Historic and Artistic Works, 1996.

Grissom, Carol A. "La conservation des statues néolithiques d'Äin Ghazal." In *Jordanie sur les pas des archéologues*, edited by Eric Delpont, pp. 39-45. Paris: Institut du Monde Arabe, 1997.

Hare, P. Edward, David W. Von Endt, and J.E. Kokis. "Protein and Amino Acid Diagenesis Dating." In *Chronometric Dating in Archaeology*, edited by R.E. Taylor and M.J. Aiken, pp. 261-296. New York: Plenum Press, 1997.

Hedges, R.E.M., J.A. Thorpe, and **Noreen C. Tuross.** "Is Tooth Enamel Carbonate a Suitable Material for Radiocarbon Dating?" *Radiocarbon* (1995): 285-290.

Henrickson, Robert C. and **M. James Blackman.** "Large-Scale Production of Pottery at Gordion: A Comparison of the Late Bronze and Early Phrygian Industries." *Paleo-Orient* **22**, no. 1 (1996): 67-87.

Holbrow, Katherine A., Emily Kaplan, and **Harriet F. Beaubien**. "Desalination Parameters for Harappan Ceramics." In *Objects Specialty Group Postprints, vol. 3*, pp. 70-76. Washington, DC: American Institute for Conservation, 1996.

Iwanaga, K.K., M. Eberle, **Connie J. Kolman**, E. Bermingham, and D.I. Watkins. "Further Diversification of the HLA-B Locus in Central American Amerindians: New B*39 and B*51 Alleles in the Kuna of Panama." *Tissue Antigens* **50** (1997): 251-257.

Joel, Emile C. "Lead Isotope Analysis." In *Encyclopedia of Near Eastern Archaeology*. Oxford: Oxford University Press, 1996.

Joel, Emile C., Edward V. Sayre, Robert D. Vocke, and Frank Willett. "Stable Lead Isotope Characterization of Various Copper Alloys used in West Africa: An Interim Report." *Journal of the Historical Metallurgy Society* **29**, no. 1 (1995): 25-33.

Joel, Emile C., J.J. Taylor, R.A. Ixer, and **Martha Goodway**. "Lead Isotope Analysis and the Great Orme Mine." In *Archaeological Sciences 1995*. Oxbow Monographs in Archaeology 64, edited by A.G. Sinclair, E.A. Slater, and J.A.J. Gowlett, pp. 123-131. Oxford: Oxbow Books, 1997.

Kaplan, Emily and **Harriet F. Beaubien**. "Artifact Conservation during the 1994 Study Season." In *Preliminary Report of the Cerén Project, 1996 Field Season*, edited by Payson D. Sheets and Linda A. Brown, pp. 26-31. Boulder: Department of Anthropology, University of Colorado, 1998.

Klein, Elyse, **Jia-sun Tsang**, and **Mary T. Baker**. "Non-Instrumental Methods for the Identification and Characterization of Artists' Acrylic Paints." In *Painting Speciality Group Postprints*, pp.49-53. Washington DC: American Institute for Conservation, 1996.

Klein, S., A. Hauptmann, and **Pamela B. Vandiver**. "Refractory Ceramics from an Iron Age Bronze Melting Workshop at Khirbet edh-Darih, Jordan." In *Materials Issues in Art and Archaeology V*. Proceedings, vol. 462, edited by P. Vandiver, J. Druzik, J. Merkel, and J. Stewart, pp. 135-142. Pittsburgh, PA: Materials Research Society, 1997.

Koch, Paul L., **Noreen C. Tuross**, and **Marilyn L. Fogel**. "The Effect of Sample Treatment and Diagenesis on the Isotopic Integrity of Carbonate in Biogenic Hydroxylapatite." *Journal of Archaeological Science* **24**, no. 5 (1997): 417-430.

Kolman, Connie J. and Eldredge Bermingham. "Mitochondrial and Nuclear DNA Diversity in the Chocó and Chibcha Amerinds of Panamá." *Genetics* **147** (1997): 1289-1302.

Mann, Robert W., **Melanie E. Feather, Charles S. Tumosa**, and K.N. Schneider. "A Blue Encrustation Found on American MIA Bones from Vietnam." *Forensic Science International* **97**, no. 2-3 (1998): 79-86.

McCarthy, Blythe, **Pamela B. Vandiver**, and J. Kruger. "A Study of the Role of Heterogeneities in the Initial Stages of Corrosion of Glazes Using Dynamic Imaging Microellipsometry (DIM)." In *Materials Issues in Art and Archaeology V*. Proceedings, vol. 462, edited by P. Vandiver, J. Druzik, J. Merkel, and J. Stewart, pp. 31-38. Pittsburgh, PA: Materials Research Society, 1997.

McCormick-Goodhart, Mark H. "The Allowable Temperature and Relative Humidity Range for the Safe Use and Storage of Photographic Materials." *Journal of the Society of Archivists* **17**, no. 1, United Kingdom (1996): 7-21.

McCormick-Goodhart, Mark H. "Moisture Content Isolines and the Glass Transition of Photographic Gelatin; Their Significance to Cold Storage and Accelerated Aging." In *Research Techniques in Photographic Conservation*, pp. 65-70. Proceedings of the Copenhagen Conference, 14-19 May, 1995. Copenhagen: The Royal Danish Academy of Fine Arts, School of Conservation, 1996.

McCormick-Goodhart, Mark H. "Temperature and Relative Humidity Recommendations for the Use and Storage of Photographic Materials." In *I. S. & T.'s 49th Annual Conference - Final Program and Proceedings*, pp. 190-193. Springfield, VA: The Society for Imaging Science and Technology, 1996.

McCormick-Goodhart, Mark H., Charles S. Tumosa, and Marion F. Mecklenburg. "Predicting the Environmental Response of Gelatin Containing Composite Structures." *The Imaging Science Journal* **45**, no. 3/4 (1997): 244-245.

Mecklenburg, Marion F. and Charles S. Tumosa. "The Relationship of Externally Applied Stresses to Environmentally Induced Stresses." In *Fiber Composites in Infrastructure*, edited by H. Saadatmanesh and M.R. Ehsani, pp. 956-971. Proceedings of the First International Conference on Composites in Infrastructure. National Science Foundation and University of Arizona, 1996.

Mecklenburg, Marion F. and Charles S. Tumosa. "Research About Artists' Materials." *American Artist* (April 1996): 12-16.

Mecklenburg, Marion F., Charles S. Tumosa, and W. David Erhardt. "Structural Response of Painted Wood Surfaces to Changes in Ambient Relative Humidity." In *Painted Wood: History and Conservation*, edited by V. Dorge and F.C. Howlett, pp. 464-483. Los Angeles: The Getty Conservation Institute, 1998.

Mecklenburg, Marion F., Charles S. Tumosa, Mark H. McCormick-Goodhart, and W. David Erhardt. "Keep It Wet." *New Scientist* (6 January 1996): 44.

Neff, Hector, M.D. Glascock, **Ronald L. Bishop**, and **M. James Blackman.** "An Assessment of the Acid-Extraction Approach to Compositional Characterization of Archaeological Ceramics." *American Antiquity* **61** (1996): 389-404.

Oudemans, Tania F.M. and **W. David Erhardt**. "Organic Residue Analysis in Ceramic Studies: Implications for Conservation Treatment and Collections Management." In *Archaeological Conservation and its Consequences: Preprints of the Contributions to the Copenhagen Congress, 26-30 August 1996*, edited by Ashok Roy and Perry Smith, pp. 137-142. London: The International Institute for Conservation of Historic and Artistic Works, 1996.

Oudemans, Tania F.M., **W. David Erhardt**, and **David W. von Endt**. "Organic Residues as Use Indicators: Comparative Spectroscopic Studies of Contemporary and Archaeological Kalinga Ceramics." In *International Symposium on Archaeometry*, p. 80. 1996.

Redford, Scott and **M. James Blackman**. "Luster and Fritware Production and Distribution in Medieval Syria." *Journal of Field Archaeology* **24** (1997): 233-247.

Reents-Budet, Dorie. "Classic Maya Painted Ceramics and the Stories They Tell." In *Il Maya*, edited by Peter Schmidt, Mercedes de la Garza, and Enrique Nalda, pp. 270-295. Italy: Palazzo Grassi and Rizzoli Press, 1998.

Reents-Budet, Dorie. "Elite Maya Pottery and Artisans as Social Indicators." In *Craft and Social Identity*, edited by Cathy Costin and Rita Wright. Washington, DC: Archaeological Papers of the American Anthropological Association Number 8, 1998.

Reents-Budet, Dorie. "Los Maestros Pintores: Cerámica Maya." In *Arqueología Mexicana*, vol. V, no. 28. México: México, D.F., 1997.

Reents-Budet, Dorie, Marilyn Beaudry, and James Brady. "North Central Honduras: A Maya Landscape? (Shamans, Saurians and Bats: Symbols from Central Honduras)." In *Proceedings of the 1995 and 1996 Latin American Symposia*, edited by Alana Cordy-Collins and Grace Johnson, pp. 49-66. San Diego, California: The Museum of Man, 1997.

Richard, Mervin, **Marion F. Mecklenburg**, and **Charles S. Tumosa**. "Technical Considerations for the Transport of Panel Paintings." In *The Structural Conservation of Panel Paintings*, edited by Kathleen Dardes and Andrea Rothe, pp. 525-556. Los Angeles: The Getty Conservation Institute, 1998.

Rosenthal, Ellen F. and **Harriet F. Beaubien**. "Artifact Conservation during the 1996 Field Season." In *Preliminary Report of the Cerén Project, 1996 Field Season*, edited by Payson D. Sheets and Linda A. Brown, pp. 18-25. Boulder: Department of Anthropology, University of Colorado, 1998.

Sayre, Edward V., K. Aslihan Yener, and **Emile C. Joel**. "Comments on 'Oxhide Ingots,' Recycling and the Mediterranean Metals Trade." *Journal of Mediterranean Archaeology* **8.1** (1995): 45-53.

Sears, Erin L., **Ronald L. Bishop**, Irma Rodas, and Hector Escobedo. "Excavaciones en La Paciencia, 1994: Un Esfuerzo de Rescate." In *Proyecto Arqueológico Regional Petexbatun Informe Preliminar #6*, edited by Arthur A. Demarest, Juan Antonio Valdes, and Hector Escobedo, Chapter 21-1. Vanderbilt University, 1996.

Soffer, O. and **Pamela B. Vandiver**. "The Ceramics from Pavlov I - 1957 Excavation." In *Pavlov I - Northwest: The Upper Paleolithic Burial and Its Settlement Context*, edited by B. Klima, et al., pp. 383-402. Prague: Academy of Sciences of the Czech Republic and Inst. of Archaeology in Brno, Prague, 1997.

Steponaitis, Vincus P., **M. James Blackman**, and Hector Neff. "Large-Scale Patterns in Chemical Composition of Mississippian Pottery." *American Antiquity* **61**, no. 3 (1996): 555-572.

Stott, A.W., E. Davis, Richard P. Evershed, and **Noreen C. Tuross**. "Monitoring the Routing of Dietary and Biosynthesized Lipids through Compound-Specific Stable Isotope (Date 13C) Measurements Natural Abundance." *Naturewissenschaften* **84** (1997): 82-86.

Stott, A.W., Richard P. Evershed, and **Noreen C. Tuross**. "Compound-Specific Approach to the Delta13C Analysis of Cholesterol in Fossil Bone." *Organic Geochemistry* **26**, no. 1/2 (1997): 99-103.

Taylor, R.E., **P. Edward Hare**, **David W. von Endt**, and J.E. Kokis. "Biochemical Criteria for the Characterization of Thermally-Altered Bone." In *International Symposium on Archaeometry*, p. 102. 1996.

Tennison, Heather. "Marking Time with 'Buried Treasures:' Issues of Preservation and Access." *The Grapevine* **23** (September 1996): 4-5.

Tennison, Heather, **Dianne van der Reyden**, **Fei-wen Tsai**, and Mary Parrish. "An 'Angel Project' of Dinosaur Proportions." *American Institute for Conservation, Book and Paper Group Annual* **15** (1996): 145-160.

Tsai, Fei-wen. "Disaster Preparedness - Prevention, Response and Recovery Procedures for Water-Based Emergencies: Paper-Based and Magnetic Media Materials." In *On Preservation and Disaster Planning: Symposium on the Conservation and Preservation of Cultural Properties*, pp. 10/1-10/11. Organized by Hwa Kang Museum of Chinese Culture University. Sponsored by the Council for Cultural Affairs, Executive Yuan, R.O.C. 1996; In *Postprints for the Symposium on the Conservation and Preservation of Cultural Properties, 1996* (in English [with **Dianne van der Reyden**] and Chinese), pp. 462-498.

Tsai, Fei-wen and **Dianne van der Reyden**. "Analysis of Modern Chinese Paper and Treatment of a Chinese Woodblock Print." *The Paper Conservator* **21** (1997): 43-62.

Tsang, Jia-sun, **Walter R. Hopwood**, and Susan Lake. "Analysis of A Moisture-Sensitive Painting." In *Painting Speciality Group Postprints*, pp. 115-120. Washington DC: American Institute for Conservation, 1996.

Tumosa, Charles S. "Alfred Lucas, O.B.E." *Mid-Atlantic Association of Forensic Scientists Newsletter* **25**, no. 3 (1997): 28-30.

Tumosa, Charles S. "Articles from the International Journal of Osteology of Forensic Interest." *Mid-Atlantic Association of Forensic Scientists Newsletter* **26**, no. 2 (1998): 9-12.

Tumosa, Charles S. "The Detection and Species Identification of Blood: A Review of Relevant Papers from 1980-1995." *Forensic Science Review* **8**, no. 2 (1996): 73-90.

Tumosa, Charles S. "Die Longevity of the Silver Ruble from 1829 to 1847." *Journal of the Russian Numismatic Society*, no. 59 (1996): 50-52.

Tumosa, Charles S. "Edward Oscar Heinrich." *Mid-Atlantic Association of Forensic Scientists Newsletter* **26**, no. 1 (1998): 12-13.

Tumosa, Charles S. "19th Century Russian Platinum Medals." *Journal of the Russian Numismatic Society*, no. 62 (1997): 16-26.

Tumosa, Charles S. "Species Identification by Hemoglobin Crystals." *Mid-Atlantic Association of Forensic Scientists Newsletter* **25**, no. 2 (1997): 25-27.

Tumosa, Charles S. "Review of Forensic Taphonomy." *Mid-Atlantic Association of Forensic Scientists Newsletter* **25**, no. 4 (1997): 30-31.

Tumosa, Charles S., Mark H. McCormick-Goodhart, and Marion F. Mecklenburg. "The Physical Properties of Photographic Film Polymers Subjected to Cold Storage Environments." *Polymer Preprints: Division of Polymers, American Chemical Society* **39**, no. 2 (1998): 1245-1246.

Tumosa, Charles S. and Marion F. Mecklenburg. "Some Mechanical Properties of Skin." *Mid-Atlantic Association of Forensic Scientists Newsletter* **25**, no. 1 (1997): 18-22.

Tumosa, Charles S., Marion F. Mecklenburg, W. David Erhardt, and Mark H. McCormick-Goodhart. "A Discussion of Research on the Effects of Temperature and Relative Humidity on Museum Objects." *WAAC Newsletter* **18**, no. 3 (1996): 19-20.

Tuross, Noreen C. "The Contributions of Light Isotope Ratio Mass Spectrometry to the Study and Preservation of Museum Objects." In *Spectrometric Examination in Conservation*. pp. 135-143. Tokyo: Tokyo National Research Institute of Cultural Properties, 1996.

Tuross, Noreen C. "Organic Preservation at Monte Verde." In *Monte Verde, Volume II*, edited by T. Dillehay, pp. 73-80. Washington, DC: Smithsonian Institution, 1997.

Tuross, Noreen C., I. Barnes, and R. Potts. "Protein Identification of Blood Residues on Experimental Tools." *Journal of Archaeological Science* **23** (1996): 289-296.

van der Reyden, Dianne. "Paper Documents." In *Storage of Natural History Collections: A Preventive Conservation Approach: Volume I*, edited by Carolyn L. Rose, Catharine A. Hawks, and Hugh H. Genoways, pp. 327-353. Washington, DC: Society for the Preservation of Natural History Collections, 1995.

van der Reyden, Dianne, Heather Tennison, and Fei-wen Tsai. "Publish, Then Perish: The Reclamation of a Collection of Scientific Illustrations." *Restaurator* **17** (1996): 104-115.

Vandiver, Pamela B. "Pavlov I Pigments and their Processing." In *Pavlov I - Northwest: The Upper Paleolithic Burial and Its Settlement Context*, edited by B. Klima, et al., pp. 373-382. Prague: Academy of Sciences of the Czech Republic and Inst. of Archaeology in Brno, Prague, 1997.

Vandiver, Pamela B. "Review of KENDRICK, The Jomon of Japan: The World's Oldest Pottery." *Journal of Asian Studies* **56**, no. 1 (January 1997): 210-211.

Vandiver, Pamela B., Anne Bouquillon-Mossman, Rosemary Scott, and Rose Kerr. "The Technology of Early Chinese Overglaze Enamels from the Chinese Imperial and Popular Kilns." *Techne* **6** (1997): 25-34.

Vandiver, Pamela B. and S. Chia. "The Pottery Technology from Bukit Tengkorak: A 3,000-5,000-Year-Old Site in Borneo, Malaysia." In *Materials Issues in Art and Archaeology V*. Proceedings, vol. 462, edited by P. Vandiver, J. Druzik, J. Merkel, and J. Stewart, pp. 269-277. Pittsburgh, PA: Materials Research Society, 1997.

Vandiver, Pamela B., James Druzik, J. Merkel, and J. Stewart, ed. *Materials Issues in Art and Archaeology V*. Proceedings, vol. 462, Fall Meeting December 1996, Pittsburgh, PA: Materials Research Society, 1997.

Vogt-O'Connor, Diane and **Dianne van der Reyden.** "Handling Archival Documents and Manuscripts." *Conserve O Gram 19/17*, National Park Service, Superintendent of Public Documents, U.S. Government Printing Office, September, 1996.

Vogt-O'Connor, Diane and **Dianne van der Reyden.** "Housing Archival Paper-Based Materials." *Conserve O Gram 19/16*, National Park Service, Superintendent of Public Documents, U.S. Government Printing Office, September, 1996.

Vogt-O'Connor, Diane and **Dianne van der Reyden.** "How to Care for Bound Materials." *Conserve O Gram 19/18*, National Park Service, Superintendent of Public Documents, U.S. Government Printing Office, September, 1996.

Vogt-O'Connor, Diane and **Dianne van der Reyden.** "Storing Archival Paper-Based Materials." *Conserve O Gram 19/15*, National Park Service, Superintendent of Public Documents, U.S. Government Printing Office, September, 1996.

von Endt, David W. "Heritage Preservation Report to SPNHC." In *Society for the Preservation of Natural History Collections 1998 Annual Report*, p. 33. 1998.

von Endt, David W. "Research Committee Report to SPNHC." In *Society for the Preservation of Natural History Collections 1998 Annual Report*, p. 25. 1998.

von Endt, David W. "Spirit Collections: A Comparison of Keratin and Collagen Stability in the Storage Fluids Ethanol and 2-Propanol." In *Society for the Preservation of Natural History Collections, 1997 Annual Meeting Program with Abstracts*, p. 26. 1998.

von Endt, David W., W. David Erhardt, and Walter R. Hopwood. "Evaluating Materials Used for Constructing Storage Cases." In *Storage of Natural History Collections: A Preventive Conservation Approach: Volume I*, edited by Carolyn L. Rose, Catharine A. Hawks, and Hugh H. Genoways, pp. 269-282. Washington, DC: Society for the Preservation of Natural History Collections, 1995.

von Endt, David W., J. Harasewych, and J. Post. "Byne's Disease Revisited." In *Program with Abstracts, SPNHC 1996 Annual Meeting*, p. 19. 1996.

von Endt, David W. and Shaun J. Hardy. "Information Surveys and Conservation Research: The Stability of Fluid Preserved Specimens." In *Annual Meeting Program and Abstracts*, p. 13. American Institute for Conservation of Historic and Artistic Works, 1997.

von Endt, David W. and P. Edward Hare. "High Temperature Experiments Concerning the Stability of Bone." In *2nd World Congress on the Preservation of Natural History Collections*, p. 62. 1996.

von Endt, David W. and P. Edward Hare. "Spirit Collections: Rates of Change in the Amino Acids of Bone at Elevated Temperatures." In *Society for the Preservation of Natural History Collections, 12th Annual Meeting Program and Abstracts*, p. 26. 1997.

von Endt, David W. and P. Edward Hare. "Spirit Collections: Rates of Change in the Amounts and Stereo chemistry of the Amino Acids of Hair at Elevated Temperatures." In *Society for the Preservation of Natural History Collections, 12th Annual Meeting Program and Abstracts*, p. 26. 1997.

von Endt, David W. and P. Edward Hare. "Spirit Collections: The Stability of Keratin at Elevated Temperatures." In *2nd World Congress on the Preservation of Natural History Collections*, p. 63. 1996.

von Endt, David W. and P. Edward Hare. "The Stability of Collagen and Keratin in Museums: Nitrogen-Containing Heterocycles Found in Bone, and the Preservation of Keratin in Ethanol and Formalin." In *Perspectives in Amino Acid and Protein Geochemistry, A Symposium, 1998*, p. 29. 1998.

Williams, Donald C. "A Survey of Adhesives for Wood Conservation." In *The Structural Conservation of Panel Paintings*, edited by Kathleen Dardes and Andrea Rothe, pp. 79-86. Los Angeles: The Getty Conservation Institute, 1998.

Wilson, Andrew S., **Noreen C. Tuross**, and **Melvin J. Wachowiak, Jr.** "Blood Residues on Archaeological Objects - a Conservation Perspective." In *Archaeological Conservation and its Consequences: Preprints of the Contributions to the Copenhagen Congress, 26-30 August 1996*, edited by Ashok Roy and Perry Smith, pp. 213-217. London: The International Institute for Conservation of Historic and Artistic Works, 1996.

PRESENTATIONS

SCMRE staff often make oral and poster presentations of their projects at conferences, civic organizations, and other public venues. A listing of these presentations follows; this list does not include internal teaching and presentations as part of regular SCMRE courses.

Alden, Harry A. "Qualified Determination of Provenance of Wood of the Firs (*Abies* spp. Mill.) Using Microscopic Features of Rays: An Aid to Conservators, Curators and Art Historians." American Institute for Conservation Conference, Arlington, Virginia. June 1998.

Alden, Harry A. "Scientific Limits of Microscopic Wood Analysis of Objects d'Art." American Institute for Conservation Conference, Arlington, Virginia. June 1998.

Baker, Mary T. "Polymer Chemistry: Degradation and Morphological Changes." University of Wisconsin, Stevens Point, Wisconsin. July 1996.

Baker, Mary T. "Micro-ATR Analysis of Polyurethane Binders in Museum Videotape Collections: Natural Aging Reactions in Archive Tapes." American Chemical Society National Meeting, Orlando, Florida. August 1996.

Baker, Mary T. "Hidden Secrets in Rubber." America's Smithsonian, Houston Children's Museum, Houston, Texas. December 1997.

Baker, Mary T. "Modern Space Suits and Ancient Rubber." America's Smithsonian, Houston Public Library System, Houston, Texas. December 1997.

Baker, Mary T. "Research on Modern and Ancient Rubber." Exxon Chemical Corporation, Houston, Texas. December 1997.

Baker, Mary T. "Thermal History Studies in Ancient and Modern Rubber." American Chemical Society National Meeting, Boston, Massachusetts. August 1998.

Ballard, Mary W. "Textile Storage in Your Museum." Annual Meeting of the Southeastern Museums Association, New Orleans, Louisiana. October 6, 1995.

Ballard, Mary W. "You Can do It! Workshop on Collections Care for Non-Conservators." Annual Meeting of the Southeastern Museums Association, New Orleans, Louisiana. October 7, 1995.

Ballard, Mary W. "How Backings Work: the Effect of Textile Properties on Appearance." Lining and Backing: The Support of Paintings, Paper and Textiles, The United Kingdom Institute for Conservation Conference, London, England. November 7, 1995.

Ballard, Mary W. "Textile Conservation and Drycleaning." Advanced Stain Removal Course, International Fabricare Institute, Silver Spring, Maryland. November 17, 1995.

Ballard, Mary W. "Hanging Out With Tapestries, Carpets, and Quilts: The Effect of Textile Properties on Appearance." Textile Conservation Group, New York, New York. February 26, 1996.

Ballard, Mary W. "Why Tapestries Look the Way They Do." Conservation Center, Institute of Fine Arts, New York University, New York, New York. February 26, 1996.

Ballard, Mary W. "Textile Conservation and Drycleaning." Advanced Stain Removal Course, International Fabricare Institute, Silver Spring, Maryland. March 15, 1996.

Ballard, Mary W. "Why Heirloomng Won't Work." Advanced Stain Removal Course, International Fabricare Institute, Silver Spring, Maryland. May 17, 1996.

Ballard, Mary W. "Textile Conservation vs. Drycleaning." Advanced Stain Removal Course, International Fabricare Institute, Bethesda, Maryland. June 20, 1996.

Ballard, Mary W. and I. Skals, "Masking and Misinterpreting Cotton Fibers: Dangers Associated with the Fiber Analysis of Archeological Textiles." Archaeological Conservation and its Consequences, IIC Copenhagen Conference, Frederiksberg, Denmark. August 27, 1996.

Ballard, Mary W. "Hanging Out: Strength, Elongation, and Relative Humidity - Some Physical Properties of Textile Fibers." ICOM Committee for Conservation, Triennial Meeting, Edinburgh, Scotland. September 3, 1996.

Ballard, Mary W. "Preventive Care: Climate and Museum Preservation." Introduction to the Management of Museum Collections: Collections Care Workshop, Center for Museum Studies, Smithsonian Institution, Washington, DC. September 18, 1996.

Ballard, Mary W. and R. Rushfield. "Chemistry in Textile Preservation: What's Missing and Why." American Chemical Society Meeting, Greenville, South Carolina. November 11, 1996.

Ballard, Mary W. "Textiles and Preventive Care." Introduction to the Management of Museum Collections: Collections Care Workshop, Center for Museum Studies, Smithsonian Institution, Washington, DC. September 18, 1997.

Ballard, Mary W. "Fibres naturales y hechas por el hombre y sintético: químico y físico/Natural, Manmade, and Synthetic Fibers, Chemical and Physical Properties." Textile Conservation, Fundación Antorchas, Buenos Aires, Argentina. August 18, 1998.

Ballard, Mary W. "Principio de proceso de desmanches/Principles of Stain Removal." Textile Conservation, Fundación Antorchas, Buenos Aires, Argentina. August 18, 1998.

Ballard, Mary W. "Proceso de Desmanche/Stain Removal: con agua (with Water)." Textile Conservation, Fundación Antorchas, Buenos Aires, Argentina. August 18, 1998.

Ballard, Mary W. "Proceso de Desmanche/Stain Removal: con disolvente (dryside)." Textile Conservation, Fundacion Antorchas, Buenos Aires, Argentina. August 19, 1998.

Ballard, Mary W. "Blanqueadores: oxidantes, reductores/Bleaching: oxidative, reductive." Textile Conservation, Fundacion Antorchas, Buenos Aires, Argentina. August 20, 1998.

Ballard, Mary W. "Tintes (por proceso de demanche)/Colorants and Stain Removal." Textile Conservation, Fundacion Antorchas, Buenos Aires, Argentina. August 20, 1998.

Ballard, Mary W. "Fiber Identification Methods, including Microscopy." Textile Conservation, Fundacion Antorchas, Buenos Aires, Argentina. August 21, 1998.

Ballard, Mary W. "Tintes naturales y synthetico/Natural dyes and synthetic dyes." Textile Conservation, Fundacion Antorchas, Buenos Aires, Argentina. August 25, 1998.

Ballard, Mary W. "Climate and Conservation: The Importance of Textile Preservation in Argentina for Museums Worldwide." Museo Ethnografica, Buenos Aires, Argentina. August 26, 1998.

Ballard, Mary W. "Light and Color on Textiles: Lightfastness, Blue Wool Standards, and the Colour Index." Textile Conservation, Fundacion Antorchas, Buenos Aires, Argentina. August 28, 1998.

Ballard, Mary W. "Archeological Textiles: Storage with Pressure Mounts." Textile Conservation, Fundacion Antorchas, Buenos Aires, Argentina. September 1, 1998.

Ballard, Mary W. "Pest Control: Insects, Fumigation, Pesticides." Textile Conservation, Fundacion Antorchas, Buenos Aires, Argentina. September 3, 1998.

Ballard, Mary W. "Textiles and Preventive Care." Introduction to the Management of Museum Collections: Collections Care Workshop, Center for Museum Studies, Smithsonian Institution, Washington, DC. September 17, 1998.

Beaubien, Harriet F. "Archaeological Ceramics - A Conservator's Perspective." Johns Hopkins University Material Science/Engineering program course Material Science of Art and Cultural Objects, Baltimore, Maryland. April 18, 1996.

Beaubien, Harriet F., Catherine Magee, Ellen Rosenthal, and Susan Peschken. "Conservation Overview." Harvard University field school, Copán, Honduras. July 9, 1996.

Beaubien, Harriet F. "Field recovery of Artifacts with Painted Surfaces: Case Studies from two Mesoamerican Sites" (poster). IIC Conference on Archaeological Conservation and its Consequences, Copenhagen, Denmark. August 23-30, 1996.

Beaubien, Harriet F. "Conservation of the 'Ain Ghazal Statues." to George Mason University graduate students in Museum Studies course (in History Department, taught by Jeffrey Stuart), Ain Ghazal exhibition, Freer and Sackler Galleries of Art, Washington DC. October 12, 1996.

Beaubien, Harriet F. "Recognizing a New Artifact Category: Painted Gourds from the Excavations at Cerén, El Salvador." New York University graduate anthropology/conservation course Archaeology, Anthropology and Conservation, New York, New York. November 5, 1996; repeated at SCMRE. December 18, 1996.

Beaubien, Harriet F. "Conservation in the Field: Finds Processing Issues and Practical Considerations." New York University graduate anthropology/conservation course Archaeology, Anthropology and Conservation, New York, New York. November 26, 1996; repeated at SCMRE. December 19, 1996.

Beaubien, Harriet F. and Lynn Grant. "Archaeological Research at Cerén, El Salvador." (poster). Maya Weekend session on The Role of the Conservator on Archaeological Excavations, University of Pennsylvania, Philadelphia, Pennsylvania. April 11-13, 1997.

Beaubien, Harriet F. and Lynn Grant. "Archaeological Research at Copán, Honduras." (poster). Maya Weekend session on The Role of the Conservator on Archaeological Excavations, University of Pennsylvania, Philadelphia, Pennsylvania. April 11-13, 1997.

Beaubien, Harriet F., C. Mei-An Tsu, Susan Peschken, and Scott Fulton. "Conservation Overview." Harvard University field school, Copán, Honduras. July 4, 1997.

Beaubien, Harriet F., C. Mei-An Tsu, Susan Peschken, and Scott Fulton. "Handling and Storage Issues." Harvard University field school, Copán, Honduras. July 4, 1997.

Beaubien, Harriet F. "Ordinary Things from Extraordinary Contexts: Recent Finds from Excavations at Cerén (El Salvador) and Copán (Honduras)." Pre-Columbian Society of Washington, Washington, DC. September 5, 1997; repeated at SCMRE. October 10, 1997.

Beaubien, Harriet F. "Cerén, Copán and CAL." Washington Conservation Guild session entitled Around the World in 80 Minutes: Archaeological Conservation at Active Sites, Washington, DC. December 4, 1997.

Beaubien, Harriet F. "The Trappings of Kingship among the Classic Maya: Ritual and Identity in a Royal Tomb from Copán." 15th Annual Visiting Scholar Conference entitled Fleeting Identities: Perishable Material Culture in Archaeological Research, Southern Illinois University, Carbondale, Illinois. April 17-18, 1998; previously at SCMRE. April 15, 1998.

Beaubien, Harriet F. "Conservation of the Structure 26 Tomb." University of Colorado field school, Bluff Great House archaeological project, Bluff, Utah. June 15, 1998.

Beaubien, Harriet F. Field conservation workshops focusing on finds processing issues, ceramics reconstruction and lifting techniques, Edge of the Cedars Museum and Park, Blanding, Utah. June 16-19, 1998.

Beaubien, Harriet F. and **Elizabeth Robertson.** "Conservation of the Structure 26 Tomb." Harvard University field school, Copán, Honduras. June 29, 1998.

Beaubien, Harriet F. and **Elizabeth Robertson.** "Overview of Archaeological Conservation." Harvard University field school, Copán, Honduras. July 2, 1998.

Beaubien, Harriet F. and **Elizabeth Robertson.** Workshop on ceramics reconstruction techniques. Harvard University field school, Copán, Honduras. July 2, 1998.

Beaubien, Harriet F. and **Elizabeth Robertson.** "Finds Processing." Harvard University field school, Copán, Honduras, July 16, 1998.

Beaubien, Harriet F. and **Elizabeth Robertson.** "Lifting Techniques." with workshop exercise. Harvard University field school, Copán, Honduras. July 16, 1998.

Bishop, Ronald L. "History, Art and Science of Maya Ceramics." Smithsonian Voices of Discovery in Kansas City, Missouri, 4 venues. May 1-7, 1996.

Bishop, Ronald L. "Scientific Analysis of Archaeological Materials." Smithsonian Voices of Discovery in Kansas City, Missouri, 3 venues. May 1-7, 1996.

Bishop, Ronald L., Dorie Reents-Budet, Virginia Fields, and David Mora Marín. "El Jade en Costa Rica y la region Maya en la epoca Precolombina: sus implicaciones en la ineraccion 'internacional'." VII Encuentro: Los Investigadores de la Cultura Maya, Campeche, Mexico. December 10, 1997.

Bishop, Ronald L., Daniela R. Triadan, and M. Nieves Zedeño. "Integration of Compositional Analysis in Archaeology." Patterns and Process: a two-day symposium in honor of Dr. Edward V. Sayre, Smithsonian Institution, Washington, DC. September 21, 1998.

Blackman, M. James and **Jacqueline S. Olin.** "Chemical Characterization of French Colonial Ceramics from Old Mobile, Alabama." Society for Historical Archaeology. January 7-11, 1997.

Blackman, M. James and Sophie Méry. "Les importations de céramiques harappéennes en Arabie orientale: état de la question." Conference on South Asian Archaeology, Paris, France. 1997.

Blackman, M. James. "Chemical Characterization of Local Anatolian and Uruk Style Sealing Clays from Hacinebi." Society for American Archaeology Annual Meeting, Seattle, Washington. March 1998.

Blackman, M. James. "Northern Syrian Luster and Fritware: Evidence for Production and Distribution from Chemical and Petrographic Analysis." Séminaire annuel de l'Équipe de recherche en archéométrie, Université Laval, Quebec, Canada. March 19, 1998.

Blackman, M. James. "Chemical Characterization of Arslantepe Sealing Clays." Patterns and Process: a two-day symposium in honor of Dr. Edward V. Sayre, Smithsonian Institution, Washington, DC. September 21-22, 1998.

Canouts, Veletta and Ronald L. Bishop. "Hopi Yellow Wares: Yellow Where?" Society for American Archaeology 62nd Annual Meeting, Nashville, Tennessee. April 3, 1997.

Canouts, Veletta and Ronald L. Bishop. "Modern Measures of Traditional Hopi Pottery: Physical and Behavioral Sources of Variation in Hopi Pottery Production and Exchange, A.D. 1540-1980." Patterns and Process: a two-day symposium in honor of Dr. Edward V. Sayre, Smithsonian Institution, Washington, DC. September 21, 1998.

Erhardt, W. David. "Evaluation of 'Dosimetry of the Museum Environment: Environmental Effects on the Chemistry of Paintings'." MOLART 98, The Evaluation Workshop, FOM Instituut voor Atoom - en Molecuulfysica, Amsterdam, The Netherlands. January 1998.

Erhardt, W. David. "Evaluation of the Artificial Induction of Resin Growth in Aquilaria Trees." Ho Chi Minh University, Ho Chi Minh City, Vietnam. March 6, 1998.

Erhardt, W. David. "Preventive Conservation and Preservation Science." Conservation Course, Smithsonian Institution Center for Museum Studies and Fondacion Antorchas, Buenos Aires, Argentina. May 4-7, 1998.

Erhardt, W. David. "The Museum Environment." Museo Etnografico, Buenos Aires, Argentina. May 6, 1998.

Foias, Antonia E. and **Ronald L. Bishop.** "A Window onto Classic Period Maya Economy: The Production and Exchange of Utilitarian Pottery in the Petexbatun Region, Peten, Guatemala." Society for American Archaeology 62nd Annual Meeting, Nashville, Tennessee. April 5, 1997.

Goodway, Martha. "The Material Science of Art Objects." Course 510.108, Johns Hopkins University, Baltimore, Maryland. March 7, 1996.

Goodway, Martha. "Wootz Processing Temperatures: Preliminary Research Results." Camborne School of Mines, Cornwall, England. September 28, 1996.

Goodway, Martha. "Latest Developments in Museum Metallurgy." ASM International Worcester Chapter, Worcester, Massachusetts. December 17, 1996.

Goodway, Martha. "Metals in the Fortepiano: Hardware, Kapsels and Strings." Tavolo Rotunda, Third Laboratorio Fiorentino del Fortepiano, Florence, Italy. December 6-7, 1997.

Goodway, Martha. "Scientific Examination Corrects Documentation: a Case Study." The Second International Conference on Ancient Mining and Metallurgy and Conservation of Metals, Cairo, Egypt. April 14, 1998.

Goodway, Martha. "Discovery of Metallic Nickel Inclusion in 5000 B.P. Tin Bronze from Tell es-Sweyhat, Syria." Historical Metallurgy Society Annual Conference, Plas Tan y Bwlch, Wales, September 12, 1998.

Goodway, Martha. "Processing Temperatures of the Wootz Process at Gattihosahalli based on Crucible Refiring Experiments." Historical Metallurgy Society Annual Conference, Plas Tan y Bwlch, Wales. September 12, 1998.

Grissom, Carol A. "'Ain Ghazal Plaster Figures." The 1995 March of the East Coast Archaeological Marching and Chowder Society, National Museum of Natural History, Smithsonian Institution, Washington, DC. October 28, 1995.

Grissom, Carol A. "Beneath the Surface: Exposing History by Excavating the Plaster Statues of 'Ain Ghazal." 35th Material Culture Forum Dinner Meeting entitled Marking Time with Buried Treasures, Museum Support Center, Smithsonian Institution, Suitland, Maryland. May 22, 1996.

Grissom, Carol A. Served as a panelist on USIA's Worldnet television program entitled Ancient Jordanian Statues, made on July 31, 1996, and broadcast in Jordan.

Grissom, Carol A. "Conservation of Neolithic Plaster Statues from 'Ain Ghazal." IIC 16th International Congress entitled Archaeological Conservation and its Consequences, Copenhagen, Denmark. August 28, 1996.

Grissom, Carol A. "Measuring Surface Roughness: Three Techniques." 8th International Congress on Deterioration and Conservation of Stone, Berlin, Germany. October 3, 1996.

Grissom, Carol A. "From Excavation to Exhibition: Preserving the Ancient Statues from Jordan." Freer Gallery of Art/Arthur M. Sackler Gallery Lecture, Smithsonian Institution, Washington, DC. October 24, 1996.

Grissom, Carol A. and Ann Gunter. "Ancient Art of the Near East." Joint meeting of the Bryn Mawr Club of Washington and Wellesley Club of Washington, Freer Gallery of Art, Smithsonian Institution, Washington, DC. October 27, 1996.

Grissom, Carol A. "Preserving Ancient Statues from 'Ain Ghazal, Jordan." The Philosophical Society of Washington, Washington, DC. November 1, 1996.

Grissom, Carol A. Appeared in Allbritton Television Productions' "Field Trip: In Search of the Nation's Attic," which premiered November 2, 1996.

Grissom, Carol A. "Preserving the Ancient Statues from 'Ain Ghazal, Jordan." Tuesday Morning Smithsonian Associates Lecture, National Museum of American History, Smithsonian Institution, Washington, DC. November 19, 1996.

Grissom, Carol A. Moderator of the research session for the Save Outdoor Sculpture Meeting Play for Keeps: A Game Plan to Save Outdoor Sculpture, Washington, DC. November 19, 1996.

Grissom, Carol A. "Preserving the Ancient Statues from 'Ain Ghazal (Jordan)." Meeting of the AIA Baltimore Club, Baltimore, Maryland. March 7, 1997.

Grissom, Carol A. and Annie Caubet. "La statue d'Ain Ghazal du VIIe millénaire." Louvre Museum, Paris, France. May 30, 1997.

Grissom, Carol A. "Deconstructing and Reconstructing Ancient Plaster Statues." New York History of Technology Seminar, Graduate School and University Center of the City University of New York, New York. March 20, 1998.

Grissom, Carol A. Prepared a 10-minute video entitled Treatment of Plaster Statues from 'Ain Ghazal.

Lange, Frederick W., Erin L. Sears, Ronald L. Bishop, and Roland H. Cunningham. "Usulután Decorated Pottery and the Southern Frontier of Mesoamerica." Patterns and Process: a two-day symposium in honor of Dr. Edward V. Sayre, Smithsonian Institution, Washington, DC. September 21, 1998.

Mecklenburg, Marion F. Keynote dinner address. Joint meeting of IFMA and ASHRAE in Edmonton, Alberta, Canada. February 18, 1998.

Mecklenburg, Marion F. "Environmental Research." Indoor Climates, for Special Places seminar sponsored by IFMA Northern Alberta Chapter and the Alberta Building Envelope Council - North and ASHRAE, the Provincial Museum of Alberta, Edmonton, Canada. February 19, 1998.

Oudemans, Tania F.M., **W. David Erhardt**, and **David W. von Endt.** "Organic Residues as Use Indicators: Comparative Spectroscopic Studies of Contemporary and Archaeological Kalinga Ceramics." International Symposium on Archaeometry, Italy. 1996.

Rands, Robert L. and **Ronald L. Bishop.** "The Dish-plate Tradition at Palenque: Continuity and Change." Patterns and Process: a two-day symposium in honor of Dr. Edward V. Sayre, Smithsonian Institution, Washington, DC. September 21, 1998.

Reents-Budet, Dorie. "Parvenues of the Classic Period: Social Rituals and Classic Maya Ceramics." Invited paper, The 14th annual Maya Weekend. The University Museum, University of Pennsylvania, Philadelphia, Pennsylvania. March 30-31, 1996.

Reents-Budet, Dorie. "The Human Spirit in the Art of the Maya." Invited gallery talk, The Mead Art Museum, Amherst College, Amherst, Massachusetts. April 1-2, 1996.

Reents-Budet, Dorie and Marilyn Beaudry. "Shamans, Saurians and Bats: Symbols from Central Honduras." The annual meeting of the Society for American Archaeology, New Orleans. April 10-14, 1996.

Reents-Budet, Dorie. "Classic Maya Pottery as Cosmological Metaphor." The annual meeting of the American Anthropological Association, San Francisco, California. November 7, 1996.

Reents-Budet, Dorie, Simon Martin, Richard Hansen, and **Ronald L. Bishop.** "Codex-Style Pottery: Its First K'atun Anniversary." Invited paper for The XIII Texas Symposium, The Maya Meetings at Texas, The University of Texas at Austin, Austin, Texas. March 6-7, 1997.

Reents-Budet, Dorie and **Ronald L. Bishop.** "Jade de la Epoca Precolombina de Costa Rica y la Región Maya: Sus Implicaciones para Interacción 'Internacional'." Invited lecture for the VII Encuentro: Los Investigadores de la Cultura Maya, Centro Cultural y Deportivo Universitario, Universidad de Campeche, Campeche, México. November 11-15, 1997.

Reents-Budet, Dorie and **Ronald L. Bishop.** "La Cerámica Maya de Calakmul, Campeche, México." Invited lecture for the VII Encuentro: Los Investigadores de la Cultura Maya, Centro Cultural y Deportivo Universitario, Universidad de Campeche, Campeche, México. November 11-15, 1997.

Reents-Budet, Dorie and **Ronald L. Bishop.** "La Ceramica de Calakmul." VII Encuentro: Los Investigadores de la Cultura Maya, Campeche, Mexico. December 10, 1997.

Reents-Budet, Dorie. "Metaphor, History or Mythology: Classic Maya Painted Ceramics." Invited lecture, Museum of Fine Arts Boston, Massachusetts. January 18, 1998.

Reents-Budet, Dorie. "Type: Variety Analysis and The Role of Stylistic Investigations in the Study of Classic Maya Painted Pottery." The College Art Association 1998 annual meeting, Toronto, Ontario, Canada. February 16, 1998.

Reents-Budet, Dorie. "Calakmul, Campeche, México: The Style and Chemistry of Classic Maya Power." Invited lecture, Archaeological Institute of America and the Department of Classical Studies, University of North Carolina at Greensboro, Greensboro, North Carolina. April 1, 1998.

Reents-Budet, Dorie and **Ronald L. Bishop.** "Investigaciones Químicas de la Cerámica Monocroma Negra del Período Clásico de Calakmul, Campeche." El IV Congreso Internacional de Mayistas, UNAM, Antigua, Guatemala. August 2-8, 1998.

Reents-Budet, Dorie and **Ronald L. Bishop.** "More than Methodology: INAA and Classic Maya Painted Ceramics." Patterns and Process: a two-day symposium in honor of Dr. Edward V. Sayre, Smithsonian Institution, Washington, DC. September 21, 1998.

Russ, Jill L., Connie J. Kolman, S.L. Jewett, and **Noreen C. Tuross.** "The Whites of their Eyes: Criteria for Selection of Fluid Stored Fish for Molecular Studies." (poster). Society for the Preservation of Natural History Collections 12th Annual Meeting, University of Wisconsin-Madison, Madison, Wisconsin. July 1997.

Russ, Jill L., Connie J. Kolman, and Noreen C. Tuross. "Time in a Bottle: The Effects of Fluid Fixation on Biomolecules." Society for the Preservation of Natural History Collections 12th Annual Meeting, University of Wisconsin-Madison, Madison, Wisconsin. July 1997.

Russ, Jill L., Connie J. Kolman, K.E. Hartel, D.J. Siebert, and Noreen C. Tuross. "Natural History Fluid Collections as Genetic Repositories." (poster). Society for the Preservation of Natural History Collections 13th Annual Meeting, University of Alberta, Alberta, Canada. May 1998.

Taylor, R.E., **P. Edward Hare**, J.E. Kokis and **David W. von Endt.** "Determining Thermally-altered Bone from Archaeological and Paleoanthropological Contexts." XII Congress of the International Union of Prehistoric and Protohistoric Sciences, Italy. 1996.

Taylor, R.E., **P. Edward Hare, David W. von Endt,** and J.E. Kokis. "Biochemical Criteria for the Characterization of Thermally-altered Bone." International Symposium on Archaeometry, Italy. 1996.

Triadan, Daniela R., Ronald L. Bishop, M. James Blackman, and Eduardo Gamboa Carrera. "Production and Distribution of Polychrome Ceramics in the Casas Grandes Region, Chihuahua, Mexico." Society for American Archaeology 63rd Annual Meeting, Seattle, Washington. April 8, 1998.

Tsai, Fei-wen. "Preventive Conservation and Its Seven Responsibilities." the Lecture Hall, National Palace Museum, Taipei, Taiwan. February 28, 1996.

Tsai, Fei-wen. "Disaster Preparedness - Prevention, Response and Recovery Procedures for Water-Based Emergencies: Paper-Based and Magnetic Media Materials." the Symposium on the Conservation and Preservation of Cultural Properties, Taipei, Taiwan. June 5, 1996.

Tsai, Fei-wen. "How to Use Clam-Shell Boxes." staff meeting, the National Anthropological Archives, Smithsonian Institution, Washington, DC. November 26, 1996.

Tsai, Fei-wen. "Introduction to Disaster Preparedness." the Smithsonian Institution Archives Council, National Museum of African Art, Washington, DC. January 24, 1997.

Tsai, Fei-wen. "Introduction to SCMRE and Its Facilities." the review committee of the Conservation Center for the Culture Properties, Taipei, Taiwan. February 13, 1997.

Tsai, Fei-wen. "Preservation and Research: Characterizing Collections of Specialty Papers." Workshop on Art Conservation, the Museo de Bellas Artes, Caracas, Venezuela. November 7, 1997.

Tsai, Fei-wen and Mary Parrish. "O.C. Marsh Dinosaur Drawings: Care and Conservation of Historical Scientific Illustrations." The Dinofest Symposium presented by The Academy of Natural Sciences, Philadelphia, Pennsylvania. April 17, 1998.

Tsai, Fei-wen. "Seven Areas of Preservation Responsibilities." Kaohsiung Museum of Fine Art, Kaohsiung, Taiwan. July 23, 1998.

Tumosa, Charles S., W. David Erhardt, and Marion F. Mecklenburg, "Chemical and Physical Changes in Naturally and Accelerated Aged Cellulose." Historic Textiles and Paper Materials, National Meeting of the American Chemical Society, Boston, Massachusetts. August 26, 1998; repeated at SCMRE. September 7, 1998.

Tumosa, Charles S., Mark McCormick-Goodhart, and Marion F. Mecklenburg. "The Physical Properties of Photographic Film Polymers Subjected to Cold Storage Environments." Polymers in Museums Symposium, National Meeting of the American Chemical Society, Boston, Massachusetts. August 27, 1998; repeated at SCMRE. September 7, 1998.

van der Reyden, Dianne. "150 years at the Smithsonian - Case studies in Preserving the Real Thing, from the Ridiculous to the Sublime: Chairs, Globes and Screens; Coatings, Tracings and Chinese Papers." State University of New York at Buffalo, Graduate School for Conservation, Buffalo, New York. April 26, 1996.

van der Reyden, Dianne. "A Sesquicentennial Update - Research in CAL=s Paper Conservation Laboratory: From Specialty Papers in Archives and Libraries to Scanning Photos on Demand in Cold Storage." University of Delaware, Winterthur Graduate Conservation Program, Winterthur, Delaware. May 9, 1996.

van der Reyden, Dianne. "Marking TIME with 'Buried Treasures': The Crypt of Civilization." Material Culture Forum 25th Meeting, Smithsonian Institution, Washington, DC. May 22, 1996.

van der Reyden, Dianne. "Photographs: How to Recognize and Preserve Them." Fundamentals of Condition Reports, Exhibits, Loans and Preservation: Finding the Balance, CAPNET, Library of Congress, Washington, DC. June 3, 1996.

van der Reyden, Dianne. "Paper, Book and Box-making: Preservation of your Document, Photograph and Art Collections." Demonstrations for Smithsonian Institution's Folklife Festival on the Mall, Washington, DC. June 9, 1996.

van der Reyden, Dianne. "Research into the Technology and Preservation of Paper-Based Collections: Demonstrations in Paper, Book and Box-making." Smithsonian Institution's 150th Birthday Party on the Mall, Washington, DC. August 3-4, 1996.

van der Reyden, Dianne. "The Technology and Treatment of a Chinese Wood Block Print." ICOM, Edinburgh, Scotland. September 5, 1996.

van der Reyden, Dianne. "Deciding Selection Criteria for Digitization." National Park Service, School for Scanning, NEDCC and NPS, New York, New York. September 11, 1996.

van der Reyden, Dianne. "Preventive Care for Paper-Based Collections at the Smithsonian." Smithsonian Institution, Center for Museum Studies, Washington, DC. September 19, 1996.

van der Reyden, Dianne. "Treatment of Paper Documents." two-week course for professional conservators from Latin America, sponsored by ICCROM and the Centro Nacional de Conservacion y Restauracion, Santiago, Chile. November 4-15, 1996.

van der Reyden, Dianne. "Publish, then Perish: Reclamation of Scientific Illustrations." public program for ICCROM, Santiago, Chile. November 1996.

van der Reyden, Dianne. "Surface Cleaning Techniques." Smithsonian Institution, for Office of Smithsonian Institution Archives and National Air and Space Museum technicians, Washington, DC. January 1997.

van der Reyden, Dianne. "Introduction to Paper Preservation." Smithsonian Institution, National Air and Space Museum's Mutual Concerns Program, Washington, DC. March 20, 1997.

van der Reyden, Dianne. "Lining Procedures and Demonstration." interns from the Hirshhorn, Winterthur, and Taiwan. SCMRE. June 23, 1997.

van der Reyden, Dianne. "Paper Storage and Research." Smithsonian Institution, National Air and Space Museum, Smithsonian National Associates Program (SNAP) volunteers, Washington, DC. July 28, 1997.

van der Reyden, Dianne. "Deciding Selection Criteria for Digitization." National Park Service, School for Scanning, NEDCC and NPS, New York, New York. November 3, 1997.

van der Reyden, Dianne. "Conservation Treatment of Paper Documents." two-week course for professional conservators, for the "Catedra Miguel Arroyo" preservation program, co-sponsored by Smithsonian Institution's Voices of Discovery, the USIA, the Museo de Bellas Artes, the Galeria de Arte Nacional, and the Biblioteca Nacional, Caracas, Venezuela. November 5-15, 1997.

van der Reyden, Dianne. "Preservation and Strategic Planning: Case Studies and an Angels' Project to Save a Dinosaur Collection" and "Preservation and Scientific Analysis: Photos, Fakes, Forgeries, and Virtual Reality." lectures for the general public, co-sponsored by the Smithsonian Institution's Voices of Discovery, the USIA, the Museo de Bellas Artes, the Galeria de Arte Nacional, and the Biblioteca Nacional, Caracas, Venezuela. November, 1997.

van der Reyden, Dianne. "Doubtful Documents, Manipulated Manuscripts, and the Case of the Mysterious Michelangelo." Museums in Fact and Fiction: Mysterious Stories of Deceit, Deception, and Discovery (a fakes and forgeries conference targeting mystery writers), Winterthur Museum, Delaware. March 28, 1998.

van der Reyden, Dianne. "Preserving Memories." Memorial Day Weekend Workshop for Military Survivors, sponsored by the Tragedy Assistance Program for Survivors (TAPS), Washington, DC. May 22, 1998.

van der Reyden, Dianne. "Preventive Conservation Strategies for Paper-Based Collections." two-week course for Argentinean conservators, sponsored by the Fundación Antorchas, Buenos Aires, Argentina. August 3-14, 1998.

Vandiver, Pamela B. "Ancient Ceramic Technology and its Various Reconstructions." Departments of Physics and Chemistry, City Polytechnic University of Hong Kong, Hong Kong. October 1995.

Vandiver, Pamela B. "Technological Families of Ancient Glazed Ceramics." International Conference on Ancient Ceramics, Shanghai, Peoples Republic of China. November 1995.

Vandiver, Pamela B. "Excavation of a Parthian Kiln from Nippur, Iraq." American Ceramic Society, Indianapolis, Indiana. March 1996.

Vandiver, Pamela B. "Reconstructing and Interpreting the Technologies of Ancient Ceramics." Princeton Materials Institute, Princeton University, New Jersey. March 1996.

Vandiver, Pamela B. "The Appearance of Chinese Painted Ceramics." Center for Solid State Science, Arizona State University, Conference on Science and Art, Tempe, Arizona. April 1996.

Vandiver, Pamela B. "Hydrogen Reduction as a Firing Strategy for Ancient Chinese Ceramics." Archaeometry Conference, Urbana, Illinois. April 1996.

Vandiver, Pamela B. "Properties and Processing of Ancient Ceramics and Glasses." Department of Materials Science, Johns Hopkins University, Baltimore, Maryland. April 1996.

Vandiver, Pamela B. "Specialized Ceramic Technologies of Urban Polities." Massachusetts Institute of Technology, Cambridge, Massachusetts. May 1996.

Vandiver, Pamela B. "Radiographic Imaging of Ceramics to Determine Method of Manufacture" and "Report on the Interdisciplinary Archeomaterials Program at the Northwest Institute of Light Industry." Chinese Research Society for the Study of Ancient Ceramics, Jianyang, Fujian, Peoples Republic of China. October 1996.

Vandiver, Pamela B. "Hydrogen Reduction as a Strategy for Firing Ancient Chinese Ceramics from the Neolithic Period to the Present." International Conference on Ancient Ceramics, Shanghai, Peoples Republic of China. November 1996.

Vandiver, Pamela B. "Prehistoric Ceramics from Bukit Tengkorak, Malaysia." Symposium on Materials Issues in Art and Archaeology V, Materials Research Society, Boston, Massachusetts. December 1996.

Vandiver, Pamela B. "Chinese Overglaze Enamels." Louvre Museum, Research Laboratory for the Museums of France, Paris, France. January 1997.

Vandiver, Pamela B. Series of 5 lectures as Lois Langland Scholar in Residence, including Humanities Institute Lecture, Scripps College, Claremont, California. February 1997.

Vandiver, Pamela B. "The Technical Study of East Asian Ceramics." Asian Studies Association, Annual Meeting, Chicago, Illinois. March 15, 1997.

Vandiver, Pamela B. "Egyptian Faience Technology." Conference on Egyptian Pigments and Glazes, European University Center for Cultural Heritage, Ravello, Italy. March 20-22, 1997.

Vandiver, Pamela B. "Properties and Processing of Ancient Ceramics and Glasses." Department of Materials Science, Johns Hopkins University, Baltimore, Maryland. April 1997.

Vandiver, Pamela B. "The Context of Glass Production in Southwest Asia." American Ceramic Society Annual Meeting, Cincinnati, Ohio. May 4-7, 1997.

Vandiver, Pamela B. "The Kunckel Manuscript on Glass Technology." American Ceramic Society Annual Meeting, Cincinnati, Ohio. May 4-7, 1997.

Vandiver, Pamela B. "Materials Science in Museums." Case Western Reserve, Cleveland, Ohio. September 23, 1997.

Vandiver, Pamela B. Smithsonian Institution 150th Anniversary Exposition, New York, 6 lectures on Paleolithic ceramics, the technology of Tiffany glass, and others at the National Museum of the American Indian, Cooper-Hewitt Museum, Queens Museum, Brooklyn Museum, and New York Historical Society. 1997.

Vandiver, Pamela B. "Ceramics" and "Glasses." New York University, Institute for the Arts, New York, New York. October 1997.

Vandiver, Pamela B. and Zhang Fukang. "The Mechanism and Significance of Yaobian Phase Separation in Chinese Glazes." Chinese Research Society for Ancient Ceramics, Hebei, China. October 20-23, 1997.

Vandiver, Pamela B. "Visual Properties of Ancient Ceramic Glazes." National Cultural Properties Research Institute and National Museum, Conservation Laboratory, Seoul, Korea. October 27, 1997.

Vandiver, Pamela B. "The Scientific Analysis of Ancient Ceramics and Glasses." Kyunggi Provincial Museum, Korea. October 28, 1997.

Vandiver, Pamela B. "Early Pottery in East Asia" and "Southeast Asian Paddle and Anvil Forming and Finishing." Pottery in the Making, Ceramic Technology and Production Conference, British Museum, London, United Kingdom. November 20-22, 1997.

Vandiver, Pamela B. "Faience Technology in Context." American Research Center in Egypt, East Coast Chapter, Washington, DC. December 6, 1997.

Vandiver, Pamela B. "Paleolithic Pigments and Ceramics in Eurasia," "Different Trajectories for the Development of Plasters and Pottery in East and Southwest Asia," and "Progress in Green Glaze Research." lecture series for Nara National Cultural Properties Research Institute, Nara, Japan. March 1998.

Vandiver, Pamela B. "Pottery from 13,000 to 10,000 in Japan, China and Siberia and Its Paleolithic Antecedents." International Conference on Archaeology, Linguistics and Ethnography of the Russian Far East, Siberian Institute for History and Archaeology, Siberian National Academy of Sciences, Vladivostok, Russia. April 1-4, 1998.

Vandiver, Pamela B. "Ancient Technologies of Ceramics and Pigments." Smithsonian Institution Associates Lecture on Paleolithic Technologies, Washington, DC. April 1998.

Vandiver, Pamela B. "Properties and Processing of Ancient Ceramics and Glasses." Department of Materials Science, Johns Hopkins University, Baltimore, Maryland. April 1998.

Vandiver, Pamela B. "East Asian Pottery Production, 13,000-10,000 B.P." Indo-Pacific Prehistory Association, Melaka, Malaysia. July 1-10, 1998.

Vandiver, Pamela B. "Materials Science in Museums." Gordon Research Conference on Solid State Chemistry, Colby-Sawyer College, New London, New Hampshire. July 26-31, 1998.

Vandiver, Pamela B. "A Case of Recycling in Antiquity: Islamic Glass from Sardis." Patterns and Process: a two-day symposium in honor of Dr. Edward V. Sayre, Smithsonian Institution, Washington, DC. September 1998.

von Endt, David W. "Information Surveys and Conservation Research: The Stability of Fluid Preserved Specimens." American Institute for Conservation 1996 Annual Meeting, San Diego, California. 1996.

von Endt, David W. "Byne's Disease Revisited." SPNHC 1996 Annual Meeting, Victoria, British Columbia, Canada. 1996.

von Endt, David W. "High Temperature Experiments concerning the Stability of Bone." 2nd World Congress on the Preservation of Natural History Collections, Madrid, Spain. 1996.

von Endt, David W. "Spirit Collections: The Stability of Keratin at Elevated Temperatures." 2nd World Congress on the Preservation of Natural History Collections, Madrid, Spain. 1996.

von Endt, David W. "The Relationship between Preservation Treatment, Nucleic Acid Content, and Amino Acid Racemization in Otter Skin." SPNHC 1997 Annual Meeting, University of Wisconsin, Madison, Wisconsin. 1997.

von Endt, David W. "Spirit Collections: A Comparison of Keratin and Collagen Stability in the Storage Fluids Ethanol and 2-Propanol." SPNHC 1997 Annual Meeting, University of Wisconsin, Madison, Wisconsin. 1997.

von Endt, David W. "Spirit Collections: Rates of Change in the Amino Acids of Bone at Elevated Temperatures." SPNHC 1997 Annual Meeting, University of Wisconsin, Madison, Wisconsin. 1997.

von Endt, David W. "Spirit Collections: Rates of Change in the Amounts and Stereochemistry of the Amino Acids in Hair at Elevated Temperatures." SPNHC 1997 Annual Meeting, University of Wisconsin, Madison, Wisconsin. 1997.

von Endt, David W. "The Stability of Collagen and Keratin in Museums: Nitrogen-Containing Heterocycles found in Bone, and the Preservation of Keratin in Ethanol and Formalin." Perspectives in Amino Acid and Protein Geochemistry, A Symposium in Honor of P.E. Hare, Washington, DC. 1997.

von Endt, David W. "Spirit Collections: A comparison of Amino Acid Stability in Skin, Hair, and Bone." SPNHC 1998 Annual Meeting, University of Alberta, Edmonton, Alberta, Canada. 1998.

Wachowiak, Melvin J. "The Use of Optical Microscopy for the Analysis of Blood Residues." Society of American Archaeologists Annual Meeting Workshop, New Orleans, Louisiana. April 10, 1996.

Wachowiak, Melvin J. "Coatings Technology of Historic Violins." American Federation of Violin and Bowmakers, Suitland, Maryland. April 26, 1996.

Wachowiak, Melvin J. "Microscopy at the Conservation Analytical Laboratory." Washington Conservation Guild Meeting, Washington, DC. May 1, 1996.

Wachowiak, Melvin J. "A Team Approach to The Conservation of a Ship's Figurehead by William Rush." American Institute for Conservation General Session, Richmond, Virginia. June 12, 1996.

Wachowiak, Melvin J. "Microscopy and Examination of Historic Objects." Smithsonian Institution 150th Birthday Party on the Mall, Washington, DC. August 10-11, 1996.

Wachowiak, Melvin J. "Conservation of Historic Coatings." Eastern Michigan University, Ypsilanti, Michigan. November 1, 1996.

Wachowiak, Melvin J. "Wood Technology in Historic Aircraft." Shared Concerns in Air and Space Museums, Suitland, Maryland. March 20, 1997.

Wachowiak, Melvin J. "Wood: Selection and Use, Preservation and Analysis." The Preservation of Imágenes, Suitland, Maryland. September 23, 1997.

Wachowiak, Melvin J. "Wood: Selection and Use, Preservation and Analysis." Preservation of Santos, San Juan, Puerto Rico. May 19, 1998.

Wachowiak, Melvin J. "Paint Analysis and Treatment." Preservation of Santos, San Juan, Puerto Rico. May 19-20, 1998.

Williams, Donald C. "Molding and Casting." Smithsonian Folklife Festival on the Mall, Washington, DC. July 5-7, 1996.

Williams, Donald C. "Marquetry Demonstration." Smithsonian 150th Birthday Party on the Mall, Washington, DC. August 9-11, 1996.

Williams, Donald C. "Furniture Care." Fort Ward Historical Museum, Alexandria, Virginia. October 12, 1996.

Williams, Donald C. "An Art-based Secondary Science Curriculum: The Suitland High Project." Annual Meeting of the National Institute for Conservation, Washington, DC. October 21, 1996.

Williams, Donald C. "Historic Coating Materials." Chemistry Department, Eastern Michigan University, Ypsilanti, Michigan. November 1, 1996.

Williams, Donald C. and **Jia-sun Tsang.** "The Suitland High Project" (poster). Dialogue II Colloquium, Smithsonian Institution, National Zoological Park, Washington, DC. March 17, 1997.

Williams, Donald C. "Coatings Technology and Preservation." Shared Concerns in Air and Space Museums, Suitland, Maryland. March 20, 1997.

Williams, Donald C. and **Jia-sun Tsang.** "The Suitland High Project." Annual conference of the Education Outreach Fund, Smithsonian Institution, Office of Education, Washington, DC. March 26, 1997.

Williams, Donald C. "Restoration of Papier Mache' Furniture." Early American Decoration Society, Williamsburg, Virginia. September 23, 1997.

Williams, Donald C. "Molding and Casting." Smithsonian Institution Teacher's night, Washington, DC. November 12, 1997.

Williams, Donald C. "Furniture Conservation." Annapolis Woodworkers' Guild, Annapolis, Maryland. May 14, 1998.

Williams, Donald C. "Material Technology of Artifacts." Smithsonian Institution, Office of Education workshop Artifact-based learning, Washington, DC. June 25, 1998.

Williams, Donald C. "What Collections Tell Us." Smithsonian Institution, Office of Education Behind the Scenes workshop, Washington, DC. July 29, 1998.

GRANTS AND IN-KIND SUPPORT

Smithsonian Institution Funding

SCMRE received \$124,300 from the Smithsonian Research Equipment Pool in 1996, \$120,000 in 1997, and \$120,000 in 1998.

The May 1998 SCMRE workshop "Preservation of *Santos*" in San Juan, Puerto Rico, was underwritten by a grant of \$30,196 from the Smithsonian Center for Latino Initiatives Outreach fund.

SCMRE paper laboratory staff consulted with NAA's staff regarding a Research Resource Grant proposal for contracting a paper conservator to stabilize the archives' fine art collection. The proposal was accepted and funded in 1998 for the amount of \$19,000 for a one-year period.

The project "Science Teaching Art Teaching Science (STATS)" received a grant for \$15,000 in 1996 and for \$3,000 in 1997 from the Smithsonian Education Outreach Fund.

The September 1997 SCMRE workshop "Preservation of *Imágenes*: Hispanic American Religious Art on Wood" was underwritten by a grant of \$17,000 from the Office of the Provost Latino Outreach fund.

SCMRE received \$5,100 from the Smithsonian Research Opportunity Fund in 1996, \$5,100 in 1997, and \$5,000 in 1998 to help fund research sampling trips.

The Entomology Department received one grant from the Smithsonian Women's Committee (\$15,000) and two NMNH Collection Improvement Fund grants (\$6,000) in 1997 for the purpose of setting up a Departmental Archive and an Illustration Archive in the department. Dr. Marc Epstein, member of the collection management team, is actively in charge of care of paper-based illustration collections under the guidance of SCMRE paper laboratory staff.

SCMRE received \$7,100 from the Smithsonian Information Resource Management Pool in 1996 and \$5,700 in 1997 to purchase computer equipment.

The Latino Studies Fellowship Program (funding from the Office of Fellowships and Grants through the Center for Latino Initiatives) provided \$4,000 for a 1998 summer fellow to study at SCMRE.

External Funding

The Chiang Ching-kuo Scholarly Exchange Foundation provided \$87,518 in 1997 to fund Chinese Papers research.

The Samuel H. Kress Foundation provided \$5,000 in 1996, \$5,000 in 1997, and \$5,000 in 1998 for intern travel as part of the Archaeological Conservation Program.

Several organization from Puerto Rico contributed money towards the 1998 "Preservation of *Santos*" workshop. These included: La Compañía de Fomento Industrial - Oficina de Desarrollo Artesanal (\$1,305 for simultaneous translation), Cable TV of Greater San Juan (\$900), La Compañía de Turismo - Oficina de Asuntos Culturales (\$500 for a reception), Castle Book bookstore (\$125), and Museo de las Américas (\$100).

Smithsonian In-Kind Support

SCMRE received seven Dell Pentium computers from the Smithsonian Information resource Management Pool in 1998.

External In-Kind Support

The host of the 1998 workshop "Preservation of *Santos*" in San Juan, Puerto Rico, the Universidad del Sagrado Corazón, contributed approximately \$75,000 worth of lecture, office, and laboratory facilities, office supplies and copying, transportation, videotaping of the conference, receptions and staff support.

Harvard university provided supplies, staff travel, and room/board on site for the Harappa and Copán Archaeological Research Projects, totaling \$5,543 in 1996, \$5,428 in 1997, and \$6,034 in 1998.

The University of Wisconsin provided supplies, staff travel, and room/board on site for the Harappa Archaeological Research Project, totaling \$4,065 in 1996, \$4,344 in 1997, and \$4,448 in 1998.

Leica Microsystems contributed staff time and expertise (approximately \$7,500) and loaned ten teaching microscopes (approximately \$1000) for the 5-days of the Applied Optical Microscopy course during September 1998.

The Museo de Arte de Ponce contributed approximately \$8,000 worth of facilities as host of a one-day symposium that followed the San Juan workshop in 1998.

The University of Pennsylvania provided supplies, staff travel, and room/board on site for the Early Copán Acropolis Project, totaling \$1,478 in 1996, \$1,084 in 1997, and \$1,586 in 1998.

Yale University provided supplies, staff travel and room/board on site for the Aguateca Archaeological Research Project, totaling \$1,914 in 1998.

The University of Colorado provided supplies, staff travel, and room/board on site for the Cerén Research Project, totaling \$763 in 1996 and \$760 in 1997.

Organizations contributing to the 1998 workshop "Preservation of *Santos*" in San Juan, Puerto Rico included Cable TV of Greater San Juan (\$500 worth of advertisements), Museo de Arte Contemporáneo (\$500 worth of facilities), Puerto Rico Convention Bureau (\$500 worth of publications), and the Instituto de Cultura Puertorriquena (\$250 worth of publications).