Garuda at North Side of East Gopura, Preah Khan.
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1. INTRODUCTION

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1. INTRODUCTION

PREFACE

The World Monuments Fund (WMF) has worked since its first mission to Cambodia in December 1989 to draw attention to the vast architectural conservation challenge which is faced at the Historic City of Angkor. Since March 1991, at the invitation of the Royal Government of Cambodia, WMF has focused its activities on the monastic site of Preah Khan (1191 A.D.) which is considered to be among the most important sites at Angkor. The aims and accomplishments of WMF's international team at Angkor and Preah Khan are documented in previous reports entitled: I - Conservation Considerations for the Historic City of Angkor; II - Preah Khan, Project Identification; III - Preah Khan, Conservation Plan, and IV - Preah Khan, Field Campaign I - Project Mobilization.

These reports were organized and written by John Stubbs, WMF Program Director, and John Sanday, WMF Preah Khan Project Manager, with contributions and assistance from a large number of the international team members. Synopses, in French, of each report were produced by Dr. Corneille Jest with assistance from WMF's European Representative, Isabelle de Broglie. For the past three years these reports and proposals for subsequent work have been formally presented to the Supreme National Council (SNC) of the Royal Government of Cambodia and UNESCO for review and approval. Formal approval in principle for the overall concept of WMF's activities was received from the SNC in January 1993 and final clearance for WMF's proposed work in Field Campaign II was given with minor modifications on November 18, 1993.
The various missions within Field Campaign II varied slightly from original proposals made to the SNC in August 1993 due to political uncertainties through the month of November caused by the formation of the present government.

This report documents work accomplished during Preah Khan Field Campaign II which occurred between November 1, 1993 and May 8, 1994. Campaign II continued work on-site that was begun in Field Campaign I and documented in Report IV. Field Campaign I was completed on April 15, 1993. Between campaigns, a crew of between 15 and 25 workers remained at Preah Khan continuing site maintenance and protection activities.

PREAH KHAN HISTORICAL SKETCH

Preah Khan (built by the Khmer King Jayavarman VII as a monastery and teaching complex) is an extensive building complex covering about 56 hectares. It is located in the northern part of Angkor, a short distance beyond the North Gate of the Angkor Thom precinct. Preah Khan is the most prominent of several temple complexes associated with the Northern Baray (often referred to as the Preah Khan Baray), which stretches eastward approximately five kilometers linking Preah Khan with Neak Pean and Ta Som. This group constitutes one of Angkor’s major axial arrangements and is joined as a unit within Angkor’s vast hydrological system.

The central sanctuary of Preah Khan was dedicated in 1191 and was modified in various ways over the next three centuries. Preah Khan is subdivided by four concentric enclosure walls. The outer wall, which is encircled by a wide moat, today encloses a large tract of jungle. The living quarters of the monks, students and attendants of Preah Khan were located in this area. The second enclosure wall delineates the principal religious compound within which there is a dense concentration of temples and shrines consecrated to the Hindu sects of Vishnu (North) and Shiva (West); the central shrines are Buddhist and the southern quadrants are dedicated to the worship of the late kings.
Like most of the monuments of Angkor, Preah Khan is in a state of ruin resulting from the slow decline following its loss of royal patronage in the middle of the 15th century. Evidence suggests that some of the temples and shrines remained in use, probably until the end of the 17th century, but it was not until the end of the 19th century that Preah Khan, like many of the other sites, was rediscovered. Between 1930 and 1955 the Ecole Francaise d’Extreme Orient (EFEO), which established the Conservation d’Angkor in Siem Reap as a center for research and restoration of the monuments of Angkor, concentrated on archaeological analysis and preservation at Preah Khan. The work undertaken by EFEO is well documented and preserved in a comprehensive archive which has recently been computerized.

In its present state Preah Khan can best be described as a partial ruin set deep in the jungle which, over the years, has taken its toll on the structures. (It is one of the few temple complexes which is totally surrounded by jungle.) The coexistence of these man-made remains in an untouched natural setting has given Preah Khan a patina that differs from the special character it must have possessed in its original splendor.
PREAH KHAN PROJECT GOALS

The World Monuments Fund fielded its first mission at Angkor in December 1989 and has since sent ten missions to assist the national authorities in Cambodia with developing a conservation project at Preah Khan. In November 1992, WMF mobilized a team of craftsmen and laborers at Preah Khan for work over a period of five months. This was the culmination of its previous missions, and with the commencement of this conservation program on-site WMF is demonstrating its commitment to contribute to the much larger UNESCO campaign to safeguard Angkor.

In previous reports the World Monuments Fund has articulated the course of action it proposes to take at Preah Khan. The development of basic conservation principles and procedures will guide the WMF team and its work force towards a long-term program to repair and conserve the site as a partial ruin. Major reconstruction in this instance is out of the question due to the lack of historical data, the magnitude of the task, and the fact that such an approach would be philosophically dubious. WMF sees its responsibility as passing Preah Khan on to future generations in a state similar to that in which it was found but with the added assurance that, by using modern conservation technology, the site will be rendered structurally sound. In addition, using improved interpretive techniques, Preah Khan will be presented and made more intelligible to visitors.

In the long term WMF sees its involvement at Preah Khan as assisting the present international campaign in establishing the broader principles and procedures to be adopted in the efforts to safeguard Angkor; providing opportunities for training nationals at both the professional and crafts levels; and, on a more practical level, establishing conservation methodologies which are appropriate for use on Khmer monuments.

Training is a key driving force behind the Preah Khan Conservation Project. WMF realizes the immense benefits that the students of architecture and archaeology from the University of Fine Arts, Phnom Penh can gain from using Preah Khan as a conservation training laboratory. As described in its previous reports, WMF has advocated and administered an “on-site” training program for Cambodian students.
World Monuments Fund
PREAH KHAN, ANGKOR
ARCHITECTURAL NOMENCLATURE

N.B. Projects 2, 7, 8, 9 & 10 are associated with features located outside Enclosure Wall III shown on this plan.
since 1991. In the long term it is hoped that the students who have assisted at Preah Khan will become part of the much needed national force required to care for the monuments of Cambodia in the future. Equally, craftsmen are being taught the skills of conservation technology as an extension of their traditional crafts.

FIELD CAMPAIGN I

Preah Khan Field Campaign I, which occurred between October 1992 and April 1993, comprised three principal field missions to the site while work on-site at Preah Khan was continuous. During this campaign, WMF established a longer term presence at Preah Khan in order to initiate the project's conservation plan. The March 1993 mission within Campaign I involved the on-site five members of the WMF international team, whose task it was to draw the five-month field operation to a conclusion. Work efforts during this period concentrated on documentation and materials testing which led to the further establishment of policy for structural repair, consolidation, and planning for Preah Khan Field Campaign II. (See Preah Khan Conservation Project Report IV: Field Campaign I - Project Mobilization and the three separate appendices.)

FIELD CAMPAIGN II

Campaign II, from November 1993 to May 1994, consisted of four separate missions. The program of activities for each mission contained several components that expanded WMF's involvement and commitment to the safeguarding of Angkor.

The work on-site at Preah Khan during Campaign II was continuous from November 1993, when site clearance and preparation for the technical team's arrival in January began, through May 1994, when Campaign II came to a close.

The January 1994 mission engaged a nine-member team to commence and continue work at Preah Khan. The program included cleaning, repair and maintenance of
stonework; structural testing, repairs, and consolidation at the south portico of East Gopura III, the Hall of Dancers, and the Lanterns (Bornes) along the West Processional Way; surveying of and proposals for the natural environment; and both graphic and photographic documentation for architectural, archaeological, engineering and interpretation purposes. Throughout the January mission filming went on to document the site and ongoing work, and produce a brief promotional video.

The March 1994 mission dealt mainly with completing work begun earlier in the campaign, undertook a few new activities such as structural repairs and archaeological sondages, and planned for the production of an annual report on WMF's accomplishments at Angkor. Members of the team spent considerable time working with those in charge of or who are otherwise involved with Angkor during this mission.

During the April 1994 mission, WMF Project Manager John Sanday and WMF team members participated in the filming of 'The Glories of Angkor' for the U.S. cable television channel the Discovery Channel. Preah Khan was used to illustrate the present day efforts to conserve the monuments of Angkor and the cultural heritage of Cambodia.

Throughout Field Campaign II, a series of meetings took place between members of the Ministry of Culture and WMF representatives and included an opportunity to guide the Minister of State, H.E. Vann Molyvann, through Preah Khan and the other sites where WMF is proposing that new work be undertaken.

John Stubbs and John Sanday also participated as observers at the first session of the Technical Committee of the International Coordinating Committee on the Safeguarding and Development of the Historic Site of Angkor (ICC) held in Phnom Penh on March 21, 1994. This meeting provided an opportunity to share experiences with other national and international groups active at Angkor.

In response to a request by the Minister of State, a proposal to provide the Royal Cambodian Government with assistance in providing better security for the temple site of Banteay Srei was submitted by WMF at this conference and, with minor modifications, approved. The funding for the proposal was provided participants
of WMF's tour to Angkor in November 1993. The WMF Board of Trustees understood the urgent nature of the government's request and approved funding and basic protection measures in December 1993 for immediate implementation.

The Minister asked that WMF become involved in additional activities at Angkor as well as submit conservation reports on the structural condition of the Temple of Pre Rup and the West Causeway leading to Angkor Wat.

The Minister also requested submission of a proposal to provide technical support to the Conservation d'Angkor. It was officially submitted with the full support of the Royal Government of Cambodia to the UNESCO Secretariat in April 1994. WMF's proposal was enabled by a generous grant from the now former British Ambassador to Cambodia, H.E. David Burns. The proposal is slated for formal approval by the International Technical Committee in September 1994.

Through the experience gained at Preah Khan, WMF proposed possible conservation interventions at other sites which would be the next appropriate focus in the international effort to protect the Historic City of Angkor.

ACKNOWLEDGMENTS

WMF is grateful to the individuals who have served as members of its various Angkor research missions since 1989, and to the experts who have produced and reviewed this report. The WMF team of consultants for Preah Khan Field Campaign II consisted of returning team members John Sanday, John H. Stubbs, Dr. Predrag Gavrilovic, Dr. Corneille Jest, Dr. Frank Preusser; and the new members of the team, Kevin Lee Sarring, Frank Briscoe, Linda Karsteter, Wayne De La Roche and Ronnie Yimsut.

WMF acknowledges the valuable assistance that Simon Warack, stone conservation consultant for the Royal Angkor Foundation, provided in helping with the repair of a stone column in the Hall of Dancers at Preah Khan. Architect Nils Tremmel of the British Volunteers Organization based at Conservation d'Angkor aided greatly with regard to matters of information exchange.
Specialists who have also contributed in various ways to this report include: Bonnie Burnham, Dr. Corneille Jest, Isabelle de Broglie, Daniel Burke, Monika Riely, Rebecca Anderson, Norma and Maurice Joseph and Felicia Mayro. Students from the Departments of Archaeology and Architecture of the University of Fine Arts at Phnom Penh who have helped on site at Preah Khan include Lek Sareth, Var Maurin, Ms. Cheam Phally and Ms. San Soma from the Department of Architecture; Chan Chamroen and Nay Sophean from the Department of Archaeology.

Special gratitude is expressed to WMF's hosts in Cambodia, in particular: Prime Ministers Norodom Ranaridh and Hun Sen; His Excellency Vann Molyvann, Minister of State; members of the Ministry of Culture including Minister Nouth Narang, and M. Michel Tranet; Mr. Ouk Chea, Director of the Department of Cultural Patrimony; Mr. Pich Keo, Director of the National Gallery Phnom Penh; Governor Ton Chay of Siem Reap Province; Mr. Uong Von, Director of Conservation d'Angkor; and members of the University of Fine Arts, Phnom Penh, including Deans Chuch Poeurn and Sophean Phuong.

Colleagues and collaborators from other governmental organizations who have been of particular assistance include: Minja Yang, Richard Engelhardt and Veronique Dauge of UNESCO; and Denys Lombard, Director, Ecole Francaise d'Extreme Orient.

WMF is especially grateful to the local administrative staff, in particular Sarun Kussom, and the work force that has worked hard in helping to address the physical challenge posed by Preah Khan. The WMF team is equally grateful to the house owner and staff who cared for the consultants during their missions to Siem Reap and for all the local help they have provided.

WMF's efforts have also been aided by important contributions from considerate individuals acting on their own initiative, both in Cambodia and throughout the world. Some of these contributions were material gifts such as surveying equipment, drafting instruments and books for use by the Cambodian students who have worked at Preah Khan. WMF thanks these individuals, who are too numerous to specify, for their interest in its efforts to conserve and present the Historic City of Angkor.

The Preah Khan Conservation Project team gratefully acknowledge the continuing support of the Board of Trustees of the World Monuments Fund.
WMF expresses most profound gratitude to its sponsors, without whose financial support the organization's important work in Cambodia would not have been possible.

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2. CAMPAIGN II OVERVIEW

November Mission (Mission One)
January Mission (Mission Two)
March Mission (Mission Three)
April Mission (Mission Four)
2. CAMPAIGN II OVERVIEW

Preah Khan Field Campaign II included the following description in diary format of the sequence of events which occurred over the five month period, between November 1, 1993 and May 1, 1994. The actual research work and technical accomplishments of the mission are further described in subsequent sections of this report.

November Mission (Mission One): November 1 - December 7, 1993

After a preliminary visit to Preah Khan to prepare for a tour of project supporters organized by the World Monuments Fund, John Sanday returned to Phnom Penh to participate in a series of meetings with members of the Ministry of Culture and Bonnie Burnham, WMF Executive Director.

John Sanday led a tour of WMF contributors to the sites of Angkor and focused on the work at Preah Khan. Dr. Corneille Jest, a former team member, joined the WMF group for the latter part of their visit. During Bonnie Burnham’s stay in Siem Reap, the opportunity arose to invite the Minister of State H.E. Vann Molyvann, to Preah Khan and guide him through WMF’s proposed work at other sites at Angkor.

A site of particular interest to the WMF tour group was Banteay Srei, a unique temple complex dating from the ninth century located approximately 21 kilometers to the North East and beyond Angkor (and outside the limits of the Historic City of Angkor). The tour participants were in awe of this jewel built in the Sikhara style of pink Kulen sandstone. The stone carving on these temples is exceptional.

The beauty of the site heightened the group’s dismay when they discovered the desecration and vandalism which has recently occurred to this precious work of art. The group resolved to support a proposal to the Royal Government to assist in
providing basic security for the site. This proposal had previously been requested of WMF by the Minister of State. In December 1993 the WMF Board of Trustees in December 1994. (See Appendix K.)

There were many other special visitors to Preah Khan during the November mission, including two large groups from the Chief Executive Officers (CEO) organization from the USA; a group from the San Francisco Museum of Fine Arts Asia Society; and alumni travel groups from both Cornell and Columbia Universities in New York. All exhibited great enthusiasm and support for WMF's work at Angkor.

Following their return to Phnom Penh, John Sanday and Corneille Jest made a concerted effort to meet and brief key members of the Royal Government concerning WMF's future plans for the Preah Khan Conservation Project. Meetings were held with H.E. Vann Molyvann; Mr. Nouch Narang, Secretary of State in charge of the Ministry of Culture; Mr. Ouk Chea, Director General of the Department of Archaeology; Mr. Pich Keo, Director National Museum; Mr. Chuch Poeurn Dean of Archaeology; and Mr. Aul Cheng, the new dean of the School of Architecture at the University of Fine Arts.

After extended meetings held between WMF project staff and H.E. Vann Molyvann a proposal for WMF to provide technical support to the Conservation d'Angkor was drafted. His Excellency requested WMF assume a leading role in three further activities at Angkor:

1. The protection and development of the site of Banteay Srei. (It was coincidental that WMF had already identified this as a site for potential assistance.)

2. The protection and development of the site of Preah Vihar. (A threatened site located on the Thai Border.)

3. Assistance with mine removal in the immediate Angkor region.

John Sanday spent the rest of this first mission in Siem Reap planning a work schedule and instructing the newly established work force of 50 men in the
clearance and preparation required before the arrival of the technical staff for the
January mission (Mission Two).

**January Mission (Mission Two): January 4 - February 2 1994**

On January 4, 1994 the full complement of WMF team members met in Phnom
Penh. The team included returning members John Sanday, John Stubbs, Predrag
Gavrilovic, and Frank Preusser; and new members Kevin Lee Sarring, Linda
Karsteter, Wayne De La Roche, Frank Briscoe and Ronnie Yimsut. New team
members were given a tour including the National Museum, the Royal Palace area,
the waterfront and the Tuol Sleng Museum.

John Sanday and John Stubbs visited various government officials including H.E
Van Molyvann, Mr. Pich Keo, Mr. Ouk Chea, Mr. Chuch Poeurn and Mr. Aul
Cheng.

The following day the team members flew to Siem Reap and were lodged in both
the WMF house at Quartier 4, Wat Bo Village, and a nearby guest house. The first
afternoon and the next three days were used for orientation which included visits to
Angkor Wat, the Bayon, the Terrace of the Leper King, the temples of the Roluos
group, West Mebon, Ta Prom, Bantei Kdei, Ta Som, Neak Pean, Banteay Srei and
Preah Khan. Over the next two weeks, additional reconnaissance trips included
Siem Reap and villages at the north end of the Tonle Sap.

After a general introduction to the site by Messers. Sanday and Stubbs, work at
Preah Khan began with team members being assigned their various tasks.
Returning team members Predrag Gavrilovic and Frank Preusser continued with
projects begun on prior missions. The newcomers were given tasks suited to their
interests and abilities.
OVERVIEW OF ACTIVITIES (BY TEAM MEMBERS)

Project Manager John Sanday acted in his usual role as organizer and team leader of the orientation tours and work in the field. In consultation with WMF Program Director John Stubbs, the work plan for the mission was finalized and team members were dispatched to various tasks with the necessary number of Khmer assistants. John Sanday worked on administrative details relating to the work force, financial matters, logistics and tracking the progress of the various team members. He also organized several WMF and government liaison activities.

WMF Program Director John Stubbs participated in a number of the above mentioned tasks. He spent considerable time in discussion and correspondence with government officials, particularly H.E. Vann Molyvann, on issues concerning cultural resource management issues. John Stubbs has served as editor, organizer and a principal contributor to past and present annually published reports on WMF's work in Cambodia.

Engineer Predrag Gavrilovic reviewed the extensive amount of structural shoring which had been erected since his last visit in March 1993 and, together with John Sanday, made plans for testing specific conservation interventions at the south portico of East Gopura III and the Hall of Dancers, and for a series of sample repair and re-erection activities for the Lanterns (Bones) along the West Processional Way. During this period John Sanday and Predrag Gavrilovic also spent considerable time planning for and procuring scaffolding and hoisting machinery. They also acquired from local sources a generator, a compressor, an electric drill set and a stock of stainless steel for doweling.

Architect/Archaeologist Kevin Lee Sarring began by reviewing all the architectural plans and previous surveys made at Preah Khan. During the mission he was able to produce numerous drawings with the help of the two archaeological students from the Department of Archaeology of the University of Fine Arts, Phnom Penh. Graphic documentation of the following items was done: sketches of ornamental details; 'as-found' drawings of the South Portico of the East Gopura III; numerous drawings for Engineer Predrag Gavrilovic which illustrate the various structural problems throughout the site; and designs for hoisting devices and scaffolding arrangements. Kevin Lee Sarring also produced several designs for 'Danger'
signs to be posted around the site (as requested by Conservation d' Angkor) and illustrated WMF's proposal to protect the site of Banteay Srei.

Materials Conservator Frank Preusser performed various types of stone conservation research based on initial observations made on his first trip to Preah Khan in November 1992. Dr. Preusser, with the assistance of Conservator Frank Briscoe, conducted a series of tests on techniques for cleaning stonework, followed by a series of preventive treatments for the elimination of biological growths. Tests were also carried out to ascertain methods for consolidating fractured and delaminating stonework. All the work was performed in situ and was evaluated. This intensive effort to examine the most significant of the materials conservation issues largely satisfies the most pressing questions regarding stone cleaning and protection at Preah Khan. (See Appendix B.)

Conservator Frank Briscoe assisted Dr. Preusser on all stone conservation tests during the January mission and contributed to the final writing of the Stone Conservation Report. He also served as field coordinator for the sample repair and re-erection of the stone Lanterns located along the West Processional Way as well as assisting other team members in a variety of ways, including illustrations for proposals and reports.

Wayne De La Roche worked throughout the mission filming work in progress for purposes of documentation and for making a brief promotional video on the work of WMF at Angkor. He shot some 17 hours of video footage to edit back in New York for video films in two lengths. One will be a longer version providing a detailed tour of Preah Khan where numerous technical issues are discussed. A second version will be a brief overview for the lay visitor who may want orientation about the project before visiting. (See Appendix Q.)

Linda Karsteter worked with Wayne De La Roche on the video documentation project. She also helped with mission organizational tasks at WMF in New York before the January mission. In the field she assisted other team members with a variety of items including illustrations and word processing.

Robert Sanday performed a number of useful tasks ranging from running errands to site tours. His knowledge of comparative religions proved helpful to some of the
other team members who had questions regarding the religious significance of the abundant Buddhist and Hindu imagery in stone found at Preah Khan.

*Landscape Architect and Forester Ronnie Yimsut* introduced a number of new perspectives with regard to the environmental context of Preah Khan and its presentation to visitors. During the course of the mission he conducted a general survey of botanical specimens at Preah Khan, including a conditions analysis. Subsequent to the January 1994 mission, Ronnie, a Cambodian-American, taught architectural design at the University of Fine Arts in Phnom Penh where he encouraged student interest in designing a temporary reception and interpretive center for placement at the entrance to Preah Khan.

*Archaeology students Chea Sophea and Chan Chamroeun* actively participated in the January mission to Preah Khan assisting Kevin Lee Sarring in the recording of the south portico of the East Gopura as well as generally helping the team in all aspects of work. On two other occasions during the spring, Sophea and Chamroeun helped at the site with a variety of documentation tasks. In their spare time, WMF team members helped the students with the preparation of their dissertations (Memoires de fin d'Etude) on archaeological topics at Angkor.

*Kussom Sarun* served as principal assistant to the Project Manager and proved invaluable in the accomplishment of a large number of tasks. He was in charge of logistics and materials acquisitions, and served as chief Khmer interpreter. Since January 1993 Sarun has represented WMF's interests in Siem Reap when John Sanday was away.

**March Mission (Mission Three): March 9 - April 3, 1994**

John Stubbs, John Sanday and Predrag Gavrilovic arrived in Phnom Penh in March where they attended several meetings. One meeting was at the Institute of Engineering with Mr. Ouy Vanthon, the President du Conseil d'Administration. Mr. Vanthon proposed a future link between the Institute and the Preah Khan Conservation Project where the Institute would serve as the primary location for the testing of materials and soils from Preah Khan.
Discussions were also held with Secretary of Minister of Culture, H.E. Vann Molyvann, and Under Secretary of the Ministry of Culture, Michel Tranet, concerning WMF's contribution towards the safeguarding of the sites of Angkor.

At Preah Khan, John Sanday and Predrag Gavrilovic concentrated their efforts on two principal activities, the consolidation of the south portico of East Gopura III and the study and degagement of a collapsed section of Enclosure Wall IV just north of East Gopura IV. Other structural interventions of a more generic nature focused on the doweling and gluing of a split sandstone column and the structural repair of two different types of stone lintel failure.

A grant from Pacific Asia Travel Association (PATA) was used towards the design and construction of an interpretation center using local traditional materials for Preah Khan which expands the present visitor facility. Construction of this building commenced in March 1994.

On March 21, 1994, John Stubbs and John Sanday, representing WMF as observers, attended the first session of the Technical Committee of the International Coordinating Committee on the Safeguarding and Development of the Historic Site of Angkor (ICC) held in Phnom Penh. This meeting provided the WMF representatives with the opportunity to meet other national and international groups active in the drive to safeguard Angkor and in particular H.E. the British Ambassador David Burns. At this meeting WMF's proposal to provide the Royal Cambodian Government with assistance to provide better security for Banteay Srei was presented and, with minor modifications, approved.

Subsequent meetings with Ambassador Burns resulted in a generous pledge of financial support for a proposal by WMF to provide technical assistance to the Conservation d'Angkor. The British Embassy on behalf of WMF wrote to each of the British companies active in Cambodia asking for their support by matching the donation from the Ambassador and the British business community.

The Ambassador offered to assist further by providing a Chevening Scholarship to York University's Advanced Architectural Studies Program, or a similar program in the United Kingdom, for one of the Cambodian students working at Preah Khan.
On March 23, 1994 John Sanday, as a representative of World Monuments Fund, attended a workshop jointly organized by Ecole Francaise d'Extreme Oriente (EFEO) and Sophia University (Japan) to study the issues regarding the conservation of the monuments and environment at Angkor. Dr. Jacques Dumarcay provided new insights on the technical work undertaken by EFEO in the 1950s and 1960s.

In response to requests from the Ministry of Culture, Predrag Gavrilovic and John Sanday undertook brief surveys to study the structural condition of the Temple of Pre Rup (one of the eastern temple complexes of Angkor) and the West Causeway of Angkor Wat. Conservation reports were sent to the Ministry of Culture on both sites (See Appendices H & I).

April Mission (Mission Four): April 18 - May 8, 1994

In April, John Sanday went to Angkor to assist in the preparation of a documentary film entitled 'The Glories of Angkor' to be shown on the Discovery Channel (U.S. cable television) as the lead program in their series on archaeology. The team at Preah Khan, including architectural students Lek Sareth and Var Maurin, was instrumental in providing subject matter for the documentary. Preah Khan was used to illustrate the efforts to conserve the monuments of Angkor and the students acted as spokesmen for the present generation's efforts to conserve the cultural heritage of Cambodia.

John Sanday had the opportunity to show Preah Khan to Ms. Minja Yang and other officials from UNESCO headquarters and to discuss both the philosophy and technology adopted for the project.

With the support of the Royal Government of Cambodia, John Sanday officially submitted to the UNESCO Secretariat a proposal to provide technical assistance to the Conservation d'Angkor. This proposal was submitted in April 1994 and is slated for formal approval by the International Technical Committee in September 1994 (See Appendix F).
3. CAMPAIGN II RESEARCH ACCOMPLISHMENTS

Management & Presentation of the Natural Environment
Stone Conservation Analysis and Recommendations
Enclosure Wall East IV - North Section
Enclosure Wall III West - North Section
The Role of Water at Angkor & Preah Khan
Morphological Growth of the Preah Khan Complex
Special Aerial Mapping of Angkor
Video Documentation Project
Architectural Space Identification
Educational Assistance to the University
Preah Khan Sculptural Art Inventory
3. CAMPAIGN II RESEARCH ACCOMPLISHMENTS

MANAGEMENT & PRESENTATION OF THE NATURAL ENVIRONMENT

Preah Khan is one of the few monumental complexes at Angkor that is still surrounded by the jungle. The area between Enclosure Walls IV and III of the monastery encloses a dense forest that has suffered some minor tree loss due to logging. Realizing the importance of protecting the natural environment at Preah Khan, WMF enlisted the assistance of a specialist to draw up both short- and long-term plans to manage the natural environment of the site. Ronnie Yimsut, who was born and spent most of his childhood in Siem Reap, joined the WMF team for two weeks to advise on the conservation and presentation of the natural environment of Preah Khan. (See Appendix A.)

This environmental protection and resource management document aims to identify and describe objectives and specific actions which are necessary to accomplish a program for the protection and management of the forest in and around Preah Khan. A strategy has been developed which provides recommendations for overall environmental protection with consideration for the monumental structures and other archaeological concerns. The recommendations also take into consideration the preservation and improved presentation of the perimeter moat as well as protection of its adjacent vegetation.

Specific proposals have also been made for overall site interpretation and for providing nature trails and vistas of the monumental ruins in their special jungle setting. Considerations and recommendations have also been given to vehicular parking, access management and the road system around Preah Khan.
West Entrance Path to Preah Khan, Looking West, 1994.
Existing site conditions, growth patterns and rates of vegetation, and future uses of the site were analyzed to identify potential opportunities and constraints. Specific recommendations have been established and ranked in priority for implementation in either single or multiple phases of development.

Land use zoning and recreational opportunities were also considered and recommendations were made for a number of appropriate ancillary site uses. Recommendations include maintaining a buffer zone, preserving the forest through a "hands off" policy, and enforcing a ban on illegal logging operations within the immediate area.

One of the zones to receive special attention is the moat. Elsewhere in this report are recommendations to restore the edges of the moat, to remove vegetation currently choking the moat, and to remove some of the existing water plants to re-establish its reflective qualities.

Within the limited duration of the January mission, field data was collected and analyzed. The study area was divided into 10 distinct zones for the purpose of site management. Recommended action plans are proposed for each zone which consider overall environmental protection and resource management. During the survey it was discovered that a number of large, medium and small size tree species are found in all the zones. However, it was noted that the succession stands are very poor. There are a large number of either very large or very small trees with little in between. Vegetation currently has three distinctive layers. The bottom layer is composed of shrubbery, brushes, vines and grass species. The middle layer is represented by medium size tree species and the top layer is represented by a number of large timber species.

Most of the stands in these three layers are in fair to excellent condition, although some of the larger trees are beginning to die of old age. A new generation to replace them has failed partly due to the change in micro-climate brought on by past and present logging operations conducted in the area.

Many sections of the free-standing Enclosure Walls of Preah Khan are overgrown with ficus trees and other species. The ficus are "parasite" plants causing destruction to a number of structures within the complex. Many of these trees,
especially the giant ficus, are either dead or dying. Others are leaning and threaten to fall.

The removal of identified hazard trees should be a serious consideration in the overall management of the site. This is also a major issue with regard to protecting above grade archeological remains and in some instances might even be a life safety issue.

Socioeconomic considerations were studied with regard to the site of Preah Khan as there is evidence that it has been a source of income for the local population for many generations. Resin collection from the dipterocarpus tree, firewood cutting and the collection of fruits, plants, and fibers have been a way of life for many surrounding villagers for countless generations. These can be described as low impact activities that do not destroy the environment. Most of the local villagers know how to work and care for their forest environment. They take only what can be removed without compromising their tradition, livelihood and environment.

It is strongly recommended that those in charge of preserving and presenting Angkor should encourage, not discourage, the above-mentioned responsible activities that exist in the area. The local inhabitants of the jungle can teach us much about natural resource management, and indeed one aspect of interpreting Preah Khan should be to explain these ecological concerns.

The site of Preah Khan was built to honor the Gods. It is a place of serenity, peace and as a result the site is spiritually uplifting. A visitor cannot help but experience this unique quality. All efforts should be directed towards retaining this distinctive character.

The Preah Khan Conservation Project will serve as a destination where visitors can learn about the natural and the cultural heritage of Cambodia. The site can serve as an outdoor classroom where all visitors will have the opportunity to explore, experience and understand the dynamism of a site which possesses a remarkable combination of both natural and cultural assets.
STONE CONSERVATION ANALYSIS AND RECOMMENDATIONS

Dr. Frank Preusser first visited the Preah Khan in March 1992 and undertook a preliminary study of the stone conservation problems at the site. During that visit he conducted some small cleaning tests on carved stone surfaces covered by biological growth. Subsequent to this initial inquiry, further cleaning tests were conducted by John Stubbs in March 1993. Dr. Preusser's report, written jointly with Frank Briscoe, (Appendix B) is based on a more in-depth study of Preah Khan made during the January 1994 mission within Field Campaign II and should be read in conjunction with previous field reports published by WMF.

During this campaign Dr. Preusser and Frank Briscoe conducted a detailed survey of the materials conservation needs of the monument, especially along the central W-E and the central N-S-axes. Their research resulted in treatment recommendations. These recommendations and an outline of cleaning procedures is included in the attached Appendix B.

The 1992 cleaning tests were evaluated, additional cleaning tests were conducted, and copper sulfate (CuSO₄) solution was applied to parts of the cleaned areas to evaluate its effectiveness as a biocide in this climate. One apsara at the South Gate was cleaned since it was feared that the cupping black crust might damage the stone. An inscription in the southern part of the N-S axis was cleaned to prevent damage from graffiti.

Testing of two stone preservatives was also carried out on stone fragments. First, experiments with stone adhesives were undertaken. Later some of the Lanterns on the West Processional Way were restored and re-erected. (See Appendix O.)

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ENCLOSURE WALL EAST IV - NORTH SECTION

About 15 meters to the North of the principal East Gopura IV, a 20 meter section of laterite Enclosure IV, standing approximately 4 meters high, had collapsed outward at an unknown time probably within the past one hundred years. (See Appendix P.)

The collapse outward, in the direction of the moat, was uniform and caused by an upheaval of stones located directly above the present ground level. A section drawing of the area suggests that the foundations, which went down approximately 1.20 meters below modern ground level, were set out using corbelled laterite stones which eventually met to form the visible base stones for the wall. At the point where the stones emerged from the ground the laterite had disintegrated causing a tilting movement which led to the collapse.

Discussions with the senior foreman on-site suggested that a small wall penetration in corbelled stone at this location could have been designed to serve as drainage, though the structural void appears to have always been filled with sand. The
foreman indicated that a similar detail had been found at Angkor Wat where, at intervals of approximately 30 meters, the renovation work crews found drainage outlets from a wall. The penetration, through Enclosure Wall IV at Preah Khan, proved to be an irregular shape and, at some points, quite small in size. This suggests that it is unlikely that it was intended for drainage.

A careful study of fallen stones from the collapsed wall was made and diagrammatic drawings prepared so that each stone could be referenced. Each stone was numbered 'in situ' and has been carefully stacked ready for reconstruction. WMF plans to rebuild this section of the wall as a monumental wall reconstruction prototype in the forthcoming Field Campaign III. Engineer Gavrilovic has prepared details to consolidate the failed foundation structure.

On checking the condition of the entire outer Enclosure Wall which totals approximately two kilometers in total length, it is estimated that approximately 75% - 80% of the wall is still standing and is in good condition.

**ENCLOSURE WALL III WEST - NORTH SECTION**

In order to corroborate evidence concerning recent investigations of the foundations of Enclosure Wall IV, a similar excavation was undertaken at a section of wall that had failed in a similar manner.

Enclosure Wall III is much higher (approximately five meters) and has a somewhat broader foundation. However, the structural design is similar, as was the cause for failure of the wall. A detailed measured survey of this area of Enclosure Wall III has been undertaken and a plan and sectional drawing of the present condition of the structure was prepared.

It remains undecided whether this section of wall will be reconstructed due to the fact that a much greater percentage (over 50%) of this Enclosure Wall has collapsed.
THE ROLE OF WATER AT ANGKOR & PREAH KHAN

Even the most cursory inquiry into the marvel that is Angkor reveals that the civilization, from beginning to end, was based on the successful manipulation of water. This spiritually and physically necessity was pervasive when Angkor was operational and can be seen on a closer examination of the imperial city's history and physical remains in our time. The vast hydrological system which allowed for the construction of the capital city that was otherwise in an arid and not easily habitable savanna (save for monsoon replenishment and a meandering river, the Stung Siem Reap in its earlier form) is legendary, and is the subject of many scholarly studies of which some of the most revealing have only just been completed. Such studies have addressed the 'macro' role of water at Angkor relative to irrigation, water storage and transportation.

References to water and water creatures are commonplace in Khmer iconography and are found, along with man-made water features, at nearly all architectural sites surviving from the Angkorian period which dates from the 9th to the 14th centuries. An important part of WMF's ongoing research at Angkor is to examine how water enabled the existence of a large city and was manifest in the architectural design and religious iconographic features at the 12th-century monastic complex of Preah Khan. [See Appendices R (Analysis of the Roles of Water) & L (Proposal for Aerial Radar Imaging by NASA).]

Analysis of the Roles of Water at Preah Khan

The development of Angkor's vast hydrological system that served the agricultural, transportation and everyday needs of inhabitants of the city remains a major subject of study among historians and other experts.

Preah Khan survives as an excellent location at which to conduct detailed studies on the various roles that water played at a representative temple site. Questions range from macro to micro concerns, from the very real and practical to the symbolic. All of these questions must be understood in light of the fact that the site today is largely overgrown and in ruin. Thus many of the vital points of information on this
subject are forever lost. WMF proposes to conduct ongoing research on all aspects of water at Preah Khan. Points for consideration are listed below.

MORPHOLOGICAL GROWTH OF THE PREAH KHAN COMPLEX

Since 1991 research has been conducted on the development of the Preah Khan complex. These analyses were based on the reports of French scholars who began work at the site in the second decade of this century. To this day, new information is being realized regarding the chronology of some of the buildings at Preah Khan. At present, the most pressing need is for a coherent graphically depicted document that expresses the constructional sequence of the complex with reference to special iconographic features and changes in religious uses which occurred at Preah Khan over time.

It is proposed that a graphic description of the evolution of Preah Khan during its nearly three centuries of occupation beginning 1191 be developed with text suitable for use by both technicians working at the site and tourists. Historical evidence suggests that there may well be the remains of an earlier settlement in the area of Preah Khan which can only be verified through archeological excavation or prospecting.

SPECIAL AERIAL MAPPING OF ANGKOR

In April 1994 John Stubbs contacted the United States National Aeronautics and Space Administration (NASA) while the space shuttle Endeavour was in flight on a scientific mission to, among other things, record selected archaeological sites using an advanced geographical mapping technique known as 'radar imaging'. NASA's chief scientist for the mission, Dr. Diane Evans, arranged to add four locations at Angkor to the Endeavour mission agenda of sites for radar scanning. The late entry of this information on the space shuttle's agenda meant that the coverage of Angkor might not be attempted on the April Endeavour Mission but scheduled for the next mission, in October 1994.
In responding to NASA’s request for the precise coordinates of areas to be mapped, Stubbs, with the cooperation of Janos Jelen, President of the Royal Angkor Foundation and an expert in the recently developed Geographical Information System (GIS), provided the following mapping coordinates for four sites.

Site Coordinates at Angkor for Radar Scanning in North Central Cambodia

Project Supersite:
Site 1 - The Eco-Site of the Angkor region (an approx. 5000 km area)
  Northern Latitudes 13°04' - 13°45' and Eastern Longitudes 103°35' - 104°15'

Proposed Swath Centers:
Site 2 - The Temple of Preah Khan
  Latitude N. 13°27'36.6" and Longitude E. 103°52'30.6" (the center of the temple)

Site 3 - The Temple of Preah Ko
  Latitude N. 13°20'28.8" and Longitude 103°58'30" (the center of the temple)

Site 4 - The Temple of the Bayon
  Latitude N. 13°26'20", Longitude 103°51'25"

The type of aerial radar mapping provided by NASA could provide new information about Angkor. The capacity of radar imaging to penetrate vegetation and document surface and immediate sub-surface conditions is a special form of archaeological prospecting. Radar imaging at sites similar to Angkor has revealed impressive images of subterranean anomalies such as objects, structures and disturbed soil conditions. If WMF is fortunate enough to receive radar imaging of Angkor from NASA, many old and new questions about Angkor can be addressed in an altogether new way. At the time of this writing, the results of the NASA radar scanning of Angkor had not been provided to WMF except for early verification that at least some of the area was covered by the April 1994 Endeavour mission. Of greater promise is what may occur in the October 1994 mission. (See Appendix L.)
VIDEO DOCUMENTATION PROJECT

During WMF's January 1994 campaign, video taping was introduced as a tool for recording conservation activities at Preah Khan. (See Appendix Q.) This form of documentation brought the actual conservation process to life in a way that captures the experience of being there. On one level, the video medium was used as a visual notebook for surveying the condition of sandstone sculpture and evidence of recent theft of Cambodian artifacts. Video documentation more easily allows coverage of the visual context of an artifact than does still photography. It also was used to produce an archival record of ongoing conservation procedures, and to create footage for a film that will give interested parties throughout the world an updated report on WMF's involvement at the site, showing how WMF employs a Cambodian work force, students and several conservation experts to work in a true international collaboration to conserve and present Preah Khan.

Edited video will provide an important means for demonstrating WMF's involvement in Cambodia as an advisory, educational and technically effective organization. By involving viewers at an emotional level video also serves as an effective promotional and fundraising tool.

In March 1994, New Dominion Pictures, Inc. approached WMF to ask if the team would assist in the preparation of a television documentary for a new archaeology series on the U.S. cable channel the Discovery Channel. Filming took place at Angkor and Preah Khan between April 21 and 29, 1994 and the program will be aired in January 1995. The documentary outlines the history of Khmer art and culture, the trauma of the last two decades in Cambodia and its effect on the nation's culture. The film will also stress present day efforts of the new generation of Khmers, with assistance from international conservation specialists, to preserve and present as the title of the film states, 'The Lost Glory of Angkor'.
ARCHITECTURAL SPACE IDENTIFICATION

For purposes of identifying the location of the hundreds of rooms and other major architectural features of Preah Khan, an annotated Space Identification Plan was produced by Archaeologist/Architect Kevin Lee Sarring. (See illustration.)

The rationale for the number and letter system of the Space Identification Plan is simple and direct. The present system is an elaboration on previous systems of labeling spaces at Preah Khan as are reported in earlier WMF field reports.

The components of the site are named verbally by the temple's architectural parts (e.g., buildings) and geographical position. For example, South Gopura III is the Gopura on the entrance gate east of the main north/south axis within the third enclosure wall. There are no second story spaces (save for one in the two story pavilion which presently possesses no floor). The spaces of each building are numbered in a concentric clockwise manner from the most central space outward. Courts, areas without roofs, and areas between buildings are likewise identified, but by letters assigned in a clockwise direction.

EDUCATIONAL ASSISTANCE TO THE UNIVERSITY

Training Activities in Phnom Penh

For the third year, WMF has continued training students from the University of Fine Arts in Phnom Penh. It must be said, however, that due to the slow start of Field Campaign II and due to internal changes at the Department of Architecture at the University, WMF was unable to accomplish as much on-site training during Campaign II as it had hoped. WMF's normal lecture series given by international consultants working at Preah Khan was scaled back to only a few presentations. Nevertheless, progress was made in other areas of training which should prove to be significant.
At the end of the January mission Gavrilovic and Sanday visited the Institute of Technology, University of Phnom Penh, and checked on the status of some materials tests which were ordered in March. These materials tests had not been completed at the time of this visit. In March 1994, Sanday and Stubbs visited Mr. Ouy Vanthon, the new President du Conseil d'Administration, of the Institute which was in the process of being reorganized by the French Government. Mr. Ouy expressed interest in resuming materials testing services for WMF and possibly providing faculty and students to work with WMF's Engineer during upcoming field missions.

At the University of Fine Arts WMF consultants were able, in some cases, to conform with the new timetable of the Department of Architecture and gave several illustrated lectures. At the end of January 1994, at the invitation of Ronnie Yimsut who was teaching the second year architectural students, Conservator Briscoe, Engineer Gavrilovic and Architect Sanday presented general summaries of their work at Preah Khan. The lectures were enthusiastically received by the students. Interested students were encouraged to consider joining the WMF team to learn about architectural conservation from first-hand experience.

On March 19, 1994, at one of the Department of Architecture's special Saturday sessions, Dr. Predrag Gavrilovic gave an illustrated talk entitled "Results of the Structural Survey at Preah Khan and Some Proposed Solutions."

**Training Activities Siem Reap and Angkor**

During John Sanday's first mission (within Field Campaign II) in November, archaeology students Chan Chamroeun and Nay Sophea spent two weeks from November 14, 1993 in Siem Reap undertaking field research for their final dissertations. Sanday was able to give them advice and direction on conducting research relating to their topics on the role water played at Angkor and a study of Khmer bridges.

Beginning on January 6, 1994, Chan Chamroeun and Nay Sophea returned to Siem Reap for three weeks to participate in the January mission. During this period they assisted Architect/Archaeologist Sarring and Engineer Gavrilovic in recording the South Portico, East Gopura III and produced several excellent 'as found' condition
drawings of this area. While in Siem Reap, team members Stubbs, Preusser, Sarring, De La Roche, Karsteter and Briscoe actively advised these students and heard three progress reports on their dissertations.

During the March 1994 mission architecture student Lek Sareth joined the field mission for a fifth time to assist the team in recording the location of fallen laterite stones at the collapsed section of the Enclosure Wall IV, North East. He also documented spot excavations along the foundations of Enclosure Walls III and IV and helped the engineer and conservators with the analysis of these areas.

In April Lek Sareth and Var Maurin, another architectural student, participated with Sanday and other WMF team members in the filming of the documentary by New Dominion, Inc. Both Sareth and Maurin were interviewed and gave comments on their reasons for participating in the overall effort to conserve Angkor.

Miscellaneous Educational Assistance

In September 1993, the Dean of Architecture, Mr. Hor Lat, took leave from his post at the University of Fine Arts to complete his degree in Architecture at the Polytechnic University in Milan, Italy. This opportunity was made possible by a grant from Dr. Rodrigo Rodriquez, WMF International Council member.

In January and March, WMF team members Stubbs and Sanday assisted Lek Sareth and Var Maurin in their efforts to locate graduate schools of architecture outside Cambodia where they could complete their Master’s degrees to enable their licensure to practice architecture. A survey of suitable schools was provided by the New York office of WMF and as of the time of this writing it appears that at least Sareth will be studying abroad next year. He hopes to attend the University of Oregon, the University of Hawaii or the Frank Lloyd Wright Foundation’s Taliesin Apprenticeship Program. In addition to helping place these students WMF intends to try and arrange financial aid for both of them should it be necessary.

On-Site Work Force Training

The original plan to start the program in Preah Khan slowly and build on achievement has produced a full complement of conservation activities at Preah
Khan during Field Campaign II. A well-trained team of skilled workers has been developed. Activities such as vegetation removal, degagement of half-buried fallen stones, hoist lifting of three-ton lintels and epoxy gluing have been accomplished with very good results. The key to the success of the work thus far can be attributed to sensible planning, the quality of the workmen, close supervision, good communication and the cheerful and cooperative spirit had by all during the work process.

As a result of its more recent activities using a work force at the site, WMF has developed a program to train masons in the degagement (clearance of fallen stone and debris), cleaning and inventory of stonework. Likewise carpenters working with the WMF team have set up a major program for shoring up damaged sections of the structures.

PREAH KHAN SCULPTURAL ART INVENTORY

A recent spate of thefts at Angkor which has targeted carved Nagas, Guardian Lions and Linga at the more remote temple complexes, has forced the Conservation d'Angkor to remove all threatened art pieces to the security of the Conservation d'Angkor compound. 31 pieces have been taken back to the compound and, following this course of action, WMF has prepared an inventory of these pieces using a modified version of the form printed in the report for Field Campaign II.

In light of the tests at the site, WMF has revised the form to make it more flexible for use to other sites. Using Microsoft Access software, a user-friendly computer program adopted by other agencies working at Angkor, WMF has designed a simple database for this material. Copies of the original inventory forms have already been circulated to the Royal Cambodian Government.

Preah Khan was also invaded by looters. Five Nagas, each weighing over a ton, were stolen. Of these, two were traced to their hiding places: one in the eastern moat and one alongside the road to the north of Preah Khan.
Degagement (Clearance of Fallen Stone and Debris) at West Vishnu Complex, 1993.
4. CONSERVATION ACTIVITIES

East Gopura South Portico Stabilization
North Axial Passage Way Degagement
Clearance of East Processional Way
Repair and Conservation of Lanterns
General Degagement
Plant Control
Structural Repair and Stabilization
4. CONSERVATION ACTIVITIES

EAST GOPURA SOUTH PORTICO STABILIZATION

At the time of WMF's first visit to Preah Khan in 1989 it was noticed that a portico on the south half of East Gopura III (the primary entrance to the complex) was in imminent danger of collapse. Subsequent emergency propping prevented its collapse, which would have caused extensive damage to its monolithic columns and other carved details comprising this impressive architectural feature.

Prior to undertaking any work, all stones including paving stones (Level 1 & 2), lintels, vaults and wall structure were measured and drawn to scale as part of an 'as found' conditions survey document. All stones were carefully referenced against the drawings and number coded to facilitate removal and accurate replacement. Stones still incorporated in the adjacent wall that needed to be moved were also referenced. The stones were then carefully removed from the structure and laid out in an order that made reconstruction as simple as possible. The following procedure was used:

- After erection of the temporary emergency support using raking shores, a steel scaffolding was built around the structure to provide further support and for working lifts or platforms on which to off-load the stone vaults and lintels.

- Stone vaults and lintels were raised by block and tackle and placed high on the scaffolding as close to their original locations as possible.

- A detailed assessment was made of the structural stability of columns, their foundations, and wall piers, and a plan was developed for structural consolidation.
• The west pair of columns were individually tilted back to the vertical position using hydraulic jacks. The east pair of columns and the joining lintel were moved back to the vertical position in tandem using pairs of jacks. (One column which had fractured at its base was temporarily splinted using steel plates and bands.)

• Damaged pieces of stonework were refixed, prior to their relocation using epoxide glues, and the below grade stone bases of the columns were consolidated using cast in place concrete.

• Suspect joints and connections were strengthened using stainless steel dowels and steel plates previously coated in epoxide. These interventions were made so as to be invisible.

**East Gopura IV - South Portico Paving**

The necessary re-laying of the paving of the south portico work was undertaken with great care and according to the instructions below:

• Remove all loose stones and aggregate to expose laterite. Save all gravel-size fragments for use in concrete.

• Remove sandstone forming front steps as directed and stack in order ready for reconstruction.

• Carefully remove stones below ground level to a level which has sound bearing capacity. Prepare the excavation to receive a concrete foundation.

• Mix concrete (1:3:5) and place concrete to a depth of at least 10 cm below the present finished surface level.

• Rebuild stone steps drilling and doweling the stones together. No concrete or mortar is to be used to bed the stones. Place horizontal stainless steel ties to secure stone layers into the concrete base, as per instructions given on site.


• Line the surface of original stone construction with a heavy duty plastic sheet membrane so as to prevent contact between new concrete and stonework.

• Lay a relatively weak concrete bed (1:5:9) and bring it to 5 cm above the level of the laterite base.

• Relay the lower course of sandstone and prepare it to receive the top layer of paving stones.

• Replace the top layer of sandstone pavers in their original position.

Additional photographic and graphic documentation of the south porch, East Gopura stabilization project is located in Appendix M.

NORTH AXIAL PASSAGE WAY DEGAGEMENT

Always in search of ways to better present the site of Preah Khan, it was decided to clear the north axial route from the central shrine so as to allow passage again in this area for the first time in centuries. The former covered passage had been blocked by the collapse of its vaulted roof which both physically and visually blocked the way to the northern Gopuras which form the northern entrance to the monastery. This newly opened route now allow as an alternative access or egress passageway for visitors and a striking view northwards as far as Gopura II North and beyond.

During the process of degagement it was found that the corbelled vault stones, once located overhead, were for the most part badly damaged and the possibility of their reconstruction into working roof vaults was highly unlikely. Consequently, the stones were carefully stacked in the adjoining courtyard, organized according to instructions given by the chief stone mason.
CLEARANCE OF EAST PROCESSIONAL WAY

Following the successful reestablishment of the complete entrance sequence from the west to Preah Khan during Field Campaign I, it was decided to continue with limited clearance of the East Processional Way in the area between the eastern causeway and the North (Preah Khan) Baray. Thisdegagement activity was considered important to the interpretation of Preah Khan as the principal entrance to the complex was always from the East.

Initial clearance at the easternmost end of the eastern processional way exposed an important feature about Preah Khan with regard to the original access. On the containment levee for the Preah Khan Baray was found the remains of a jetty (boat landing) complete with stone steps and traces of sculpture which marked its borders. This reveals that one means of access to the monastic complex was by boat travel on the baray.
The Preah Khan baray also contains the marvelous Neak Pean temple at its center and at its east end, the Ta Som temple which is located in an almost exact counterpoint position to Preah Khan. Thus, clearance has made the relationship of the three temple complexes of Preah Khan, Neak Pean and Ta Som as parts of a planned arrangement along a four kilometer long east-west axis is much more intelligible.

The processional way located between the baray jetty and the Eastern Causeway is bordered by two rows of Lanterns raised on an uninterrupted carved linear plinth. In the process of clearing some twenty years of growth consisting of bush and small trees, the laterite paved surface between the two lines of has been exposed. Now the area can be easily understood as the primary historic pedestrian and vehicular passageway to Preah Khan.

Except for some recent damage caused by trees that fell during the 1989 storm, most of the lanterns are intact. During the degagement process three lanterns were found which still contained rare surviving undefaced seated Buddha images in their niches. (One of these has been recently removed to the safety of the site depot.) There are plans to clear the road along the raised embankment defining the western boundary of the baray and to encourage visitors to enter the temple from the east along the principal axis. Once this work has been authorized the jetty will also be properly cleared of debris and fallen stone. (See also photo documentation, Appendix N.)

REPAIR AND CONSERVATION OF LANTERNS

The repair and conservation of the Lanterns (Bornes) began based on the recommendations and priorities outlined in the appendices to Preah Khan Conservation Project Field Campaign I. The work performed during this campaign can be summarized as follow:

- Many of the Lanterns were realigned according to the recommendations so that they are positioned correctly on the platform,
• The upper section of Lanterns in several cases were reset in their correct and original positions.

• Several of the upper and lower sections were carefully pinned with stainless steel rods and glued together with a suitable matrix of resin bonded adhesives, sand and stone dust.

• The fracture joints were carefully pointed with a stone dust matrix.

This work will continue during the next season. See the appendices for further technical information from the materials conservation specialist (Appendix B) and the structural engineer specialist (Separate Appendix V/A) as well as additional graphic and photo documentation of repairs to the West Processional Way (Appendix O).

GENERAL DEGAGEMENT

Each year sees increased access to areas at Preah Khan that were lost to jungle. During Field Campaign II a concerted effort was made to clear fallen stones and debris and clear passages on both sides of Enclosure Walls III and IV - work that was partly inspired by the Environmental Study. The reason for this clearance was to begin controlling the plant growth on walls, which in many instances has caused severe disruption to their stability.

Along Enclosure Wall IV, which is bordered by the protective moat, is Preah Khan's magnificent collection of sandstone garudas located on approximate 50 meter centers. In several locations, vegetation has displaced the carved stonework forming the garudas to the point where in some instances it has collapsed. It is planned to further extend the work to the area of the garudas during the next field campaign, and to perhaps initiate a campaign to restore Preah Khan's unique collection of protective garudas.

PLANT CONTROL

For the most part it is preferred to continue controlled clearance and maintenance of the site using the trained labor groups (flottants). Certain areas, especially those areas where vegetation has taken a strong hold on structural fabric, were selected as locations for conducting some tests on the effectiveness of biocides. Of special interest has been the effectiveness of one particular systemic herbicide, which is considered the equivalent of the well-known product 'Round-Up'. In areas where ficus plants have taken root their leaves were sprayed with this systemic herbicide. Early tests have shown good but imperfect results. A major benefit of using such a product, as opposed to simply cutting the plant, is that the root system perishes and dries out, facilitating its removal without causing damage or disturbance to the stone work.
Garuda at Southeast Corner of Enclosure Wall IV, Preah Khan, May 1994.
Four Damaged Garudas Along North Side of Enclosure Wall IV, Before Degagement, May 1994.
STRUCTURAL REPAIR AND STABILIZATION

Following Engineer Gavrilovic's systematic structural survey, it was decided to carry out some prototypical examples of structural repairs for common failures throughout Preah Khan. Necessary materials and equipment were all found locally or in the region (in Siem Reap, Phnom Penh and Bangkok) which ensured minimal expenditure. The stainless steel used for dowels was purchased secondhand in Siem Reap, at a fraction of the cost normally paid in the U.S. or Europe. Adhesives suitable for stone repair are 'Sika' products that are readily available in Bangkok.

Column Repairs in the Hall of Dancers

The majority of sandstone columns at Preah Khan are monolithic. These columns, some over five meters in height, were usually cut from their quarry such that their long dimension was in line with the natural bedding plane of the stone. When stones cut in this fashion are placed vertically with significant weight above, stress from weight tends to cause them to split lengthwise and/or delaminate at their sides. At Preah Khan several dramatic stone column fractures can be found. Such fractures become weak points in the structural integrity of a building and can eventually lead to structural failure. When severe splitting of stone structural elements occurs, it is often necessary to reinforce the element or replace it in order to re-establish its original structural integrity.

Repaired Column, S.E. Corner of Hall of Dancers, April 1994.
A simple but effective method has been introduced to consolidate the split columns. The method is as follows:

- The column is relieved of its loading by carefully raising the lintel or beam above it.
- The fracture is cleaned out using compressed air.
- The fractured joint is pulled together using adjustable metal clamps (contact between the stone and metal is avoided, using timber wedges).
- Once the fracture is closed, the column is drilled through completely using a 12mm masonry bit.
- Spaces for bolt heads are countersunk by cutting out slots to receive the washer and nut.
- The bolts, which have been cut and tapped to the correct length, are coated in epoxy resin glue, placed in the drilled holes and tightened to close the fracture as tightly as possible.
- The remaining open section of the fracture and bolt is carefully filled with a resin bonded mortar matching the stonework. Interventions are carefully touched up and cleaned of any residue.

**Fractured Lintels**

A very common problem at Preah Khan is fractured lintels over door and window openings due to the failure of structural components above (endemic structural failures). In response to this fracturing, many lintels have failed from shear. In most cases cracked lintels remain in place in misaligned position. In other situations parts of lintels completely fall away. When lintel failure occurs, load bearing weights from above are transferred to adjacent areas such as wall sections which are usually not designed for either significant top loading or eccentric loading as is often the case when a structure in is the process of collapse.
Since January 1993 there has been a major effort to provide temporary emergency shoring to structures in danger of collapse. This shoring consists of temporary timber supports that are fixed into position as functioning props with the use of folding wedges. A series of repair measures have been devised for failed lintels at Preah Khan by Engineer Predrag Gavrilovic. (See Separate Appendix V/A.) Two such lintels were selected for repairs along the central east-west axis as prototypes for structural consolidation - one as a permanent intervention, the second as a simple solution for short term (up to 15 years) use.

One of the temporary solutions was implemented for a diagonal crack in a lintel that had opened near the juncture of a lintel and a column pier to a width of 20 mm. Temporary consolidation was undertaken by placement of an "L" shaped steel section at the juncture of the lintel underside and the vertical face of its supporting piece which was, in this instance, a wall pier. The procedure involved raising the beam with the use of a hydraulic jack and securing a custom made reinforced shelf angle to both the faces of both lintel and pier using stainless steel bolts. Epoxies which did not touch stonework were used to protect all the exposed metal against corrosion.

The procedure for a permanent solution for repairing fractured lintels involved initially relieving as much of the load as possible through the use of temporary shoring. The fracture was then closed as much as possible by careful jacking and kept shored in position for the drilling of two countersunk 12mm holes through the fracture at right angles to the fracture line. Stainless steel bolts were cut, threaded to size and coated with an epoxy resin. The bolts were then inserted and fitted with washers and nuts, and the outer nut on the threaded bolt is firmly tightened. After this, the internal portion of the fracture is filled by injection grouting. The placement of mortar should start from the lowest position and proceed to the top of the repaired stone. After the internally placed mortar has hardened, surface grouting is done with a weaker strength mortar that is color matched with the adjacent stone surfaces.

5. ADMINISTRATIVE MATTERS

WMF/Royal Government Relations
Labor Management
Collaboration with Royal Angkor Foundation
Technical Committee Meeting
Visitor & Project Promotion
5. ADMINISTRATIVE MATTERS

WMF/ROYAL GOVERNMENT RELATIONS

The recent transitional period was a time of uncertainty for Angkor. It included a change of the Hun Sen Government, interim management of Cambodia by the United Nations Transitional Authority in Cambodia (UNTAC), and subsequent government changes through Fall 1993, was a time of uncertainty for Angkor. Conservation issues for Angkor were a relatively low priority. Throughout this period WMF chose to maintain close communication with the Minister and staff of the Ministry of Culture/Sports/Education; the Director General and staff of the Department of Archaeology; the National Museum staff, and the Director and staff of Conservation d'Angkor in Siem Reap.

Following formal approval in January 1993 of WMF's application to proceed with the Preah Khan Conservation Project, WMF's work at the site began in earnest and is documented to date in four reports. All of the WMF reports pertaining to Angkor and Preah Khan have been circulated with summaries in French. At the time of submission of each annual report in September, WMF also submits a proposal for the upcoming field campaign period covering November through April.

Following confirmation of the present Royal Government in August 1993, the appointment of the two joint Prime Ministers, Mr. Hun Sen and Prince Ranaridh, and the reinstatement of King Sihanouk, WMF reestablished its relationships and status with the new Royal Government. During its first mission within Field Campaign II in October/November 1994 the newly created Ministry of Culture was presented copies of the 1993/94 Program and Work Plan along with field reports documenting work undertaken during the previous year. WMF was very pleased to renew its acquaintance with the new Minister of State in Charge of the Safeguarding of Angkor, H.E. Vann Molyvann. After several extended meetings with H.E Vann
Molyvann WMF realized the desperate need for support and assistance that the Royal Cambodian Government had for the development of a suitable Conservation Management Plan for the monuments of Angkor and its environment and endeavored within its limited resources to put forward a series of proposals beyond those relating to Preah Khan. See Appendix K "Proposal for Security Measures for Banteay Srei" and Appendix F "Technical Assistance Proposal to Conservation d'Angkor." Other proposals relate to WMF's possible involvement at other sites at Angkor.

Government personnel, who have themselves worked so hard to preserve Angkor, have praised WMF for working to build this strong connection. As a result, WMF enjoys a strong relationship with the present Royal Government. WMF has been pleased to receive many members of the Ministry of Culture and other government officials for tours of the Preah Khan Project.

As the procedures for application and consent to work at Angkor are still being developed, WMF has outlined its program to both the Ministry of Culture and the Ministry of Foreign Affairs. In the meantime WMF has endeavored to inform all agencies and organizations having purview over Angkor of its intentions for the near future. The most recent permission granted by the Government pending final review by the newly formed International Coordinating Committee on the Safeguarding & Development of the Historic Site of Angkor (ICC) is for Preah Khan Project Manager John Sanday to also serve as an official Technical Advisor to Conservation d'Angkor. This will increase John Sanday's presence at Angkor to an average of 10 days per month for 12 months beginning in late September 1994. The acceptance of this and various other project proposals submitted by WMF is indicative of the mutual trust and understanding which exists between WMF and the Royal Government of Cambodia.

**LABOR MANAGEMENT**

The size and quality of the work force at Preah Khan in Field Campaign II is very different from that of Field Campaign I. During Field Campaign I, the first extensive period of site activity (six months), there were as many as 110 people
working at Preah Khan. This work force was mostly made up of a large number of 'flottants' or casual laborers. At the close of the field campaign in April 1993, it was necessary to reduce the number of workers. As the UN-brokered election approached in May, WMF decided to close the site completely for fear of it being a target of political unrest. (As it turned out a valiant group of twelve determined workers stayed at the site throughout the monsoon period to protect Preah Khan.)

A selected work force of 50 people was reassembled in November 1993 under new leadership. The former chef de chantier, Im Mar, requested leave to work with the EFEO project at the Terrace of the Leper King and a new chef, Ouk Samon, who had been helping WMF at Preah Khan since 1992, took charge of the work force. He was supported by WMF’s chief administrative assistant Kussom Sarun.

The type of worker and the skills required at Preah Khan had become apparent during Field Campaign I and the best qualified people were selected and organized into specialized work groups in Field Campaign II. Each group was controlled by a foreman (carporal) and recently two sous chef de chantier were appointed - Chet Kuy and Sao Sar, both experienced men with remarkable skills for piecing together fallen stone structures.

Each of these groups was assigned specific tasks and was trained in conservation procedures developed by the WMF for use at Preah Khan. All were oriented on the daily maintenance requirements for the site.

The following summarizes the Field Campaign II work force:

**Stone Working Group 1:** Responsible for all major repair and consolidation interventions requiring the highest degree of skill and experience.

**Stone working Group 2:** Responsible for degagement of fallen structures and similar activities which requires experience in piecing together building and carved elements.

**Emergency Stabilization Group:** Responsible for noting structures on the point of collapse and providing temporary emergency timber shoring.
Vegetation Clearance Group: Responsible for clearance of vegetation and maintenance of cleared areas.

Carpenters Group: Responsible for conversion of logs in forest into planks for use at site either as decking for scaffolding or for the construction of a new visitor facility near the Preah Khan depot.

The Preah Khan Forge: Responsible for the construction and maintenance of all the metal tools at site, for the hand manufacture of steel bands, dowels, bolts, etc., used in structural consolidation work.

Guardians/Storekeepers: Responsible for guarding the depot and equipment used at the site, for maintaining the depot store and for minding the present temporary reception area for visitors.

Time Schedules

Winter Hours: In recognition of the climate, WMF has set different work periods for the winter and summer seasons. The winter period of normally runs eight hours from between 7 am to 11 am and between 1pm to 4 pm. The winter work schedule was in effect from the beginning of October to the end of April.

Summer Hours: The summer work period was reduced by one hour to a seven hour work day. Work in the morning started as usual from 7am and ended at 11am. The afternoon work shift lasted from 1 pm to 3 pm. The summer period was in effect between the beginning of May and the end of September.

Overtime: Any time worked beyond these periods is considered as overtime and is paid at the rate of 1.5 the normal rate. Overtime was spent on several occasions during the major field missions of Field Campaign II since the WMF team of consultants would, on occasion, conduct operations that required completion within a particular time frame.
Workers Wages

There has been some concern at all levels with regard to the salaries of Cambodians working on site at Angkor. There is no parity between the very low rates provided by the Conservation d'Angkor which are established through government policy, the rates set by the EFEO who are working on a fixed budget, and those which WMF is presently paying at Preah Khan. Meetings have been called to establish a standard for payment and recently, at the request of the Minister of Culture Mr. Nouch Narang, WMF presented a recommendation for wage rates based on the present system used at Preah Khan.

WMF is firmly of the opinion that the various skills of its work force at Preah Khan should be properly recognized by the use of a simple graded wage scale. WMF also strongly supports the idea that the same wages be paid to all who are working on historic structures in the Angkor region. These rates should not be tied to the standard labor rates for modern construction. WMF will gladly adopt a standard rate for the Cambodian workers at Preah Khan once the matter has been decided by the Royal Government of Cambodia.

These following wage rates were set at the beginning of the season in November 1993. (They have subsequently been revised upward.)

**Monthly Salaries**

<table>
<thead>
<tr>
<th>Position</th>
<th>Rate</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chef de Chantier</td>
<td>$80.00</td>
<td>Per Month</td>
</tr>
<tr>
<td>Sous Chef de Chantier</td>
<td>$50.00</td>
<td>Per Month</td>
</tr>
<tr>
<td>Administrative Assistant</td>
<td>$36.00</td>
<td>Per Month</td>
</tr>
<tr>
<td>Guardian</td>
<td>$28.00</td>
<td>Per Month  (Extra to their wages)</td>
</tr>
</tbody>
</table>

**Daily Wages**

<table>
<thead>
<tr>
<th>Position</th>
<th>Rate</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chefs de Groupe</td>
<td>3,500 Riels</td>
<td>Per Day</td>
</tr>
<tr>
<td>Ouvriers</td>
<td>2,800 Riels</td>
<td>Per Day</td>
</tr>
<tr>
<td>Flottants</td>
<td>2,500 Riels</td>
<td>Per Day</td>
</tr>
</tbody>
</table>
Labor rates used by WMF during Field Campaign II generally reflected the skills and experience of the workers, and the number of hours that were worked at the site.

COLLABORATION WITH ROYAL ANGKOR FOUNDATION

The Royal Angkor Foundation (RAF) based in Budapest, Hungary was founded in 1992 with the specific purpose of advocating revitalization of the material and intellectual heritage of the ancient culture of Angkor. As outlined in its mandate the Foundation has focused "...on three specific areas of interest: an eco-cultural, hydrological history of the Khmer Empire, comparative cartography of the Angkor region, and the consolidation of all available information on Angkor into a modern Geographical Information System (GIS)." In this capacity RAF provided support to the UNESCO Zoning and Environmental Master Plan Program (ZEMP) which is due for publication at the end of July 1994.

RAF recently launched an emergency consolidation program at Preah Ko at Roluos, 12 km to the east of Siem Reap. Preah Ko, founded in 879 AD., consists of a group of five stuccoed brick temples with sandstone decoration and is enclosed by two perimeter walls and a moat. Because Preah Ko represents the only surviving example of a type of Khmer temple architecture at Angkor, and because of its severe state of dilapidation, RAF has established this program to stabilize threatened stone and stucco at the site prior to commencing a more large-scale program conservation program.

WMF sees an affinity between its own conservation program at Preah Khan and the Preah Ko project and is keen to collaborate with RAF. The opportunity arose at Preah Khan in March when the WMF team conducted trial projects involving the consolidation of three fractured columns (See Separate Appendix V/A - Structural Repair and Consolidation.) WMF had a limited amount of epoxy to complete work it had undertaken and on approaching RAF to borrow some of their materials, was not only provided with epoxy but also with the services of its stone conservation specialist, Simon Warrack, who assisted Engineer Gavrilovic in the refixing and grouting of one of the three columns. WMF thanks the Royal Angkor Foundation
for its quick and cooperative response to a call for assistance and hopes this will be
the start of a long-term sharing of skills and experience.

Collaboration began in May 1994 when WMF Program Director John Stubbs
invited RAF Chairman Janos Jelen to participate in a proposal to the United States
National Aeronautics and Space Administration (NASA) to survey the Historic City
of Angkor, Preah Khan, Preah Ko and the Bayon using a special radar imaging
technique used aboard the space shuttle Endeavour. (See Appendix L.)

TECHNICAL COMMITTEE MEETING - MARCH 21, 1994

WMF was invited by the International Coordinating Committee on the Safeguarding
and Development of the Historic Site of Angkor (ICC) to attend the First Session of
the Technical Committee on March 21, 1994. John Stubbs and John Sandy of
WMF attended as observers.

The ICC was established as an international mechanism for assisting the Royal
Government of Cambodia in matters pertaining to the safeguarding the Historic City
of Angkor. The formation of the ICC was one outcome of the Tokyo Declaration
which resulted from a high level meeting held Tokyo in October 1993. The
Declaration established that the ICC will meet three times a year and will be attended
by counselors from embassies in Cambodia and invited international organizations
having special interests in Angkor. NGO's such as WMF will be able to participate
as observers on request.

The March 21st meeting provided insight into activities currently underway which
are part of the overall campaign to safeguard Angkor. WMF's assistance at Angkor
to date was gratefully acknowledged by Minister of State H.E. Vann Molyvann in
his opening address as Cambodia's Chief of Delegation to the meeting.

During the latter part of the meeting WMF's proposal for implementing site
protection measures at Bantay Srei was submitted for comment to the Technical
Committee of ICC. (See Appendix K.) After some minor modifications it was
accepted.
VISITOR AND PROJECT PROMOTION

Field Campaign II at Preah Khan has received considerable local and international publicity, resulting in an increased number of visitors to the site. The number of people passing through Preah Khan per day often exceeds 150, and represents well over 70% of those people visiting Angkor. (Preah Khan is usually not included on the tour of the one-day package groups.)

Local Publicity

A concerted effort is made at the site to welcome visitors to Preah Khan, and to inform them of the work that WMF is undertaking. Each visitor is presented with a free brochure outlining the history of the site, a suggested visitation route and a statement of WMF's mission in Cambodia. Brochures are available in both English and French. Plans are underway to publish the brochure in Khmer and Japanese during Field Campaign III.

Special Tours

Guided tours of Preah Khan were given by special request to groups such as the Chief Executives Organization (CEO), the Museum of San Francisco's Asia Society and Columbia University's and Cornell University's alumni groups. John Sanday provided an extensive two-hour tour explaining the history of the monastic complex, insight into its religious aspects, and the principles and procedures for conserving and presenting Preah Khan and the other monuments at Angkor.
During the November mission, American groups from the Chief Executive Officers (CEO), and San Francisco Museum of Fine Arts Asia Society. Another group included Ms. Minja Yang and other officials from UNESCO headquarters with whom John Sanday discussed both the philosophy and technology adopted for the project.

At the instigation of WMF, representatives of several international funding organizations visited Preah Khan during the past year with a view to providing assistance to the project in one form or another. Special tours of Preah Khan and
other sites arranged for potential funders have encouraged a number of philanthropists to support the project.

**Local Fund Raising Efforts**

As a result of increased visitation to the site and of the remarkable amount of visitor interest in the on-going conservation activities at Preah Khan, WMF has expanded its active presence at Angkor to be a year-round program. For visitors to Preah Khan who may wish to contribute towards the site conservation activities, WMF has organized a local fund raising effort involving the offer of locally made products in return for visitor contributions. Product offerings include special T-shirts with designs relating to Preah Khan, small grass cutting knives made by the Preah Khan blacksmiths, and castings of bronze garuda book ends produced in Siem Reap using the lost wax process. These items are offered as premiums in recognition of various levels of cash contributions to the project. During the busy tourist season WMF collects sufficient contributions to pay the wages of the work force.

**Interpretive Center for Visitors**

Following the success of offering simple brochures and mementos to visitors at Preah Khan, WMF decided to extend its visitor facilities. The construction of a larger visitor's center was made possible by a grant from the Pacific Asia Travel Association (PATA). By the beginning of the Field Campaign III, the new Preah Khan Interpretation Center for Visitors will be operational. (See Appendix D.)

A design competition was held among the second year students from the Department of Architecture, University of Fine Arts Phnom Penh. All the students were provided with the project budget, program requirements and materials specifications. Five proposals were received for the new building, which had to be sited adjacent to an existing reception center and depot located along the pathway to the west entrance of Preah Khan just inside the West Gopura at Wall IV. Some of
the schemes were very ambitious and went beyond the simple requirements for the structure. The design selected was by Lek Sareth and, with small modifications by the WMF team, was constructed between the months of April and July 1994.

The new structure was designed to use only local materials and traditional construction techniques. It is constructed entirely of lumber from fallen trees at Preah Khan. The structure is set on concrete piers which rest on the ground surface, so as to avoid the need for excavation. The visitor center and depot is laid out to enable extension as required.

Water Well at Worker's Depot, March 1994.

Sawing Lumber From Dead Trees, March 1994.
6. OTHER WMF ACTIVITIES AT ANGKOR

WMF's Assistance at Banteay Srei
Angkor Conservation Planning Conference
Technical Assistance to Conservation d'Angkor
WMF's Assistance at Neak Pean & Ta Som
Structural Assessment of Pre Rup
Structural Assessment of Angkor Wat Causeway
6. OTHER WMF ACTIVITIES AT ANGKOR

WMF's contributions to the conservation of Angkor have been recognized in a number of different ways. During Field Campaign II the advice of consultants was sought by the Ministry of Culture and by the Conservation d'Angkor in Siem Reap. Outlined below are some of the activities WMF has been involved in beyond its program at Preah Khan.

WMF'S ASSISTANCE TO BANTEAY SREI

A proposal was made by WMF in January 1994 in response to an invitation by the Royal Government of Cambodia for WMF to help address an alarming increase in looting of sculpture and other objects of cultural value from the highly important temple site of Banteay Srei (967 AD). A number of pieces of fine sculpture have been stolen from this site in recent months - a fact corroborated by the recent appearance of architectural elements from Banteay Srei for sale in the antiquities markets of Thailand and the rest of the world.

Following a visit to Banteay Srei in November 1994 WMF's sponsors, who were shocked by evidence of this recent looting, declared an interest in supporting efforts to protect Banteay Srei from further violation. By coincidence, a request was sent to WMF by H.E. Vann Molyvann, Minister of State for the Royal Government of Cambodia, for assistance in providing effective protection of the site. The Board of Trustees of WMF asked the technical staff to conduct a survey of the possibilities for safeguarding Banteay Srei at the time of WMF's next Cambodia mission which was planned for January 1994. At this time WMF staff and consultants carefully examined the temple complex and parts of its environs for purposes of improving security at the site. The task was to propose measures to discourage further vandalism and treasure seekers. Following this survey WMF prepared a project
proposal entitled: "Recommendations for the Protection of Banteay Srei" which was presented to the Royal Cambodian Government for their consideration. See Appendix K. The same document was submitted to the International Coordinating Committee's Technical Committee in March 1994 and approved with minor modifications. The project will commence, once areas of the site have been de-mined, sometime after the end of September 1994.

ANGKOR CONSERVATION PLANNING CONFERENCE

Due to WMF's success in running "charrettes" (intensive project planning sessions) for several of its projects elsewhere in the world, due consideration was given to organizing such a planning conference involving all parties working at Angkor with input by selected additional experts. The purpose was to respectfully attempt to force consensus, on at least interim solutions, for the most important conservation challenges being faced at Angkor. H.E. Vann Molyvann encouraged this proposal which was submitted in draft form in January 1994. (See Appendix E.)

The assumption here was that much had been accomplished in the past five years in establishing a coherent plan for the conservation and presentation of the Historic City of Angkor\(^2\) and its adjacent areas, and that a problem of consensus that existed at the time might be resolved if there were a well planned and managed solution-oriented planning conference. The whole range of issues ranging from research,

\(^2\) The most recent and extensive effort to provide a comprehensive historic resource development guide for Angkor, Siem Reap and its outlying areas was formulated in 1993 and 1994 under the aegis of UNESCO as a Zoning and Environmental Master Plan (ZEMP). The ZEMP document addresses a wide range of challenges at Angkor which must be met, including legislation, data base management, zoning, conservation, archaeology, hydrology, training, tourism, new development, infrastructural improvements and administration. It also contains proposals for the implementation of many of its recommendations, especially the immediate next steps.

WMF which has been interested in ZEMP's progress but, like many other national and international organizations, was sidelined during the development of the report, realized its importance to the future of Angkor. WMF therefore offered to the Royal Government to organize an intensive workshop to help align some of the ZEMP recommendations with the new Royal Government's requirements, to co-ordinate proposals offered by other donor agencies, to finalize an acceptable cultural resource management structure and to help implement conservation plans for Angkor and its adjacent areas.
documentation and environmental conservation to water management, improved interpretation and site security were to be addressed.

Subsequently it was decided by both the Royal Cambodian Government and WMF to postpone the planning symposium until after UNESCO's ZEMP report was published around the end of July 1994 and to reconsider the options later in the year.

TECHNICAL ASSISTANCE TO CONSERVATION D'ANGKOR

Since 1989, WMF has assisted the Cambodian Government with the planning and implementation of projects at Angkor ranging from the preparation of an initial overview in 1989 of the problems of conserving and protecting the historic zone of Angkor to the planning and development of the conservation, protection and presentation of Preah Khan. As a result of the impact that the Preah Khan Conservation Project has had on the philosophies of conserving and protecting Angkor, WMF was asked in March 1994 to extend its activities to assist the Royal Cambodian Government beyond the confines of the Preah Khan Project.

Following recent meetings with the Minister for State Vann Molyvann WMF was requested to provide further assistance to the Conservation d'Angkor in Siem Reap in the form of general technical support. As an interim measure for a period of at least one year, John Sanday, Preah Khan's Project Manager will become a part-time adviser to the Conservation d'Angkor for the purpose of assisting in the development of a Department of Architectural Conservation.

As of June 1994, details of this proposal were presented and accepted in principle by the Royal Government and are being formally presented for endorsement by the Technical Committee of the International Coordinating Committee on the Safeguarding and Development of the Historic Site of Angkor which will meet again in October 1994. (See Appendix F.)
WMF'S ASSISTANCE AT NEAK PEAN & TA SOM

Since February 1994 the Ministry of Culture has been eager to have groups of monuments adopted by teams working in Angkor. Such work was to initially involve the setting up of programs for degagement and presentation of sites within the capacity of the donor agency, and the provision of guidance and assistance to the Conservation d'Angkor in Siem Reap with regard to these sites.

At the invitation of the Minister for State H.E. Vann Molyvann, WMF was invited to undertake the necessary survey and analysis work relevant to the conservation and presentation challenges posed at the temple sites of Neak Pean and Ta Som which comprise two of the larger 12th century Khmer temple sites located along the north border of the Angkor Archaeological Park. Together with Preah Khan, which WMF has been working on since 1991, these three temple complexes form an ensemble linked by the 4 km long reservoir known as the Preah Khan or "Northern" Baray with Neak Pean located at its center. The possible addition of the sites to WMF's program for Preah Khan was thought to be a logical extension of WMF's activities at Angkor. (See Appendix G.)

Subject to the approval of the WMF's Technical Assistance Proposal for the Conservation d'Angkor, WMF is considering deploying part of its present work force from Preah Khan to undertake initial clearance of the sites of Neak Pean and Ta Som to enable visitors to obtain a better understanding of the relationship of both the sites to the Preah Khan Baray and indeed to Preah Khan itself.

STRUCTURAL ASSESSMENT OF PRE RUP

Following the announcement at the Technical Committee meeting on March 21, 1994 when a summary report was circulated concerning emergency works at Pre Rup, WMF's Conservation Architect Sanday and Engineer Gavrilovic visited the site to check the diagnosis presented at the meeting. The report stated that there was deformation of the platforms due to settlement which was causing severe structural problems to the foundations of the towers of the upper platform. Having addressed similar questions at Preah Khan, the WMF team was keen to share its experience
and to assist the Royal Government in deciding on the most suitable intervention at Pre Rup.

The fears that the foundations to the high platform of Pre Rup are failing were unfounded, in the view of the Preah Khan team members. It was evident, however, that the five brick towers raised on the high platform of Pre Rup need structural stabilization. It is hoped that, with minimal intervention, the towers can be consolidated. The Institute of Engineering in Skopje, Macedonia, under Gavrilovic's supervision, is planning to submit a proposal to undertake the survey and implementation of this exacting piece of engineering work. (See Appendix H.)

STRUCTURAL ASSESSMENT OF ANGKOR WAT CAUSEWAY

A proposal for a collaboration between the National Council for Culture of the Royal Cambodian Government and the Institute of Asian Studies, Sophia University (Japan) to restore the northern half of the west causeway to Angkor Wat was in its early stages of research in March 1994.

Following a survey of the site during the Ecole Francaise d'Extreme Orient (EFEO) and Sophia University's workshop on the afternoon of March 22, 1994, the World Monuments Fund team was concerned about the diagnosis of the structural failure of the foundations of the northern wall of Angkor Wat's west causeway. Subsequently, John Sanday and Dr. Predrag Gavrilovic made a closer investigation and submitted a brief note regarding this issue for the purpose of assisting the Royal Cambodian Government in their deliberations on the extent of work required at this site. (See Appendix I.)
7. APPENDICES

A. Management and Presentation the Environment
B. Stone Conservation Principles and Procedures
C. Design for Site Safety Signs
D. Proposal for Visitor Reception Facility
E. Angkor Cultural Heritage Planning Conference
F. Technical Assistance Proposal for Conservation d'Angkor
G. Project Proposals for Neak Pean & Ta Som
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APPENDIX A

MANAGEMENT AND PRESENTATION OF THE ENVIRONMENT AT PREAH KHAN

by Ronnie Yimsut
APPENDIX A

MANAGEMENT AND PRESENTATION OF THE ENVIRONMENT AT PREAH KHAN

OBJECTIVES

This preliminary environmental management and protection document aims to analyze the condition of the forest and grounds of Preah Khan and its immediate environs since vegetation, wildlife and the overall ecology are a vitally important aspect of the temple complex.

The objectives and specific actions which are necessary to accomplish a program for the management and protection of Preah Khan are described herein. A strategy has been developed which provides recommendations for overall environmental protection and which gives special consideration for the monumental structures and other archaeological concerns at the site. This report will address strategies for:

1. protection of the existing forest surrounding Preah Khan's outer wall;
2. protection of the existing moat;
3. overall site management and presentation;
4. emphasizing and enhancing the visitor experience including awareness of the environment;
5. emphasizing and enhancing exceptional views of the area;
6. improving overall environmental protection and resource management of Preah Khan's archaeology, vegetation, wildlife and visual aesthetic;
7. management of the different means of access to, through, and around the site (i.e., road systems, parking facilities and nature trail systems);
8. overall site interpretation; and
9. site safety and security considerations.
PROCESS

Existing site conditions, vegetation growth patterns, and future uses of the site were analyzed to identify potential opportunities and constraints. Specific recommendations have been established and ranked for implementation in either single or multiple phases of development. The implementation section includes recommended action plans including step-by-step procedures required to achieve stated objectives. Land use zoning and recreational opportunities were also considered and recommendations have been made for a number of appropriate ancillary site uses.

Site monitoring during the implementation stage is critical to ensure the success of this project.

Conceptual Site Analysis and Site Planning

The objectives of this report are based on concerns and recommendations derived from the conceptual site analysis and site planning which evaluated the following:

1. Site sensitivity considerations, such as social, political, cultural, economic, plant and animal species, wildlife habitat, unique landscape and water features.

2. Analysis of site attributes, such as micro-climate, geology, soil, topography, vegetation, hydrology, past and present land use.

3. Analysis of existing and potential important/unique cultural resource sites.

4. Visual resources.

5. Overall site experience relating to the recreational opportunities.

6. Site opportunities and limitations.

7. Estimated site holding/handling (carrying) capacity.

8. Site suitability for development and management.
Existing Site Analysis and Recommendations

During the January 1994 mission, field data was collected and analyzed. The study area was divided into 10 distinct zones for site management planning purposes. Recommended action plans which consider overall environmental protection and resource management are proposed for each zone. The action plans include a proposed Visual Quality Objective (VQO) which defines the degree of allowable intervention by man on the natural environment.

Visual Quality Objective (VQO) Codes:

**Preservation VQO** Absolutely no environmental management intervention is allowed. The area shall not be disturbed by man. Nature shall be allowed to run its course.

**Full Retention VQO** Management activities which are not evident to the casual visitor. In this instance vegetative buffers will be protected and well maintained.

**Partial Retention VQO** Management activities may be visible to the casual visitor, but must be subordinate to the surrounding environment. Any interventions by man must be minimal.

**Modification VQO** Management activities can be visible to the casual visitor, but will be subordinated to the surrounding environment. No drastic changes to the environment would be made which would affect the overall visual quality.

**Plant Communities, Succession and Association** During the survey it was discovered that a number of large, medium and small size tree species are found in all the zones of the overall Preah Khan site. However, it was noted that the succession stands are very poor. There are a large number of either very large or very small trees with few in between. According to the field survey, very few medium sized trees still exist in the area. Currently, the site has a fair number of large trees but very few small seedlings, shrubbery, brushes and vines are the most common. This could present a major problem in terms of the site maintenance, wood fiber production, and forest coverage in the future.
Vegetation Layer  Vegetation currently has three distinctive layers. The bottom layer is composed of shrubbery, brushes, vines and grass species. The middle layer is represented by medium size tree species and the top layer is represented by a number of large timber species.

Most of the stands in these three layers are in fair to excellent condition, although some of the larger trees are beginning to die of old age. A new generation to replace them has failed partly due to the change in micro-climate brought on by past and present logging operations in the area.

Hazard Trees  The removal of identified hazard trees should be a serious consideration in the overall management of the site. This is also a major issue with regard to protecting above-grade archaeological remains and in some instances might even be a life safety issue.

Moat  The moat located at the outside of Enclosure Wall IV is overgrown with water plants and other vegetation and no longer functions as it was originally intended. Eventually, it should be restored to its former glory, but initially the edges along both sides of the moat should be protected. Routine maintenance should seriously be considered along with removal of unwanted vegetation.

Outer and Inner Wall  Many sections of the free-standing Enclosure Walls III and IV of Preah Khan are overgrown with ficus trees and other species. Parasidic ficus trees are destroying a number of structures within the complex. Many of these trees, especially the giant ficus, are either dead or dying. Others are leaning and threaten to fall.

Removal of the identified hazard trees should be a serious consideration in overall site management and presentation and directly relates to the safety considerations for this site.

Spiritual Aspect  The site of Preah Khan was built to honor the Gods. It is a place of serenity and peace and as a result the site is spiritually uplifting. A visitor cannot help but experience this unique quality. All efforts should be directed towards retaining this distinctive character.
Socio-economic Consideration  Socio-economic considerations relative to the natural environment of Preah Khan were studied as there is evidence that the site has been a source of income for the local population for many generations. Resin collection from the dipterocarpus tree, firewood cutting and the collection of fruits, plants and fibers have been a way of life for many surrounding villagers for countless generations. These can be described as low impact activities that do not destroy the environment. Most of the local villagers know how to work and care for their forest environment. They take only what can be removed without compromising their tradition, livelihood and environment. The forest utilization traditions of local villagers should be incorporated into the new environmental management process. Local villagers should be engaged to tell about their experiences with these "sustainable activities" and how they believe their resources should be managed. Policy should be only to regulate irresponsible and illegal logging operations, which is currently in practice just a few hundred meters away from Preah Khan.

It is strongly recommended that those in charge of preserving and presenting Angkor should encourage, not discourage, the above-mentioned responsible activities that exist in the area. The local inhabitants of the jungle can teach us much about natural resource management and one important aspect of interpreting Preah Khan should be to explain these ecological concerns.

ZONE RECOMMENDATIONS

It is best to develop a wide range of alternatives to better implement and manage this project. An overall action plan can be designed which assumes implementation in either a single or multiple phases. See Land Use Zoning Map for the location of the recommended actions(s) for each zone.
LAND USE ZONING MAP

WORLD MONUMENTS FUND

PREAH KHAN CONSERVATION PROJECT

ANGKOR CAMBODIA 16 JANUARY 1994
Zone One  (The area along both sides of the roads located to the west, north and northeast of Preah Khan)

Recommendation: Retention of Foreground Visual Quality Objective (VQO)

Clear and maintain a three to five meter areas on both sides of these roads of all undergrowth, with the exception of any major timber species. This is a vehicular travel way and should be cleared of all unwanted vegetation to help improve safety and presentation. The clearing of both main and minor access roads could be done by local laborers on a monthly basis.

The East Entrance of Preah Khan should be re-established as the primary entry way for all visitors. For this to occur a vehicle turn around loop and drop off point must be provided in the area of the East Entrance axial pathway area.

A parking area should be created across the road from the West Entrance of Preah Khan. This will serve as the pick-up point for visitors who are approaching from the East. This will also help relieve the congested parking and circulation problems currently faced at this location.

Zone Two  (The area along the North, South, East and West approaches to the Preah Khan complex and the historic boat landing area at the East Baray.)

Recommendation: Retention of Foreground VQO

Maintain a three to five meter clearance of vegetative edge, parallel to and along both sides of the walkway. All vegetation, except large trees should be removed and the areas maintained. This will help highlight the axial effect originally experienced at Preah Khan. Considering all the vegetation which is present within this zone, when cleared the resultant "framed view" will have a dramatic appearance.
Zone Three (The forested area surrounding the outside edge of the perimeter moat.)

Recommendation: Preservation VQO

This area should remain undisturbed without any intervention of any kind, especially tree removal. Preservation of this "buffer zone" is critical. Any disturbance will alter the complex ecosystem found within the area. The slightest impact on this important micro-climate will have serious negative implications for the area. This zone will maintain itself through natural processes.

Zone Four (The areas at the immediate outer edges of the moat and between Zone III and the moat.)

Recommendation: Retention, Partial Retention and Modification VQO.

This zone has great potential as an interpretative nature trail along the picturesque outside edge of the Preah Khan's impressive perimeter moat. The open views of Preah Khan's outer wall are exceptional. A narrow trail of approximately three meters in width with a one-half meter wide bare soil walkway should be provided and continuously maintained. This trail system would require maintenance at least one a month, and more frequently during tourist peak season. A nature trail maintenance team would need to be in place in order for this kind of visitor offering to properly function.

Zone Five (All areas that fall within the moat and its edges.)

Recommendation: Modification VQO

Retain and protect the buffers of vegetation along the edges on both sides of the moat. This will help preserve the moat system from erosion and other problems. If the laterite edging forming the moat is someday restored, then all vegetation along both edges of the moat should be completely removed.

Areas that fall within 50 meters of the N, S, E and W causeways to Preah Khan should be cleared of all vegetation, including all water plants, with the exception of
Water Lilly. This intervention will create reflecting pools of water that will enhance the aesthetic quality of the site. Removal of such a small portion of vegetation will not degrade the water quality nor quantity through evaporation.

Ideally, the moat should be completely restored to its original function as a drainage canal though this seems unrealistic at the present time since the water management system, (e.g. supply and exit channels) in this part of the Historic City of Angkor has been in disuse for centuries. Still, by utilizing the dredging method, removal and disposal of at least selected areas of water plants should be seriously considered.

**Zone Six** (Area between the moat (Zone Five) and Enclosure Wall IV of Preah Khan.)

*Recommendation:* Retention, Partial Retention and Modification VQO.

This zone has great potential as a location for an interpretative nature trail that could take visitors along the inside edge of the moat. The open views of the forest across the moat (Zone 3) are exceptional. A narrow trail that varies in width (up to three meters) with a one-half meter wide bare soil walkway should be provided. This trail system would require maintenance at least once a month; more frequently during the peak tourist season.

**Zone Seven** (The area immediately along the inside Preah Khan Enclosure Wall IV.)

*Recommendation:* Retention, Partial Retention and Modification VQO.

This zone has great potential as an interpretative nature trail that could take visitors around the inside of the outer enclosure wall of Preah Khan. The enclosed feeling of walking through a tunnel of jungle, guided by the height of the outer wall provides a special experience in system of loop trails. A narrow trail approximately three meters in width, with a one-half meter wide bare soil walkway should be continuously maintained. This trail system would require regular maintenance at least once a month; more frequently during the peak tourist season.
Zone Eight  (The forested areas between Enclosure Wall IV and the archaeological conservation zone at the center of Preah Khan.)

Recommendation: Retention and/or Partial Retention VQO

This area was originally probably devoid of tall trees and occupied by domestic buildings and other support buildings built of perishable materials. During Preah Khan’s centuries of abandonment the present forest of tall trees and undergrowth have become established which provides a completely different experience in this area of the site, albeit one which is quite special in its own way.

The first option is to keep this zone in an essentially undisturbed state as it is now. Site managers could continue to allow access for both tourists and villagers, using the existing meandering trail systems located throughout this zone.

The second option is to clear this area of all the underbrush that has been choking it, preventing the growth of more large tree species. Clearance of undergrowth would create an even stronger park-like feeling. One would be able to enjoy filtered views in almost every direction which would boost the overall visual and sensual experience for visitors. Under this option, the cost of site maintenance will be higher thus making this less feasible.

Zone Nine  (The area of approximately ten to fifteen meters immediately outside Enclosure Wall III of Preah Khan.)

Recommendation: Partial Retention VQO

The area should be completely cleared of all underbrush. All existing large tree species should be retained and their natural regeneration encouraged. The encroaching forest will be held at bay as a buffer zone. Continuous maintenance of this area is absolutely essential as it allows for important first impressions of the monumental ruins of Preah Khan and provides allows for an understanding of the overall size and shape of the most architecturally significant parts of the site.
**Zone Ten** (The area within Enclosure Wall III of Preah Khan.)

**Recommendation:** Modification VQO

Ideally this zone should be completely cleared of all vegetation since uncontrolled plant growth is a chief culprit in the destruction of the Khan temple complex. For 'atmospheric' and educational reasons, a number of big trees have been allowed to remain. Nearly all of these giants are either dead or dying. Many pose major hazards to the structural integrity of the complex, not to mention to visitors passing below. For that reason, it is strongly recommended that all identified hazard trees should be removed. After an initial on-site examination made in January 1994, a list of all potential hazard trees was prepared and prioritized for further review.

Implementing these recommended large tree removal actions should be seriously considered as part of the overall site conservation and presentation plan. Expert tree removers should be used for this work to avoid damage to architectural fabric at the site. For educational purposes, some of the root systems of the trees might be retained. (See Hazard Tree Map and Hazard Tree Priority Removal List.)

**Hazard Tree Priority Code:**

**Priority I** Requires immediate attention and consideration for action due to the type and condition of the trees. They are either dead or dying, and some are badly leaning. These trees had a high to extreme risk of danger of the time of initial examination.

**Priority II** Requires careful consideration for action. The condition of the trees is fair. They are still alive but in the process of dying. They have a moderate to high risk of danger at the time of initial examination.

**Priority III** Requires little or no action. The condition of trees is good and fairly healthy. However, their condition may change. They pose low to moderate risk of danger at the time of initial examination.
HAZARD TREE PRIORITY LIST

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HAZARD TREE PLAN

WORLD MONUMENTS FUND N.T.S.

PREAH KHAN CONSERVATION PROJECT ANGKOR, CAMBODIA 16 JANUARY 1994

KEY

TREE
SUMMARY OF RECOMMENDATIONS

The following is a summary of proposed specific actions with regard to the nine point list given in the "Objectives" section of this report:

1. Protection of Existing Forest Surrounding Preah Khan's Outer Wall:
   • Maintain a buffer zone of Full Retention Visual Quality Objective (VQO).
   • Preserve the forest though a "hands-off" policy.
   • Prevent illegal logging operation within the immediate area.

2. Protection of the Existing Moat:
   • Management of Partial Retention VQO.
   • Moat's edges should be restored.
   • Consider removing some of the existing water plants to create a reflecting pool.
   • Remove vegetation currently growing and choking the moat.
   • Consider a full dredging of the moat as an alternative following the completion of a feasibly study.

3. Overall Site Management and Presentation:
   • General site beautification to highlight Preah Khan temple complex.
   • Management of vegetation, including continued site clearance and planting.
   • Grooming of existing access roads and proposed nature trail systems.

4. Emphasizing and Enhancing Visitor Experience and Awareness of the Environment:
   • Provide guided tours of both the temple complex and the surrounding forest.
   • Educate visitors about the forest ecosystem found within the area. For instance; show how the forests have historically been used, are used today, and how they might be used in the future. Demonstrate which plant species are edible and which are not. Demonstrate the aspects of plant species that attract wildlife to the area. Explain to visitors which plant materials are hazardous to people and buildings.
5. Emphasizing and Enhancing Exceptional Views:
- Open up views of the temple complex and create a distinctive North-South/East-West axis, through vegetation management.
- Create focal views, through vegetation management displaying special architectural and natural features and characteristics, such as the trees, the moat, the outer wall, or the Gopuras and processional ways.
- Establish the most advantageous viewing areas for observing both architectural and landscape features by creating viewpoints with easy access.

6. Improving the Overall Environmental Protection and Resource Management of Preah Khan's Archaeology, Vegetation, Wildlife, and Visual Aesthetic Qualities:
- Work closely with local officials, professionals, laborers, and general public, especially those who directly benefit from and/or those who are affected by this project.
- Provide proper site circulation that is clearly defined and marked having easy access and good road and trail systems to minimize resource damage.
- Discourage access to any restricted areas.
- Provide friendly, thoughtful and effectively worded warning signs to keep wandering visitors away from sensitive areas.
- In general, provide protection of the forest, wildlife, archaeology, and visual resource through design and education, as well as through enforcement and penalty to violators.

7. Management of Different Means of Access To, Through, and Around the Site:
- Provide convenient roads and trail systems involving minimal vegetation clearance which requires a minimum of annual upkeep.
- Provide adequate parking including turn-around areas for all vehicles, including large tourist buses.
8. Overall Site Interpretation:
   • Provide guided tours of the temple complex and surround areas by qualified personnel.
   • Provide interpretation of work being done by WMF consultants and local laborers.
   • Provide signs which point out plants and wildlife species, social and cultural aspects of the site, and dangerous areas.
   • Provide graphic or written materials that provide basic information that answers the most commonly asked questions about the site.

9. Site Safety and Security Considerations:
   • Provide a safe, secure and inviting environment for all visitors. Consider utilizing local police escorts; travel in small groups instead of traveling alone; implement a sign-in and out policy; etc.
   • Remove any hazardous vegetation (trees and roots) that may pose dangers to structures.

ISSUES TO BE FURTHER CONSIDERED

The following list of unresolved issues should be seen as additional opportunities and constraints:

1. The essence of the site is not clearly defined.

2. Overall access to the site needs further consideration.

3. Adequate parking, information and service on-site for visitors.

4. Lack of on-site information, orientation and interpretation.

5. Control of pedestrian circulation.

6. Educate visitors about resource protection and conservation.

7. Duration of stay on-site during visitation.

8. Overall site experience in terms of physical and spiritual impressions.
9. Site safety and security.


11. Erosion and other problems related to heavy visitor usage.

12. Vegetation - finalizing a policy for preservation and presentation.

13. Buffer zone.

14. Overall site protection and preservation.

15. Physical, spiritual, socio-economic consideration for the local inhabitants.

The Preah Khan Conservation Project in the future will serve as a destination where visitors can learn about aspects of the natural and the cultural heritage of Cambodia. The site can serve as an outdoor classroom where all visitors will have the opportunity to explore, experience and understand the dynamism of a site which possesses a remarkable combination of both natural and cultural assets.
ZONE TWO: View Looking West from Land Bridge Toward the Lantern Walkway.

ZONES TWO AND THREE: View Looking Northwest at Overgrown Forest from Land Bridge.
ZONE FIVE: View Looking North from Land Bridge Toward Moat.

ZONE FIVE: View Looking West at Overgrowth at Moat from Southeast Corner of Land Bridge.
ZONE TWO: View Looking East from Entrance of Outer Wall Toward Preah Khan Complex.

ZONES FIVE AND THREE: View Looking Southwest at Overgrowth at Moat and Forest from the Southeast Corner of Land Bridge.
ZONE SIX: View Looking North Along Outside of Outer Wall from West Entrance.

ZONE SIX: View Looking South Along Outside of Outer Wall from West Entrance.
ZONE SEVEN: View Looking North from West Entrance Along Inside of Outer Wall.

ZONE SEVEN: View Looking South Along Inside of Outer Wall from West Entrance.
APPENDIX B

STONE CONSERVATION PRINCIPLES AND PROCEDURES

by Frank D. Preusser and Frank Briscoe
May 1994
APPENDIX B

STONE CONSERVATION PRINCIPLES AND PROCEDURES

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SUMMARY

Frank D. Preusser first visited Preah Khan in March 1992 and undertook a preliminary study of the stone conservation problems of the monument. During that visit he also conducted some small cleaning tests of carved stone surfaces covered by biological growth. Following his visit further cleaning tests were carried out by John Stubbs.

The following report is based on a more in-depth study of Preah Khan during the January 1994 World Monuments Fund (WMF) field campaign and should be read in conjunction with the previous field reports published by the WMF.

During this campaign Dr. Preusser and Frank Briscoe did a more detailed survey of the conservation needs of the monument, especially in the central W-E and the central N-S-axis areas, and developed research and treatment recommendations.

The 1992 cleaning tests were evaluated, additional cleaning tests were conducted and copper sulfate (CuSO4) solution was applied to parts of the cleaned areas to evaluate its effectiveness as a biocide in this climate.

One apsara at the South Gate was cleaned since it was feared that the cupping black crust might damage the stone. An inscription in the southern part of the N-S axis was cleaned to prevent damage from graffiti.

Two stone preservatives were applied to stone fragments for field testing.

The first experiments with stone adhesives were undertaken and selected lanterns on the West Processional Way were restored and re-erected.

INTRODUCTION

The following report and recommendations are based on WMF's philosophy to preserve the site as a partial ruin as described in its Report IV\textsuperscript{1}. Minimum intervention is the guiding principle of the approach to stone preservation being used at Preah Khan and the emphasis is placed on site maintenance and protection. Stone cleaning and chemical treatments are recommended only where the stonework is truly endangered and presentation to visitors requires intervention.

1. STONE DETERIORATION AT PREAH KHAN

The site has a variety of micro-climates which vary depending on location and orientation; the existence of roofs; the ventilation; the number of fallen stones and debris in proximity to walls and columns; drainage; and the density and type of vegetation. Accordingly, the deterioration patterns, and amounts and types of biological activities sometimes vary within each room. It is to be expected that the clearing and partial restoration of the site will change the micro-environments and their manifestations. Therefore, it is advisable to postpone certain treatment decisions until the impact of those interventions can be assessed.

The main causes for the deterioration of the stone work at Preah Khan are physical (structural damage and erosion caused by running water) and 'inherent vice' (instability of some minerals in the stone under the climatic conditions of Preah Khan). While the growth of higher plants (brushes, trees) has done great structural damage, it appears from visual observation and previous analyses by other research groups that bacteria, algae, fungi, lichen and mosses contribute insignificantly to the deterioration of the stone at Preah Khan (Fusey 1991, Doehne 1992).

\textsuperscript{1}ibid. p.5
During the January 1994 campaign the following conditions of the stones at Preah Khan were observed:

A. Undamaged
B. Sanding
C. Spalling:
   • Thin layer spalling
   • Thick layer spalling
D. Color Changes
E. Biological Activities:
   • Bacteria, algae, fungi, lichen
   • Black crusts (assumed to be dead algae or lichen)
   • Bright to dark green homogeneous growth (algae)
   • Mosses
   • Shrubs, trees
   • Ants, termites, spiders, insects, wasp nests (?), bats and bat excrement
F. Physical Damage:
   • Structural cracks
   • Losses due to vandalism, looting and carelessness
   • Graffiti

The stone work was found in pristine condition in well-protected dark areas where biological growth could not develop and rainwater did not erode the surface. This underlines the importance of physical protection for the survival of important architectural and artistic features.

Where the stonework is less protected or not protected at all, surfaces are partially or fully covered with biological growth (algae, lichen, mosses). The type and density of the biological activity depend on the location and its micro-climate.

Many surfaces exposed to the outdoor environment displayed roughened and sometimes sanding surfaces. This is mostly due to the eroding action of water running over the surface of the stone. Running water leads to physical erosion and to the dissolution of soluble materials in the stone. In some cases this has led to complete destruction of surface detail.
Throughout the site (as at other temples of the Angkor complex) one can observe the erosion of the bases of columns and walls. This appears to be mostly due to improper drainage of the site during the rainy season and the accumulation of dirt and dead plant material on the floors. Lack of proper drainage and the presence of dirt can lead to rising damp and extended periods of wetness of the stone. This in turn leads to the increased dissolution of soluble minerals and to the accelerated transformation of unstable minerals (e.g. feldspars) in the stone.

Areas that experience extended periods of wetness (e.g. due to roof leaks or improper drainage) frequently are spalling in thick (≥ 5 mm) layers. This is most likely due to the swelling and shrinking of the clay minerals in the stone and to the transformation of unstable rock minerals (e.g. feldspar to illite; see Doehne, 1992; Fusey, 1991).
In some of the carved areas one can observe the spalling of very homogenous 1/2 to 1 mm thick surface layers. This is probably due to changes in the physical properties of the outer layer of the stone, introduced by the work of the ancient stone carvers. To verify this hypothesis further scientific studies (e.g. electron microscopy) will have to be undertaken.

Thin layer spalling.

The presence of algae, fungi and lichens has led to color changes on a number of surfaces. These color changes range from dark gray or black streaking to deep red (iron oxide?) colorations.

A special case of discoloration, combined with sanding of the surface was first observed on the columns of Area D, Room 2 of the East Hall (Hall of Dancers). (See Space Identification Plan, page 47, for locations.) It strongly depends on the orientation of the surfaces and appears to only occur in unsheltered, frequently wetted areas. Where there is evidence of water running frequently over the stone surface, it

\[1\] This phenomenon could also be observed in other temples of the Angkor district, e.g. Pre Rup and the Bayon
appears unaltered, probably due to the removal of the alteration layer by the water. The alteration layer also seems to be associated with the presence of white lichens (\textsuperscript{7}). During a cleaning experiment in March 1992, and again during this campaign it was found that the outer surface of the stone can be easily washed away with water and very little mechanical action. Close inspection of the surface under 10x magnification revealed a very thin (1 to 2 quartz grains thick) fragile surface layer consisting of quartz grains and red iron oxide (\textsuperscript{7}). Mica is also clearly visible, as are features (in some areas) that could be interpreted as being of biological origin. The true nature and cause of this alteration can only be determined through chemical, mineralogical and biological analyses. The stone under this thin alteration layer appears to be in very good condition. In our present assessment this process can only be stopped through sheltering of the affected areas.

2. TESTS CONDUCTED

CLEANING & COPPER SULFATE TREATMENT

There are three main reasons for the cleaning of stone surfaces:

- Biological growth or deposits are damaging to the stone.
- Preparation for chemical consolidation and/or treatment with a water repellent.
- Surface deposits or biological growth are obscuring important features such as carvings, inscriptions or tool marks.

When planning extensive cleaning it is, however, important to ascertain that the surface remains clean/uninfested for extended periods of time, either through continuous maintenance, the application of a biocide or other means of protection. The cleaning tests in March 1992 and March 1993 served a dual purpose, to determine the mildest and simplest cleaning method(s) and to determine the time until re-infestation of the surfaces with biological growth occurs.

\textsuperscript{1}Fusey mentions the potential presence of "ferro-lichens" (Fusey, 1991, p.24)
Cleaning with water without additives at ambient temperature with the aid of soft brushes, obtained at the local market, turned out to achieve a fully satisfactory surface. Furthermore, this cleaning can be carried out on stable surfaces by local workers after a short training period.

In March 1992 limited cleaning tests were undertaken on a column in the East Gopura, Enclosure Wall I, within Room 1 on the main East-West axis, and on the carved walls of East Gopura II Room 1. Very little new biological activity was observed on this column in January 1994. The sample on the southern part of the east wall of Room 1 on the main East-West axis of the East Gopura, Enclosure Wall I (re-cleaned) was covered with a new thin layer of algae, but was still clearly recognizable as cleaned. The cleaning test on the eastern part of the north wall however was completely overgrown. These differences are due to the different micro-environments.

It was decided to clean three additional areas of approximately 1 m² each in the Central Tower's Room 5 (on the main North-South Axis) and to treat the right half of each cleaned area with a highly diluted (approx. 10 mg/l) solution of copper sulfate (CuSO₄) in bottled water (three spray applications). The areas were chosen on the basis of their micro-climates as indicated by the type and intensity of the biological activity. The cleaning was done with water from the moat and soft brushes. The areas were first pre-soaked with water from the moat and then gently brushed with a generous supply of water. After the cleaning was completed the areas were washed with bottled water. After drying, the right half was sprayed three times with the copper sulfate solution, allowing the test areas to dry between applications.

A fourth area of approx. 1/4 m² was cleaned in Room 5 of the East Hall, where the area is exposed to the outside. The right half was again treated with three spray applications of copper sulfate solution. Since this test area is exposed, a higher concentration of copper sulfate (approx. 30 mg/l) was chosen. This surface had been covered by lichen and mosses. During the cleaning it was observed that the roots of the mosses were deeply penetrating the stone, requiring more mechanical action for complete removal. No macroscopic damage to the stone due to the roots was observed.

One apsara at the South Gopura was cleaned since it was feared that the cupping black crust might be damaging the stone. The cleaning process revealed that the stone under
the crust was in excellent condition. No further cleaning was undertaken in this part of
the structure. No copper sulfate was applied.

An inscription in the southern part of the central N-S axis was cleaned to expose it and
prevent potential damage due to graffiti.

Two spot cleaning tests were done on the Preah Khan Stela with bottled water and soft
paper tissue.

All test areas have been marked on an approx. 1:1000 map of Preah Khan.

**STONE PRESERVATIVES**

Most of the stonework at Preah Khan does not require any chemical treatments. There
are, however, a few areas that require chemical consolidation and/or treatment with a
water repellent:

- Carved areas spalling in thick layers (mainly the upper parts of doors) require
  chemical strengthening before re-adhesion of the spalling layers.
- Carved areas with fragile surfaces may benefit from a treatment with a water
  repellent.

During the January 1994 campaign two stone preservatives were applied to stone
fragments collected in the Hall of Dancers:

*GE Silicone DF 1040®, and*

*Silbond 40®*

Silbond 40 was brushed on neat in three applications. A 10% solution of GE Silicone
DF 1040 in nitro-thinner, obtained at the local market (mineral spirit was not available
locally), was sprayed on in three applications. The depth of penetration appeared to be
in the range of 5 mm for both materials, which was less than we had hoped for. The
exact depth of penetration and the effectiveness of the tests will be determined during
one of the next campaigns.
3. RECOMMENDATIONS FOR FUTURE WORK

Proposed future work should consist of:

1. Research and testing
   - Analyses
   - Field tests
   - Materials testing
   - Literature research

2. Site maintenance
   - Further site clearance and clean-up
   - Roof repairs and other protective measures

3. Treatments
   - Cleaning of selected stone surfaces
   - Consolidation and re-adhesion of spalling sculpted areas
   - Edge protection where losses have occurred
   - Consolidation and protection of painted plaster remains

4. Documentation

5. Development of a long-term monitoring and maintenance plan

6. Training
   - Training of students and local workers in different aspects of stone preservation
   - Development of a stone preservation manual for Preah Khan

\[^1\text{See Separate Appendix VI A - Report on Structural Repair and Consolidation Methods.}\]
RESEARCH & TESTING

A number of scientific studies of the Angkor stone monuments have been published in the past (e.g. Hyvert 1968, Chihara 1990, Fusey 1991, Doehne 1992), providing us with valuable information about the stones, biological activities, and stone deterioration mechanisms at the Angkor temple complex. There remain, however, a number of questions at Preah Khan which should be addressed through chemical, mineralogical, and biological analyses:

• Verify cause(s) of thick layer spalling.
• Verify cause(s) of thin layer spalling.
• Verify cause(s) of discoloration and sanding of the surfaces of the columns in the Hall of Dancers (see page 135).
• Composition and stratigraphy of the painted plaster remains (for historic and documentary purposes).
• Testing of the Preah Khan stela for surface coatings.

The results of these studies will aid in the development of appropriate treatments and protective measures. For these analyses it will be necessary to take a limited number of drill-cores and surface scrapings, and, in the case of the Stela, solvent and water extractions from the surface.

Additional field testing will be necessary to:

• evaluate Chlorox™ as a cleaning agent for specific cases,
• evaluate other biocides,
• identify appropriate herbicides for the control of higher plants,
• evaluate other stone preservatives,
• formulate appropriate stone adhesives and repair mortars.

The evaluations of adhesives started by Predrag Gavrilovic should be continued.

During the cleaning of a small area in Room 5 of the East Hall it was observed that the roots of the mosses had penetrated into the porous structure of the stone. Their removal required more mechanical action than other areas. In the past Chlorox™ has been successfully used to clean sensitive surfaces from biological growth (Hale 1975).
A test program in the use of Chlorox should be carried out during one of the next campaigns.

While it is expected that copper sulfate will be effective against lichen, algae and mosses in protected areas, it will most likely be necessary to treat some exposed areas with a water insoluble biocide. This biocide should be environmentally safe, have a proven effectiveness in humid tropical climates, and, if possible, be available in the region. Possible candidates are Polybor™, quaternary ammonium compounds and organotin/quaternary ammonium formulations (Richardson 1988).

At present higher plants are removed manually. New growth can be observed throughout the site. The continuous mechanical removal of plants is not only very labor intensive but also puts significant stress on the monument and unavoidably leads to mechanical damage of stone. Therefore, an effective, environmentally safe herbicide is needed that does not pose any risks for the stone. Roundup™ is one material to be considered, others might be identified in the literature and through contacts with manufacturers.

Most of the stonework does not require chemical consolidation or treatment with water repellents. However, areas that display thick layer spalling will need strengthening before they are re-attached with an appropriate adhesive. Materials that should be evaluated are high silica containing potassium silicate and silanes.

Other areas such as the columns in the Hall of Dancers might benefit from a treatment with a water repellent and the tests commenced during this campaign (see page 138) should be continued\(^1\).

Thick layer spalling has led to local losses on columns and walls, leaving the adjacent areas very vulnerable. To prevent further losses, the edges of the remaining original surfaces must be protected through the application of a repair mortar. The repair mortar should have equal or less strength than the original stone. A mixture of lime, sand or crushed Kulen sandstone and Portland cement should be suitable for this purpose.

\(^1\) Treatments with water repellents should only be carried out if the stone cannot be protected by a roof, and if one can achieve deep enough penetration and prevent water from penetrating the stone behind the impregnated zone.
The adhesives used for the repair of cracked stones should also have slightly less strength than the stone. Formulations based on epoxy resins and sand or crushed and washed Kulen sandstone, and pinning with stainless steel rods are considered most suitable. Predrag Gavrilovic has already undertaken some preliminary testing, which is reported elsewhere.

SITE MAINTENANCE

Throughout the site one can observe that the stonework is in excellent condition where it is protected against running water and excessive humidity. For the protection of important sculptural elements one should therefore, wherever possible:

- repair roof leaks,
- reconstruct collapsed roofs,
- install temporary roofs or shelters,
- cap walls with important carvings and install drip edges to prevent water from running over the carved surfaces.

To reduce basal erosion one should:

- improve site drainage,
- and remove dirt and organic matter on a regular basis,
- move temporarily stored stones away from walls and columns and put them on supports to improve ventilation.

As mentioned earlier in this report, the site consists of a number of micro-climates. In areas of reduced ventilation one can observe increased biological activities, dominated by algae and mosses. Stones that are presently stored in rooms should be moved away from the walls and be put on supports to increase ventilation. Often collapsed parts of the structure are blocking doorways, thus effectively reducing ventilation. Wherever possible these doorways should be cleared.

Another issue of great concern is the significant increase in graffiti which should be addressed in the near future.
TREATMENT RECOMMENDATIONS

The following recommendations focus mainly on the architectural resources of the two main axes, the East-West and the northern half of the North-South axis which have been, or will be, cleared of vegetation. Since there are also important architectural and sculptural elements in the parts of the temple presently not included in the preservation plan, a site visit by a qualified historian or archaeologist is suggested to help determine important additional carvings and features to be included in the long term stone preservation program.

In general, the proposed treatments may be divided into those directed at the preservation of fabric, and those directed at improving the presentation of fabric.

At Preah Khan, potential preservation treatments include chemical pre-consolidation, chemical consolidation, edge protection with repair mortars, replication, installation of physical barriers, and control of biological activities. Physical protection is generally preferred over chemical treatments. Specific treatments are described in greater detail in the following section. These treatments are recommended to preserve features under the following circumstances:

- a feature of exceptional contextual importance, in generally good condition, is deemed to be threatened by a process that can be effectively slowed through a cost-effective treatment;
- resources indicative of exceptional craftsmanship, deemed to be threatened.

Treatments are not recommended in cases where a feature is so deteriorated that it has become illegible.

The only treatment related to presentation recommended in this report is the cleaning of surface deposits from decorated surfaces. This is described in greater detail in the following section. Cleaning is recommended to improve presentation when the following test have been met:
• particularly fine carving is obscured by biological growth
• carving or decoration is located in especially important "nodes" along the axis, or
  entrances where visitation is concentrated.

In some cases, recommendations are made that stem from a combination of preservation and presentation issues. In the West Gopura, for example, it is hoped that cleaning will discourage graffiti by making the decoration more visible. Cleaning has also been recommended in a few instances when it is hoped that revealing wall decoration currently obscured by biological growth will encourage more careful movement of objects (and persons) through the spaces.

CLEANING

Based on the criteria established above and discussions with the project directors and other team members we have identified areas to be cleaned during the next campaigns. With the assistance of Architect Kevin Lee Sarring and Les Stephens the areas were measured and marked on a 1:1000 plan of Preah Khan. A total surface area of approx. 1,200 m² has been targeted for the first cleaning phase. At a determined rate of 1 to 2m²/person/hour this amounts to approx. 600 to 1,200 person-hours. As described in part 3 the cleaning is to be carried out with water without additives and soft brushes.

Cleaning is not recommended at this time in areas that will not be protected by a roof or covering of some kind since these surfaces will soon be again obscured by biological growth. Once an appropriate biocide for outdoor application has been identified, other surfaces may be specified for cleaning.

While it might be possible to reduce biological and mineralogical staining of the carved surfaces it is presently not recommended to pursue this issue since it is considered purely cosmetic.
RE-ATTACHMENT OF SPALLING DECORATION

As previously described, some of the carved areas show spalling in thin (.5 to 1 mm) layers. To prevent further losses, these areas should be re-attached. It is proposed to use either solvent or water-based acrylic resins (such as Paraloid B72, Plexon, or Rhoplex) as adhesives. These adhesives are reversible, which is considered important in this specific case.\(^1\)

Where losses due to thick layer spalling occurred, adjacent areas are normally weakened and detached. Those areas need chemical consolidation prior to re-attachment. The choice of consolidant depends on the results of the field-testing proposed in part 3. After consolidation they can be re-attached using either an acrylic adhesive, an epoxy adhesive, an epoxy/sand mortar, or a lime/sand/Portland cement mortar. The edges of the remaining original have to be protected with a (weak) mortar.

The total area proposed for consolidation in this report is estimated at 100 m\(^2\). The total area for reattachment is estimated at 30 m\(^2\).

EDGE PROTECTION

Where losses have occurred the edges of the remaining original are extremely fragile. There is a high risk that further losses will occur due to the action of water, accidental damage, or vandalism. It is important to protect these edges with a weak mortar (lime/Portland cement/sand or epoxy/sand). In some cases it might be necessary to strengthen the original with a silane, an aqueous acrylic resin emulsion, or an epoxy resin.

CONSOLIDATION & PROTECTION OF PAINTED PLASTER REMAINS

In a number of rooms remain patches of painted plaster. Observations with a 10x magnifying glass indicate the presence of multiple layers of paint and plaster. It is at

\(^1\)For most of the treatments “re-treatability” is the guiding principle.
present not known at what time these plasters and paints were applied. Representative samples should be preserved through re-attachment with a suitable adhesive (such as Paraloid B72, Plextol, or Rhoplex) and consolidation/protection with Paraloid B72. Samples should be removed and stored together with the project archives for future studies.

DOCUMENTATION

All treatments have to be fully documented in writing, on the site plan, and with black & white photography, 35 mm and, in special cases, medium format photography. Photography in raking light will also be required in many cases. This documentation is essential for the long-term monitoring of the site and the effectiveness of any treatments, and as a reference for future treatments.

LONG-TERM MONITORING AND MAINTENANCE PLAN

Preservation is not a one time effort but an ongoing commitment. Since no treatment lasts for eternity and the majority of the stone surfaces will remain untreated, it is essential that a long-term monitoring and maintenance plan be developed to detect any changes in their early stages and mitigate them when it is still a minor effort. We propose to base the monitoring on a continuous photographic record of a few selected areas that are most likely to show change.

TRAINING

Since the task of the long term preservation, monitoring and maintenance of the temples rests with the Cambodian authorities, training of local and national staff in the preservation and monitoring techniques should be an essential part of the stone preservation program. This training program should include lectures, on-site training, and the development of written guidelines.
Cambodian staff and students should be included in every phase of this part of the project.

4. THE PREAH KHAN STELA

The Preah Khan stela is the most important sculptural element at the Preah Khan temple. At present the loss of inscribed surfaces is still limited, but the stela is at very high risk:

- It is in a very narrow passage, with visitors and tour guides constantly touching it and inadvertently brushing at it with clothes and bags.
- The roof has partially collapsed, leaving the stela exposed to the weather.
- There are clear signs of beginning basal erosion.

The stela has only a very slight covering of biological growth (algae?) that can be easily removed with water and soft brushes. The appearance of the surface, however, suggests that it has been cleaned (mechanically?) and treated with a surface coating in the past. Spot cleaning with drinking water and paper tissue led to the dissolution of a yellow material. Before deciding on any surface treatment of the stela one should extract some of this material and analyze it for its constituents (see also part 3).

The long-term preservation of the stela has to be carefully planned. Presently there are a number of options, some of which might not be feasible due to historic or religious reasons:

- preservation of the stela in its present location;
- preservation of the stela in situ, but at a different location in the temple;
- move the stela to a museum and replace it with a high quality replica on site.

Additional archival and archaeological research should be undertaken to establish whether the present location of the Stela is the original location, or if it has been moved there from another location.
If the stela has to remain at its present location it has to be protected against the weather and visitors. This can only be accomplished with a physical barrier such as *Plexiglas* or polycarbonate sheets. Sufficient ventilation in the space between the protective sheets and the stela has to be assured to avoid the creation of a micro-climate which might accelerate the stela's deterioration.

Even if the stela is moved to a different location it will have to be protected physically against accidental or deliberate damage by visitors to the site.

The long-term preservation of the Stela is best guaranteed if it is moved to a museum with an appropriate environment and physical protection. A high quality replica could be placed on-site.
If the stela were to remain on-site, at its present or a different location, it would still be advisable to make a high quality replica to document it in three dimensions and its present state of preservation. The replica(s) could then be displayed at (a) regional or national museum(s). When replicating the stela, care has to be taken that no damage or appearance changes are introduced during the process.

5. THE WEST LANTERN APPROACH

In January 1994 a walk-through was conducted by John Sanday, Predrag Gavrilovic, Frank D. Preusser, and Frank Briscoe to determine the needed repairs at the West Processional Way. The aim was to develop a simple, repetitive schedule of repair treatments for the stone lanterns, based on the recommendations made by Fred Aldsworth in Report IV, Appendix A. To achieve consistency and continuity of the program it was decided to utilize as few different materials as possible.

The general aim of this repair program is to return as many lanterns as possible to a state of structural integrity that is sufficient to present them in their original positions. Re-erection of the fallen lanterns not only enhances the presentation of the Processional Way to visitors, but also reduces further deterioration by removing the stones from direct contact with the soil, and reducing the risk of accidental physical damage by people walking along the Processional Way.

The program agreed upon during this walk-through calls for epoxy resin injection of deep fissures in unfragmented features, after filling the crack edges; rejoicing of large fragments with stainless steel pins set in epoxy adhesive or mortar; rejoicing small fragments with small pins or epoxy mortar. It was decided that, in general, adhesives would only be used when fractures were vertically oriented. Original joints in the lanterns would not be altered by the introduction of adhesives or other material unless required for stability.
The following applications for adhesives at the Processional Way were identified:

- low-viscosity epoxy resins for injection into fissures, under low pressure;
- to secure stainless steel reinforcing pins when rejoining large stone fragments;
- to act as a weak adhesive "filler" between (generally) loose-fitting surfaces to be rejoined with pins;
- to rejoin tight-fitting fragments, generally without pins; and
- as a filler for large cracks.

FIG. 5.40. LANTERN REPAIR
ADHESIVE TESTS

Five samples of adhesives for possible use in repairs at the West Lantern Approach were mixed. Three epoxy adhesives were used neat or mixed with two aggregates. The epoxy materials, which had been selected by John Sanday and are available in Bangkok, were: Sika™ 35 High Mod, Sika 731, and Sika 732. Sika 35 High Mod is a liquid resin. Sika 731 and 732 are both adhesive pastes. The two aggregates used were washed masonry sand, and pulverized stone - i.e. stone dust, of stone similar to those being repaired.

The purpose of the tests was to determine product properties such as quantity of aggregate that could be mixed into each type of resin; working time under site conditions; general workability; color of product when dry; and relative strength of the mix.

In most cases the adhesive/mortar should be formulated strong enough to provide a long lasting stable bond, but weaker than the stone, so that any future failure will occur in the repairs and not the original stone.

For injection applications, it was decided to use the Sika 35 straight. For setting stainless steel pins in mortises, Sika 35 was also was used straight, except where a thickener was required to prevent substantial running of material in fragments that had to be turned over to be put into position.

INTERVENTIONS AT PROCESSIONAL WAY

Fred Aldsworth's analysis of the West Processional Way (Report IV, Appendix A) was used to document the interventions. 'As found' conditions were documented in Aldsworth's report and, with black & white photographs, notes were made directly on photographs contained in the report and written notes were recorded in the spaces.

\[1\] Sika is a trademark of ICI
provided. Copies of entries regarding alterations to specific lanterns were made, and the report containing the original field notes was left with the WMF field office in Siem Reap.

The first work undertaken at the West Processional Way during this field campaign was to re-erect those lanterns sufficiently sound enough to be returned to their original positions without structural consolidation. Fragments of lanterns N25 and N35 were reattached, using Sika 35 High Mod and stainless steel pins. No pedestal or lantern was re-erected if there remained a question about its correct position. In almost every case, re-erection of pedestals and lanterns was carried out with the use of a tripod designed by Predrag Gavrilovic and John Sanday. Cleaning prior to re-assembly was done with bristle brushes, dry, or with water. The Khmer team was instructed not to use the traditional bamboo brushes which are considered too stiff and potentially damaging to the stone surface.

6. COLLAPSED SCULPTURAL STONE

Throughout the temple, parts of sculptures and carved stones are sitting directly on the soil and rotting plant materials. Frequently, one can observe severe deterioration in and around the contact zone with the soil. Therefore, all important sculptural and carved stones in collapsed parts of the temple should be isolated from the soil and be stored in well ventilated areas under protective (temporary) roofs.
7. OUTLINE OF CLEANING PROCEDURE

- Do not use any cleaning agent other than water.
- Do not use any scrubbing tools other than soft brushes.
- Clean only specified areas.
- Clean areas of approximately one square meter at a time.
- Start cleaning at the top of the wall and work downwards.
- Thoroughly soak area to be cleaned with water, prior to brushing; allow to stand for 15 to 30 minutes.
- Use water generously during clean.
- Always be on the lookout for loose or delaminating areas (do not clean these areas).
- Often feel the area being cleaned, check for grit (loose material); proceed more gently if grit is present, or stop cleaning of the area.
- Do not attempt to clean to an appearance 'as new'; do not try to remove stubborn stains or tenacious mosses.
- Always rinse with clean (e.g. drinking) water after the cleaning is completed.
8. SELECTED BIBLIOGRAPHY


B.A. Richardson, *Control of Microbial Growth on Stone and Concrete*, Biodeterioration 7, 1988, 101-106.
APPENDIX C

DESIGN FOR SITE SAFETY SIGNS
PROPOSED ADVISORY & OTHER SIGNS
PREAH KHAN CONSERVATION PROJECT
APPENDIX D

PROPOSAL FOR VISITOR RECEPTION FACILITY
Project Description

Tourist Reception Facility at Preah Khan
Siem Reap, Cambodia

At present there are no tourist reception or orientation facilities at the Historic City of Angkor in Cambodia other than post card stands at the 2 local hotels.

WMF plans to erect a simple structure inspired by traditional building forms at the site of Preah Khan where the WMF archaeological site conservation program has been under way since 1991.

The timber framed structure will be raised on concrete piers and have walls of clapboard siding and a thatched roof with slightly upturned gable ends. The plan of the one story 1500 sq. ft. structure will be L shaped with a porch across the primary elevation. One leg of the L shape will feature a display area for architectural wall displays, objects and an architectural models, the other leg of the L will serve as a work room and storage. The primary entrance to the entrance building will be at the joint of the L where a modest gift shop will be located.

The building will be positioned along the principal pedestrian access route to the Preah Khan monastic complex within the site's outer moated enclosure wall. (An estimated 4500 visitors pass along this path each year in order to visit the heart of the vast 12th century temple complex.) The structure will be inserted among existing large banyon and ficus trees in the special jungle setting that distinguishes Preah Khan. A small structure constructed of similar materials which was built in this area in 1992 will be converted from its present use as guest sign-in area to a custodian's station.

The estimated cost of the facility is $5,000 and will commence construction on March 12, 1994.
List of Interpretative Materials Planned for Display and Distribution at the Preah Khan Reception Facility

Enlarged aerial photos of drawings of Preah Khan

Representative photos of special features of the site

Diagram showing suggested visitor routes

Photos and drawings showing of ongoing research and conservation methods at the site

Examples of University of Phnom Penh students drawings of the sculpture of Preah Khan

Post card packets of above mentioned students drawings and photos of site

Upgraded visitors brochure

Display of representative site artifacts or facsimiles thereof.

Architectural model(s)
A PROPOSAL FOR

A WORKING CONFERENCE TO ADDRESS

CULTURAL RESOURCE MANAGEMENT SYSTEMS

FOR

ANGKOR AND ITS VICINITY

for the
Ministry of Culture
of the
Government of the Kingdom of Cambodia

The World Monuments Fund
New York, USA

16th January 1994
PROSPECTUS FOR A CONFERENCE TO ADDRESS CULTURAL RESOURCE MANAGEMENT SYSTEMS

Location: Siem Reap, Cambodia
Proposed Date: 11-13th March 1994

Background
Much has been accomplished in the past five years in establishing a coherent plan for the conservation and presentation of the Historic City of Angkor and its adjacent areas.

One of the most recent and extensive efforts to provide a comprehensive historic resource development guide for Angkor, Siem Reap and its outlying areas was formulated under the aegis of UNESCO as a Zoning and Environmental Master Plan (ZEMP). Currently available in 'Draft' form, the 178 page ZEMP document addresses a wide range of challenges at Angkor which must be met, including legislation, database management, zoning, conservation, archaeology, hydrology, training, tourism, new development, infra-structural improvements, and administration. (See attached "ZEMP Discussion Draft-Executive Summary"). It also contains outline proposals for the implementation of many of its recommendations, especially the immediate next steps.

It should be noted that provision of acceptable protective legislation and cultural heritage management plans were conditions of Angkor and its outlying areas being nominated to the World Heritage List one year ago.

In light of the recent major positive developments in the political and economic situation of Cambodia, there now exists for the first time in over 20 years an atmosphere for reinstituting an improved Angkor Cultural Heritage Area which reflects the desire of Cambodians to feature Angkor as one of the most important artistic achievements of mankind.
It is taken as given that the attractions of the Angkor region will be the primary generator of foreign currency income for Cambodia for the foreseeable future. It is also assumed that a rare opportunity exists at present for the Angkor region to be sensitively developed to meet the fast increasing demands of tourism and other local economic development pressures.

Conference Planning

To advance the realistically achievable proposals found in the ZEMP document and other master planning proposals developed over the past five years, WMF has been invited by the Minister of Culture of the Kingdom of Cambodia to organize and conduct an intensive work session or "Charrette" to finalize an acceptable cultural resource management structure and implementation plan for Angkor and its adjacent areas.

Objectives of the Charrette will include:

1. Consensus on a viable management structure and an implementation strategy (Business Plan) for the most essential aspects of the ZEMP and/or any newly developed cultural resource management schemes.

2. Concise articulation of the above-mentioned solution(s) in formats and languages which are readily understood by a variety of users of the document, ranging from local and national Government officials to foreign lenders and other project supporters.

3. Provision of a jointly created and authoritative plan for managing and sensitively developing Angkor and its adjacent areas, which will be decided upon and utilized by Cambodian authorities.

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1 WMF has appropriated the term 'charrette' as a label for an intensive multi-disciplinary planning session which culminates in critical review. The term has its origins in the Ecole des Beaux Arts training in France where architectural students raced to finish their projects before their work was placed on a wheeled cart (a charrette) and removed for grading by jury.
Conference Format

Participants will consist of the principal Cambodian government officials, representatives of other interested parties such as the various Non-Governmental Organizations (NGOs) working at Angkor, and supplementary experts as may be required. The three-day session will be preceded by orientation to the site for those unfamiliar with Angkor, followed by presentations on management structures currently in use or proposed to date, and explanations of the challenges which are currently being faced. Through a series of plenary sessions and meetings of specialist working groups, specific solutions and strategies for their accomplishment will be formulated in light of the overall task.

There are two types of involvement for those attending the Charrette:

1. As 'participants' who are expected to be in full attendance from the opening to the closing session, or
2. As 'respondents' who are to serve as critics (an audience) on the last day.

All participants and respondents at the Charrette are expected to bring to the event open minds, a positive and cooperative spirit, and a willingness to work hard.

Attendance of all scheduled sessions is required (i.e. a minimum of three days for participants and one day for respondents). A limited number of observers and possibly journalists will be invited for the concluding session.

The progression of meetings will culminate in a final presentation of a solution (or solutions) to a group of respondents who will evaluate the best proposal with a view towards its improvement. Any and all sensible cultural resource management systems for conserving and presenting Angkor will be considered, ranging from maintaining the present system of administration to leasing the Area, or parts thereof, for a limited time to a profit-making entity.

The meeting document, based upon a consensus of those present, will provide the guidelines and a working plan for an entity that can manage Angkor effectively in the future, supported by revenues generated through tourism.
Dissemination
A rapporteur will document the proceedings emphasizing the results and will be responsible for disseminating a draft report on the proceedings within three weeks time. After a brief review period the report will be published in Khmer, English and French and distributed under the supervision of the Cambodian authorities.

Proposed Participants

Cambodia
- HRH King Norodom Sihanouk
- Prince Norodom Ranaridh First
- Mr Hun Sen
- Mr Vann Molyvann
- Mr Son Soubert
- Mr Nouch Narang
- Mr Michel Tranet
- Mr Ouk Chea
- Mr Pich Keo
- Mr Uon Vong
- Mr Chuch Peurn
- Mr Oul Chen

World Monuments Fund
- Ms Bonnie Burnham
- John Stubbs
- John Sanday
- David Sassoon (rapporteur)
<table>
<thead>
<tr>
<th>Name</th>
<th>Position/Institution</th>
<th>Role</th>
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<tbody>
<tr>
<td>Senake Bandaranayake</td>
<td>Dept. Archaeology, Sri Lanka</td>
<td>Participant</td>
</tr>
<tr>
<td>Lester Borley</td>
<td>Chairman, Europa Nostra</td>
<td>Participant</td>
</tr>
<tr>
<td>Bill Chapman</td>
<td>University of Hawaii</td>
<td>Participant</td>
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<tr>
<td>Henry Cleere</td>
<td>World Heritage Convention</td>
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<tr>
<td>Robertson Collins</td>
<td>PATA</td>
<td>Participant</td>
</tr>
<tr>
<td>Dr John Evans</td>
<td>Chairman, Rockefeller Fdn.</td>
<td>Respondent</td>
</tr>
<tr>
<td>Robert Fitzpatrick</td>
<td>Cultural Parks Developer</td>
<td>Respondent</td>
</tr>
<tr>
<td>Archibald Gilles</td>
<td>Warhol Foundation, New York</td>
<td>Respondent</td>
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<tr>
<td>Cornelia Higginson</td>
<td>American Express Foundation</td>
<td>Respondent</td>
</tr>
<tr>
<td>Donald Insall</td>
<td>Conservation Architect, U.K.</td>
<td>Participant</td>
</tr>
<tr>
<td>Janos Jelen</td>
<td>Angkor Foundation, Hungary</td>
<td>Participant</td>
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<tr>
<td>Corneille Jest</td>
<td>CNRS Paris</td>
<td>Participant</td>
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<tr>
<td>Hugh Miller</td>
<td>SHPO, State of Virginia</td>
<td>Participant</td>
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<tr>
<td>Hassan U. Khan</td>
<td>Aga Khan Foundation</td>
<td>Participant</td>
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<tr>
<td>Denys Lombard</td>
<td>Director EFEO</td>
<td>Respondent</td>
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<tr>
<td>Christophe Poitier</td>
<td>Local Representative EFEO</td>
<td>Participant</td>
</tr>
<tr>
<td>Terry Rambo</td>
<td>East-West Institute</td>
<td>Respondent</td>
</tr>
<tr>
<td>James Sherwood</td>
<td>Entrepreneur</td>
<td>Respondent</td>
</tr>
<tr>
<td>Roland Silva</td>
<td>President, ICOMOS</td>
<td>Respondent</td>
</tr>
<tr>
<td>Yoshi Tsuboi</td>
<td>Representative, Sophia Univ.</td>
<td>Participant</td>
</tr>
<tr>
<td>Nils Tremmel</td>
<td>Representative of VSO</td>
<td>Participant</td>
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<tr>
<td>Jonathan Wager</td>
<td>UNESCO Consultant</td>
<td>Participant</td>
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<tr>
<td>Michael Ward</td>
<td>World Bank</td>
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<tr>
<td>Ms Minja Yang</td>
<td>UNESCO Headquarters</td>
<td>Participant</td>
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<tr>
<td>Project Director</td>
<td>Borobudour, Indonesia</td>
<td>Participant</td>
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APPENDIX F

TECHNICAL ASSISTANCE PROPOSAL FOR
CONSERVATION D'ANGKOR
COOPERATIVE AGREEMENT
BETWEEN

THE MINISTRY OF CULTURE
KINGDOM OF CAMBODIA

&

THE WORLD MONUMENTS FUND
NEW YORK

Title: Technical Assistance Proposal for the Upgrading and Development of the Department of Architectural Conservation at Conservation d’Angkor, Siem Reap.

Primary Function: Direct Support
Secondary Function: Institution Building
Sector: Culture
Government Implementing Agency: Department of Conservation, Archaeology & Museums

Approved: ___________________________ Date: ________________
On Behalf of the Royal Cambodian Government

Signed: ___________________________ Date: ________________
On Behalf of the World Monuments Fund
PART 1.

The Project Document shall be the instrument (therein referred to as the Plan of Operation) envisaged in the Agreement between the Royal Cambodian Government and World Monuments Fund New York, signed by both Parties on

PART 2.

A. DEVELOPMENT OBJECTIVES

The Project will assist the Royal Cambodian Government in developing a strategy for the conservation of the historic monuments of Angkor and continue to manage World Monuments Funds activities at Angkor.

1. Long Term Objectives

To assist the Ministry of Culture in the Reactivation of the capabilities of the Conservation d'Angkor, Siem Reap to protect conserve and maintain the structural and material fabric of the historic monuments of the area defined as the Archaeological Park of Angkor.

2. Immediate Objectives

The specific objectives planned to be accomplished in the first year of operation include:

a) To assess the present situation regarding the architectural conservation challenge at Angkor including a review of all relevant surveys, project proposals and plans that are available.

b) In collaboration with the Conservation d'Angkor, to identify and develop acceptable principles and procedures to be used on all architectural conservation projects at Angkor.
c) To establish a secure office facility within the Conservation d'Angkor for the Department of Architectural Conservation including offices, work space, storage systems, reference materials, meeting rooms, etc. This facility will serve as a central meeting place for organisations working at Angkor.

d) To engage a competent office staff including a primary assistant and secretary. Office members will consist of Cambodian experts, trainees, UBA graduate students and representatives of other NGO's working in conjunction with the Conservation d' Angkor.

e) To work towards the preparation of suitable project applications and reporting procedures for groups working at Angkor.

f) To assist the Conservation d'Angkor in initiating a priority list of emergency works at Angkor and to help in the preparation of individual architectural conservation management plans for the priority list.

g) To develop project budgets under the terms of this agreement for activities listed and to insure adherence to the approved budgets.

h) To continue to manage the World Monuments Fund's activities at Preah Khan and other sites as approved by the Royal Cambodian Government. It is anticipated that the ongoing Preah Khan Conservation Project will serve as a useful prototype for conservation activities in Angkor.

B. BACKGROUND & JUSTIFICATION

Since 1989, the World Monuments Fund, New York has been involved in a variety of ways in assisting the Royal Cambodian Government with the planning and implementation of different projects in Angkor, Cambodia. These activities range from the preparation of an initial overview of the problems of conserving and protecting the historic zone of Angkor, to the planning and development of a detailed programme for the conservation, protection and presentation of Preah Khan, a 12th Century Buddhist monastic site set deep in the remaining jungles of Angkor.
As a result of the contribution that the Preah Khan Conservation Project has made on the philosophy of conserving and protecting Angkor, WMF has been requested to expand its activities to include the safeguarding and presentation of the adjacent 12th Century sites of Prasat Neak Pean and Ta Som as well as helping to implement a security plan to protect the 10th Century temple complex of Banteay Srei.

With their increasing brief and longer term investment of manpower in Angkor, WMF has, following recent meetings with the Minister for State, His Excellency Vann Molyvann, agreed to contributing further technical assistance to The Kingdom of Cambodia by providing technical assistance to the Conservation d'Angkor for the protection and conservation of the fabric of the historic monuments of Angkor that will fill a requirement overlooked by the more global approaches of the recently accepted Regional Masterplan for Siem Reap Province and a Masterplan for Tourism.

C. OUTPUTS

1. The preparation and publication of a working handbook (manual) for architectural conservation information and cultural resource management systems.

2. The rebuilding of the Conservation d'Angkor as an institution and the establishment of an architectural Conservation Section office and workshops.

3. The development and preparation of suitable application procedures for bilateral or multilateral architectural conservation projects.

4. The preparation and publication of Field Campaign Reports on the World Moments activities at Preah Khan.

D. ACTIVITIES

1. To assist the Conservation d'Angkor as Departmental Adviser (in collaboration with the Director of Conservation d'Angkor) in developing and monitoring the identification, planning and implementation stages of architectural conservation activities for sites within the newly defined Angkor Cultural Reserve as required by the Royal Cambodian Government.
2. To work in close coordination with institutional counterparts in charge of Archaeology, Interpretation, Infrastructure, Environmental Management and other specialty concerns.

3. To work in close cooperation with Cambodian authorities and to advise on all architectural conservation activities at Angkor.

4. To cooperate with directors and technicians of Royal Cambodian governmental agencies, NGO's and others who are involved in architectural conservation activities at Angkor.

5. To serve as adviser to the National Council for Culture and L'Authorité pour la Sauvegarde de la Région d'Angkor (APSARA) and through them to advise and assist government organisations, NGO participants, and other international consultants having architectural conservation responsibilities and interests at Angkor.

6. To continue to act as Project Manager for the World Monuments Fund at the Preah Khan Conservation Project and for other activities entrusted to WMF by the Royal Cambodian Government.

E. INPUTS

1. Government Inputs

a) Counterpart Staff:
The Director of The Conservation d'Angkor will act as counterpart staff to the World Monuments Fund’s advisor. The Director of The Conservation d'Angkor, or an officer nominated by the Ministry of Culture, will function as the Project Director for the overall administration of the Project. Members of the Conservation d'Angkor staff will be seconded as necessary to the newly created section as required. Trainees nominated by the Royal Cambodian Government will be accommodated in the section.
b) Administrative Support:
The Conservation d'Angkor will provide necessary shared accommodation to facilitate the operation of this project within their compound.

c) Support of Field Activities:
Where feasible, the Royal Cambodian Government will contribute in cash or in kind towards the payment of the work force and specific designated activities such as road reconstruction, site maintenance etc.

2. Donor Inputs

a) Technical Assistance:
World Monuments Fund will undertake to provide for a minimum period of one year their technical advisor, who is a specialist in the field of architectural conservation in Asia, to assist the Royal Cambodian Government in revitalising the building conservation activities of the Conservation d'Angkor. The advisor who is also the current project manager for WMF's Preah Khan Conservation Project, will be present at Conservation d'Angkor in Siem Reap between 10 and 30 days per month according to the demands of his workload and schedule. This post is renewable on an annual basis with the consent of both parties. WMF will also arrange for its consultants engaged at Preah Khan to be available as advisers to the Department of Architectural Conservation for part of the time they are in Siem Reap.

b) Staff Training - On Site Training & International Fellowships:
World Monuments Fund will provide, through its ongoing programme at Preah Khan, on site training activities to the students of the Faculties of Architecture and Archaeology at the University of Fine Arts, Phnom Penh. The programme will be developed in consultation with the Ministry of Culture and the deans of the respective faculties.
Technical staff will be able to benefit from the following scholarships:

1. **Architecture**: Negotiations are in hand for a final year architectural student to be provided an apprenticeship at the studio's of Frank Lloyd Wright's Taliesin.

2. **Architectural Conservation**: Funds are available for a Chevening Scholarship to be provided by the British Government for a specialised course in architectural conservation at the Institute of Advanced Architectural Studies, York.

3. **Joint Training Programme**: World Monuments Fund will, subject to the Royal Cambodian Governments approval, explore the possibility of further joint training programme activities for architects and/or craftsmen. If these are acceptable they can be the subject of amendment to the Cooperative Agreement.

c) Equipment
The following equipment has been selected for use

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<th>Ref</th>
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<td>Office Furniture</td>
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**TOTAL** $22,600
d) Field Activities
The support of specific field activities at Preah Khan will be described in detail in the Work Programme accompanying Field Report II to be presented to the Royal Cambodian Government by the end of July 1994.

F. PREPARATION OF A WORK PLAN

A workplan will be prepared in consultation with the national project director at the start of the project and presented to the Ministry of Culture within two months of commencement of the project.

G. INSTITUTIONAL FRAMEWORK

The institutional framework is undergoing several changes critical to the establishment of a successful management organisation to manage the Angkor sites. Recently the National Council for Culture has been established with King Norodom Sihanouk as the President. Under the umbrella of the NCC, a public institution known as APSARA ( Autorite pour la Protection du Site et l’Amenagement de la region d’Angkor) is in the process of being formed to manage the National heritage in the region of Angkor. At present the Ministry of Culture administers all matters relating to monuments and museums through the Department of Archaeology, Museums and Conservation and the Conservation d’Angkor. The status of Conservation d’Angkor is likely to be raised to Department under the Ministry of Culture with direction from APSARA.

PART III MONITORING & EVALUATION

a) Monitoring & Evaluation
The project will be subject to regular monitoring and evaluation by the Director of Programs, WMF in consultation with the Ministry of Culture.

b) Reports
As well as the documents identified in Section C. Outputs, monthly reports will be forwarded to the Secretary of Culture, The Governor of Siem Reap, the Director of Conservation d'Angkor, WMF and other project sponsors no later than the 15th day of each month after the first full month of operation.
PART IV  BUDGET

The budget is to be divided between two budget lines Budget A, for technical assistance which will cover the activities directly related to the support of the regeneration of the Department of Architectural Conservation at the Conservation d'Angkor as set out in the document above and Budget B which will cover the field activities outlined in Development Objectives Section 2 (h) above which will be described in detail in the forthcoming Work programme accompanying the Reports of Field Campaign II. The Field Campaign III Budget is designed for three separate missions during the months of November 1994, January 1995 and March 1995 based at Preah Khan and the other identified sites at which time the project adviser will share his time with both activities.
At the invitation of the Minister for State H.E. Vann Molyvann, WMF has been invited to undertake the necessary survey and analysis work relevant to the conservation and presentation challenges posed at the temple sites of Neak Pean and Ta Som which comprise two of the larger 12th century Khmer temple sites located along the north border of the Angkor Archaeological Park. Together with Preah Khan, which WMF has been working on since 1991, these three temple complexes form an ensemble linked by the 4 km long reservoir known as the Preah Khan or "northern" Baray with Neak Pean located at its center and are a logical extension of WMF's activities in Preah Khan.

The research, documentation and conservation planning work at each of these sites undertaken in collaboration with the appropriate department in the Conservation d'Angkor, will include the following:

PHASE I - Project Identification

1. Historical and general informational research into EFEO records and other sources regarding these sites.
2. Procurement of available graphic, photographic and written data on each site.
3. Statement of the physical conditions of each site.
4. Statement of the historical significance of each site.
5. Provision of scale rectified photographic documentation of each site.
6. General assessments of the existing conditions of each site.
PHASE II - Project Preparation and Conservation Planning

1. Determination of the conservation challenge faced at each site.
2. Prioritizing of the conservation issues at each site.
3. Articulation of conservation program(s) for each site which consider priorities, Angkor master planning considerations and funding realities.
4. Provision of budget cost estimates for each project, both global and by phase.
5. Proposal for procedures for the implementation of conservation measures at each site.

Work Plan
Once the Project Proposal has been agreed to in principle, the present activities can be initiated, as an extension activity to the Preah Khan Project and a small maintenance work force can be stationed at these sites to undertake basic degagement from the vegetation and, in collaboration with the present guards/guardians, establish monitoring procedures for protection against vandalism.
APPENDIX H

CONSERVATION NOTE - PRE RUP, ANGKOR
CONSERVATION NOTE

SITE: PRE RUP, ANGKOR.

Date Visited: 23 March 1994

PURPOSE OF VISIT
BRIEF DESCRIPTION

Following the announcement at the Technical Committee Meeting on 21st March 1994 when a summary report was circulated concerning emergency works at Pre Rup, the WMF’s Conservation Architect Sanday and Engineer Gavrilovic visited the site to check the diagnosis presented at the meeting. The report stated that there was deformation of the platforms due to settlement which was causing severe structural problems to the foundations of the towers of the upper platform. Having had some first hand experience in Preah Khan, the WMF team were keen to share this knowledge and to assist the Royal Government in deciding on the most suitable intervention at Pre Rup.

The main structure at Pre Rup which was built during the latter half of the 10th Century is one of the early temple mountain structures with a three tiered laterite base and five towers, built of brick, placed in quinqux formation on the upper platform. These towers were originally highly decorated with a protective stucco finish.

PRESENT CONDITION

Platforms: A brief inspection of the laterite platforms showed almost no deformation of to the structures at ground level. What little damage there is appears to have resulted from lack of maintenance of the laterite stone work and subsequent infiltration of rainwater or from vegetation growth.
Towers: The towers are in a dangerous condition due to heavy water percolation which, through lack of maintenance has caused severe degradation of the upper sections of the towers causing heavy saturation of the porous brickwork and its eventual crumbling. Damage level decreases at the lower levels of the towers. However, they all manifest the same pattern of cracking on the wall opposite the opening with the fractures widest at the upper levels.

DIAGNOSIS

Platforms: On careful inspection at the ground or base level of all the platforms showed no deformation of the stone courses. The stones are in the same condition as when laid and parallel to the ground. If there had been any deformation there would be buckling or settlement which would "deform" the alignment of the wall base. Equally there was no dipping anywhere along the walls or even on the upper level that was not localised damage.

Towers: A careful study was made of the bases of each tower to check for settlement and all the bases were of similar condition perfectly aligned and parallel. The critical sandstone blocks at the corners were checked to see for signs of recent crushing and for earlier movement. There was no visible evidence. A careful study to establish the principal causes of the severe degradation of the towers was made and it was apparent that the walls opposite the entrances had vertical cracks compensation for the inherent weakness of the wall with the opening. These cracks were almost vertical and wider at the top than at the bottom and not the tell tale diagonal fractures common in foundation settlement. The type of degradation in all the towers was similar whether to the central tower or the four towers placed at the edge of the platform where one would have expected more evidence of settlement. There are fractures evident through all the door cills and lintels - the weak point in the entrance walls, but the cracks are wider through the lintel than through the cill. All this evidence points towards failure in the brick material increasingly from the upper levels. The brickwork at the upper levels has lost its structural integrity due to heavy rains and old age and is crumbling hence the manifestation of thee cracks. The visual analysis indicates that the platforms and foundations are in better structural condition and the towers are failing due to the ravages of the climate.
RECOMMENDATIONS

Procedures: We are recommending that before any proposals are presented to the technical committee that a thorough investigation of the structural condition is carried out. The following should be the methodology:

- Soil Investigation and Physical Analysis of Foundation Conditions
- Geophysical Investigations and Analysis of Terrace Structures
- Structural & Fabric Survey of Temple Structures and Platforms
- Analysis of Building Materials
- Development of Structural Designs with Minimal Visible Impact

Proposed Structural Interventions: Any intervention to consolidate the foundations will require heavy funding and a major structural intervention. From the preliminary analysis it is anticipated that it will not be necessary to undertake any work to the foundations of either the platforms or the temple structures. All the works will be in the consolidation of the superstructures alone. It is anticipated that the careful placement at three different levels of post stressed reinforcing bars and the creation of a web of interlinking vertical pieces of steel in the towers will be the only structural intervention necessary. There is no apparent need even to place concrete.

Proposed Architectural Conservation Methodology: It will be necessary to create special channels for the steel. This work will be carried out with due respect to the stucco finish. It is anticipated that the stucco and present brickwork will be consolidated first and afterwards the channels will be created by removing and replacing courses of brickwork. During the period of structural investigation a scientific study of the condition of the masonry and stucco will be undertaken.

Proposals for Implementation: Following the procedures of project identification, project preparation and project implementation, it is recommended that, before any intervention to the historic structures is undertaken, it is necessary to undertake an investigation mission to prepare design proposals, a budget and a workplan programme, as outlined above.
Emergency Interventions: As a matter of urgency, it is recommended that, prior to the coming monsoon temporary protection is provided to the tops of the towers to prevent further rainwater percolation. It is also recommended that as much vegetation is removed as possible from the structures, possibly using herbicides.

BUDGET

A more detailed proposal is under preparation for consideration by the Royal Cambodian Government. It is anticipated that a budget of between $50,000 and $60,000 will be required to field the proposed mission and to prepare detailed designs for structural consolidation and for architectural conservation.

Prepared By:  John SANDAY, Project Manager,
Preah Khan Conservation Project
World Monuments Fund, New York USA.

Prof. Dr. Predrag GAVRILOVIC,  Civil Engineer
Adviser to Preah Khan Conservation Project
Institute of Engineering Seismology
Skopje, Macedonia.
APPENDIX I

CONSERVATION NOTE - ANGKOR WAT CAUSEWAY
CONSERVATION NOTE

SITE: THE WEST CAUSEWAY, ANGKOR WAT, ANGKOR.

Date Visited: 25th March 1994

PURPOSE OF VISIT

Following a survey of the site during the Ecole Francaise d'Extreme Orient (EFEO) and Sophia University's Workshop on the afternoon of 22nd March 1994, the World Monuments Fund team were concerned about the diagnosis of the structural failure of the foundations of the northern wall. Subsequently, John Sanday and Dr Predrag Gavrilovic made a closer investigation and submit this note to assist the Royal Cambodian Government in their deliberations on the extent of work required at this site.

BRIEF DESCRIPTION

The structure in question is the Western Causeway, across the moat which is the main access point to the Temple Complex. The causeway contains an interesting and innovative feature of a remarkable Naga or "snake" balustrade which was cantilevered beyond the retaining walls of the causeway and supported off a colonnaded structure which seems to be independent from the main structure, most of which have been lost over the centuries. This structure has undergone a bizarre series of restorations in that the structure has been divided longitudinally into two halves which have been the subject of two different "restoration" philosophies. The southern section was for the most part dismantled section by section and new mass concrete foundations were placed to support both the walls and the colonnades. Prior to the reconstruction of the wall in laterite a standard section concrete retaining wall was erected within the causeway, a concrete base was laid beneath the stone paving which was raised off the base and an elaborate storm water collection and removal system was introduced.
The northern section underwent various maintenance works under the supervision of Mr Maurice Glaise and the surface of the paving is in contrast rough and undulating, perhaps more characteristic of its age and history.

PRESENT CONDITION

The contrast between the old and new methods of repair are very striking. The southern section is in sound condition but uncharacteristic to the rest of the Angkor Wat structure, whereas the condition of the northern sector is in contrast more dilapidated. A brief inspection was made of the foundations, the laterite wall and the paving surface. The general concerns of failure to the foundation along the northern side are unnecessary. It appears from a visual inspection that the condition of the foundations is satisfactory. There are no signs of settlement evident, except for localised settlement which is apparent at the base of the landing stage at mid point. There is evidence of degradation to the laterite walls and a certain amount of undulation of the paving on the causeway.

DIAGNOSIS

The damage that is apparent, however, is related to the portion of wall that is subject to periodic immersion and drying out - an area where air meets water - which is always the cause of damage to any building material. At the point where the wall comes out of the earth up to an average height of 1 meter there is evidence of disturbance to the wall and of degradation to the laterite due to water seepage or saturation caused when the water level rises in the moat during the monsoon. This damage subsequently has resulted in the continual replacement of the laterite blocks, sometimes even with stone as part of a necessary maintenance programme. At the upper levels of this retaining wall there is also evidence of outward thrust or leaning which may have been caused by instability due to the failure of the laterite blocks below or by the change of conditions caused by the more recent interventions on the southern side. The construction of the retaining wall and the placement of a mass concrete base to the southern half of the causeway has no doubt changed the original drainage pattern on the causeway and it is possible that the water is washing away the subsoil to the northern half of the paving and also having an adverse affect on the upper portion of the wall.
RECOMMENDATIONS

**Procedures:** We are recommending that a thorough investigation of the structural condition is carried out. The following should be the methodology adopted and the order of research should be as listed:
- Collection of Data on Previous Interventions
- Soil Investigation and Physical Analysis of Foundation Conditions
- Geophysical Investigations and Analysis of Terrace Structures
- Structural & Fabric Survey of Structure and Platform
- Analysis of Building Materials
- Development of Structural Designs with Minimal Visible Impact

**Proposed Structural Interventions:** Any intervention to consolidate the foundations will require heavy funding and a major structural intervention. From the preliminary analysis it is anticipated that it will not be necessary to undertake any work to the foundation below ground level. The majority of the work will be related to the maintenance of the outer wall by replacing damaged blocks of laterite. The upper portions of the wall will probably require rebuilding and tying back to the main structural mass.

**Proposed Drainage System:** One of the critical interventions required will be proper drainage which will need to compensate for the concrete retaining wall which is preventing natural seepage to the south. A system should be devised to allow continuous and free drainage at all levels through the existing and/or reconstructed north wall.

**Proposed Architectural Conservation Interventions:** The paving will require relaying following the existing pattern and it may best be laid on a concrete base. It is recommended that the paving is laid open jointed (as before) to allow rainwater to percolate through the joints and to link up with the proposed drainage outlined above.
CONCLUSION

If, as anticipated, the condition of the foundations below ground level is found to be satisfactory a great budgetary saving will be made. It is therefore important to undertake a very thorough investigations as a matter of urgency to establish the present condition of the structure and fabric which will then enable the research and survey team to expand their recommendations for the repair, maintenance and conservation of the causeway. It is important to realise that the correct approach for the repair and conservation of the Causeway is best described as a programme of maintenance. It is not necessary in our view to expend large sums of money on such a project when there are many other more pressing and more urgent tasks of emergency repairs and structural consolidation to be undertaken elsewhere in Angkor.

Prepared By:  John SANDAY, Project Manager,
Preah Khan Conservation Project
World Monuments Fund, New York USA.

Prof. Dr. Predrag GAVRILOVIC, Civil Engineer
Adviser to Preah Khan Conservation Project
Institute of Engineering Seismology
Skopje, Macedonia.
APPENDIX J

PROPOSAL FOR TRAINING IN ARCHITECTURAL DOCUMENTATION
20 April 1994

Proposal

Re: Training in Architectural Documentation for Cambodian Students

Proposed Dates: October-November 1994

Location: Preah Khan, Historic City of Angkor, Cambodia

Background

Since 1989 the World Monuments Fund has been working at the Historic City of Angkor on various projects involving the conservation and presentation of this world famous archaeological site. Since 1991 WMF has focused its attention on safeguarding the 12th century site of Preah Khan, which is considered one of the most important sites in the history of Khmer civilization.

Conservation activities at Preah Khan have included jungle clearance, documentation of ruins in their 'as found' condition, emergency stabilization of buildings in danger of collapse, and a number of conservation interventions. A hallmark of the Preah Khan project has been field and classroom training of graduate students of architecture and archaeology from the University of Fine Arts in Phnom Penh.

The educational systems in Cambodia, especially at the college level, are under extreme stress. There is a flood of students in the vanguard of the post-war generation who are accommodated in seriously substandard facilities throughout the country. For instance, electricity is yet to be fully installed at the University of Fine Arts in Phnom Penh requiring the use of gasoline-powered generators when a slide projector is used. Furthermore, in the School of Architecture, for instance, the student to faculty ratio is 85 to 1.
In response to these facility inadequacies and the overcrowded classroom conditions in Phnom Penh, WMF has worked with the faculties of graduate schools of architecture and archaeology to establish field schools at Angkor so that students can participate in actual 'hands-on' work at Cambodia's most important historic site. This instruction is conducted under the supervision of highly qualified international consultants, several of whom teach at other universities and who participate in WMF's regular field missions.

**Proposal**

Expanding upon the training activities that WMF has sponsored over the last four years at Preah Khan, it is proposed herewith to have an expanded field school in architectural documentation at Preah Khan as an adjunct to the University of Phnom Penh's normal training in archaeology and architecture.

The program would consist of the following:

- Organized instruction of 24 students over a four week period at the site of Preah Khan where a variety of conservation activities will be underway at the time.

- Accommodation of these students in nearby Siem Reap in a healthy dormitory environment with meals and ground transportation.

- Provision of drafting and writing equipment for use in field, classroom and drafting studio settings.

- Arrangement for the release of the students from the University of Phnom Penh architecture and archaeology programs for this special training opportunity as part of their University curriculum, for which they will receive credit.

- Close and careful instruction of the students in all aspects of architectural documentation methodologies.

- Guidance of the overall field work effort so that it produces useful results that is considered a contribution to the international campaign to safeguard Angkor.
Budget

Student Expenses

Transportation
24 students x 1 round-trip (P P - S R) x $200 US $ 4,800
Ground transportation for 30 days $ 1,400

Room and Board
24 x $25.00/day x 30 days $ 18,000

Facilities and Equipment
Drafting equipment and teaching tools $ 3,100
Drafting studio set up costs and rental $ 3,500
Printing and photography costs $ 2,400

Incidental Costs
Reception and Farewell Events $ 450
Tours to other sites $ 400

Administrative Expenses

Time in Field
20% of Project Manager John Sanday’s time $ 2,000
85% of instructor Architect Kevin Sarring’s time $ 3,600
20% of the time of 3 other specialty instructors (Stubbs, Gravilovich & Briscoe) $ 5,000

Transportation
Ground transportation at Angkor and Phnom Penh $ 600
International travel
Architect Sarring from Chicago $ 1,900
Manager Sanday (50% of normal travel cost to Camb.) $ 700

Miscellaneous

Preparation of an Exhibition of Student Work $ 3,600
Publication of Field School results $ 2,400

Project Budget $ 53,850
APPENDIX K

PROPOSAL FOR SECURITY MEASURES AT BANTEAY SREI
RECOMMENDATIONS FOR THE PROTECTION OF BANTEAY SREI
ANGKOR SIEM REAP, CAMBODIA

for the
Ministry of Culture
of the
Government of the Kingdom of Cambodia

Prepared by:
The World Monuments Fund
New York, USA

January 1994
Entrance Way at First Enclosure, Banteay Srei (967 AD), Crest of Fronton Stolen in September 1993.
Defaced Apsara Figure, Banteay Srei, January 1994.
RECOMMENDATIONS FOR PROTECTING THE BANTEAY SREI TEMPLE COMPLEX

PROJECT INCEPTION

At the request of Mr. Vann Molyvann, Minister of State for the Kingdom of Cambodia, the World Monuments Fund has conducted an initial survey of the temple complex at Banteay Srei to consider methods of securing and protecting the site against vandalism and treasure seekers. Banteay Srei is located 32 km to the northeast of Siem Reap.

This study is necessitated by an alarming increase in looting of sculpture and other objects of cultural patrimony from Banteay Srei. The problem has become more apparent as many pieces of fine sculpture have been stolen in recent months - a fact corroborated by the recent appearance of architectural elements from Banteay Srei for sale in the art markets of Thailand and the rest of the world.

While protection of such important sites can be a complex matter involving legislation, international communications, police enforcement and effective security measures, the World Monuments Fund team conducting the present analysis has focused on measures for physical protection which are site-specific, cost-effective, and available for immediate implementation. The following issues and activities have been identified and are outlined below:

1. Improved Road Access
2. Repair of Laterite Enclosure Walls
3. Restoration of the Moat
4. The Conservation Management Team
5. A Permanent Work Force
6. Appropriate Security Gateways
7. Improved Guard Facilities and Equipment
8. Design and Placement of Signage
9. Installation of Checkposts
10. Provision of a Buffer Zone
11. International News Releases
Consideration is also given to the development of a conservation management plan within the consulting and staffing arrangements of the existing WMF Preah Khan Conservation project in close collaboration with the Cambodian Government staff in Siem Reap and in Phnom Penh.

The proposal, by force of circumstance, is necessarily site specific. Therefore, recommendations for the improvement of tourist amenities is limited to Banteay Srei visitors only.

OUTLINE OF PROPOSED ACTIONS

Improved Road Access
The present dirt road leading east-northeast from Park d'Angkor to Banteay Srei is an extremely difficult passage. WMF considers that improved access will enhance the number of visitors to the site, which will in turn improve the security and protection of the site.

Repair of Laterite Enclosure Walls
The restoration of the two outermost wall with gates at their only two entrances can provide added security to the sanctum sanctorum. It is proposed therefore to reconstruct the damaged and collapsed sections of the enclosure walls using where possible the original material.

Restoration of the Moat
The present moat surrounding the sanctum sanctorum has a minimal amount of standing water at most times of the year. Recent efforts to clean the moat and site clearly demonstrate that the moat plays a key role in the presentation of the architecture. It is proposed that the moat is cleaned out and refilled using water taken from the nearby river, and that the water level is raised to approximately 50 cm below the surrounding ground, thereby restricting access to the inner area. This would also allow the architecture of Banteay Srei to be seen in reflection as was probably originally intended.

The Conservation Management Team
It is recommended that a conservation management team be established immediately to plan and develop the recommendations set out in this document to undertake the
urgently required research and inventory program of moveable and immovable objects. Activities such as photogrammetric architectural documentation will be undertaken. An analysis of the rainwater drainage from the superstructure of each of the temple structures should be undertaken since it has been nearly 50 years since the last major restoration.

A Permanent Work Force
An essential requirement of site protection is the presence of employees on the site. It is therefore recommended to establish a work force of skilled and semi-skilled people to undertake emergency repairs and security measures, including site clearance and maintenance, possible superficial stone cleaning (e.g. algae removal), and possible replication of selected missing sculptural elements.

Appropriate Security Gateways
Proper control of access to the site will enhance security. It is proposed that specially designed removable security gates are installed on all gates that provide access through the Enclosure Walls. These gates should be easily detached during visiting hours.

Improved Guard Facilities and Equipment
A range of ideas should be explored including: round-the-clock guard facilities; raised but visually discrete observation platform(s); telecommunications with provincial police headquarters; guard dogs; and improved site lighting.

Design and Placement of Signage
The design and placement of appropriate, multilingual signage consistent with the requirements of the Angkor Park that will:
- Remind visitors of the cultural significance of the site;
- Inform visitors that the site is being security monitored and has been thoroughly inventoried;
- Notify all visitors that vandalism or theft will be prosecuted to the fullest extent of the law.

Installation of Checkposts
Establish an appropriately designed checkpoint on the road near the entrance to the site where everyone entering and leaving the temple complex will be required to register their visit.
Provision of a Buffer Zone
As a further security measure, it is proposed that for a distance of 20 meters from the outer enclosure wall all undergrowth should be cleared (except for selected trees) on the north, west, and south sides of the site. Consideration should be given to the erection of a 2.5 meter high security fence enclosing the buffer zone. (Materials may be available from old UNTAC stock.)

International News Release
Publicity is a great deterrent to looting. It is therefore recommended that a news release is prepared describing the present comprehensive international effort to safeguard the site from looting. This release should be disseminated to the national and international press organizations in Cambodia, Thailand, Vietnam, Malaysia, Japan and to the more distant art markets of Europe and the United States.

CONSERVATION MANAGEMENT PLAN
Following the Cambodian Government’s approval in principle of the above recommendations and in close collaboration with the Cambodian Government’s staff in Siem Reap and in Phnom Penh, WMF proposes to augment the present WMF Angkor team as necessary to conduct a thorough “as found” survey of the historic architectural fabric of Banteay Srei. This report would be published and widely circulated. The survey would also verify the present suspicions that a considerable amount of architectural fabric is rapidly deteriorating due to open joints and deferred maintenance. The Banteay Srei site survey will provide an essential basis for a forthcoming long-term conservation management plan which would include minimum repairs, site interpretation and long-term maintenance.
IMPROVED TOURIST AMENITIES

Tourist Facilities
The recent construction of a guard's facility and a tourist picnic hut is a good start to providing the necessary facilities. It is recommended that similar structures are planned to include toilets, a gift shop, the daytime use of observation platforms etc.

Site Interpretation
At the moment there is no interpretative material available at the site. It is therefore proposed that a range of interpretative information is made available for visitors in several languages and at different prices (e.g. an overview of cultural significance; an annotated site plan, sculpture/iconographic location and explanation guides.)

BUDGET CONSIDERATIONS

The following budget considerations have been derived for the mobilization and implementation of the immediate activities at Banteay Srei:

1. Improved Road Access (Govt.'s Responsibility) $US 16,000
2. Repair of Laterite Enclosure Walls $US 12,000
3. Restoration of the Moat $US 10,000
4. The Conservation Management Team $US 15,000 (P/A)
5. A Permanent Work Force
6. Appropriate Security Gateways $US 4,000
7. Improved Guard Facilities and Equipment $US 8,000
8. Design and Placement of Signage $US 1,000
9. Installation of Checkposts $US 1,500
10. Provision of a Buffer Zone $US 3,000
11. International News Releases $US 300

$US 70,800

- Special Computer Hardware/Software $US 3,000
- Administrative Support $US 1,500

GRAND TOTAL $US 75,300
WORK PLAN

The following is a proposed work plan for the Banteay Srei security improvement program. For details refer to Illustration 2.

CONDITIONS

The following terms and conditions are proposed to enable the project to get under way:

- The World Monuments Fund Team are provided transport free of cost to Banteay Srei and are provided armed guards for the duration of their stay at the site.

- The World Monuments Fund are provided with a full time staff representative from the Conservation d'Angkor with authority to implement proposals and recommendations cleared by the Royal Government of Cambodia.

- The Royal Government of Cambodia are responsible for arranging or for undertaking road improvements and all costs associated with salaries and maintenance personnel.
SECURITY IMPLEMENTATION SCHEDULE

January 1994

RECOMMENDATIONS FOR THE PROTECTION OF BANTEAY SREI

WORLD MONUMENTS FUND
RECOMMENDATIONS FOR THE PROTECTION OF BANTEAY SREI

January 1994

WORLD MONUMENTS FUND
APPENDIX L

PROPOSAL FOR AERIAL RADAR IMAGING BY NASA
15 July 1994

Dr. Diane L. Evans
Project Scientist
NASA
180703 Jet Propulsion Laboratory
Pasadena, CA 91109
telefax 818-393-1492

Dear Dr. Evans,

Per your request we are providing a more detailed application to NASA for including the Eco-Site of Angkor in north central Cambodia as a SIR-C/X-SAR Supersite in the upcoming August 18th Space Shuttle Endeavor mission. The following application serves to supplement previous telephone and fax correspondence on the subject of radar documentation at Angkor since March, the time of the last mission.

The short title of our project is termed Eco-Site of Angkor Radar Imaging Survey. The project is part of an on-going investigation which is termed "Eco-historical Cycles of Human Civilization and its Environment: the balance of manmade and natural elements at World Heritage Sites". The four specific study areas are the region referred to as the Eco-Site of Angkor, and three temple sites within: Preah Khan, the Bayon and Preah Ko.

World Monuments Fund (New York) with strengths in architectural monuments conservation, and the Royal Angkor Foundation (Budapest) with special interests in conservation and geographical information systems have specially formed a scientific collaborative for this survey. WMF and RAF strongly believe that SIR-C/X-SAR data would provide an immeasurable aid to a number of recently re-activated archaeological and geographical research programs at Angkor. It would facilitate, for the first time, a coherent and comprehensive analysis of both surface and sub-surface features particularly environmental, archaeological and hydrological anomalies.

The fact that Angkor today is a vast city of stone, over a thousand years old, situated on relatively soft soil makes the possibilities of discovering new surface and sub-surface anomalies using radar imaging a highly likely prospect. Thus the Eco-Site of Angkor Radar Imaging Survey could also satisfy the NASA mission objectives concerning the provision of useful geological and ecological development patterns at selected areas of earth's surface in Indochina, an area of the world which received relatively little attention in the March mission.

Some recent medium resolution aerial photogrammetry and infrared documentation of Angkor provided by the French have answered a number of questions pertaining to geography and has raised others. It is felt that the vegetation and
The WMF/RAF collaborative guarantee that research data provided by NASA will be used solely for constructive historic cultural resource management purposes and will be accessible only to qualified individuals making serious scientific inquiries. NASA will always be appropriately and respectfully credited for its generous assistance to the Angkor research project team.

We are most hopeful that NASA will include Angkor as a 'Supersite' on the upcoming mission. If there are any questions, please do not hesitate to contact me or project co-director Janos Jelen in Budapest at tel./fax 011 (361) 122 4270.

Thank you for the cooperation and encouragement you have given us thus far.

Sincerely,

John H. Stubbs
Program Director

encl
RADAR IMAGING SURVEY OF THE ECO-SITE OF ANGKOR

Introduction

The Eco-Site of Angkor, the historical capital of the Khmer civilization from the 8th to the mid-15th century, extends over an area of approximately 5000 square kilometers in north central Cambodia. Renowned for the beauty of its sculpture, the magnificence of its architecture, and the extraordinary engineering achievement represented in its vast hydrological works, the Eco-Site of Angkor is listed as a World Heritage Site by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

Today, after two decades of neglect, there is an ongoing international effort to conserve and present the Eco-Site of Angkor as a unique achievement of man and as a symbol of the history and cultural identity of the Cambodian people.

World Monuments Fund and the Royal Angkor Foundation are conducting two scales of research at Angkor: 1) special investigations of the ancient hydro-engineering system and related historic urban development matters, and 2) detailed above-, at-, and below-grade archaeological research and documentation at the representative temple sites of Preah Khan, Preah Ko and the Bayon. It is strongly felt that remote sensing investigations of these sites using data from NASA's SIR-C/X-SAR Earth Imaging Radar system would provide fruitful results. Some of the questions we seek to answer have vexed archaeologists and others since Angkor was 're-discovered' in 1852.

Radar Scan Location Requests

WMF and RAF respectfully request that NASA conduct SIR-C/X-SAR scans of the following four locations:

**Project supersite:**
The Eco-Site of the Angkor region (an approximate 5000 km area)

13°04' - 13°45' Latitude, 103°35' - 104°15' Longitude

**Proposed swath centers:**
The temple of Preah Khan
13°27'36.6" Latitude, 103°52'30.6" Longitude

The temple of Preah Ko
13°20'28.8" Latitude, 103°58'30" Longitude

The temple of Bayon
13°26'20" Latitude, 103°51'25" Longitude
Polarimetric requirements: NASA, please advise. The WMF/RAF team seeks highest imagery resolution which is technically possible for the three (3) above mentioned temple sites. The same is needed for the vastly larger 'Supersite' of the general Eco-Site of Angkor.

Executing agencies: World Monuments Fund, New York, USA, and Royal Angkor Foundation, Budapest, Hungary

Investigators: J. Stubbs (WMF, New York), J. Jelen (RAF, Budapest), Dr. P. Logan (CERS, Los Angeles), J. Sanday (WMF, Nepal), Dr. E. Moore (Univ. of London, UK), Prof. J. Allan (Univ. of London, UK), I. Klinghammer (ELU, Budapest), Dr. C. Jacques (Ecole Pract. des Hautes Etudes, Paris), Dr. C. Jest (Paris), Kevin Sarring (Chicago), R. Yimsut (Seattle).

Affiliations: School of Oriental and African Studies, and Geography Department, University of London; Eotvos Lorand University, Faculty of Science, Institute of Environmental Physics, Dept. of Cartography, Budapest; the Schools Archaeology and Architecture, University of Beaux Arts, Phnom Penh; and the Ministry of Culture, Royal Cambodian Government, Phnom Penh.

Project Description and Objectives: The main purpose of the investigation is to identify environmental change in the Supersite's Quaternary geomorphology and its biomass, and artifactual gaps which have been suspected but not confirmed, ranging from sculpture to monuments, canals and roads. Included are not only the superimposition of temples, but important earlier settlements destroyed in the construction of enormous barays or reservoirs.

The construction of Angkor was an immense technological achievement. While cities are generally sustained by an already established agricultural prosperity, Angkor was conceived to create its own prosperous agriculture. Because the land beyond Angkor is not well watered naturally, gigantic barays were built to store water, fill the moats and canals in the city and irrigate the fields beyond. From these great reservoirs, navigable canals conveyed water to moats encircling the temple complexes and provided a mode of transportation for people and goods. Water flowed south from the high points where the barays were located to the Tonle Sap (a great lake). These irrigated tracts provided fertile land where several crops were grown each year, which supported the strength and prosperity of the Khmer empire. Today the vast hydrological system of Angkor is almost entirely in disuse and its original system of operation is little understood.

In examining change in form and vegetation, critical features are found in the south to north progression of lake, plain, and mountain zones which comprise the setting of Angkor. These incorporate variations of the perimeter and depth of the Tonle Sap, the present classification of the plain into recent and ancient alluvial zones, natural and manmade diversions of river courses, and the effects of constructing the four major barays.

The data generated by the project would provide an unprecedented lever enabling us to 'lift up' the present setting of Angkor and its remains, so as to expose its roots or origins. If the balance of natural and man-made alterations to the Angkor zone at regular intervals over the last seven thousand years could be charted, both the evolution of the urban center ('Angkor' means 'The City') and its demise would revolutionize our knowledge about the history of Angkor. It could also
provide a more supple framework for conceptualizing the site: more than a palimpsest of temporal layers, we could begin to comprehend and interpret the overlapping geographical and cultural microzones, and thereby uncover not just the effects, but the forces which led to the remarkable concentration of man-built cultural patrimony and current human activity which we call 'Angkor' today.

The data from SIR-C/X-SAR could be integrated into the existing Angkor database, the Geographical Information System (GIS), developed by Royal Angkor Foundation and further expanded by the Zoning and Environmental Management Plan (ZEMP) for the site of Angkor, organized by the UNESCO. If it is possible to calculate temporal changes from the data then it should be feasible to extrapolate historical cycles first at Angkor and later at other World Heritage Sites elsewhere in the world.

The GIS, which the Royal Angkor Foundation established through ZEMP is primarily 'present time' data: population, roads, rivers. Some elements have begun to construct a temporal framework: aerial photos from 1945, 1954, 1992; satellite images; maps from 1907, 1927, 1973; etc. The chronology of Khmer civilization and its antecedents has preoccupied many researchers for over a century, though for the present purpose, the temporal framework labels of 'prehistoric', 'early' and 'late Angkorian' suffice. Of key importance is the relation of some of the over 1000 archaeological sites at Angkor to water features over time.

Concerning geomorphological change, certainly the lake bed, the soils of the plain, at the present and past river courses are the easiest to document, but if data were collected over a period of time, say five years, perhaps that could be used to project change over 500 years. Here we enter unknown territory, stretching the possibilities of SIR-C/X-SAR data and our hypotheses to their limits. The future of such a methodology is just breathtaking, a retrospective assessment of great human interventions into nature based on 'real-time' archaeo-environmental measurements.

Description of Organizations and Key Personnel

World Monuments Fund  Established in 1965 the World Monuments Fund is a not-for-profit private organization based in New York, USA whose purpose is to assist in the preservation of man's most significant artistic and architectural heritage through research, planning, development and funding of major conservation projects worldwide. WMF has worked at Angkor since 1989. For the past four years WMF has worked to conserve and present the monastic complex of Preah Khan which is considered to be among the most significant of the temple complexes at Angkor. In March of 1994 the Royal Cambodian Government asked WMF to oversee conservation activities at four other major temple sites and for WMF field personnel to play a major role as advisors to the government in the planning of conservation interventions throughout the entire archaeological park.
Royal Angkor Foundation

The Royal Angkor Foundation is a recently established not-for-profit organization based in Budapest, Hungary whose purpose is to revitalize the material and intellectual heritage of the ancient culture of Angkor. To achieve its goals the Foundation advocates increased international acknowledgment of the culture and civilization of Angkor through scientific research. RAF's activities to date have concentrated mainly on an eco-cultural hydrological history of the Khmer Empire, comparative cartography of the Angkor region and the consolidation of all available information on Angkor into a Geographical Information System (GIS). RAF personnel played a major role in the development of a Zoning and Environmental and Management Plan (ZEMP) for Angkor.

Principal project personnel comprising the WMF/RAF collaborative include:

John Stubbs - Program Director, World Monuments Fund
At the headquarters of WMF in New York, John Stubbs is coordinator of the various campaigns of work at Angkor. He has participated in field work at Angkor since March 1992 where he has contributed to the development of project planning and conservation policies on site. Trained as a conservation architect he has been in practice for over 20 years. He presently teaches part time as Adjunct Associate Professor at Columbia University's School of Architecture and Historic Preservation. His educational experiences included serving as surveyor and illustrator on archaeological excavations in Italy and Egypt. Graduate and post graduate training included a masters thesis on conserving and presenting 'in situ' archaeological remains and course work in archaeological prospecting at the Lerici Foundation in Rome.

Janos Jelen - Chairman, Royal Angkor Foundation
Janos Jelen is a career diplomat with a long-standing interest in the political and cultural history of Indochina. Over the past five years he has directed the incorporation of Angkor on the Geographical Information System, which is the first of its kind. He was also responsible for incorporating the mapping of Angkor as an integral research activity of the Division of Geography at Lorand Eotvos University in Budapest. He founded the Royal Angkor Foundation in 1992. His recent book *Angkor and the Khmers* is considered one of the very best of the modern overviews of Angkor available. Janos Jelen has served as emissary for Hungary in several countries and received high acclaim for his work as Deputy Director of United Nations Transitional Authority operations in the Siem Reap province in Cambodia where Angkor is located.

Dr. Pamela Logan - Science Director
Dr. Logan presently holds a similar post as science director at the China Exploration & Research Society (CERS) in Los Angeles. Her role in the Eco-Site of Angkor Radar Imaging Survey is to use photographic and aerial imaging to help identify man-made constructs at Preah Khan, Preah Ko, the Bayon and other sites. She has worked with John Sanday, WMF Preah Khan Project Director, in Tibet and at the Palpung Monastery near Derge (a CERS project). Dr. Logan holds a doctorate in Aerospace Science from Stanford University and received her Bachelors and Masters degrees in Mechanical Engineering from the California Institute of Technology.
John Sanday - Conservation Architect
Since the inception of the WMF program in Cambodia in 1989, John Sanday has been involved in promoting and managing the project for WMF and has led all the missions. His main skills are in the planning and development of the special sub-projects and in the mobilization of the site activities and workforce. John Sanday has over 25 years experience conserving historic buildings and sites. He established his architectural practice in Katmandu, Nepal in 1972 and has since conserved several dozen sites in Southeast Asia. His career accomplishments include serving as Program Officer for the J. Paul Getty Trust in Los Angeles.

Corneille Jest - Environmental Scientist
Dr. Jest is Maître de Recherche Centre National de Recherche Scientifique and oversees CNRS’s general research program for the Himalaya and the Karakoram. Dr. Jest was a member of the first WMF team to Cambodia in 1989. He has contributed widely to WMF's understanding of the environmental aspects of the Preah Khan project as well as being a liaison between Cambodian officials and the French contingent with common interest in Angkor.

Dr. Elizabeth Moore - Archaeologist
Dr. Moore is a specialist in Khmer art and in remote sensing in archaeology in Cambodia. Dr. Moore is on the faculty of the Department of Art and Archaeology at the School of Oriental & African Studies at the University of London. She has written widely on the topics of hydrology and urban development at Angkor and served as the archaeological consultant to Unesco's Zoning & Environmental Management Project. Her special contributions to the ZEMP were in the areas of habitation and hydraulic features and the development of the GIS database. She has also participated in a wide range of projects concerning archaeology and hydrologic development in various locations in Thailand and Myanmar.

Professor J. Anthony Allan - Geography
Professor Allan teaches in the Department of Geography at the School of Oriental & African Studies at the University of London. His specialties include water management, land evaluation, remote sensing and global monitoring and he has published articles and reports including "The value of Earth observation data in Logica Space and Communications" in Issues in Earth Observation data Policy for Europe (Report for DG XII of the Community for the European Communities, London. 1993). Professor Allan serves not only as a member of the Governing Body and Academic Board of SOAS but also the Chairman of the Computing Committee.

Claude Jacques - Historian
Dr. Jacques is one of the most prominent historians and epigraphers to have studied the Khmer Kingdom and Angkor. His contributions to the World Monuments Fund's work at Angkor have ranged from advising on the chronological development of the site to translation of the famous Preah Khan Stele. Professor Jacques is presently Directeur d'Etudes at l'Ecole Practique des Hautes Etudes, Paris. He has published widely on the subject of Angkor and the Khmers and serves as advisor to nearly all important scientific and governmental authorities with interests in Angkor.
Kevin Sarring - Architect/ Archaeologist
Kevin Sarring is an architect and archaeologist who has worked on important excavations in Pompeii and Rome. His role in WMF's Angkor missions is to document the sites in their 'as found' state and to record the progress of the various conservation sub-projects. To date he has produced numerous drawings with the help of archaeological students from the Department of Archaeology, University of Beaux Arts in Phnom Penh. Mr. Sarring's accomplishments as a restoration architect include serving as restoration coordinator for the Raffles Hotel in Singapore. He is a graduate of Columbia University's Graduate Program in Historic Preservation.

Ronnie Yimsut - Landscape Architect and Forester
Ronnie Yimsut, a Cambodian-American, whose chief responsibilities include surveying and planning for the conservation of the ecology of the five sites at Angkor where WMF is working. For WMF and for numerous other scientific teams working at Angkor he has opened a series of new perspectives with regard to the environmental context of the various man-built structures. Ronnie Yimsut holds degrees in Forestry and Landscape Architecture from the Universities of Oregon and Washington.
To: Mr. John H. Stubbs  
Program Director, World Monuments Fund  
174 East 80th Street, NEW YORK, U.S.A.  
FAX: (212) 528 3146

Phnom Penh, 22 July 1994

Dear Mr. Stubbs,

Mr. John Sanday, Project Director of the Prasat Khan Conservation Project, informed me of your recent contact with NASA’s space shuttle Endeavor, in an attempt to obtain a radar scan of the whole of Angkor, as well as Preah Khan and Praih Ko.

The Royal Government of Cambodia sincerely thanks the World Monuments Fund for its generous efforts, of which it entirely approves. It hereby presents a request for NASA to consider the possibility to perform such radar scans of the entire Monumental Site of Angkor, which has been classified in the list of the World Heritage in December 1992.

The results obtained will be of utmost importance for our country for the updating of all data related to the Monumental Site of its patrimony and for the implementation of the international campaign for the preservation, conservation and development of this rich archaeological Site.

With best regards,

Yours sincerely,

Hun Molyvann  
Minister of State  
for Culture and Fine Arts,  
Country and Urban Planning and Construction.
APPENDIX M

DOCUMENTATION OF REPAIRS TO SOUTH PORCH, EAST GOPURA

Tilting Column and Beam Failure, January 1994.
Reset Portico Lintel with Fronton Fragment in Place, 1994.


Re-Aligned Column on New Concrete Footing, 1994.
Removal of Steps, South Portico, East Gopura.

Numbered Paving Stones.
STONES REMOVED
AND RESET
METALS DOWELS
AND STAPLES -
COLUMNS JACKED
PLUMB

NORTH ELEVATION

RESTORED PORCH

5 TON BLOCK + TACKLE

PLANKING
PROPPING

NORTH ELEVATION

RECONSTRUCTION OF THE PORCH
Paving Stone Documentation, South Porch, East Gopura.
APPENDIX N

CLEARANCE OF EAST PROCESSIONAL WAY
(PHOTO DOCUMENTATION)

Central and Northern Portals of East Gopura, March 1994.


South Side of East Causeway Looking West, 1994.
APPENDIX O

REPAIRS TO LANTERNS (BORNES) AT WEST PROCESSIONAL WAY

BORNE REPAIR  WORLD MONUMENTS FUND  PH (K-L.S)  MTS.
Mismatched Borne Base and Stylobate (As Found), 1994.

APPENDIX P

RESEARCH AT ENCLOSURE WALL IV, NORTH OF EAST GOPURA (DRAWINGS & PHOTOS)

Enclosure Wall IV Section, Outside Looking South, March 1994.


Relocated Stone from Collapsed Enclosed Wall IV, March 1994.
APPENDIX Q

VIDEO DOCUMENTATION

by Wayne De La Roche

May 1994
APPENDIX Q

VIDEO DOCUMENTATION

PROJECT GOALS

While it has been abundantly photographed and drawn for the purpose of surveys and reports, Preah Khan's architecture is not fully represented by two-dimensional photographs or drawings. An important part of experiencing the site is moving through its narrow passage ways, passing from interior corridors to outdoor courtyards, and participating in the volumetric or sculptural layering that unfolds as one travels through it on foot. Adequate documentation calls for movement. It calls for simulation of the way the human eye discovers and enjoys architecture in the round.

During WMF's January 1994 campaign, video taping was introduced as a tool for recording moving images that make Preah Khan come alive in a way that captures the experience of being there. On one level, it was used as a kind of visual "notebook" for surveying the condition of sandstone sculpture and the level of theft that has affected Cambodian artifacts. On another level, it was used to produce an archival record of ongoing conservation procedures, and also to create a film that will give interested parties throughout the world an updated report on WMF's involvement at the site.

EQUIPMENT USED

For purposes of portability and availability, two 8mm Sony Handycams were used during all phases of this project. Both cameras were the property of WMF, one providing an NTSC format for viewing or broadcasting in the U.S., the other a PAL format for European television. Both utilized 2 1/2 hour video cassettes, and shot a combined total of more than 27 hours of tape during a three week period.
VIDEO NOTEBOOK

Using a PAL 8mm Handycam, WMF's field director has been able to survey architectural conditions in Cambodia with an ease and precision that is equally time-saving. Instead of taking written field notes and later matching them up with still photos or drawings made on location, he can now marry picture and word in camera by speaking into the Handycam's onboard microphone while filming a particular building or sculptural detail. The result is a speedy "sketch pad," which eliminates much of the need for assembling information back in the office. The resulting videotape links disjunct or adjacent parts of an architectural site, providing a visual map that vividly recreates a sense of place and makes it easier to analyze the contextual placement of an artifact than if it had been individually photographed. While there is no substitute for photos or drawings which can be studied in detail or reprinted in books and reports, the videotape provides a kind of "glue" that helps to give an overall view of an architectural site. As a recording tool, it is a quick, accurate means of documenting a great amount of material in a relatively short amount of time.

The PAL Handycam proved particularly useful in helping to prepare an important proposal for Banteay Srei, a remarkable temple site 28 kilometers north west of Preah Khan, whose preservation and development may soon be assigned to WMF. In this case, the video notebook facilitated documenting the condition of an intricate assemblage of sculpture and buildings in a few short days, and helped WMF meet a critical deadline in presenting its findings to the Cambodian government.

DOCUMENTING CONSERVATION ACTIVITIES

The 8mm video camera has proven an invaluable tool in contributing to a growing library of information about the preservation of Preah Khan, which will be of great use to scholars, conservators, students and professionals in the field of historic architecture. A primary goal in video taping WMF's 1994 campaign has been to capture the immediacy of the conservation process and to archive the personalities and procedures involved therein. The field of architectural conservation has a number of professional journals in which conservators are able to share their thoughts and techniques with colleagues. But, to date, there have been few, if any, vehicles for
showing these men at work, revealing their procedures through actual demonstration as they talk on the job. Through 8mm video documentation, we have attempted to fill this void. We have started an archive of moving pictures depicting a range of conservation procedures from stone cleaning to structural repair. The effort has been to capture these techniques with a camera that gives an insider's view of each process, up close and dynamically revealing its constituent elements. As a counterpoint, the conservators have been interviewed in situ, and have been asked to describe their work at Preah Khan, shedding light on the particular circumstances they have found there and on the approaches they have chosen for dealing with specific preservation problems.

Additionally, video documentation focuses on showing how WMF incorporates a Cambodian workforce into the process of saving Preah Khan. The camera follows students from the University of Beaux Arts in Phnom Penh as they tackle a number of questions regarding bridges and waterways throughout the Angkor complex. It also traces the traditional methods used by Cambodian laborers as they deftly move giant piles of carved rock with a simple winch and a few wooden levers.

When complete, these videotapes will provide a full record of preservation efforts enacted by a wide range of participants at Preah Khan. It will intimately depict their interaction and a sharing of ideas and technologies that, in the end, will mean growth for Cambodia's people as well as new life for its monuments.

INFORMATIONAL FILM

While preservation professionals require an in-depth representation of conditions and procedures at Preah Khan, potential donors, tourists, and lay persons back home would benefit from a more generalized, but equally stimulating overview of work at the site. As they show increasing interest in WMF's involvement in Cambodia, they need an accurate introduction to the specific goals and achievements of its mission. To this end, we have begun work on a concise, thought-provoking film.

During the January 1994 campaign, sufficient footage was generated to complete this phase of the documentation process at Preah Khan. While the videotaping of conservation procedures will continue over time, there is enough material at present to develop a solid 20-minute informational film. The goal of this film will be to take
viewers through a progressive series of visual scenes and montages that both excite and gratify their curiosity about Preah Khan. It will introduce the site within the broad context of Cambodian culture, and will strive to reproduce the immediacy of being on location with a team of preservation experts in one of the world's most sacred and haunting places.

In striving to make the architecture of Preah Khan come alive on film, a purposely fluid style of shooting has been chosen to tie disparate parts of the temple together with a grace and ease that is in keeping with the mood of the site. Floating through chambers and across sculptural detail or across test patches where cleaning techniques are being evaluated on sandstone, the camera attempts to give a true-to-life impression of what it's like to wander through Preah Khan at a point in history where the past and future of this historic monument are coming together in an important restoration project. In order to communicate the factual truth of the moment, the camera uses an impressionistic, subjective style of documentary shooting to portray a vast range of subject matter.

Shot primarily on the shoulder without the aid of a tripod or other support system, the camera captures intimate, often fleeting moments of daily life and work at Preah Khan. It gets down in the dirt with Cambodian laborers as they bring large pieces of sculpture to light after centuries of entombment; and it stumbles upon a nun and her family as they perform ancient, sacred rites in the soft, filtered light of a sanctum sanctorum that is still a center for prayer after centuries of neglect. In its effort to create a living portrait of Preah Khan, the camera interacts with and bears witness to a dynamic cast of characters, including the very stones with which the temple is constructed. It works its way into crevices of rock to highlight architectural detail at a macro level, and it sweeps the temple's rooftops from a high vantage point to give a broad, contextual overview. In all cases, the camera tries to humanize the photographic experience by making all the parts and players at Preah Khan as accessible and as memorable as possible.

When edited, the resulting film will be an important vehicle for demonstrating WMF's successful involvement in Cambodia as an advisory, educational, and technically effective organization. By providing information through vivid example and by involving viewers at an emotional level, it will be an effective promotional tool and an especially useful implement for fundraising.
POST PRODUCTION

Currently, there are 17 hours of raw, unedited video dailies that need to be edited into a 20-minute informational film. The large disproportion of dailies versus cut tape is due to the fact that the WMF documentation project required shooting many hours of archival footage to record preservation techniques and procedures. Only a small portion of this footage can be presented in a short informational film. The rest, as noted above, will appear on a longer documentary tape produced for specialty audiences interested in technical aspects of architectural conservation.

In all cases, 8mm master tapes will need to be transferred to formats that are suitable for editing and/or viewing.

Archival Tapes: In the case of archival footage, 8mm master tapes will first be transferred to 3/4" video cassettes. Since the master tapes contain a multitude of scenes that are extraneous to a technically-oriented video, it will be necessary to sort out and edit together all conservation and procedural material that is deemed worthy of archiving, thereby creating a 2nd-generation compilation tape from which multiple 1/2" VHS viewing copies can be generated and disseminated as required. Unfortunately, by adding an additional video generation through editing, we end up with a "noisier" image and a consequent reduction in picture quality. To prevent such loss, we could selectively transfer our 8mm originals two times: once by choosing only those scenes that are required for archival documentation, and a second time by transferring all material pertaining to an informational video. However, there is a potential danger of harming and therefore losing important visual material each time the 8mm master is played for transfer. It is therefore best (even though it forces us to sacrifice image quality in the edit) to transfer our master tapes only once in their entirety so that scenes can be edited off a single transfer tape without destroying any source material. If budget or access to a digital editing facility permitted, we would ideally transfer our complete 8mm original to a D-2 digital format with a time code address track, making 3/4" window dubs for an off-line edit, and finishing on-line in a digital editing suite. This would circumvent the problem of losing picture quality through the addition of an extra video generation since digital editing virtually eliminates image loss. Instead, both our archival tape and informational film will be finished off line on 3/4" editing hardware, which will need to be obtained through rental or donation.
Informational Film  In order to create a short informational film from hours of raw footage, 8mm master tapes will, as in the case of archival documentation, be transferred to 3/4" cassette. Since this film will include scenic or human interest footage that is not required for archiving, it is essential that the master tapes, which contain a wide variety of subject matter, be transferred in their entirety in order to permit an unrestricted choice of material during editing. While the archival tape will be a fairly linear assemblage of documented events and interviews, the informational film will require a more intuitive approach in selecting and shaping its story line. To this end, it will demand a creative and motivated editor, who can guide this project to completion and help to generate 1/2" VHS copies for distribution.

(NOTE: 8mm master tapes could be transferred directly to 1/2" videotape for a VHS edit. However, this practice is not recommended. While VHS editing equipment is less expensive to rent and provides the possibility of a home edit, the end product would be vastly inferior than if edited on 3/4", which provide for greater frame accuracy in cutting, and for better overall image quality, especially since original footage was shot on regular 8 rather than on Hi8 video.)

RECOMMENDATIONS FOR FUTURE DOCUMENTATION

Regular 8mm Handycams were used for taping at Preah Khan because of availability and cost effectiveness. Had these cameras been Hi8, they would have provided an advanced technology and, hence, an image more closely approximating broadcast quality. 8mm video does not have the capability of creating as true a rendition of color as Hi8. Because it uses an inferior color chip, its picture is more desaturated and muddy. For this reason, it may prove wise to finish our 8mm informational film in black and white, since this will probably give better tonality to the video image and make for a more pleasing picture. If image quality is of concern for future WMF video projects, it is recommended that original material be generated in Hi8. Alternately, if there is a desire to broadcast any of its documentation projects, WMF might consider originating its footage on Betacam, or, if funding permits, on 16mm film, which can then be transferred to videotape, providing the highest image quality of any TV medium.
Finally, it should also be noted that, in discussing our Cambodia project with producers from National Geographic's television division in Washington, D.C., interest has been shown in the possibility of developing a proposal for an Explorer program on Preah Khan. At present, pitching such a proposal is still in a very preliminary talking stage. If, on further discussion, it proves feasible to proceed with this plan, then selected scenes from WMF's 8mm footage will be presented to National Geographic as a location scout, depicting aspects of the Preah Khan project that would lend themselves to filming for television. If such a proposal is accepted for production, then filming in Cambodia could possibly begin as early as the summer or autumn of 1994, although weather might make it more favorable to recommend shooting in January of 1995.
APPENDIX R

ANALYSIS OF THE ROLES OF WATER
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ANALYSIS OF THE ROLES OF WATER

The development of Angkor's vast hydrological system that served the agricultural, transportation and everyday needs of inhabitants of the city remains a major topic of study among historians and other experts.

Preah Khan survives as an excellent representative temple site at which to conduct detailed studies on the various roles that water played. Questions range from macro to micro concerns, from the very real and practical to the symbolic. All of these questions must be understood in light of the fact that the site today is largely overgrown and in ruin. Thus, many of the vital pieces of information on this subject are lost.

WMF proposes to conduct on-going research on all aspects of water at Preah Khan. The points for consideration are listed below.

Points for Consideration
1. Specifics on water at Preah Khan:
   1. Overview of Preah Khan's significance, purpose and maintenance history.
   2. Av. annual rainfall amount.
   3. Rainy season - May through September.
   4. Peak period of rain is the SW monsoon between May and October.
   5. Location of water features at Preah Khan.
   6. Capacity of outer moat and tanks.
7. Mean water table-(historic and present).

8. Absorptive capacity of soil.

9. The presence of water and soil bearing capacity.

10. Historical references on Preah Khan stele.

11. Access to site by water - East baray boat landing, steps at causeways.

12. Moats and barays as borrow pits - arguments for and against.

13. Causeways, levees, dams and bridges.

II. Architectural/Engineering Features at Preah Khan:

1. Site topography - fall from central shrine.

2. Water tanks - their construction, purpose and use (incl. bathing rituals).

3. Water pools (basins) - their constructional detailing [ref.PKS-'CLVI.-93,507 brasses de perimetre de bassins,...." (See Coedes,G. and Finot, L. "Le Symbolism de Nak Pan" BEFEC XXIII, pps. 401-405.)].

4. General (open) site runoff and collection.

5. Subterranean drainage systems.

6. Surface drainage systems (at ground level).
   - Pavement (pitches and finishes).
   - Channels.
   - Gutters.
   - Drains (thru-wall and vertical).
   - Pool features - reflecting, evaporative cooling, aesthetic/symbolic.
   - Illustration of ornamental water bodies.
   - Longevity of architectural water features - short, seasonal, year round.

7. Roof drainage systems.
   - Vault roofs.
   - Tower roofs.
   - Roof valleys.
   - Roof pitches.
   - Water 'throw' from roofs.
   - Drip lines and overhangs.
   - Lack of gutters.
   - Internal drains.
8. Khmer stone detailing for water protection:

- Compound joints in roof stones.
- Tightness of joints.
- Roof creasing and tile representation.
- Acroteria.
- Moulding profiles and water drainage.

III. Water Symbolism in Art & Religion:

1. Sea surrounding Mt. Merou (Separations of sea, earth and heaven).
2. Water creatures, benign and fearsome (ref. Bayon scenes).
5. Holy water.

- Snake/water relationships.
- Railings at causeways.
- Use of 3,5,7 or 9 heads.
- Head and tail motifs in frontons.
- Body representation as roof ridges.
- Mucilinda, King of the Nagas whose coiled body form the base and outspread hood of the Buddha.
- Naga vs. garuda motif (antithesis and harmony).
- Representing the wet season.
- Naga representing rainbow (?)..
- Nagas churning the 'sea of life'.
- Naga emitting water.

IV. The conservation challenge posed by water today at Preah Khan:

1. Ref."Waterproofing" section of WMF Report IV, pp.43-49.
2. Restoration of selected water features.
3. Diagram of probable water features and possible future presentations.
APPENDIX S

CAMBODIAN ROYAL DANCERS AT PREAH KHAN'S HALL OF DANCERS
Cambodian Royal Dancers at 'Hall of Dancers', Preah Khan, April 1994.
Cambodian Royal Dancers at 'Hall of Dancers', Preah Khan, April 1994.