

STUCCOED FLOORS: A RESOURCE FOR THE STUDY OF RITUAL ACTIVITIES. THE CASE OF TEMPLO MAYOR, MÉXICO

AGUSTÍN ORTIZ*, L. BARBA*, L. LÓPEZ LUJÁN**, AND K.F. LINK*

*Laboratorio de Prospección Arqueológica, Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México (UNAM), Ciudad Universitaria, Del. Coyoacán, D.F, 04510, México, D.F.

**Museo del Templo Mayor, Instituto Nacional de Antropología e Historia (INAH), Guatemala 60, Col. Centro, 06060, México, D.F.

INTRODUCTION

Since early 1978, the Proyecto Templo Mayor of the INAH has recovered part of one of the most prominent ceremonial complexes of the Mesoamerican world: the Sacred Precinct of Mexico-Tenochtitlan. Some of the most outstanding discoveries include the remains of 15 structures (almost all with various sub-structures), 117 rich offerings with more than 8,000 elements, along with a large number of sizable sculptures, bas-reliefs, mural paintings and ceramic fragments.

THE HALL OF THE EAGLE WARRIORS

Among the most impressive discoveries made during the first season of fieldwork was Building "E" or the "Hall of the Eagle Warriors" [1]. The structure is approximately 52 meters in length by 24 meters in width and corresponds to Phase VI of the Templo Mayor (c. 1486-1502 A.C.). There are two flights of steps leading into the building at its western end, one facing west and the other south. The stairs are flanked by double inclined moldings in the form of knots. A pair of polychromatic sculptures in the form of eagle heads emerge from the west facing moldings.

In 1981, after excavating the interior of this building layer, an earlier structure that corresponds to Phase V of the Templo Mayor (c. 1481-1486 A.C..) was uncovered and found to contain a series of interior rooms that were in an excellent state of conservation. From the exterior plaza level rise two flights of steps which lead to a large portico which was probably covered by a flat roof, of which a series of column bases in the form of an L still remains. Two life size clay statues which represent full bodied eagle warriors flanked the entryway to the first room. A large hearth and offering were excavated in this first room. A doorway protected by a pair of ceramic human skeletons leads to an open air patio with two additional adjoining rooms at its northern and southern ends. The entrances to both these rooms were framed by ornamental moldings in the form of four-petaled flowers painted in blue and red. Offerings were also discovered under the floors of both these rooms.

Almost all of the interior walls of the hall conserve the remains of painted murals depicting diminutive warriors. The lower parts of the walls are furnished with long benches which are composed of two vertical sections of bas-relief basalt. The lower and larger section of these polychrome carvings represent various processions of armed warriors which converge on a small altar where a *zacatapayolli* or straw ball that held the maguety thorns bloodied in self-mortification. The upper section, detailed as a frieze, was decorated with undulating feathered-serpents in bas-relief. A total of eight ceramic braziers containing carbonized plant material were found in front of these benches.

It is noteworthy to mention that the physical layout, form, proportions and decorations of the benches of the Hall of the Eagle Warriors strongly alludes to the Burnt Palace of Tula, as well as the Market, Temple of the Warriors and northern and north-eastern columns of Chichén Itzá. The strong analogies which can be made between the Hall of the Eagle Warriors and other older structures from Toltec and Mayan cultures, along with the ceramic representations of eagle warriors, and the continual allusion to acts of self-mortification on the benches, has been the subject of many controversies concerning the function and significance of this building [2,3,4,5].

Precisely, our current research seeks to obtain archaeological, iconographic, and ethnohistorical information which will allow us to define the functions for which this building

was destined, its relation to other structures within the ceremonial complex, its religious significance and certain aspects of the military order to which it was dedicated.

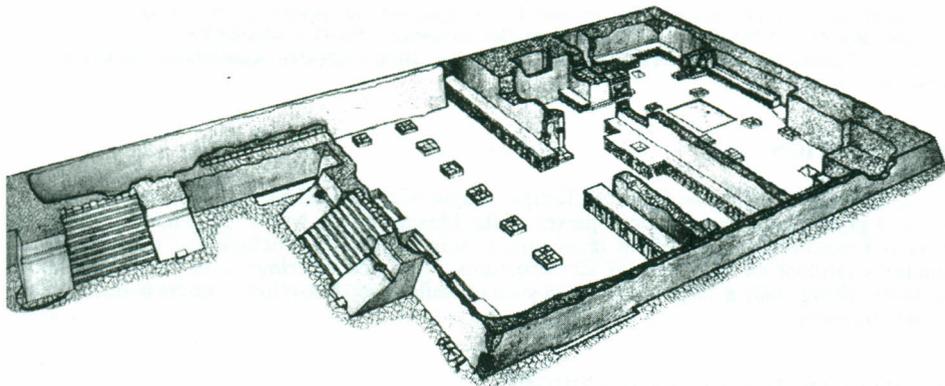


Figure 1. Isometric view of the excavated Hall of the Eagle Warriors.

ANALYSIS OF THE FLOORS

Between 1991 and 1994 a series of geophysical and chemical studies have been carried out within the hall. The research based on geophysical techniques have used electrical resistivity and magnetic distortions to detect possible sub-structures, caches and drainages.

The chemical analysis of the floors has been the main focus of our research efforts. Based on a 24 x 22 meter grid, we extracted approximately 500 core samples from the plaster floor using a drill bit 2 cm. in diameter. Only the small areas which have been restored or repaired after excavation were excluded from the sampling process.

Once in the laboratory, each sample was subject to a simple series of tests such as Munsell color, phosphates, carbonates and pH. The results of these analysis displayed notable differences and concentrations in certain areas, which motivated us to apply a further series of tests to determine the proportion of total carbonates, organic residues such as albumen, carbohydrates and fatty acids, as well as the presence of iron in certain areas in order to supplement the investigation.

It is important to mention that up until now most of the chemical research into activity areas within archaeological sites has been oriented towards domestic dwellings. The interpretations in these cases have been based upon ethnographic analogies and ethnoarchaeological experiments, in which the areas of food storage, preparation and consumption, as well as areas of high traffic were determined [6,7]. Previous studies associated with ritual activities have analyzed a mexica altar or *momoztli* in the center of Mexico City [8], a Mayan structure called Satunsat in Oxkintok, Yucatán [9], and a domestic shrine in Oztoyalualco, Teotihuacan [10].

We propose that via a detailed investigation which integrates diverse fields of study such as archaeology, chemistry, historical philology, and iconography it is possible to identify the the kinds of ritual activities which took place within the Hall of the Eagle Warriors.

Ritual ceremonies are considered here as individual or group acts of symbolic nature, which are repeated according to a set of rules. The same ritual ceremony may present prayers, orations, taboos, games, immolations, sacrifices, magic, or mythical representations [11].

The contaminating liquids (blood, sweat, foodstuffs, etc.) which were repeatedly distributed on the floors during the ritual, allows us to chemically identify the areas where the act took place and characterize the perishable materials that were utilized.

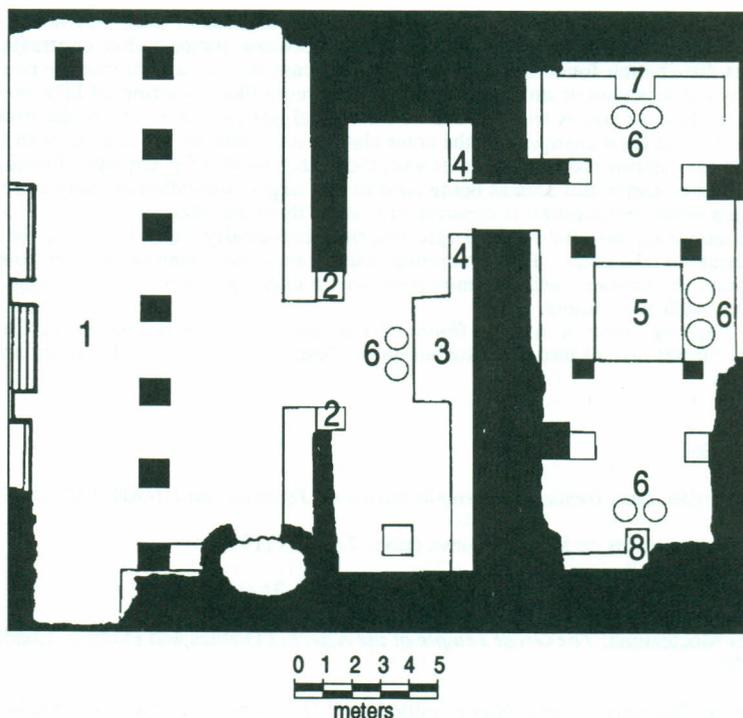


Figure 2. Localization of main elements within the Hall of the Eagle Warriors.
1. portico, 2. figures of eagle warriors, 3. main altar, 4. figures of *Mictlantecuhli*,
5. interior patio, 6. braziers, 7. north altar, 8. south altar.

RESULTS

According to Leach [12], there are three spatial components in any ritual scene: the first being the sacred area in itself. Normally there is some sort of symbolic icon which indicates the materialization of the sacred. The second area is adjacent to the first, and is where most of the ritual takes place. Access to the first and second areas is reserved for the priests and religious servants. Finally we find the faithful in a third area, which is separated in turn from the sacred area by the sector of ritual activity.

Both the first and second areas can be identified in the Hall of the Eagle Warriors: the first is represented by a series of iconographic elements, such as the *zacatapayolli*, placed on the altars and physically located in the interior or most hidden areas of the hall. The second type of area, where most of the rituals took place, were located in the central and back parts of the hall and can be distinguished by the presence of a series of elements such as braziers and offerings.

The highest levels of chemical indicators were found in the ritual areas around the braziers and representations of *zacatapayolli*. This element of ceremonial importance is depicted

as a straw ball bristling with various types instruments used in self-mortification and blood letting (agave thorns, bone needles, mantaray spines, etc.).

The floor around the braziers was high in pH and fatty acids. The first can be attributed to the ashes resulting from combustion, and the second due to the ceremonial burning of wood and resins.

Phosphates were concentrated around the immediate areas of ritual action in the interior of the building, and diminished in concentration between sectors; this contrasts with the homogenous distribution found in the portico. In this case we can affirm that the ritual act was conducted by a sole person or small group of priests or more likely warriors of high merit.

The analysis of colors and carbonates clearly defines two areas where the proportion of lime and sand in the floor changes and the color also varies. Here we are dealing with the portico in contrast to the interior rooms. Together with the higher levels of phosphates found across the portico, we can conceive this area as being subject to a larger population of users and more wear and tear. This same deterioration is apparent in front of the main altar.

In conclusion, the Hall of the Eagle Warriors chemically exhibits two of the three key areas for a ritual to take place. The ceremonial activity areas that stand out are: in front of altars, directly around the braziers, and the entryways where clay figures representing eagle warriors and *Mictlantecuhli* were found.

The ongoing research into the floors of Tula and the future possibility of Chichén Itzá will provide further insight into the distribution of chemical indicators and activity areas within ritual contexts.

REFERENCES

1. L. López Luján, *Las ofrendas del Templo Mayor de Tenochtitlan* (INAH, México, 1993).
2. B. de la Fuente, *Artes de México, nueva época* 7, 36-53 (1990).
3. R. Bonifaz Nuño, *Artes de México, nueva época* 7, 26-35 (1990).
4. E. Matos Moctezuma, *The Great Temple of the Aztecs*, (Thames and Hudson, London, 1988), pp. 19-20.
5. C. Klein, in *The Aztec Temple Mayor*, edited by E.H. Boone, (Dumbarton Oaks, Washington, D.C., 1987), pp. 293-370.
6. L. Barba, in *Unidades habitacionales mesoamericanas y sus áreas de actividad*, edited by L. Manzanilla (UNAM, México, 1986), pp.21-39.
7. L. Barba and A. Ortiz, *Latin American Antiquity*, 3 (1), 63-82 (1992).
8. F. Getino and A. Ortiz, *Imagen* 6, (5) p. 60. (1988).
9. A. Ortiz and L. Barba, *Oxkintok* 4, (Misión Arqueológica de España en México, Madrid, 1992), pp. 119-126.
10. A. Ortiz and L. Barba, in *Anatomía de un Conjunto residencial teotihuacano en Oztoyalhuaco*, Vol. II, Coordinated by L. Manzanilla (Instituto de Investigaciones Antropológicas-UNAM, México, 1993) pp. 617-660.
11. J. Cazeneuve, *Sociología del rito*, (Amorrortu, Buenos Aires, 1972).
12. E. Leach, *Cultura y comunicación. La lógica de la conexión de los símbolos, una introducción al uso del análisis estructuralista en la antropología social*, (Siglo. XXI, Madrid, 1978).

Materials Issues in Art and Archaeology IV

Symposium held May 16-21, 1994, Cancun, Mexico

EDITORS:

Pamela B. Vandiver

Smithsonian Institution
Washington, D.C., U.S.A.

James R. Druzik

The Getty Conservation Institute
Marina del Rey, California, U.S.A.

Jose Luis Galvan Madrid

Escuela Nacional de Conservacion
Restauracion y Museografia
Mexico, D.F.

Ian C. Freestone

The British Museum
London, United Kingdom

George Segan Wheeler

Metropolitan Museum of Art
New York, New York, U.S.A.



MATERIALS RESEARCH SOCIETY
Pittsburgh, Pennsylvania

Single article reprints from this publication are available through
University Microfilms Inc., 300 North Zeeb Road, Ann Arbor, Michigan 48106

CODEN: MRSPDH

Copyright 1995 by Materials Research Society.
All rights reserved.

This book has been registered with Copyright Clearance Center, Inc. For further
information, please contact the Copyright Clearance Center, Salem, Massachusetts.

Published by:

Materials Research Society
9800 McKnight Road
Pittsburgh, Pennsylvania 15237
Telephone (412) 367-3003
Fax (412) 367-4373

Library of Congress Cataloging in Publication Data

Materials issues in art and archaeology IV : symposium held May 16-21, 1994, Cancun,
Mexico / editors, Pamela B. Vandiver, James R. Druzik, Jose Luis Galvan Madrid,
Ian C. Freestone, and George Segan Wheeler
p. cm.—(Materials Research Society symposium proceedings, ISSN 0272-9172;
v. 352)

Includes bibliographical references and index.
ISBN 1-55899-252-9

1. Antiquities—Collection and preservation—Congresses. 2. Art objects—Collection
and preservation—Congresses. 3. Cultural property, Protection of—Congresses.
I. Vandiver, Pamela B. II. Druzik, James R. III. Galvan Madrid, Jose Luis
IV. Freestone, Ian C. V. Wheeler, George Segan VI. Series: Materials Research
Society symposium proceedings; v. 352

91-657699
CIP

Manufactured in the United States of America

Contents

PREFACE	xiii
INTRODUCTION Pamela B. Vandiver	xvii
MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS	xxxi

PART I: MODELS AND STRATEGIES FOR THE FUTURE

*HIGH RESOLUTION ELECTRON MICROSCOPY OF MAYA BLUE PAINT M. José-Yacamán and M. Carmen Serra Puche	3
*VICEREGAL ARCHITECTURE: MATERIALS, RECONSTRUCTION, AND ENVIRONMENT Juan B. Artigas	13
*THE CONTRIBUTION OF MATERIALS SCIENCE TO MATERIAL CULTURE STUDIES W. David Kingery	21
ECO-ARCHAOMETRY AND CONSERVATION G. Burns and A.N. Bond	31
*ARCHAEOLOGICAL ARTIFACT AND BIOMOLECULE AFFILIATION: TESTING THE CONSEQUENCES OF CLEANING Noreen Tuross	41
*A MULTIDISCIPLINARY APPROACH FOR THE STUDY OF THE DETERIORATION OF THE JUAN O'GORMAN'S MOSAIC MURALS COVERING THE CENTRAL LIBRARY BUILDING OF THE UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO (UNAM), IN MEXICO CITY Mercedes Gomez-Urquiza de la Macorra, Luis Torres Montes, Manuel Reyes Garcia, Jose Luis Galvan Madrid, Joan Genesca Llongueras, and Tezozomoc Perez	51
PRESERVATION RESPONSIBILITIES: MATERIAL CARE AND MATERIALS SCIENCE FOR PAPER-BASED RESEARCH COLLECTIONS Dianne van der Reyden	63

PART II: NEW METHODS AND APPLICATIONS OF MATERIALS SCIENCE IN ART AND ARCHAEOLOGY

*X-RAY MICROTOMOGRAPHY OF CERAMIC ARTIFACTS J.H. Dunsmuir, P.B. Vandiver, R.R. Chianelli, H.W. Deckman, and J.H. Hardenbergh	73
*INTERPRETING LIPID RESIDUES IN ARCHAEOLOGICAL CERAMICS: PRELIMINARY RESULTS FROM LABORATORY SIMULATIONS OF VESSEL USE AND BURIAL Richard P. Evershed, Stephanie Charters, and Anita Quye	85
*INFRARED MICROSCOPY MAPPING TECHNIQUES FOR THE ANALYSIS OF CROSS SECTIONS AND AS A NON-DESTRUCTIVE ANALYSIS METHOD FOR PAINT ON A MANUSCRIPT Michele R. Derrick	97

*Invited Paper

AN ASSESSMENT OF MINOAN SLIPS FROM PSEIRA, CRETE, USING SCANNING ELECTRON MICROSCOPY	663
Cheryl R. Floyd	
EAST CRETAN MIDDLE MINOAN AND LATE MINOAN I DARK SLIPS: PIXE CHARACTERIZATION STUDIES	673
Charles P. Swann, Philip P. Betancourt, and Cheryl R. Floyd	
TECHNICAL INVESTIGATION OF AN HISPANO-MORESQUE LUSTERED DEEP DISH IN THE WALTERS ART GALLERY	681
J.M. Baker	
CERAMIC TECHNOLOGY AT THE CROSSROADS	687
Pamela B. Vandiver and Valerie Chaussonnet	
STUDYING THE TECHNOLOGY OF RENAISSANCE BRONZES	701
Francesca G. Bewer	
PAPER INVESTIGATIONS OF MAYA AND AZTEC CULTURES	711
Hans G. Wiedemann	
STUCCOED FLOORS: A RESOURCE FOR THE STUDY OF RITUAL ACTIVITIES. THE CASE OF TEMPLO MAYOR, MÉXICO	723
Agustín Ortiz, L. Barba, L. López Luján, and K.F. Link	
MEDIEVAL PIGMENT AND PLASTER TECHNOLOGY IN THE XII-XIII CENTURY MURAL PAINTINGS AT DAVID-GAREDDJI, GEORGIA	727
Marie B. Dneprovskaya	
MECHANICAL CHARACTERISTICS OF SOME VOLCANIC TUFFS USED IN THE BUILDINGS OF ANCIENT ROME	733
G. Sappa, G. Giglio, and G. De Casa	
ENVIRONMENTAL MONITORING AND DAMAGE ASSESSMENT AT THE ANCIENT SANCTUARY OF DEMETER IN ELEUSIS, GREECE	745
Antonia I. Moropoulou and K.G. Bisbikou	
RESTORATION SYNTHESIS OF CRUSHED BRICK MORTARS SIMULATING BYZANTINE LIME AND MATERIAL TECHNOLOGIES IN CRETE	759
A. Moropoulou, A. Theodoraki, K. Bisbikou, and M. Michailidis	
CHEMICO-PHYSICAL INTERACTIONS AMONG THE CONSTITUENTS OF HISTORICAL WALLS IN VENICE	771
A. Bakolas, R. Bertonecello, G. Biscontin, A. Glisenti, A. Moropoulou, E. Tondello, and E. Zendri	
STUDY OF PRE-HISPANIC METALLIC OBJECTS FOUND IN CUBA	779
Alberto A. Tagle	

**PART XII: PRESERVATION STRATEGIES AND THE TESTING
AND MONITORING OF CONSERVATION TREATMENTS**

*REBURIAL OF THE RED BAY WRECK AS A FORM OF PRESERVATION AND PROTECTION OF THE HISTORIC RESOURCE	791
John Stewart, Lorne D. Murdock, and Peter Waddell	
*THE EFFECTS OF SOLVENT QUALITY ON SOME PROPERTIES OF THERMOPLASTIC AMORPHOUS POLYMERS USED IN CONSERVATION	807
Eric F. Hansen	

*Invited Paper

Preface

This symposium, Materials Issues in Art and Archaeology, is the fourth in a series in which the goal is to present "cutting edge," multidisciplinary work on: (1) the characterization of ancient materials; (2) the technologies of selection, production and usage by which materials are transformed into the objects and artifacts we find today; (3) the science underlying their deterioration, preservation and conservation; and (4) sociocultural interpretation derived from an empirical methodology of observation, measurement and experimentation. Unlike the three previous symposia, this meeting was organized as a collaboration of the Materials Research Society (MRS) in the U.S.A. and the recently established Materials Research Society of Mexico. A special focus was placed on problems common to North America.

Our call for papers read: "This symposium will provide a multidisciplinary forum on scientific and technological issues in art, archaeology and conservation. Of particular interest will be papers which explore the interface and overlap between traditional materials science, the history of technology and the archaeological and conservation sciences. Special, but not exclusive, attention will be given to common concerns in North America—Mexico, Canada and the United States. Some areas of interest for the meeting are the following:

ANCIENT AND HISTORICAL MATERIALS TECHNOLOGIES:

- Processes of Craft Transmission and Technology Transfer
- Analysis of Production Sites, Events, Tools and Techniques
- Compositional, Structural and Other Technical Studies of Artifacts
- Reconstruction of Architectural Building Methods
- Field Identification of Materials and Permanent Labeling of Artifacts

CONSERVATION AND PRESERVATION SCIENCE:

- Environmental and Structural Monitoring, Control and Stabilization
- Modeling and Testing of Materials and Objects of Art, Archaeology and Architecture, including Related Conservation Materials
- Deterioration and Treatment of Materials of Art, Archaeology and Architecture."

Unlike previous symposia that were integrated into MRS spring or fall meetings, this one was separate. In order to facilitate this meeting, the cooperation and support of many individuals and institutions was realized. Seven cultural and scientific organizations are thanked and acknowledged for their co-sponsorship and promotion of this meeting. Particularly, we thank our sponsors: Dr. Miguel Jose Yacaman, Consejo Nacional de Ciencia y Tecnologia (CONACYT); Dr. David Rios Jara, Academia Mexicana de Ciencia de Materiales; Lic. Teresa Franco y Gonzales Salas, Instituto Nacional de Antropologia e Historia; Dr. Jose Luis Galvan Madrid, Escuela Nacional de Conservacion, Restauracion y Museografia; Dr. Russell Chianelli, Materials Research Society; Dr. Lambertus Van Zelst, Conservation Analytical Laboratory, Smithsonian Institution; and Dr. Michel Angel Corzo, The Getty Conservation Institute. Special thanks are given to Dr. David Grattan of the Canadian Conservation Institute for his organization of the Canadian contributions to the program.

We wish to thank the coverers of the sessions for their contributions, especially Ian Freestone of the British Museum, Department of Scientific Research; Prof. David Kingery of the Department of Materials Science, University of Arizona; Drs. Charles Tumosa and Noreen Tuross of the Conservation Analytical Laboratory, Smithsonian Institution; Prof. Victor Castano of the Instituto de Fisica, Universidad Nacional Autonoma de Mexico

(UNAM); Dr. Jose Luis Galvan Madrid, now of the Environmental Sciences Center, UNAM, and formerly head of the Escuela Nacional de Conservacion, Restauracion y Museografia; Prof. John Merkel, Institute of Archaeology, University of London; Diana Magaloni, Instituto de Investigaciones Esteticas, UNAM; Dr. Pamela Vandiver, Conservation Analytical Laboratory, Smithsonian Institution; Dr. David Rios, Academia Mexicana de Ciencia de Materiales; Mercedes Gomez-Urquiza de la Macorra, newly appointed director, and Hayde Orea of the Escuela Nacional de Conservacion, Restauracion y Museografia; and Dr. Russell Chianelli, Exxon Research and Engineering and councillor and representative of the Materials Research Society.

Special thanks are due the academic and support committees. We thank the members of the academic committee who insured both high quality and great diversity of scholarly pursuit presented at the meeting; Dr. Juan Benito Artigas, Facultad de Arquitectura, UNAM; Dr. Victor Castano Meneses, Facultad de Fisica, UNAM; Lic. Luciano Cedillo, Coordinacion Nacional de Restauracion del Patrimonio Cultural, INAH; Dr. Salvador Diaz-Berrio Fernandez, Escuela Nacional de Conservacion, Restauracion y Museografica, INAH; Ing. Francisco Fernandez Noriega, ENCRYM; Dr. Helio Flores Ramirez, Facultad de Quimica, UNAM; Arqijo Eduardo Matos Moctezuma, Museo del Templo Mayor, INAH; M. en A. Luis Nishisawa Flores, Escuela Nacional de Artes Plasticas, UNAM; M. en A. Jose de Santiago Silva, Escuela Nacional de Artes Plasticas, UNAM; and Dr. Mari Carmen Serra Puche, Museo Nacional de Antropologia, INAH. Without diligence and sticktuitiveness of a particularly outstanding support committee, the meeting would not have convened. We thank the coordinators, Sonia Gutierrez Salinas and Edgar Anaya Rodrigues of ENCRYM, and Patricia Thirion for arranging board, lodging and field trips. These three people are thanked not only by the organizers but by the attendees. We also thank Martha Isabel Hernandez for secretarial services, Margarita Montano for photographic services, and Miguel Angel Pages Lagunes and Luis Amaro for arranging and maintaining the audio-visual equipment. Nine enthusiastic students from the ENCRYM are gratefully thanked for their outstanding service as aide-de-camps: Mercedes Aguado, Carmen Dolores Chami, Cynthia De la Paz, Adriana Gallegos, Veronica Lozano, Liliana Olvera, Sandra Ortega, Maria de los Angeles Rodriguez and Lucrecia Velez. Lastly, we thank the staff of the Westin Regina Hotel in Cancun for their exceptional kindness and support of our activities.

As with previous symposia, each of the papers was reviewed by three peers, some by more, according to criteria for originality, significance, technical validity and conciseness. We wish to thank the many unnamed reviewers who gave their time, energy and expertise to ensure the quality of this manuscript. Especially we acknowledge the assistance of members of each of our several labs who served as critics and reviewers. Comments were sent to the main author or authors. In several cases, the revised manuscripts were not received prior to press time, and Vandiver made decisions as to whether the scholarly merit of contributions warranted publication in spite of technical errors. Several of the papers were first-time student efforts, including one that was revised four times. Unfortunately, only a few of these papers are included in this volume.

At the meeting a contest was held with monetary awards for the best student papers. Four categories were recognized—oral and poster presentations for Mexican predoctoral students, and for non-Mexican students. Linda Bedal and Hayde Orea were the winners of the oral presentation categories, and Sonya Cruz and Javier Vazquez were the winners of the poster category. None of the non-Mexican students presenting a poster were present. We commend the excellent quality of all the student work, as well as their contributions of intense energy and perceptive questions. Student papers are authored by L. Bedal, G. Clancey, G. Cruz, S. Cruz, S. Gutierrez, P. McCray, E. Marcus, M. Neupert, H. Orea, M. Picollo and M. Taube, J. Vázquez, R. Velasquez and M. Villegas.

Finally, we welcome the participation of each of you who reads this book, or part of it, in planning and attending the next conference, which will be held in Boston on December 2-6, 1996. Most especially, we welcome people who are interested in organizing a session which would focus on a timely topic of significance for our interdisciplinary, multidisciplinary and developing field.

Pamela B. Vandiver
James R. Druzik
Jose Luis Galvan Madrid
Ian C. Freestone
George S. Wheeler

October 1994