Saving WWII Historic Sites

Metals Conservation Course in the Marshall Islands

The Republic of the Marshall Islands (RMI), Australia, and the United States sponsored a metals conservation course and demonstration project December 3-10, l992, which was attended by nine students—two from the Commonwealth of the Northern Mariana Island (CNMI), two from the Republic of Palau (RP), one from the Federated States of Micronesia (FSM), and the others from the RMI. Micronesia is located in the Western Pacific. The Marshall Islands lie between 7 to 14 degrees north of the equator at the eastern end of Micronesia, which is over two thousand miles WSW of Hawaii. The Historic Preservation Office of RMI organized the course and project. The government of Australia awarded a $16,000 grant to purchase the supplies and equipment for the demonstration project. The National Park Service (NPS) provided the technical assistance and one of the instructors. Bonded Chemicals of St. Louis donated the primer and paint to the RMI.

In l991 Carmen Bigler, Historic Preservation Officer (HPO), requested technical assistance from NPS to arrest the deterioration of World War II historic sites in the RMI. Micronesia's climate is highly conducive to deterioration, especially the corrosion of metals—heavy rain, high humidity, salt air and spray, rapid growth and decay of tropical vegetation. In addition, being close to the equator, it has strong ultraviolet rays, which have little or no effect on bare metals but which rapidly degrade any paint and primer films. Since these sites are deteriorating at an alarming rate, RMI has placed their conservation as one of its highest priorities for the next five years. In February l992 Margaret Pepin-Donat, chief, Division of National Register Programs, Western Regional Office (WRO), sent David W. Look, AIA, chief, Preservation Assistance Branch and co-author of *Metals in America's Historic Buildings*, to assess the situation. Dirk H.R. Spennemann, Ph.D., then RMI archeologist and acting deputy HPO, gave Look an extensive tour of these sites on Majuro, the capital of RMI, and the outer atolls of Mile, Wotje, and Maloelap.

After World War I, the former German Colonies in Micronesia were awarded to Japan under a mandate of the League of Nations. By the 1930s Japan began actively planning for a military confrontation with England and the U.S. in a bid to extend its sphere of influence into Southeast Asia. In order to create a suitable defense system at its perimeter, the Japanese navy decided to develop some of the atolls of the Marshall Islands (Kwajalein, Jaluit, Majuro, Mile, Wotje, and Maloelap) into bases for seaplanes, surface ships, and submarines; and, with the advent of long-range land-based bombers, as airfields, contrary to the arms limitation agreement of the Mandate. The development of Wotje base began in December 1939 as part of their defense strategy. Wotje Island on Wotje Atoll was planned and built as a seaplane base and airfield to provide long-range sector patrols for the defense of the outer perimeter of the Japanese South Seas possessions. In addition, the air base on Wotje was needed to carry out raids on Pearl Harbor and Midway. It was supplied by the main base, Roi on Kwajalein Atoll, with fighter and patrol-bomber planes as needed. Parts of the Wotje Base were still under construction when the first American bombs (over 15,000 tons) fell on the atoll in February 1942. Once the military value of Wotje was destroyed, the Americans moved on to other targets. Although WWII was only a very short episode in the history of Micronesia which many would rather forget, it was a world-wide event that forever changed the lives of Micronesia. Unfortunately, the Marshallese were on the battlefield of two world powers.

After the war, Wotje was so destroyed by U.S. bombing and so littered with unexploded ammunition that little development took place. In the mid-1970s a development plan for Wotje was drawn up, major clean-up of war debris undertaken, and the atoll once again made a district center. Marshallese who had fled to other islands of the atoll slowly returned to Wotje. Since WWII the Marshallese have tried to rebuild their lives and devastated economy. Needless to say, the sites and artifacts from WWII were not valued or maintained. On the contrary, many were the victims of souvenir hunters and scrap metal dealers. Other artifacts have been moved and adaptively reused for a variety of uses.

Two different primers with corrosion inhibiting pigments were used to test their effectiveness in the severe tropical marine climate.

Today, RMI has a small tourist industry. The visitors are predominately Americans (both veterans and non-veterans), Japanese (especially Japanese bereavement associations), and Australians. The 24 atolls and five separate islands of RMI have thousands of miles of white sandy beaches and beautiful scenery, but Mile on Mile Atoll, Wotje on Wotje Atoll, and Taroa on Maloelap Atoll have the added attraction of almost totally intact WWII sites. The outer atolls are very unspoiled—without electricity, cars, roads, and all the modern conveniences of Majuro. With the assistance of the RMI historic preservation office, Air Marshall Islands has developed one-day guided excursions from Majuro. There are five thatched

guest cottages on Mile for those who wish to stay longer than just a few hours.

Since the assessment visit, Spennemann and Look have been developing a conservation management plan of World War II sites in a tropical marine climate which is still in draft, but should be published in the near future after peer review and editing. Wood, coral, concrete, and metals were the main materials used in the construction of these bases. The Japanese-imported lumber was ill-suited for the climate and has been almost totally consumed by dry rot and insect infestation. The only standing wooden Japanese building is in Majuro and is in such an advanced state of decay that it cannot be saved. It is being documented with Historic American Buildings Survey (HABS) drawings and photographs. The coral blocks quarried from the reefs were mainly used to construct seawalls along the ocean beaches; these are in good condition except where beach erosion and tidal surge have demolished the walls. The concrete construction is in various states—early construction under civilian Japanese administration with imported and/or washed beach sand is in relatively good condition, while later military construction done with haste, dwindling supplies, and frequently with beach sand is in poor condition. With no maintenance since WWII, the metals are in the worst condition with advanced states of corrosion. Thin-gauged metal elements were either removed by

Participants of the Metal Preservation Workshop (from left): David W. Look, AIA (U.S. National Park Service); Dr. Dirk H.R. Spennemann (RMI Historic Preservation Office); John Diego C. Camacho (Northern Mariana Islands Historic Preservation Office); Elvis Killion O'Sonis (FSM Chuuk State Historic Preservation Office); Florencio Gibbons (Republic of Palau Division of Cultural Affairs); Hemley M. Benjamin (RMI Historic Preservation Office); Carthney Laukon (Alele Museum and National Archives, Majuro); Kautechang V. Blaivok (Republic of Palau Division of Cultural Affairs); John Diego Palacios (Northern Mariana Islands Historic Preservation Office); Henrik Christiansen and Laan Lorance (both Alele Museum and National Archives, Majuro).

souvenir hunters and scrap metal dealers or totally consumed by corrosion. Although the thick metal elements are extant, they are heavily encrusted with corrosion. A very few artifacts have traces of paint and primer where they were sheltered enough to create a protective microclimate. Classic examples of almost every type of corrosion can be found at these sites—atmospheric corrosion, pitting, stress corrosion cracking, galvanic corrosion, etc. The study, treatment, and monitoring of these sites is, therefore, not only very beneficial to the RMI and the other Micronesian governments, but also to the NPS which has numerous military sites, both WWII and other eras, in coastal marine climates many of which are also tropical.

The tourists who come to the Marshall Islands are mainly interested in seeing the large coastal defense artillery and dual-purpose anti-aircraft guns, planewrecks, shipwrecks, and to a lesser extent, concrete buildings and bunkers. The thickness of the metal used in the manufacture of the large guns is considerable and explains why they have survived even with advanced deterioration. The government of the RMI is very interested in preserving these large guns for future generations of Marshallese and tourists. The ideal solution would be to hoist the large guns, move them to a conservation laboratory, place them in a large tank for corrosion removal by electrolysis, followed by rinsing, coating with microcrystalline wax, heating in an oven, and then displaying in a museum or storing them in a vault with climate control. The RMI has a very fine museum in Majuro, the Alele Museum, but it is too small to display these guns and does not have a conservation laboratory and a storage vault. The RMI does not have the funds to construct a larger museum, a laboratory, or a vault, nor does it have the funds to send these artifacts elsewhere to be conserved. The lowest estimate for the conservation treatment is about $100,000 per gun without transportation. There are approximately 30 guns per base. Although the conservation treatment described above would be ideal for the artifact, it would have an adverse effect upon the WWII sites as a whole. Even with the advanced state of deterioration of the sites, the viewer can still receive a strong sense of what these installations were like during and after the war. If these artifacts were removed, the sites would lose part of their integrity and their ability to convey the historic character of these bases. It would also eliminate the reasons most tourists take the long trip to these remote atolls.

As a part of the conservation management plan, Spennemann and Look developed two demonstration projects. The first was vegetation removal. Plants and trees grow very rapidly in the tropics and soon take over, not only obscuring the sites from view by tourist and maintenance workers but also contributing to their deterioration. Plants in contact with the metal surfaces hold moisture and eventually decay—providing an ideal situation for corrosion similar to wet, rotting leaves in a metal gutter. Overhanging limbs continue to drip long after the rain stops and the shade they create slows down evaporation, thus allowing moisture to stand on the metal surface for a prolonged period of time.

The second demonstration project was the treatment and monitoring of the large guns. The objective was to find a cost effective method of slowing down the deterioration. Without being able to treat and place them in a controlled environment, there is no way of being able to arrest deterioration, but if it can be slowed down, the large guns may survive long enough in this severe climate for more effective means to be developed. Heat, chemical, and electrochemical removal of corrosion *in situ* is impossible, impractical, and/or not economical at this time.

*(**Metals Conservation**—continued on page 24)*

(***Metals Conservation***—*continued from page 23)*

In compliance with the *Secretary of the Interior's Standards for Preservation Projects,* historic materials should always be cleaned with the most gentle means possible. More severe methods of cleaning should only be used when necessary to accomplish the state of cleanliness necessary, but stopping short of doing any damage to the resource. Ferrous metals (iron and its alloys) are hard enough to withstand mechanical cleaning methods of scraping, wire brushing, and sanding and even grit blasting within limits. Also, any remaining rust on the surface of ferrous metals will continue to spread under the paint, causing it to peel (a common condition found on automobiles). For best results, paint preparation requires that the rust be removed to bare or white metal. The $16,000 grant from Australia was used to purchase a generator and sand-blasting equipment and supplies. The RMI used their own funding to purchase additional supplies.

Extensive research was done to study various corrosion-inhibiting primers and paint systems available from the U.S. and Australia. The three systems selected were red lead, zinc-rich, and epoxy primers followed by compatible finish coats of paint. Since the manufacturer of the epoxy system did not respond in time to order their product, only the red lead and zinc rich systems were used. E. Blaine Cliver, chief, Preservation Assistance Division (PAD); the National Association of Corrosion Engineers (NACE); Herbert D. Bump, Research and Conservation Laboratory, State of Florida; and Daniel Riess, metals conservator, Harpers Ferry, WV, were helpful in providing technical assistance.

At the suggestion of Joseph Wallis, chief, Grants Administration Branch, NPS, the demonstration projects were combined with classroom training; and invitations were sent to all of the historic preservation offices in the Pacific. The demonstration projects were conducted during the day when it was not raining, and classroom training was conducted during the rain and in the evening. Dirk Spennemann gave lectures and walking tours on the history of the Marshall Islands (especially WWII) and on the identification and operation of military equipment and guns and their emplacements, safety, and vegetation removal. David Look gave classes on the *Secretary of the Interior's Standards for Preservation Projects,* identification of metals and alloys, properties of metals and alloys, causes of corrosion, types of corrosion, methods of corrosion removal, and coatings. A battery of three six-inch British guns manufactured between l898 and l905 by Elswick Ordinance Company, a subsidiary of W.G. Armstrong & Co., Newcastle-on-Tyne, U.K., were cleared of vegetation by one team while another team assembled the sand-blasting equipment. During the clearing, one 50lb. unexploded American bomb was found and marked. The other team discovered another problem. Unfortunately, two hoses were missing and the sand-blasting equipment could not be used.

The original plan was to clean and prime two of the large 6" guns, one with each of the primer and paint systems. Without the use of the sand-blasting equipment and with the daily rains, it was necessary to scale back the demonstration to only one gun. All corrosion had to be removed by hand methods of scraping, wire brushing, and sanding. Instead of cleaning two of the guns that were cleared of vegetation, the 120 mm gun in the village next to the church was selected because it eliminated the 45-60 minute walk twice a day to and from the site along the ocean. This 120 mm gun has been moved twice: in 1942 it was moved from the shipwrecked *Goyotsu Maru* to a location on the oceanside of Wotje (at the end of the presently used runway) and in the l970s it was moved again from the ocean side to the church. Conserving the gun by the church had the added advantage of increased public awareness. Villagers, especially the children, watched with great interest our progress of corrosion removal, priming, and painting. At first it seemed awkward and untimely for the class to be working on the gun next to the church which had part of its roof torn off by super typhoon Gay the week before the class arrived. But we did not have the supplies or equipment to help them with their church and the Federal Emergency Management Agency (FEMA) did not arrive until two days after commencement of the class.

The zinc-rich primer was used on the middle section of the barrel and the red-lead primer was used on the remainder of the gun. Two coats of primer were applied followed by two coats of finish paint. Two different colors were selected for the finish coats of paint so that the painters could easily see what had or had not been painted. The final coat was a taffy color. It is close enough to the existing rust color so as to not totally change the character of the resource but different enough to detect rust during future inspections. Twenty-four hours were allowed between each coat of primer and finish paint. If there had been more time, it would have been preferable to allow more time for each coat to dry. The frequent rains and high humidity slowed the drying of primer and paint. Large tarpaulins were stretched between metal scaffolding to provide protection for the students from the strong tropical sun and to keep the rain off the metal surface. To extend the project another four days until the next plane would have been impossible and too expensive.

Each student took a seven-page final examination which lasted about two hours. All passed the exam with high grades. The results of the test showed that the students had studied hard and learned a lot.

On the last day after the final coat of paint was applied, the minister of the church gave an invocation, the acting mayor of the village gave an address and thanked the class, the youth choir sang, and certificates were presented. The students were very proud of their work. The students flew back to Majuro. That evening Carmen Bigler had a graduation party for the students at her home.

In the future, the condition of the 120 mm gun will be monitored and the two paint systems will be assessed for their effectiveness in this situation.

The information in this article was provided by Dirk H.R. Spenneman and David W. Look. For additional reading see *CRM,* Vol. 15, No. 2, p. 15.