

# Chapter 7

## A History of the Mines at Tiger

©1991 by Kim K. Howell

The former mining camp of Tiger is located approximately three miles southwest of the town of Mammoth in Pinal County, Arizona. A part of the old townsite is now covered by the leach pads and solvent extraction-electrowinning facilities of Magma Copper Company, immediately adjacent to its San Manuel Mine. Since 1953, Magma has owned the townsite and mines of Tiger.

The reason for the enduring interest in Tiger is not so much the dollar value of the metals produced from its mines as it is the chemical and mineralogical complexity of its ores, which led to the camp being at various times a gold producer, a molybdenum producer, a molybdenum-vanadium-lead producer, and a lead-zinc-silver producer. Above all, Tiger is known as the source of rare and beautiful mineral specimens. Of the 89 mineral species known to occur at Tiger, 15 are virtually unique to that locality, having been found at no more than five other places in the world. Two minerals have been found nowhere else, and seven minerals were first discovered in specimens from Tiger. These lists may continue to grow as new minerals are discovered in material collected long ago.

The various mines at Tiger had a combined production of approximately 400,000 ounces of gold; 1,000,000 ounces of silver; 3,500,000 pounds of copper; 75,000,000 pounds of lead; 50,000,000 pounds of zinc; 6,000,000 pounds of molybdenum oxide; and 2,500,000 pounds of vanadium oxide. The value of this production was approximately \$5,000,000; at today's prices it would be \$300,000,000.

### The First Incarnation—Gold

Although many references attribute the staking of the first mining claim at Tiger to Frank Schultz, Bureau of Land Management records indicate that the initial claim was the Hackney, located in July of 1879 by Charles Dyke and T.C. Weed. This claim was on the oxidized outcrop of a southwest-dipping quartz vein which eventually became known as the Collins vein. At the time of their discovery, the two major veins at Tiger could be traced in outcrop or as lines of float down the hillside and across much of the small topographic basin in which the camp was located.

The Hackney claim was first developed by surface

cuts; the Collins vein was not mined underground for over ten years. The first recorded gold production from the district was in 1881. This "production" may have been what Alexander J. Davidson was describing in his reminiscences recorded by the Arizona Historical Society: "John Bates lived below [the present location of] Mammoth. Bates and Winkleman each had a big four-horse team. I and another man had taken an option on the Mammoth [Hackney?] mine, had hired the two to haul ore. We were to ship five tons. If it went \$8.00 a ton, we were made; if not—well, it went less than \$7.00." Charles Dyke and one of the Collins brothers recorded the Aaven claim along the southeastern projection of the Collins vein in July, 1885. Dyke was also involved in ranching in the San Pedro River area, and at one time he owned the E.O. Stratton homestead near Reddington.

In February of 1882, Frank Schultz recorded the Mars claim and the Mammoth claim on a down-faulted segment of the Collins vein which has come to be known as the Mammoth vein. These two claims lie immediately northeast of and parallel to the Hackney and Aaven claims. According to the reminiscences of Frank Murphy, another old timer in the San Pedro valley area, the discovery was not particularly glamorous. "In the 1880s old Frank Schultz was stopping at [Albert] Weldon and [Alex] McKay's at Oracle, eating their grub but spending his time prospecting. Finally he got angry at something and left, wandered down toward [the present location of] Mammoth, and located the Schultz mine." Weldon and McKay are considered to be the founders of the town of Oracle.

In order to develop his claims, Schultz formed a partnership with a man named Goldtree, who helped him install a Dyer Cannon Ball mill on the banks of the San Pedro River, where water was available. The mill included a 25-horse-power boiler and a 30-horse-power engine and was projected to crush 12 tons a day. However, as Murphy recalled, "it was not put up right and was a failure." Schultz and Goldtree either leased or sold the claims to "a Nevada company." Merrill P. Freeman was manager for the company, which sunk a shaft on the vein. By August of 1884, the Mammoth shaft was down to a depth of 118 feet, well timbered, with a number of crosscuts. At this point, however, the miners lost the "pay streak."

Frank Schultz, an Austrian immigrant, remained in the camp which came to bear his name until his death in 1918; he was buried in the Mammoth cemetery. In 1883 he took his bride, Bertha, who had come to Tucson from Germany in 1880, to live on his claims. Schultz was a central figure in the settlement which developed around the mines, but he never got rich off of his discoveries. In 1884, Schultz or the Nevada company sold the Mammoth and Mars claims to George M. Fletcher, a wealthy lumberman from Michigan.

Schultz is credited with giving the vein, mine and town of Mammoth their names when he called his claim a "mammoth lode gold vein." Schultz is also credited with naming the Old Hat Mining District, which eventually extended from Schultz to mining camps on the flanks of the Santa Catalina Mountains. After the sale of his initial mining claims, Schultz continued to prospect and stake claims. In 1889, he opened a store in the growing community of Schultz. Schultz staked and retained an interest in at least one claim which was held by his family for many years. This claim was described as "a wedge claim between the Mammoth mine...and the Mohawk claim," which undoubtedly corresponds to the Mohawk Wedge claim as shown on current claim maps. Schultz's daughter, also named Bertha, inherited his five-eighths' interest in the claim and did the annual assessment work on it herself, in partnership with a local prospector and later with the help of her two sons. The other three-eighths' interest was owned by a man named Putnam, a Mammoth merchant and undertaker. Bertha Schultz married H.H. Freeman, who purchased the Pinal Lumber and Hardware store in Florence in 1911. According to her sons, W.K. and N.R. Freeman, their mother's interest in the Schultz claims helped the family hardware business to survive the Great Depression. Although records of the claim are unclear, the Schultz family also appears to have held ownership to the New Year claim for many years, and to several claims elsewhere in the Mammoth area.

George Fletcher, who purchased the fledgling Mammoth mine late in 1884, hired a manager named Captain Johnson to develop the property. Captain Johnson deepened the Mammoth shaft to 300 feet and found the vein. He began construction of a 30-stamp mill on the San Pedro River about 3 miles from the mine. Although the San Pedro is an ephemeral stream, at that time water could be found year-round at a depth of 15 to 20 feet. This availability of water made the location on the river more desirable than Schultz not only for a mill but also for a town to develop.

By 1887, a U.S. Post Office was established in the town of Mammoth. A school was opened early in the history of the town, while the stamp mill was still under construction, and stores and saloons soon appeared. The ore from the mine was hauled to the mill in 20-mule-team wagons, on a contract with William "Bill" Neal of Oracle. Neal also had the stage and mail contracts for the area, and a contract to provide fuel wood and water to the Schultz mines and Mammoth mill. After the supply of oak wood from the Oracle area dwindled, and Neal's continued cutting was protested by local residents

and the U.S. government, he began to cut mesquite along the San Pedro River valley. For many years Neal personally carried the gold bullion from the Mammoth mill to Tucson, as often as twice a month. He always traveled without a guard, and always by a different route and different mode of transportation, to avoid the possibility of robbery.

During 1887, the Remnant and Raven claims were located in the name of George Fletcher, the Raven being a millsite claim. At about the same time, Fletcher began negotiations with a British syndicate for the sale or lease of the mine and mill properties. During 1888, the Mammoth shaft was deepened to 500 feet in preparation for this transfer. Although contemporary newspaper accounts and engineers' reports all refer to the transfer of the Mammoth properties as a sale, later documents indicate that it was a lease. The Fletcher family retained ownership of the Mammoth mine and continued to add to its holdings at Schultz until at least 1916. Various claims in the Schultz area were recorded or amended by George or Frank W. Fletcher, or by their agent J.B. Bourne, from 1887 to 1913, and include the Remnant, Raven, Erfletch, Erfletch Extension, Remnant Extension, Ford, Ford Fraction, Quien Sabe, and Manana claims. Through time, there were various lessees of the Fletcher property. Bourne and E.W. Childs, both of Mammoth, acted as official and unofficial representatives of the Fletchers.

The British syndicate formed Mammoth Gold Mines, Ltd., in 1889, with headquarters in London, and acquired control of the Mammoth mine at Schultz and the Mammoth mill at Mammoth. Among the new company's first acts was to enlarge the mill from 30 to 50 stamps, during 1890. Captain Johnson was retained as manager, and G.H. "Harry" Barnhart, M.E., (also spelled Barnhardt or Bernhart) was the assayer and accountant. By 1893, Barnhart was manager of the Mammoth mine and had been elected Justice of the Peace. The average value of ore produced from the Mammoth mine in 1890 was \$14/ton, and the average mining and milling cost was \$4/ton. In 1890 the town of Mammoth had a population of 600 to 700, the school had 70 pupils and one teacher, and the town had six saloons.

The Mohawk claim, on the Mammoth vein southeast of the Mammoth mine, was officially recorded by Andrew Dannon and J.G. Fraser in 1891. However, the Mohawk claim was mentioned in newspaper reports as early as 1884. An 1891 newspaper article listed Fraser, Dannon, John Bowers and Stephen Roberts, of San Francisco, as owners of the property. In 1892, these men sold the Mohawk claim in a relatively undeveloped condition to a group of investors from Hartford, Connecticut. At that time, there were two shafts on the property, each down about 110 feet and each with a crosscut of less than 30 feet, ending in ore. The Connecticut investors, led by N.B. Allyn, formed the Mohawk Gold Mining Company and over the next three years sunk a shaft and developed the vein down to a depth of 300 feet. They also built a small, 10-stamp mill near the mine.

The Mohawk stamp mill at Schultz began production on May 1, 1896, at a rate of 70 tons per day. George

Hilzinger, in a promotional book published in 1897, described the development of the Mohawk property: "This company has pursued a conservative policy in developing its property before going to the expense of erecting works, having, by means of a horse whim, sunk a double compartment shaft 330 feet on the lead, and driven over 1,000 feet of crosscuts and drifts at different levels. The results proving highly satisfactory, machinery for hoisting works and a twenty-stamp [sic] mill were put up, and a three-inch pipe line laid to the pumping plant, five miles distant and 700 feet lower. The pump, a Riedler, with six-inch suction and five-inch discharge, has a capacity of 500,000 gallons per twenty-four hours."

The assayer at the Mohawk mill was a part-time student named Franklin Wakefield Fish. He was the son of E.N. Fish, a prominent Tucson businessman and former "Forty-Niner," and the brother of Clara Fish (Roberts), reportedly the first student to enroll at the newly formed University of Arizona in Tucson. Frank Fish had the distinction of playing on the University of Arizona's first football team in 1899. The Mohawk stamp mill was enlarged by an additional 20 stamps in 1898, but the mine was shut down at the end of that year. The Mohawk did not go back into production until 1907.

In 1893, the closest railroad shipping point to Schultz was the Southern Pacific at Tucson, a distance of 50 miles. A good stage road connected Schultz and Mammoth to Tucson, and there were daily stage runs. In 1893, wagon freight from Tucson to the mines cost \$15 a ton. Fuel in the form of mesquite wood cost \$6 a cord, delivered. Lumber for mine timbers was at that time brought from California and cost \$46.75 per thousand feet; however, it was calculated that pine from the top of the Santa Catalina Mountains could be had as cheap as \$30 per thousand feet, delivered. Miners were paid \$3 a day, underground laborers \$2.50, and surface laborers \$2. The Mammoth mine and mill were connected by a telephone line, and the mill had electric lights.

Because of the high cost of mine timber, most of the ore was taken in untimbered shrinkage stopes, although the shafts, drifts and crosscuts sometimes had to be heavily timbered. The amount of unsupported ground in the Mammoth mine was sufficient by 1893 that a large area between the 200- and 400-foot levels caved in. After this cave-in, operations at the Mammoth mine were suspended for several years. The company was also tied up with litigation among its stockholders at the time.

During this interval the company's managers, Johnson and Barnhart, along with Mammoth mine foreman A.J. Collins, developed the Collins vein on the Hackney and Aaven claims. It is unclear from available records whether they did this work as employees of Mammoth Gold Mines, Ltd., or as independent contractors or lessees. The property, called the Collins mine, or Collins group, had been acquired by Mammoth Gold Mines, Ltd., sometime before 1891. Mining up to this time had created large open cuts along the sintery, iron-stained surface of the quartz vein, where gold had been concentrated by oxidation and leaching.

The Hackney claim lies on the side of Collins hill, so underground access could be gained by tunneling into the vein horizontally. Johnson, Barnhart, and Collins drove two tunnels into the hillside at different elevations. In the lower of these tunnels, an internal shaft was sunk 226 feet deep with a small hoist. Ore shoots on the Collins vein ranged from 5 to 30 feet wide and 110 to 160 feet long; drifts were driven from the internal shaft on three different levels along the vein. Meanwhile, another employee of Mammoth Gold Mines, Ltd., named Rabix, was reworking the upper levels of the caved Mammoth mine on an independent contract basis. The mill at Mammoth processed ore from both of these operations. The ore from the Collins vein was valued at \$16/ton, and between 40,000 and 46,000 tons were shipped to the mill through 1895. Very little waste was generated, as almost all of the drifting was done in ore.

On July 27, 1896, a U.S. Post Office was established for Schultz, Arizona. During that year Mammoth Gold Mines, Ltd., began the process of reorganization in order to develop new capital and to settle a dispute among shareholders. The company was renamed Mammoth Gold Mining Company. A feasibility study was done to determine whether or not to move the company's mill from Mammoth to the mine site and pump the needed water from the San Pedro River. At this time, the lowermost workings in the Mammoth shaft were still dry at a depth of 600 feet. Another option which was considered was the construction of a railroad between the mine at Schultz and the mill at Mammoth. Ultimately, the decision was made to continue hauling ore to Mammoth by wagon until an innovative ore-handling system could be installed.

By the end of 1897, the company had been renamed again and became Mammoth Collins Gold Mines, Ltd. It was still headquartered in London and was capitalized at 100,000 pounds in shares of one shilling each. The company set about combining the Mammoth and Collins operations and invested in a 2 3/4-mile-long "automatic wire rope tramway" to transport the ore from the mines to the mill at Mammoth. A year or so later, the tramway was enlarged. The tramway was a very efficient means of transport, taking advantage of the relatively steep grade from mine to mill. The cost of wagon haulage was eliminated; the only difficulty encountered was an initially high rate of rope breakage. This problem was eventually overcome with the purchase of higher quality rope and the institution of a rigorous maintenance program. The tramway was built in three sections, each a mile long, with a weighted "tension station" between each section to keep the rope taut. It carried fifty 560-pound cars. At the mine site, the ore was broken and passed through a grizzly before being loaded into the cars; the empty cars were used to transport water from Mammoth to Schultz on their return trip.

As the mine workings at Schultz were extended deeper on the veins, the proportion of "free-milling" gold steadily decreased. Amalgamation was only recovering 45% to 60% of the gold in the ore. The great difficulty of treating the ore from the Mammoth and Collins veins, due to its chemical and mineralogical complexity, was

compounded by a less-than-efficient mill. The millsite was originally selected for the availability of water, and the mill was built on the flat flood plain of the San Pedro River. Such a location made it difficult to move material through the mill by gravity and made tailings disposal a constant nightmare.

By 1900 the Mammoth mill had been enlarged to 70 stamps, set up in 14 mortars of 5 stamps each. Each stamp weighed 820 pounds and dropped a distance of 6 inches at a rate of 96 drops per minute. Although the mill was considered to be one of the quieter stamp mills of the day, the vibrations could be felt at Schultz, three miles away. The ore was self-feeding from the tramway terminus into the mortars. Mercury was added to the mortars from time to time to begin the amalgamation process, which was achieved primarily on copper plate tables onto which the mortars discharged. The milled pulp was crudely spread over the mercury-charged copper tables. An engineering study done at the time ascertained that amalgamation was hindered by at least two factors—the coating of the copper plates by a thin film of finely crushed wulfenite, a heavy lead molybdate mineral, and some sort of coating, perhaps iron oxide, on the gold particles themselves. This same study decried the arrangement of the assay lab, which was located in the same room where the amalgam was retorted and the bullion melted, and subject to the constant vibration of the stamps.

At about the same time that the aerial tramway was constructed, a block of ground immediately north of the Mammoth mill was acquired by Mammoth Collins Gold Mines, Ltd., for the construction of a 200-ton-per-day cyanidation plant. This new technology was brought to the district in an attempt to recover some of the gold being lost in the tailings. The plant, known as the Mammoth Cyanide Works, was apparently constructed by a contractor, the St. Louis Gold Recovery Company, also referred to as the St. Louis Gold Saving Company. The tailings from the amalgamation process were picked up with a mule-drawn scraper and loaded into large wooden tanks where the gold was dissolved in a cyanide solution. The gold was then recovered by precipitation on zinc shavings. By this means, 50% to 60% of the gold which had been missed by the amalgamation process was recovered.

The cyanidation contractor paid Mammoth Collins Gold Mines, Ltd., a royalty based on the assay value of the tailings processed. Upon the expiration of the contract with St. Louis Gold Recovery, a local resident named Iram Blaisdell was awarded the cyanidation contract. Blaisdell formed the Mammoth Cyanide Company along with investors who eventually included Albert Steinfeld of Tucson, Merrill P. Freeman, and Selim M. Franklin. It is not clear whether Mammoth Cyanide Company erected its own plant or somehow acquired the existing facility, but the company was involved in litigation with St. Louis Gold Recovery for several years over rights to various tracts of tailings. In any event, by the summer of 1900 the supply of workable amalgamation tailings was exhausted, and Mammoth Cyanide Company suspended operations,

retaining ownership of all the tailings at Mammoth.

Among the waste materials which accompanied the gold in the Mammoth and Collins ores were various lead, molybdenum, and vanadium minerals including anglesite, cerussite, vanadinite, and most abundantly, wulfenite. These minerals were a considerable nuisance to gold recovery, as they are all heavy and tend to be concentrated with gold by gravity. However, by the end of the 1890s various engineers began to consider the possibility of concentrating these minerals for the value of their lead and molybdenum content. In 1898, the Mammoth mill shipped 12 tons of a 90% wulfenite concentrate to a buyer, who was unfortunately not able to develop a market for it. Nothing more was done with the Mammoth wulfenite until 1914.

By the end of the year 1900, the Mammoth Collins operations at Schultz had reached a critical point at which decisions concerning major investments had to be made. The Mammoth mine, which was serviced by one main working shaft, had drifts along the vein at regular intervals down to a depth of 760 feet. Most of the ore had been mined out down to the 700-foot level; ore was being blocked out between the 700- and the 760-foot levels, and winzes were being sunk below the 760-foot level. The main shaft was bottomed at 800 feet, at which point the water table was finally encountered. The shaft had been sunk on the vein in the early days, but the vein was dipping away from the shaft in a southwesterly direction. By the time the shaft was down 800 vertical feet, it was necessary to crosscut almost 200 feet to reach the vein. It was during the process of this crosscutting operation on the 800-foot level that the influx of ground water became so great that work had to cease.

The company brought in an engineer named Thomas G. Davey to evaluate the entire operation, mine and mill, and to come up with some projected costs for the various options open to them. Among Davey's findings were that the main Mammoth shaft was poorly located for the ore bodies yet to be mined and not adequate for the volume of material that needed to be hoisted, or for the water discharge lines from the heavy pumping system which would have to be installed if work were to continue. At the time of sinking, steam-powered pumps were being used, fueled by mesquite wood. Davey recommended the installation of electric pumps with a capacity of 500 gallons per minute, which would require some source of electricity at the mine site. He also recommended a sinking pump driven by compressed air, with the installation of a compressor adequate to also support pneumatic rock drills.

Davey strongly urged that work be renewed on a crosscut which had been started from the Mammoth 700-foot level toward the Collins workings. This crosscut had been driven a distance of 310 feet before it was stopped, and it lacked almost 1,000 feet to reach the Collins. Such a connection would make the deeper parts of the Collins vein economically minable and might reveal new ore bodies, as well.

In the area of milling, Davey recommended first, that some hand separation of galena and the various copper

oxides be done on the Collins ore, both to produce salable concentrates of lead and copper and to enhance gold recovery at the amalgamation and cyanidation plants. He considered the entire mill set-up to be grossly inefficient and made some specific recommendations of equipment additions and modifications to try to improve recovery. He also strongly advised the construction of a new assay lab in a solid, adobe building at a sufficient distance from the stamps to be free from dust and vibrations.

Finally, Davey recommended two alternatives for the generation of electric power, which he considered to be the only practical option for operating the pumping plant which would be required to continue mining at the Mammoth mine. His proposals were to build a wood-fired generating plant near the Santa Catalina Mountains, where fuel wood was more abundant, or to construct a dam and hydroelectric plant, using Pelton wheels, on Aravaipa Creek, and run transmission lines to the mine.

Costs in 1900 had risen to \$8.00 per cord for fuel wood delivered to the mill, \$9.00 per cord delivered to the mines, and \$50.00 per thousand feet for 1" x 12" lagging. Mining costs were calculated at \$1.15 per ton, milling at \$0.64 per ton, transportation at \$0.13 per ton, and administrative costs at \$0.28 per ton, for a total cost of \$2.20 per ton. The value of the ore mined at that time ranged from \$5.06 per ton to as much as \$23.80 per ton, with about half of the value lost in the tailings. A mill test requested by Davey yielded an average assay value of \$8.25 per ton of ore delivered to the mill, and an actual extraction of \$4.14 per ton through the amalgamation plant. Proven ore reserves in the Mammoth mine were estimated at 39,000 tons with an average value of \$7.74 per ton, and probable reserves at 19,000 tons with a similar value. Proven reserves at the Collins were estimated at 14,000 to 20,000 tons, with up to 103,000 tons of probable reserves.

General Manager for Mammoth Collins Gold Mines, Ltd., in 1900 was a Mr. Blair; Mine Manager, Mr. Lester; Engineer, Mr. Myder; Accountant, Mr. Blackman; Assayer, Mr. Humphreys; and Mill Superintendent, Mr. McGregor. One report estimated production at \$200,000 a year. Through 1901, the official combined production of the Mammoth and Collins mines was 150,000 ounces of gold from 350,000 tons of ore. None of the recommendations made by T.G. Davey appear to have been implemented, at least not by Mammoth Collins Gold Mines, Ltd. The company was again embroiled in litigation among its shareholders, and in April 1901, a massive ground failure on the Collins vein resulted in caving from the bottom level to the surface. About an acre of the surface over the north end of the vein dropped suddenly, as much as 25 feet. This event appears to have been the final blow for the entire mining and milling operation. The company failed to make its lease payments and the owners sued to regain possession. During the 12-year period of inactivity and litigation which ensued, the Mammoth mill was destroyed by fire.

The U.S. Post Office at Schultz was closed in 1902. With the loss of jobs and income from the mines and

mill, people began to leave the area. By 1903, the population of Mammoth was down to about 300. The only mining activity in the Schultz area for the next several years was the staking or restaking of a few claims by T.H. and Andrew J. Collins and T.E. Baier. The Golden Slipper claim was located to the southeast of the Aaven, along the projection of the Collins vein, and the Washington claim to the southwest of that. Amended notices on the Arizona and Wyoming claims were filed in December, 1905, by the Arizona Gold Mining Company, with Andrew J. Collins listed as President.

## A Modest Revival—Gold

In 1906, activity at Schultz picked up a little as the Mohawk Gold Mining Company was reorganized and refinanced. William Roberts was appointed manager of the operations. Although the ore in the Mohawk mine was of considerably lower grade than that of the neighboring Mammoth mine, the Mohawk workings were still above the water table and were accessible. The company modernized its mill near the mine, adding a concentration plant to the 30-stamp mill and amalgamation plant. Arrangements were made to use water from the bottom of the Mammoth shaft for the Mohawk mill.

According to some reports, a new vertical shaft was sunk on the Mohawk property, down to a depth of 500 feet. However, a comparison of photographs taken in the 1890s with one dated 1914 shows the Mohawk headframe in an identical relationship to the main mill building. Perhaps the existing shaft was rehabilitated. In any event, by 1912 it had been deepened to 600 feet. The ore at that time was reported to average \$14/ton. Through 1912, the Mohawk mine produced an estimated 20,000 ounces of gold. It was closed at the end of that year.

Another property, the Extension, which adjoined the Mohawk to the south along the same vein, was also being developed around 1912. The owners were described only as "local parties" in a 1912 engineering report; most likely this was a Mammoth resident named Pascual Figueroa. The workings consisted of a 200-foot shaft and a 26-foot crosscut. Another small prospect was being worked at the time by Ed Brady of Mammoth.

A letter written by Eugene M. Sawyer in January of 1912 paints a vivid picture of the Mammoth and Schultz area at the time. Sawyer worked for Copper Queen Mining Company and James Douglas for many years, doing prospect examination and evaluation. "I don't remember whether I told you of my planned trip over to Mammoth or not. A man over there has a mine which he has been trying to interest the company in...I went down to Oracle the first day and spent the night at the Trowbridges. They are nice people and it is nice to have a place to go down there. I don't like Neal's [Mountain View Hotel]. The next day I rode over to Mammoth and spent the night in a little adobe house where they take boarders. Mammoth is an old mining camp, a relic of the early days. There is still a little work going on over there but it looks pretty dismal and deserted and the coyotes yelping all night made it seem more so. I examined

the mine the next day...I found the mine very interesting but rather small to do much with..."

In 1913, William J. Young and G.U. Young, "millionaire brothers from Iowa," obtained a \$400,000 working bond and option on the Mammoth-Collins claim group, which consisted of six patented and seven unpatented claims for a total of 273 acres. The Youngs had been active in Arizona mining and politics for many years, having formed the Great Western Copper Company in 1900 for the purchase of a group of claims in the Courtland district. G.U. Young was Mayor of Phoenix and president of Madiselle Mines, located west of Prescott.

The Youngs proposed some grand schemes in their press releases, including the deepening of the Mammoth shaft to 1,800 feet, running a power line to Schultz from Ray Consolidated's power plant at Hayden, and building a railroad down the San Pedro valley to Winkleman. They hired a young mining engineer named Wilbert G. McBride to manage the operations at Schultz. McBride installed a 150-horsepower engine to pump out the Mammoth shaft. By the end of 1913, 30 men were employed at the operation, cleaning up and doing development work. The Young brothers made an agreement with Pinal County for the County to pay half the cost of repairing the Oracle-Mammoth road to the Pima County line if the Youngs would do the work.

An improved road was especially desirable for one of the innovations which the Youngs introduced to Schultz. Beginning in August, 1913, the operation employed two "Alco 3 1/2-ton motor-trucks" for hauling fuel, machinery, timbers, rail, pipe, and other supplies from Tucson to the mines. McBride published an engineering analysis of the use of these vehicles in the July 9, 1916, issue of *Mining and Scientific Press*. The trucks were driven to Tucson empty. Drivers were paid \$4.50 to \$5.00 a shift, and a one-way trip was considered a shift. The drivers were provided with a room in Tucson for their overnight stay. The price of gasoline ranged from 17 to 21 cents a gallon.

McBride described the conditions of the road: "There were no excessive grades or bad sand, but wagon-ruts, too narrow for the truck wheels and of a different gage, caused heavy tire loss; while chuck-holes, sharp curves, and stones, both imbedded and loose, were objectionable features. During wet weather the trucks could not get sufficient traction to climb some of the hills and were likely to stick in the mud, so that no attempt was made to run them unless they were on the road when the rain started." The cost of hauling a load from Tucson to the mines with a truck was \$12 a ton, compared with no less than \$15 a ton for a freight team. Furthermore, a team made only one round trip a week, while a truck made a round trip in two days, and occasionally one day. The only disadvantage of the trucks was that they lost twice as much time as the teams in wet weather.

During 1914 the Youngs deepened the Mammoth shaft to 840 feet, which required the pumping of 300 gallons per minute of water. They connected the Mammoth and Collins workings underground, finally completing the drift begun 14 years earlier on the 700-foot level of the Mammoth mine. They drove a drift around the old cave

on the Collins vein. The operation employed 75 men in January of 1914. By the middle of July, they had erected a new headframe and installed a new hoist, replaced timbers, cleared drifts, and had a crew diamond drilling on the 600-foot level of the Collins mine.

In August of 1914, the operation faltered. The payroll was cut to 4 or 5 men. The status of the situation was described in a letter written by E.W. Childs of Mammoth in April, 1915: "The Young's [sic] have made no payments on the purchase price, as yet to Mr. Fletcher, who is not entirely satisfied with their methods, although he was finally persuaded to give them a further extension of time, upon their option, until next August." Childs and J.B. Bourne, who was by that time Pinal County Treasurer, appear to have taken it upon themselves to promote the various properties at Schultz. Childs wrote a series of letters during 1915 promoting another group of claims at Schultz, the Pickwick group. This group included the Golden Slipper claim which lies immediately to the southwest of the Mohawk and Mammoth claims. Among those Childs contacted were Philip Wiseman, of Los Angeles, John Devine, of Ray, Arizona, and Louis Wright of El Paso, Texas. When the Youngs finally pulled out completely at the beginning of 1916, Bourne had several interested parties waiting in the wings.

The Young brothers had spent an estimated \$200,000 on the Mammoth-Collins property, and they estimated that it would cost \$250,000 more to replace the mill which had burned. They concluded that the ore was of too low a grade to justify such an expense, and that furthermore, the ore was too complex to concentrate profitably. They never made the first \$100,000 payment required under the bond and never produced any ore.

As of 1916, the workings of the Mammoth mine consisted of the main shaft, 833 feet deep, and about a mile of drifts on eight levels. The Collins mine consisted of an access tunnel 550 feet long with an internal shaft 700 feet deep and about 2,000 feet of tunnel and drifts. The Mammoth mine was equipped with a shaft house, engine and compressor house, boiler house, machine and blacksmith shops, and oil storage tanks. The primary fuel was no longer mesquite wood, but petroleum. A 100 horsepower Fairbanks-Morse engine operated a Sullivan compressor with a capacity of 528 cubic feet per minute at 100 pounds of pressure. A 150 horsepower Fairbanks-Morse was set up to run a 440-volt generator which supplied power for the mine pump, electric lights, and various small motors in the shops. The hoisting equipment could be operated either by steam or compressed air. The mine pump was on the 750-foot level and had a lifting capacity of 400 gallons per minute.

## The Second Incarnation—Molybdenum

The outbreak of World War I in 1914 drastically altered metal markets. Suddenly molybdenum was a valuable commodity, needed for steel-making. In December of 1914, two prominent Tucson men formed a corporation called Arizona Rare Metals Company for the purpose of acquiring and processing molybdenum-bearing tailings and ores. The two partners were Frank H. Hereford and William Jennings Bryan, Jr. The first board members

were Hereford and Robert O. Boykin, of Mammoth. Hereford, originally from California, was admitted to the Arizona bar in 1884. He made a specialty of mining and corporation law and was the chief counsel for a number of large mining companies in Southern Arizona. He was a member of the Arizona Constitutional Convention in 1891, served as Pima County District Attorney, and held various positions on the University of Arizona Board of Regents, including Regent, Treasurer, and Chancellor. Bryan was the son of the famous orator and presidential candidate. He was an attorney who served as Assistant U.S. District Attorney, Arizona, and was also a member of the University of Arizona Board of Regents, holding the positions of Regent, Treasurer, and Secretary at various times.

It does not appear that Bryan took any active part in Arizona Rare Metals; Hereford handled all of its legal and business activities. The corporation acquired control of the old mill tailings at Mammoth and erected a processing plant to concentrate wulfenite, which had originally been discarded as waste. The operation was so successful that the plant was enlarged and remodeled in 1915. The volume of workable tailings was estimated at 250,000 tons. They were spread out over such a large area, and had lain undisturbed for so long, that parts of them had been farmed. The tailings were dug with a 4-horse scraper and dragged up an incline to a loading platform where the material was passed through a coarse grizzly to remove brush, wood, and large debris. The material then dropped into one-ton rail cars in a tunnel beneath the loading platform, and the cars were hand-trammed several hundred feet to the base of an incline leading to the mill bin. At the incline, the cars were hooked to a cable and pulled along rails up to the top of the bin, 30 feet above the ground. They were dumped by hand and allowed to glide down the incline under their own weight, onto a siding. The scraping and tramping work was done by contract at a cost of about 14 cents per ton.

Two Fairbanks-Morse "oil engines" supplied power for the processing plant and generated electricity for lighting the mill and the scraping and tramping operations. Ten to 12 men worked three shifts, 24 hours a day. The mill consisted of seven concentrating tables which had an output of two tons of concentrate a day from about 200 tons of tailings. The concentrate averaged 22% molybdenum, 62% lead, and 1% vanadium. Some samples contained over 1% tungsten. Ninety-one percent of the concentrate was made up of the minerals wulfenite, cerussite, vanadinite, and anglesite. The concentrate was valued at \$300 a ton. It was bagged into 150-pound sacks and hauled to Tucson by freight teams belonging to J.L. Clark of Mammoth. From Tucson it was shipped by rail to a refinery in Pittsburgh, Pennsylvania. A contemporary newspaper report described the appearance of the yellow-orange wulfenite concentrate as giving "the mill and surroundings the appearance of being a large grain-buying institution." For three years during World War I, this operation accounted for the entire output of molybdenum marketed in the United States.

Beginning in 1916, Frank Hereford and R.O. Boykin became involved with an unsuccessful effort on the part of a young metallurgist named Alan Kissock to perfect a patented process for separating molybdenum metal, in the form of "ferro-molybdenum," from wulfenite concentrate. Since Arizona Rare Metals was the only source of wulfenite concentrate at the time, Frank Hereford and Robert Boykin became involved in Molybdenum Products Company, which purchased concentrate from Arizona Rare Metals for its experiments in molybdenum concentration. Among the investors in Molybdenum Products Company were Harold Steinfeld, Maxwell Milton, H.S. "Hi" Corbett, Kenneth Smith, R.K. Shelton, R.O. Boykin, Mr. and Mrs. Hereford, and Alan Kissock. This company erected a smelting plant on First Street in Tucson on land leased from Steinfeld, and Kissock carried on his various extraction experiments there. The company never generated any income, and in December of 1917, Hereford and Boykin formed a new company, Arizona Smelting and Molybdenum Company, which bought out all the assets of Molybdenum Products Company. Stock in the new company was held by R.O. Boykin, Frank Hereford, Harold Steinfeld, and one share by Alan Kissock. This company acquired Kissock's patent and also experimented with the smelting and chemical refining of wulfenite concentrate, but it does not appear to have ever generated any profits.

In May, 1918, Arizona Rare Metals Company formally purchased all rights to the Mammoth tailings from the stockholders of the old Mammoth Cyanide Company. At about this time, the Hondo Oil Company erected a plant in Mammoth and arranged to process the tailings from Arizona Rare Metals by a flotation process. The old gold tailings had been so finely milled that recovery by gravity concentration was not terribly high.

In 1916, the U.S. Bureau of Mines studied the Mammoth and Collins mines for the possibility of mining them for wulfenite. At that time the mines were idle; all the molybdenum production in the district came from the old gold tailings at Mammoth. The study, published as U.S.B.M. Bulletin 111, described the molybdenum mineralization as follows: "Wulfenite is of common occurrence throughout the veins and much of it is beautifully crystallized. The Mammoth mine alone has probably furnished more fine cabinet specimens [sic] of the crystallized mineral than any other locality. Most of the crystals are light orange, but they range through various shades of orange, brown, and green, to almost black...In many places there are 1-inch and 2-inch streaks of nearly pure wulfenite near the center of the ore bodies, and many cracks and fractures throughout the vein material are filled with the mineral. On the 750-foot level of the Mammoth mine the writer noted a shoot of wulfenite and cerussite ore, exposed for 100 feet or more, that averaged 10 to 12 inches wide, and probably contained 20 to 30 percent of wulfenite...veinlets and minute stringers of wulfenite are visible throughout the stopes and in the roofs and floors of most of the drifts...The mines have, however, never been worked for wulfenite, but have been developed chiefly for gold, of which their ores are said to carry \$6 to \$7 per ton." The study

concluded that there would be problems with trying to extract wulfenite from the Mammoth mine ores. The presence of so many other lead minerals with similar specific gravities would make it impossible to separate the wulfenite from them by gravity methods. A successful separation would require a complex, expensive, high-technology process.

In mid-1917 a Tucson mining engineer named Colin Timmons, E.M., prepared a report on the Mohawk mine, still owned by the Mohawk Gold Mining Company. The main shaft was vertical, 532 feet deep, timbered, with two hoisting compartments and a manway compartment; it was sunk in rhyolite. The 3rd and 4th levels were square-set timbered, with 8" x 8" or 10" x 10" posts, 10" x 12" caps, and 3-inch plank chutes every 15 feet. Stopping had been done without timbers, in shrinkage stopes. A winze had been sunk 115 feet below the 5th level and was an estimated 50 feet above the water table. Timmons recommended deepening the winze to obtain water for the mill, so that it would not have to be pumped from the river. The surface plant consisted of a blacksmith shop, assay office, manager's residence, bunk houses, office buildings, and a 30-stamp amalgamation mill. Although contemporary newspaper reports announced the renovation of the Mohawk mine and mill by "Colin Timmons and Associates," no production was recorded for the Mohawk until 1934.

In late 1917 or early 1918, a group of investors formed the Mammoth Development Company for the purpose of acquiring and operating the Mammoth and Collins mines. These investors included Frank Hereford and R.O. Boykin of Arizona Rare Metals Company and Col. Epes Randolph, another prominent Tucsonan. Randolph was primarily a railroad man, having been manager or officer of a number of southwestern railroads at various times, including Southern Pacific Company; Los Angeles Railway Company; Pacific Electric Railway Company; Gila Valley, Globe and Northern Railway Company; Maricopa, Phoenix and Salt River Valley Railway Company; Cananea, Yaqui River, and Pacific Railway Company of Mexico; Southern Pacific Company of Mexico; and Arizona Eastern Railway Company. He was a member of the University of Arizona Board of Regents and was Chancellor at the time of his death in 1921.

Early in 1918, just as work at the Mammoth mine was getting under way, the main shaft caught fire from gasoline dripping near a compressor exhaust pipe. The shaft timbers were destroyed, along with the hoist and compressor buildings. The miners were able to escape by way of another shaft, probably the Collins, and no one was injured. By April, 1918, the mines and plant of Mammoth Development Company had a combined payroll of 100 men. The burned-out shaft had been enlarged to three compartments as it was retimbered, and ore was being produced from the 6th level of the Collins. Production at that time was 150 to 175 tons a day, and it was projected at 400 tons a day when full capacity was reached. It is not clear from available records where this ore was milled. Production figures for the period include gold, which was most likely recovered before the ore was put through the Arizona

Rare Metals plant at Mammoth. Perhaps the old Mohawk mill at Schultz was used, or some sort of mill erected at Mammoth. The old tramway was no longer functional, and the ore was hauled by truck from Schultz to Mammoth. The Arizona Rare Metals concentrating plant was shut down for several months during 1918, due to "an unsettled market," and when it reopened it was under the name of Mammoth Development Company.

At the end of 1918, Jack Acres was mine superintendent at the Mammoth mine, D.W. Hales was mill superintendent, and Horace Pomeroy was general manager. Sometime in early 1919, the Mammoth Development Company was renamed St. Anthony Mining and Development Company, perhaps due to a merger or to a buyout of Hereford and Boykin, whose names ceased to appear in company documents. The officers at that time were R.C. Gillis of Los Angeles, California, president; a Mr. Fleming of Pasadena, California, vice president; Epes Randolph of Tucson, Arizona, treasurer; Charles Bundy of Los Angeles, California, secretary; and Horace Pomeroy of Schultz, Arizona, general manager. The company's assets included the Mammoth and Collins mines at Schultz and a refining plant at Vernon, California. By the end of 1919, the war-time market for molybdenum had vanished, and all of the mining and processing operations were shut down. The plant at Mammoth was dismantled and sold. Official production from the Mammoth-Collins mine from 1916 to 1919 was 10,450 ounces of gold and 447,876 pounds of molybdenum, most of it from reworked tailings.

During the early 1920s there was no mining activity at Schultz. The owners of the various mines were involved in promoting them for their valuable mineral content, which by this time included gold, molybdenum, and vanadium for the Mammoth, gold, molybdenum, and a higher concentration of vanadium for the Mohawk, and lead and zinc from sulfides for the Collins. In 1924 or 1925, the Mohawk mine was purchased by C.S. McClevins of Denver, Colorado, acting for the Metal Exploration Company of New York. The Mohawk Gold Mining Company was incorporated in November of 1925; George W. Logan of Denver, Colorado, was Secretary-Treasurer. The Mohawk mill was renovated and modernized by J.A. Poindexter, a local mining man, beginning in March of 1925. The old stamps were replaced by a concentrating and chemical plant designed to recover gold, silver, lead, and molybdenum.

During the summer of 1926, the Mammoth-Collins property was sampled and examined by the United Verde Copper Company. The results of this examination, as relayed in a letter from Frank Hereford to W.P. Gohring and Horace Pomeroy, showed an estimated 30,000 tons of workable ore which assayed 0.5% copper, 9.3% lead, 7.2% zinc, 1.7 ounces silver per ton and 0.015 ounces gold per ton. The cost to properly equip the mine and put it into production was estimated at \$134,000. No further action was taken by United Verde, and the mines sat idle until the middle of the Great Depression.

## The Third Incarnation—Gold, Molybdenum, And Vanadium

During 1926 a young mining engineer named Sam Houghton, who had recently graduated from Princeton, obtained an option on the New Year claim from Bertha Freeman, daughter of the late Frank Schultz. The New Year claim lies east of and adjacent to the Mohawk claim. Houghton sunk a shaft 140 feet deep and encountered gold, vanadium, and lead mineralization in lateral workings. He began what turned out to be a lengthy career of promoting various mining properties in the Schultz area. The onset of the Great Depression in 1929 hindered his efforts for a time, but by the end of 1931 he had assembled a group of financial backers which included Jack Mulcahy, head of Mulcahy Lumber Company in Tucson; Clyde Martin Reed, former Governor of Kansas and publisher of the Daily Sun in Parsons, Kansas; and F.B. Houghton, of Chicago, vice-president of Santa Fe Railroad.

The increases in the official price of gold in 1933 and 1934 aided Houghton in his endeavors. He managed to interest the Molybdenum Corporation of America in both the New Year and the Mohawk properties. In June of 1933, the Molybdenum Gold Mining Company was incorporated in Tucson as a subsidiary of the Molybdenum Corporation of America. Incorporators were Cleon T. Knapp and B.G. Thompson, with \$100,000 of capital stock. Fred Marston was made manager of the operation, and by January of 1934, 32 men were employed. During 1934, the combined Mohawk-New Year mine shipped several carloads of ore to the Molybdenum Corporation of America refinery in Washington, Pennsylvania. The company demolished the old Mohawk mill and constructed a new one which employed gravity concentration and cyanidation. It was completed in May of 1935, with a capacity of 200 tons per day. Karl V. Geib was mine superintendent and W.H. Fowler was mill superintendent. By June of 1935, 75 men were employed by the Mohawk-New Year operation: 25 in the mines, 25 in the mill, 10 in the shops, and the rest in various surface jobs.

During 1934, the Mammoth-St. Anthony Mining Company, Ltd., was formed by the stockholders of St. Anthony Mining and Development Company as a means of raising capital. The two companies shared in the operation of their various holdings until 1945, when Mammoth-St. Anthony was formally dissolved. Under the management of Foster S. Naething, the company began investigating the relative cost of generating its own power at the mine site or running a power line, and began preparations to reopen the Mammoth-Collins mine. The company contracted with Molybdenum Gold Mining Company to furnish up to 300 tons of ore per day to its new mill. The decision was made to run a power line at a cost of \$60,000, and by March of 1935 the poles were up and wire was being strung on an extension of the line from Coolidge Dam to Hayden. At the same time, crews were doing development work at the mine under superintendent Edwin A. Stone.

Continuous electrical power was available beginning April 1, 1935. Twenty-four miles of line, from Hayden

to Mammoth, had been erected in 45 days. In exchange for building the power line, Mammoth-St. Anthony received light and power at a reduced cost from the Federal Government. Power was also supplied to the town of Mammoth, and by 1939 the line had been extended to Oracle and was providing electricity to a number of guest ranches in the area. The Federal Power Project insured against a power failure due to low water at the dam by having the U.S. Indian Service construct a 2,600 horsepower Diesel electric generating plant a mile and a half north of Coolidge. This stand-by unit cost \$164,000.

During the Depression, miners were paid \$1 a day and glad to have any job at all. Although a few old adobe houses were available near the mines, the sudden influx of mine workers created a tent city. As former resident Daisy Willeford recalled, "The company would loan people the money to buy tents...People would just set up tents on a piece of land." Some of the workers rode horses to work; those who couldn't afford a horse, walked. Bunkhouses and a boarding house were established, where hungry job-seekers were provided with a meal even when there was no work for them.

## The Fourth Incarnation—Add Lead and Silver

The year 1936 began a period of general economic recovery from the Great Depression. By May, 1936, 39 men were employed in the Mohawk-New Year mine. In June, the mill was enlarged from 200 to 300 tons a day, with half of the feed still coming from the Mammoth-Collins mine. Twenty-thousand dollars' worth of new equipment was installed, including crushing and flotation units. A flotation concentrate containing gold, lead, zinc, molybdenum, and vanadium was shipped to the Molybdenum Corporation of America plant at Washington, Pennsylvania. The mill employed a very complex process. There was a gravity concentrating plant with six concentrating tables, from which the tailings went to a cyanide leaching plant. The gravity concentrate went to two sets of eight-cell, mechanically driven flotation machines.

A "motor-driven aerial tramway" was constructed between the Mammoth shaft and the Mohawk mill, with tram cars traveling high over the townsite to bins at the mill. In July, 1936, St. Anthony Mining and Development began sinking a new shaft near the old Collins glory hole for supply, ventilation, and production. It was a three-compartment vertical shaft with two-ton, self-dumping skips and a 100-horsepower double-drum hoist. One million gallons of water were pumped from the shaft per month. The water was sold to the Molybdenum Gold Mining Company for its mill. The Mammoth-Collins mine was producing 3,000 tons of ore a month.

On March 15, 1937, Mammoth-St. Anthony Mining Company, Ltd., purchased the Molybdenum Gold Mining Company mill. The mill had been treating ore from the mines of both companies for its entire history; at the time, it claimed 90% recovery. The ore being processed at this time was a complex combination of oxide and sulfide minerals from which gold, silver, lead,

molybdenum, and vanadium were extracted. Copper and zinc were not reported in production statistics until 1943. In April of 1937, a small smelter was built to further process the flotation concentrate from the mill. The concentrate was roasted with soda ash; molybdenum and vanadium were concentrated in the slag, and gold and silver went with the molten lead which was tapped off and poured into bars. The lead bars were trucked to the railhead at Hayden and then shipped to the lead smelter at El Paso, Texas. The slag was crushed; molybdenum and vanadium were taken into solution, filtered, and then recovered by evaporation in large pans heated by waste heat from the reverberatory furnace. The resulting sodium molybdate and vanadate salts were packed into drums for transportation by truck to San Diego, California, where they were further processed before going to various markets which included Italy and possibly Germany.

In October of 1937, St. Anthony Mining and Development was producing 5,000 tons of ore a month and employed 60 men in the Mammoth and Collins mines. By July of 1938, the company was producing 9,000 tons a month and employed 122 men. Molybdenum Gold Mining Company was producing 3,000 tons a month from the Mohawk and New Year mines. By October of 1938, St. Anthony Mining and Development employed a total of 250 men working seven days a week, twenty-four hours a day. Production had risen to 500 tons a day. At that time, Warren L. Howes was mill superintendent, K.V. Geib was mine superintendent at the Mohawk-New Year operation, and Sam Fields was mine superintendent at the Mammoth-Collins operation. Harvey Willeford recalled Sam Fields for the *San Manuel Miner* years ago: "Fields always walked around with a newspaper in his hand, and his hands behind his back, smoking a pipe. If he saw someone he thought was not working, he would just walk up to them and fire them. There were always men waiting for a job."

On February 15, 1939, Mammoth-St. Anthony Mining Company, Ltd., acquired the Mohawk and New Year mines from the Molybdenum Gold Mining Company. This action consolidated all the producing mines in the camp under one company. Foster S. Naething was made general manager of the entire operation; the company employed 260 men and was producing 550 tons of ore a day. On March 15, 1939, a U.S. Post Office was established for the growing community around the mines, which had been rechristened Tiger. There are so many versions of the story behind this name that the real truth will probably never be known. One version traces the name to Sam Houghton, who began calling the camp "Tiger" back in the late 1920s after the mascot of his recent alma mater. Another version attributes the name to another Princeton man, a wealthy New York attorney named Wilton Lloyd-Smith, who was a major stockholder or officer of the company. He was said to have been an avid big-game hunter who sported a tobacco pouch made from the scrotum of a tiger. Ownership of the tobacco pouch was attributed to other individuals in other versions. At any rate, Harvey Willeford claimed to have been given the task of polling the community members

as to their choice of names when the company applied for a post office. The choices were Tiger and St. Anthony, after the company. The vote was unanimous in favor of Tiger.

The population of Tiger peaked at around 1,800 people, and the payroll of the company at nearly 500. By mid-1939, 20 new houses had been built in the community, plus dormitories for single men, a company store with a refrigerated meat counter, a barber shop and a beauty salon. Restaurants, a gas station, and a movie theater were added over the years. Rosalee Hendrickson ran the cafe-boardinghouse. The adobe schoolhouse was supplemented by a barracks building as enrollment increased. The company was never very successful in operating the store and eventually brought in a Tucson company which ran the store under a lease arrangement. At one point, Bill Powers was manager of the store, and its final operators were Kenny and Janet Creed.

Foster Naething died in January, 1940, and was replaced as managing director by a San Francisco consulting mining engineer named Henry C. Carlisle. At some time around 1940, a "salt plant" was constructed for the purpose of separating molybdenum from vanadium. Up to that time, a combined molybdenum-vanadium concentrate had been shipped out for further processing. Now molybdenum was taken into solution separately, and discrete molybdenum and vanadium concentrates could be shipped. Underground miners' wages had risen to \$3.25 per day by 1940. Battery-powered cap lamps provided light to work by, and pneumatic rock drills were standard mining equipment. Much of the mucking and tramping was still done by hand.

On September 21, 1941, revised articles of incorporation for Mammoth-St. Anthony, Ltd., a Delaware corporation, were published detailing the merger of Mammoth-St. Anthony with Tiger Management, which had been incorporated on July 21, 1939. The president of Mammoth-St. Anthony at that time was James A. Fowler, Jr. After the United States entered World War II in December of 1941, able-bodied miners were hard to find. Because the mines at Tiger were producing strategic metals, the U.S. Army sent 65 men to the mines in the fall of 1942, discharging them early in order to keep the mines operating at capacity. But by June of 1943, the labor shortage at Tiger was critical. The company was exploring the possibility of importing Mexican nationals as miners and again requested U.S. troops to help work the mines. Production was down by 50%; peacetime employment had been 415 to 500 men, and there were only 340 on the payroll in 1943. The company needed another 100 men to achieve full production. At that time, Tiger had one of only two processing plants in the United States which could separate molybdenum and vanadium from other metals.

### The Final Incarnation—Lead and Zinc

In June of 1942, a 150-ton-per-day plant was completed for the purpose of concentrating lead and zinc ore from the deep, unoxidized portion of the Collins vein. A great deal of test work was done on the sulfide ore by several

equipment companies, the Arizona Bureau of Mines, and the St. Anthony staff. Lead recovery was only about 65% and zinc recovery, 50%. Although a very complicated flowsheet was developed to deal with the ore, recovery was never high. As of June, 1943, J.L. Fozard was General Manager of both St. Anthony Mining and Development and Mammoth-St. Anthony, Ltd. The two companies still shared the operation of the Tiger mines, with Mammoth-St. Anthony handling shipments.

In October of 1943, the War Production Board granted a 40-cent-a-day pay increase to company employees as a result of a dispute with the Mine, Mill, and Smelter Workers Union. This increase brought miners' base pay to \$6.40 per day. By the end of 1943, the company was in a precarious financial condition. It was on the verge of shutting down at any time due to the extremely high pumping costs. The only thing keeping the mines in operation were government bonus payments for strategically important metal production, which now included lead and zinc along with molybdenum and vanadium.

On September 3, 1944, the Mohawk shaft caught fire. All of the timbering in the shaft was destroyed, along with the wooden headframe, hoist house, warehouse, coarse ore bins, coarse crushing plant, fine crushing plant, and all wiring and pipe lines. Shortly after the fire broke out, the pumps in the shaft failed, leaving the entire community of 1,400 people without water. And there was no water with which to fight the fire. The fire was not brought under control until help arrived from Davis-Monthan Air Base in Tucson. The company arranged to haul water for the town until the pumps could be put back into operation. At that time, John A. "Jack" Richards was general manager, Henry Carlisle was referred to as "consulting engineer," R. Eddy, Sr., was mine superintendent, and C.E. Craven was mill and smelter superintendent. All employees of the company were kept on the payroll after the fire, doing clean-up and repair work.

The mine pumps were back in operation by September 6, and by September 12, most of the clean-up work was completed. By November 15, the shaft had been repaired by a rather ingenious method. The Mohawk shaft was accessible underground through the Mammoth shaft. The burned-out shaft was filled to within 15 feet of the collar with mill tailings, which were loaded by hand into trucks and dumped into the shaft. New timbers were set at the collar and were concreted. Then the tailings were drawn out of the shaft from below in stages, far enough to allow the miners a floor to stand on while they installed new timber. This method eliminated the hazard of working in an open shaft, over a 900-foot-deep hole. As work progressed downward, the air was sampled frequently and care was taken to remove any carbon monoxide left from the fire.

A steel headframe was purchased from the Verde Central mine in Arizona, and a hoist from the Atolia mine in California. Compressors and steel ore bins were scavenged. The truck hauling the hoist overturned on its way to Tiger, and the hoist was destroyed; another one had to be purchased and brought in from Tonopah,

Nevada. The change of hoists forced the workmen to tear out and remodel the newly installed foundation for the headframe. While the fire damage was being cleaned up and repaired, the mill, which was not damaged by the fire, was overhauled. New steel ore bins and crushers were installed there. Before the fire, all of the ore was hoisted from the Mammoth shaft and carried by tramway to the crushing plant and mill near the Mohawk shaft. When the wooden tram towers near the Mohawk shaft burned, it was decided to equip the Mohawk shaft for hoisting ore. After the shaft was repaired, it was deepened, and sulfide ore was mined from the lower part of the Collins vein between the 700- and 900-foot levels. The ore minerals of primary significance now were the lead and zinc sulfides, galena and sphalerite.

When World War II ended, some of the miners who had gone off to war returned to work at Tiger. During the latter half of the 1940s, the manager of the operations at Tiger was John A. "Jack" Richards; mine superintendent was Richard Eddy; assistant manager was Joe Strutzel; mill superintendent was Vern Given; chief electrician was Homer Wood; master mechanic was Earl Snodgrass; accountant was Brooks Roebuck, whose wife, May, was postmaster at Tiger; and purchasing agent was James "Jim" Gardner.

After the end of World War II, St. Anthony Mining and Development continued to produce lead and zinc sulfide ore from the lower levels on the Collins vein. No further mining was done on the Mammoth vein, which was oxidized for its entire depth. On December 31, 1945, Mammoth-St. Anthony Mining Company, Ltd., was formally dissolved; St. Anthony Mining and Development Company took over its functions and continued to operate the mines and processing facilities as a single entity. Lead and zinc production continued, with 1946 production exceeding that of 1945. The year 1949 marked a peak in demand for and production of lead and zinc. A tapering off in production began in 1950. By 1951, a flood of lead and zinc imports had caused many lead and zinc mines in the United States to shut down.

The situation became progressively worse. During the entire period of lead and zinc production at Tiger, mill recovery had been erratic. The best recovery was from pure sulfide ore, from the deepest levels of the Collins vein. The more oxide minerals present in the ore, the worse recovery was. But as the mine workings progressed deeper, the influx of water increased. By 1952, mining on the Collins vein was down to the 1,125-foot level. The amount of lead and zinc in the ore was decreasing with depth and the amount of water which had to be pumped out of the workings was increasing. At the same time, the prices of lead and zinc continued to decrease. Production during 1952 was about 8,000 tons a month, and there were 190 men on the payroll.

On December 1, 1952, St. Anthony Mining and Development Company suspended operations at Tiger. On February 11, 1953, Magma Copper Company announced the purchase of nearly all the property of St. Anthony Mining and Development at Tiger. The property was acquired in exchange for 10,000 shares of Magma capital stock, which was worth \$275,000 at that time

on the New York Stock Exchange. The townsite was evacuated, and the post office was closed on November 26, 1954. During the 1960s, '70s, and '80s, lessees, contractors, and Magma dug out old tailings and quarried surface rock for use as gold-bearing smelter flux, both from Tiger and from the old Mammoth millsite along the banks of the San Pedro River. Both Magma and Cyprus Minerals Company have drilled and evaluated the Tiger area for its gold potential. Further chapters may yet be written on the history of the mines at Tiger.



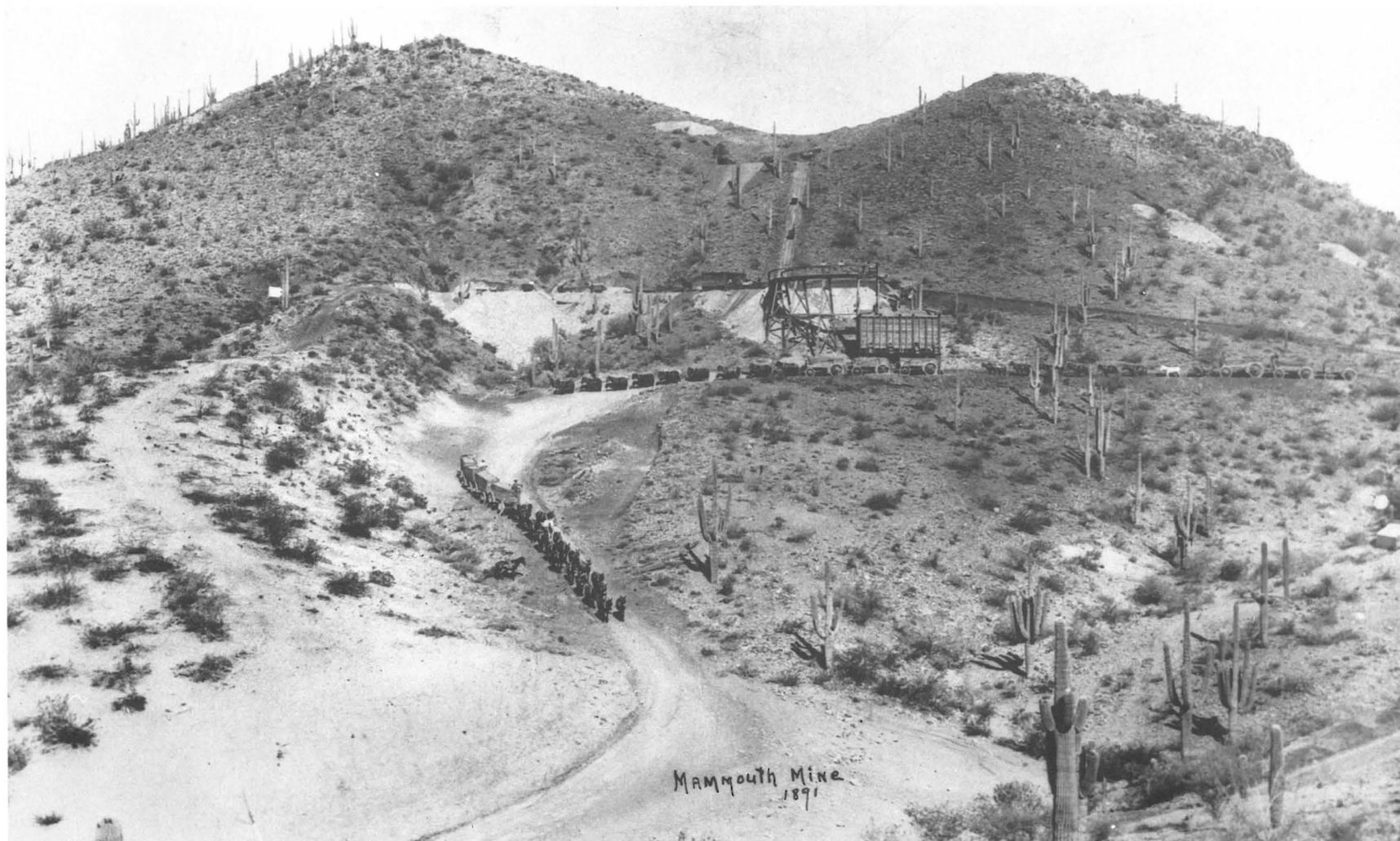
## Acknowledgements

This history was compiled from a large variety of sources, both published and unpublished. For the sake of readability, no attempt was made to cite specific references except for direct quotations. Many of the old newspaper clippings which were used had no identification as to what publication they were taken from. Memories become hazy, press releases can be garbled or intentionally misleading, and misinformation can be perpetuated by succeeding research efforts. The information presented in this history represents a "best fit" among conflicting versions, the most reliable and consistent sources having been given the greatest credibility. The writer would like to acknowledge help, information, and/or photographs from the Arizona Historical Society, Richard Bideaux, Mike Canty, Anna Domitrovic and the Arizona Sonora Desert Museum, the late Violet (Mrs. James) Gardner and her daughter, Jamie (Mrs. John) Dicus, Mike Greeley, Frank Harris and Magma Copper Company, Bill Howell, Earl Snodgrass, the University of Arizona Special Collections, and Daisy (Mrs. Harvey) Willeford.

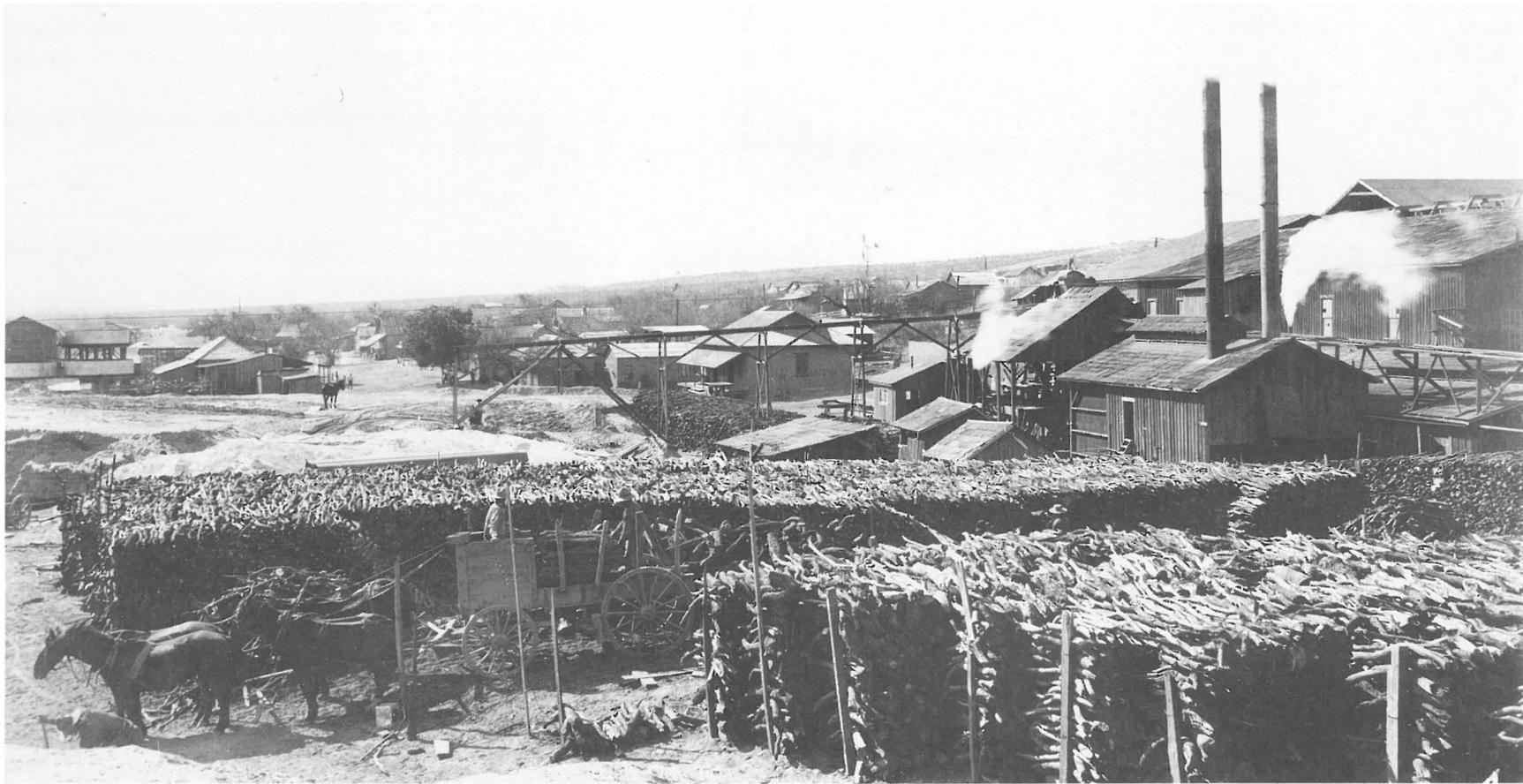
## References

- Anthony, J.W., Williams, S.A., and Bideaux, R.A., and Grant, R.W., in press, *Mineralogy of Arizona*, 3rd edition: The University of Arizona Press, Tucson.
- Arizona Geological Survey (formerly Arizona Bureau of Mines and Arizona Department of Geology and Mineral Technology), CRIB files, clippings files, and miscellaneous reports and correspondence.
- Arizona Historical Society library and photograph collections, including newspaper files of the *Tucson Daily Citizen*, *Arizona Mining Index*, *Arizona Blade Tribune*; oral history transcripts; biographical files; letters; and business papers.
- Arizona Mining Journal*, October, 1917, January and June, 1918, and April, 1919, issues.
- Arizona State Department of Mineral Resources, Engineer's field reports, clippings files, miscellaneous reports.
- Arizona State Department of Mineral Resources, 1963, *History of Mining in Arizona*, 47 pp.
- Benedict, P.C., January 5, 1934, Report to E.D. Wilson, in files of Arizona State Geological Survey (formerly Arizona Bureau of Mines).
- Bideaux, Richard A., 1980, "Famous Mineral Localities: Tiger, Arizona": *The Mineralogical Record*, May-June, 1980, pp. 155-181.
- Blake, William P., 1901, Report of the Governor of Arizona to the Secretary of the Interior, Washington, pp. 188-190.
- Creasey, S.C., 1950, "Geology of the St. Anthony (Mammoth) Area, Pinal County, Arizona" in *Arizona Bureau of Mines, Arizona Zinc and Lead Deposits, Part I*: University of Arizona Bulletin 156, pp. 63-84.
- Creasey, S.C., 1965, *Geology of the San Manuel Area, Pinal County, Arizona*: U.S. Geological Survey Professional Paper 471.
- Davey, T.G., 1900, unpublished report in the files of the Arizona Sonora Desert Museum.
- Dorenfeld, A.C., 1944, *Lead-zinc Separation at Mammoth-St. Anthony*: American Institute of Mining and Metallurgical Engineers Technical Publication No. 1714, 4 pp.
- Hess, Frank L., 1924, *Molybdenum Deposits*: U.S. Geological Survey Bulletin 761, 35 pp.
- Hilzinger, J. George, 1897, *Treasure Land*: Arizona Advancement Co., Tucson, 160 pp.
- Hockett, R.L., June 1984, "Tiger: A Brief Look at Current Utilization and Potential": unpublished transcript of a talk given before the Arizona Conference—A.I.M.E. Mining Geology Spring Meeting.
- Horton, Frederick W., 1916, "Wulfenite at the Mammoth and Collins Mines, Pinal County" in *United States Bureau of Mines Bulletin 111, Mineral Technology 15, Molybdenum; Its Ores and Their Concentration*, pp. 46-48.
- Joseph, P.E., 1915-16, *Molybdenum*: Arizona State Bureau of Mines Bulletin No. 5, Mineral Technology Series 3, 9 pp.
- Magma Copper Company, *Magma Update*, February, 1985, and October, 1990, issues.
- McBride, Wilbert G., July 8, 1916, "The Motor-Truck in Arizona": *Mining and Scientific Press*, pp. 45-46.
- Oracle Historian*, 1978, v. 1, no. 2; 1980, v. 3, no. 1; and 1984-85, v. 7, no. 1: Oracle Historical Society, Oracle, Arizona.
- Panczner, William D., 1976, "The Mammoth-St. Anthony Mine, Tiger, Arizona, Its history, geology, and mineralogy": *Mineralogical Society of America—Friends of Mineralogy Second Biennial Symposium Field Trip Guidebook*, 16 pp.
- Paydirt*, January 24, 1972, Tiger and the Mammoth-St. Anthony District, p. 16.
- Peterson, N., 1938, *Geology and Ore Deposits of the Mammoth Mining Camp Area, Pinal County, Arizona*: University of Arizona, Arizona Bureau of Mines Bulletin 144, 63 pp.
- Peterson, N., 1938, Mammoth Mining Camp Area, Pinal County, Arizona: *Some Arizona Ore Deposits*, University of Arizona, Arizona Bureau of Mines Bulletin 145, pp. 124-127.
- Rickard, T., 1896, *Vein Walls: Transactions of the American Institute of Mining Engineers*, v. 26, pp. 214-215.
- San Manuel Miner*, April 22, 1954; March 2, 1972 issues: San Manuel, Arizona.

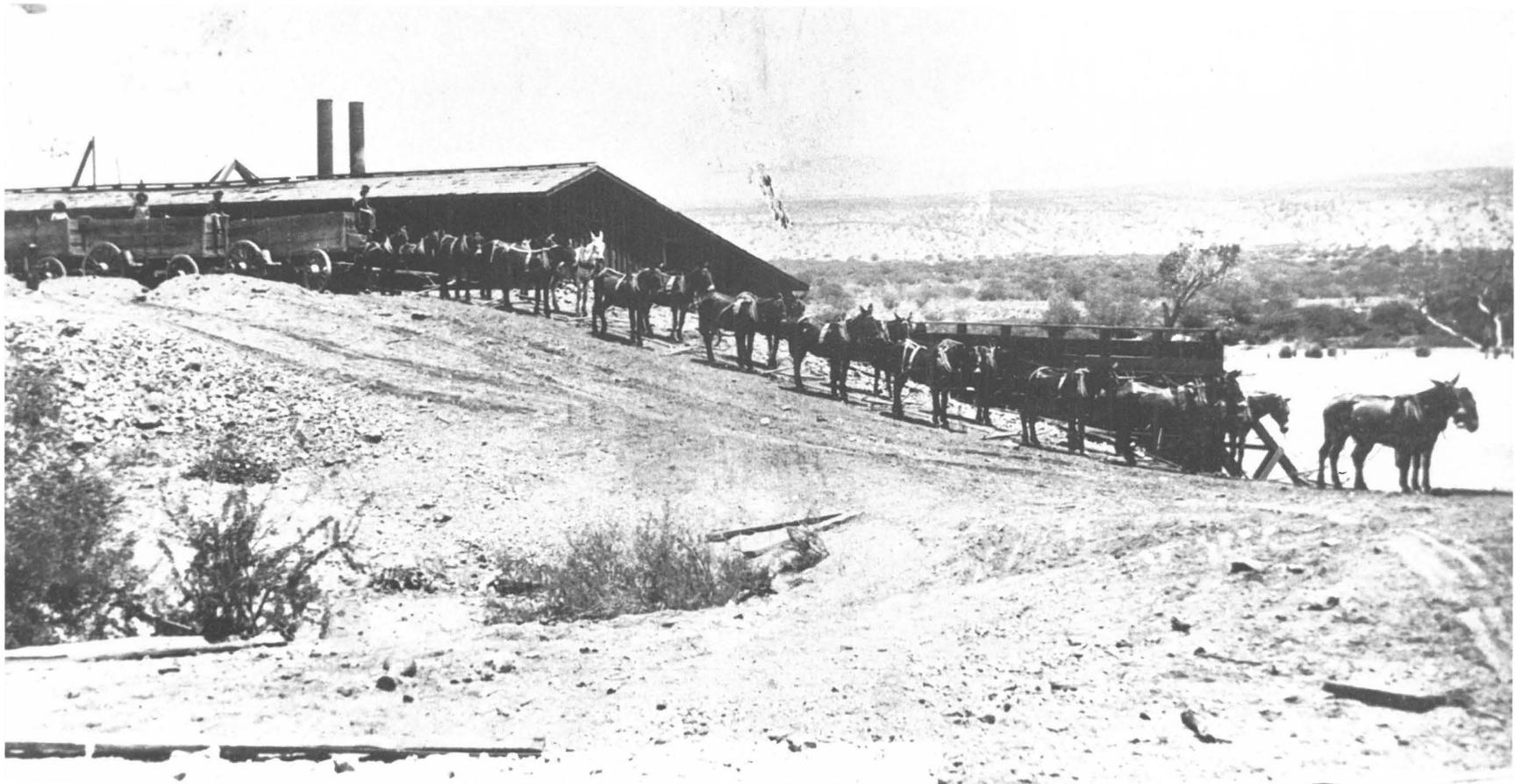
- Stewart, S.O., 1912, The Old Hat Mining District, Pinal County, Arizona: *Mining and Engineering World*, v. 36, p. 952.
- Tenney, James B., 1927-29, *History of Mining in Arizona*: Asst. Geologist, Arizona Bureau of Mines, Tucson: University of Arizona Special Collections, manuscript collection.
- Timmons, Colin, June 5, 1917, unpublished report in files of Arizona Geological Survey (formerly Arizona Bureau of Mines).
- United States Bureau of Land Management, patent survey records, Phoenix, Arizona, office.
- University of Arizona Special Collections, miscellaneous photograph, manuscript, and biographical files.
- Wilson, E.D., Cunningham, J., and Butler, G., 1934, *Arizona Lode Gold Mines and Gold Mining*: Arizona Bureau of Mines Bulletin 137, 261 pp.



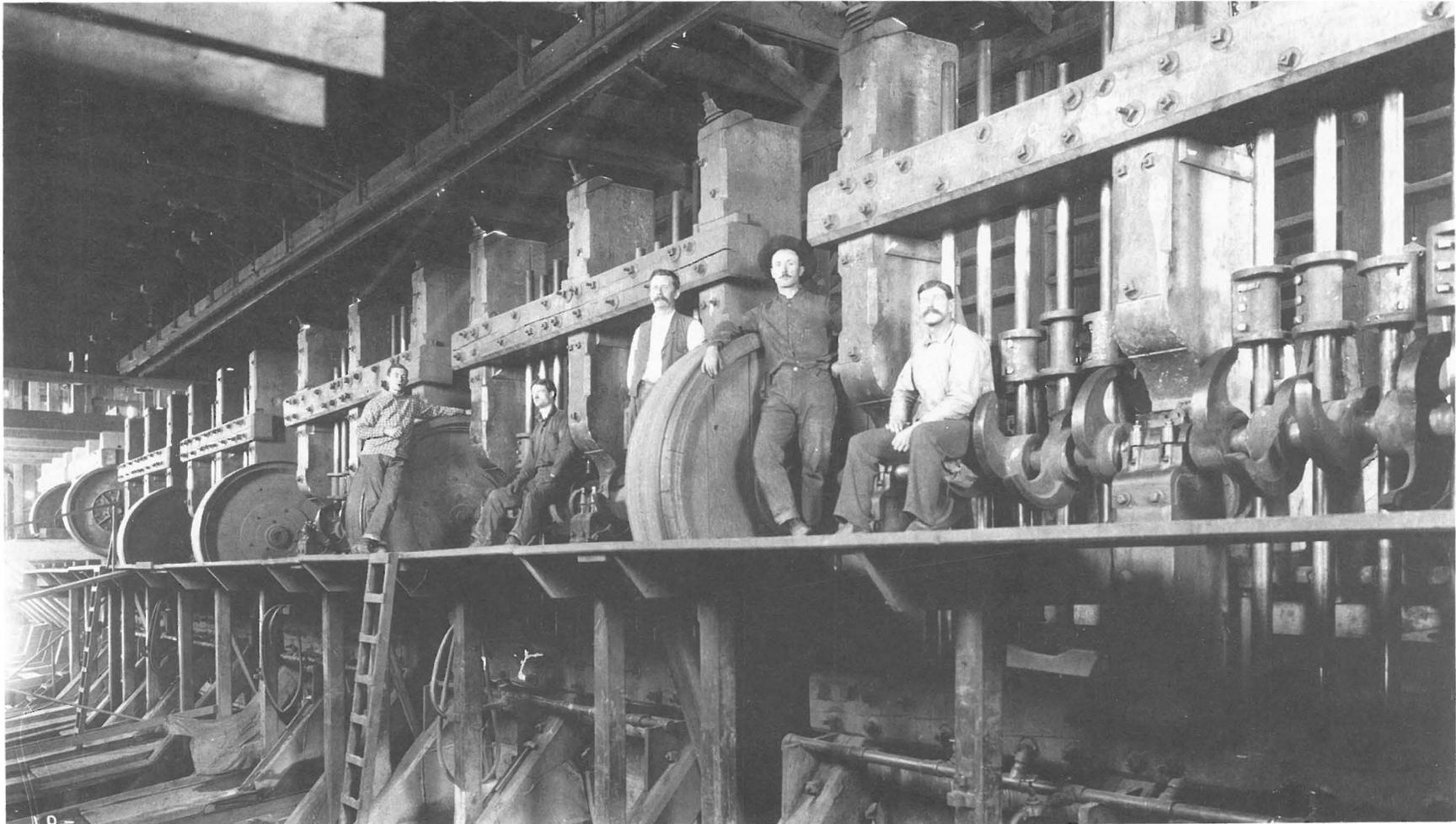
This photo appears to be mislabeled; the workings shown are the Collins open cut. The ore-loading facilities may also be for the Mammoth Mine, however, which would be off the edge of the photograph to the right. Dated 1891. Courtesy of the Arizona Historical Society/Tucson.



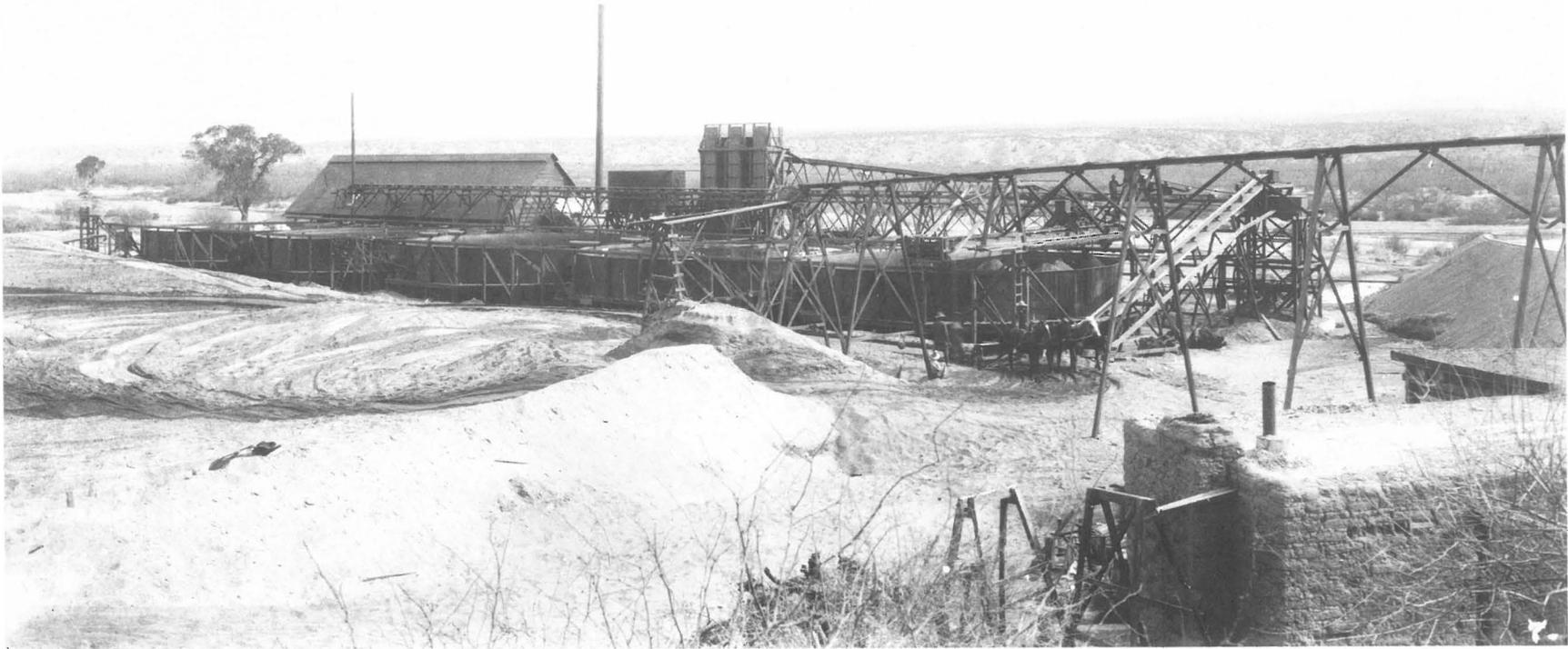
Mammoth stamp mill, c. 1896. Stockpiles of mesquite fuel wood are shown in the foreground, and the town of Mammoth in the background. Courtesy of the University of Arizona Library—Special Collections.



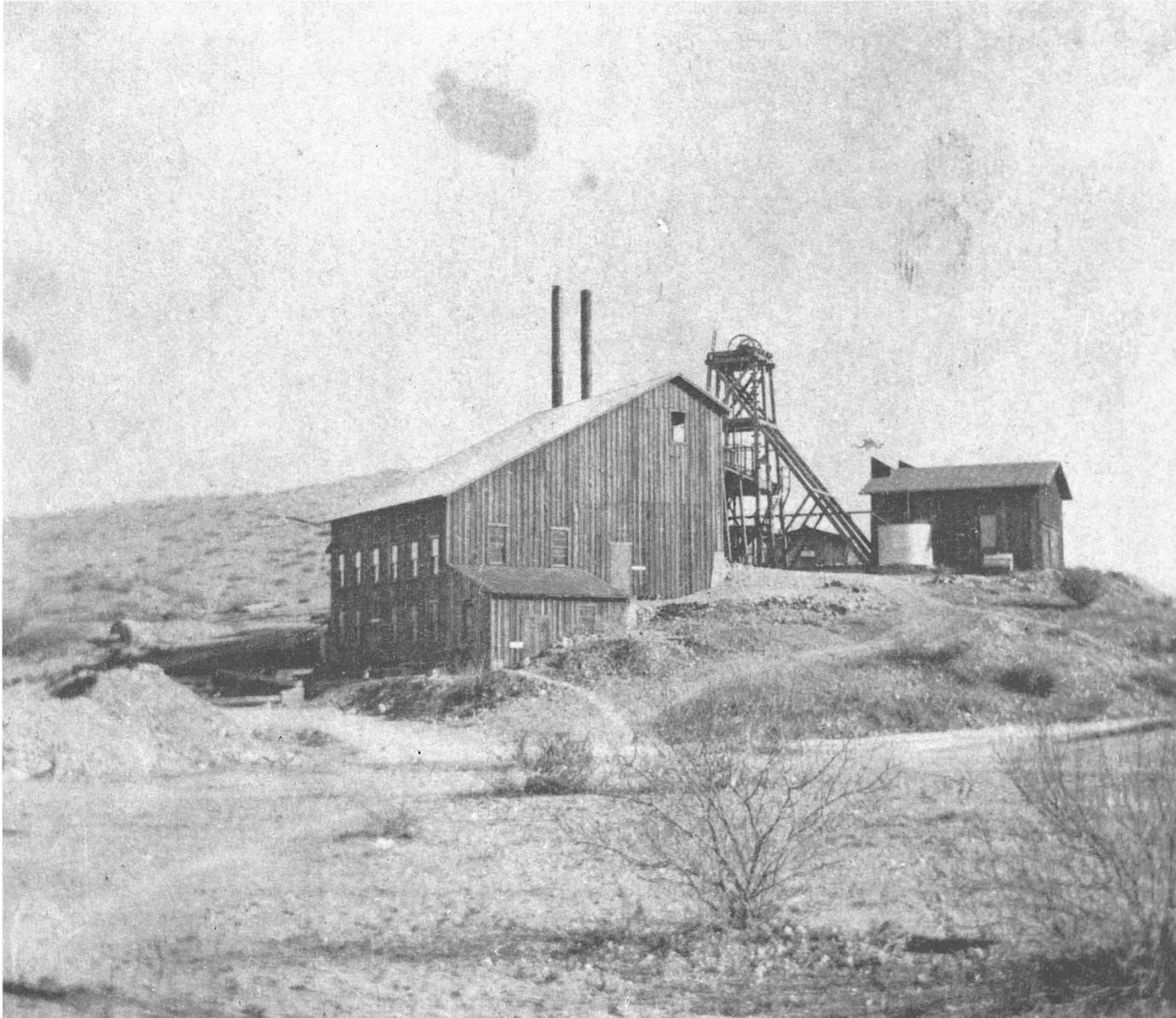
Another view of the Mammoth stamp mill, c. 1896 or earlier. The 20-mule-team ore wagons are shown unloading at the mill, after the trip from Schultz. The San Pedro River can be seen at right-center, behind the mill. Courtesy of Magma Copper Company.



Interior view of the Mammoth stamp mill, c. 1895, showing all 70 stamps in 14 sets of 5 each. Courtesy of the University of Arizona Library—Special Collections.



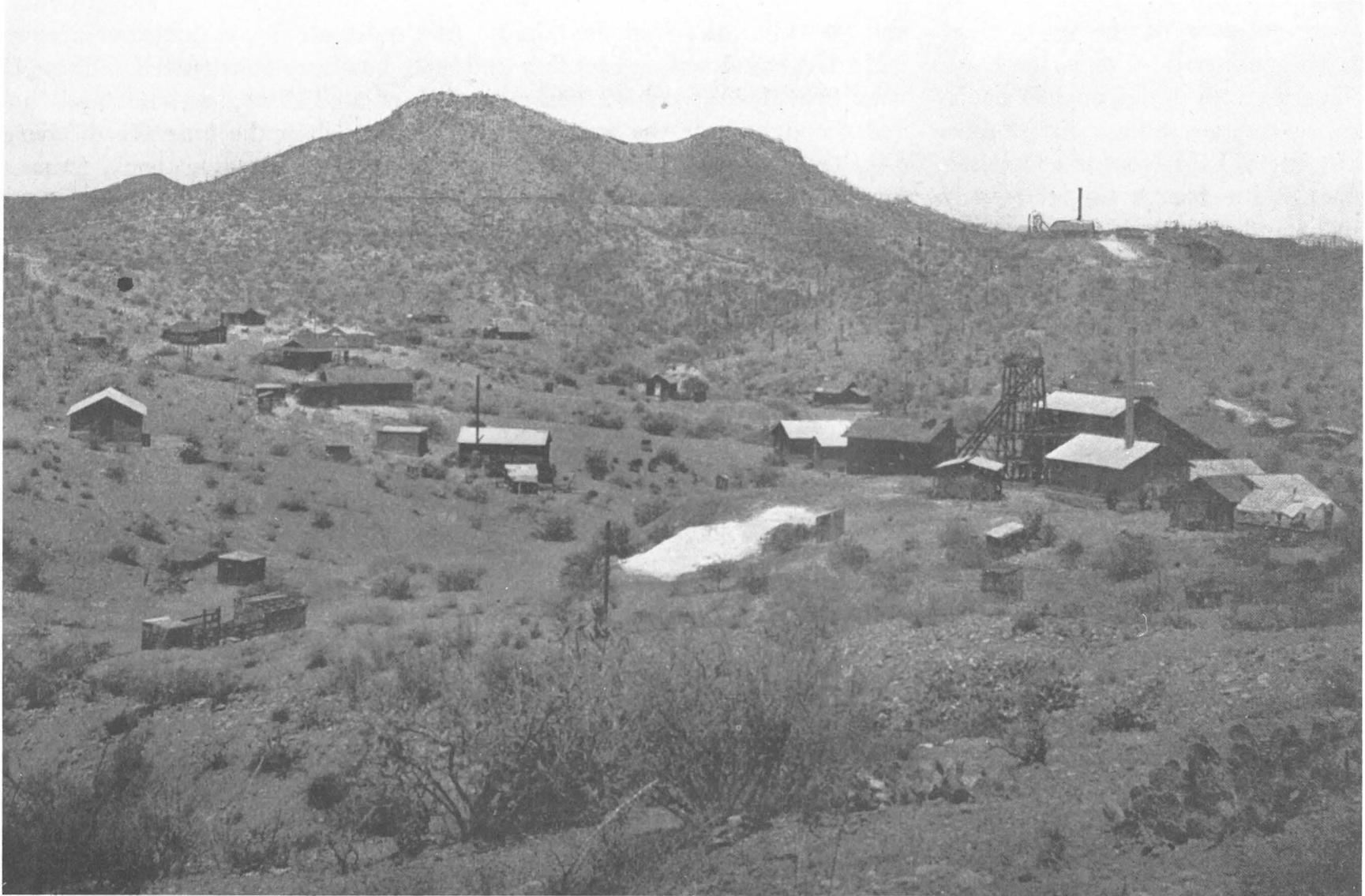
The Mammoth Cyanide Works, which was constructed in 1897. The San Pedro River can be seen immediately behind the plant, especially at left-center. This photograph must have been taken some time between 1897 and 1900, when cyanide operations were suspended. Courtesy of the University of Arizona Library—Special Collections.



Mohawk stamp mill, c. 1896. At this time, the mill only contained 10 stamps. The Mohawk headframe is also shown. Courtesy of the Arizona Historical Society/Tucson.



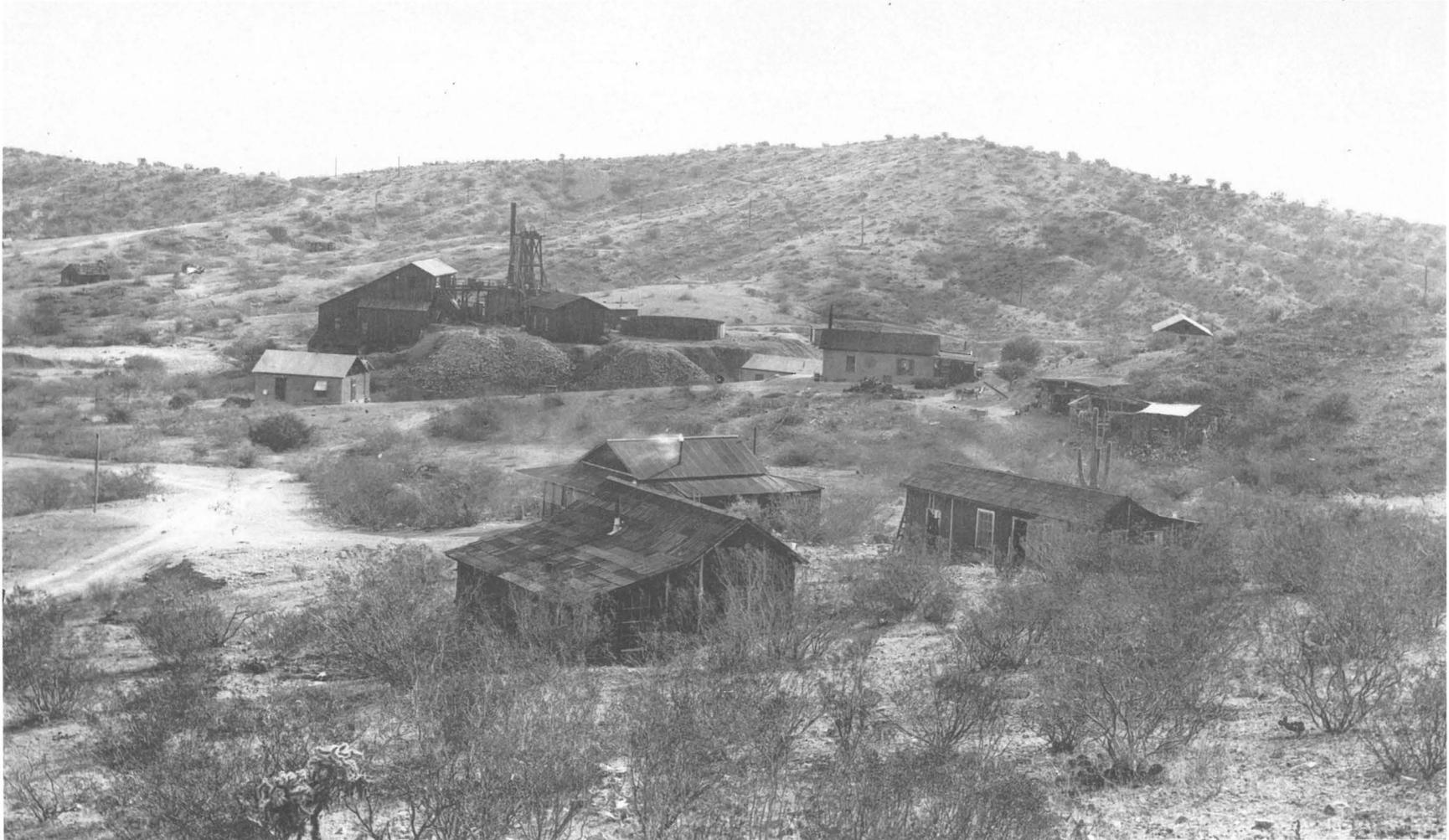
Crew of the Mohawk Mine, taken behind the hoist house, c. 1898. Second from left, on the burro, is assayer Frank W. Fish. After the Mohawk was shut down in late 1898, Fish attended the University of Arizona and was a member of its first football team in 1899. Courtesy of the Arizona Historical Society/Tucson.



Town of Schultz, late 1890s. The Mammoth Mine can be seen at upper right, and the Mohawk Mine and mill at right-center. Nothing remains of the ore bin and loading chutes on the hillside at top-center, shown in the first photo on page 178.  
Courtesy of the Arizona Historical Society/Tucson.



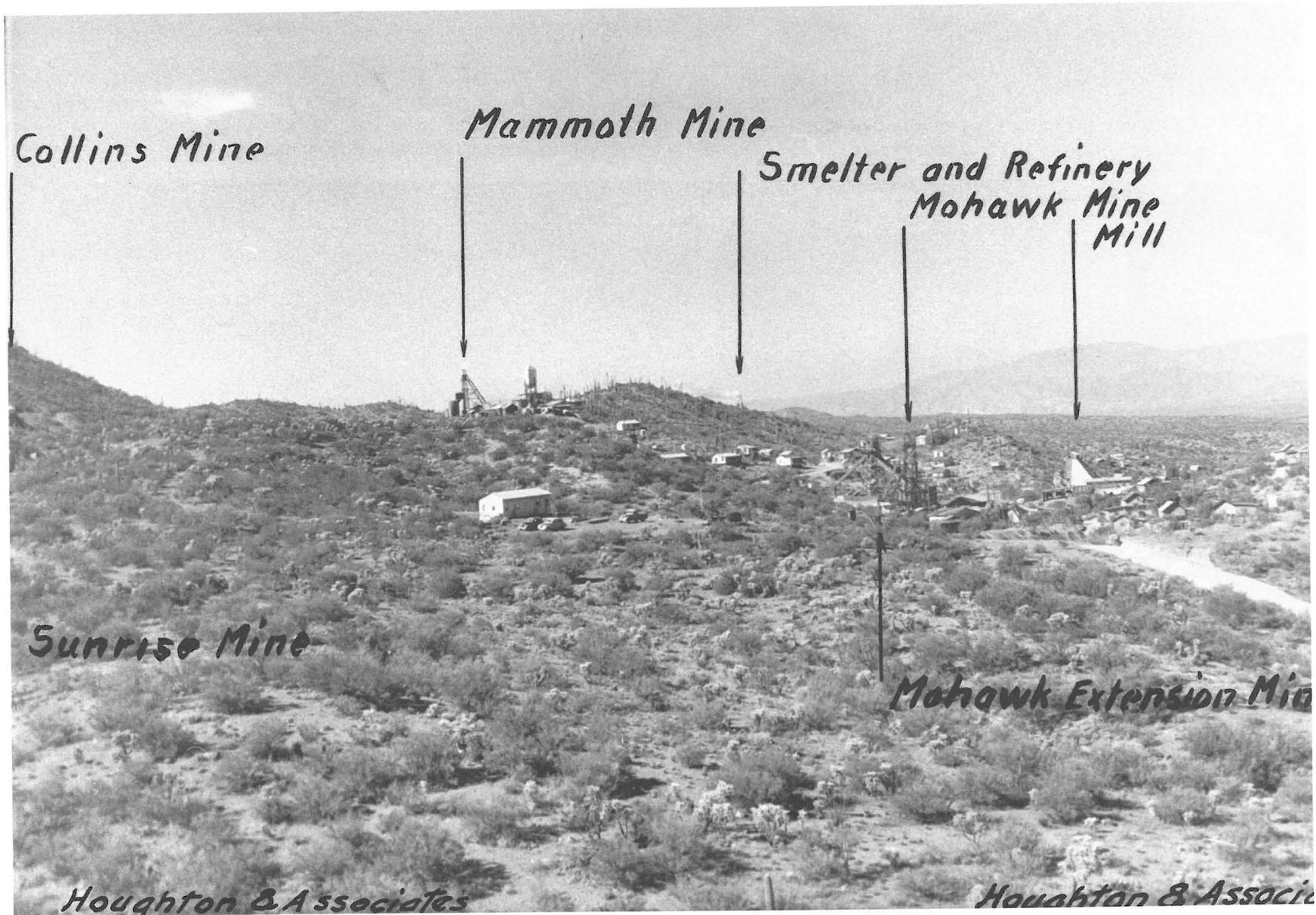
Trucks and garage at the Mammoth Mine, 1914, Part of the Young brothers' operation.  
Courtesy of the Arizona Historical Society/Tucson.



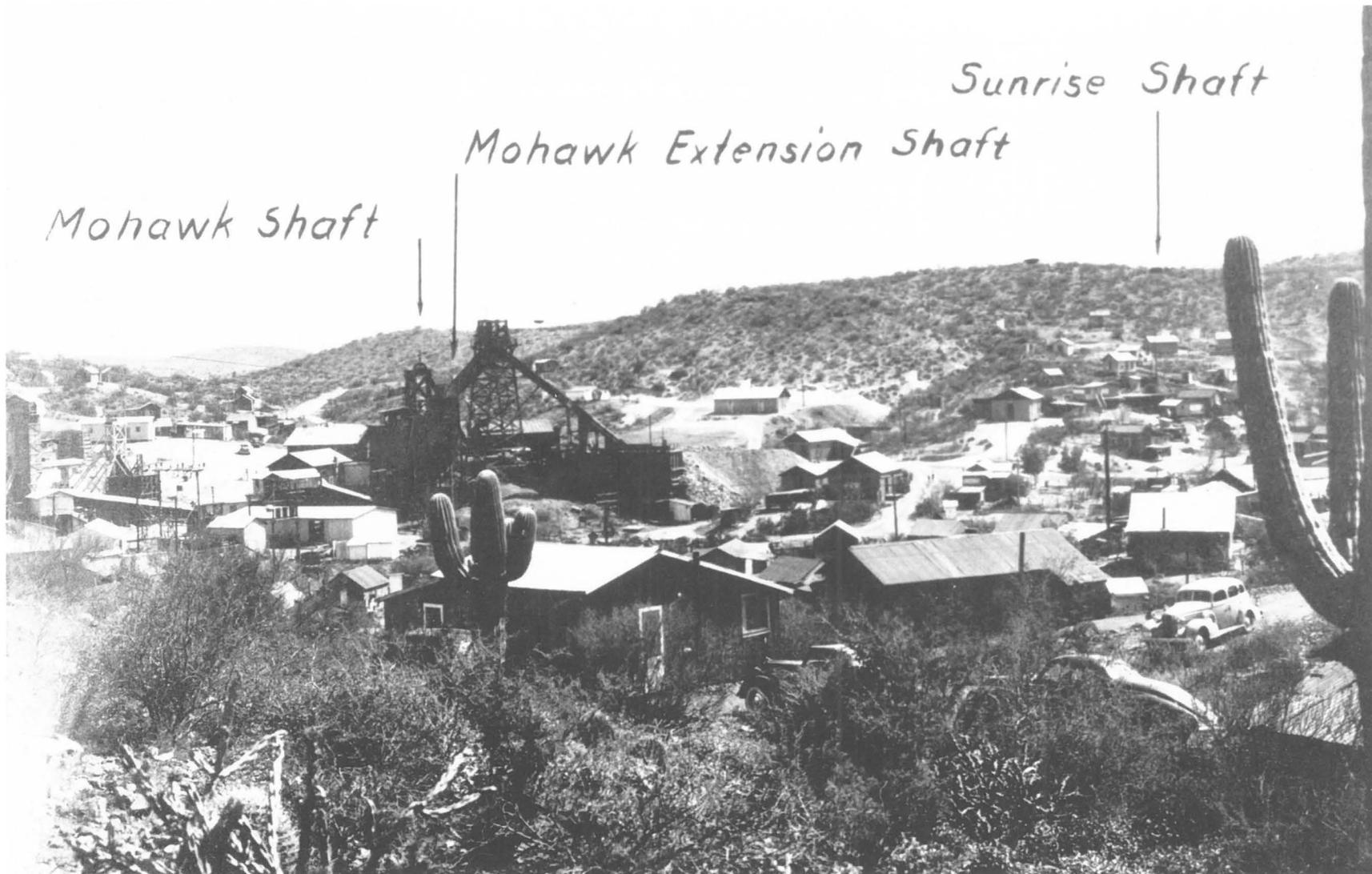
The town of Schultz, c. 1914, with the Mohawk Mine and mill at center.  
Courtesy of the Arizona Historical Society/Tucson.



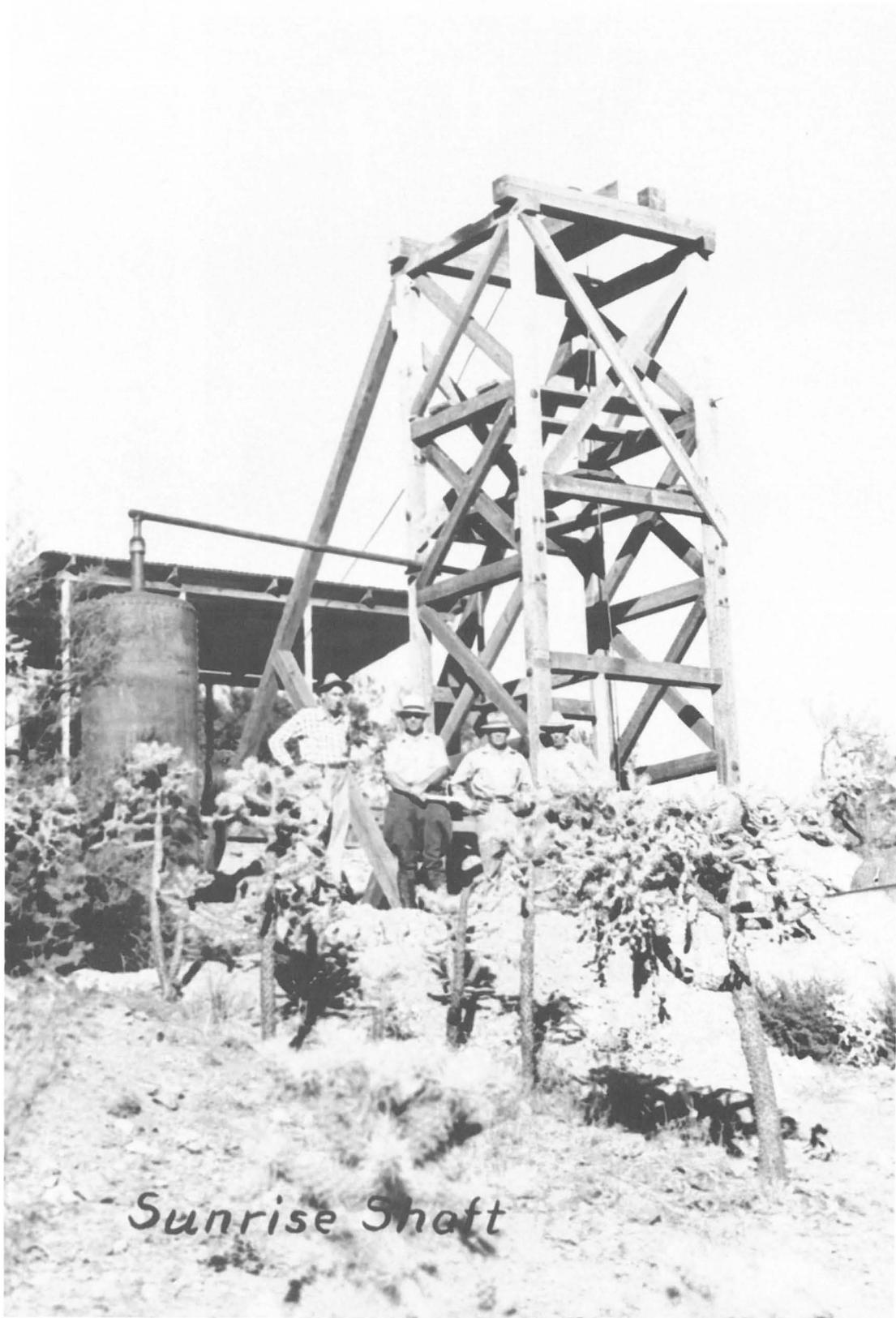
Mammoth Mine headframe and buildings, c. 1914. Courtesy of the Arizona Historical Society/Tucson.



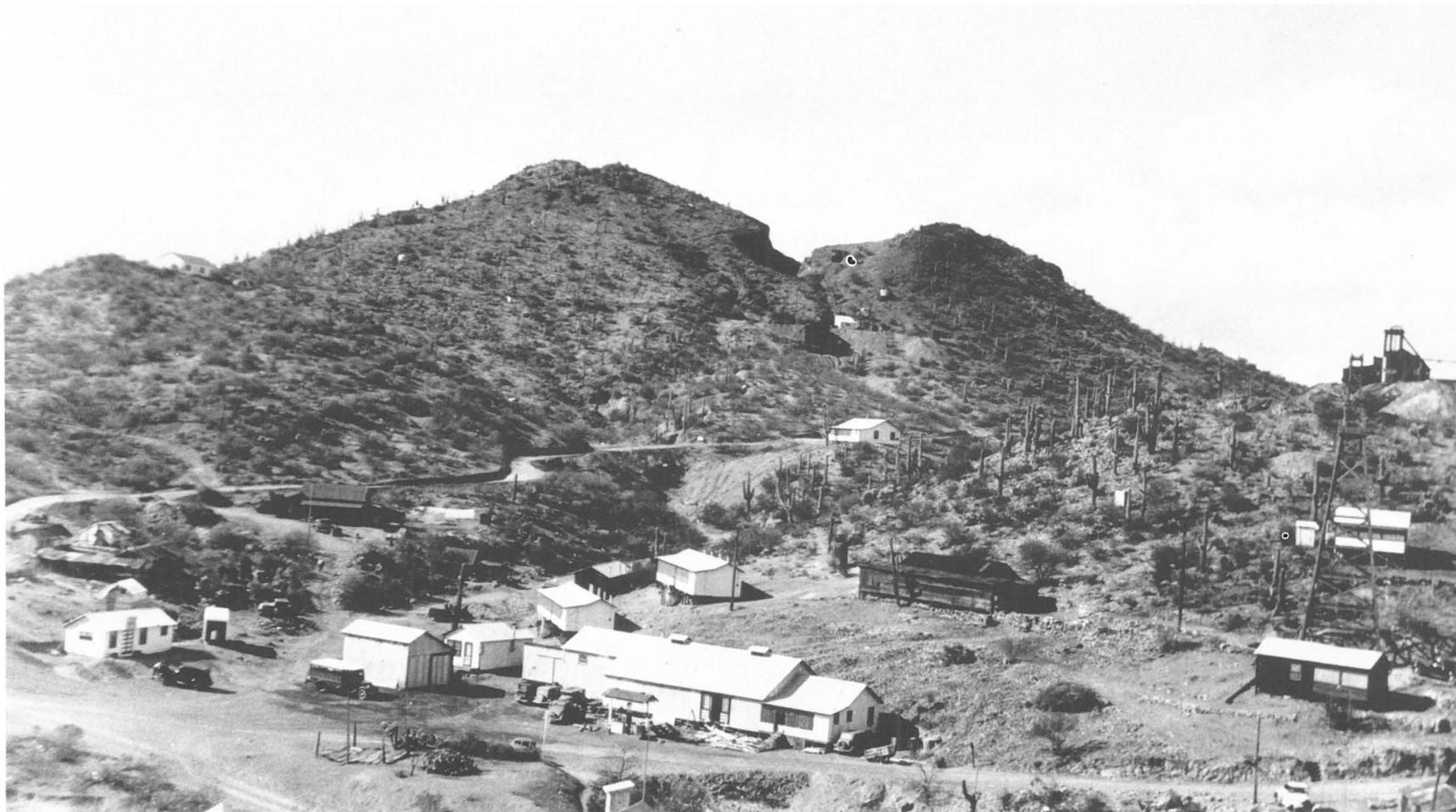
A promotional photograph of Tiger labeled by Houghton & Associates, which was probably taken sometime between 1937 and 1940. The Sunrise Mine, labeled on the far left, never recorded any production. View is looking north and east, with the Galiuro Mountains in the background. Courtesy of the Arizona Sonora Desert Museum.



Another view of Tiger, a promotional photograph labeled by Houghton & Associates, which was probably taken sometime between 1937 and 1940. The new Mohawk mill can be seen at the far left, next to the Mohawk headframe and the tramway terminal tower. There is no headframe visible at the "Mohawk Extension Shaft." Courtesy of the Arizona Sonora Desert Museum.



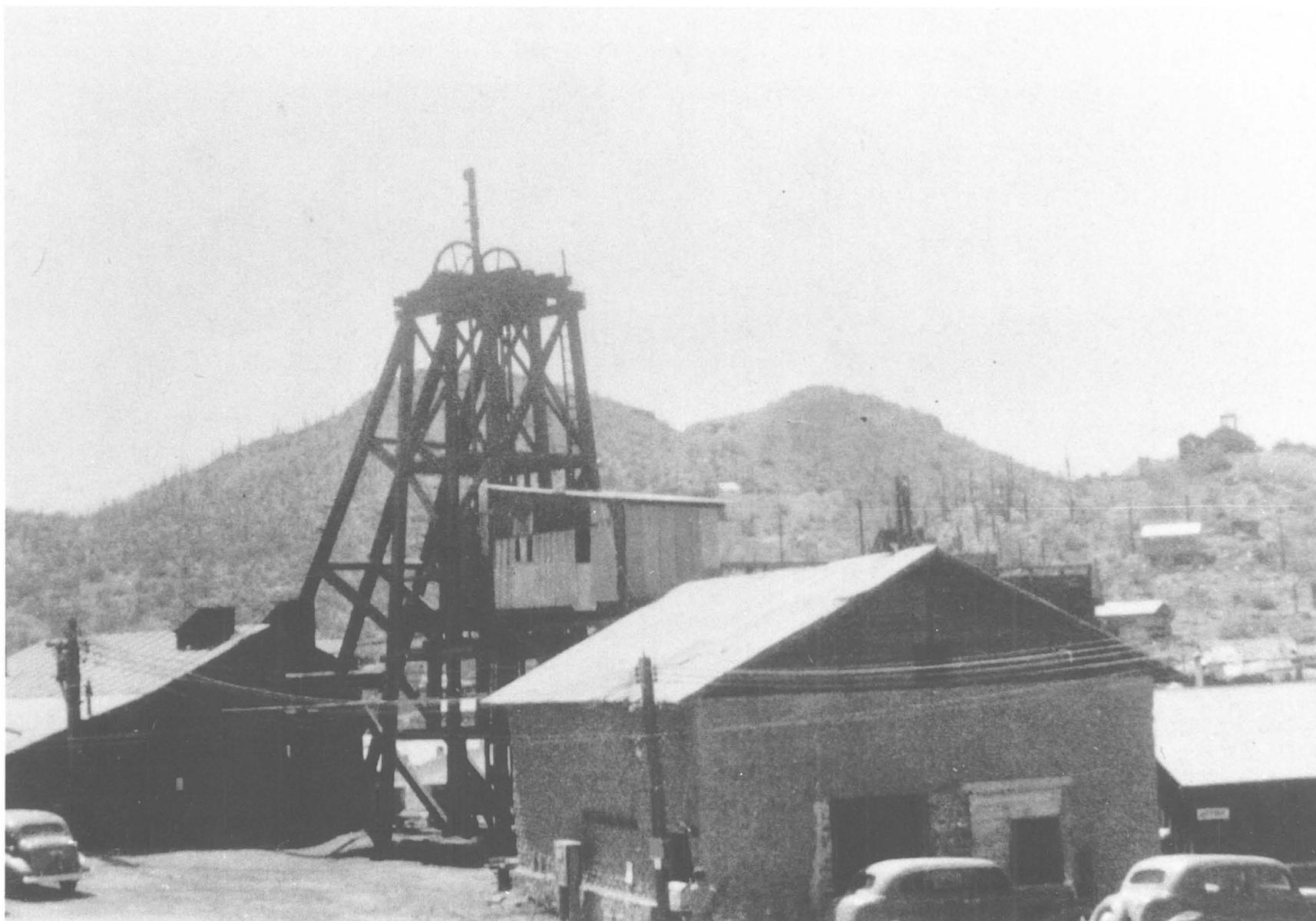
Promotional photograph by Houghton & Associates of the Sunrise Mine, which never recorded any production. The only man who has been identified in this photograph is George Biggs of Mammoth on the left. Biggs was a carpenter and handyman. Courtesy of the Arizona Sonora Desert Museum.



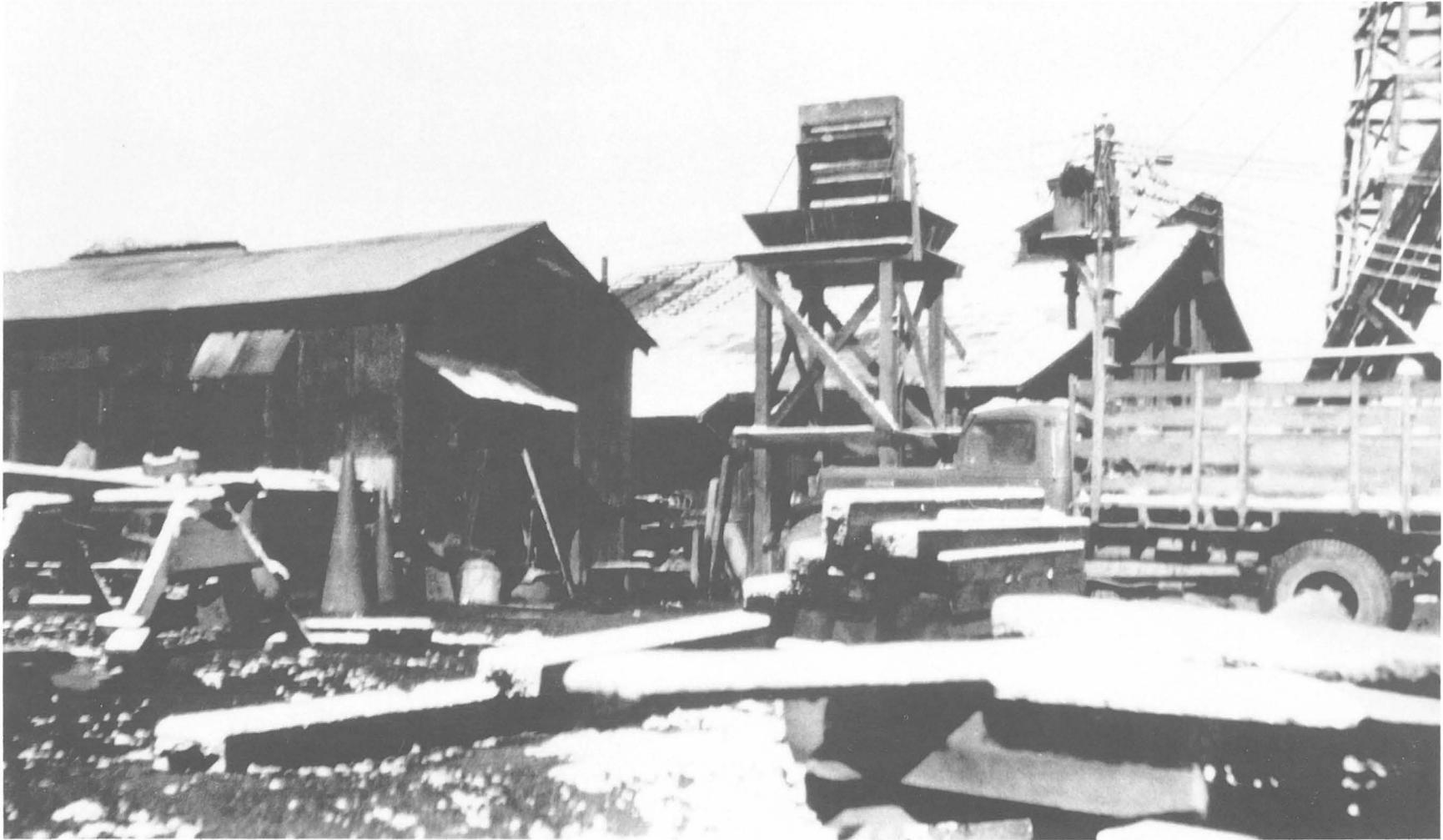
The town of Tiger, c. 1939. Tram towers from the Mammoth shaft to the mill are visible at the far right, and the photo was taken from a tram tower. The general store is at bottom-center, with the service station, restaurant, and barber shop to the left. The Collins glory hole is at top-center. Courtesy of Earl Snodgrass.



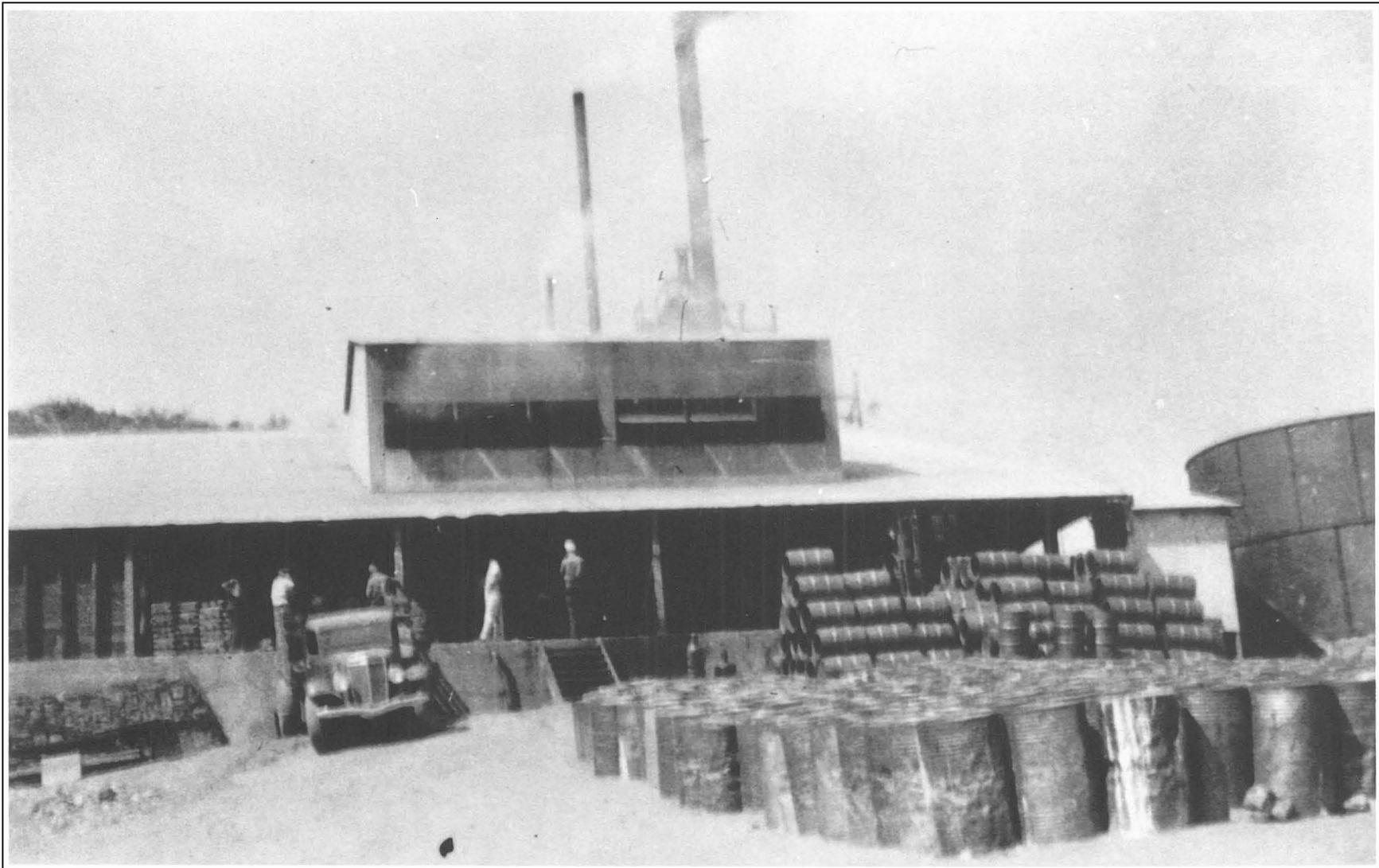
The Mohawk mill, c. 1938. Constructed by Molybdenum Gold Mining Company in 1935 and enlarged in 1936. Purchased by Mammoth-St. Anthony Mining Company, Ltd., in 1937. View looking southwest toward the tailings pond. Courtesy of Earl Snodgrass.



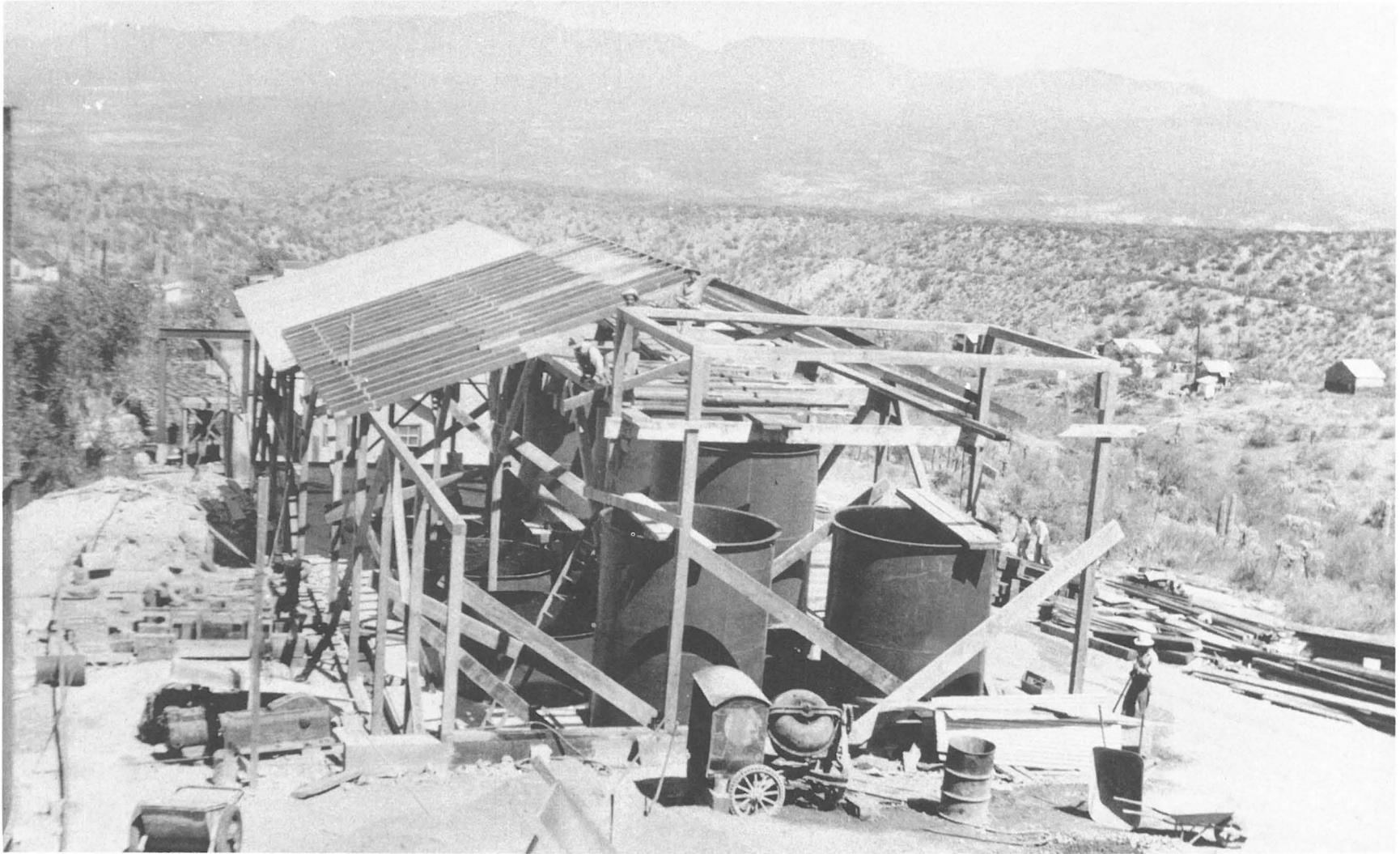
Old wooden headframe at the Mohawk shaft, c. 1939. The headframe and all the buildings in this photograph burned in 1944. The Mammoth shaft can be seen at right-center. Courtesy of Earl Snodgrass.



Blacksmith shop and hoist house at the Mohawk shaft after a rare snowfall, c. 1938. All the buildings and the wooden headframe at far right burned in 1944. Courtesy of Earl Snodgrass.



The lead smelter, c. 1939, with drums of molybdenum-vanadium salts waiting to be shipped out for further processing. Construction of the salt plant around 1940 allowed for such processing at Tiger. Courtesy of Earl Snodgrass.



The salt plant, under construction in 1940. This plant allowed for molybdenum and vanadium to be concentrated separately. Courtesy of Earl Snodgrass.



Shift change at the Mammoth Mine, c. 1940. Courtesy of Magma Copper Company.



Lamp room at the Mammoth Mine, c. 1940. Courtesy of Magma Copper Company.



Drilling on the Collins with "pneumatic 9er drills," c. 1940. Courtesy of Magma Copper Company.



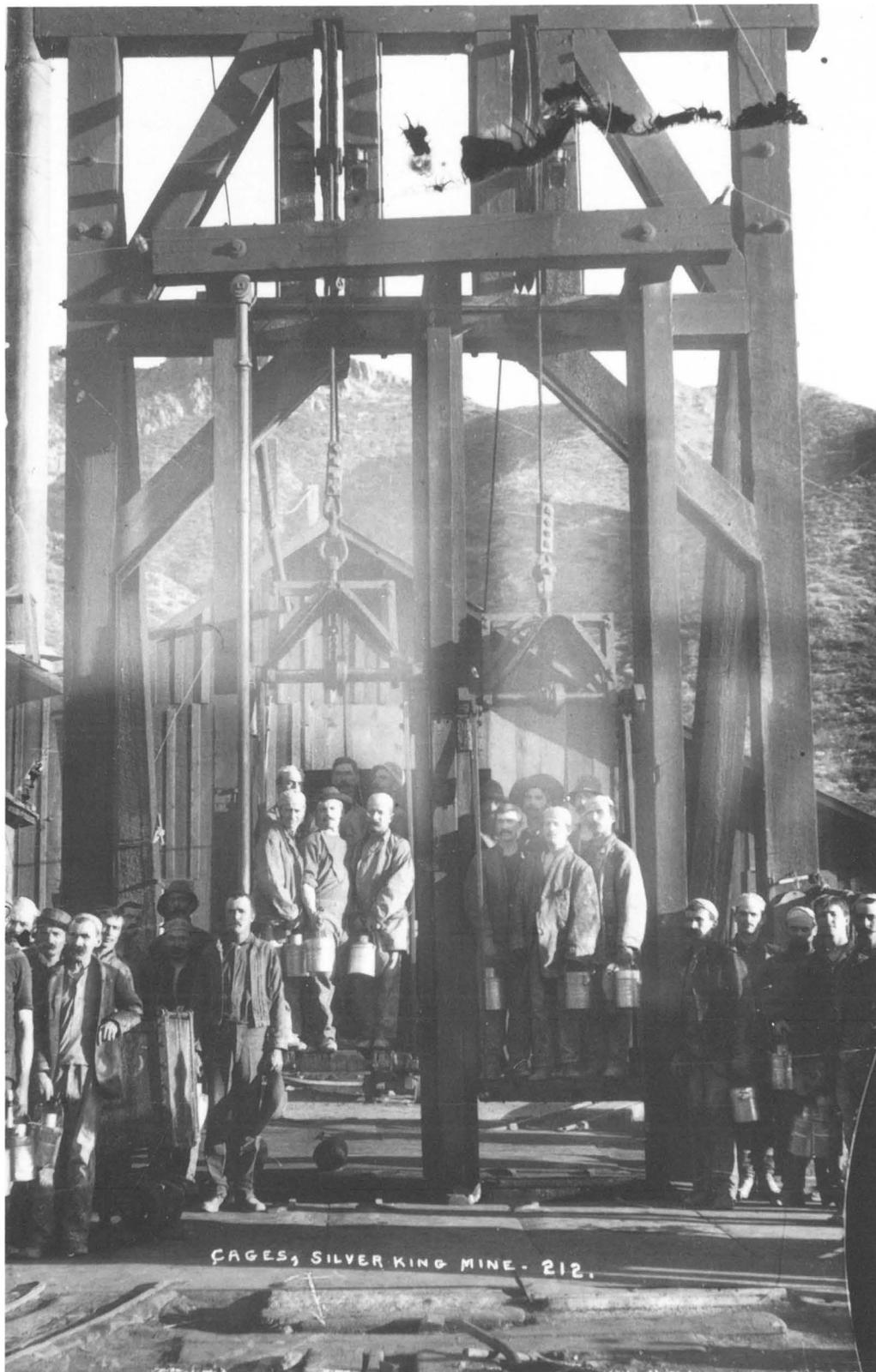
There was plenty of water—hand tramping, c. 1940. Courtesy of Magma Copper Company.



Ingots waiting for shipment from a smelter at Tiger. Courtesy of George Argall.



View of the town of Tiger, 1937. Courtesy of George Argall.



Miners at hoist cages at Silver King Mine, Pinal County. Courtesy of the Arizona Historical Society/Tucson.

**HISTORY OF MINING IN ARIZONA**  
**VOLUME II**

**EDITORS**  
**J. MICHAEL CANTY**  
**MICHAEL N. GREELEY**

PUBLISHED BY



**MINING CLUB OF THE SOUTHWEST FOUNDATION**  
**TUCSON, ARIZONA**