

THE TUMACÁCORI MISSION GARDEN AND ORCHARD: PAST, PRESENT AND FUTURE

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In the fertile Santa Cruz Valley of southern Arizona lies the Franciscan mission site of San José de Tumacácori. Visitors to the site are familiar with the church's picturesque white dome and unfinished brick bell tower, which dominate the local landscape (Figures 1 and 2). It's an image that evokes the area's Spanish colonial past, which began more than three centuries ago under the auspices of the Jesuits.

Father Eusebio Francisco Kino, Jesuit priest and explorer, first visited the O'odham village of Tumacácori, on the east side of the Santa Cruz River, in 1691. He dedicated the settlement to San Cayetano and asked the O'odham to build an adobe and flat-roofed house in anticipation of a resident missionary. It was the upstream village of Guevavi, however, that became the *cabecera*, or main mission, with San Cayetano de Tumacácori as one of its *visitas*, or visiting stations. In 1752–1753, follow-

ing the 1751 Pima Revolt, the Jesuit *visita* was moved to the west side of the river and its patron saint changed to San José. By 1757, the Jesuits had built a small adobe church measuring 60 ft by 15 ft; the foundation of this church was discovered in 1934, when National Park Service archaeologist Paul Beaubien excavated at Tumacácori (Figure 3).

The Jesuit Order was expelled from the New World in 1767, and the Franciscan Order took over in 1773. The Franciscans designated Tumacácori the *cabecera*, whose resident priest administered the nearby *visita* settlements of Calabasas and Guevavi (Figure 4), but construction of the large Franciscan church at Tumacácori did not begin until some time between 1799 and 1802. The church was consecrated in 1822, still unfinished, and construction continued intermittently until the last padre departed for Magdalena in 1841. A small number

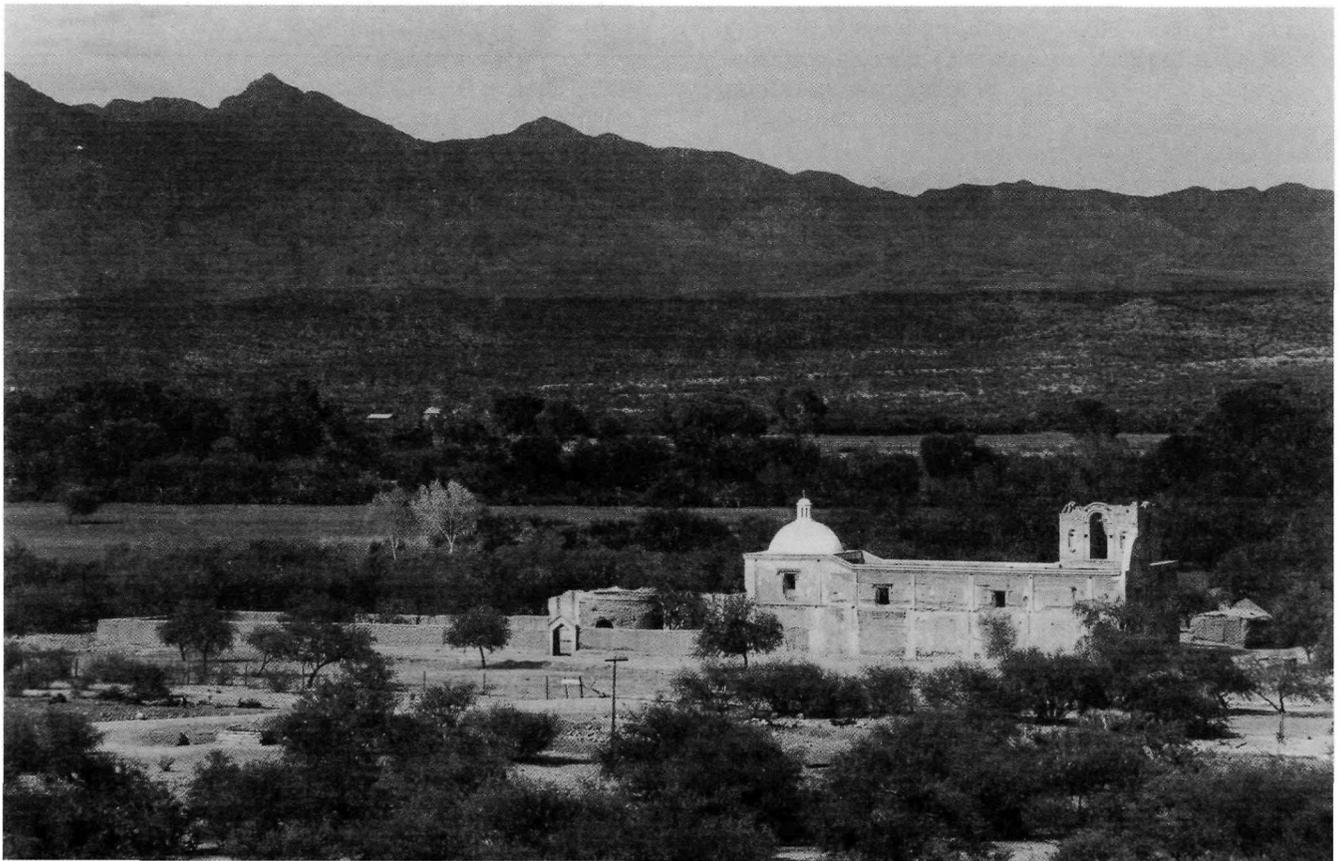


Figure 1. The Franciscan church of San José de Tumacácori in 1929, looking northeast toward the Santa Rita Mountains. (Photo courtesy of U.S. National Park Service.)

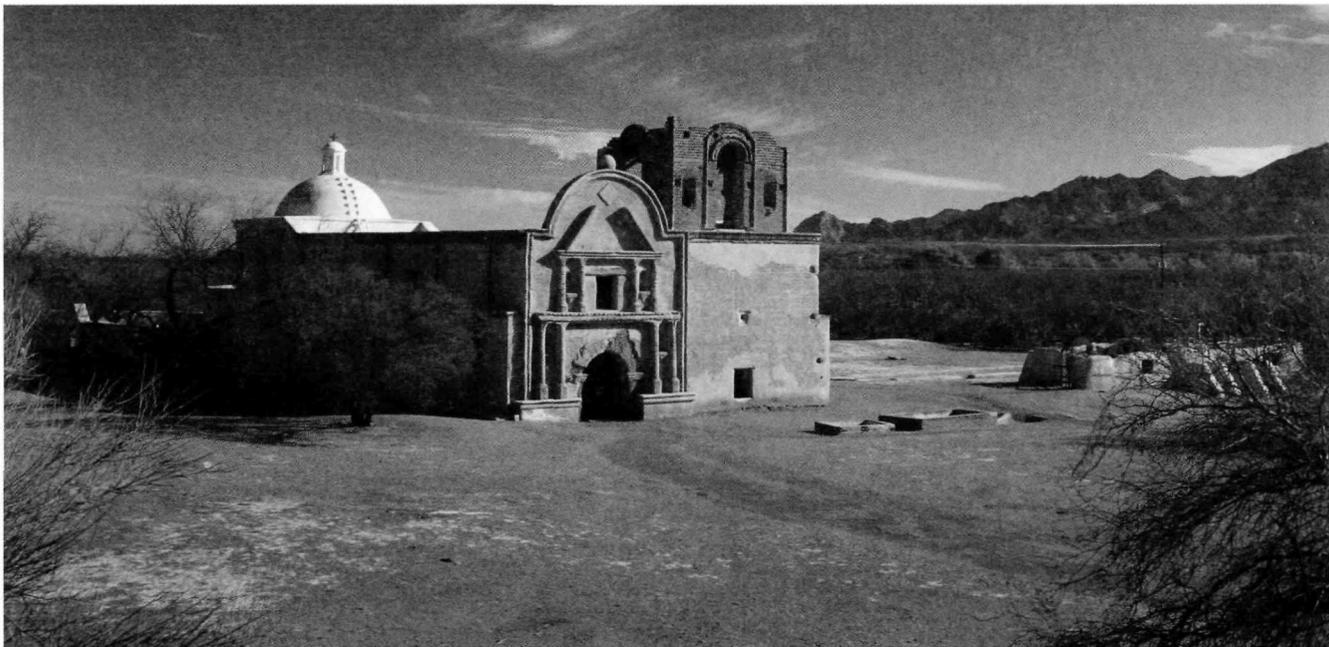


Figure 2. San José de Tumacácori, looking northeast toward the Santa Rita Mountains. (Photo by Jeff Axel, courtesy of U.S. National Park Service.)

of O'odham continued to reside on the mission grounds and in the church, and when this remaining population departed during the harsh winter of 1848, they carried its consecrated sacramental furnishings to San Xavier del Bac.

After 1848, the church and *convento* began to deteriorate and were heavily damaged by treasure hunters. The site was not adequately protected until the National Park Service (NPS) took over in 1916. Tumacácori now forms the centerpiece of a National Historical Park that also includes the nearby sites of Calabasas and Guevavi, which under the mission system were connected economically as well as religiously. NPS protects, preserves, and interprets the mission churches and associated ruins at all three of the park's sites (Calabasas is located 9 miles south of Tumacácori, whereas Guevavi is located 3 miles south of Calabasas, near Nogales, Arizona).

In 2002, the boundary of Tumacácori National Historical Park was expanded to include the Tumacácori mission's orchard/garden and agricultural fields, opening new opportunities for the study of mission period garden construction and design. This article summarizes current research on the mission's orchard/garden.

Tumacácori Orchard/Garden Research

The idealized image of eighteenth- and nineteenth-century Spanish mission orchards and gardens is nostalgic and often romantic, yet the physical, or archaeological, aspects of mission-period orchards and gardens are poorly understood. Tantalizing clues about Tumacácori's orchard and garden design—including the walls, fruit trees, and *acequia* (irriga-

tion ditch) systems—are found in the accounts of miners and ranchers who traveled through southern Arizona and northern Sonora during the mid to late nineteenth century and who described remnants of mission orchards, gardens, and *acequias*. Until recently, however, archaeological excavations at the mission have focused on the church and *convento*, and very little archaeological or ethnographic research has been done to investigate these accounts.

The situation has changed following the expansion of Tumacácori National Historical Park's boundary. Archaeological investigations in the mission orchard/garden began in 2004. Nearly complete two years later, they leave us with more questions than answers. Excavations are complemented by ethnohistorical and ethnobotanical research on Spanish mission gardens and orchards, currently underway. The goals of this research include: 1) increasing our understanding of mission orchard construction and design, 2) compiling historical accounts of the mission orchard and fields, 3) identifying the types of plants that could have been grown in the orchard, 4) studying the genetic stock of old trees, and 5) developing park interpretive programs. These studies provide the Park with information needed to revitalize the mission period cultural landscape, recreate the historical setting, and provide accurate information to visitors.

Orchard or Garden?

The area alternatively called the mission orchard or mission garden lies to the east of the Franciscan *convento* (see Figure 3). It was separated from the *convento* and other agricultural fields

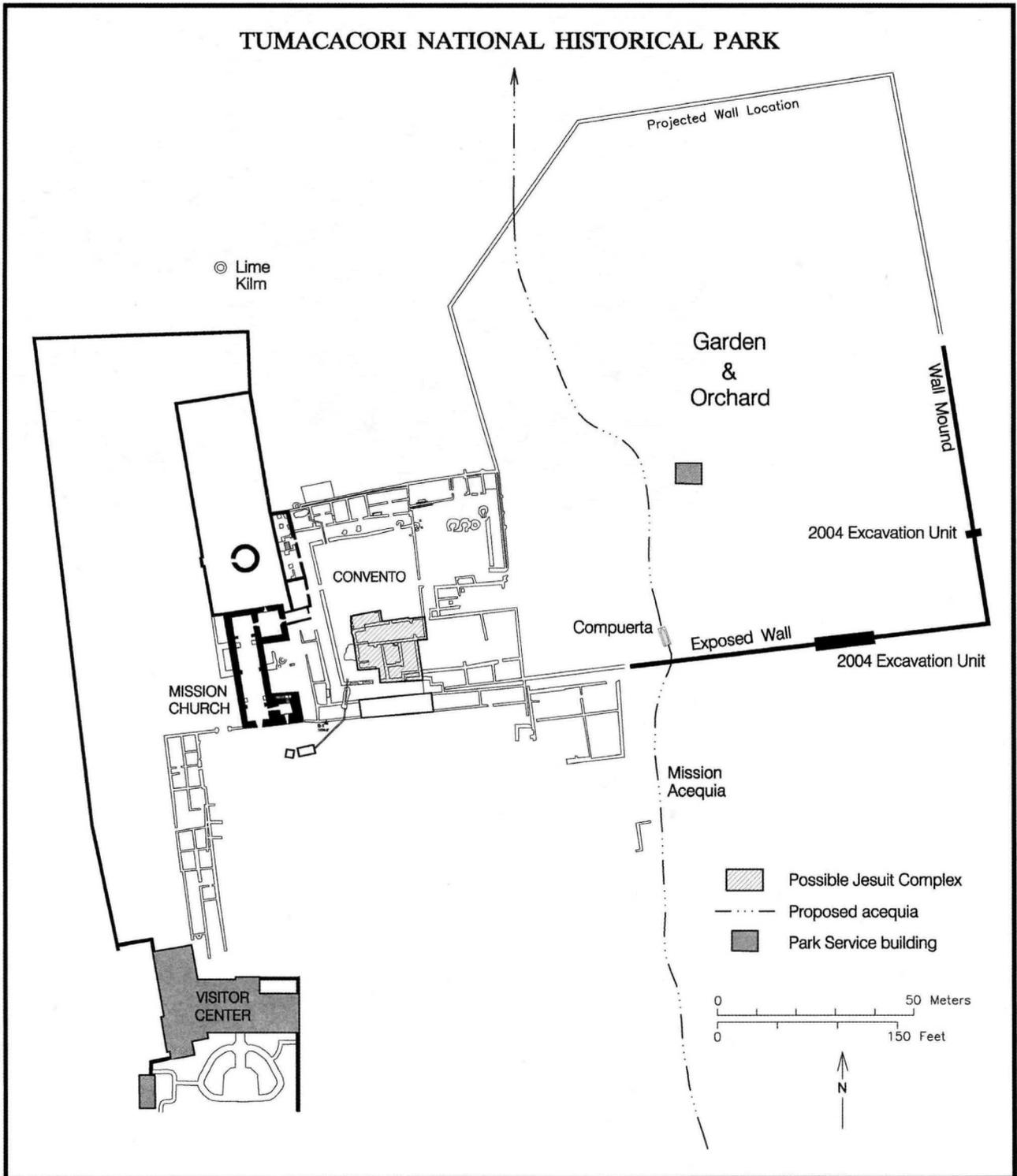


Figure 3. Archaeological map of Jesuit and Franciscan Tumacacori. (Illustration by Ron Beckwith, courtesy of Western Archaeological Conservation Center, U.S. National Park Service.)

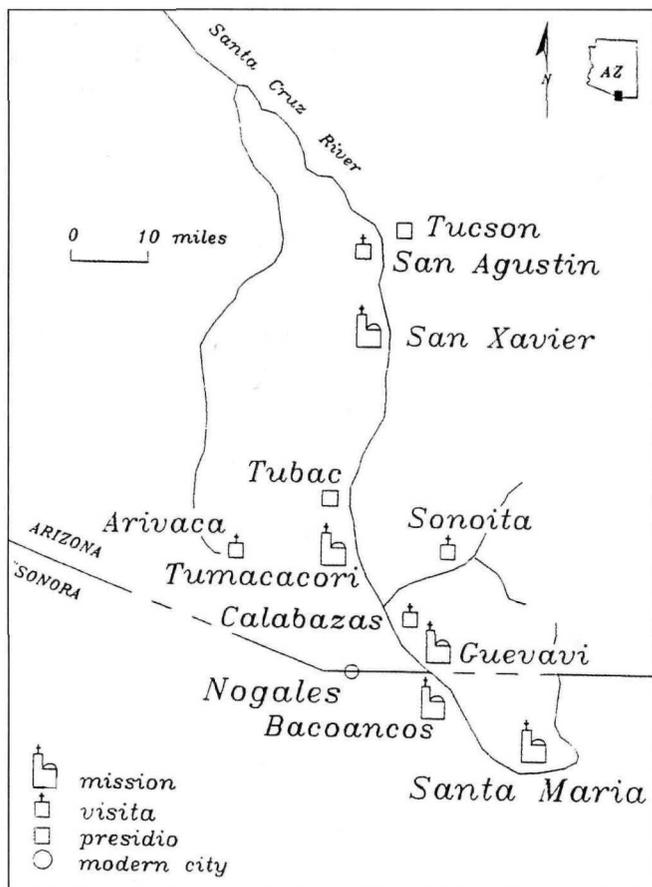


Figure 4. Selected missions, visitas, and presidios near Tumacácori.

by an enclosing wall. In an 1860 report to investors, William Wrightson of the Santa Rita Mining Company depicted the orchard as adjacent to the *convento*, observing that it enclosed about five acres.¹ He was close—the area of Tumacácori's orchard and garden is actually 4.6 acres. In this space, the liberal use of water and a focus on propagating fruit trees, vegetables, herbs, and possibly flowers transformed the desert landscape into an earthly paradise.²

Although the Park presently refers to the area as an orchard, it was probably more than that. The perception that the area east of the *convento* was primarily an orchard derives from historic accounts mentioning that peach, quince, pomegranate, mulberry, and fig trees still grew within the confines of the enclosing wall as late as 1849.³ An 1891 article published in the *New York Times* added oranges, limes, and lemons to the list of fruit trees. Father Kino lists grapes, apricots, apples, pears and pecans in his description of Pimería Alta mission gardens.⁴

In 1899, Frank N. Wright and Ricardo de Luna, of Los Angeles, camped near Tumacácori. Luna "suggested watching the mission orchard by moonlight as a good way of getting deer; they did and they shot a deer who was feeding on fallen apples. The trees were old and scraggly then, but still bearing." Other

visitors noted pomegranate, pears, peaches, apples and apricots in the garden during the late 1880s and early 1900s.⁵ In 1934, custodian George Boundey wrote that his wife canned fifty quarts of "the peaches Father Kino introduced to this country."⁶ Peach trees persisted along the *acequia* and in the garden until 1936, when the *acequia* stopped flowing and the land was cleared for cotton.

Travelers' accounts attest to fruit-bearing trees, but make no mention of vegetable or herb gardens. This is not surprising, because well-established fruit trees can survive without tending for some time, and the 1849 accounts were made just one year after the last remaining Indians departed for San Xavier del Bac. Medicinal herbs, cooking herbs, and vegetables, which require more attention, were probably no longer growing when the area was described in 1849 and after, or were simply not as noticeable or enticing as standing fruit trees and did not warrant mention in historic accounts. But Father Kino's list of specialty plants carried to Jesuit missions suggests that "cabbages, melons, watermelons, white cabbage, lettuce, onions, leeks, garlic, anise, pepper, mustard, mint, Castilian roses, and white lilies" were under cultivation at Tumacácori.⁷

Historical precedence suggests that the enclosed area served multiple functions. The layout and design of Spanish mission gardens and orchards developed during the eighth century from an Andalusian form of monastic gardens, but was influenced by Islamic garden design, aesthetics, horticultural knowledge, and irrigation technology. The transfer of Islamic landscapes and garden sensibilities to Spain is evident in Valencia and Seville after the fifteenth-century reconquest.⁸ Islamic design of agricultural spaces usually incorporated gardens and orchards into one defined area, but sometimes gardens and orchards were divided by walls. In the New World, border plants including quince and pomegranate may have been used to divide space, as can be seen today in Mexico. According to this model, the enclosing wall at Tumacácori would have served to protect fruit trees, beds of medicinal herbs and cooking herbs, and possibly flowers or sensitive and rare vegetables. The space represents an important part of the Spanish institutionalized cultural landscape replicated at Tumacácori and other missions.

We do not know the full variety of plants grown within the garden and orchard. Pollen analysis has been inconclusive due to poor soil preservation.⁹ Nor have any site plans of the Jesuit or Franciscan mission gardens and orchards been located, despite their physical replication throughout the Pimería Alta. All that can be said is that both orchards and gardens likely coexisted within the enclosed area east of the *convento*. This 4.6-acre area will be called the mission garden here, but keep in mind that it was also an orchard.

The Tumacácori Garden Wall

Remnants of the garden walls described in travelers' accounts and surveyed by archaeologist Paul Beaubien in 1934 formed a rough orthogonal shape on three sides; the west side connected

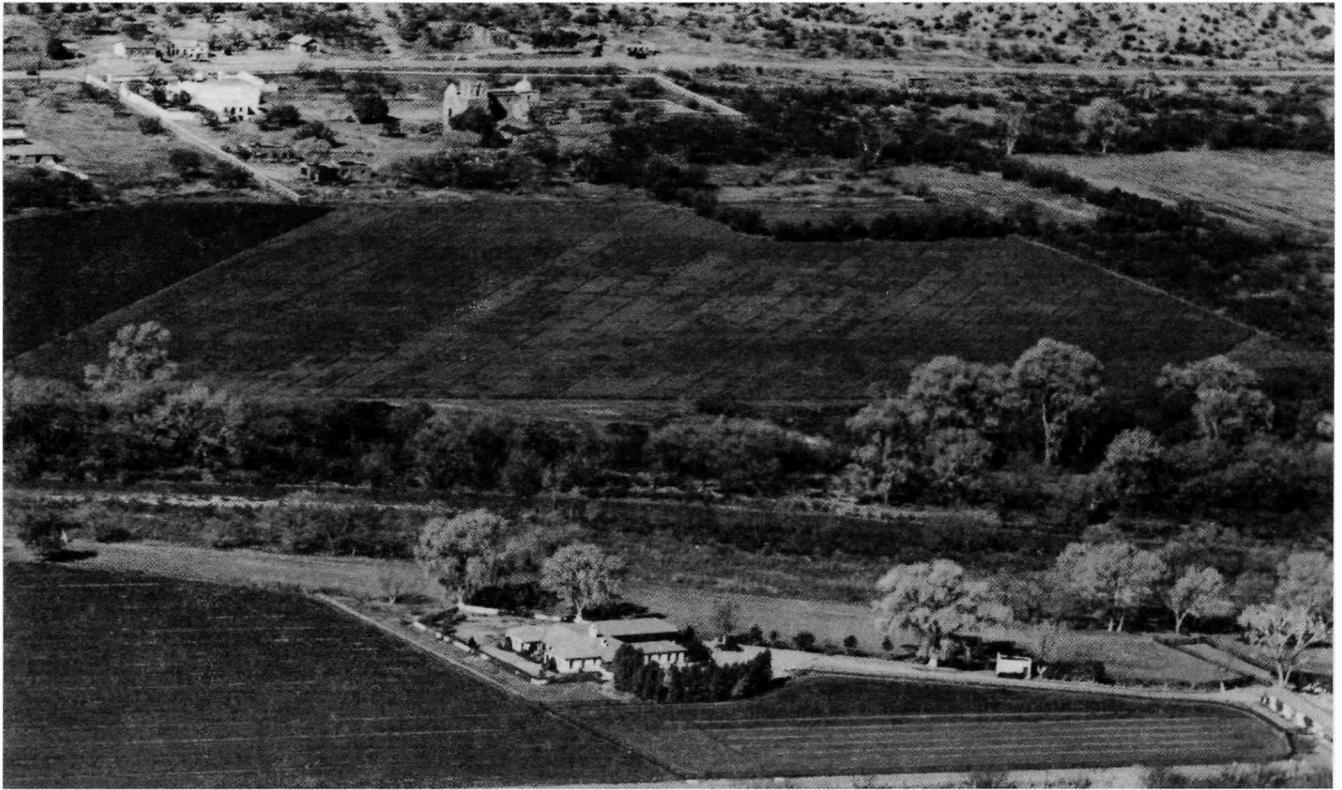


Figure 5. Aerial showing tree lines defining the garden walls (in the upper right) in 1936. (Photo courtesy of U.S. National Park Service).

to the north wall by a diagonally-indented fifth wall, which formed the northwest corner (see Figure 3). Other buildings were built along the south and west side, resulting in double walls in places.¹⁰

Aerial photographs from 1936 show the original configuration of the garden walls (Figures 5 and 6), indicated by the squared tree lines. The tree lines seen in Figure 5 appear young; today these trees are some of the tallest on the mission grounds. Figure 6 shows the outline of the garden and is also the only photo showing the full extent of the mission *acequia*. The north wall of the garden was destroyed some time after 1949, but somehow the plowing of surrounding agricultural fields managed to avoid the southeast corner.

The diagonal, northwest corner of the garden is an interesting, but perplexing, aspect of the garden. Why was the corner diagonal rather than squared? Was it a change in design to reduce construction cost, or does it represent a purposeful design choice related to planting or some other function?

Cutting the corner with a diagonal wall reduces the distance by 24.4 m (80 ft), minimally decreasing the amount of labor and materials needed to construct the northwest corner. At Tumacacori, funds and materials often ran out during construction episodes, forcing changes in the design of the church and *convento*. Another possibility is that the missionary fathers were

in a hurry to construct the wall and truncated the northwest corner to save time; the wall would have been useful for defensive purposes, and Apache attacks were always imminent.

An equally plausible explanation for the northwest corner wall is that the interior space along the wall was meant to provide a microclimate for certain plants. A microclimate is an environment that offers something other than the usual climate and soil characteristics of a location. Most gardens and orchards contain a range of microclimatic zones, which make it possible to plant species that are not standard for a particular area. Sunlight, southern and northern exposures, wind directions, and low spots where cold air and water drains down, all contribute to the type and function of microclimates.

From April 20th to August 20th each year, the sun rises in the northeast and has a southerly declination, or arc, before setting in the northwest. Thus, the interior of the northwest corner would have offered shade during hot summer afternoons when the sun was in the northwest sky, and would have held the sun's warmth during winter months. The three-sided corner could have provided an additional microclimate for certain trees, vegetables, and herbs that require moist soils and lower temperatures. Shallow-rooted plants require soil with high moisture content and low temperature. Vegetables and herbs that may have benefited from the microclimate of the northwest



Figure 6. Aerial of San José de Tumacácori shows the full extent of the mission acequia and garden wall in 1936. (Photo courtesy of U.S. National Park Service.)

corner include tepary beans, chiles, lettuce, cucumber, melons, *tomatillos*, tomatoes, cilantro, oregano, and possibly potatoes.

The *acequia* once passed through the northwest corner wall, indicating that the wall may be diagonal to accommodate the *acequia* or other lateral ditches, angled to fit the contour of the land for irrigation ditches that passed through it. This hypothesis is not testable, however, since agricultural activities have destroyed *acequia* traces and modified the land contours.

Archaeological Investigations of the Garden Walls

Although the mission was visited and described by travelers many times after it was abandoned, Wrightson was the only one to describe the garden wall. In 1860, Wrightson described the orchard as "surrounded by a cahone wall."¹¹ The word *cajón* means box, suggesting that Wrightson may have been describing the orchard as surrounded by a box, or square enclosing wall. (*Cajón* is also an architectural term for the space

between a buttress and wall, but Wrightson was probably not using this definition of the word.)

Though archaeological investigations along the south and east garden wall found great variability in construction technique, the garden wall was made of adobe. Construction began with the excavation of a trench that was filled with mud and river cobbles. Adobes were then laid on top of the upper course of the river-cobble foundations. Remnants of adobe walls and foundation stones were mapped in 1934 and photographed in 1949. Park staff recalled standing, but eroded, adobe walls as late as the 1970s.

Archaeological investigation of the garden wall began in 2004 with assistance from NPS's Western Archaeological and Conservation Center. Work began along the south garden wall where river-cobble foundation stones are exposed at the surface. Two 1 x 1-m units were excavated adjacent to the foundation stones showing at the surface, one along the interior and another along the exterior (Figure 7). The excavation of the interior unit revealed cobbles 20 cm below the ground surface. No cobbles were found in the unit along the exterior of the wall, but the cobbles along the interior look like a ledge or step in the lower subsurface portion of the foundation (Figure 8).

It is unclear why the cobble foundation for the south wall was constructed with a ledge. The initial assumption was that buttresses were placed along the foundations' interior to help strengthen the wall. An example of the use of buttresses to strengthen a garden wall was discovered in the 2004 excavations at San Agustín, in Tucson. There, buttresses were placed at regular intervals along the interior of the garden wall.¹² As more units were excavated along the interior of the Tumacácori garden wall, however, the rock ledge was found to continue along the full extent of more than 20 m of exposed foundation, suggesting that it served a different purpose.

If the cobble ledge isn't a buttress, could it be the edge of the foundation for an earlier wall? The cobble foundation showing at the surface, apparently tied into the lower cobble ledge, argues against this. Yet, if all of the cobbles are part of one foundation, the south wall foundation is 1.4 m wide, which is extremely thick for a simple garden wall.

The construction method for the foundation of the east garden wall significantly differs from the south wall. The east wall foundation is only 80 cm wide, and was constructed using the core and veneer technique of placing large river cobbles on the sides and filling the space between with smaller cobbles and mud (Figure 9). In contrast, the foundation stones for the south wall are size-sorted and the core and veneer technique was not used. The east wall foundation stones are not exposed at the surface like those of the south wall, but are instead covered by a mound of adobe melt.

In 1949, Charlie Steen took two photographs of the garden wall remnants. Steen's photo of the east wall shows an eroded, but standing, adobe wall approximately 3 feet high (Figure 10). The second photo from 1949 is of the north orchard wall that

was later destroyed by agricultural activities, before the park acquired the land (Figure 11). This photo shows only foundation stones exposed at the surface, similar to how the south garden wall appeared before the 2004 excavations, suggesting that adobes of the north and south wall eroded at the same rate. Either the south wall adobes eroded faster than the east wall adobes, or the east wall was constructed after the south wall and was not exposed to the elements as long.

I have offered several explanations for differences between the south and east garden walls. The most plausible explanation is that the east wall was built at a different time than the north and south walls. The differences in foundation size, construction technique, and rates of adobe erosion can be explained by repairs to wall foundations following floods and by differential erosion of the walls.

Although the garden area does not flood today, high intensity floods were more frequent in the past. The south and east walls may have been repaired multiple times. It is probable that the ledge of the south wall foundation represents an attempt to strengthen the south wall by providing a footing or toe for the foundation on which the adobe wall was built. The south wall would have been perpendicular to the flow of rushing water, causing increased adobe erosion and subsidence of the wall, requiring it to be rebuilt. Subsequent flooding and wind erosion destroyed the adobes of the south wall after it was rebuilt. In this scenario, the east wall remained intact longer because it was parallel to the flow of rushing water during floods.

The original height of the garden wall can not be determined from the current physical evidence. In 1849, the wall is described as being "high"—but how high? The walls were probably higher than four feet to keep out animals, raiding Apaches, and to create a microclimate for plants. A photo of the San Agustín mission in Tucson shows a garden wall that appears to be 4–6 feet high.¹³ The width of the wall foundations imply that the garden wall at Tumacácori was a similar height.

The Age of the Garden Wall

We don't know when the garden wall was built or when plants were first established in the garden. In 2004, we excavated trenches to locate the garden wall where it meets the *convento* at its southwest corner, in the hope that known construction sequences of the *convento* could be linked with construction of the garden wall and allow relative dating of the garden. The trenches revealed disturbed soil, however, and no intact foundations.

Although it's possible that portions of the garden wall date to the Jesuit period, determining this is extremely difficult. It's more likely that a smaller garden enclosure was built near the southeast corner of the present garden wall, just east of the *convento*, some time between 1770 and 1800 when modifications of the Jesuit complex were completed by the Franciscans. The larger 4.6 acre enclosure was probably built during the flurry of construction activity that took place from 1802 to 1828.¹⁴



Figure 7. Excavation along the interior and exterior of the south garden wall in 2004.



Figure 8. Photo of the foundation for the south garden wall, showing lower ledge or footing along the interior. Adobes were probably stacked on the portion of the foundation showing at the surface to the right.

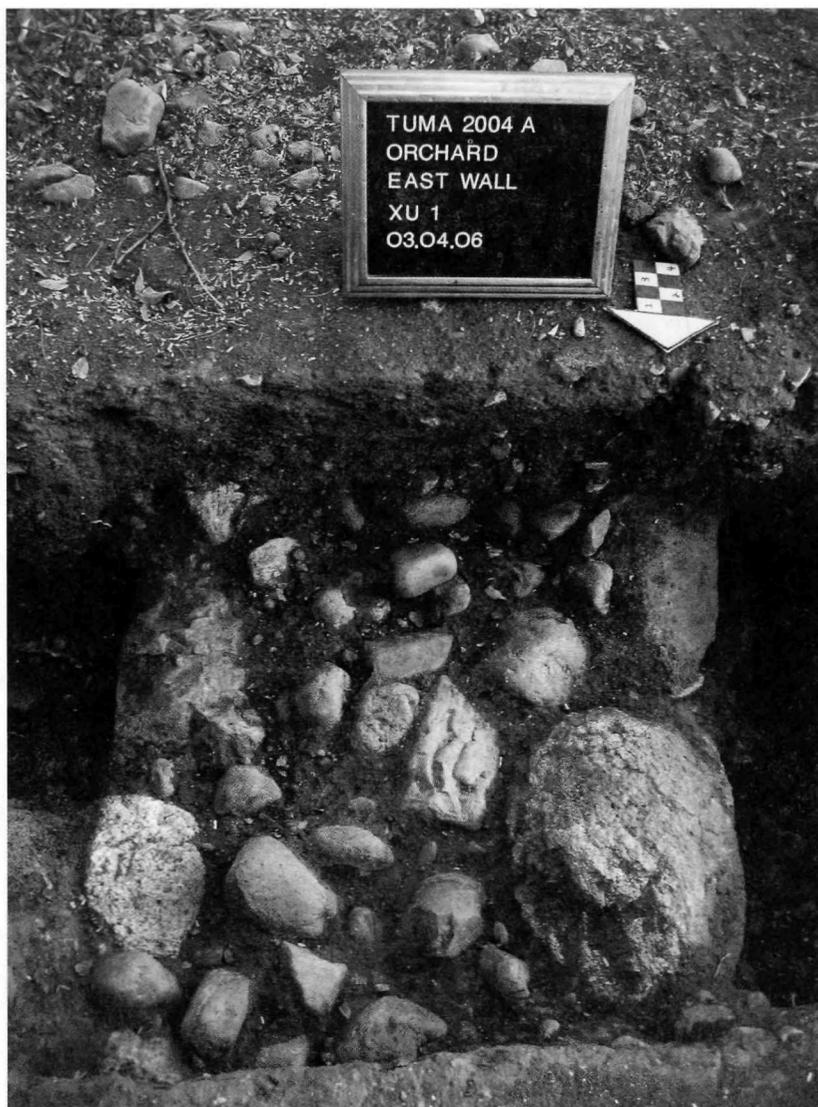


Figure 9. East wall foundation after excavation.

The Acequia and Compuerta

The mission *acequia* was constructed to bring water from the Santa Cruz River to a network of irrigation ditches that supplied the mission farm fields, orchard, and gardens. The *acequia* ran from the south end of the mission, where it picked up water from the Santa Cruz, to the north end of the mission, where it re-entered the river. Eighteenth- and nineteenth-century accounts of the mission attribute the beauty and prosperity of the mission gardens and orchard, and the high state of cultivation of the farm fields, to the mission's irrigation network.¹⁵ The *acequia* carried water through the park until 1938, when new wells significantly lowered the local water table.

Archeological investigations at the park have identified few irrigation features. The original *acequia* has been largely obliterated by modern farm fields, although some segments

were straightened and reinforced with concrete for modern use. The location of the *acequia* can be inferred from historic maps, descriptions, and photographs of TUMA dating to the 1930s (see Figure 6). Only one *acequia* is known, but there were probably multiple *acequias* that helped water thousands of acres.

In 1860, Wrightson stated that "the acquia [sic] passes through this [the garden wall], and here is the remains of a washing vat and bathing place." The *acequia* Wrightson referred to is probably the *acequia madre*, which enters the garden near the southwest corner. The washing vat is the diversion box or *compuerta* located 14 ft inside the south orchard wall; this feature was first identified by Beaubien in 1934. The structure measures 4 ft 1 in wide by 13 ft 10 in long, with a three-inch dip in the ends of the north and south floor (Figures 12 and 13). It is constructed of fired adobe bricks and hydraulic lime



Figure 10. Adobe remnant of the east wall of the garden in 1949. (Photo by Charlie Steen, courtesy of U.S. National Park Service.)



Figure 11. Exposed foundation stones of the north garden wall in 1949. (Photo by Charlie Steen, courtesy of U.S. National Park Service.)

plaster with crushed brick (*cacho pesto* finish). Although its function is unknown, the feature probably served to impound water, by constricting and slowing ditch flow, in order to create sufficient head for lateral ditches that fed gardens and orchard trees.

The *compuerta* may have also served as a *lavandaria*, or laundry tank, a common element of mission gardens in the Pimería Alta and Alta California.¹⁶ In 1849, Forsyth described the feature as one of the “beautiful baths,” suggesting there was more than one *compuerta*.¹⁷ Only one has been found to date, but it is probable that numerous diversion boxes would have been needed along the *acequia madre* to feed lateral ditches for wheat and corn fields. The relationship between the *acequia*, *compuerta* or *lavandaria*, and the mission garden and orchard needs to be studied in more detail.

Visions of an Active Garden and Orchard at Tumacácori

Tumacácori NHP is presently working on re-establishing a fruit tree orchard within the confines of the original garden wall. European-style orchards and fields established by Spanish missionaries were part of the cultural transformation of the local landscape. The park’s goal is to recreate the historic mission cultural landscape including gardens, orchards, fields and possibly livestock. Establishing orchard trees is the first step.

The vision of an active garden and orchard actually began in the 1920s and continued through the 1930s, but there are very few details of attempts to re-establish plants. In a 1923 letter to NPS director Stephen Mather, Southwest Monuments Superintendent Frank Pinkley wrote that:

“Governor Hunt has donated a hundred or more cuttings of grapes, olives, figs, and peaches, which we have in trenches where they are starting nicely and which we will move to their final location as soon as we have our wind-

mill, tank, and water system installed. He has promised us anything in the way of cuttings we may need to restore the mission grounds.”¹⁸

There are no records on how the cuttings donated by Governor Hunt fared. In 1973, Mrs. King, whose family resided near the mission in the late 1800s—early 1900s, said she had cuttings of the “original fruit trees (peaches, figs, and pomegranates) in her yard in Tucson.”¹⁹ Recent attempts by TUMA staff to locate the trees have failed.

Today, the search for historic cuttings of fruit trees continues with the Kino Fruit Trees Project, led by Jesús Manuel García Yáñez (Arizona-Sonora Desert Museum) and Robert M. Emanuel (University of Arizona). This project, which aims to research, locate, propagate, and re-establish historically accurate fruit cultivars, is divided into three phases: Phase I uses archive-based research, ethnography, and field visits to determine the types of cultivars that were present at missions in the area and to identify modern areas where genetically related trees still exist. Phase II involves acquiring stock for planting, and Phase III completes the project by replanting and interpreting the mission orchard within the confines of the garden wall.²⁰

Old trees that can be traced back to genetic stocks of Old World trees introduced 150–300 years ago have been identified in mission orchard communities in Sonora, Mexico; on the University of Arizona campus; at Quitobaquito Springs in Organ Pipe National Monument; and at historic houses and backyards of private residences. Cuttings and seeds are being propagated at various farms and nurseries throughout southern Arizona. Hopefully, stock from historic tree cuttings will be transplanted in the Tumacácori garden area within the next 3–5 years.

There’s no question that re-establishing the mission orchard and garden will contribute to the interpretive, educational, and preservation objectives of Tumacácori NHP, but reintroducing



Figure 12. The compuerta or lavandaría just inside the south garden wall.

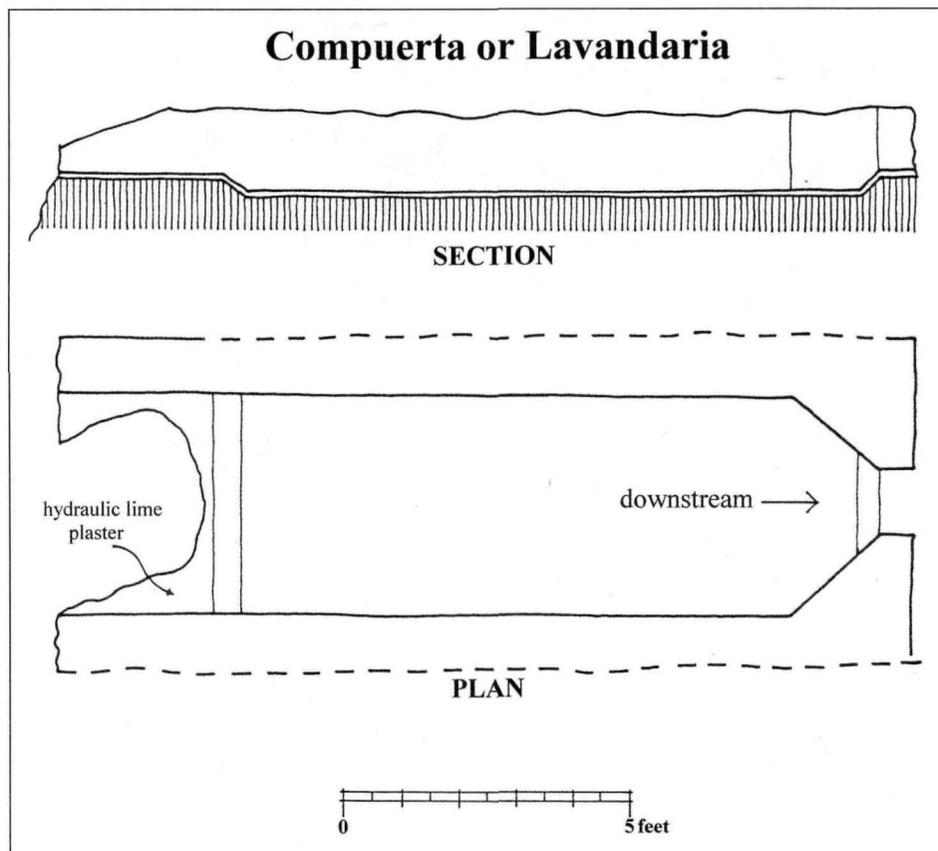


Figure 13. Plan and section of the compuerta attached to the acequia.

Spanish-era plant stocks is a formidable task. A feasibility study is needed to address issues concerning sustainability, water rights, water consumption, irrigation systems, frost damage, plant spacing, management, maintenance, and interpretation.

All ambitious projects begin with a vision. For years, park staff developed the vision of an active garden and orchard that allows visitors to experience another aspect of mission life. Our hope is that one day visitors can walk out of the *convento* and into the green “earthly paradise” of the mission orchard and garden. Perhaps visitors will be able to pick a peach and savor the sweetness of Father Kino’s labors in the Pimería Alta.

Acknowledgements

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Notes

¹ William Wrightson, *Second Annual Report, Santa Rita Mining Company* (March 19, 1860), pp. 14–15.

² James Dickie, “The Islamic Garden in Spain” in *The Islamic Garden*, edited by E. MacDougall and R. Ettinghausen, pp. 89–105, Dumbarton Oaks and the Trustees for Harvard University, Washington, D.C., 1976.

³ John R. Forsyth, *Journal of a Trip from Peoria, Illinois to California on the Pacific in 1849*, pg. 75, Peoria Public Library, Peoria, Illinois. Lorenzo D. Aldrich, *A Journal of the Overland Route to California and the Gold Mines*, pp. 29–30, Alexander Kirkpatrick, Printer, Lansingburgh, New York, 1851. 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. William Wrightson, (March 19, 1860), pp. 14–15. Also see: *New York Times*, March 1, 1891, which mentions fruit trees on the mission grounds. The passage describing the trees and “gardens of vegetables and plants” is written in the past tense, suggesting the author used conjecture and the plants were not actually seen in 1891. Also, no specific location is given.

⁴ Herbert Bolton, *Kino’s Historical Memoir of Pimeria Alta*, pp. 89, 265, Arthur Clark Company, Cleveland, 1919.

⁵ Sallie Brewer, *Tuma Fact Files*, TUMA, National Park Service, 1944. Brewer interviewed Frank Wright September 6, 1944. She also interviewed locals José Wise, Juan Méndez, and Nacho Flores. Wise remembered pomegranates in the 1880s; Méndez mentioned pears, peaches, pomegranates, and apples in the early 1900s; and Flores remembered peach and apricot trees along the *acequia*, and a few trees in the mission garden area.

⁶ George Boundey, *Superintendent’s Monthly Report*, National Park Service, Western Archaeological Conservation Center, November, 1934.

⁷ Kino in Bolton (1919), pp. 89, 265.

⁸ Mildred Stapley Byne and Authur Byne, “Spanish Gardens and Patios,” *The Architectural Record*, 1924:115–116, New York. William W. Dunmire, *Gardens of New Spain: How Mediterranean Plants and Foods Changed America*, pp. 13–14. University of Texas Press, Austin, 2004. Thomas F. Glick, *Islamic and Christian Spain in the Middle Ages*, pg. 54, Princeton University Press, Princeton, New Jersey, 1979.

⁹ Soil samples from the garden were recently analyzed for plant pollen. The results showed that wet-dry cycles from irrigation and plowing have damaged pollen grains. Besides native grasses, Arizona walnut was identified, but no cultivars found.

Pollen analysis of soils from excavations in the plaza area south of the church identified corn, wheat, melons, squash, watermelon, beans, lentils, cotton, and peaches. Other native foodstuffs identified include mesquite beans, saguaro cactus, prickly pear, cholla, ocotillo, native walnut, amaranth, netleaf hackberry, and graythorn seeds. See Lisa Huckell, “The Plant Remains from Tumacacori Mission” (Appendix B), in Lee Fratt, *Tumacacori Plaza Excavation 1979: Historical Archeology at Tumacacori National Monument, Arizona*, pg. 212, National Park Service, U. S. Department of the Interior, 1979.

¹⁰ Paul Beaubien, *Excavations at Tumacacori-1934*, NPS Southwest Monuments Report, National Park Service, 1937.

¹¹ Wrightson (March 19, 1860), pp. 14–15.

¹² Homer Thiel (Desert Archaeology, Inc., Tucson), personal communication pertaining to Rio Nuevo Project excavations.

¹³ Carlton Watkins photo, AHS# 18233, Arizona Historical Society, Tucson.

¹⁴ James Ivey, personal communication 2006, and information in “Here was Troy: Architectural and Archaeological History of the Tumacacori Missions,” draft Historic Structure Report, National Park Service, Santa Fe.

¹⁵ J. Ross Browne, *Adventures in Apache Country: A Tour Through Arizona and Sonora, 1864*, 2nd ed., University of Arizona Press, Tucson, 1974). William Wrightson (March 19, 1860), pp. 14–15.

¹⁶ Tonia Horton, *Tumacacori National Historical Park Cultural Landscape Study*, pg. 33, TUMA, National Park Service, 1998.

¹⁷ John R. Forsyth (1849), pg. 74.

¹⁸ Frank Pinkley, *Superintendent’s Monthly Report*, National Park Service, Western Archaeological Conservation Center, Tucson, December 1923.

¹⁹ Author Unknown, *TUMA Fact Files*, TUMA, National Park Service, October 7, 1973.

²⁰ Jesús Manuel García Yáñez and Robert M. Emanuel, *The Kino Fruit Trees Project: Phase I (January–October 2004)*, pg. 3–4, National Park Service, Desert Southwest Cooperative Ecosystem Studies Unit, January 12, 2005.