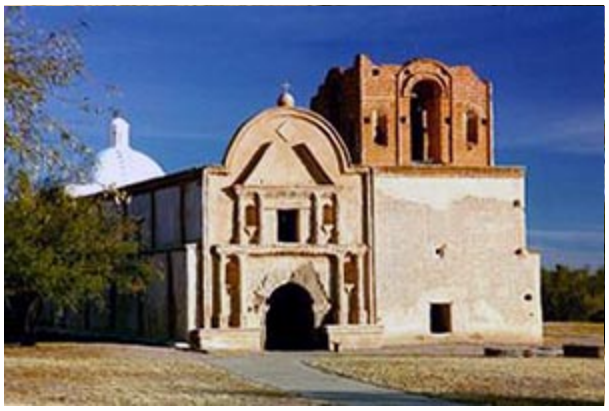
**Of Adobe, Lime, and Cement: The Preservation History of the San José de Tumacácori Mission Church (Part I - The Fabric)**

**Introduction**



**Spanish colonial mission church of San José de Tumacácori.**

The year 2008 marks the centennial of the establishment of Tumacácori National Monument in southern Arizona. Tumacácori is located within the Santa Cruz River Valley, south of Tucson, Arizona, and north of Nogales, Mexico. President Theodore Roosevelt proclaimed the Spanish colonial mission church of San José de Tumacácori a national monument on September 15, 1908. Roosevelt used the power of the Antiquities Act to establish the monument in response to citizens' concern for the fate of the mission church.[1] The monument was born out of local awareness of the church's significance, interest in old buildings, and concerns over the looting of antiquities.

In 1907, the Tucson Pioneer Historical Society formally asked the U. S. Forest Service to help preserve the mission church at Tumacácori. On February 27, 1908, James Wilson, Secretary of the Department of Agriculture, wrote a letter of support to the Secretary of the Interior, explaining that "the old Tumacácori mission is of sufficient historical interest to warrant its protection from all unseemly exploitation by the creation of a National Monument."[2] The NPS began managing the site in 1918. In 1990, Tumacácori was designated a National Historical Park in recognition of the significant historic structures within the park. After several expansions, the park is now 360 acres, including a one-mile stretch of the Santa Cruz River, and the mission sites of San José de Tumacácori, Calabasas, and Guevavi.

The theme of Tumacácori's centennial celebration is “One Hundred Years of Preservation and Stewardship,” in recognition of the preservation specialists, archeologists, historians, interpreters, masons, and maintenance workers who have strived to preserve the mission for future generations. Keeping with this theme, this article summarizes the preservation history of San José de Tumacácori. Yet, historic structures are more than their original fabric: they are part of past events and people's lives. By preserving historic structures, we are also preserving associated life ways, events, personal histories, religious beliefs, customs, and cultural values.

**Need for Preservation Histories**

Preservation is defined as the maintenance of a property without significant alteration to its current condition. The idea is to maintain a good or pre-determined condition, while preserving a structure's original fabric, historic integrity, and scientific information. Maintenance actions, often called preservation treatments, are any actions taken to preserve a structure. Structures change over time, however, and each change, whether from natural erosional forces or from maintenance actions, is part of its preservation history and integrity. Preservation histories provide a written and visual history of how original historic fabric was protected in the past and how much original fabric is left. They inform future treatment strategies and are useful for interpreting or assessing the historic integrity of buildings. These histories summarize and interpret past preservation efforts.

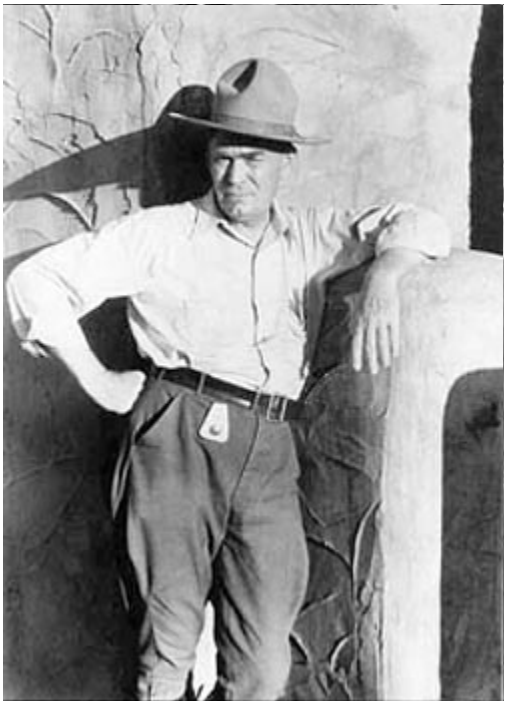
The mission church of San Jose de Tumacácori is a partially restored ruin. Restoration is the return of a building, and its structural elements, to its original condition, if possible, which often means rebuilding. The history of preservation at Tumacácori offers insight into the development of historic preservation in the southwestern United States. The types of materials used, application techniques, and preservation philosophies all changed over time. These changes, and the preservation successes and failures, result in the church we see today. By studying the success or failure of different treatments at Tumacácori we gain the perspective of nearly 100 years of experimentation in preservation methods.

**The Development of a Preservation Philosophy at Tumacácori**

As a discipline, historic preservation in the early 1900s was in its infancy. Lacking a clear philosophy, historic preservation often focused on restoration. Restoration was favored for many of the national monuments with standing architecture in states of disrepair and rapid loss. Restoration often resulted in a more structurally sound building and improved the interpretive potential of cultural sites. J.H. Tovrea, the first historic architect at Tumacácori, recorded his thoughts about restoration at Tumacácori following a tour of other churches in the Kino mission chain in 1935:

> ... since the buildings were designed to impart a feeling of mystery and sanctity, so should such a feeling be re-created in Tumacácori, as nearly as would be practicable... At the present time, the interior of Tumacácori could be mistaken for the interior of an old banquet hall, a fortress or even a storage room. A little restoration here and there would make it impress the visitor that it was the interior of a place of worship and he would be getting a truer picture of the mission.[3]

Frank "Boss" Pinkley, the first Tumacácori superintendent, contributed to the development of a preservation philosophy about building materials that is now the standard for preservation work: follow the original construction techniques as close as possible and use similar or "in-kind" materials. To reach this ideal philosophy required experimentation, slowing the work but resulting in a more accurate product. Experimentation ensured that proper materials and techniques were used in restorations. Photographs and descriptions of the church ruins were also helpful in reconstructions and in developing a standard for preservation, particularly the photos taken by George Roskruge in 1889.



**Frank "Boss" Pinkley, first superintendent of Tumacacori.**

By the 1940s, however, restoration on national monuments lost favor, and the maintenance of existing conditions became the primary goal. Today, NPS management policies allow restoration under certain conditions, but promote less dramatic interventions such as rehabilitation and stabilization of building fabric. The 1940s saw a significant change in preservation philosophy at Tumacácori. From the 1940s through the late 1970s, synthetic and non-traditional materials were used more often to maintain existing conditions. Synthetic materials like ethyl silicate and poly-vinyl acetate sprays for plaster lost favor by the 1960s, but Portland cement continued to be used until the late 1970s.

Preservation treatment projects that involve alteration of walls and/or ground disturbance should use archeologists and architects as consultants to ensure that the archeological and architectural record is documented. Several opportunities for collecting significant information for interpreting Tumacácori architecture were lost through inadequate archeological investigations. At present, preservation and historic archeology work together to understand

architecture and landscape use.

**History of Tumacácori National Monument**

San Jose de Tumacácori is part of a chain of missions established by the Jesuit Father Eusebio Kino. Kino's missions lie along a 75 mile chain in the *Pimeria Alta*. The *Pimería Alta* (upper land of the Pimas) encompassed parts of what are today southern Arizona and northern Sonora, Mexico, in the Sonoran Desert. Some of the best known of the missions he founded include the churches at San Ignacio, Magdalena, Cocóspera, and Caborca in Sonora, Mexico; and San Xavier del Bac and Tumacácori in Arizona. Shortly after his death in 1711, the missions fell into disuse. After the expulsion of the Jesuits from Spanish domain in North America in 1767 as a result of conflict with King Charles III, the Franciscans took over the Jesuit missions on the northern Mexican frontier. At most sites, they rebuilt larger, more elaborate churches of fired brick. The mission church of San Xavier del Bac, near Tucson, Arizona, was rebuilt in 1783-1797 by the Franciscans on the foundations of Kino's simple adobe church of 1700.

Unlike San Xavier, which is still an active church, San Jose de Tumacácori remains in a state of arrested decay. Begun around 1800, with more construction taking place in the 1820s, the mission church was finally abandoned, still unfinished, in 1848. The monument includes the remains of the Franciscan church (1800-1848), the outline of the Jesuit church (1757-1822), three preserved *convento* rooms and buried *convento* remains, a buried room block, the *campo santo* (cemetery) and mortuary chapel, the *acequia madre* and associated irrigation features, the lime kiln, and the orchard/garden wall that once enclosed 4.6 acres of fruit trees, vegetables, and other foodstuffs. Geophysical prospecting, archeological testing, and traveler's accounts attest to the possibility of buried structures including wells, mill houses, and Native American habitations.

**Tumacacori mortuary chapel, seen from above.**

Following abandonment, the roof was probably the first part of the church to be destroyed, primarily due to neglect, but also from the stripping of roof beams by local ranchers. The earliest account of a roofless church comes from Mr. Hayes who visited Tumacácori in December of 1849; however this account is questionable.[4] The church was not fully abandoned until 1848, but the roof may have started to collapse around 1848-1850. Thomas Davies, Superintendent of the Aztec Syndicate Mines, wrote that when he passed by in 1849, the church roof was *nearly* intact and "much of the interior in a good state of preservation."[5] Samuel P. Heintzelman's journal of 1858 noted the church "now without a roof."[6] Pinkley talked with two men who saw beams in place in the 1880's.[7] One man saw a beam in place in 1882, the other in 1886, both said the beams were pine. By the time the 1889 Roskruge photos were taken there were no beams. If Pinkley's informants are correct, the last roof beams fell between 1886 and 1889. Most of the beams may have been taken from the roof by Joseph King and William Lowe, sometime in the 1860s-1870s.[8] A photo from circa 1905 shows reuse of the roofless nave.

The 1887 earthquake was, at an estimated 7.4 magnitude, the largest historical earthquake of the southern geological Basin and Range Province. The epi-center was in the Teras Mountains of Sonora, near Bavispe, Mexico. The trembler caused destruction from Guayas, Mexico, to Tucson, Arizona, and as far east as El Paso, Texas. At towns as distant as Albuquerque, New Mexico, water in tanks spilled over, buildings cracked, chimneys were toppled, and railroad cars were set in motion. An observer in Tombstone reported sounds like prolonged artillery fire.[9] A large crack in the interior west wall of San José de Tumacácori Mission Church was most likely initiated by the earthquake. It also damaged the base of the façade columns, and weakened the pediment and the choir loft.

Tumacácori and Casa Grande National Monuments were the first national monuments that protected historically significant earthen architecture. Earthen structures were generally ignored until 1889 when Congress appropriated $2000 to protect the Casa Grande ruins, the first funding ever allocated for historic preservation.

**Ramada at the altar ca. 1905. Church is roofless. Rubble in foreground is the remains of the choir loft.**

When Tumacácori's first preservation specialists, Frank "Boss" Pinkley and A. S. Noon, began work in 1918, the NPS was only two years old and large parks like Yellowstone and Yosemite received most of the financial support. Some people in the Department of Interior questioned whether the NPS should administer National Monument sites.[10] It was unclear how the small, newly designated national monuments, which were often focused on single historic sites, fit into the large park system.

**Treasure Hunting**

Once the roof collapsed, the interior of the church was pounded by rain and wind, but it was intense vandalism and reuse that caused the most damage. For seventy years treasure hunters dug in walls and floors looking for the "lost Tumacácori treasure." Treasure maps were sold in Nogales. Even today legends of the Tumacácori treasure persist. Tumacácori park rangers are frequently asked whether they know or have heard about the Tumacácori treasure. The nave was hit hard by treasure hunters, and the walls and floors were torn open in the search for the lost Tumacácori gold. Much of the early repairs on the nave interior focused on filling holes caused by vandalism and treasure hunting. This is also true for the sanctuary, where treasure hunters sought gold and jewel studded sacraments.

Treasure hunting in the nave and *convento* was a persistent problem until the 1940s. The first resident superintendent, George Boundey, arrived in 1929 and throughout the 1930s his monthly reports discuss the constant presence of treasure hunters. It was such a problem that he acquired a German police dog to alert him of intruders. Boundey writes:

> Treasure hunters are very much in evidence at the present time. They spend quite a bit of money among the local people in the way of labor, guides, etc. If it wasn't for our police dog it would be necessary for us to look after the Mission and grounds during the night time as they are all anxious to do some digging on the monument (1933).[11]
>
> We have many treasure hunters at work in this vicinity and they are continually asking to run some lines or do some surveying on the Monument. I find that all the survey lines seem to center at certain points. I know of two men who are careful diggers and to forestall any night digging, I am letting those men under my personal supervision trace out the foundations of buildings which lie in the immediate vicinity where the lines seem to center. This work has forestalling any digging by the night forces and I am sure it will satisfy the treasure hunters that there is not the $5,000,000 in gold they are searching for (1934).[12]
>
> During the six years we have been stationed at Tumacácori, the wife and I have driven away in the night time at least 50 different parties of treasure hunters who were trying to excavate or try out some new apparatus for locating treasure. One evening, or rather night, this month parties actually succeeded in excavating quite a hole under one of the walls of the main altar. They also made a small excavation in the Baptistery. The fact our German police dog failed to make a fuss leads us to believe it was somebody who was well acquainted with the dog(1935).[13]

Treasure hunting not only impacted the church and *convento* structures; it also diminishes the archeologist's ability to study site occupation and answer questions concerning life on the Pimeria Alta. Although treasure hunting decreased after the 1930s, the effects of almost 100 years of treasure hunting were catastrophic to Tumacácori's buried archeological resources. It is hard to find cultural layers or archeological features that are unaffected by treasure hunting activity.

**Preserving the fabric of the San José de Tumacácori Mission Church**

Between 1908 and the establishment of the NPS in 1916 Tumacácori was administered by the U.S. Forest Service. Ranger Dubois, a Forest Inspector, visited the site in May 1907. He wrote to his superiors that the mission was "rapidly falling into ruins and suffering considerably from vandalism of visitors. Portions of the paintings in the old Chancel have been knocked off for souvenirs, and the whole of the inside of the nave is written over with the names of visitors."[14]

Pinkley was appointed custodian of Tumacácori National Monument on December 9, 1918, after responsibility for the site was turned over to the newly created NPS. Pinkley was the first Superintendent of National Monuments in the Southwest. At the time, he was also responsible for Casa Grande Ruins National Monument. By 1922, he was the custodian and preservation specialist for 14 national monuments. In his letters to NPS Director Steven Mather, he consistently pled for increased support of the monuments in the Southwest. In a letter to Director Mather written soon after arriving, Pinkley states that "after carefully looking the place over [Tumacácori]…five things must be done soon; 1. Underpinning the southwest corner of the bell tower, 2. Putting a cement floor in room over Baptistery, 3. Repair arch over entrance while part of the original still exists, 4. Repair of the east wall of the Sacristy, 5. Underpinning the yard wall of the cemetery."[15]

Pinkley hired A.S. Noon, a Nogales contractor and blacksmith, to complete most of the listed repairs. Noon began restoration work in 1919 and was paid $8 per day. He hired local workmen using a starting budget of $400.[16] Noon was constantly frustrated with government bureaucracy and, in a letter to Pinkley, dated May 10, 1919, he writes: "I am enclosing the time sheets, Jack those fellows up at headquarters. No money has been received yet for the first work and I have to pay the interest on the money out of my pocket. Tell them to wake up."[17]

Pinkley had little money for restoration work, but possessed an uncanny ability to stretch every dollar.[18] If not for Pinkley's master planning and ingenuity, only half of the work could have been accomplished with the available funds. Pinkley hired local workers instead of "high priced workman" from out of town. The need to budget wisely and the difficulty of working in a remote location resulted in a preservation philosophy that is now the standard of preservation work: follow the original construction techniques as close as possible and use similar or "in-kind" materials. Adobe shaping and firing techniques had to be perfected as many of the brick sizes and shapes needed were not available from construction yards in Nogales.[19]

It was Pinkley's genius for getting money in a difficult budgetary climate, however, that kept the mission standing. Pinkley acquired the first state government gift to a specific NPS site in 1922 when he was awarded one thousand dollar from the state of Arizona s for repair work at Tumacácori.[20] The Nogales Chamber of Commerce, Knights of Columbus, and Arizona Archaeological and Historical Society also helped fund some of Pinkley's early work.

Documentation of the structures at Tumacácori was imperative. The first mention of this problem comes from Tovrea, in 1936:

> Twenty years from now if someone asks the Ranger at Tumacácori questions on what parts of the mission are original and what parts are restored, the Ranger is going to be embarrassed- because the chances are that he will not know… because there is no record of what is old and what is restored... I would respectfully suggest that the NPS make detailed measured drawings of the walls of the buildings, showing all restored portions. If this is not done soon this

very necessary information will be lost forever.[21]

Fortunately, assistance was at hand. President Roosevelt's New Deal program included legislation, the Historic Sites Act of 1935, to employ nearly 1,000 architects and photographers to document historic structures throughout the United States. The Act established a policy "to preserve for public use historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States."[22] It established a National Historic Landmarks program and incorporated the Historic American Buildings Survey (HABS) and the Historic American Engineering Record (HAER) programs, which encouraged documentation of historic structures. HABS focused originally on documenting significant 17th and 18th century endangered buildings, while HAER emphasized industrial structures and projects, such as canals.

Charles E. Peterson, a founder of the HABS/HAER programs, may have been inspired by Tumacácori's needs. He visited Tumacácori on January 15, 1930, to assess structure conditions and took the first picture of the lime kiln north of the church (Figure 2). In his trip report Peterson states that the church "has been used as a bat roost, school house, bootlegger's joint and a shelter for lonely cows," but "this old monument is a real treasure and too much loving care can not be put into the study of it's history, and physical condition, past and present."[23] The church was drawn by HABS crews in 1937.

**C. E. Peterson's photo of the lime kiln in 1930.**

**The History of Archeology at Tumacácori**

Archeology at Tumacácori has largely been driven by preservation projects and mitigation of damaged cultural deposits during NPS undertakings. Archeology done at the monument has emphasized identification of building sequences and architectural details relating to the *convento* and church. A significant amount of the archeology focused on exposing features for interpretation. Despite a focus on the historic cultural deposits, archeology at Tumacácori has unearthed evidence of 3,500 years of habitation in the Santa Cruz River Valley.

Although not a trained archeologist, Frank "Boss" Pinkley was the first to "formally" excavate at Tumacácori. His ultimate goal was to locate enough structures to provide an interesting story to visitors. Pinkley's excavation technique consisted of trenching using shovels and picks. He trenched locations where there was physical, documentary, or anecdotal evidence of structures or archeological features.

Paul Beaubien's excavations in 1934-1935 were the first formal archeological investigations at Tumacácori. His goal was to expose the foundations of the mission complex, therefore, he did not analyze artifacts and left many questions concerning social interaction, demography and cultural contact between Spanish and Native Americans unanswered. Almost all of the areas investigated by Beaubien were previously disturbed by treasure hunters, thus limiting his attempts to understand the cultural history of Tumacácori. Despite this, engineers were able to produce a master archeological map for interpretive brochures.

Archeological work continued sporadically from the 1950's to 1990's. In 1951, Sallie Brewer placed test trenches west of the church to look for intact archeological deposits prior to construction of a visitor entry road and gate. Brewer located mostly disturbed cultural deposits, except for one locus where intact cultural deposits containing a small Native American work area. Brewer's work is significant because it shows that some areas of the mission have intact archeological deposits worthy of preservation and study.

In 1956, Gordon Vivian of the Ruins Stabilization Unit excavated along the walls of the sacristy corridor to document its' construction before repairs were done. He also studied the age of the walls to determine the original configuration of the rooms. His work showed that the *convento* room was not connected to the sacristy until sometime in the late 1800s or

early 1900s, when the church was used for habitation.

In 1964-1965 Luis Caywood excavated the north *convento* mound, the *vasos* and roasters of the *convento* courtyard/patio. He also excavated portions of the colonnade surrounding the convent patio. Caywood excavated the north *convento* mound to expose walls for interpretative exhibits. However, once exposed the adobe walls began rapidly eroding and the north *convento* wing was again reburied, resulting in the raised mound seen today.

From 1965 to 2001, most archeology was done along the church foundations, preceding work on the exterior church walls and placement of sheeting designed to reduce capillary action and moisture retention of the church walls. In 1970, portions of the granary and the cemetery outside the granary were excavated preceding stabilization work and the placement of a shelter that once covered the granary. In 1979 and 1980 minor test excavations were done in the cemetery and in the "plaza" in front of the church. During the 1979-1980 work, artifact densities mapped in the large area in front of the church showed that the largest number of artifacts occurred in the center of the "neophyte plaza" in the location where chairs are placed today for Fiesta Mass.

In 1994, NPS archeologist Jeff Burton excavated a sink hole that formed just south east of the sacristy corridor. Although the cultural remains were jumbled it appeared that the sinkhole may have been a deep well. The sinkhole lines up with the projected location of the drain/ditch that connects to the cisterns.

Testing across a large area of the Fiesta Grounds in 2001 was done to mitigate damage from a proposed new visitor center. Numerous features were found, but most features post-dated 1850. The 2004 archeological project excavated and mapped a portion of the acequia, the orchard wall foundations, and other features along the northern terrace.

In 2005, the remains of the Mendez Homestead were excavated and the mission's adobe firing kiln and the remains of a possible Cavalry camp were located. Artifacts include a metal sword scabbard, bullets, metal artifacts and charred Pima corn that may have been used to feed Cavalry horses. The scabbard has been dated to the 1840s.

**The Development of Preservation Methods at Tumacácori**

Preserving earthen architecture in a ruined state is difficult, and often requires experimentation and some level of restoration. The church and *convento* ruins at Tumacácori have been a testing ground for preservation methods and materials designed to reduce the maintenance needed to preserve earthen structures. Our present understanding of the factors affecting adobe structures evolved through trial and error and by learning from local traditional builders. Unfortunately, at times, preservation errors damaged the historic adobe walls and lime plaster, decreasing historic integrity, and diminishing the scientific value and visual appearance of the structures.

The use of Portland cement at Tumacácori is an example of the overzealous application of a hardening substance to extend maintenance cycles. Most of the original exterior plaster of the church, and some interior plaster, was covered with cement. Cement causes problems because it is more impermeable than adobe or natural stone. It traps and diverts moisture, causing erosion beneath plaster and around the edges of cement patches. The use of cement on historic buildings originally built of adobe and lime results in the loss of original fabric, decreasing the historic and structural integrity of buildings not designed to carry heavy loads of cement.

In the past, there were two types of cement repairs done on the church: cement patches which varied in thickness, but reached a maximum of 11 inches; and cement plaster, which is usually thinner.[24] In 1977, George Chambers initiated a large preservation project to remove all non-historic materials, such as cement, used in previous preservation efforts, and to monitor and prevent moisture from entering the walls.

Over the years, the continuous use of cement and sealants exacerbated moisture retention of the adobe walls, causing the disintegration of original adobes. Every time large-scale replacement occurs original walls are altered or reconstructed, resulting in a partially modern wall with less historic integrity. The preservation program at Tumacácori made great strides towards historically accurate, effective preservation when we stopped using non-traditional

cement products.

**Preservation crew removing non-historic cement plaster from church's west exterior in 1978.**

Today, the church is maintained using traditional methods and materials when possible, which is the best way to ensure good structural condition while maintaining historic integrity. Traditional materials include sun-dried soil adobe bricks, fired adobe bricks, natural lime, hydraulic lime, crushed brick, and mud/clay mortars. Traditional techniques involve hand application of materials and the use of historically accurate tools or application techniques. Common non-traditional materials continued in use include Portland cement byproducts/mixes, silicone sprays, sealants, and adhesives, metal supports, rebar and pins/nails.

**Interior Plaster Preservation at Tumacácori**

Saving original plaster is a major focus of preservation efforts at Tumacácori. The interior of the church has the most original lime plaster, consisting of three distinct layers: two 1-inch thick lime plaster layers, and a thin gypsum wash. In 1949, it was estimated that greater than 4,000 square feet of original plaster exists in the sanctuary and nave.[25] The east wall interior has less original lime plaster than the west wall, partially due to rain and wind damage when the church was roofless. The biggest problems are detachment from the adobe wall, impacts from birds and bats, and the deterioration of painted plasters due to moisture.

Over the years, many different synthetic spray-on preservatives were tested on the plasters. These hardening materials made plaster more brittle and susceptible to flaking when humidity increased. Most of the synthetic materials were types of silicones, acetates, or acrylic resins, tested for widespread use by the NPS Ruins Stabilization Unit, which oversaw ruins preservation in southwestern parks and monuments until the early 1970s. In the 1940s, small nails were drilled into the plaster in attempts to keep the original plaster attached to the wall. In 1972 and 1973, plated lag bolts were inserted at critical points where plaster was failing. The bolts detract from the historic integrity of the original plaster and may have caused more cracks.

NPS employee Charles Steen and Harvard conservator J. Rutherford Gettens initiated the first project to clean interior plasters in 1949. Plaster was cleaned using small whisk brooms and surfaces sprayed with polyvinyl acetates. This method was abrasive and the project had limited success, but it showed that the plasters could be cleaned and restored to their former glory. Most of the plaster on the west wall was cleaned in 1949-50. From 1979 to 2002 conservators cleaned and worked to conserve portions of the dome interior plasters. This work consisted of cleaning with solvents, removing synthetic materials, plaster consolidation, reattaching plaster fragments, and sealing plaster edges. Today most of the plaster in the nave is stable, but the interior plaster of the dome is eroding very slowly.

**Painted Plasters at Tumacácori**

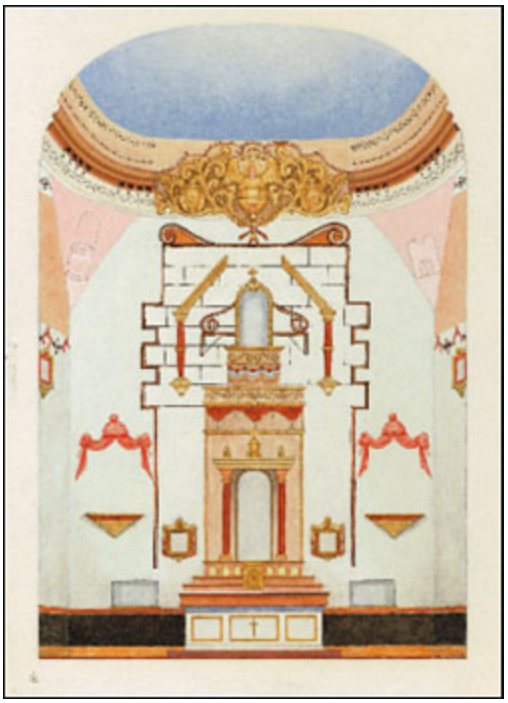
In 1949, Steen and Gettens inspected the interior plasters of the Tumacácori church. Steen spent two months cleaning plasters, while Gettens devised a formula for a clear lacquer preservative to be sprayed on the walls.[26] Gettens also collected and analyzed samples of painted plasters. Their colors derive from a large variety of materials.

Red, orange-red, and pink colors derive from iron-oxides, including ocherous hematite. Iron-oxides are the most common color additives and are available locally. Bright red, especially of the painted red draperies on the north sanctuary plaster, derives from the use of cinnabar, which is a pulverized red mercuric sulphide mineral, also known as vermillion.

The bright green paint color is an unidentified copper mineral, possibly a copper silicate.

Blue, which is most visible on the sanctuary arch and dome, is most likely derived from the

indigo plant grown in Mexico. Analysis of blue paint shows no traces of minerals such as azurite. Although azurite is a possible source of blue coloring, in the Southwest it was rarely used as paint pigment. The blue colors of the sanctuary are actually stains and not mineral-based paints. Indigo was commonly identified on 18th century *santos* (saints statues) from the Rio Grande Valley of New Mexico. It was probably brought north from Mexico by the artists who designed and painted the iconographic art of the sanctuary.



**Trujillo's reconstruction of the sanctuary's north wall and the location of the hole repaired by Pinkley in 1921. (Drawing by Jimmie Trujillo, 1952)**

Black, gray and blue-gray derives from carbon in powdered charcoal fragments. Thinly painted areas appear gray or blue-gray.

Metallic yellow occurs in small areas and appears to be a copper-zinc alloy or bronze gilt. Analysis indicates that no gold is present, contrary to the wishes of treasure hunters. The constituents of the bronze paints are strikingly similar to the bronze powders produced in Europe in the 18th century. Although little is know about the use of "bronze powders" in the New World, the materials and methods of application are in the tradition of old Italian gilding in which iron-oxide colored clay is used as the foundation for gold leaf.[27] At Tumacácori metallic yellow copper-zinc was used instead of gold. Once again precious metals, common in Old World churches, are nowhere to be found. Re-analysis of painted plasters confirms some of the results of Steen and Getten's (1949) study.[28]

All paint consists of a colorant and a binding medium. Presently, we do not know what vehicle or binding medium was used in the paints at Tumacácori. Protein-based mediums, like eggs or milk, are common in the Old World, but there are no proteins present in the analyzed paint samples. The paints were probably not applied using a true fresco technique, as the paints [and plasters] are covered with a thin coat of gypsum plaster.[29] A true fresco technique involves painting on a wet lime plaster surface using pigments mixed with limewash. The lime in the paint chemically bonds with the lime plaster, giving the image durability.

**Interior Adobe Preservation**

Approximately 70 percent of the interior adobe bricks are original. The base of many of the walls had moisture problems, partially due to the use of Portland cement, but also from capillary action. Capillary action is the upward wicking of water that occurs when the soil beneath walls reaches 15% water content. The water content of the soil underlying the church is high because the church lies across a natural drainage system that runs west to east from the Tumacácori Mountains to the Santa Cruz River. Drainage improvements beginning in the 1950s reduced surface run-off and flooding, but the natural subsurface water course still runs towards the west wall of the church and continues through the center of the *convento*, draining in the lower flat area of the mission orchard and garden. This drainage system may be the primary source of the capillary moisture within church and *convento* walls.

The erosion of original adobe bricks was also exacerbated by the use of impervious coatings and veneers, beginning in the late 1920s. After 1978, only traditional lime plaster was used.

*By Jeremy Moss*

**Acknowledgements**

I would like to thank David Yubeta, and Superintendents Ann Rasor and Lisa Carrico for their support during this project. Special thanks goes to Karen Mudar for her editorial advice and assistance. Most of all I thank Frank "Boss" Pinkley for his boundless energy and will to preserve America's special places.

**Notes/References Cited**

Much of the information in this article comes from uncatalogued archives including unpublished reports, official correspondence, interviews, field notes, and historic photographs.

[1] Raymond Rigenbach, *A Short History of Tumacácori National Monument,* Appendix A, WACC Archives, Tucson. **Locals with documented interest in preserving Tumacácori in 1908 include**: A. J. Abbot (Nogales, AZ), Weldon Bailey (lawyer, and owner of mission lands between 1914 and 1917), J. E. Black (Judge, Tubac, AZ), Wirt Bowman (Nogales), J. B. Bristol (Nogales), Ramon Burruel (Tubac/ Tumacácori), Byron C. Cummings (Dean, Professor of Anthropology, University of Arizona, Tucson, AZ), Bracy Curtis (Nogales), H. C. Hallmark (Tucson), Carl Hayden (U. S. Senator, AZ), Allan B. Jaynes (Tucson), Harry Karns (Historian, Nogales), and H. O. Jaasted (Mayor, Tucson), William Lowe (Tubac), and Carmen Mendez (Tumacácori, Homestead Claimant #3035). **Land owners who deeded the land for the National Monument to the Federal Government**: First Carmen Mendez (1908) and then Weldon Bailey, James E. Bouldin, Jennie N. Bouldin, and Helen Lee Bouldin in 1917.

[2] James Wilson, Official Correspondence, USDA, (1908). Western Archeological and Conservation Center (WACC) Archives, Tucson. *The Oasis,* Chamber of Commerce Newspaper files, Nogales, Arizona.

[3] J. H. Tovrea, "Report on San Jose de Tumacácori." In S*outhwestern Monuments Special Report No.1,* pg. 42, NPS, (January 1936).

[4] Benjamin Hayes, *Diary of Judge Benjamin Hayes' Journey Overland from Socorro to Warner's Ranch from October 31, 1849 to January 14, 1850,* (Bancroft Library) in Owen C. Coy, The Great Trek, pg 247, Powell Publishing Co., San Francisco, 1931. H. E. Rencsh, *Chronology for Tumacácori National Monument.* NPS Field Division of Education, Berkeley, 1934. Hayes visited both Tumacácori and Tubac, but wrote his journal after passing them. All others who passed around the same time noted that the church had eroding timbers in place around 1849, but the Tubac church was roofless (see Watson, 1931, pg. 142), suggesting that Hayes confused Tumacácori with Tubac.

[5] Frank Pinkley, *The Mission San Jose de Tumacácori,* 1921, pg. 2, WACC Archives, Tucson.

[6] Ruth Brownell, *They Lived in Tubac,* pg. 16, Westernlore Press, Tucson, 1986.

Diana M. T. North, "Samuel P. Heintzelman and the Sonora Exploring and Mining Company", The Western Historical Quarterly, pp. 204-205, Vol. 12, No. 2 (Apr., 1981).

[7] Pinkley (1936), pg. 268. Pinkley (1937) pg. 232.

[8] Pinkley (October 1936), pg. 268-269.

[9] Jose Aguilera, "The Sonora Earthquake of 1887" pp. 31-44. *Bulletin of the Seismological Society of America.* No. 10, 1920. Dallas Morning News, May 5, 1887. Carl W. Stover, *U.S. Geological Survey Professional Paper 1527,* Abridged from *Seismicity of the United States, 1568-1989* (Revised), by Jerry L. Coffman, United States Government Printing Office, Washington, 1993. "The Mexican Earthquake; Towns Nearly Destroyed and Many Lives Lost." New York Times, Wednesday, May 9, 1887.

[10] Hal Rothman, *America's National Monuments: The Politics of Preservation,* pg 123. University of Illinois Press, Urbana, 1989.

[11] George Boundey (Custodian), *Southwestern Monuments Reports,* October 1933 (report for September).

[12] George Boundey (Custodian), *Southwestern Monuments Reports,* September 1934 (report for August).

[13] George Boundey (Custodian), *Southwestern Monuments Reports,* Nov. 1935 (report for October).

[14] Ranger Dubois, letter dated May 1907.

[15] Letter from Frank Pinkley to Director Stephen Mather, Dec. 17, 1918, pg. 7. WACC Archives, Tucson.

[16] Letter from Director Stephen Mather to Frank Pinkley concerning the hiring of A.S. Noon, Feb. 20, 1919, pg. 1. WACC Archives, Tucson.

[17] Letters from Noon to Pinkley, May 10th & May 19th, 1919. WACC Archives, Tucson.

[18] Frank Pinkley, "Repair and Restoration of Tumacácori 1921" pg. 261, In *Southwest Monuments Special Report No. 19,* NPS, (October 1936). Of the total $2155 used by Pinkley in 1921, $1195 was funded by the government, and $960 from private contributions.

[19] Pinkley (October 1936), pg. 262.

[20] Rothman (1989), pg. 121.

[21] J. H. Tovrea, pg. 51, (January 1936).

[22] Norman Tyler, Historic Preservation: An Introduction to Its History, Principles, and Practice, pg. 35, 58, W. W. Norton and Company, New York, New York, 2000. Also see: HABS Web site, http://www.nps.gov/hdp/. William J. Murtagh, Keeping Time: The Theory and History of Preservation in America, pg. 43-45. Sterling Publishing, New York, 1990.

[23] C. E. Peterson, *Report to Mr. Vint on Tumacácori National Monument,* pg. 1, NPS report submitted to chief landscape architect Thomas C. Vint, (January 25, 1930). In *Historic America, Buildings, Structures and Sites* published in 1983 by the Library of Congress, Peterson is quoted as saying: "My own background was out-of-doors in the West, like that of most of the pioneers of the NPS. Work for pay in the field of history began for me on a field trip in January of 1930 to the eighteenth-century Mission San Cayetano del Tumacácori in the desert near Nogales, Arizona."

[24] Chambers (1981).

[25] Charles R. Steen and Rutherford J. Gettens *Tumacácori Interior Decorations,* Arizoniana, 3, No. 3, pg. 10 (Fall 1962).

[26] Steen and Gettens 1962, pg. 10.

[27] Steen and Gettens 1962, pp. 30-31.

[28] Timothy Lewis and Matilde Rubio, *Study of Materials Present in Twenty One Micro Samples Taken from the Painted Murals at Tumacácori Mission,* 2002. Manuscript on file at TUMA.

[29] Steen and Gettens 1962, pg. 31.

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