AMERICAN FLAT MILL
(Comstock Merger Mine Mills)
Gold Hill vicinity
Storey County
Nevada

HAER NV-48
HAER NV-48

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
PACIFIC WEST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
333 Bush Street
San Francisco, CA 94104

HISTORIC AMERICAN ENGINEERING RECORD

AMERICAN FLAT MILL
(Comstock Merger Mine Mills) HAER No. NV-48

Location: One mile northwest of Silver City, Storey County, Nevada. The American Flat Mill is located at latitude: 39.27067, longitude: -119.66218. The coordinate represents the approximate center point of the American Flat Mill property. This coordinate was obtained on December 6, 2014, by plotting its location with Geoplaner V2.7 (www.geoplaner.com). The accuracy of the coordinate is +/- 1 meter. The coordinate's datum is WGS 84 (World Geodetic System 1984). There is no restriction on releasing the location to the public.

Present Owner/ Occupant: United States Department of Interior, Bureau of Land Management (BLM).

Present Use: Vacant.

Significance: The American Flat Mill is significant under National Register Criterion A for its historical importance as the last remaining remnant of what was once the United Comstock and the Comstock Merger mining operations. The mill and its associated mining activities represented the last large scale underground mining efforts on the Comstock. Other early twentieth century mining activities on the Comstock were either much smaller in scale, or reflected the use of alternate technologies such as open pit mining or dredging. The American Flat Mill is also a contributing element to the Virginia City National Register District under Criterion A.

The American Flat Mill is eligible for listing on the National Register under Criterion B at the local level due to the early and active participation of Royce Hardy and Alex Wise. These two local men were mining engineers who were involved in

the formation of the United Comstock Mines Company and worked with the company until its demise in 1923. Wise began developing the "middle mines" which became a key part of the Comstock Merger operation. The American Flat Mill is the largest remaining physical reflection of their actions on the Comstock.

The American Flat Mill is eligible for the National Register under Criterion C at the national level as an early representative of the International Style of architecture, which stressed the metaphor of form following function, rejection of ornament and use of modern building materials including reinforced concrete, structural steel and large window panels. All of these characteristics are strongly expressed throughout the American Flat Mill.

Historian: Written historical and descriptive data and large-format photographs were prepared by David C. Berg, historian for The Ottery Group in August through December of 2014.

Project Information: HAER documentation of American Flat Mill is part of the measures to mitigate the adverse effect that will result from demolition of all buildings at the site. The BLM has proposed the demolition of the mill for public safety reasons.

PART I. HISTORICAL INFORMATION

A. Physical History

1. **Date of Erection:** 1921-22.

2. **Engineer:** Walter L. Reid, consulting milling engineer; A. J. Weinig, metallurgist; Lee L. Fillius, superintendent of construction; B. P. Little, chief

draftsman in charge of engineering office; and Robert McFarland Doble, in charge of power and electrical engineering.

3. **Original and Subsequent Owners, Occupants, Uses:** United Comstock Mines Company, 1922-24; Comstock Merger Mines, Inc.(subsidiary of Gold Fields America Development Company/New Consolidated Gold Fields, Ltd., of London), 1924-26.

4. **General Contractor:** United Comstock Mines Company.

5. **Original Plans and Construction:** Although original plans of the mill are no longer extant, selected plans, operational flow charts and process descriptions are found in contemporary mining publications including *Mining and Metallurgy* and *Engineering and Mining Journal.* The mill as built consisted of a coarse crushing plant, a fine grinding and concentration plant and the cyanide plant. Mill support facilities included the ore bin, conveyor gallery, substation, machine shop, plate or blacksmith shop, warehouse, precipitation and refining building, and assay office.

   Photographs of the mill during operation may be found at the Nevada Historical Society, Special Collections. Additional photographs exist in a private collection held by Joseph Curtis of Virginia City, NV. Original views show an orderly industrial site with the Fine Grinding and Concentration Plant and Cyanide Plant both visually dominating the site. Worker accommodations and other buildings are visible north and west of the mill. These range from large, two-story houses to canvas covered temporary structures.

6. **Alterations and Additions:** None known.

B. Historical Context

The American Flat Mill's history began in 1919 with the efforts of local mining engineers, Alex Wise and Roy Hardy (a graduate of the Mackay School of Mines, Reno), who, with the financial backing of local rancher and banker Herbert Humphrey, began to acquire leases to local mines on the south side of the Comstock

lode. At the time, metal prices were on the rise due to shortages brought about by World War I. Silver rose from $0.67 per ounce in 1916 to $1.12 per ounce in 1919. Combined with a general advancement of mining technology, this created a new interest in the Comstock mines not seen since the late 1800s.[1]

After some initial investigation into the Imperial Mine at Gold Hill, Wise and Hardy believed there was ore of sufficient quality and quantity to construct a processing mill and they approached representatives of prominent American businessman Harry Payne Whitney of New York with the idea of developing all of the Comstock's South End properties. Whitney sent Bulkeley Wells to look over the prospect. Wells had been manager of the Smuggler Union Mine in the Telluride District of Colorado and was notorious for his strike busting techniques there. After Wells made a recommendation in favor of the venture, Wise and Hardy quickly purchased the Alpha, Imperial, Confidence, Challenge, Yellow Jacket, Crown Point, Belcher, Segregated Belcher, Overman, and Keystone Mines in the Gold Hill Area. These properties were part of the estate of Nevada Senator William Sharon.

In 1920 the United Comstock Mines Company was organized as a subsidiary of Whitney's Metals Exploration Company by merging the companies acquired by Hardy and Wise. The Metals Exploration Company was a syndicate of wealthy investors including Harry Payne Whitney, Harry Sinclair, and Daniel Guggenheim. Wells acted as president of the new company, Humphrey as vice president, and Hardy as general manager and resident engineer. Nevada banker and miner George Wingfield, an associate of Roy Hardy, was also involved in the venture. When the Gold Hill mines were reopened and sampled, the company estimated ore reserves to be 4 million tons of $6.00 (per ton) ore, largely in the Imperial Mine above the 400' level.

The United Comstock Mines Company plan was to build a tunnel connecting all their holdings and convey by 30" mine gauge rail, all the low grade ores to a cyanide processing mill. By March 1922, a 9,585' tunnel was completed from the adit in American Flat to the Knickerbocker Shaft and the Imperial Mine in Gold

1 Except when noted, historical context is excerpted from: Charles Zeier, Michael Drews and Ron Reno, "An Architectural and Archaeological Inventory of the American Flat Mill, Storey County, Nevada" (Clinton, Tennessee: Zeier and Associates, 2009.)

Hill. When begun, the mill was to have a 1,000 ton-per-day capacity, but this was soon raised to over 2,000 tons-per-day. This made it the world's largest ore processing mill for its time. The company constructed two boarding houses, one at Gold Hill and one in American Flat. Each boarding house accommodated 500 men. In addition, about 50 small houses were built to house workers in an area that came to be known as the town of Comstock. The houses were pre-fabricated and shipped to American Flat on the Virginia and Truckee (V&T) Railroad. Other buildings included an office building, a school house, a general store and an amusement hall. To connect the mill with the V&T Railroad, a two-mile long spur was constructed. Power came from an electrical transmission line constructed between Lake Spaulding, California, and the mill. Capital investment by United Comstock Mines Company for the mill and all associated facilities was estimated at $5,000,000.

The American Flat Mill began processing ore on September 23, 1922. Ore was hauled through the tunnel using an electric locomotive which could pull up to twelve ore cars. Twelve cars could haul about 6,500 ton of ore in a 24 hour period. Under normal conditions, two trains operated simultaneously.

The operation was plagued with problems from the outset. Most significantly, the value of the ore was overestimated. From the beginning, ore from the Comstock was generally of poor quality, causing costs per ton to be higher than anticipated. The mine did not operate to capacity due to insufficient supply of ore. In August of 1923, Bulkeley Wells resigned as managing director of the Metals Exploration Company and as president of the United Comstock Mines Company. Not long after production began, the price of silver began to drop. In 1924, silver dropped from $1.00 an ounce in 1920 to about 67 cents an ounce. By 1926, the price of silver was about 62 cents. Alex Wise began consolidating properties to the north of those held by the United Comstock. He sold his leases to Gold Fields America Development Company which was controlled by New Consolidated Gold Fields of London. The new operation, known as the Comstock Merger Mines, extended the haulage tunnel to access the northern claims and continued operation of the American Flat Mill. These additional mines included the Bullion, Best & Belcher, Savage, Gould & Curry, Exchequer, Caledonia, Chollar, Potosi, Hale & Norcross, Lady Washington, and Alta lodes. These properties were known as the Middle Mines.

The Comstock Merger Mines continued to produce silver from both the South End and Middle Mines until 1926, when on October 19, 1926, the Comstock Merger Mines posted a closure notice. Mine operations ceased in December of that year. Shortly after operations ceased, all of the machinery was sold to the Morse Brothers Machinery and Supply Company who stripped everything out of the mill buildings.[2]

PART II. SITE INFORMATION

A. General Description

1. **Character:** As constructed, the American Flat Mill represented industrial buildings in the International Style. This style emerged in Europe after World War I as a drive for simplicity in form led by architects such as Walter Gropius, Charles-Édouard Jeanneret-Gris (AKA Le Corbusier), and Mies van der Rohe. In America, early participants in this movement included Frank Lloyd Wright, Louis Sullivan, and Irving Gill.

   The International Style was based on modern engineering principals and materials. Concrete, glass, and steel were the primary materials and the unadorned, utilitarian factory was the resulting aesthetic. The International Style developed as a functional, stark, unadorned style, eliminating moldings and making doors and windows flush with the surface. The American Flat Mill buildings strongly expressed these ideals. The two crushing plants had extensive horizontal bands of concrete and alternating horizontal bands of windows made possible by new Fenestra steel sashes. These elements were also utilized to a lesser degree in other buildings on site.

   The mill had little ornamentation and this emphasized the structural forms of the buildings. Repetition of identical elements are present in the recurring columns of the Fine Grinding and Concentration Plant and in the

2 Morse Brothers Machinery and Supply Company. "Mining and Milling Machinery of The Comstock Merger Mines and Mills at Virginia City, Nevada" Catalog by the Morse Brothers Machinery and Supply Company, Denver, Virginia City, Reno, ca. 1927. Located in the Special Collections and University Archives, University of Nevada, Reno.

skeletal nature of the Coarse Crushing Plant and Cyanide Plant. These characteristics are further enhanced by the scale of the mill, which was massive for a concrete building of the time. It has been noted that the Ford Motor Company's Highland Park Plant, designed by Albert Kahn in 1908, is very similar in design to the Fine Grinding and Concentration Plant of the American Flat Mill.

Although the roofs and windows are no longer extant on any of the buildings, the unadorned skeletal forms of the buildings, the emphasis on function and simplicity and the horizontal lines all strongly portray these essentials of the International Style. The most remarkable aspect of the presence of these strong International Style elements in the mill is that the style was not generally utilized by American architects until the 1930s. The first major commercial building of the International Style was the Philadelphia Savings Fund Society, built in 1929-1932. The fact that the American Flat Mill was not designed by a well-known architect and was merely a mining facility in the desert may have caused it to escape notice as an early and significant example of the International Style.

2. **Condition of Fabric:** The eight mill buildings are in various states of decay and almost appear as ancient Greek or Roman ruins. As part of salvage efforts soon after the mill's close in 1926, all machinery and metal was removed from site. This included the railroad spurs, building structural members, wall and roof materials, windows and even any useable wood. All that remains are the decaying foundations and reinforced concrete walls. None of the buildings that comprised the company town, the Town of Comstock, remain. They were all either demolished or moved to other locations.

B. Site Layout

1. **Site:** The American Flat Mill consists of the concrete remains of eight mill buildings set on seven acres of a level plain known as American Flats. It is located approximately 1-1/4 mile south of Gold Hill and 3/4 mile northwest of Silver City in Storey County, Nevada.

Surrounded by hills on all sides, the site is a relatively barren plain with sage and small pines scattered upon the landscape. The primary access to the mill is via a dirt road from the north. Some historic roads are present north and southwest of the site but others have been covered by tailings from subsequent mining operations. Although the tracks are no longer extant, evidence of the several V&T Railroad spurs that led to the mill are still present near the center and east end of the site. The main line of the V&T Railroad is still in use and runs about 3/4 mile north and west of the mill site. East of the mill site on the bank of a hill, lies a rock quarry from which aggregate was mined for use in concrete during construction of the mill.

2. **Buildings:** The buildings of the mill were sited for maximum efficiency of work flow. Ore traveled from mines located to the north by electric railway car through the tunnel which terminated at the Ore Bin located at the northeast corner of the mill site. Directly adjacent to the southwest side of the Ore Bin stood the Coarse Crushing Plant. Coarse crushed ore would be conveyed 200' southeast to the Fine Grinding and Concentration Plant where it would be further ground and treated. The Cyanide Plant occupied 2-1/4 acres about 80' southwest of the Fine Grinding and Concentration Plant, connected by a series of tunnels to that building.

   Support structures, including the Assay Office, Precipitation and Refining Building and Warehouse, were situated 50' north of the Cyanide Plant. The electrical Substation stood between the Coarse Crushing Plant and the Fine Grinding and Concentration Plant.

3. **Machinery:** All machinery and equipment associated with the mill was removed upon closure in 1926.

Part III. OPERATIONS AND PROCESS

A. Operations

Mine ore was delivered to the Ore Bin via a nearly 10,000' long underground tunnel. Electric railcars dumped ore into a large

revolving tipple where it entered a concrete receiving bin below. Mine ore was delivered to the Coarse Crushing Plant via a 48" Stephens-Adamson pan conveyor with wood-cushioned pans to two Allis Chalmers No. 7-1/2 Gates gyratory crushers. The ore fell to the lower level of the building to a 30" conveyor that brought the ore to a set of 72" Garfield rolls, driven through a countershaft by a 200 horsepower motor. After passing through two Mitchell screens, the ore then went through two sets of 54" Garfield rolls, one driven through a countershaft by a 150 horsepower motor and one by a 200 horsepower motor. Once through these Garfield roll crushers, the ore passed through four additional Mitchell vibrating screens. Sampling of ore was done at this point and reject ore was fed back to the conveyors for additional crushing. Acceptable product was sent by a 250' belt conveyor through a "weightometer" and into fine ore bins of 3,200 tons capacity at the Fine Grinding and Concentration Plant.

In the Fine Grinding and Concentration Plant, the ore traveled through one of ten 56" Akins classifiers for primary wash to remove soluble salts and then to five 7' x 6' Allis Chalmers ball mills for further crushing. The ore traveled up one of two 65' high bucket elevators to tables where the ore was mixed with a strong cyanide solution. The resulting concentrate travelled to a 5' x 12' ball peb mill for re-grinding the concentrate. A 3' x 6' ball mill ground lime to add to the concentrate. Two Dorr bowl classifiers then separated ore to be re-ground in the middling ball mills. The resulting product was sent through underground conveyor tunnels to the Cyanide Plant.

Due to the variety in the size of the product produced by the mill, it was impractical to use a single method in applying cyanide solution to the ore. Therefore, the grindings were classified into two products: sand, which was sufficiently coarse to allow a solution to percolate through it by gravity, and slime, or the finer particles only separated by either agitation or pressure.[3] The Cyanide Plant had an array of 40 redwood mixing, leaching and thickening tanks. At this point, air compressors introduced low-pressure air into the ore mixtures in order to add oxygen to the solution, which was necessary for an efficient chemical reaction. The Cyanide Plant was set into cut-and-fill terraces that facilitated gravity flow of the sand and slime solutions.

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3 E. M. Hamilton. *Manual of Cyanidation*, (New York: McGraw-Hill Book Company Inc., 1920): vii, 88.

Output from the cyanide process was sent to the filter or tank house located at the northwestern corner of the Cyanide Plant. The slime would be placed in hoppers at the top of the tanks and filtered by gravity. Product from the tank house was delivered to the Precipitation and Refining Building where the gold and silver were extracted from pregnant cyanide solution. The refining building held two rectangular tanks and housed four Merrill-Crowe presses that precipitated the silver using the zinc dust method. In this process, also known as the Merrill-Crowe process, zinc replaces the gold and silver in solution and thus the precious metals precipitate out. The precipitate was then heated in a oil fired reverberatory furnace and poured into molds to produce ingots. The extracted metals were held in the bullion vault located in the Precipitation and Refining Building.[4]

B. Technology

Early methods utilized in the United States for reducing silver ore included direct smelting, where dry ore was mixed with lead or copper and smelted in a blast furnace. Amalgamation was also used. This process combined the ore with copper sulfate and mercury. The copper would reduce the silver and the mercury would then form an amalgam which could then be refined by heating. In the 1800s, the "Augustin Process" was often used, in which ore was first roasted with common salt, leached in a strong brine solution, and then precipitated with copper. This process was time consuming but generally had a high recovery rate.[5]

American Flat Mill utilized a process called Cyanidation or Leaching. This process was developed in the 1890s and involved the use of sodium or potassium cyanide to dissolve the silver and then aluminum or zinc to precipitate the metal. The ore was first sent through a series of crushing and milling operations that ground the ore to a fine powder while the leaching solution was introduced. The slurry of powdered ore and leaching solution flowed to a series of leach tanks to provide sufficient time for the leaching action to take place. The control of pH in the cyanide leach solution was critical both from a safety and cost viewpoint. The process added cyanide to solution in the form of sodium cyanide (NaCN). The

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4 Walter L. Reid, "Design and Construction of the United Comstock Mills," *Mining and Metallurgy* 191 (1922): 44-47.

5 John L. Bray, *The Principles of Metallurgy* (Boston: Ginn and Company, The Athenaeum Press, 1929), 359-363.

resulting reaction produced hydrogen cyanide gas, which is lethal in a concentrated state. The reaction also had an economic concern because the release of hydrogen cyanide gas caused greater losses of cyanide into the atmosphere, never to be recovered. Keeping the pH range between 11 and 12 with lime kept this loss to a minimum, keeping down costs and protecting workers. The lime was added during the fine grinding process. It was important to keep sufficient oxygen in the ore slurry as it was a key component in the chemical reaction. A deficiency in dissolved oxygen slowed the leaching rate. Oxygen was introduced with aerators powered by large air compressor during the time in the leaching tanks. After settling out most of the liquid in the filtration and thickening areas, the product was precipitated using the Merrill-Crowe process where zinc powder was added to cause a precipitation of silver and gold.[6]

PART IV. SOURCES OF INFORMATION

A. Architectural Drawings

Selected drawings depicting process flow charts, plans and sections of buildings at the mill may be found in: George Young, "New Treatment Plant of United Comstock Mines," *Engineering and Mining Journal* 114 (1922): 846-853.

B. Early Views

Early views of the American Flat Mill are available from the Nevada Historical Society, Special Collections and University Archives Photographs at the University of Nevada, Reno. The views range in date from approximately 1922 to 1926, with some later views dating from the 1940s and 1950s, representing a total of 86 views. An additional private collection owned by Mr. Joseph Curtis of Virginia City represents approximately 50 views of the mill during its operating years. Some unique views of the ore tipple and machinery may be found in George Young, "New Treatment Plant of

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6 A. J. Weinig, "A General Study of United Comstock Metallurgy," *Papers Related to the Geology, Mining, Metallurgy and Milling of the Comstock Orebodies of the United Comstock Mines Company,* (San Francisco: American Institute of Mining and Metallurgical Engineers, 1922): n.p.; John L. Bray, *The Principles of Metallurgy* (Boston: Ginn and Company, The Athenaeum Press, 1929), 357-359.

United Comstock Mines," *Engineering and Mining Journal* 114 (1922): 846-853. One aerial view of the mill ruins from 1947 is available from the University of California, Davis, in the Eastman's Originals Collection, Department of Special Collections, General Library.

C. Interviews

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D. Selected Sources

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Lincoln, Francis Church. *Mining Districts and Mineral Resources of Nevada.* Reno: Nevada Newsletter Publishing Company, 1923.

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Reid, Walter L. "Design and Construction of United Comstock Mills," *Mining and Metallurgy* 191 (1922): 44-47.

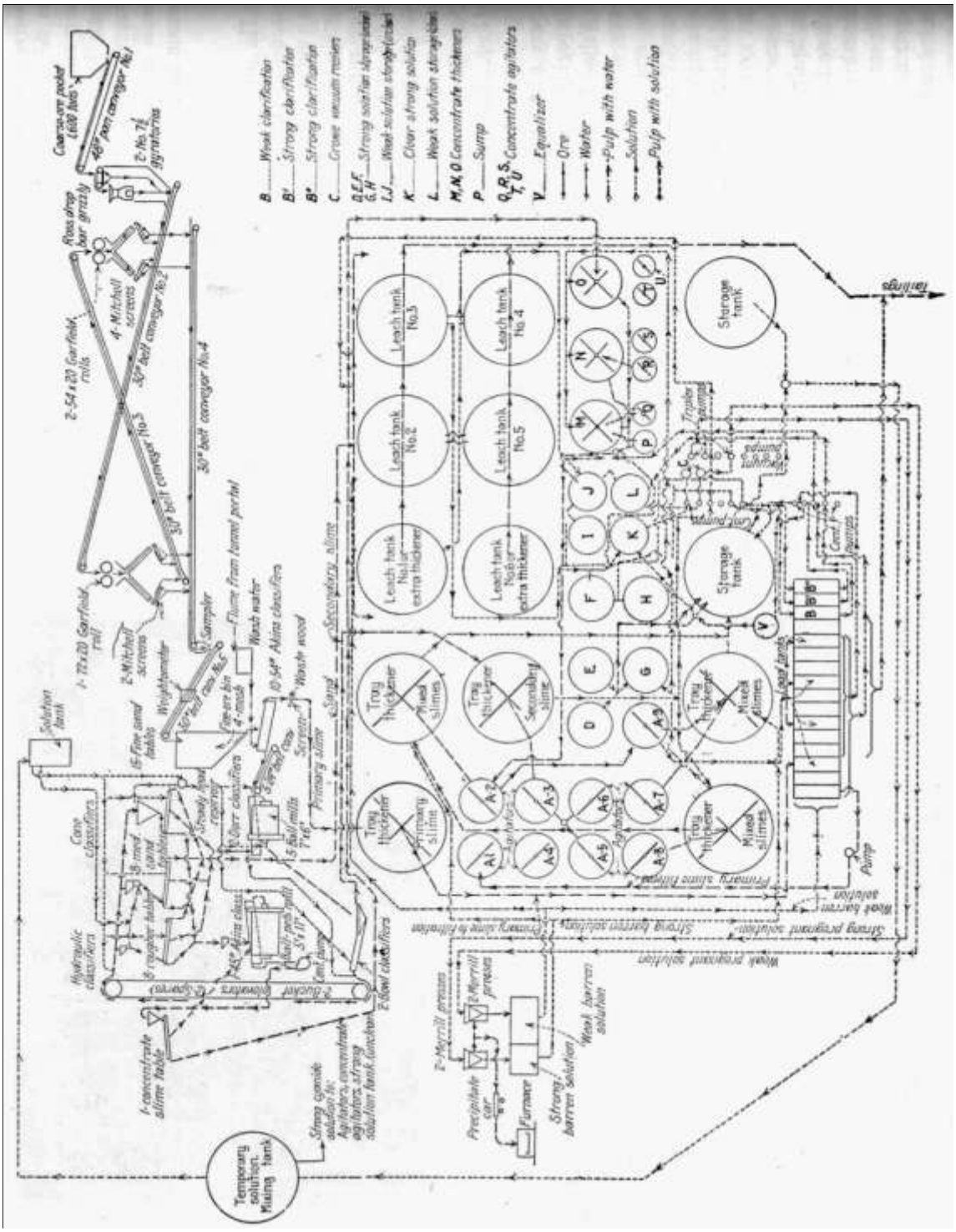
Weinig, A. J. "A General Study of United Comstock Metallurgy," in *Papers Related to the Geology, Mining, Metallurgy and Milling of the Comstock Orebodies of the United Comstock Mines Company*, San Francisco: American Institute of Mining and Metallurgical Engineers, 1922.

Young, George. "New Treatment Plant of United Comstock Mines Company," in *Engineering and Mining Journal* 114 (1922): 846-853.

Zeier, Charles, Michael Drews and Ron Reno. "An Architectural and Archaeological Inventory of the American Flat Mill, Storey County, Nevada." Clinton, Tennessee: Zeier and Associates, 2009.

E. Likely Sources Not Yet Investigated

Newspaper clippings on file at the Nevada Historical Society, Subject Card Index: "American Flat".



American Flat Mill Flow Diagram (Young 1922, 848)