Quartz Milling Technology

In the 1860s, treatment of quartz-bearing ores containing gold and silver involved breaking the ore into fine enough form that the gold would be separated from its ore and amalgamated with quicksilver (mercury). This process is known as "free milling." The simplest method for accomplishing this was the arrastra, an ancient Spanish device consisting of a circular bed of flat rocks enclosed in a retaining wall. Two or more large boulders were placed in it and attached to one end of a horizontal beam whose center was fixed to a pivot in the middle of the circular bed. Power was applied with a mule or waterwheel power to the opposite end of the horizontal beam and the boulders were dragged over broken-up ore and quicksilver. After some days of dragging, the ore would be pulverized sufficiently for amalgamation to take place (Watkins 1971:193).

Impatience with this system led to the use of the stamp mill. This contrivance consisted of a series of two or more vertical iron-headed pestles (or "stems") driven by a cam shaft that raised and plunged them into mortars (or "batteries") (Watkins 1971:193).

> [T]all upright rods of iron, as large as a man's ankle, and heavily shod with a mass of iron and steel at their lower ends, were framed together...and these rose and fell, one after the other, in a ponderous dance, in an iron box called a 'battery.' Each of these rods or stamps weighed six hundred pounds. One of us stood by the battery all day long, breaking up masses of silver-bearing rock with a sledge and shoveling it into the battery. (Twain 1871:192)

The ore was placed in the batteries, mixed with quicksilver, and after having been crushed, was either cleaned out by hand or flushed out by water (Watkins 1971:193).

> The ceaseless dance of the stamps pulverized the rock to powder, and a stream of water that trickled into the battery turned it to a creamy paste. (Twain 1871:192)

Then the mixture was run over a collection surface, often riffle tables, or any number of other devices designed to extract as much gold as possible (Watkins 1971:193).

> The minutest particles were driven through a fine wire screen which fitted close around the battery, and were washed into great tubs warmed by superheated steam--amalgamating pans, they were called. (Twain 1871:192)

A device developed in conjunction with the stamp mill was the grinding "pan," a kind of mechanical arrastra some 4 or 5 ft across, which put stamped ore through another grinding process to further reduce it and increase the quantity of amalgamated gold. This pan figured prominently in the development of one of the West's major contributions to the technology of working gold and silver ores: the "Washoe Pan Process" of the Comstock (Watkins 1971:194).

The Washoe Process was commonly used on the Comstock and in Washoe Valley, and was the system employed at the New York quartz mill. After passing through the ore breaking stamps,

pulverized ore was dumped into iron pans. Heavy iron mullers were added to grind the ore to a fine powder, then quicksilver was introduced along with salt and copper sulphate (Watkins 1971:194).

> The mass of pulp in the pans was kept constantly stirred up by revolving 'mullers.' A quantity of quicksilver was kept always in the battery, and this seized some of the liberated gold and silver particles and held on to them; quicksilver was shaken in a fine shower into the pans, also, about every half hour, through a buckskin sack. Quantities of coarse salt and sulfate of copper were added from time to time to assist the amalgamation by destroying base metals which coated the gold and silver and would not let it unite with the quicksilver. (Twain 1871:192-193)

Next, the mixture was heated with steam as the mullers stirred it about. After the pans, the mix was carried into an elaborate system of settling basins and other devices designed to separate the silver amalgam from the base rock. Afterward, that the quicksilver was vaporized (Watkins 1971:197).

> Streams of dirty water flowed always from the pans and were carried off in broad wooden troughs to the ravine. One would not suppose that atoms of gold and silver would float on top of six inches of water, but they did; and in order to catch them, coarse blankets were laid in the troughs, and little obstructing 'riffles' charged with quicksilver were placed here and there across the troughs also. These riffles had to be cleaned and the blankets washed out every evening, to get their precious accumulations. (Twain 1871:193)

Potential historic structures, artifacts and features which can be expected to be found at nineteenth century milling sites include: the gravity mill building, rock crusher, grizzly, stamp mill, separators, agitators, pans, tailings dump, steam power plant, and firewood (Hardesty 1986:52).

Historic Overview

Franktown, located on the west side of picturesque and fertile Washoe Valley, was one of the earliest places settled by whites in western Utah Territory. Several Mormon families located farms there as early as 1848, constructing hewn log cabins and crops irrigated with channels built out from Washoe Lake (Kelly 1962:95). Franktown was the site of the first saw mill in the valley. Owned by J. Rose, it was still running in 1862, and along with several other valley saw mills, provided much local employment (Kelly 1962:99-100). As settlers moved in to the valley, the Washoe Indians were relegated to living miserably on the edges of the new settlement (Ratay 1984:11).

From the time of the discovery of the Comstock Lode at Mount Davidson to the east of Washoe Valley in 1859, reduction of its rich quartz-bearing ores to extract silver and gold posed a difficult problem. Mexican miners first employed stone arrastras for crushing ore, but Comstock miners were too impatient to use this slow, ancient method. In the early months of the discovery, the ore was mule-freighted across the Sierra Nevada to San Francisco. This proved to be another laborious, time-consuming and expensive undertaking which was unsuited to large scale development.

By 1860, several of the mining district's largest operators were constructing quartz ore reduction mills at Virginia City. The first quartz mill was constructed by Almarin B. Paul consisting of 24 stamps and 24 pans and initiated the "Washoe Pan Process." These mills, however, required power generated

by cord wood burned as fuel for steam boilers. Again, expensive and time-consuming freight hauling from the forests of the Sierra Nevada was required to obtain the cord wood and the miners found it impossible to bring the timber to the mills in sufficient quantities (Murbarger 1983:88).

The Comstock miners reached a compromise solution by locating the quartz mills in the Washoe Valley between Mount Davidson and the Sierra Nevada. The Washoe Valley was an ideal milling site because the cord wood fuel could be freighted downgrade from the Sierra Nevada forests to the west and the ore could be freighted downgrade from the Comstock mines to the east, "virtually a gravity haul for both commodities" (Murbarger 1983:88). The largest quartz mill constructed in Washoe Valley to process the Comstock ore was the Ophir Mill which employed about one hundred men in 1862 (Kelly 1962:100). Its buildings covered over an acre of ground and its technology was state-of-the-art for the decade. It crushed over 100 tons of rock each day with 36 stamps driven by a steam engine with 100 horsepower (Kelly 1962:100).

With the construction of mills in Washoe Valley, two towns developed on the shores of Washoe Lake: Ophir on the west shore and Washoe City at the lake's north end. A company was established to bring potable water to Washoe City (Washoe Lake being too alkaline for human consumption) and its officials claimed that the supply from surrounding mountain streams was "enough to provide for all the mills that could be built for years to come" (Ratay 1984:11). The Atchison brothers were the first to construct a quartz mill in Washoe City. They began building their water-run, sixteen stamp mill in 1861 near the outlet of Little Washoe Lake (Ratay 1984:11).

The New York quartz mill on the eastern shore of Little Washoe Lake was powered by steam, ran 24 stamps, and cost $100,000 to construct. Construction began in 1861, and after subsequent flood damage, the mill was rebuilt and enlarged in 1863. The mill structures housed a deep water well, company offices and sleeping quarters for the mill hands (Ratay 1984:11). The water in Little Washoe Lake was very alkaline and, although it might have been used to make the steam to power the mill, it was not pure enough to have been used in the amalgamation process to extract the gold and silver from the quartz-bearing ores. Instead, water from a deep well was used in the stamp mill to process the valuable metals.

By 1861 Washoe City, located across Little Washoe Lake from the New York quartz mill, had become the largest community in the valley. When Nevada officials met that year to form a territorial government, Washoe City was designated the seat of Washoe County in November (one of the nine original political subdivisions into which the new territory was divided). By 1863 Washoe City boasted a brick courthouse, a jail and hospital, as well as schools, churches and many types of business enterprises (Murbarger 1983:89). Its post office was established on July 7, 1862 (Frickstad 1958). During the middle 1860s, Dyers' stagecoach line ran daily between Carson City and Washoe City, arriving in Washoe City (Nevada State Historical Society 1920:31). The town boomed for 10 years, boasted 2000 citizens at its zenith, and four newspapers: *The Times*, *The Old Pah-Utah*, *The Eastern Slope*, and *The Weekly Star* (Murbarger 1983:90).

In his *History of Nevada* compiled in 1913, Samuel P. Davis described a Colonel Avery as the manager of the New York and Manhattan quartz mills (Davis 1913:1026). Dean B. Lyman worked as the foreman at the New York quartz mill for many years,

> and while so engaged gained such a reputation as but few men ever get in this world, giving entire satisfaction to his superiors, while those under his command regarded him

> as a just task master, and he was liked accordingly. In making out their statement of property to the Assessor in 1863 the general management tried to evade a just assessment and asked Lyman to make the necessary affidavit. Dean looked at the figures and said: 'If you want these figures verified do it yourselves; I won't.' (Davis 1913:1026)

At Washoe City, six-to-eight quartz mills were under construction or commencing operations in 1862. The combined power of these mills was over two hundred stamps and could crush two hundred tons of rock daily. They were driven by water taken through a ditch cut from Washoe Lake (Kelly 1962:101).

Comstock historian Grant H. Smith quoted a correspondent from the *Alta California* newspaper in 1862 who described seven quartz mills in the Washoe Valley built to handle ore freighted from Virginia City. Smith also detailed the disastrous winter of 1862-1863 when a heavy snowfall followed by "unprecedented rains" in December filled all the ravines and canyons with torrents of water. Washoe Valley's quartz mills were damaged or washed away and the Ophir mill was "nearly drowned out" (Smith 1943:25). Although construction was begun on the New York quartz mill in 1861, it was undoubtedly damaged in this deluge and a reconstruction occurred in 1863.

In 1863 James Pressley Yager, a 29-year-old native of Kentucky, crossed the Great Plains and the Rockies in a wagon train to arrive at Washoe City on Tuesday, September 8. His journal revealed that he was working at the New York quartz mill by Sunday, September 13, 1863 after working as a wood cutter at the Manhattan Mill in Allan Canyon between Pleasant Valley and Washoe Valley. He described the process of reconstruction at the New York quartz mill after the flood damaged the original 1861 mill (Yager 1971:33-34).

> I am now at the new mills building by Mr. Avery & Co what is called the New York & Nevada Mining Company. This mill is to have sixteen stamps or four batteries & when completed will cost about one hundred thousand dollars. Washoe City is quite a town, situated in the lower end of Washoe Valley at the upper end of Allans Kanyon & one mile from these mills. ... The population of Washoe City is about seven hundred. It has many business houses, two quartz mills, Atchisons & Norths, livery stables & a big proportion of gambling saloons & drinking houses. It has one weekly paper the Washoe Times. (Yager 1971:34) (Spelling as in original.)

The demise of the quartz mills in Washoe Valley and Washoe City began when the Virginia and Truckee Railroad began hauling Comstock ores to mills on the Carson River at a rate far cheaper than freight wagons could make the trip down the twisting grade into Washoe Valley. Along with the loss of milling business, Washoe City received competition from the new community of Reno to the north which had been established in 1868 as a Central Pacific Railroad station. Even Washoe City's newspaper, *The Eastern Slope*, relocated to Reno and becoming that town's first periodical, *The Evening Crescent* (Murbarger 1983:90).

Milling and lumbering activity faltered in the region surrounding Washoe City as early as 1865 (Paher 1970:43). By 1868, the New York quartz mill was sold, along with the Manhattan Mill, to the Union Mill and Mining Company, a Bank of California affiliate (Ratay 1973:410). With the advantage of the railroad, Reno grew so rapidly that its citizens launched a movement to acquire the county seat, and when the issue was brought to a vote in 1870, Reno swung the election. With the change approved by the state legislature in 1871, citizens of the dying mill town at Washoe City watched disconsolately

As workmen demolished their brick courthouse which had been the pride of the valley for ten years (Murbarger 1983:90). Bricks salvaged from the courthouse were hauled to Reno to be incorporated into that town's new jail building (Murbarger 1983:91).