

# FLOUR MILLING IN TERRITORIAL ARIZONA

*This article was adapted from a three-volume report prepared by Archaeological Consulting Services, Ltd. for the City of Tempe<sup>1</sup>*

By Thomas E. Jones

**F**lour milling was an essential component of frontier settlement and development in the United States, and Arizona was no exception. In the decade preceding the American Civil War, at least four flourmills were operating in southern Arizona (Figure 1), and by the end of the nineteenth century settlement had spread along all the major river drainages in Arizona Territory.

Many flourmills established in these new settlements were custom mills (commonly referred to as gristmills) that milled farmers' grains for a fee. Others, particularly in the Salt River Valley, were larger merchant mills, which produced and distributed a wide variety of flour products across the territory.

Through the 20th century, established communities in the Salt River Valley and other fertile floodplains throughout Arizona continued to develop and mature in a predominantly agricultural economy. By the mid-twentieth century, however, the bulk of Arizona's territorial flourmills had ceased operations.

Milling methods have evolved significantly since the dawn of the Neolithic period, but the principle is essentially unchanged—that is to say, reduction of the grain kernel is essential for the proper digestion of starch and other nutrients found within. Ground stone—as characterized by crushers, mortars, and metates—is the earliest and most enduring form of grain processing. Here in the Southwest, the metate has been identified in prehistoric sites dating as early as between 7,500 and 4,800 B.C.

Significant improvements of traditional milling methods occurred in the Roman World (circa BC 400–AD300) with the improvements of rotating mills such as hand-driven querns and animal-powered pushing mills, and development of water driven mills. Although ground stone would continue to be

used in less developed societies across the world, Western Civilization had entered a new age in regard to large-scale flour milling.

## The Water Driven Mill

There are two main classes of water wheel—the horizontal and vertical wheels. The crucial difference between the horizontal and vertical wheel is the mechanism(s) by which the millstones rotate. The horizontal wheel is a direct-drive unit, which means the vertical shaft attached to the wheel is connected to the millstones. Consequently, the stones turn more-or-less simultaneously with the wheel. While this construction limits the capacity of flour, its simplicity and relative low maintenance ensured the horizontal mill was the choice water mill for small rural areas.

The vertical wheel delivered motive power to the stones through a horizontal shaft and gearing mechanism. The topography surrounding the mill and waterway determined what type of vertical wheel was used. Many English colonial mills were likely undershot, requiring little or no fall to turn the wheel; however, millers were quick to learn that overshot wheels were more efficient. With the construction of a wooden flume from the headrace, water could be directed over the wheel, resulting in a controlled flow that significantly increased the efficiency of the mill process. The turbine is a descendant of the horizontal wheel that proved to be as efficient as the vertical wheel. It consists of curved

blades enclosed in a container that directs water flow and pressure directly onto the blades, thereby increasing energy output for more efficient motive power. In the mid-nineteenth century, the turbine was developed as a more efficient replacement of the vertical wheel. A large number of Arizona's territorial water mills made use of the turbine.

Although some water mills took advantage of natural waterways by constructing directly over them, most were strategically located some distance from a natural waterway with channels excavated to divert water to the wheel. In many cases, a wooden flume was installed to convey water from the channel onto the wheel (especially in horizontal mills, where a direct flow onto the wheel was required). Many mills also contained a millpond, which was constructed adjacent to the wheel pit to store water for use in the mill; a sluice gate controlled the flow of water entering and exiting the pond.

### **The Steam Mill**

Steam power was used to drain water from mines throughout Europe since at least the early seventeenth century, but was limited in scope and use. After revolutionary improvements by James Watt, the use of the more efficient steam engine in other industries became widespread. An English mill designed by Watt was completed and operating in 1784 using steam power from his improved engine. During the first decade of the nineteenth century, Oliver Evans made additional improvements to create a more-efficient high-pressure steam engine (his influence and ingenuity in the milling industry was only just beginning to be felt in regard to the automation of the interior components of the flourmill).

In 1809, the Lexington Steam Mill Company completed a flourmill in Kentucky that was powered by Evans' improved steam engine; within months, a steam mill was completed in Pittsburgh. Although water mills would outnumber steam mills through most of the nine-

teenth century, their numbers increased as the motive power did not require a dependent water source; a steam-powered mill could conceivably be built anywhere within a community.

In Arizona, at least twelve steam-powered mills were constructed between 1865 and 1912. The earliest known steam mill in Arizona was the Pima Steam Flourmill completed by Ammi White at Casa Blanca in 1864. The Pima Steam Flourmill was a significant upgrade of his original flourmill constructed in 1860.

### **The Spanish Southwest**

Spanish military excursions through the unexplored territory of New Spain in the mid-sixteenth century established initial contacts with Native Americans in the region; but strategic occupation of northwestern New Spain (which included all or portions of Mexico, Arizona, California, Colorado, Nevada, New Mexico, Texas, and Utah) wouldn't occur until 1591 with the establishment of a Jesuit Mission in Sinaloa, Mexico. This ambitious strategy was executed with the establishment of missions to serve as administrative, economic, religious and cultural centers. Churches were constructed near existing native villages and designated mission pueblos; districts were established with central missions (*cabaceras*) surrounded by smaller, outlying missions (*visitas*) that were administered by the *cabaceras* missionary.

Gristmills were constructed at a number of missions and private land holdings throughout New Spain to provide flour to the natives and Spanish residents. These mills were typical horizontal mills equipped with a single set of millstones. Acequias (irrigation ditches) conveyed water from the principal waterway to a reservoir adjacent to the mill, where water was directed into a flume to power the horizontal wheel (Figure 2).

It is unclear how many missions, settlements, or private ranches in New Spain were supplied with water-powered mills. Earl Porter is a retired engineer who has thoroughly researched and documented flourmills constructed in New Mexico through the late Hispanic period. Of approximately 450 mills documented in New Mexico, Mr. Porter has identified at least 325 of Spanish origin, all of which use the horizontal wheel. He has also documented the presence of animal pushing mills near Albuquerque and other settlements from 1850 Territorial census records. These mills were undoubtedly in use during the Mexican period, and perhaps even earlier.

**Pimería Alta—Land of the Upper Pima:  
1687–1848**

Between 1687 and 1711, Father Eusibio Kino founded at least eight missions in Pimería Alta—the northern region of Sonora that currently encompasses southern Arizona and northern Sonora. Despite the early achievements of Father Kino, no new missions were established in Pimería Alta through the course of the eighteenth century. The Franciscans were able to maintain and expand some of the missions, such as San Xavier and Tumacácori; however, intensive settlement and industry in the region were not undertaken.

Unlike its neighbor New Mexico, which had a

Spanish population greater than 25,000 by the end of the eighteenth century, Pimería Alta's regional population was sparse as a result of poor economic and cultural conditions. Consequently, there is no evidence to suggest the presence of a Spanish horizontal water mill in the region Alta. It is quite probable that cattle or burro mills were used in missions throughout Pimería Alta (Figure 3).

Consultation with Jeremy Moss—Resource Manager and Archaeologist at Tumacácori National Historical Park near Tubac has confirmed that Tumacácori and San Agustín were equipped with large millstones operated by a burro, horse, or multiple persons. At Tumacácori, two millstones were recovered in the course of archaeological excavations in 1964 (Figure 4). This room was constructed sometime after 1774, when the Franciscans had re-established the mission. A mill was also identified in the walled garden of San Agustín, though no other data is available. Missionaries in these remote areas also may have relied on native peoples to grind flour from corn or wheat with the traditional metate.

The fragile welfare of missions and native villages of Pimería Alta were compounded after 1821 when Mexico won its independence from Spain, with many of the Sonoran missions becoming severely depleted. The

isolated settlements of Tubac and Tucson continued to rely on the burro mill, as had the Spanish Missions in Tumacácori and San Agustín. Brevet Second Lieutenant Cave Johnson Coats, was en route to California with the First and Second U.S. Dragoons after the Mexican War in 1848. He reported the following in his journal:<sup>2</sup>

... [E]very house in Tucson is furnished with a Baro [Burro] flourmill and kept going

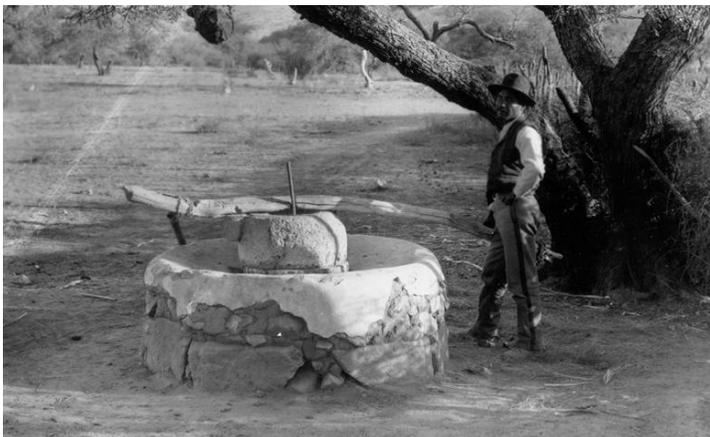


Figure 3: Typical Burro-Powered Flourmill

incessantly, probably grind a half bushel of wheat in 24 hours [approximately 30 pounds]. They are made of two large and rough stones, about the usual size; the under one fastened upon a pillar about two feet high, and of the same diameter as the stone, the upper one is placed on this and kept in its place by a wooden spindle which passes through its center and the hole serves as a hopper, taking about a handful of wheat at a time.

Indeed, the closest water-powered gristmill structures of any significance were Spanish horizontal mills located beyond the boundaries of what would become the Arizona Territory; namely Santa Cruz (Mexico), Santa Fe and El Paso. W.H.H. Davis summarized one such mill while passing through Santa Fe in 1857:<sup>3</sup>

In my rambles around the village I came across an old-fashioned Spanish gristmill, the first one of the kind I had seen in the country, which was something of a curiosity in a small way. The building was not more than ten or twelve feet square, with one run of stone, turned by a small tub-wheel by the water from a neighboring *acequia*. The upper stone was made in the form of a basin, with a rim around it some four inches wide, and fits down over the lower stone, made fast to the floor, and is about eighteen inches high. The grain is mashed by the revolution of the upper stone, and the meal falls down into a box built around the lower one. The hopper was made of bull-hide, and fastened to the beams overhead. The old miller was hard at work in his little mill, and I have no doubt he considered

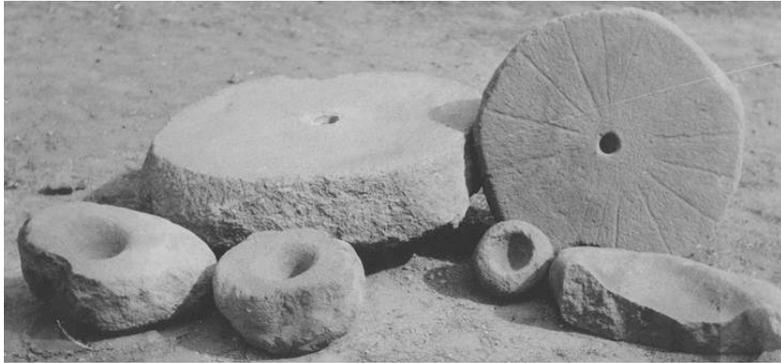


Figure 4: Primitive Grinding Stones

his simple apparatus the perfection of machinery.

#### **Arizona's Pioneer Flourmills (1856–1865)**

In the short period of American settlement before the Civil War, many emigrants traveled through the southern Arizona Territory. Early secondary accounts of conditions in Arizona between 1848 and 1861 reveal the great expense and difficulty in obtaining necessary supplies and goods from peripheral localities. It was in this early period of territorial development that at least four water-powered flourmills were operating along Sonoita Creek, as well as Tubac, Tucson, and Pima Villages (on the Gila River). These pioneer mills were constructed in locations that offered the potential for settlement and industrialization in the new territory—all of them in the recently (1856) acquired Gadsden Purchase. Unfortunately, however, the Civil War and subsequent abandonment of strategic military forts left Arizona's settlements, ranches, and mines unprotected. Consequently, only two of these mills—the Silver Lake Mill in Tucson and Ammi White's flourmill at Pima Villages—survived the chaos and turmoil of the American Civil War.

#### **Findlay and Sharp's Mill on Sonoita Creek**

A flourmill was located on the property of Findlay's Ranch on Sonoita Creek (Tucson) and jointly owned by Findlay and Sharp. The

*Weekly Arizonian* newspaper announced construction of the mill in March 1859:

A mill for grinding wheat and corn will soon be erected at Tubac on the Santa Cruz River. Also a mill of the same description on the Sonoita, near Findlay's Ranche. It is expected that with both these attributes of civilization in full operation breadstuffs will not be quite so high at present. Flour ought to be afforded at six cents per pound, and corn meal at four cents, instead of the high rates now charged.

Apparently there were delays in commencing operations of the flourmill. A June 16 update on the mill declared that the mill was "nearly ready for raising." Presumably, this was in reference to the conveyance of water from Sonoita Creek; the same update noted that if the water did not fail, it would be a substantial property. Unfortunately, no further information has been identified in relation to operation and eventual closing of the mill. Considering that the entire area was largely deserted after commencement of the Civil War, it is reasonable to presume that the mill was abandoned and possibly destroyed in this turbulent period.

### **Tubac Flourmill**

Other than the *Weekly Arizonian's* announcement of its construction (as mentioned above), archival data has offered very little information on the Tubac water mill. H.F. Dobyns mentions only that the flourmill appeared to have taken water from the old Spanish-period irrigation ditch.<sup>4</sup> The mill was constructed at the height of extensive mining in and near the Santa Cruz valley. Archival records indicate the Tubac Mill was built and operated by the Sonora Exploring and Mining Company to provide affordable flour and meal to workers and their families. The Tubac Flourmill was apparently in operation between approximately late 1859 and 1861; it is unknown if the mill was operating prior to the

mill on Sonoita Creek; what is known, however, is that both mills were early casualties of the Civil War.

My field visit to the site of the Tubac Flourmill in 2007 revealed surface remnants of the old Spanish ditch, a portion of which near the mill is lined with stone. A 15-ft wide stone-lined millpond was also apparent immediately adjacent to the cobble and mortar structural foundation and wheel pit. From these observations, the Tubac Flourmill was likely a horizontal mill; the wheel pit appeared to be too small for a vertical wheel.

### **The Silver Lake Mills near Tucson**

In 1856, two brothers, William M. and Alfred M. Rowlett, arrived in Tucson from the East Coast and were granted permission to construct a dam on the Santa Cruz River to create an artificial lake to provide power for a flourmill. They promptly began construction of the dam just south of Tucson and by late 1859, advertised the opening of their Silver Lake mill.

After only one year, the brothers sold their property and water rights in 1860 for \$5,500 to Mr. William S. Grant, a merchant who had contracts with local military establishments, as well as Fort Fillmore in New Mexico. Grant promptly renovated the flourmill and began construction of another mill immediately adjacent to the original. The total cost of the new mill was \$18,000, more than three times the amount paid for the original mill and water rights. The newly constructed mill produced an hourly capacity of 10 bushels (600 pounds) and was cited as running constantly. However, considering that Tucson, Sonoita Creek, and Tubac were effectively isolated, sparsely settled communities, it is unlikely the Silver Lake mills would have run constantly (at least prior to circa 1880).

Unfortunately for Mr. Grant, the Civil War brought an end to a promising milling venture in Tucson. In July 1861, retreating Union

troops set fire to the mills and all his merchant property in Tucson. Grant sold what remained of his Tucson properties (including the mills and equipment) to Mr. G.M. Jones, who returned to Tucson and invested in the reconstruction of the second water mill (sources after this time refer only to a single mill operating at Silver Lake). For a brief time (1862–1864), Union troops seized the Silver Lake Mill for military rations and they apparently sold flour to the community at much higher rates. Cosulich reports that James Lee and W.F. Scott finally took control of the Silver Lake mills in 1864.<sup>5</sup> For several years, the partners ran the mill, even after construction of their more efficient steam mill, the Eagle Flourmill, within the town limits of Tucson in 1870. Given the absence of a definitive date, it can only be assumed the Silver Lake Mill was abandoned sometime before, or around, 1900.

Since Grant constructed an entirely new mill adjacent to the original, it would appear the Rowlett Brothers originally constructed a simple horizontal mill that could not be substantially expanded and improved upon. The cost of Grant's new flourmill, and the fact that he hired a miller from San Francisco to equip the new flourmill suggests it was a more complex mill run by a vertical wheel or possibly a turbine. This mill was likely a two-story mill equipped with multiple runs of stone, as well as other milling equipment (bolter, smutter, or rolling screen).

#### **White's Flourmill at the Pima Villages**

Ammi White established a flourmill near the Casa Blanca stage station along the Butterfield Trail in 1860 with his partner E.S. Noyes. Initially arriving at the Pima Villages as a merchant, he has also been described in the literature as a Federal Indian agent chosen to oversee the interests of the Pima and Maricopa tribes, although the position was never officially confirmed.

It is unclear when the gristmill began operating; the earliest reference to the mill was apparently late 1861, when White was advertising a daily capacity of 2,000 lbs. (approximately 10 barrels). The flour produced by White was sold to the local Native Americans, agents of the Overland Mail Company, travelers along the road, and residents of southern Arizona, including Tucson. He also sold wheat in bulk to William Grant, owner of the Silver Lake mills.

Because of the Pima Villages' strategic location along the Butterfield Trail the Casa Blanca mill is mentioned prominently in the literature highlighting the events of the Civil War in Arizona. In March 1862, Captain Hunter and a detachment of Confederates arrived unexpectedly at the Pima Villages, confiscating stores and supplies for redistribution among the local natives. Jack Swilling, with a small party of men, escorted several prisoners, including Ammi White (an ardent Union supporter) to Mesilla. Ammi White was released as a Prisoner of War only after the Union's California Column had acquired control of New Mexico in the final months of 1862 (Arizona was officially designated a Territory of the United States of America on February 24, 1863).

Union troops established Fort Barrett on the property once occupied by White and Noyes shortly before his return in late 1862; as a result, the mill and associated outbuildings were enclosed within the fort. An inventory of buildings ordered by the Union commanders describe the original mill as a single-story building with no indication of a millrace, suggesting it was powered by steam or animal.

Ammi White began producing flour again with the help of the U.S. Army and also began major renovation to his mill; by the summer of 1864, the mill had been completely renovated and was known as the Pima Steam Flourmill. The Pima Steam Flourmill continued to operate as a small-scale merchant mill

servicing peoples of southern Arizona, although settlers in small communities north of the Gila River at times conducted business with White's mill since it was then the northernmost flour milling operation in the Arizona Territory. (Ed: See Territorial Times Vol. 5, No. 2, *An 1865 Trip to Ammi White's Flour Mill*.) The Pima Steam Flourmill was sold to W. Bichard & Co. sometime between 1865 and 1867, after which it operated a short time before Gila River floods destroyed it in late 1868.

The distinction of Arizona's first territorial flourmill belongs to either the Tubac company mill, or Findlay and Sharp's mill on Sonoita Creek (the Silver Lake gristmill in Tucson was completed and operating several months later). A number of writers have recognized other flourmills as Arizona's first without mention of their true pioneer predecessors. Farish asserts that Solomon Warner built the first mill in Tucson.<sup>6</sup> However, Warner's Tucson flourmill was actually built between 1874 and 1875—at least 15 years after the aforementioned flourmills and five years after completion of his close competitor, James Lee's Eagle Steam Flourmill. The Bichard Brothers' mill in Adamsville has also been claimed as the first mill in the territory.

#### **Post-War Milling in Arizona: 1865–1900**

Agricultural development in the pre-Civil-War Era had initially converged around Tucson, Tubac, and Yuma (a.k.a. Colorado City and Arizona City). By the end of the Civil War in 1865, settlement gradually spread along all parts of the major rivers in Arizona Territory. The 1865 *Hartley's Map of Arizona* (Figure 1) provides a visual display of new settlements like Hardyville and Prescott, as well as a number of small ranches and homesteads. By 1870, concentrated settlement had resulted in at least 34 communities in four counties. In this new era of settlement, flourmills appeared in regions with intense agriculture: along the Gila River (Adamsville

and Florence); the Hassayampa and Agua Fria rivers (Walnut Grove and the Agua Fria valley near Prescott); the Santa Cruz River (Tucson); and the Salt River (Phoenix and Tempe). Mormon settlement in northern and southeastern Arizona after 1873 prompted community and agricultural development along the Little Colorado River and its tributaries (Brigham City, Joseph City, St Johns, and Springerville), within the Gila Valley (Safford, Thatcher, Solomonsville), and on the Salt River (Lehi and Mesa). Custom mills were initially constructed to supply the needs of families and small communities. In time, some custom mills would become small-scale merchant mills as their customer base increased.

Most of the region's grain production was centered in the Salt River Valley. The desert lands of the Salt River Valley were first irrigated by Euro-Americans in 1868 from the Swilling Ditch. Within only a few years, at least six major canals had been excavated in the vicinity of Phoenix with an estimated 8,000 acres of land under cultivation. Hamilton summarized it thus:<sup>7</sup>

Maricopa County manufactures nearly three fourths of all the flour produced in the Territory. It has four flourmills in active operation: one at Phoenix [Phoenix Flouring Mills], one three miles east of Phoenix [Salt River Flouring Mill], one on the Grand Canal [Grand Canal Flourmills], and one at Tempe [Hayden Flourmill]. All these mills are supplied with the best machinery and the latest improvements, and turn out a quality of flour preferred by some to the best California.

Archival research has identified at least 44 flourmills established in Arizona Territory between 1865 and 1912 (the Flagstaff mill appears to have been constructed after statehood, around 1920). While every effort was made to identify as many flourmills as possi-

ble, this inventory is not exhaustive; the data collected on Arizona's flourmills as part of this study provides a foundation for further research and documentation. An inventory table summarizing the known flourmills will be available for download on the Prescott Corral website, [www.prescottcorral.com](http://www.prescottcorral.com).

### Arizona's Flour Milling Industry Declines

The number of flourmills declined sharply by the turn of the twentieth century, reflecting the overall national industrial pattern that was influenced by efficiency of new milling technologies. Many of Arizona's mills established after the Civil War were likely custom mills that provided flour for local farmers and settlers. It appears that many of these custom mills operated for a short period of time until mercantile businesses had been established to provide affordable flour from larger merchant mills in the territory. Flourmills established in Mormon communities operated as cooperative enterprises, several of which survived into the early decades of the twentieth century. The bulk of flourmills that operated into the twentieth century were merchant mills (small-scale and large enterprises). Reflecting national trends in the flour milling industry, these merchant mills managed to compete in the twentieth century only by converting to new milling technologies. Even so, before the end of the 1960s, the Hayden Flourmill was the only operating merchant mill in Arizona, distributing its well-known brands of flour throughout the state.

The Hayden Flourmill ceased operations in 1998, after more than 120 years of operation, but the Hayden Mill name lives on. Recently, a Phoenix entrepreneur purchased the rights to the Hayden Flourmill name and the best known of its brand names, *Arizona Rose*. They currently are producing flour from heirloom Arizona wheat on an imported electric stone mill located in downtown Phoenix at Pane Bianco.<sup>8</sup>



### Illustration Credits

Figure 1: Portion of Hartley's 1865 Map of Arizona showing locations of water mills operating between 1859 and 1865 (supplemental text and graphics by author).

Figure 2.: West-facing sectional view of the Mission San José gristmill. This sectional drawing shows the typical components of a Spanish Mill, including the reservoir, wooden flume, horizontal wheel, vertical shaft, and millstones.

Figure 3: Mexican burro-powered flourmill. Photograph by William Dinwiddie November 8, 1894 (Special Collections: CP-SPC 58-3 Arizona State University, Hayden Library Arizona Collection).

Figure 4: Mortars, a metate fragment and two millstones (molinas) collected during archaeological investigations at Tumacácori National Park. Photograph courtesy of Tumacácori National Park, National Park Service.

### ENDNOTES

---

<sup>1</sup> Vargas, V.D., et al., *Hayden Flourmill: Landscape, Economy, and Community Diversity in Tempe, Arizona*. Vol. 1: Introduction, Historical Research, and Historic Architecture. Cultural Resources Report No. 143. 2008, Tempe: Archaeological Consulting Services.

<sup>2</sup> Cosulich, B., *Tucson*. 1953, Tucson: Arizona Silhouettes.

<sup>3</sup> Davis, W.H.H. *El Gringo; or New Mexico and her People*. Harper and Brothers, New York, 1857.

<sup>4</sup> Dobyns, H.F., *Tubac Through Four Centuries: An Historical Resume and Analysis*. Prepared for the Arizona State Parks Board, in *Manuscript on file, Arizona Collections, Arizona State University*. 1959: Tempe.

<sup>5</sup> Cosulich, B., *Tucson*. 1953.

<sup>6</sup> Farish, T.E., *History of Arizona*, 1918, San Francisco: Filmer Brothers Electrottype Company.

<sup>7</sup> Hamilton, P., *Resources of Arizona*. 1881, Prescott: Legislative Assembly of the Territory of Arizona.

<sup>8</sup> *Arizona Republic*, Sunday, July 22, 2012.