

---

# Before the Volcano Erupted

THE ANCIENT CERÉN VILLAGE IN CENTRAL AMERICA

---

Edited by Payson Sheets

CHAPTER 18

---

## *The Conservation Program at Cerén*

Harriet F. Beaubien



UNIVERSITY OF TEXAS PRESS  
AUSTIN

---

COPYRIGHT © 2002 BY THE UNIVERSITY OF TEXAS PRESS

All rights reserved

Printed in the United States of America

First edition, 2002

Requests for permission to reproduce material from this work should be sent to Permissions, University of Texas Press, P.O. Box 7819, Austin, TX 78713-7819.

© The paper used in this book meets the minimum requirements of ANSI/NISO Z39.48-1992 (R1997) (Permanence of Paper).

---

LIBRARY OF CONGRESS CATALOGING-IN-PUBLICATION  
Before the volcano erupted : the ancient Cerén village  
in Central America / edited by Payson Sheets. — 1st ed.  
p. cm.

Includes bibliographical references and index.

ISBN 0-292-77761-2 (hardcover : alk. paper)

1. Ceren Site (El Salvador) 2. Mayas—Antiquities.  
3. Mayas—Urban residence—El Salvador—Zapotitán  
Valley. 4. Volcanic ash, tuff, etc.—El Salvador—  
Zapotitán Valley. 5. Social archaeology—El Salvador  
—Zapotitán Valley. 6. Plant remains (Archaeology)—  
El Salvador—Zapotitán Valley. 7. Animal remains  
(Archaeology)—El Salvador—Zapotitán Valley.  
8. Zapotitán Valley (El Salvador)—Antiquities.

I. Sheets, Payson D.

FI435.I.C39 B43 2002

972.84'22—dc21

2002003611

---

## Contents

---

- Preface ix  
*Payson Sheets*
1. Introduction 1  
*Payson Sheets,*  
*with an Appendix by Brian R. McKee*
- PART I. Multidisciplinary Research 9
2. Volcanology, Stratigraphy, and Effects on Structures 11  
*C. Dan Miller*
3. Geophysical Exploration at Cerén 24  
*Lawrence B. Conyers and Hartmut Spetzler*
4. Cerén Plant Resources: Abundance and Diversity 33  
*David L. Lentz and Carlos R. Ramírez-Sosa*
- PART II. Household Archaeology 43
5. Ancient Home and Garden: The View from Household 1 at Cerén 45  
*Marilyn Beaudry-Corbett, Scott E. Simmons,*  
*and David B. Tucker*
6. Household 2 at Cerén: The Remains of an Agrarian and Craft-Oriented Corporate Group 58  
*Brian R. McKee*
7. Structure 16: The Kitchen of Household 3 72  
*Inga Calvin*
8. Structure 4: A Storehouse-Workshop for Household 4 74  
*Andrea I. Gerstle and Payson Sheets*
- PART III. Special Buildings 81
9. The Civic Complex 83  
*Andrea I. Gerstle*
10. Structure 9: A Precolumbian Sweat Bath at Cerén 89  
*Brian R. McKee*
11. Structure 10: Feasting and Village Festivals 97  
*Linda A. Brown and Andrea I. Gerstle*
12. Divination at Cerén: The Evidence from Structure 12 104  
*Scott E. Simmons and Payson Sheets*
- PART IV. Artifacts 115
13. Ceramics and Their Use at Cerén 117  
*Marilyn Beaudry-Corbett,*  
*with contributions by Ronald L. Bishop*
14. The Chipped Stone Artifacts of Cerén 139  
*Payson Sheets*
15. Groundstone Artifacts in the Cerén Village 145  
*Payson Sheets*
16. Household and Community Animal Use at Cerén 151  
*Linda A. Brown*

- 
17. Artifacts Made from Plant Materials 159  
*Harriet F. Beaubien and  
Marilyn Beaudry-Corbett*
- PART V. Topics and Issues of Cerén  
Research 167
18. The Conservation Program at Cerén 169  
*Harriet F. Beaubien*
19. Household Production and Specialization  
at Cerén 178  
*Payson Sheets and Scott E. Simmons*
20. Cultivating Biodiversity: Milpas, Gardens,  
and the Classic Period Landscape 184  
*Payson Sheets and Michelle Woodward*
21. Continuity and Change in the Contemporary  
Community of Joya de Cerén 192  
*Carlos Benjamín Lara M. and Sarah B. Barber*
22. Summary and Conclusions 197  
*Payson Sheets*
- Glossary 207  
References 209  
Index 221

## *The Conservation Program at Cerén*

Harriet F. Beaubien

---

### ***Introduction***

Conservation's primary purpose is the preservation of materials of cultural and natural value, so that they are available for future study and enjoyment. At Cerén, the particular circumstances of burial have enabled an unusually complete body of material evidence to survive, providing an exceptional resource for research and ultimately for public edification. Yet many of the materials—e.g., the earthen architecture and items of organic origin—are inherently vulnerable, and neither fare well over the short term in tropical conditions nor survive long-term burial without significant deterioration. Ash inundation conferred some protection in this case, but their exposure by excavation puts these materials once again at risk. As a result, conservation has been of necessity an integral part of the archaeological process at Cerén since the inception of the project.

### ***Development of the Project's Conservation Infrastructure***

#### **SALVADORAN PARTNERSHIP**

The development of full Salvadoran partnership in site development decisions was considered of critical importance for the successful realization of preservation goals. From the public sector, key participation has come from the Consejo Nacional para la Cultura y el Arte (CONCULTURA) of the Patrimonio Cultural, and from the Museo Nacional David J. Guzmán (MNDG); from the Patrimonio Natural and the Jardín Botánico La Laguna (JBL); as

well as from the Ministerio de Educación, the sponsoring agency. From the private sector, the Patronato Pro-Patrimonio Cultural, a nongovernmental organization, has provided unprecedented leadership—visionary, practical, and financial.

#### **PROFESSIONAL CONSULTATION**

Assistance initially sought in 1989 from the author (regarding conservation of a fragile object once thought to be a codex and subsequently identified as a painted gourd) developed into a full-fledged collaboration with the Smithsonian Center for Materials Research and Education (SCMRE) (formerly Conservation Analytical Laboratory [CAL]). This resulted in the establishment and staffing of a field conservation laboratory and formation of an advisory committee. Naturally, the site's spectacular earthen architecture drew the attention of specialists, from the Getty Conservation Institute (GCI) in March 1990, and from the site of Chan Chan, Peru, during the 1990–1991 season (Del Mar and Benites 1991). Members of the advisory committee, representing SCMRE, the National Park Service, and the World Monuments Fund, visited the site in January 1992. Their report (Charola et al. 1992) took a holistic approach to the site's conservation issues and offered specific recommendations that have formed the basis for actions taken by the project in subsequent years. The architectural and regional planning issues were at the core of a multi-year contract signed in 1998 between the GCI and CONCULTURA.

#### LABORATORY FACILITIES AND STAFFING

A basic laboratory and storage structure was built at the site in 1990. Since then, the lab has been staffed by conservators each season through an advanced internship program at SCMRE specializing in archaeological conservation. Additional work has been carried out in collaboration with restoration workshop staff at the MNDG in San Salvador. At the site, a skilled Salvadoran team, hired on a permanent basis by the Patrimonio Cultural, cares for the architectural monuments year-round.

#### CONSERVATION TRAINING

Conservation awareness and a strong experience base among team members have been built through daily collaboration with lab staff as well as through more structured training activities, including demonstrations in practical techniques such as block lifting and ceramics reconstruction. More extensive hands-on training has been offered to MNDG personnel, including staff members and volunteers from the restoration workshop. In the fall of 1993, the architectural team benefited from an on-site training course funded by the United States Information Agency (USIA), which examined the interaction between the adobe construction materials and climate conditions in the interest of preservation planning (Charola 1993).

#### FUNDING FOR CONSERVATION

Direct grant funding for conservation has come from the Samuel H. Kress Foundation, the Smithsonian Institution's Office of Sponsored Projects, USIA, and the Getty Conservation Institute, in addition to local funding and contributions-in-kind from the Patronato and CONCULTURA. Project overhead support for the conservation program has come primarily from the National Science Foundation and from team members' institutions.

#### *Conservation Components and Goals*

Cerén's program of conservation consists of a number of integrated activities which further the long-term preservation of the site and its contents. These fit within a general framework of conservation professional practice (AIC 1994), outlined below.

#### CONDITION ASSESSMENT AND RELATED TECHNICAL STUDIES

Careful examination, supported by technical investigation, is carried out in order to gain a better understanding of a particular material and to assess its current state. This forms the basis for devising an appropriate course of action.

#### CONSERVATION ACTIONS

Conservation actions are undertaken first and foremost to prolong the useful life of the material in question, interfering as little as possible with its material nature, appearance, and evidence of past use. Excavation in particular may pose immediate risks of damage or loss, or set changes in motion, given materials that are already compromised by use, age, and long-term burial, and that are exposed to new ambient conditions. As a result, the need for conservation action may begin at the time of exposure; other conservation actions may be necessary at subsequent times.

**Interventive Measures for Stabilization** When the physical integrity of artifacts or architecture is at risk, it may be necessary to introduce new materials in order to strengthen the original (with consolidants), to reconstruct (with adhesives), or compensate for losses (with fills). These conservation actions, whose purpose is to improve the physical stability of the material or to aid in its comprehensibility, are considered interventive. Wherever possible, materials of known stability, compatibility, and reversibility are used. In an archaeological setting, when much depends on the original's potential research value, a minimalist approach is favored. For display purposes, however, more extensive restoration is often carried out in order to improve the aesthetic effect of the material.

#### **Noninterventive Measures for Stabilization**

Whether intended for public access or research, original materials are best protected by limiting direct contact and exposure to damaging environments. Those measures which address the material's immediate surroundings are increasingly recognized as the most effective as well as cost-efficient in enhancing long-term preservation, promoted as preventive conservation. For immovable features such as architecture, these include physical protection and environmental regulation; for movable materials, the issues of handling, packing, and transport are additionally of concern. Materials and

techniques must be selected carefully, as poor choices, such as unstable housing materials, may eventually force the need for interventive conservation measures.

**Replication** Replication is an effective conservation measure when it is undertaken to limit the handling or exposure of the original material, particularly if its potential use is heavy and when a replica (or similar object) would serve for study or didactic purposes. Consideration must be given to the potential for damage to the original by some replication processes.

#### DOCUMENTATION

Documentation generally includes written and illustrative information about the original material's nature and condition, conservation interventions, and any materials introduced. These records aid conservators by providing a basis for monitoring change and evaluating treatment. This information may take on critical importance to researchers in interpretation and future scientific analysis, as well as in the event of loss. As such, the documentation itself becomes an invaluable part of the history of the original material.

#### *Artifact Conservation*

At Cerén, all materials lifted from the site, identified as field specimens (FS), are processed through the field laboratory. Analytical goals, general conservation procedures, and individual interventions are routinely discussed by the archaeological and conservation staff. In general, artifacts receive basic cleaning as appropriate, are labeled, and are given some form of protective housing. Those toward which more extensive conservation attention is directed include artifacts whose particular fragility necessitates treatment in order for them to be successfully lifted, stabilized, and studied, and artifacts composed of numerous components whose reassembly requires some skill.

#### CONDITION

Stone, ceramics, and bone generally survive in good condition at Cerén, although affected by the circumstances of their deposition. Ceramics are frequently shattered, having fallen from elevated storage or been crushed by overburden. Many also show some stress-cracking or -springing, related to sudden exposure to heat and the release of fabrication

stresses. Shell (composed largely of calcium carbonate) and mineral-based paint materials tend to be powdery and fragile as a result of long-term moist burial.

The complete disintegration of organic materials is not unexpected under these conditions. Those which survive directly are most often carbonized. These retain their morphology but are in exceedingly fragile and friable condition. Surprisingly, some uncharred fibrous materials resist complete decay, notably thatch and some basketry, although these too are severely weakened and embrittled.

To understand more fully the nature of some of these materials, technical analyses have been carried out, such as neutron activation analysis (NAA) of ceramic paste (see Chapter 13) and characterization of paints and pigment materials. Results of analyses carried out to date are reported in Table 18.1.

#### CONSERVATION ACTIONS

**Interventive Measures for Recovery and Stabilization** *Fragile Artifacts.* A number of artifacts required in situ interventions in order to permit excavation, including consolidation and the use of subsidiary supports during lifting. A notable group of these are the remains of painted gourds, indicated only by their paint layers. Eight relatively complete forms were recovered, one of which was brought to SCMRE for analysis and treatment during the 1989 season and returned in 1992 (Beaubien 1993); additional gourd segments and associated fragments were also found. Other objects whose conservation began in situ included a deer skull headdress and two baskets. Treatments continued in the lab with further consolidation, reassembly of pieces, and use of reinforcing supports (such as facings) where required. Also treated in the lab were a turtle carapace and plastron; worked and unworked shell; worked bone or antler items and a tooth pendant; carbonized organics, including a carved palm fruit endocarp and several pieces of twine; and uncarbonized fibrous items, including a ring support (yagual) and woven remains around the neck of a ceramic vessel. Paint traces on a variety of objects were consolidated, and four objects of stone were reconstructed. One in situ artifact, a built-in corn crib composed of fibrous matting and plant stem walls (casts), was sparingly consolidated and protected with a removable wooden hood. These activities were carried out by field conservators or by others under their direct supervision.

Materials commonly used to aid lifting include

TABLE 18.1. Technical Analyses of Cerén Samples, Carried Out at the Smithsonian Center for Materials Research and Education (SCMRE/CAL Reports)

<i>FS#/Location</i>	<i>Sample Description</i>	<i>Results [Technique]</i>
<b>A. Paints and pigment materials</b>		
<b>Artifacts</b>		
1-40	Pigment cylinder, red	Hematite + quartz [a]
1-41	Pigment cylinder, red	Hematite + quartz [a]
1-158	Pigment cylinder, red	Hematite + quartz [a]
1-275	Pigment cylinder, red	Hematite [a]
1-275	Pigment cylinder, micaceous	Muscovite [a]
2-329	Pigment cylinder, red	Hematite + quartz [a]
1-65	Pigment in pot, red	Hematite + quartz [a]
2-213	Pigment in pot, red	Cinnabar [a]
2-214	Pigment in pot, red	Cinnabar [a]
2-215	Pigment in pot, red	Cinnabar [a]
2-222	Pigment in pot, red	Cinnabar [a]
2-230	Pigment in pot, red	Cinnabar [a]
1-247	Paint on gourd, white ground	Kaolinite + opal/silica [a]
1-247	Paint on gourd, red	Ferropyrromaltite + hematite [a]
1-247	Paint on gourd, green/white	Palygorskite?, kaolinite, opal + other [a]
1-247	Paint on gourd, yellow	Goethite [a]
2-51	Paint on gourd, white ground	Kaolinite [a][c]; binder inconclusive [d][e]
2-51	Paint on gourd, red	Hematite + other [a]
2-51	Paint on gourd, red	Cinnabar + other [a][b][c]
2-51	Paint on gourd, yellow	Goethite + other [a][b][c]
2-51	Paint on gourd, green	Clay minerals/"green earth" + other [a][c]
2-527	Paint fragments, red/white	Cinnabar + kaolinite [a][c]
2-533	Paint on sherd, green/white	Green earth, illite, kaolinite [a][c]
2-579	Paint on sherd, pink/white	Kaolinite + other [a][c]
8-34	Paint on deer skull, red	Hematite + silica, illite, albite [a]
8-34	Paint on deer skull, white	Kaolinite + cristobalite [a]
<b>Architecture</b>		
Str. 10	Paint on door jamb, red	Hematite + quartz [a][c]
<b>B. Efflorescent Salts</b>		
Op. 1	Salts on Unit 14 tephra	Gypsum [a][c]
Str. 1	Salts on bench	Gypsum [a][c]
Str. 1	Salts on SE column	Gypsum [a][c]
Op. 2	Salts on Unit 14 tephra	Gypsum [a][c]
Str. 2	Salt on S wall tephra	Gypsum [a]
Str. 3	Salts on Unit 4 tephra	Gypsum [a][c]
Str. 3	Salts on E side platform	Gypsum [a][c]
Str. 7	Salt on SE corner wall	Gypsum [visual comparison][c]
Str. 12	Salts on W wall	Gypsum [a][c]



TABLE 18.1. Continued

FS#/Location	Sample Description	Results [Technique]
<b>C. Ash Composition</b>		
—	Tephra, Unit 1 ash	Plagioclase feldspar + pyroxene [a][c]
—	Tephra, Unit 2 ash	Plagioclase feldspar + pyroxene [a][c]
—	Tephra, Unit 3 ash	Plagioclase feldspar + pyroxene [a][c]
—	Tephra, Unit 4 ash	Plagioclase feldspar + pyroxene [a][c]
—	Tephra, Unit 5 ash	Plagioclase feldspar + pyroxene [a][c]
—	Tephra, Unit 6 ash	Plagioclase feldspar + pyroxene [a][c]
—	Tephra, Unit 7 ash	Plagioclase feldspar + pyroxene [a][c]
—	Tephra, Unit 8 ash	Plagioclase feldspar + pyroxene [a][c]
<b>D. Mucilage Composition</b>		
—	Mucilage evaporate	Inconclusive [d]

**Key to analytical techniques:**

[a] X-ray diffraction of powdered sample, using a Gandolfi camera with a Philips PW 1720 XRD unit.

[b] Polarized light microscopy of sample dispersed in Aroclor 5442, examined with a Leitz microscope.

[c] Scanning electron microscopy/energy dispersive x-ray analysis of carbon-coated sample mounted in cross-section, using a JEOL JXA-840A Electron Probe Microanalyzer and Tracor Northern SEM/EDX in backscatter mode.

[d] Fourier Transform Infrared Spectrophotometry, using a Mattson Cygnus 100 FTIR with a Spectratech IR-plan microscope.

[e] Ultraviolet fluorescence microscopy of sample in cross-section, examined with a Leitz Dialux illuminator.

plaster of paris, with barriers of aluminum foil or plastic wrap. Japanese tissue paper and spunbonded nylon tissue are used for facings and backings, and aqueous methylcellulose and acetone-soluble acrylic resins for adhesives and consolidants.

**Ceramics.** One figurine and more than fifty vessels were reconstructed by field conservators or MNDG personnel to enable formal and stylistic analyses to be carried out; additional pieces were preliminarily reconstructed by archaeological staff. This was done after the ceramic paste had been sampled for NAA, usually from break faces where drill marks would not be visible after reassembly.

During the initial season, the use of a water-based polyvinyl acetate emulsion adhesive was eliminated because of the glue's poor aging characteristics and eventual insolubility. It was replaced by an acetone-soluble acrylic resin adhesive (Rohm & Haas Acryloid series). This adhesive is strong, reversible in acetone, and has excellent long-term stability. Fills were made where missing pieces affected the vessel's physical stability or where NAA samples were taken from the base, using toned plaster of paris after original surfaces were isolated with a consolidant application. More extensive filling and inpainting was carried out by museum personnel on a number of ceramics selected for museum loan or display.

**Casts of Decomposed Organics.** Many organic artifacts or plants which decomposed in the course of burial "survive" as voids in the tephra. As they are encountered in the course of excavation, the hollows are investigated with a fiber-optic procto-

scope. The form of the artifact is then recovered by pouring a fine dental plaster (plaster of paris) into the cavity and removing the surrounding tephra (Murphy 1989). If left in situ, however, the casts are susceptible to breakage from animal tunnels undermining the supporting ash, and are unstable over the long term when exposed to groundwater. As a result, the casts are routinely removed for storage after careful documentation. The casting activities are primarily carried out by excavation personnel, with further cleaning, consolidation, or adhesion of parts taking place in the lab.

**Noninterventive Measures for Stabilization Housing and Storage.** A restricted storeroom at the MNDG is reserved for Cerén material, including plant casts which were initially housed at the Jardín Botánico La Laguna. Given ceramic and lithic dominance in the artifact inventory, the museum's lack of environmental controls has been less of a concern than physical protection and inventory control. Each season, as new materials are added to the stored collection, improvements are made in the organization of the storeroom's limited space and in housing. It should be noted, however, that a new museum with environmental controls is currently under construction, and by the time this book is published, Cerén materials will be maintained in a stable storage area.

Small finds are housed individually in transparent polyethylene self-closing bags or in fitted boxes with protective supports and padding. These are stored within modular lidded plastic containers,

organized by material type and by operation. Larger objects are housed in fabricated boxes; foam support props and padding are provided for these and for unboxed items such as reconstructed ceramics. Any deteriorating plastic bags, temporary cardboard boxes, and unstable padding materials are systematically replaced with archivally sound materials. Bags and boxes are clearly labeled on the outside with FS numbers using a permanent black marking pen. Finally, metal and wooden shelves are lined with thin polyethylene foam sheets where objects are in direct contact, and canvas strips are attached along the sides of open shelves to protect against earthquake movement.

*Display.* The thoughtfully designed site museum occupies a building whose primary environmental regulation is through two roof-mounted extraction fans. Although display decisions and installation occurred when no conservator was available for consultation about mounting, the selected artifacts are generally stable to ambient temperature and relative humidity levels and are exhibited in vitrines.

**Replication Activities** Because the plaster casts cannot be left safely in situ, tests are ongoing to find suitable synthetic materials and techniques to make replicas (from the casts or from plants which resemble the originals) that can be used for display.

#### DOCUMENTATION

Written conservation records are kept in hardbound notebooks, which are stored with all excavation documents in the project house library in Joya de Cerén; photocopies exist at SCMRE (SCMRE/CAL Reports). Photographs of treatments in progress are also taken as is necessary or desirable. Lab notebook references are inked onto tags or bags of treated objects, and computerized project inventories, maintained by FS number, are updated to include lab as well as other reference numbers such as sample or MNDG accession numbers. Detailed reports of laboratory activities are submitted to CON-CULTURA (in Spanish) and to project personnel and interested colleagues (in English), and an abridged version is included in the preliminary reports published by the project each season (Beaubien 1989, Beaubien 1990a, 1990b, Beaubien and Fenn 1992, Beaubien and Lundberg 1993, E. Kaplan and Beaubien 1996, Rosenthal and Beaubien 1996, Peschken 1997).

#### *Conservation of the Site and Its Architecture*

The conservation of earthen structures, surrounding gardens, and other occupation surfaces requires an integrated approach that addresses both the needs of the material and the implications of public access. The activities begin before exposure and continue with ongoing maintenance activities, primarily carried out by the year-round team (Murcia and Sheets 1993).

#### CONDITION

Earthen materials are susceptible to weathering on their surfaces (e.g., from rain and windblown debris), damages from the support of biological growth when damp, and physical changes related to moisture content, such as shrinkage cracking from wind- or sun-induced drying. Cerén's structures were additionally affected by the variously erosive and hot eruptive events; some areas show color alterations from differential oxidation of iron-bearing constituents, which apparently correlate with hardness changes in the surface. Burning as well as long-term burial significantly compromised the structural stability of the architecture by destroying key constituents made of organic materials.

To aid in condition and treatment assessment, climate data were collected over a period of 2 years of ambient conditions both at ground surface (from a weather station located between Operations 1 and 3) and in Structure 3, one of the excavated structures in a deep trench. Despite problems with the instruments, diurnal fluctuations of temperature and relative humidity measured in Structure 3 were half of that at the surface, demonstrating a buffering effect conferred by roofing and trench depth. Records from the first quarter of 1990 noted 750 seismic events, indicating continued risk to unstabilized structures. Under the Getty Conservation Institute/CONCULTURA contract, structures currently under protective roofs are being monitored over several years to evaluate environmental factors such as relative humidity, temperature, ultraviolet light, and air movement. These data will be used in designing future roofing.

Materials studies carried out thus far have included characterization of the adobe (Coffman et al. 1990), tephra (identified as a plagioclase feldspar), and architectural paints (identified as hematite, as well as TBJ) (see Table 18.1). Salts, not a severe problem but noted on several structures, are deposited through capillary rise and subsequent evaporation

of groundwater; these were sampled and identified as gypsum, or calcium sulfate.

#### CONSERVATION ACTIONS

##### **Interventive Measures for Structural Stabilization**

*Consolidation.* Stabilization of the earthen structures begins at the time of their exposure with the systematic application of a diluted extract from the escobilla plant (*Sida rhombifolia*) (Murcia and Sheets 1993). The solution is prepared by soaking the chopped plants in water for several hours to extract the sap, then filtering the soak water through a sieve and a fine cloth; a 2% solution of phenol is added as a biocide. Once the mucilage solution has fermented for at least 6 months, it is applied by pipette onto the exposed earthen surfaces until they are evenly and well saturated. The procedure is repeated daily until the adobe becomes very hard, and subsequently once a week or less often.

This consolidation procedure was initially developed for use at the site of Tazumal and modified for Cerén (Murcia 1991). Attempts during the initial season to consolidate using an aqueous acrylic dispersion manufactured by Rohm and Haas were soon abandoned, as it concentrated at the surface to create a plastic film with dubious consolidative effect. In September 1989, the film was mechanically removed from the structures, and these along with all subsequently excavated structures have been consolidated with the escobilla mucilage solution. Although its consolidative effect is not well understood, the regular application of the solution to the structures seems to have contributed significantly to their relatively sound condition.

*Structural Compensation.* The most fragile walls are those which were originally made by applying an earthen dab over an armature of *Tithonia rotundifolia* stems, termed bajareque locally and generally referred to as wattle and daub. Their rigidity was maintained by anchorage in the adobe platform and linkage to the roofing superstructure. Through carbonization or complete deterioration of the organic components and fracture along adobe joins, these walls have lost their structural integrity. They are stabilized by inserting new canes of slightly smaller diameter into the voids and securing them with a pastelike mixture of clay and the escobilla consolidant solution. The mixture is also used to fill cracks, to cap walls with vulnerable upper surfaces, and to secure replacement wooden beams that are sterilized before insertion. This treatment has the advantage of compatibility with the wall material

and physically prevents moisture or animal pests from entering the wall structure.

*Structural Support.* Other approaches to stabilization include the use of supports, such as wooden posts with foam padding, to prop up fragile walls, cornices, and earthen doorway lintels; in one instance (Structure 4), buttresses of volcanic rock and clay mortar have been used against a fragile dividing wall. Ash is also judiciously retained to support vulnerable elements, such as bajareque walls that detached during the eruption and splayed outward as an intact entity. Some of the ash deposits have been additionally strengthened with the mucilage solution or, in particularly loose airfall units, solidified with a pastelike application of clay, volcanic ash, and small stones.

##### **Noninterventive Measures for Structural Stabilization**

*Backfilling.* Since partial exposure of features puts them at risk through differential drying and erosion, backfilling is used as a temporary protection measure until full excavation can be carried out systematically. This approach was used first for Structure 6, exposed in 1989 and not systematically excavated until 1991. At the end of the 1989 season it was covered with black plastic and TBJ ash but not well roofed, which resulted in some biological growth from entrapped moisture. The backfilling method subsequently was modified with the substitution of geotextile and screened volcanic ash, and was successfully used for Structure 10 in 1991 and Structure 12 in 1992, each of which was excavated the season following backfilling. Similarly, the open areas of Operations 1, 2, and 4 have been covered with geotextile and a 5 cm layer of TBJ to protect these occupation surfaces from excavation-related foot traffic.

*Shelters.* The erection of adequate shelters against the weathering effects of rain, sun, and wind has been a priority since the first season. In 1989 the Patronato provided crucial help in obtaining large tarpaulins, protective roofing, and chain-link fencing, and the Ministry of Education donated twenty-four roofing modules with steel posts and beams. These were extremely useful as initial roofing, since the support posts penetrated only 1 m, leaving cultural material undisturbed; they could be situated with some flexibility for maximum effectiveness and, with side screening, provided effective shelter. They were gradually replaced by permanent aluminum roofs, which have been found to reflect heat better. Four large roof units were donated by then First Lady Margarita de Cristiani and erected

in 1993 over Operations 1, 3, 5, and 8. They are positioned with utmost care, as their posts are set in concrete down to bedrock, 2–5 m below the occupation surface.

*Drainage.* Because of the heavy rainfall during each year's rainy season and natural runoff collection in the deep trenches, control of water flow is integrated into site planning. Roofs are pitched to funnel runoff through gutters, and the ground surface is graded to direct flow away from the trenches and vulnerable surfaces. These feed into ditches which drain into the Río Sucio.

*Air Circulation.* Maintaining a stable microclimate is achieved in part by appropriate trench size. Control of airflow around the structures minimizes damage caused by either overly fast drying or the retention of excessive moisture. Experience has shown that at least 2 m cleared away from walls reduces excessive dampness. Side curtains of geotextile, canvas, and plastic are also used to control drying and additionally provide some protection from wind erosion.

*Biological Control.* While excavation during the rainy season slows the drying rate to some advantage, the climate is conducive to fern and moss growth, particularly in the deep trenches; this is moderated by good air circulation. Parachutes are hung over two structures as protection from bird and bat droppings, but animals and destructive insects are naturally difficult to exclude. Fragile materials, including plant casts, are removed from the site, and nest building is controlled by routine maintenance.

**Site Management for Public Use** Plans for public access to the site were developed by project archaeologist Andrea Gerstle in conjunction with the Patronato and CONCULTURA (Gerstle 1992b). With additional Fulbright funding, retrofitting of existing buildings and new construction were carried out from 1992 to 1993, and in June 1993 the archaeological park was opened to the public. It continues to be maintained by the Patronato. The public entry from the paved San Juan Opico road is marked by several signs and opens onto a parking area, picnic ground, and visitor facility that includes a refreshment stand, rest rooms, and park offices.

The site museum, occupying a remodeled agricultural storage building, introduces visitors to the history of the site, its excavation, and its conservation through color photographs, artists' renderings, and wall text; vitrines with a comprehensive

sample of the artifacts yielded by the site; and a re-created kitchen structure. A model of Structure 3 is located just outside the museum, replicating its adobe construction and thatch roofing and surrounded by a garden with a selection of the plants identified from plaster casts.

A walkway leads from the museum past the replica structure to an overlook of the Río Sucio, and then follows the original bulldozer cut which currently defines the northern edge of excavation. Separated from the structures by an unobtrusive fence, visitors have a clear view of Structures 1, 6, 10, 11, and 12, located close to each other, and, slightly apart, Structures 3 and 4; access to Structures 2, 7, and 9 should be open to the public early in 1997 when additional pathways are completed. The circulation pattern does not impinge on excavated areas or otherwise interfere with ongoing excavation activities. Informative signage is placed at useful points along the path. Guides are also available to accompany visitors and provide more extensive information.

**Site Protection** The excavated area of the site and the public archaeological park are each surrounded by protective fencing with controlled access. One gate opens to the public area, one provides access to the excavation zone from the unpaved Joya de Cerén road, and one adjacent to the service building links the two areas. The site is guarded 24 hours a day, 7 days a week by five armed police officers and one project worker. Because the project has worked collaboratively with the local community at all stages, an informal neighborhood watch has emerged to assist in site protection.

#### DOCUMENTATION

Site maintenance activities are documented by the year-round team, whose efforts are supplemented by extensive photodocumentation of the structures carried out annually by project personnel. These records are archived in the architecture conservation office located on the site.

#### *Implications*

In 1993, soon after the site and 10 hectares to the south and west were officially recognized as a national archaeological park, Cerén was added to the World Heritage Monument list. With this designation comes the responsibility for meeting UNESCO's preservation guidelines (Feilden and

Jokilehto 1993). Among these is a site management plan which addresses issues of preservation and tourist development.

First written in 1990, Cerén's much revised plan articulates its development as part of a regional strategy which links it with several important nearby sites. These include the volcanic remains of Loma Caldera, 0.7 km north of the site, and the ceremonial center of San Andrés, a small but established archaeological park 5 km away. Featured in the plan are an expanded site museum at San Andrés (which opened in 1997), a system of self-guided trails, coordinated through a visitors' center, and didactic materials including detailed signage, publications, and school programming. The recent collaboration of CONCULTURA with the Getty Conservation Institute to produce a detailed ver-

sion of both site and regional management plans is an indication of CONCULTURA's commitment to this important aspect of conservation.

With such strong support, Cerén is well positioned to continue in good condition, an asset to El Salvador and a resource for visitors and researchers worldwide. At the same time, its success argues forcefully for the proactive provision of conservation care. In contrast to situations where exposure or neglect exacerbates problems to critical levels before conservation measures are introduced, Cerén showcases the results of a well-integrated approach to site conservation—one that addresses both the immovable features of the site and its artifact inventory, and one that balances the site's research value, material needs, and public usage.