



NEVADA MINING AND YOU

SECOND EDITION

DID YOU KNOW?

THAT the United States, with only 5% of the world's population and 7% of its land area, consumes about 25% of all the minerals produced worldwide.

THAT in the United States, the total amount of nonfuel minerals used for the construction of roads, buildings, cars, refrigerators, etc. indicates that **each person requires approximately 40,000 pounds of new minerals every year.**

THAT there are only two basic industries that produce raw materials—mining and agriculture. If it can't be grown, it has to be mined.

THAT surface mining is practiced in all 50 states, but despite extensive exploration, over 99% of the land surface has never been worked by a miner's pick.

THAT hardrock (precious and base metals) mineral exploration and development is at an all time high in Nevada. Almost one-half of all mining claims in the United States are in our state.

THAT mining in the United States is highly regulated. Under the present mining, public land, and environmental laws, generally 15 to 20 separate permits are required to open a mine.

THAT the various transportation systems now established in the United States require approximately 10 times more land than mining requires.

THAT Nevada, as of 1990, ranks number one in the domestic production of gold, silver, barite, mined magnesite, and mercury. Nevada is the second largest domestic producer of lithium, diatomite, and gemstones.

THAT the United States dependency on the import of critical minerals is extremely high. For example, over 90% of the four most critical minerals to national security—cobalt, manganese, chromium, and the platinum group minerals—must be imported.

THAT in the last 50 years, the mining industry in its search for mineral resources has disturbed only a small portion of the land in Nevada. Much of this land has been reclaimed, and modern technology is enabling the industry to significantly increase reclamation.

THAT over 3,000,000 barrels of oil are produced annually in Nevada. The oil is recovered from eight major oil fields in Nye and Eureka Counties.

THAT Nevada geothermal power plants have a capacity of 130 megawatts of electric power, enough to supply the needs for approximately 375,000 homes. Nevada has even greater potential for future geothermal resources development.

NEVADA MINING AND YOU

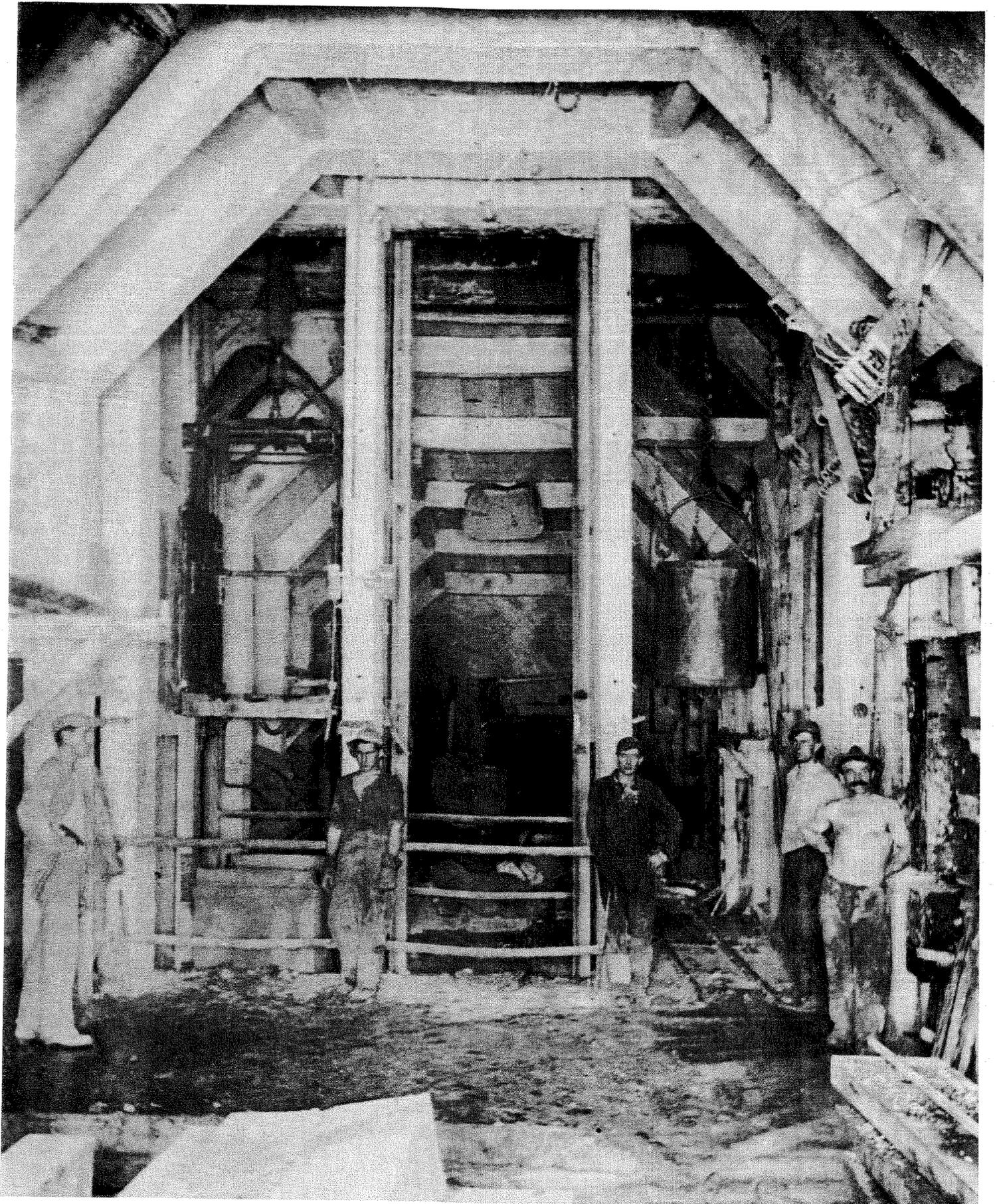
SECOND EDITION

*A resource guide
with sections on historical mining camps,
modern exploration and mining methods,
and an overview of some
mineral-producing areas in the state*

Prepared cooperatively by the
Nevada Department of Minerals

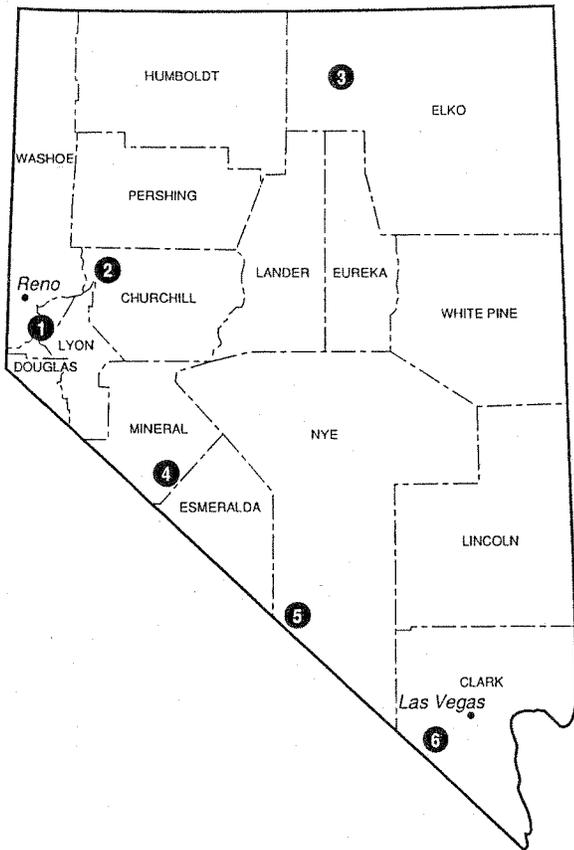
NEVADA BUREAU OF MINES AND GEOLOGY
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Miners in shaft at the Mizpah mine, Tonopah, circa 1905. *Nevada Historical Society photo.*

HISTORY OF MINING IN NEVADA



1. Comstock
2. Leete
3. Tuscarora
4. Candelaria
5. Rhyolite
6. Goodsprings

The earliest locations of mining activity in Nevada were in the southern tip of the state. Local legend has it that the Spanish mined in the El Dorado district on the Colorado River south of Las Vegas in the 1700s and that Native Americans mined there before that. The old Spanish Trail between Sante Fe, New Mexico and Los Angeles, California passed through this area, and mining by the Spanish could have been possible. An early route established by Mormons between Utah and San Bernardino in southern California also passed through Las Vegas. Two separate discoveries near there are credited to Mormons who were traveling the route. The silver-gold camp of

Wahmonie, located in southern Nye County north of Las Vegas, was established in 1847. A large piece of rock from a fireplace in an old cabin near Wahmonie bears an 1847 inscription. The lead deposits at Potosi, southwest of Las Vegas, were discovered in 1856, the year production was first recorded there.

In the north, gold *placer* deposits were discovered in 1850 in Gold Canyon, downslope from the Comstock Lode, and were mined during the early 1850s, leading to the eventual discovery of the Comstock silver-gold deposits in 1859. The Comstock discovery and resulting developments set into motion a period of general prospecting activity in the state and in the entire west that is only now being approached in intensity by a similar activity, the search for *disseminated gold*. The Comstock discovery has been compared, by analogy, to a stone tossed into a quiet pool, the ripples created being the waves of prospectors scrambling in all directions seeking other *bonanza* discoveries. Many of Nevada's famous mining camps were established within a few years after 1859, and most of them, at least the *precious-metal* camps, were known and worked prior to the turn of the century.

The study of Nevada history is, to a large extent, the study of Nevada's mines. Mineral discoveries created a reason for settlement; agriculture and other industries were established in the outlying areas to serve the mining population. To illustrate the nature of early mining activity in Nevada and to place this mining activity into perspective in the overall development of the state, historical sketches of six mining camps are included in this resource guide. The areas selected host a variety of minerals, and illustrate a cross section of early mining in Nevada. Most famous of these is the Comstock mining district, a silver and gold bonanza that brought statehood to Nevada in 1864. Leete's salt production played an important role in Comstock mining. An account of early gold mining at Tuscarora in Elko County tells of hundreds of Chinese workers extracting over \$1,000,000 in gold from "leftover" workings. We look at the silver camp of Candelaria and at Rhyolite, in the Bullfrog district of Nye County, where a city of cement, wood, and brick grew around such mines as the Montgomery-Shoshone. Lead and silver were found at Goodsprings in 1868 but not mined until 1886. After being idle for many years, several of these old mining areas are again flourishing and are yielding mineral resources for society. Modern mining operations are active at Candelaria and Rhyolite, demonstrating the vital and exciting role mining has played in Nevada's progressive economy.

Special note: The dollar amounts used throughout this resource guide reflect the actual value at the time of production.

COMSTOCK

The Comstock *mining district*, originally known as Washoe, includes several mining areas situated along the length of the Comstock Lode, a mineralized vein system that extends for over 6 miles along the lower slopes of the Virginia Range northeast of Carson City. The Virginia City and Gold Hill mines in Storey County, the Silver City or Gold Canyon mines in Lyon County, and the Flowery area of Storey County are all commonly included within the Comstock district.

The story of the Comstock began on a May morning in 1850 when a wagon train from Salt Lake City, bound for California, stopped for a rest on the banks of the Carson River near the site of the present-day town of Dayton. William Prouse, one of the passengers on the train, tried his hand at panning in a small stream nearby. He found a few *colors* of gold in his pan but placed no importance on the discovery and went on his way. Others returned to the site, later named Gold Canyon, and followed the stream up to the general area of Silver City, where small-scale placer gold mining was carried on for the next few years. Other prospectors, many of them disappointed gold-seekers returning from California, explored the nearby ravines and, in 1857, gold was also found in Six Mile Canyon several miles to the northeast of the original placer discovery. The Comstock Lode was discovered in March or April of 1859 by placer miners in Gold Canyon. At their diggings at Gold Hill, the miners found a broken reddish quartz vein that carried significant amounts of gold but little silver. To the north, placer mining was also being done near the head of Six Mile Canyon. In June of 1859 two placer miners, Peter O'Riley and Patrick McLaughlin, were in the process of digging a deeper hole to collect more water for their *rockers*. They found, much to their surprise, the bottom of their rockers covered with black sand and pale yellow gold. Henry Comstock happened along and, when he saw the gold, exclaimed the now-famous words, "You have struck it boys." Comstock received an interest in the discovery for his good fortune in being in the right place at the right time. He soon sold out for a few thousand dollars and went on his way, leaving only his name on the lode as his legacy. Meanwhile, the two placer miners, who were only interested in gold, were annoyed by some heavy "blue stuff" that clogged their rockers, although it too contained some gold. When the material was *assayed*, it was found to be almost three-quarters silver and was worth \$3,876 per ton. O'Riley and McLaughlin had accidentally uncovered the top of what was later called the Ophir.

The "Rush to Washoe" got off to a rather slow start considering the *high-grade* silver values that were reported by the early mining claimants. California was suffering a period of depression, its gold placers were playing out, and the deep *lodes* there were not yet being developed. The Californians who rushed to Washoe found only silver, however, not the placer gold they were seeking, and many left quickly when the winter of 1859 approached.



Savage mine hoisting works at Virginia City in 1869. Ore was loaded and unloaded by hand. *Nevada Historical Society photo.*

Work steadily advanced on the Ophir and Gold Hill discoveries, and in late 1860, bonanza *ore* was found on the 160 level of the Ophir. The Ophir *orebody* was so soft and unstable that in 1860 an innovative new method of reinforcing the soft rock, *square-set stoping*, was developed. As a block of ore was mined, a framework in the shape of a square box approximately 5 feet wide was constructed out of timbers. The mined area became a network of interlocking boxes, which when filled with waste rock, supported the heavy ground. Developments in silver *metallurgy* followed, and Virginia City and the Comstock were on their way into prominence and carried the rest of Nevada with them. Production of the Comstock mines grew to \$12,400,000 in 1863, the first major production year. Development continued into the 1870s resulting in discoveries of more bonanza *orebodies* along the lode. The 1873 Consolidated Virginia discovery, the Big Bonanza, yielded \$105,000,000. The peak production years of the Comstock were during the early 1870s. Beginning in the late 1870s, depletion of the rich bonanza ores, coupled with water and heat problems encountered as the mines became deeper, led to a gradual decline of the Comstock district. Total recorded production for the Comstock district (both Storey and Lyon Counties) is over \$400,000,000 in silver and gold. An interesting point here is, while known mainly for its silver production, the Comstock Lode produced over 8,000,000 ounces of gold and is also one of Nevada's major gold districts.

The importance of the Comstock mines to both Nevada and the nation seems overstated at times but this is far from the

actual case. Comstock silver drew a population to an otherwise empty region, resulting in the formation of the state of Nevada. Riches made in the Comstock mines built San Francisco and aided in financing the Civil War in the east. Owners of the Bank of California, using Comstock-generated money, built the Virginia and Truckee Railroad and Central Pacific Railroad. John Mackay founded his fortune on the Consolidated Virginia bonanza and went on to form what became AT&T. His heirs later provided funds to build the Mackay School of Mines on the University of Nevada campus at Reno. Engineering and metallurgical developments originating at the Comstock mines are too numerous to list but benefit the mining industry all over the world. Square-set stoping is still used where the ore is rich enough to pay for the high cost of timber and labor. The first general use of Nobel's nitroglycerine-based dynamite was in the Comstock mines, as

was the use of the compressed-air drill and diamond drill. Comstock's miners' wages set standards for pay throughout the west, and miners' unions were a powerful force in the district.

Some large-scale underground and surface mining has been attempted at Virginia City over the years since the main activity ceased. In the 1920s, a large cyanide *mill* was constructed in American Flat, southwest of Virginia City, and mining of low-grade underground ores and old *stope* fill was done. In the 1930s and early 1940s, open-pit mining was done on the Belcher and Ophir *outcrops*, and in the late 1970s another attempt was made to mine low-grade surface ores in the Yellow Jacket-Belcher area. The surface pits are now inactive but prospecting is again being done underground at the Savage, and there are reports of new discoveries in Silver City—very near the site of the 1850 discovery that started it all.



Savage mine and part of Virginia City. This photo, probably taken in the late 1870s, shows a general lack of activity in Virginia City and at the mill. *Nevada Historical Society photo.*

LEETE

Leete is situated in northwest Churchill County on the Lyon County border. The district has produced both salt and borax from Eagle Marsh. Salt was produced from the north-western end of the marsh, while borax was produced from the northern end of the marsh. The northern section was also known as Hot Springs Marsh.

Benjamin Franklin Leete discovered the salt deposits at Eagle Marsh in 1869 and began producing salt in 1870. The town of Leete was created and acquired a post office in 1871. Originally named the Eagle Salt Works post office, it was renamed the Leete post office in 1877. In 1899 the office was closed and Leete's postal customers were sent to Fernley.

The Eagle Salt Works produced 3,000 tons of salt its first year. The salt was recovered in vats, 50 feet wide by 100 feet long, that covered several acres. The salt solution crystallized on the sides and bottoms of the vats and, upon evaporation, a thick layer of salt formed, which was harvested and shipped unrefined. During summer months an acre of these vats could produce about 10 tons of salt. Peak years were from 1879 to 1884 and the total production was 334,000 tons.

The Comstock mills bought several thousand tons of salt each year from Leete for use in recovering silver from the Comstock ore. The salt was transported to Virginia City via the Central Pacific Railroad which ran just west of the marsh. Uniform price for salt delivered at the mill was \$60.00 per ton, much lower than if purchased from San Francisco.

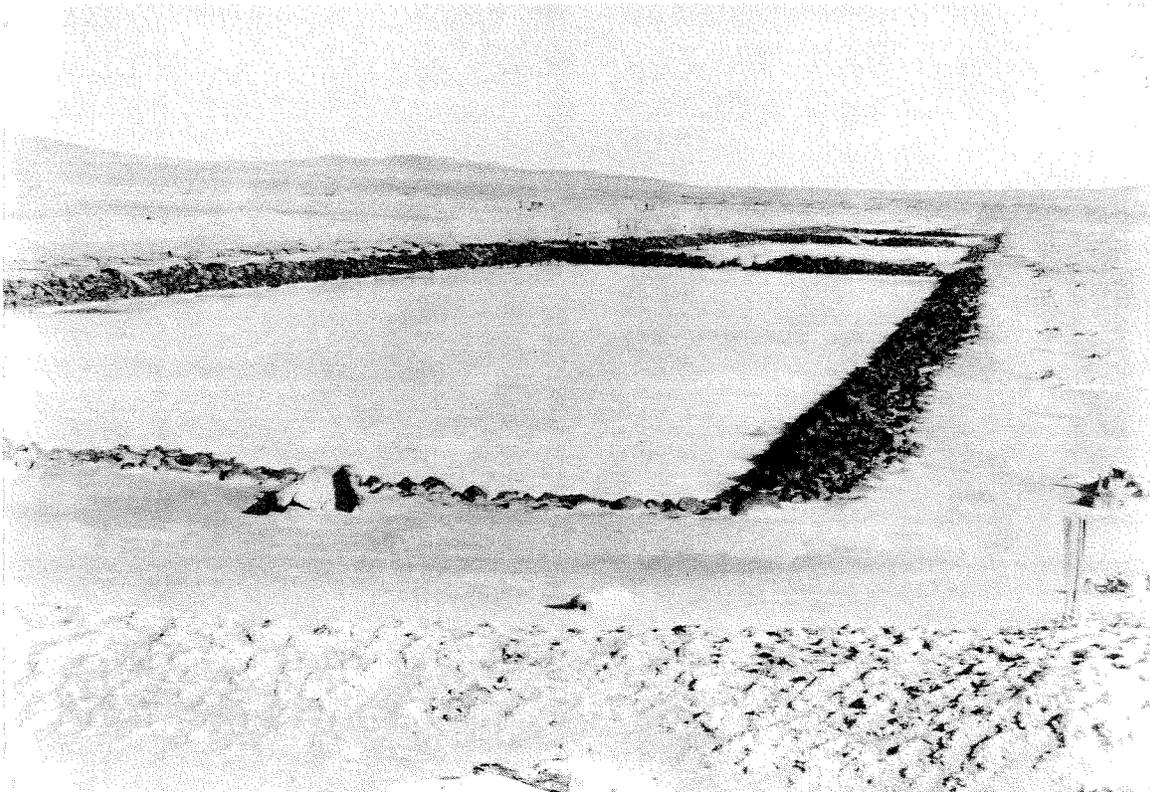
The exact role salt played in the mills of Virginia City was controversial in its day and still remains unclear. It was used

in the recovery of silver from the sulfide ore (argentite) when conventional recovery methods proved costly and relatively unsuccessful. Based on a technique developed in Mexico several centuries before the Comstock era, salt and other chemicals were mixed with finely ground ore. Mercury was also added and gold and silver were recovered by amalgamation. Large metal pans were used in the process, and the technique became known as the Washoe Pan Process.

Mr. Leete operated the salt works for many years and went on to serve in several different positions in Nevada, including that of President of the Nevada State Agricultural, Mining and Mechanical Society in 1874.

In 1871 a company worked the borax deposits at Hot Springs Marsh. According to a description in the report of the State Mineralogist for 1871-72, the company was producing about 500 pounds of borax a day using a large boiler and six tanks for crystallization. The deposits were limited, however, and the operation failed to achieve commercial success.

The Southern Pacific Railroad transported salt from Leete to markets until 1903, but subsequently, the tracks were realigned to the east of the marsh, leaving the camp isolated. The Eagle Salt Works built a railroad track over the old grade and connected it with the main line near Wadsworth but it was not long before competition from borate mines in southern California forced the entire operation to shut down. All that remains of Leete today are some old evaporators and numerous foundations.



Old evaporating pit, Leete Salt Works. *Nevada Historical Society photo.*



Main Street, Tuscarora, circa 1880. Nevada Historical Society photo.

TUSCARORA

The town of Tuscarora, named after a Union warship of the Civil War, is at an elevation of 6,200 feet on the southwest slope of Mt. Blitzen, 52 miles northwest of Elko.

The Tuscarora mining district was organized July 10, 1867, with such notables in attendance as Steve and John Beard, Ham McCann, William Heath, C. M. Benson, Jake Madiera, Charles Gardner, A. M. Berry, and John Hovendon. Placer mining was done on McCann Creek when enough water was available and, in 1868, *horn-silver* ore was found in lodes by the Beard brothers on what became known as Beard Hill. A four-stamp mill was transported from Austin to Tuscarora to treat the ore, but the operation was not successful and mining soon drifted away from the district.

The Central Pacific Railroad was completed in 1869, releasing the several hundred Chinese laborers that Charlie Crocker had imported to build the railroad. When they heard of the placer gold mining on McCann Creek, many of these workers packed their belongings and headed for Tuscarora where they set up a town right on the banks of the creek, replete with opium dens and gambling houses. In their first year, 1871, Chinese prospectors reworked the old diggings and recovered over \$500,000 worth of gold. By 1884, over \$1 million worth of gold had been recovered by these industrious people—gold which the previous prospectors had found too laborious to process.

In 1891 W. O. Weed, a placer miner, located several rich silver veins on the east side of Mt. Blitzen and the population

of Tuscarora increased to about 4,000 people and the town boasted many saloons, restaurants, a post office, a variety of stores, a ballet school, a public school, a finishing school complete with an elocution teacher, and two skating rinks. There were also two newspapers in 1879, the Times and the Review, which subsequently merged to form the Times-Review.

The town was surrounded by mines: to the east the Grand Prize mine; to the south the Dexter, the town's third largest producer; and to the northwest the Navajo, which was bought by the Beard brothers; and several lesser known mines. The Grand Prize bonanza was uncovered in 1876. In its first year it was reported to have shipped 740 dore bars for a total of \$1,390,561 to Elko. Stock in the mine bounced up and down, with a high quote in 1877 of \$940.00 per share to a low of \$5.25 per share in 1879. In 1907, the Dexter mine was purchased by a new company, the Tuscarora Nevada Mines Company, and the 40-stamp amalgamating mill was changed to a cyanide plant, but the new owners were unsuccessful in their attempt to bring the mine back to profitability. It is estimated that the total production for the Tuscarora mining district ranged from the reported \$9.4 million to a hearsay figure of \$40 million.

The town of Tuscarora still exists today and many of the original buildings are still occupied. Recently, a resurgence of mining has brought new life to once grand and sophisticated Tuscarora.

CANDELARIA

Candelaria, 16 miles south of Mina in what was originally the Columbus district, was discovered by Mexican prospectors in 1863. In the spring of 1873 the largest mine, the Northern Belle, began production. Columbus, a town with several mills, served the district at that time. The owners of the Northern Belle built a 20-stamp mill eight miles to the northwest, at a site called Belleville. In August 1876 the town of Candelaria was platted below the Northern Belle mine and by September, the town had a post office, two hotels, restaurants, a livery stable, 11 saloons, and other businesses.

Freight costs were high because all supplies had to come from Wadsworth, over 120 miles to the north. Wood was nearly impossible to find, even at \$15 to \$20 per cord. Alkali-laden water cost 4½ cents per gallon and had to be hauled from Columbus.

In 1876, the Northern Belle began paying dividends. At an ore value of \$45 to \$60 per ton, production averaged over \$1 million per year for ten years. In 1880 Candelaria was the largest town in the district.

By 1881 the town reached its residential peak of some 1,500 residents and supported a bank, a telegraph office, a school, a lumber company, two breweries, three doctors, lawyers, and two newspapers (the True Fissure and the Chloride Belt). Saloons had increased to over two dozen, including the famous Roaring Gimlet, and there were numerous hotels. Interestingly, Candelaria, which means "Candle Mass," never acquired a church. Water for the

mines and mills of Candelaria came from springs on the north end of the White Mountains. Water was piped by The White Mountain Water Company to a reservoir above Metallic City, in Pickhandle Gulch south of Candelaria.

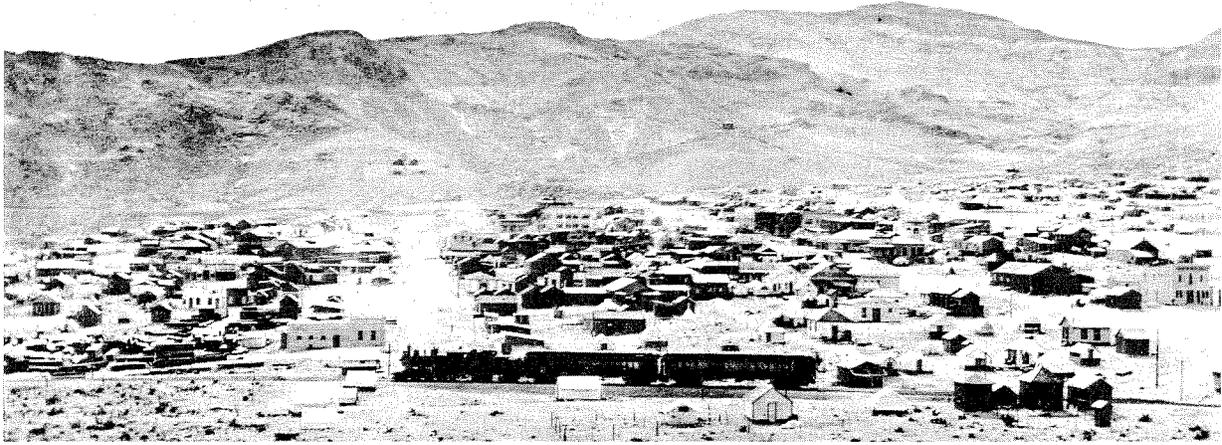
In February 1882, a narrow-gauge spur railroad, the Carson and Colorado, was completed into Candelaria from Belleville and began hauling ore from the mines and delivering supplies. Hay, grain, and meat came from Fish Lake Valley and poultry and fruit came from wherever it could be acquired—sometimes from as far away as the Owens Valley in California.

In 1883 a fire destroyed part of the town initiating its decline. Other contributing factors included legal strife between the Northern Belle mine and the adjoining Holmes Mining Company. These two properties were consolidated, but a summer-long strike brought on by the reduction of daily wages for miners, exhaustion of the bonanza ore, and a decline in the price of silver, left Candelaria in a state of decay. In 1890 Candelaria experienced a brief surge of activity and was resurrected for a period of two years. Again, in 1919, a consolidation of the most important mines by the Candelaria Mines Company resulted in about four years of production.

The district produced more than \$20 million during the boom period, \$15 million from the Northern Belle mine alone. Today, although mining is once again flourishing in the district, rock walls and crumbling foundations are all that remain of the town of Candelaria.



Candelaria, circa 1885. Nevada Historical Society photo.



First passenger train on the Bullfrog-Goldfield R.R. leaving Rhyolite, June 18, 1907. *Nevada Historical Society photo.*

RHYOLITE

Named for the hard volcanic rock of which the desert mountains in the Bullfrog district are composed, the town of Rhyolite is 2 miles west of Beatty. Eddie Cross and Frank "Shorty" Harris, two prospectors, discovered gold in the Bullfrog Hills in August 1904. Shorty aptly named his claim the Bullfrog, because of the greenish copper-stained ore he found there, and went into Goldfield to celebrate his good fortune. He sold his share in the mine for the paltry sum of \$500 and a mean-faced mule.

During the first few months the crude new community consisted of rag dwellings and canvas saloons and stores. Fuel was scarce, consisting of sagebrush and greasewood, and water had to be hauled from Beatty at a cost of \$2 to \$5 per barrel. A miner named Pete Busch, an early inhabitant of the town, had a dream beyond the gold in the mines. Pete's dream was to build a town of stone and brick, not of canvas and adobe. In February 1905, he and his brother, Ed, staked out the area which was to become the town of Rhyolite. The main street was named Golden Street. Later that year, the stakes were replaced by a smooth street and flanked by two and three story buildings, one of which housed the Rhyolite Herald, the local newspaper which began publication in May 1905. A post office was also established in June of the same year.

By 1907 the 2-year-old town consisted of 6,000 inhabitants and had telephone and electrical services, three water companies, three ice plants, three railroads (the Las Vegas and Tonopah, the Bullfrog and Goldfield, and the Tonopah and Tidewater), four banks, four newspapers, ten hotels including the 36-room Southern Hotel, not less than 45 saloons, a Miners' Union Hall, a school, an opera house, a symphony orchestra, and many other businesses. A modern city built of stone and wood was in full swing before the

mines in the area began operating. In addition to the Bullfrog were the Montgomery-Shoshone, Denver, National Bank, Mayflower, Gibraltar, Tramp, Polaris, and Eclipse mines. Of these, the Montgomery-Shoshone was the largest and most productive in the district, using a 200-ton amalgamating, concentrating, and cyanidation mill to process the ore. Production in the Bullfrog district during the period 1905 to 1921 was 286,664 tons of ore containing 111,805 ounces of gold, 868,749 ounces of silver, 5,294 pounds of copper, and 11,987 pounds of lead, for a total value of \$2,792,930.

Peak production in the Rhyolite district was in 1908 but by 1911 most of the mines had shut down. Many of Rhyolite's then 12,000 plus inhabitants streamed out of town almost as rapidly as they had streamed in. In 1910, Rhyolite's population consisted of a mere 700 people; some working at the Montgomery-Shoshone and some operating the few remaining shops and saloons. The end for Rhyolite came one year after the Herald reported, "To all appearances the Montgomery-Shoshone is dead."

The only two buildings inhabited today are the train depot and the famous bottle house. In about 1924 the depot became the property of N. C. "Wes" Westmoreland, who for years ran and operated the depot as The Rhyolite Ghost Casino until April 1947 when he leased the roadhouse. He died six weeks after leaving Rhyolite and the depot went on the auction block. The Bottle House was originally built in 1905 by a saloon keeper, Tom Kelly, from 51,000 glass bottles including Anheuser-Busch and Reno and Company beer bottles, a few Hostetter's Stomach Bitters bottles, and in the corners, some Gordon's gin bottles. The Bottle House and the depot still stand amid the ruins of the Busch brothers' dream city of cement, stone, and bricks.

GOODSPRINGS

Goodsprings, situated 8 miles northwest of Jean, is on the Union Pacific Railroad line and was the main shipping point for the Yellow Pine district. In 1868, a group of prospectors found silver-lead ore in the area and formed the New England district, which was soon renamed the Yellow Pine district. The early mining efforts ceased and the camp was abandoned when the lead ore was found to contain very little silver. One hearty prospector, Joe Good, remained behind and the town, with its local springs, was named for him.

In 1886 a group of Utah prospectors searching for lead developed a permanent settlement at Goodsprings. The Keystone gold deposit was discovered in 1892 and remained active through 1906, yielding \$600,000 in revenues. During this period, the population of Goodsprings approached 200 people.

Lead smelting was inaugurated in Nevada when Dudd Leavitt and Isaac Grundy constructed a furnace at the Las Vegas way station and produced 5 tons of lead from ore obtained at Goodsprings. About that same time, T. C. Brown, a New Mexico mining engineer, recognized that the heavy gray-white ore thrown on the dumps after lead extraction was actually high-grade zinc. This discovery brought about a vast increase in production and formation of the Yellow Pine Mining Company in 1906. The original mill at

the south end of town was enlarged in 1910 and a narrow-gauge railway spur was built in 1911 by the company and linked up with the main railroad (the San Pedro, Los Angeles and Salt Lake) at Jean. In 1912, due to lower transportation costs, ore production quadrupled to more than \$1.2 million. Between 1916 and 1921, Goodsprings grew to about 800 people and consisted of several stores, saloons, a post office, a school, a hospital, a first-class 20-room hotel (the Fayle), and a weekly newspaper (the Gazette).

During this same period several other unusual minerals were found in the Yellow Pine district. Vanadium was discovered and mined at the Christmas Consolidated mine and the Boss mine produced platinum and palladium in 1914. Good quality barite was found in 1915 and Nelson Numm discovered traces of carnotite (a uranium ore) 2 miles north of Goodsprings in 1921 but none of these minerals were found in sufficient quantities to sustain production for any length of time.

In 1966 the Fayle Hotel was destroyed by fire, leaving only a few occupied homes, surrounded by mill foundations and abandoned mines.

The total recorded production of the district was over \$31 million and has had a major economic impact on the area, accounting for approximately 40% of the total metallic mineral production of Clark County.



Fayle Hotel, Goodsprings. Nevada Historical Society photo.

THE MINING LAW OF 1872

The original basis for U.S. mining laws evolved from English and Spanish common law developed during the 14th through 16th centuries. In the West, most mining rules and traditions were based on the Spanish Royal Code of 1783, which provided general rules for acquiring mining rights and for settling conflicts between miners. There were no federal mining laws in the U.S. prior to the California Gold Rush in 1849; Congress had passed only temporary sales and leasing acts dealing with gold, silver, iron, and lead.

The development of the Comstock Lode deposits in Virginia City, Nevada further emphasized the need for a law to secure title to mineral discoveries and the right to develop and produce minerals. Since eastern capital was financing a large portion of the development on both the Comstock Lode and in the California Mother Lode, this matter quickly became a major political issue. Additionally, congressional policies concerning public domain lands during the period from 1865 through 1885 focused on means to encourage westward migration. As part of this overall plan, Congress enacted a series of laws that included legislation designed to encourage mineral exploration and development.

The first U.S. mining law, called the Lode Law of 1866, was passed by Congress on July 26, 1866. The law authorized procedures for entry and location of lode claims, and contained specifications for performance of assessment work and the patenting of lode claims. This was followed by enactment of the Placer Act on July 9, 1870, which covered the entry and location of placer claims, location by legal land survey description, and procedures for obtaining mineral patents. These two laws were then combined, with various amendments, into the General Mining Law of 1872 on May 10, 1872. Senator William M. Stewart of Nevada played an important role in the eventual enactment of this law.

The overall scope and application of the 1872 Mining Law has changed considerably over the years. Many mineral resources, such as coal, oil, gas, sand, and gravel have been removed from acquisition under this law and can only be



acquired as leasable or salable minerals. Legislation such as the Clean Air Act of 1963, the Federal Land Policy and Management Act of 1976, and a number of other laws have been enacted to address environmental concerns. Numerous federal, state, and local regulations, laws, and policies have also been enacted to regulate mining throughout the nation.

The 1872 Mining Law specifies four types of mining claims: lode, placer, mill-site, and tunnel-right claims. Placer and lode claims are located by posting a conspicuous notice on the ground identifying the locator, claim name, date of discovery, and a description of the boundaries of the claim. A claim owner must diligently work any claim to try to develop a productive mine, and at least \$100 worth of labor and improvements (assessment work) must be performed on each claim every year.

Specific information about mining, mining claims, and the relevant state and federal regulations may be obtained from the Nevada Department of Minerals, the Nevada Bureau of Mines and Geology, and the State and District Offices of the U.S. Bureau of Land Management.

EXPLORATION

Mineral exploration is the process of finding ore deposits using the science of geology in combination with specific aspects of chemistry and physics. The purpose of exploration is to locate mineral deposits—concentrations brought about by unusual combinations of natural processes—that can be profitably mined.

Yesterday's prospectors used picks, shovels, and pans to locate these deposits—somewhat of a hit or miss affair, as they were dependent to a great extent on visual signs of possible precious metal mineralization. For instance, once a gold-bearing stream was located by panning, the prospector just continued on upstream until the "mother" lode was found. This process, however simple it might seem, worked. Most of the early large deposits, including the Comstock Lode, were discovered by this method.

Today's prospectors are usually geologists searching for a more complex type of deposit than that sought by the early '49ers and they must use much more sophisticated tools. For the most part, the gold they are looking for is microscopic rather than the nuggets of the old-timers, and their primary tools are geology, geochemistry, and geophysics.

GEOLOGY

There are many types of mineral deposits and each type forms under different geologic conditions. It is the geologist's job to recognize how concentrations of a given mineral are formed; to identify features that are critical to ore formation; to analyze maps, aerial surveys, satellite images and other available data; and to pinpoint geologic anomalies—characteristics that are different from the normal—and areas of potential mineralization. Environmental factors of the potential area must also be studied, permits to explore must be obtained from a variety of national, state, and local regulatory agencies, and claims must be staked. The geologist then "goes to the field" where she or he applies the tools of the trade.

GEOCHEMISTRY

Most of the obvious orebodies in the U.S. have probably been discovered. Today's geologic challenge is to locate deposits hidden deep beneath the surface. Geochemistry is a valuable tool in this pursuit because geochemical analyses of surface material provide indications of what lies below. Usually, a deposit large enough to be mineable is surrounded by a halo of altered rock that is slightly enriched in the mineral but not in sufficient quantity to be ore. To determine if this geochemical halo exists, a variety of samples are taken from the area: rock, soil, stream sediment, and even vegetation. Sample sites and respective chemical values of these samples are then plotted on maps for comparison and evaluation.



Exploration geologist at work. Nevada Bureau of Mines and Geology photo.

GEOPHYSICS

Geophysics—the combination of geology and physics—is used to delineate certain physical properties of the earth such as its resistance to electric current, density, gravitational effects, and magnetism. These tests are conducted with state-of-the-art electronic equipment, such as electromagnetometers and computers. One of the premiere gold deposits in Nevada—the Fortitude mine near Battle Mountain—was discovered with direct aid of geophysics.

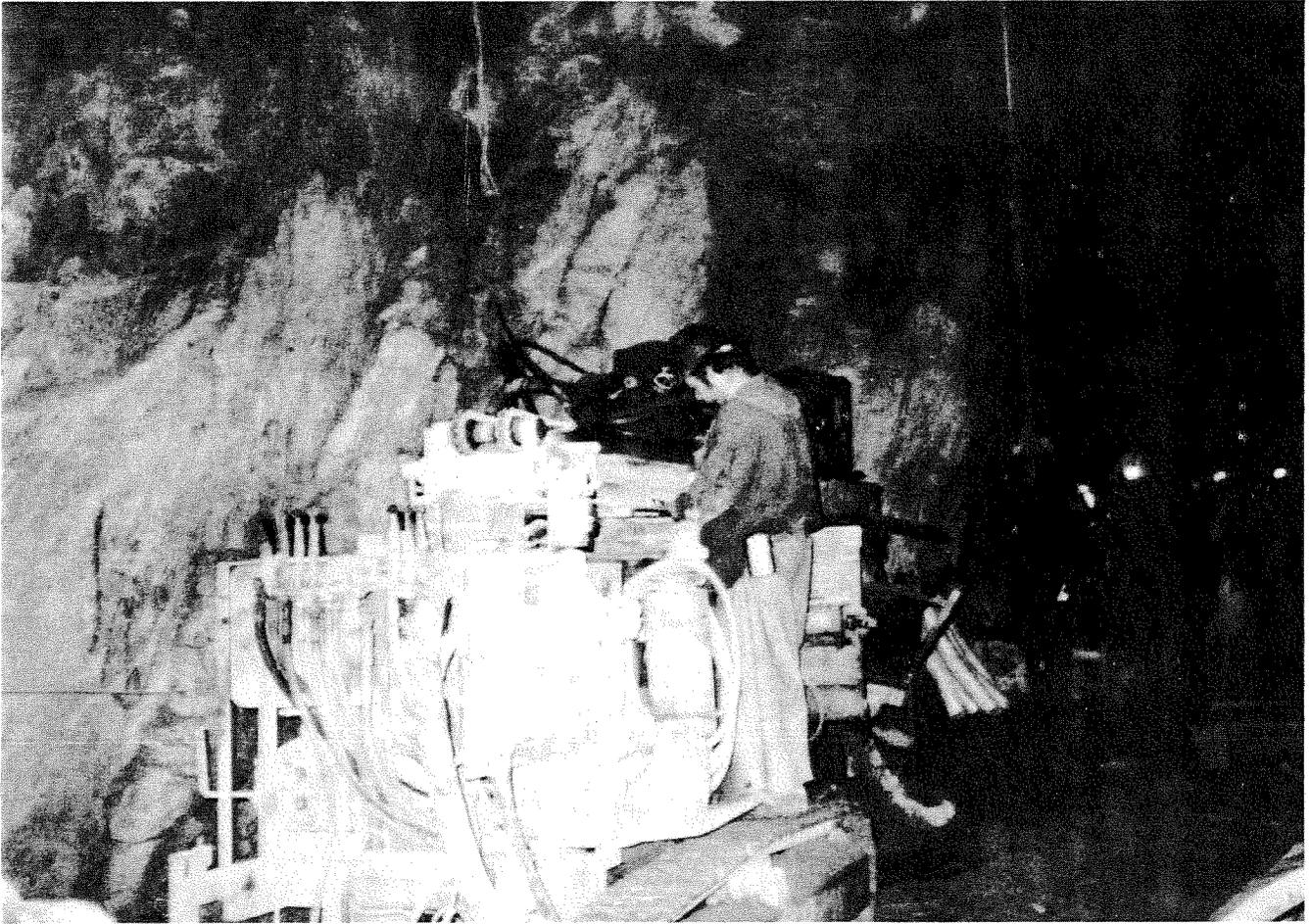
Once a potential deposit is delineated through the use of these tools the next step is to physically examine beneath the surface. This is done by trenching and/or drilling. Trenching provides shallow subsurface knowledge whereas the drill is used to discover deeper ore deposits. Once a deposit is discovered, samples from the drill holes are used to determine its size, shape, and content. Drilling is expensive because a great many holes are often needed to adequately determine the existence and size of a deposit. Therefore, the sampling and investigative analytical processes prior to drilling are of great importance.

The next phase of exploration takes place in the laboratory where more geological and chemical tests are run on the samples taken by the drill rigs. This information is compiled to establish a picture of the deposit as it appears below the surface. At this point, a feasibility study is conducted, which will ultimately decide if the geologists' long and arduous exploration efforts have indeed resulted in the discovery of a mineable deposit.

The entire exploration process can take three years or more from the initial discovery of a viable prospect to determination that it is a potentially economic deposit, and can cost many millions of dollars. And then, even if the numbers are good, other factors such as accessibility and the effects of the potential mine on the environment must be taken into consideration before the actual mining process is begun.



Exploration drill rig. *Reno Gazette-Journal* photo by Trent Saviers.



Modern equipment has replaced the pick and hand drill in today's underground mining.

MINING METHODS

Four different mining methods are in use today: placer mining, underground mining, open-pit mining, and solution mining. Placer mining is the oldest type of mining. Panning, dredging, and hydraulicking are examples of placer mining. Narrow or deep orebodies are mined using underground mining methods. Open-pit mining is used to economically mine orebodies that contain large tonnages and that are located relatively near the surface. Solution mining involves drilling a well and pumping out mineral-bearing solutions.

The size, shape, depth, and geological setting of each mineral deposit dictates which method of mining would be the most economical.

PLACER MINING

Placer mining can be traced back to prehistoric time when man searched the river bottoms for the heavy flints used in making stone tools. Egyptian hieroglyphics from about 3400 B.C. show the placer origin of their gold. In Medieval Europe, placer mining was used extensively, and some of the devices used then are still used today and have not been improved upon to any great extent.

Placer deposits are the result of erosion of mineral-bearing rock and transportation of the rock debris, usually by water. The heavier minerals, such as gold or cassiterite (a tin mineral), settle out in the sand and gravel along stream or river bottoms or along the inside curves of streams, where the water moves more slowly. The minerals can also be trapped in natural riffles made of resistant rock or in pot holes along the stream bottom. This process of settling out of heavier minerals is called mechanical or gravity concentration. A few placer deposits occur where erosion has exposed and eroded the mineralized rock or a vein, but lack of running water to carry the rock material away leaves the minerals concentrated in place or downhill.

There are several methods used to mine placer deposits. Panning for gold is the method with which most people are probably familiar, but this is slow and relatively uneconomical, especially for large-scale operations. Panning is used mainly to prospect for gold or certain other minerals. Other methods include sluicing, in which sand and gravel are washed in a box called a sluice; riffles on the floor of the sluice trap the heavier minerals. In hydraulic mining, or hydraulicking, powerful jets of water are used to blast and wash away the mineral-bearing sand and gravel, which are then run through a sluice box. Dredging is used to mine large, low-grade deposits. A dredge is a large floating machine that scoops up the sand and gravel from the edges of man-made lagoons and small ponds dug near active streams or in areas where streams were known to exist.

Gold nuggets are the most common product of placer deposits, but other heavy minerals including gemstones, platinum, and rutile (a titanium mineral) are also found.

Placer mining has taken place in many areas of Nevada, including Battle Mountain, Manhattan, Osceola, Rabbit Hole, and Round Mountain.

UNDERGROUND MINING

Underground mining has been an important method of extracting minerals for over 2,000 years. It played a major role in the settlement of the American West during the second half of the 19th century, with underground mines and the ever-present headframe a common sight in many western towns.

Underground mining methods have improved greatly in the 20th century and particularly since World War II. Today's underground mining bears little resemblance to that of 100 years ago, as it is still frequently depicted in television and in movies. Over the years, as rich orebodies were mined out and as the technology was developed to mine large, low-grade deposits, the number of underground mines began to decline. Today only a very small portion of all major producing mines in the United States are underground operations. This does not mean that underground mining has lost its importance, however. On the contrary, certain aspects of underground mining ensures that it will always have a place in the industry. Underground mining allows recovery at great depth and has some additional advantages in that the effect of extreme weather and problems with access in high, rugged areas are less. The amount of surface disturbance, an important consideration in environmentally sensitive areas, is also usually less with an underground mine. Underground mines presently are making significant contributions to the production of many important minerals in the United States. Although tonnages are relatively small compared with open-pit mines, several commodities, such as fluor spar, lead, silver, and zinc, are still produced primarily from underground mines.

OPEN-PIT MINING

Open-pit mining methods have been employed in some form for extracting minerals for several centuries. Open-pit mining as we know it, however, really came into its own following the Industrial Revolution in the late 1800s. During the early part of the 20th century, the concept of mining large tonnages of low-grade ore was developed and proven. Through the years, larger and more complex equipment was introduced, which continued to increase the tonnages mines were able to produce. As a result, today's open-pit mine is a model of manpower efficiency and safety. Many mines represent a monumental achievement in earth moving, as entire mountains have sometimes been moved in order to mine the ore. As large as many open-pit mines are however, they are

responsible for disturbing only a very small fraction of 1% of the total land area in the United States.

The most important factor that dictates the selection of an open-pit method of mining is economics. Orebodies that are located relatively near the surface and that contain large tonnages are ideally suited to open-pit mining. Typically lower operating costs for open-pit mines enable the companies to operate at a profit where they could not do so if the mines were underground. Open-pit mining lends itself well to the processing of large tonnages of ore on a daily basis because, among other factors, the number of working areas is less restricted than with underground mining. This allows open-pit mines to better take advantage of the principle of "economy of scale." This principle states that the operating cost per ton or per unit of product decreases as the quantity of material processed or product produced increases. This principle has been responsible for the development of equipment of gigantic proportions in order to mine and process the massive quantities of ore.

Open-pit mines are generally worked by first removing the *overburden*, which covers the rock in the area of the mineral deposit. Enough rock is then removed so that the ore can be mined. Mining proceeds downward with a bench established with each new level. Benches are dirt roads arranged as spirals or as levels with connecting ramps to provide access to and from the lower parts of the pit. As the pit gets deeper, more rock has to be removed in order to mine a ton of ore. The tons of waste rock that have to be removed in order to mine 1 ton of ore is called the *stripping ratio* and is an important consideration in determining the economics of an open-pit mine. The higher the stripping ratio, the greater the cost to mine a ton of ore. Mining the ore is generally done by drilling holes in the rock using mobile drilling machines, filling these holes with high explosives, and blasting. The ore is

picked up by front-end loaders or scrapers, loaded into trucks or trains, then transported to the mill. The waste rock is deposited far enough away from the mine so that it does not have to be moved a second time.

Open-pit mining's importance as a source of much-needed minerals continues to increase. Open-pit operations produce virtually all of the aluminum and iron ore mined in the U.S. together with significant amounts of gold, copper, mercury, molybdenum, uranium, and coal. In addition, barite, diatomaceous earth, and many other important industrial minerals are mined primarily by open-pit methods. Ways in which to improve productivity and efficiency are constantly being sought in an effort to keep the U.S. mining industry competitive in the world marketplace.

SOLUTION MINING

Solution mining systems generally involve drilling wells to pump out the mineral-bearing solutions, to inject chemicals for the purpose of dissolving the minerals, or both. Brining is a long-established method of extracting halite (salt) from underground salt beds. Brine is extracted by injecting water into underground salt beds and pumping the water and dissolved salt out through another well or set of wells. Lithium is extracted in a similar way. Another type of solution mining system is hydrometallurgical leaching or chemical mining. It is similar to the leaching that is used to treat stacks of crushed ore on the surface. Acidic solutions or ammonium carbonate solutions are allowed to trickle down into the fractured rock, dissolving certain minerals. The solution is pumped out and further treated to remove and concentrate the desired minerals. Some copper and uranium are mined using chemical mining methods.



Trucks capable of hauling more than 150 tons of material are tools of open-pit mining.

RECOVERY PROCESSES

After ore has been mined, whether from an underground or an open-pit mine, it must be processed into a saleable product. This product may be a refined metal or a concentrate containing one or more minerals or metals. The processing of ores is referred to as milling, and the methods employed depend largely on the mineral or mineral product being recovered and the characteristics of the particular ore. Generally, most milling processes involve crushing and sometimes grinding the ore in order to reduce the size so that the desired mineral may be extracted. Once this is accomplished, separation of the mineral product from the waste is done by a method or a combination of methods that take advantage of the unique physical or chemical properties of the mineral. An example of a physical property which may allow a mineral to be separated from the rest of the ore would be its relative weight; while an example of a chemical property would be the ability to be selectively dissolved in a particular chemical solution.

After the desired mineral is separated from the ore, the remaining waste, called tailings, is disposed of in an environmentally sound manner and the concentrated mineral product is either sold as is or is processed further to enhance its value.

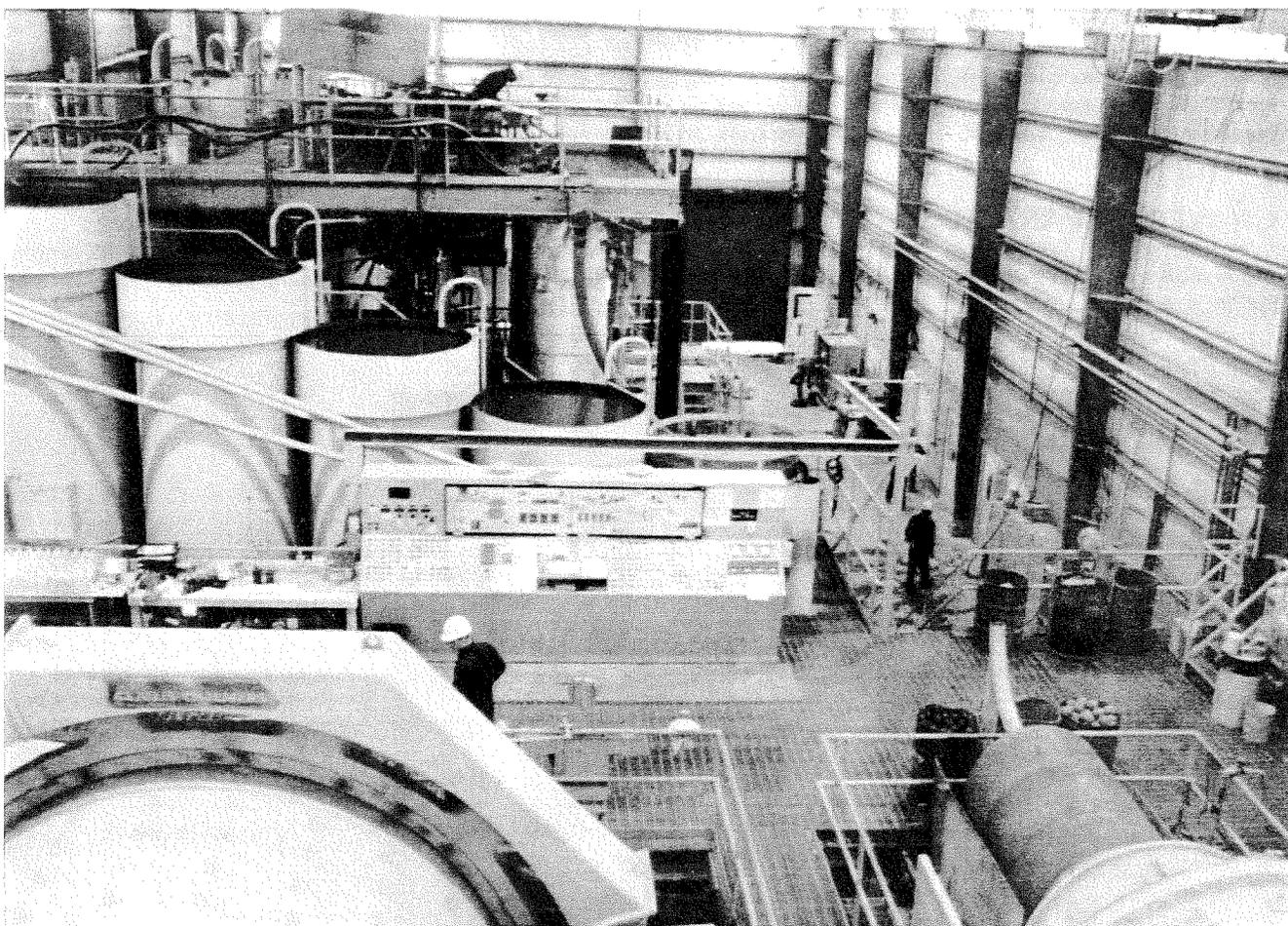
CHEMICAL LEACHING

Because different minerals vary in solubility in various kinds and concentrations of chemical solutions, these minerals can be selectively removed from the ore through chemical leaching. For example, a solution containing a low concentration of the chemical cyanide will dissolve gold, silver, and mercury without dissolving most other components of the ore. An acidic solution can be used to dissolve other metals such as copper and uranium.

The most common example of chemical leaching in Nevada is the cyanidation of gold and silver ores. Although this technique was developed over 80 years ago, recent advances in equipment, together with instrumentation and control technology, make this a very efficient and widely used means of extracting precious metals from ores. Heap-leaching is another recent development that has permitted the recovery of metals from lower-grade ores at a cost that makes processing feasible.

Milling With Cyanide

Processing gold and silver ores in a mill is done in essentially four steps. First, the ore is crushed and then ground into sand-sized particles using ball mills—large rotating



Milling with cyanide, the ore is crushed in ball mills (foreground) and processed with cyanide solution in steel tanks (background). Nevada Department of Minerals photo.

drums filled with steel balls. The gold and/or silver is dissolved from the ore by mixing the ground ore and cyanide solution together in large steel tanks for several hours. After the metal is dissolved from the ore, the valuable solution is separated from the remaining solids in tanks called thickeners. The solid portion goes to a waste area called a tailings pond. The final step in the process is to reclaim the gold and silver from the solution. This process is called precipitation and is accomplished by adding zinc dust to the solution. The zinc chemically trades places with the precious metal in solution and the gold and silver are filtered out. Some cyanide mills, particularly those processing mostly gold, use activated carbon instead of zinc to remove the metal from the solution (this process is called *carbon-in-leach* or CIL). The gold and silver are later removed or "stripped" from the carbon and plated out on steel wool in an electrolytic cell.

Heap-leaching With Cyanide

When the concentration of gold and silver in the ore is too low to pay for the cost of milling the ore, another method of recovery called heap-leaching may be employed. This technique involves taking ore directly from the mine or ore that has been crushed to smaller size and placing it in large piles or heaps on a waterproof pad. A weak cyanide solution is sprayed on the top of the piles and percolates down to the bottom, dissolving the gold and silver as it goes. When the solution reaches the waterproof pad, it follows a designed-in slope under the heap and is collected in a ditch that flows into a pond. When enough solution has accumulated in the pond, it is pumped into a zinc or carbon recovery circuit identical to regular mill recovery circuits. The ditches and ponds are lined with waterproof materials to prevent any leakage of the solution.

GRAVITY SEPARATION

Some ores can be processed by gravity separation. After the ore is reduced to a small size by crushing and grinding or

screening, the valuable mineral is physically separated from the waste by taking advantage of the different weights of the desired mineral particles and the undesired waste particles. A familiar example of this method is panning for gold. A mixture of sand and gold particles can be separated by swirling the mixture in a gold pan (usually a flat-bottomed, conical pan) that is partially filled with water. The swirling action sets all the particles in motion. However, since gold is heavier than sand, it stays on the bottom of the pan while the sand is swirled to the top and is poured off with the water. If swirled long enough, all or most of the sand will have been carried away by the water, leaving the gold particles in the pan.

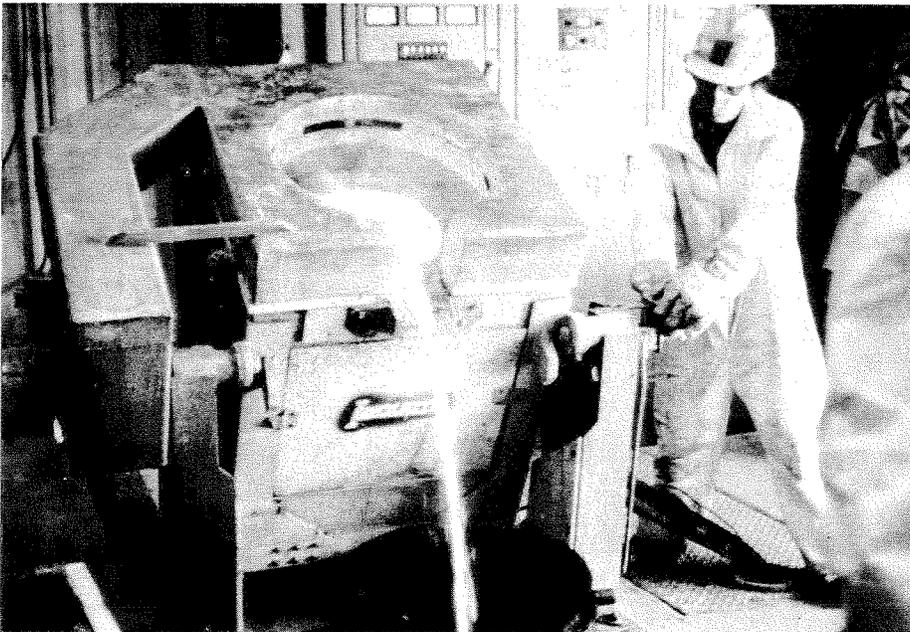
Large gravity-separation plants, of course, usually process thousands of times the amount of material that one person with a pan can handle. The plants use equipment such as sluices, jigs, shaking tables, sink-float devices, and spirals. Whatever equipment is used, all take advantage of a relative weight difference in order to produce the desired mineral.

Minerals recovered by gravity separation include gold, barite, tin, and titanium.

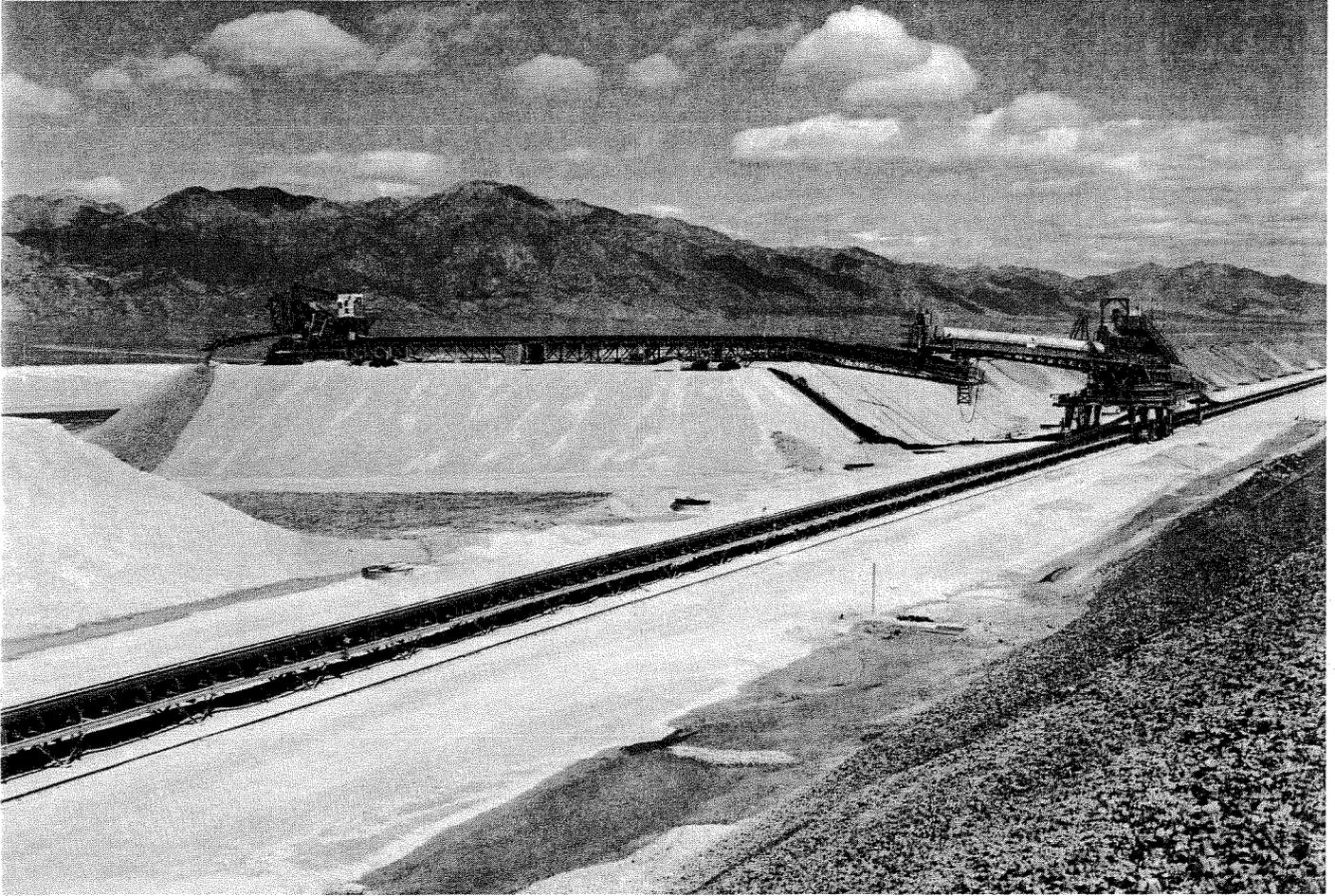
FLOTATION

Flotation is the name given to the mineral-processing operation in which certain mineral particles adhere to the surfaces of air bubbles. This is accomplished in a tank which contains a mixture of finely ground ore, water, and chemicals. Certain chemicals are used to selectively cause the desired minerals to adhere to air bubbles, while other chemicals selectively prevent the waste products from adhering to the air bubbles. The bubbles with the desired mineral attached are skimmed off the surface and collected for further processing. The material left behind in the tank is the waste product and is safely discarded.

Minerals recovered by flotation include barite, copper, fluorite, gold, lead, molybdenum, silver, tungsten, and zinc.



Pouring the *dore*—the unrefined metal product. Nevada Department of Minerals photo.



The heap-leach method of recovery is used when the concentration of gold or silver in the ore is low.

RECLAMATION

The mineral industry in Nevada has undergone many changes in the past several years which have placed particular emphasis on protecting natural resources and reclaiming mined lands. Most mines in Nevada operate primarily on public lands and must comply with reclamation requirements of the managing agencies, the Bureau of Land Management and the U.S. Forest Service. The industry is also subject to state air and water quality regulations.

Legislation requires reclamation of public and private lands affected by exploration and mining activities, and makes provisions for ensuring the safety of abandoned mine sites. The legislation also mandates permits for the many facets of mining and provides for the enforcement of the requirements of those permits. The Nevada mining industry supports these measures, sharing the view that the land should to be returned, as much as possible, to multiple use status and that assistance in the rehabilitation of old mine sites is a necessary part of this effort.

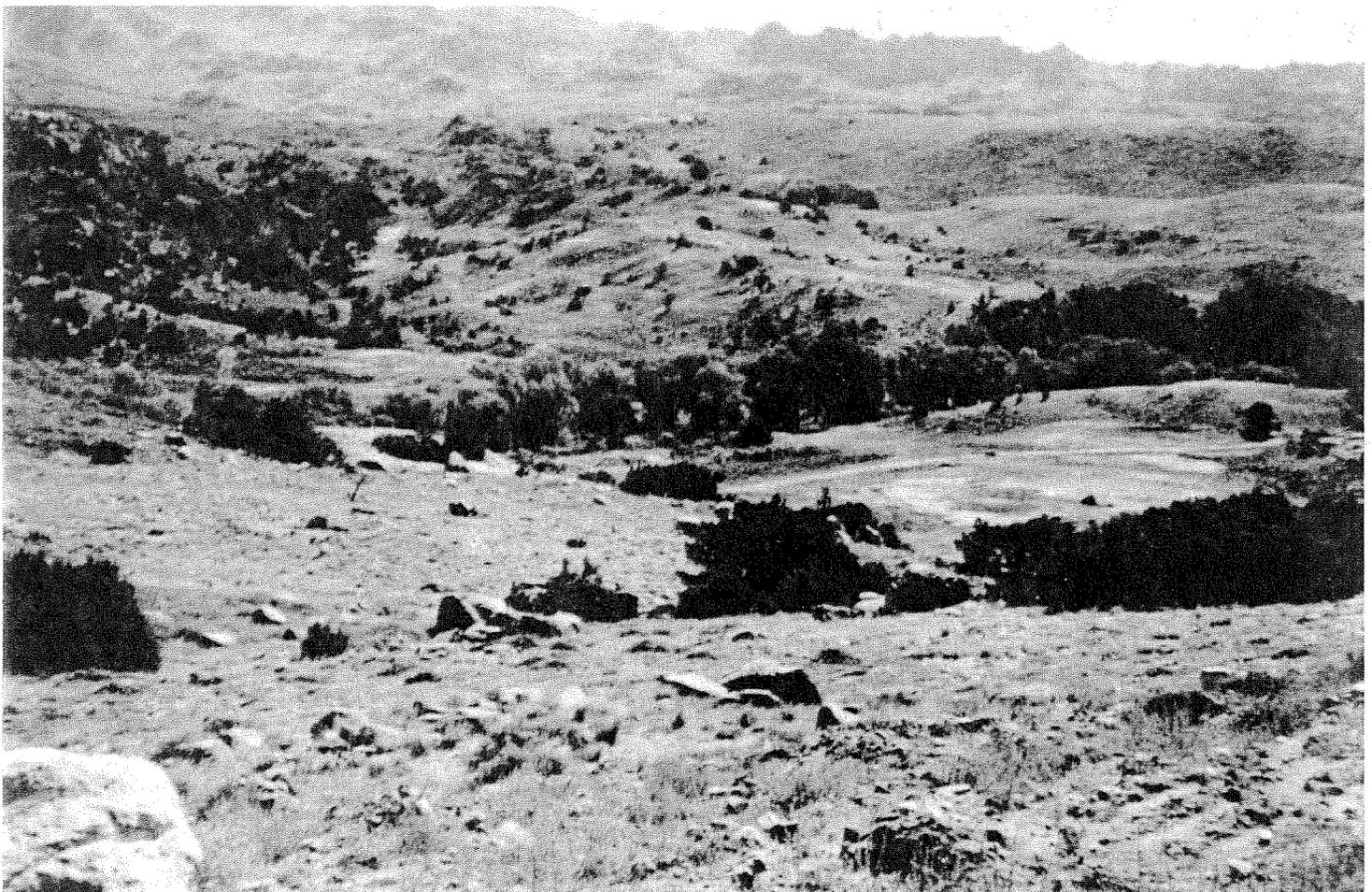


Mineral exploration disturbance. *Nevada Mining Association photo.*

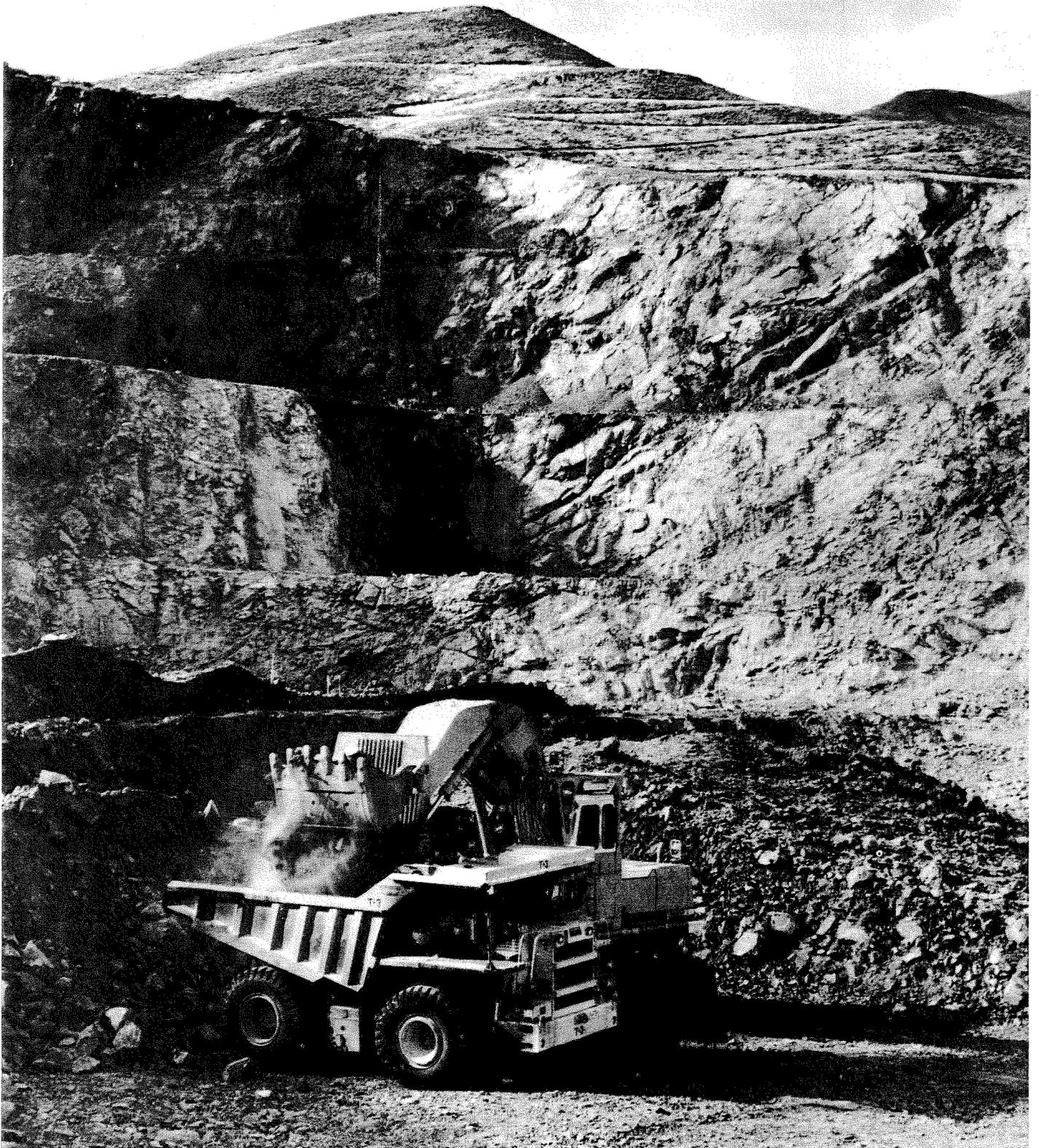
Reclamation is not a new practice in the mining industry. Just as there are differences between past and present technologies of gold discovery, ore extraction, and mineral recovery, there are corresponding differences between past and present environmental impacts and technologies for minimizing these impacts.

The major difference in environmental effects between historic and present mine operations is directly related to total land disturbed. Modern ore processing methods make the recovery of gold from low-grade ore economical, resulting in relatively large volumes of waste rock and ore being removed. In response to increasing environmental awareness, reclamation technology has also improved, and often includes reclamation concurrent with mining.

Typically, reclamation denotes a return to the productivity of land in terms of vegetation and related natural resources. What constitutes sound reclamation depends on post-mining land use goals. Evaluation and planning focus on development of site specific reclamation goals, which might range from the pre-mining land use to a combination of uses such as wildlife habitat, livestock forage, watershed, recreation, and converting pits to reservoirs.

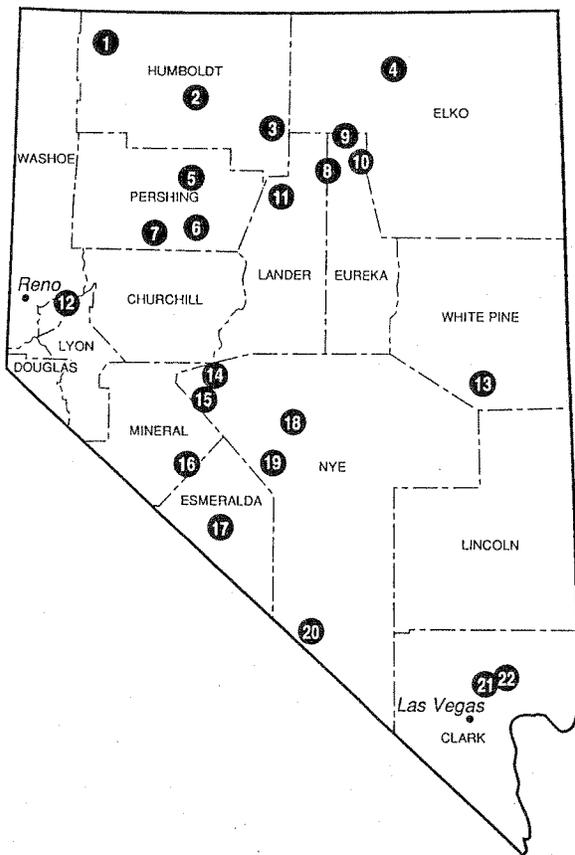


Mineral exploration site after rehabilitation. *Nevada Mining Association photo.*



Pinson open-pit gold mine. *Pinson Mining Co. photo.*

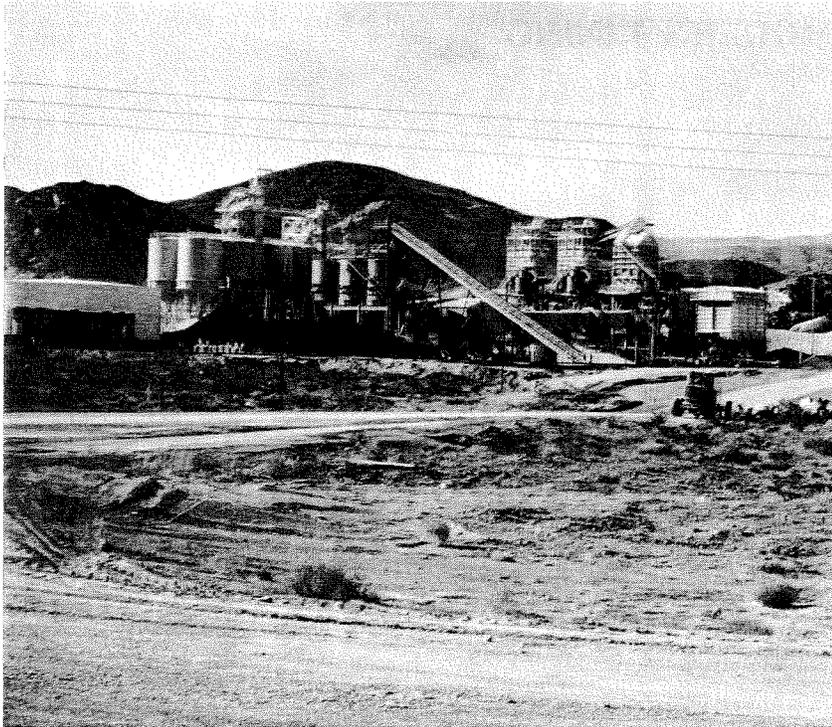
MODERN MINING



SELECTED MINING OPERATIONS IN NEVADA

<i>Mine or area</i>	<i>Mineral</i>
1. Royal Peacock	opal
2. Sleeper	gold, silver
3. Chimney Creek	gold
4. Big Springs	gold
5. Florida Canyon	gold
6. Coeur-Rochester	gold
7. Colado	diatomite
8. Argenta	barite
9. Barrick Goldstrike	gold
10. Newmont-Carlin Trend	gold
11. Fortitude Complex	gold, silver
12. Clark	diatomite
13. Ward Mountain	silver
14. Gabbs	magnesite
15. Paradise Peak	silver, gold
16. Candelaria	silver, gold
17. Silver Peak	lithium
18. Round Mountain	gold
19. Cyprus Tonopah	molybdenum
20. Bullfrog	gold
21. Apex	limestone
22. PABCO Gypsum	gypsum

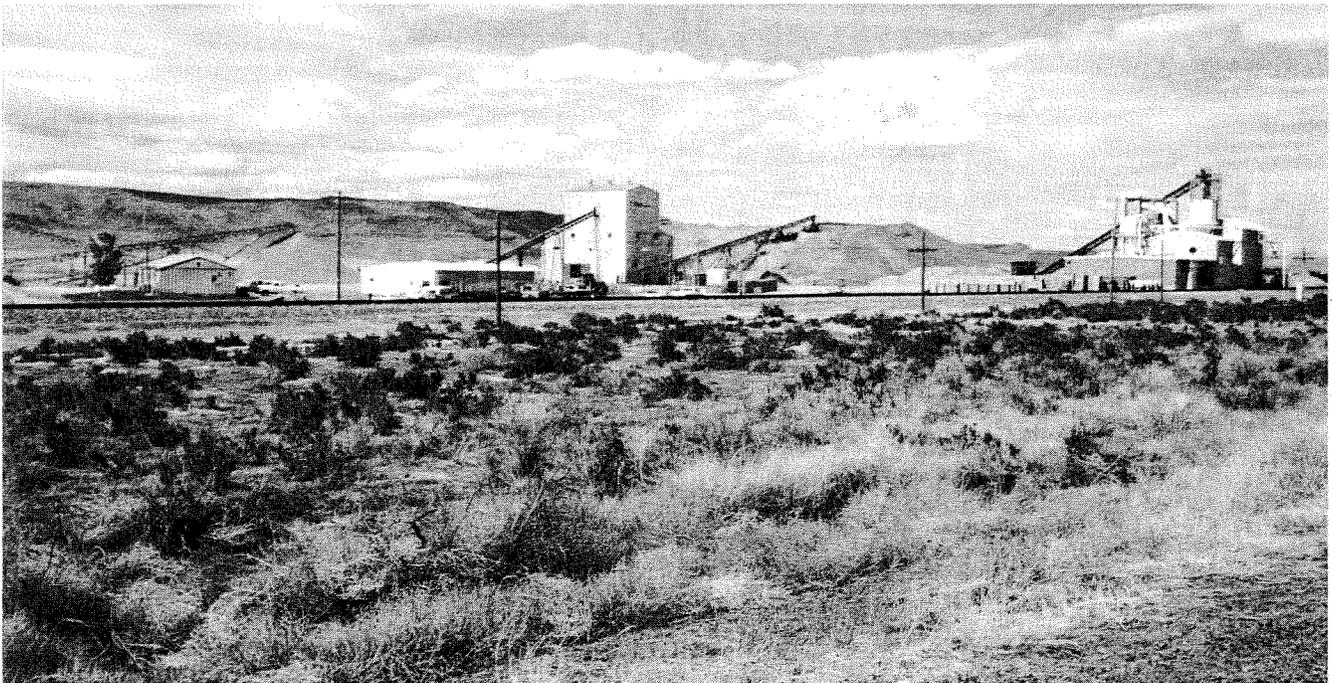
Efficiency and technology are two factors that make mining what it is today. The size of modern mining equipment makes it possible to mine and process large volumes of ore with a high degree of efficiency. As a result, productivity has increased even with decreasing grade, which is indicative of the rapid improvements taking place in modern mining. This has made it possible in many cases to mine areas that were previously considered uneconomical. Even with increased efficiency and improved technology, modern miners have many exciting challenges awaiting them. Today's engineers, geologists, and miners are working to ensure that the minerals needed for our economic well-being will be available.



Chemstar's Apex limestone processing plant near Las Vegas. *Nevada Bureau of Mines and Geology photo.*

APEX (21)

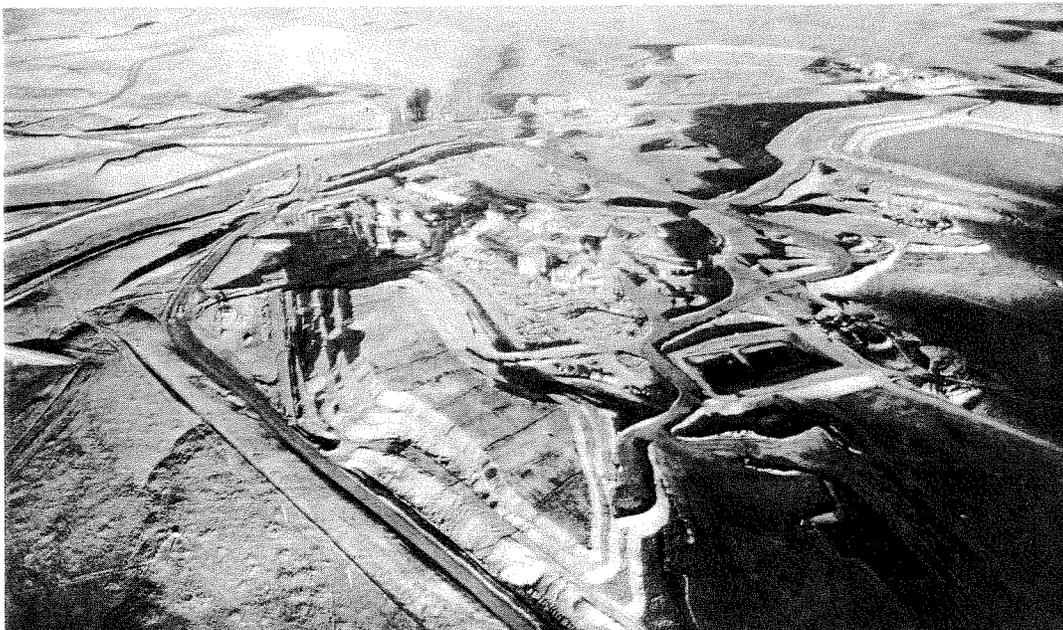
The Apex quarry and plant, operated by Chemstar, Inc., are located 19 miles northeast of Las Vegas. Limestone is a common rock composed mostly of the mineral calcite (calcium carbonate), but deposits that have a high calcium content with few impurities are rare. The limestone at the Apex quarry contains relatively high amounts of calcium. Crushed limestone and its products, quicklime and hydrated lime, probably have more industrial uses than any other substance. Such uses include metallurgy, chemicals, paper, ceramics, construction, and agriculture. Chemstar has reserves that will last hundreds of years.



Milpark Drilling Fluids' barite plant at Argenta. *Milpark Drilling Fluids photo.*

ARGENTA (8)

Owned by Milpark Drilling Fluids, a division of Baker Hughes, the Argenta mine and mill are approximately 13 miles east of Battle Mountain. Barite (barium sulfate) was first mined in the Argenta area in 1935 and was sold primarily to the paint and pigment industries. Milpark Drilling Fluids acquired the rights to the mining properties in 1966 and built a processing and grinding plant in 1972. Since that time, Milpark has depended on the Argenta mine and mill for a major share of its domestic production. Barite, a dense, nonmetallic mineral, is primarily used as a weighting agent in oil and gas-well drilling fluids. There are many other uses for barite, however, such as in paint, diagnostic medicine, glass flux, and bowling balls.



Barrick Goldstrike mine and mill. *American Barrick Resources Corp. photo.*

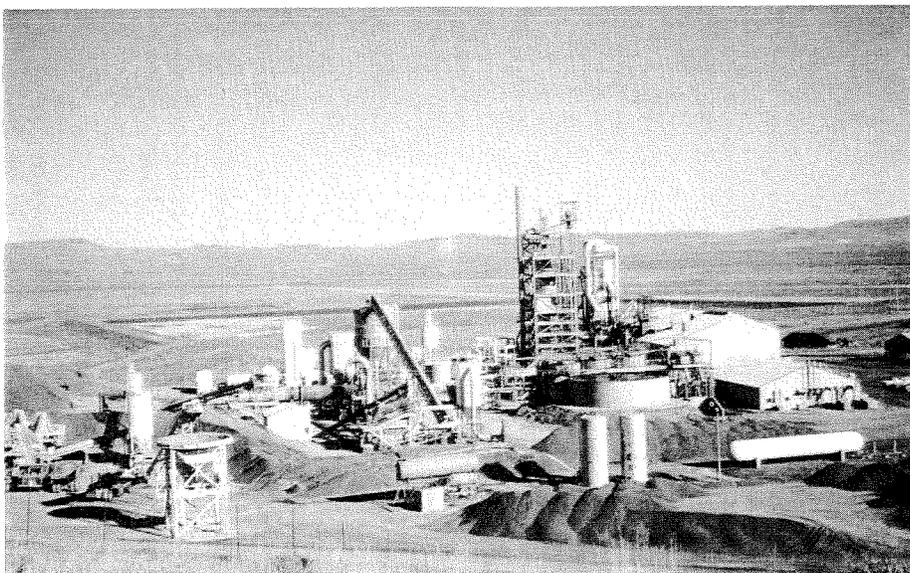
BARRICK GOLDSTRIKE (9)

The Goldstrike property, owned by American Barrick Resources Corporation, is located in north-central Nevada, about 25 miles northwest of the town of Carlin. The Goldstrike property occupies 6,870 acres on the Carlin Trend, one of North America's most prolific gold producing areas.

At the end of 1989, the Goldstrike mine had total reserves of 18.4 million ounces of gold in oxide and sulfide ore. In January 1989, Barrick announced the Betze Development Plan to develop the Post oxide and Betze sulfide reserves at the mine. Under this plan, Goldstrike is expected to become one of the largest gold mines in the U.S. with annual production of more than 900,000 ounces by 1992. A year and a half after the plan was announced, the annual mining rate had been increased to 315,000 tons per day using 24- and 42-cubic yard shovels and a fleet of 85-, 100-, and 190-ton trucks. Early in 1990, the mine commissioned a 1,500-ton-per-day autoclave unit for the treatment of sulfide ore. The Goldstrike ore requires this pretreatment to yield a high rate of gold recovery.

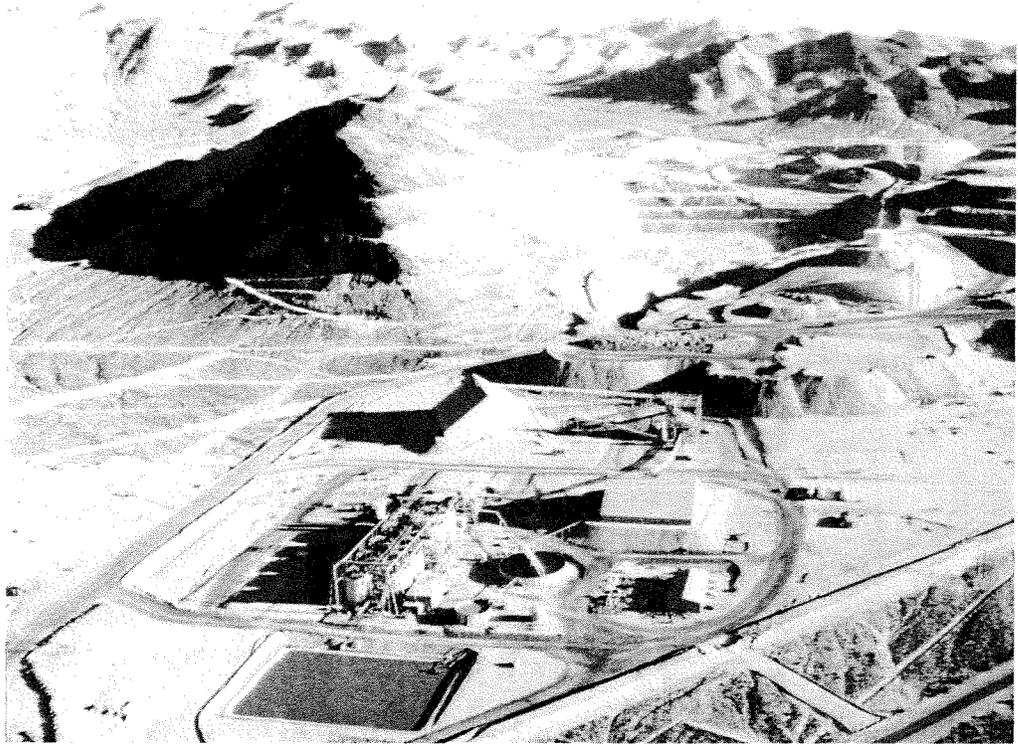
BIG SPRINGS (4)

Independence Mining Company's Big Springs mine and mill are located in the Independence Mountains, 60 miles north of Elko. Hydrothermal gold mineralization hosted in sedimentary rocks was discovered in 1982 by company geologists. Subsequent drilling proved a mineable deposit containing more than 500,000 ounces of gold. The project went into production in 1987 and is currently producing about 60,000 ounces of gold per year. Milling is done at a rate of 1,100 tons of ore per day. A *fluid-bed roaster* is utilized to oxidize the *refractory ore* and is coupled with a standard carbon-in-leach circuit. This is the first fluid-bed roaster to be used on gold ores in the U.S. and is a process that was developed by Freeport-McMoRan engineers. Mining is done at a rate of 37,000 tons of ore and waste per day. The mine is located in an environmentally sensitive area and was recently awarded the honor of being the first "Mining Showcase" by the U.S. Forest Service.



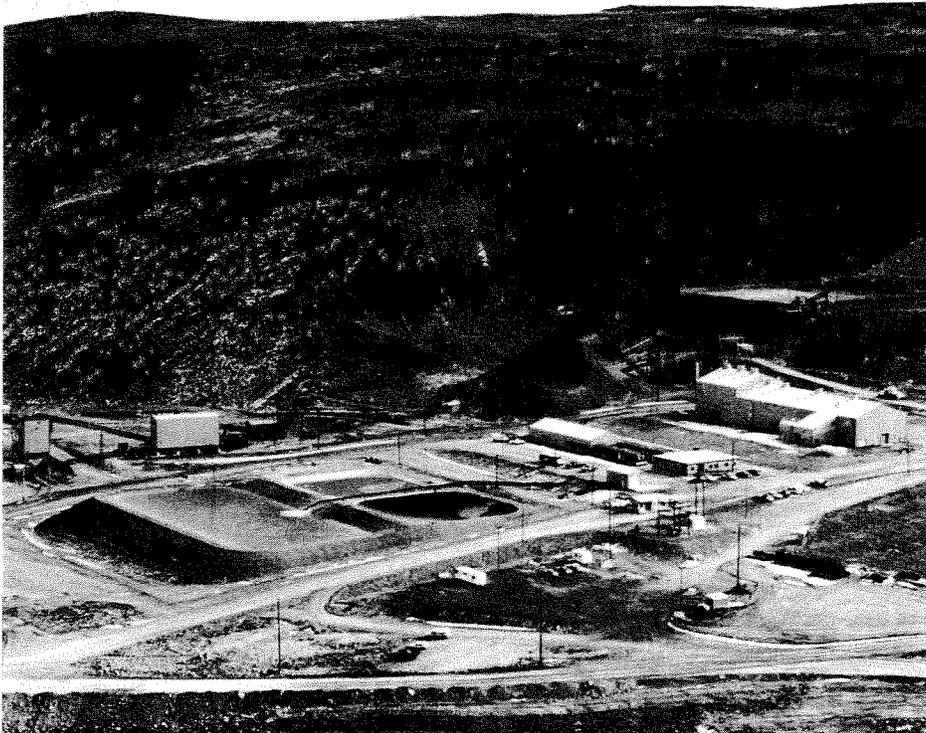
Independence Mining Company's mill at Big Springs. *Independence Mining Co. photo.*

Bond Gold's Bullfrog mine and mill near Beatty. *Bond Gold photo.*



BULLFROG (20)

Bond Gold's Bullfrog mine is approximately 4 miles southwest of Beatty. Gold was first discovered in the area by Shorty Harris in 1904. This discovery resulted in the first gold rush to the area and the establishment of the town of Rhyolite, which at its peak boasted a population of almost 10,000. Bond Gold first started exploring for gold in the area in 1981 and began mine development in 1988. The Bullfrog mine is scheduled to produce 220,000 ounces of gold per year.



Nerco Metals' mill at Candelaria. *Nerco Metals, Inc. photo.*

CANDELARIA (16)

The Candelaria silver mine, owned and operated by Nerco Metals, Inc. is in a historic mining district in the Candelaria Hills, approximately 25 miles south of Mina. Silver mining in this area began in the 1860s, and the town of Candelaria grew around it in 1876. At its peak, Candelaria had a population of 1,500 people. Many of the old buildings and residential structures still stand today. The current mine was opened in 1980, and after a temporary closure, was purchased by Nerco Metals, Inc. in 1983. Nerco re-opened the mine and has since poured over 20 million ounces of silver. Nerco's ongoing and aggressive exploration program continues to expand the ore reserves at Candelaria. The mine is one of the largest heap-leach operations in the state and one of the major contributors of silver production in Nevada.



CHIMNEY CREEK (3)

Producing more than 200,000 ounces of gold annually, Gold Fields Operating Company's Chimney Creek mine near Winnemucca is in its third complete year of operation. Started in October 1987, ahead of schedule and below budget, this operation has become one of the higher grade and lower cost major U.S. gold properties.

On a daily schedule, 45,000 tons of total material are mined consisting of 31,500 tons waste, 9,000 tons leachable ore, and 4,500 tons milling ore. The *stripping ratio* averages 2.5 to 1 with the mining area developed on 20-foot benches. Cut-offs for leaching ore and milling ore are 0.015 ounces of gold per ton and 0.06 ounces of silver per ton. Leachable ore is stockpiled in 40-foot lifts and ripped for installation of irrigation tubing and application of cyanide solution. The mill processes an average of 2,500 tons per day.

Goldfields Operating Company's Chimney Creek mill near Winnemucca. *Goldfields Operating Co. photo.*

It features a SAG (semi-autogenous grinding) mill, ball mill, cyclone, thickener and carbon-in-leach system.

Recorded reserves were 40 million tons leachable ore and 10 million tons milling ore, sufficient for an additional 8 years of mine life. Gold Fields also controls 40,000 acres in the immediate area for exploration efforts.

CLARK (12)

The Clark diatomite mine and mill of Eagle-Picher Minerals, Inc. are located about 20 miles east of Reno. The facility has been in operation since the mid 1940s, mining and milling diatomaceous earth—the fossilized remains of single-celled algae (diatoms). Eagle-Picher produces a variety of mineral fillers from milled diatomite powders for use in polishes, catalysts, fertilizers, and insulation products. A highly absorbent granular product, Floor Dry, is also produced.



Eagle-Picher's Clark diatomite mill. *Eagle-Picher Minerals, Inc. photo.*



Coeur-Rochester mine and heap-leach pads. *Coeur d'Alene Mines Corp. photo.*

COEUR-ROCHESTER (6)

The Coeur-Rochester mine is in the historic Rochester mining district approximately 20 miles northeast of Lovelock. This open-pit, heap-leach operation produces over 4.5 million ounces of silver and 45,000 ounces of gold annually. The open-pit mining operation was begun in 1986, and has an estimated life of over 15 years based on current ore reserves. The silver mined at Coeur-Rochester has many uses including photographic film, electronic circuitry and wire, coins, tableware, jewelry, mirror coatings, and investment.

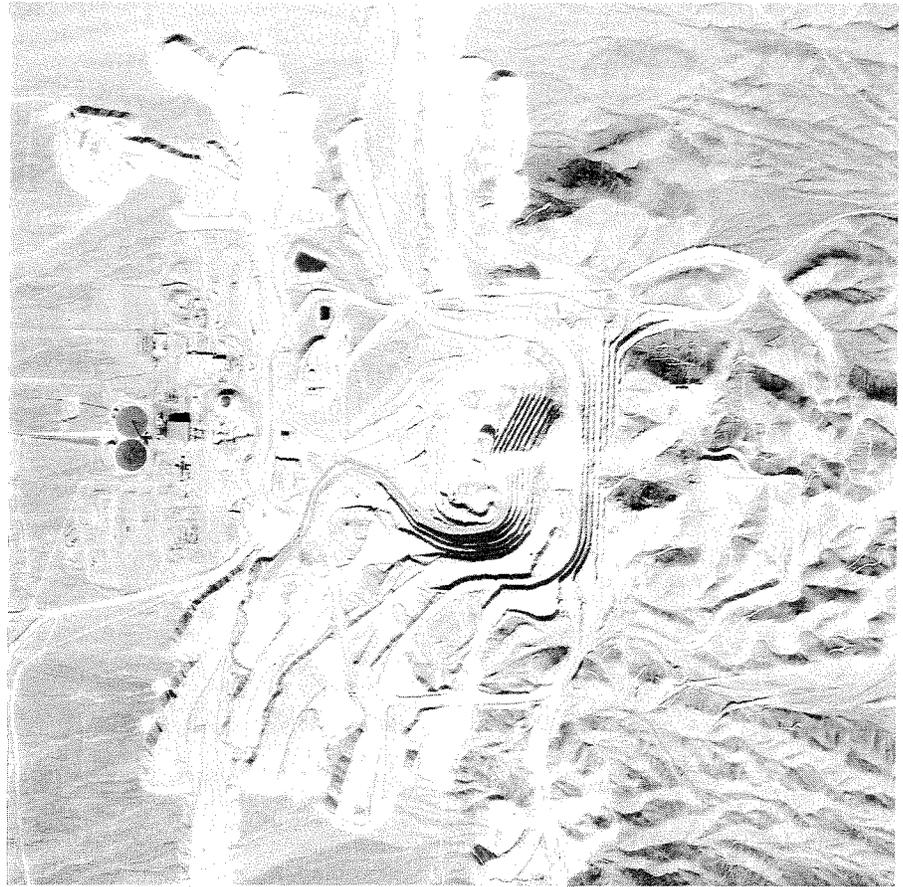


COLADO (7)

The Colado diatomite mill of Eagle-Picher Minerals, Inc. is about 6 miles east of Lovelock. It has been in operation since 1958 primarily producing diatomite filter aids from high quality crude ores mined in the Trinity Range about 15 miles west of Lovelock. Diatomite filter aids are widely used for filtering beer, wine, corn oil, corn syrup, lubrication oil additives, and for many other filtration processes requiring removal of very small particles to attain a high degree of clarity.

Eagle-Picher's diatomite mill at Colado. *Eagle-Picher Minerals, Inc. photo.*

Cyprus Tonopah mine and mill. *Cooper Aerial Survey photo.*



CYPRUS TONOPAH (19)

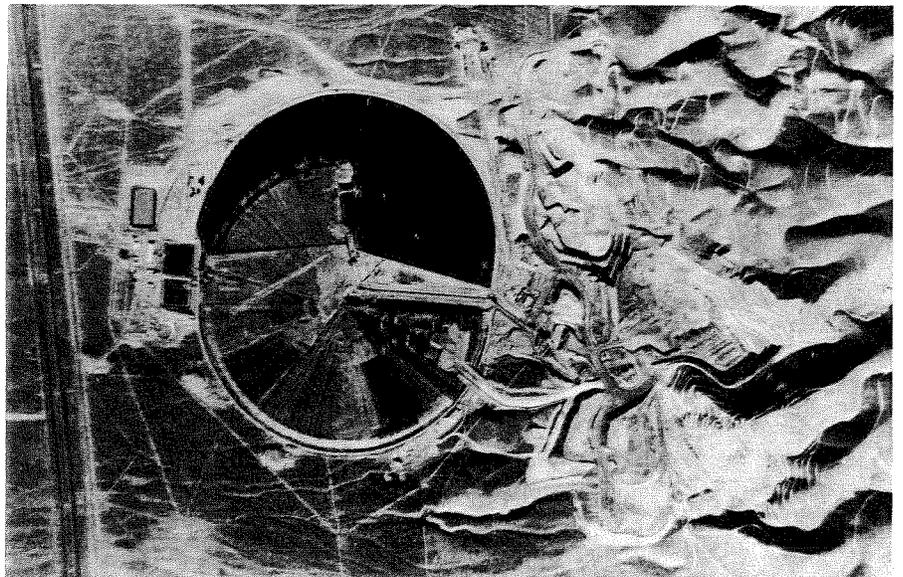
The Cyprus Tonopah molybdenum mine is approximately 20 miles north of Tonopah. The property, formerly known as the Hall deposit, was initially opened by the Anaconda Company in 1980. Due to poor economic conditions, the project was closed down in 1985. Cyprus Minerals Company, headquartered in Englewood, Colorado, purchased the property and began operations in 1988.

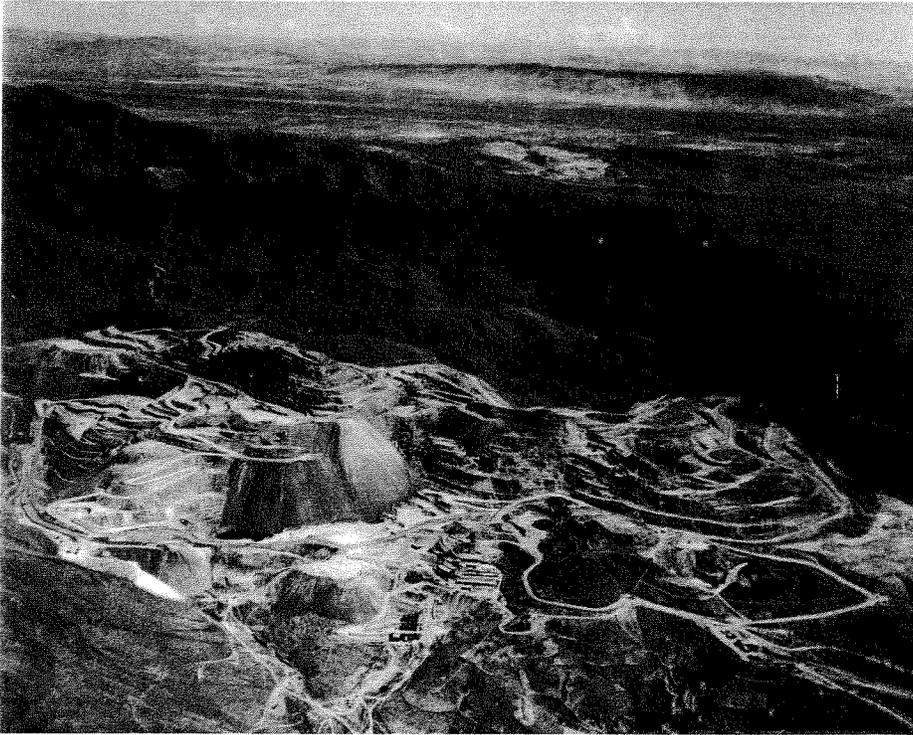
The mine is a primary producer of molybdenum, with copper as a by-product. The mineral, molybdenite, is recovered through the milling operation and is sold for use as an alloy in steel manufacturing. The ore is mined from the open-pit using electric shovels and 170-ton haultrucks. Then it is crushed and sent to the mill to be ground and processed. Copper and molybdenum minerals are recovered from this ground material using the froth flotation method, and are shipped in 2-ton bags to various customers by truck.

FLORIDA CANYON (5)

Pegasus Gold Corporation's Florida Canyon mine, adjacent to Interstate 80 between Lovelock and Winnemucca, began production in 1986. It utilizes a unique radial stacker/conveyor which delivers over 4 million tons of crushed ore per year to distinctive circular leach pads. Stretching ¼ mile from end to end, the Totally Mobile Conveyor (TMC) is one example of the technology required to make lower-grade orebodies profitable. The colorful red ore yielded 79,300 ounces of gold to make 1989 a banner year for Pegasus Gold Corporation.

Pegasus Gold's Florida Canyon mine and circular leach pads. *Pegasus Gold Corp. photo.*



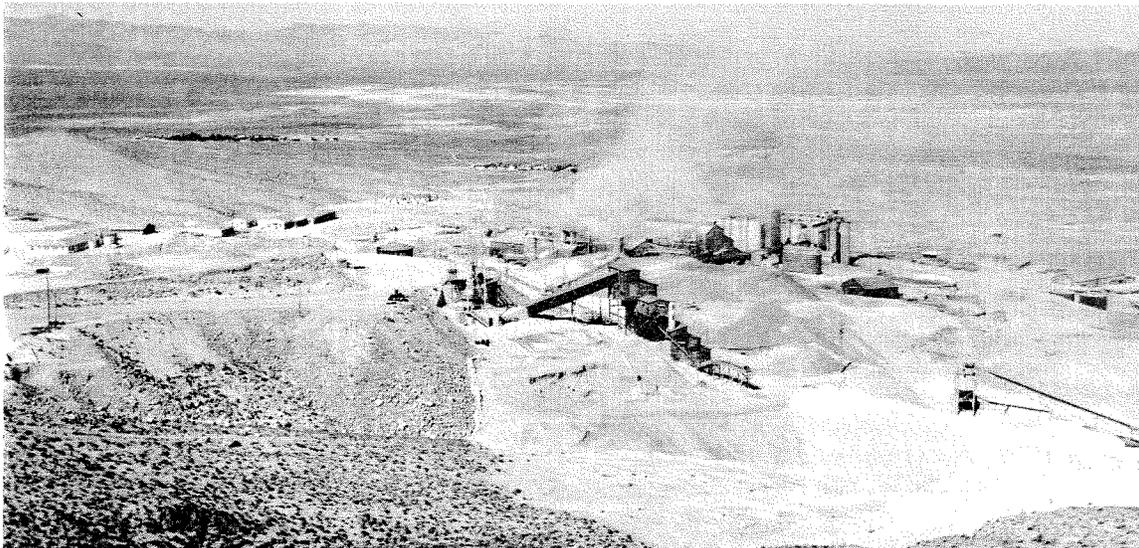


Fortitude open-pit mine at Copper Canyon. *Battle Mountain Gold Co. photo.*

FORTITUDE COMPLEX (11)

Battle Mountain Gold Company's mining complex at Copper Canyon and Copper Basin is in the Battle Mountain mining district south of the town of Battle Mountain. The earliest recorded discovery of copper ore in Nevada was at Copper Canyon in 1872. Copper ore was mined in this area by a sequence of mining companies until copper production was halted in 1978 by the Duval Corporation and gold and silver became the primary ore products.

In 1985 the Duval Corporation became the Battle Mountain Gold Company. The mine complex in this area presently produces approximately 250,000 ounces of gold and 330,000 ounces of silver per year.



C-E Basic's magnesite mine and refractory at Gabbs. *Nevada Bureau of Mines and Geology photo.*

GABBS (14)

C-E Basic mines magnesite in an open pit near Gabbs and processes the ore at its plant nearby. All of the mined magnesite produced in the U.S. comes from Gabbs. Magnesite (magnesium carbonate) is used mainly as a refractory product for steel manufacturing, but it is also used in the manufacture of cattle feed, fertilizer, and sugar, and for water purification. The U.S. Government originally mined the magnesite at Gabbs, but sold the deposit to C-E Basic after World War II. Basic has been steadily mining magnesite ever since.

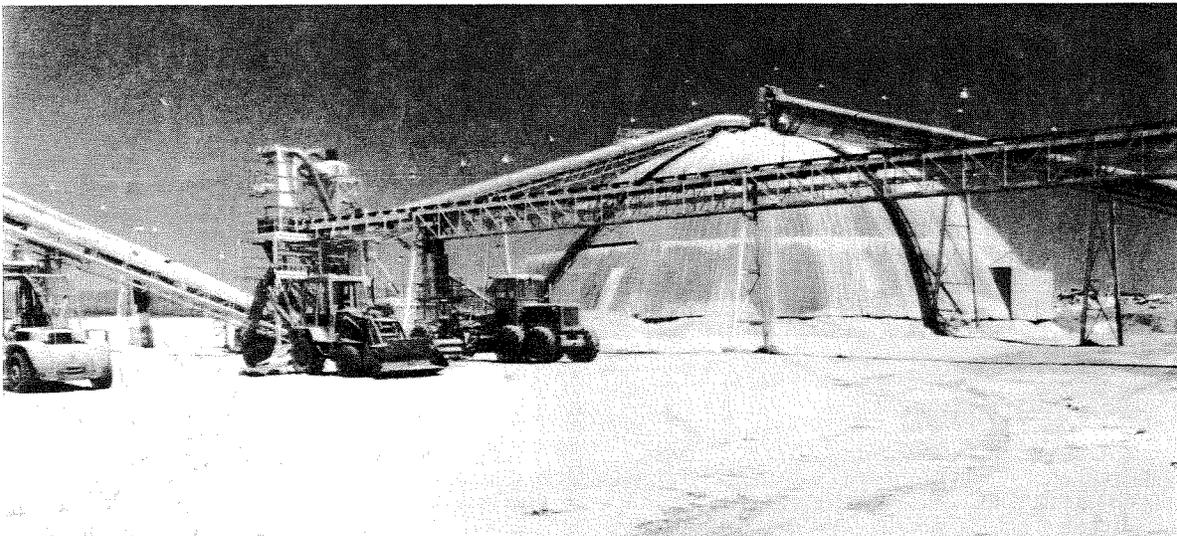
NEWMONT- CARLIN TREND (10)

Since the development of the Carlin gold mine in 1965, the Newmont Gold Company has discovered another 16 gold deposits and currently operates five mines, five mills, and four heap-leach facilities along the Carlin Trend. The mines—Gold Quarry, Genesis, Bluestar, Post, and Rain—are all open-pit operations and a total of 16 million tons of material is mined annually. Milling capacity at present runs at 40,000 tons per day and approximately 32 million tons are processed annually on the heap-leach pads. The company employs about 2,200 persons and expends about \$150 million annually on supplies and equipment in Nevada.

Newmont, using state-of-the-art technology, has grown into the largest gold producer in North America and the fourth-ranked gold producer in the world. Currently it produces 1.5 million ounces annually and the future looks bright because Newmont has the largest proven and probable reserve base in North America.



Gold Quarry mine and mill 2/5. *Newmont Gold Co. photo.*



PABCO Gypsum's plant near Apex. *Pacific Coast Building Products, Inc. photo.*

PABCO GYPSUM (22)

PABCO Gypsum, a subsidiary of Pacific Coast Building Products of Sacramento, California, operates a gypsum quarry and wallboard plant 8 miles south of Apex. Gypsum, a relatively common mineral, is used extensively to make wallboard and plaster, and as an ingredient in cement. The deposit at Apex is very large, covering several miles, and is comprised of gypsum and clay. The clay is removed in a *beneficiating* plant. To produce wallboard, the rock is ground and *calcined*, mixed with water, poured between two pieces of treated paper and dried. The finished product is stored in an on-site warehouse and/or shipped directly to customers.

PARADISE PEAK (15)

The Paradise Peak gold, silver, and mercury mine, operated by FMC Gold Company, is 8 miles south of Gabbs. Mercury was first mined in the area in the 1930s and is currently produced at the mine as a by-product. FMC discovered the gold and silver deposit in July 1983. The plant was started in April 1986 and is now one of the largest producers of gold, silver, and mercury in North America. Paradise Peak uses conventional open-pit mining techniques to remove the ore from the ground. The gold, silver, and mercury are recovered from the ore by two separate recovery processes. The first



FMC Gold's Paradise Peak mine and mill. *FMC Gold Co. photo.*

process consists of conventional crushing, grinding, cyanide leaching, countercurrent decantation, and Merrill-Crow (precipitation by zinc dust) circuits to recover the metals from the high-grade ore. The second process is conventional heap-leaching of low-grade ore. Gold and silver are used in jewelry, electronic circuits, and in dental and photography laboratories. Mercury is widely used in laboratory work and in making thermometers, barometers, diffusion pumps, and many other instruments.



Round Mountain gold mine in Smoky Valley. *Round Mountain Gold Corp. photo.*

ROUND MOUNTAIN (18)

The Round Mountain site is in the foothills of the Toquima Range on the east side of Big Smoky Valley, about 55 miles north of Tonopah. Mining began in the area in 1906 and has continued intermittently since then. In January 1985, Echo Bay Mines, Ltd. (the operating partner), Homestake Mining Company, and Case, Pomeroy & Company, Inc. purchased Round Mountain Gold Corporation, Smoky Valley Common Operation. A recent large expansion of this open-pit mine has doubled production capability to 35,000 tons per day. Round Mountain, the largest heap-leach gold mine in the world, produced 318,616 ounces of gold in 1989.

An open-pit mine and mill at Manhattan, 18 miles east of Round Mountain, became part of Round Mountain Gold Corporation in January 1989. It added mill capabilities to the operation, which provided better recovery on high-grade ore than could be obtained by heap-leaching.



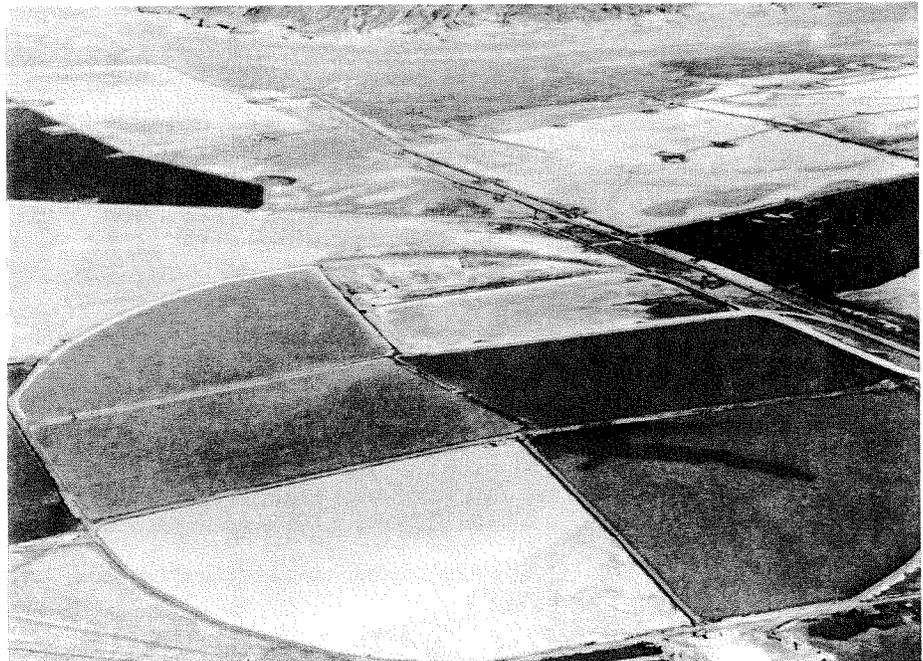
Royal Peacock fire opal mine in Virgin Valley. *Royal Peacock Opal Mines, Inc. photo.*

ROYAL PEACOCK (1)

Royal Peacock Opal Mines, Inc., is located in the Virgin Valley approximately 40 miles southwest of Denio. Precious fire opals are rare and valuable gemstones. The black precious fire opal is the official Nevada State Precious Gemstone and is found in the U.S. only in the Virgin Valley. Millions of dollars in opals have been taken from the Virgin Valley since 1905, including the famous Royal Peacock Opal, a 140-carat flawless black opal.

SILVER PEAK (17)

Cyprus Foote Mineral Company operates solar evaporation ponds and a lithium carbonate plant at Silver Peak. The brine deposit consists mainly of sodium chloride with smaller amounts of potassium, magnesium, lithium, and calcium. The brines are pumped from beneath the surface into a series of ponds where they are concentrated by solar evaporation. This process is effective because the potential evaporation rate in this region of Nevada is 35 to 40 inches per year, while the rainfall is usually 3 inches or less per year. Lithium is recovered from the concentrated brine by precipitation as lithium carbonate, a white crystalline substance. The product is shipped worldwide from Cyprus Foote's warehouse, also located at Silver Peak.

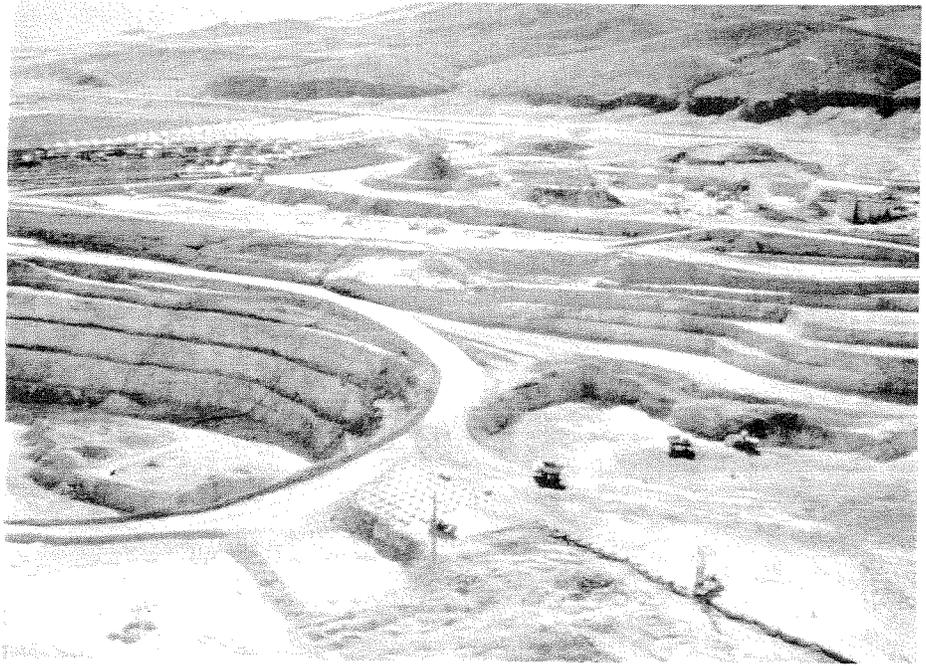


Cyprus Foote's evaporation ponds at Silver Peak. *Cyprus Foote Mineral Co. photo.*

Lithium carbonate is used by the ceramics industry as a fluxing agent, and by the aluminum industry to lower the melting point of the cryolite bath to save on energy costs and reduce fluorine emissions. Lithium is used in other forms in lubricants, batteries, synthetic rubber, air conditioning, industrial drying, carbon dioxide scrubbing, pharmaceuticals, and welding and brazing.

SLEEPER (2)

Amax Gold Inc. discovered the Sleeper gold and silver ore deposit in 1984. The construction phase began in 1985 and was completed in a record time of 101 days from first concrete pour to initial feed into the mill. The first shipment from this world-class orebody was made in March 1986. Sleeper is an open-pit operation with both milling and heap-leaching in the recovery process. The mine and mill are 28 miles northwest of Winnemucca.



Amax Gold's Sleeper mine and mill.
Amax Gold Inc. photo.

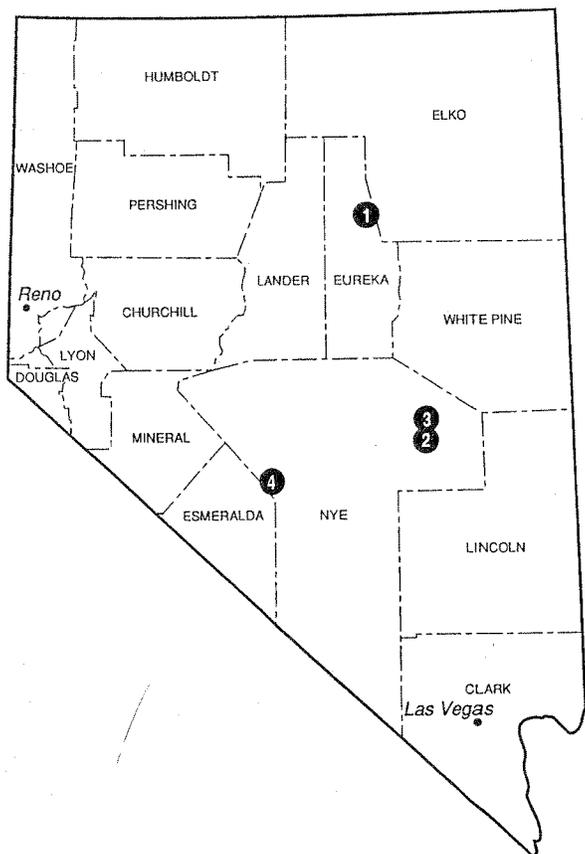


Ward Mountain mine. *Alta Gold Co. photo.*

WARD MOUNTAIN (13)

The Ward mine, owned and operated by Alta Gold Company, is a zinc-copper-lead-silver underground mine 15 miles south of Ely. The ore is mined by a modified open stope technique using diesel-powered, rubber-tired equipment, and hauled 14 miles east to the Taylor mill. At Taylor the ore is milled by selective flotation, and the concentrates are shipped by truck and rail to Trail, British Columbia for smelting.

OIL AND GAS



OIL FIELDS

1. Pine Valley
Blackburn
Tomera Ranch
North Willow Creek
Three Bar
2. Railroad Valley
Eagle Springs
Trap Spring
Kate Spring
Grant Canyon
Bacon Flat

REFINERIES

3. Railroad Valley
4. Tonopah

In 1954 Shell Oil Company drilled Nevada's first producing oil well in the Eagle Springs field in Railroad Valley. Since this initial discovery several additional wells have been drilled and developed in this field. Currently, the average production is approximately 1,000 barrels per day under the operation of Draycutt Corporation and John Lyddon, Independent.

Further exploration in Railroad Valley led to the discovery of the Trap Spring field by Northwest Exploration. At the present time over 5,000 barrels per day are being produced from 27 active wells in this field. Current operators are Makoil, Inc., Apache Corporation, and J. R. Bacon Drilling Company.

Other discoveries in Railroad Valley include the Currant field and the Bacon Flat field, both of which are now inactive. However, plans are underway to rework the well at Bacon Flat, which produced over 300,000 barrels in seven years. Another discovery is the Grant Canyon field, where two wells are currently producing over 6,000 barrels per day.

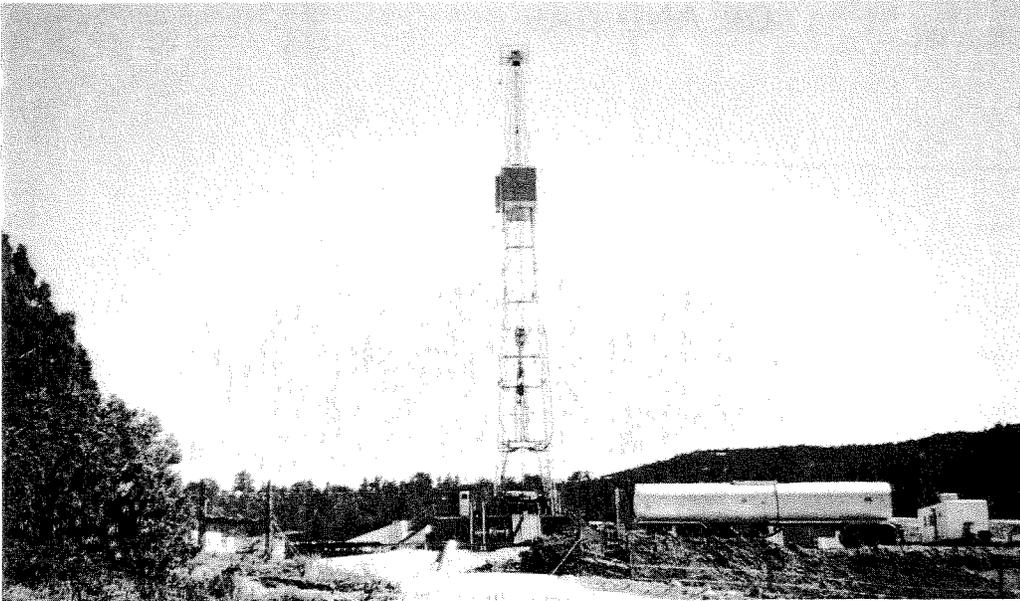
The first well in the Kate Spring field in Railroad Valley was drilled by Marathon Oil Company in 1984. This well was sold to Western General, Inc., and is currently producing over 10,000 barrels per month. Three other wells in the Kate Spring field are currently producing about 40,000 barrels per month. This is the only oil field in Nevada that produces natural gas; none of the gas is sold but is used to fuel the well-site equipment.

The Blackburn field, in Pine Valley in Eureka County, was discovered in 1982 by Amoco Production Company. The Petroleum Corporation of Nevada purchased it in 1989, and is producing more than 700 barrels per day from four wells.

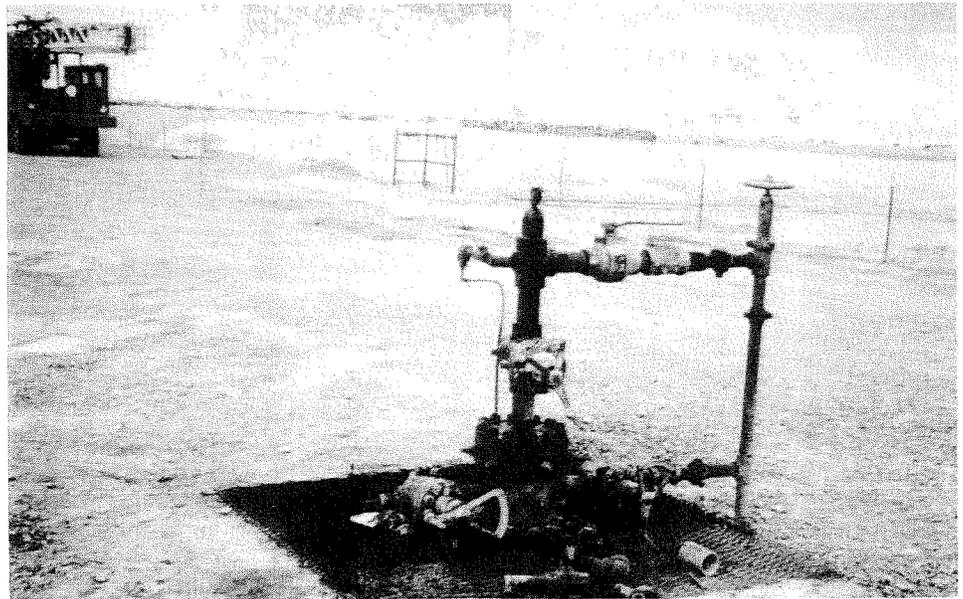
Three more fields have been discovered in the Pine Valley area since the discovery of the Blackburn field. The Tomera Ranch field was discovered in 1987, and the North Willow Creek field in 1988. Tomera Ranch had produced 6,500 barrels and the North Willow Creek had produced 13,500 barrels by the end of 1989. These two fields are operated by the Foreland Corporation. The most recent oil discovery in Nevada is the Three Bar field, where a well discovered by the Gary Williams Company went into production in March 1990.

Nevada is presently producing over 3,200,000 barrels of oil annually and active exploration for oil in Nevada is a continuing process.

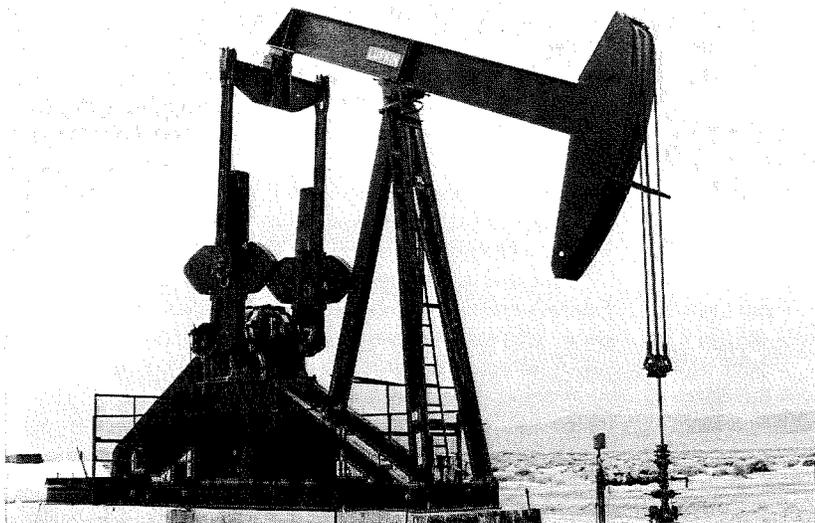
There are two oil refineries in Nevada processing nearly 3,500 barrels of oil per day. The Tonopah refinery, on line since 1974, and the Petro-Source refinery in Railroad Valley, which started up in 1987, are owned and operated by the Petro-Source Company. The refinery in Railroad Valley has an asphalt unit which processes over 3,000 barrels of asphalt per day using crude oil from the Kate Spring field. Other products refined from Nevada oil are diesel fuel, stove oil, kerosene, and solvents.



Oil and gas drilling rig.

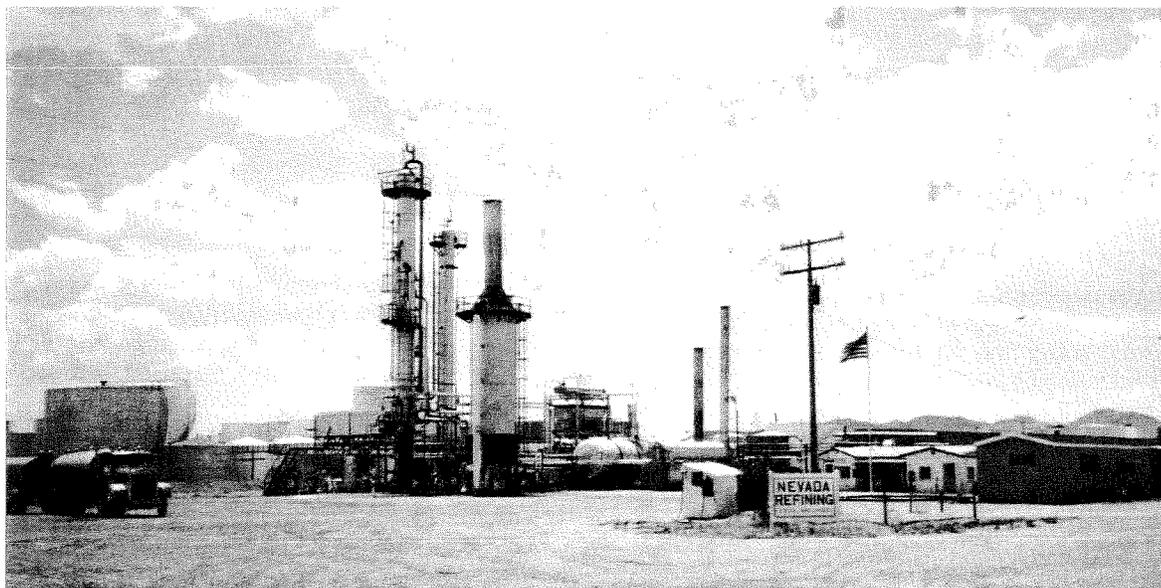
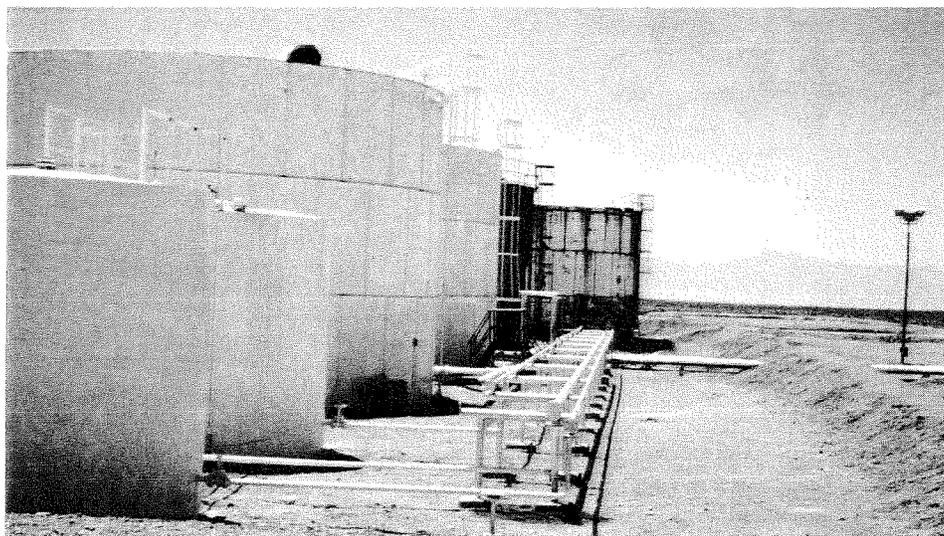


Free-flowing oil well.

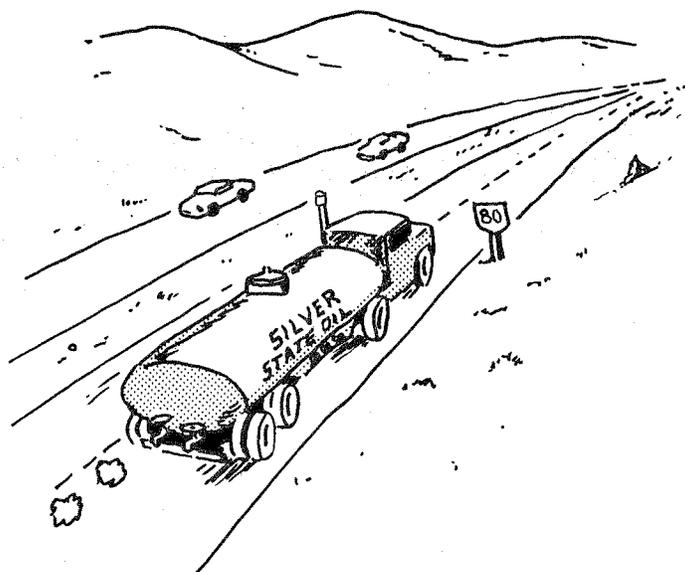


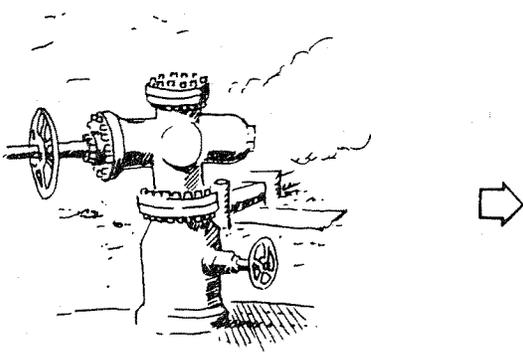
Pumping oil well.

Tank farm.

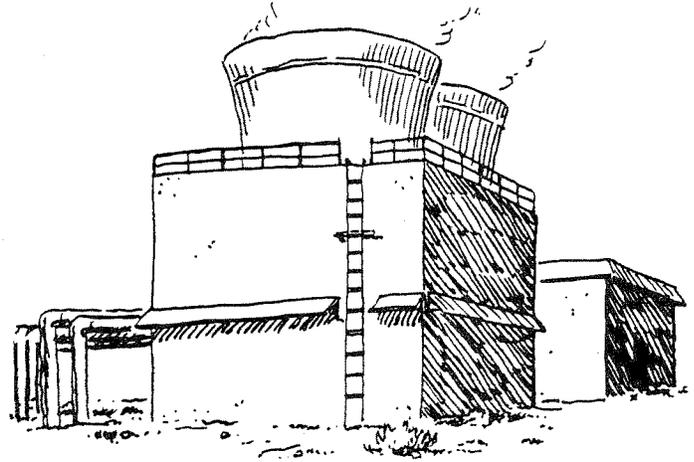


Refinery.

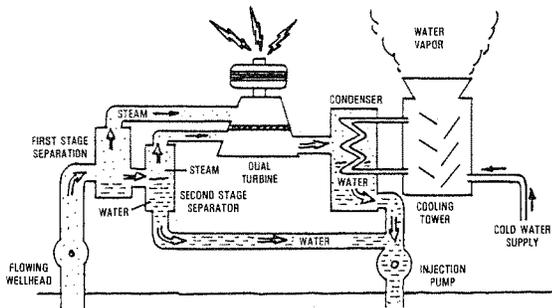




Steam and/or geothermal water are produced from well and piped to geothermal power plant where power is produced.

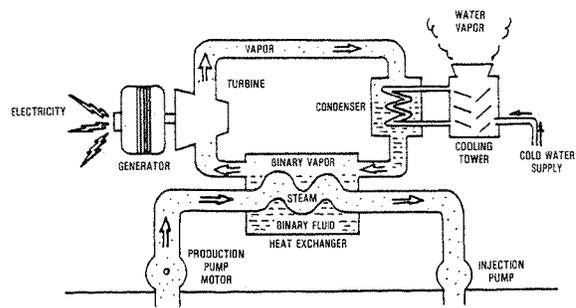


In the flash system, steam is separated from water in a flash tank.

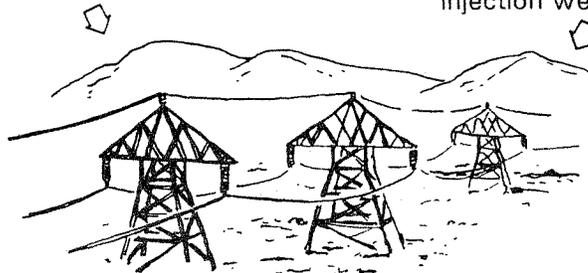


Steam from the upper part of the tank spins a turbine connected to a generator. Unvaporized geothermal water and condensed steam are pumped into an injection well.

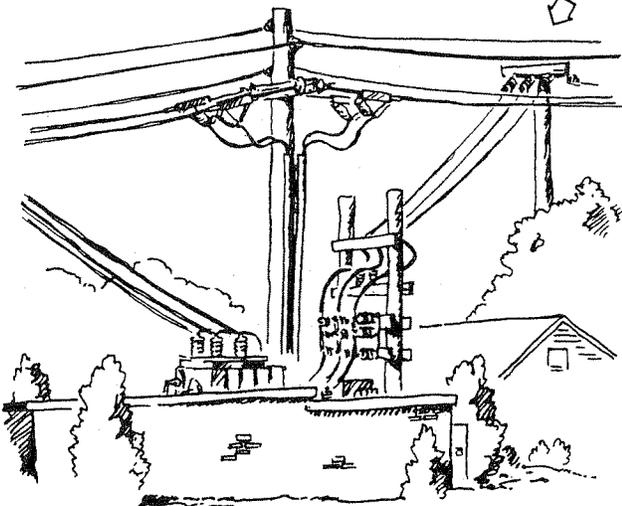
In the binary system, geothermal water travels by pipeline to heat exchanger.



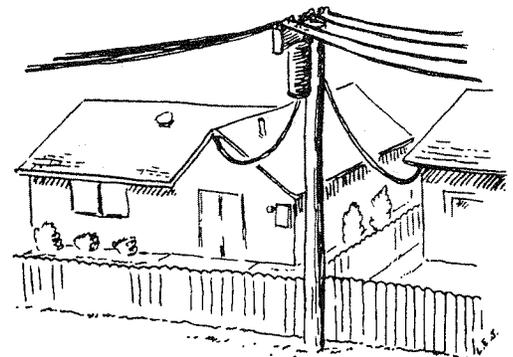
In heat exchanger, geothermal water heats a working fluid and changes it to a vapor that drives a turbine connected to a generator. Geothermal water is then pumped into an injection well.



The generated electricity is carried by transmission lines . . .

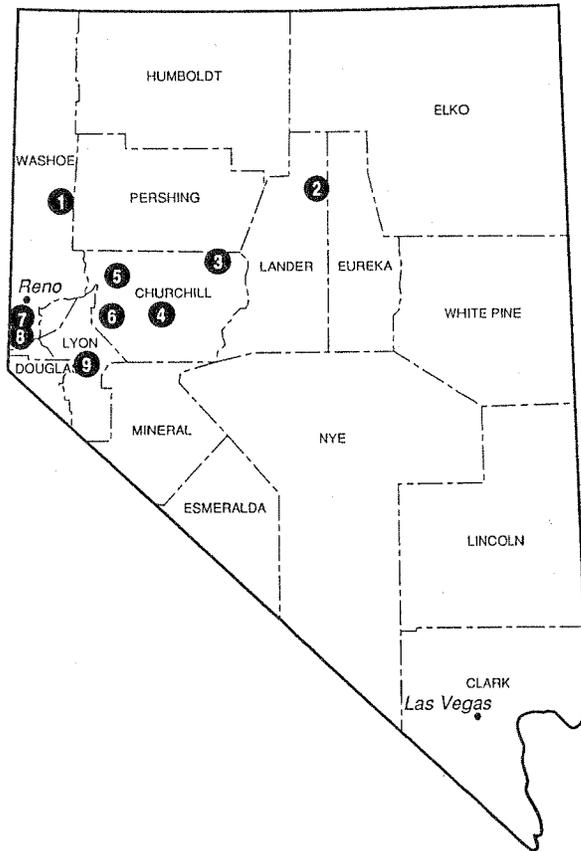


to a power substation which distributes . . .



electrical power to consumers.

GEOTHERMAL ENERGY



GEOTHERMAL PLANTS

1. Empire
2. Beowawe
3. Dixie Valley
4. Stillwater
5. Desert Peak
6. Soda Lake
7. Steamboat-Lower Terrace
8. Steamboat-Upper Terrace
9. Wabuska

Geothermal energy can be considered a geologic resource because it is derived from heat from within the earth. Nevada is rich in this natural resource and presently has nine geothermal power plants in operation.

The primary use of geothermal energy is in the production of electric power. There are two types of geothermal power plant systems in operation in Nevada: flash and binary. The flash system of generating electricity uses superheated (above 300°F) geothermal water. In the power plant, the pressure of the geothermal water is reduced and some of the superheated water vaporizes (flashes) into steam in a separator. The water that does not vaporize is sent to a second separator where its pressure is further reduced and another portion of it vaporizes. Water that does not turn to steam in the separators is injected back into the geothermal reservoir. The steam from the separators is directed against the blades of a turbine which turns a generator, producing electricity which is transmitted into a utility power system.

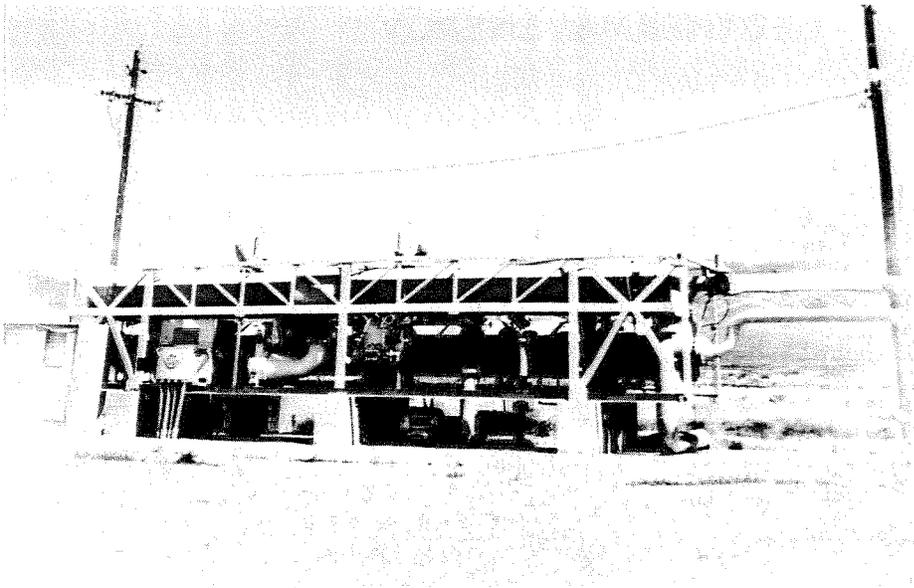
The binary system, or heat exchange method, operates on a different principle. Geothermal water, which can be at a lower temperature than that required for the flash system, is pumped through a heat exchanger and then injected back into the geothermal reservoir. The heat exchanger contains a fluid that has a lower boiling point than water. In the heat exchanger, heat from the geothermal water causes this fluid to vaporize. It is this vapor that pushes against the turbine

blades and makes the generator produce electric power. The vapor is condensed back to liquid and recycled through the heat exchanger to be transformed into a vapor again. Unlike the flash system, the geothermal water in the binary system is kept under pressure by pumps to prevent vaporization.

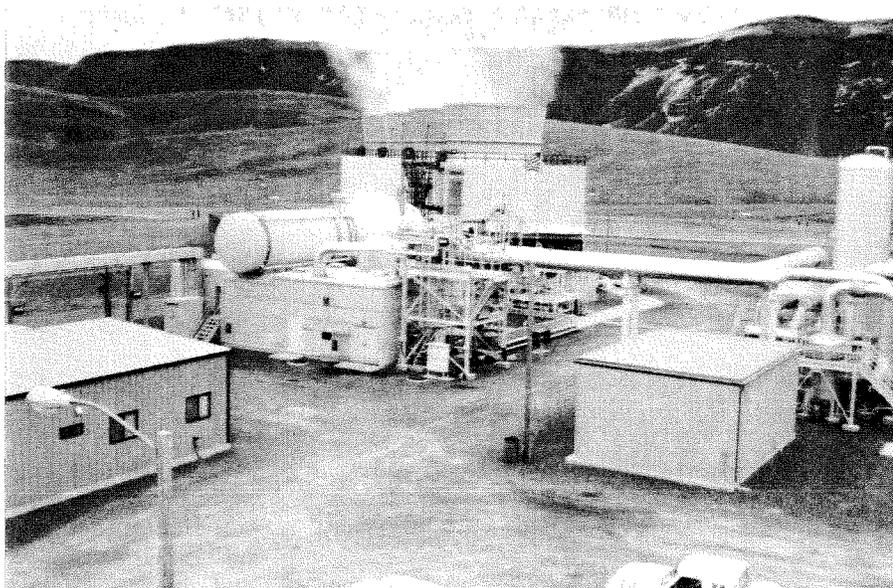
The first power plant to produce electricity from a geothermal resource in Nevada went on line at Wabuska in Lyon County in 1984. Its initial capacity was 600 kilowatts. In 1987, with the addition of a generator and another production well, its gross capacity was increased to 1.8 megawatts.

Eight more geothermal power plants have been brought into production: Beowawe (16 megawatts) in 1985; Steamboat (Lower Terrace - 9.8 megawatts) in 1986; Soda Lake (3.6 megawatts) in 1987; Desert Peak (10.5 megawatts), Dixie Valley (60 megawatts) Empire (3.6 megawatts), and Steamboat (Upper Terrace - 12.5 megawatts) in 1988; and Stillwater (13 megawatts) in 1989. The Dixie Valley plant, 85 miles northeast of Fallon, is the largest geothermal power plant in Nevada.

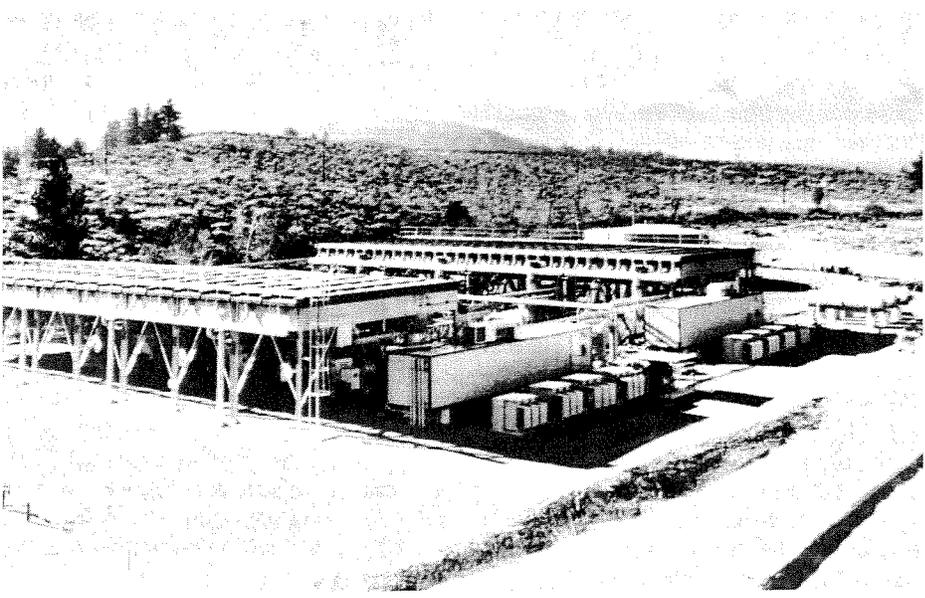
While electric power is by far the greatest use of geothermal energy, it is also used commercially for space heating hotels, motels, offices, schools, and hospitals, and for food dehydration and aquaculture (fish-farming). Additionally, over 400 single family dwellings in Nevada are heated by geothermal energy.



Wabuska
(Tad's Enterprises)

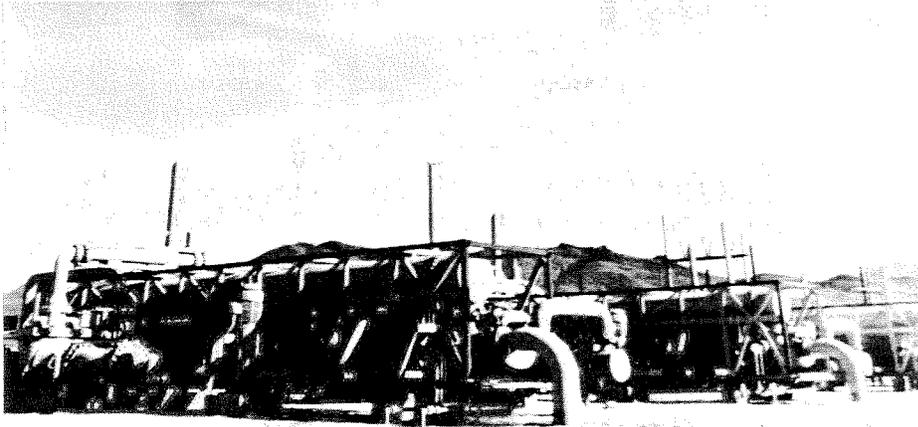
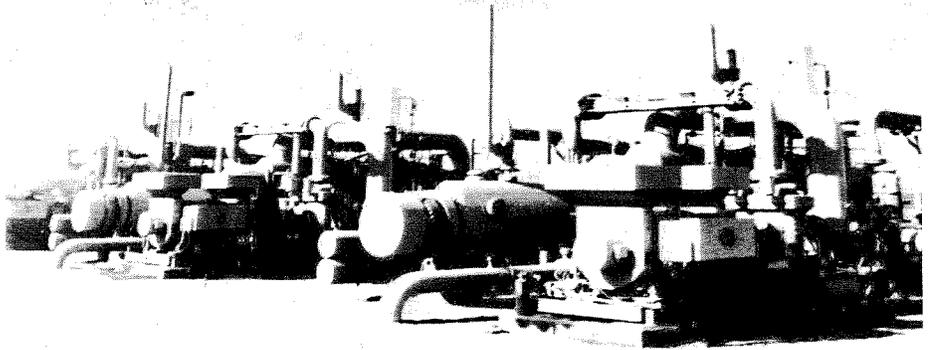


Beowawe
(Chevron Resources)



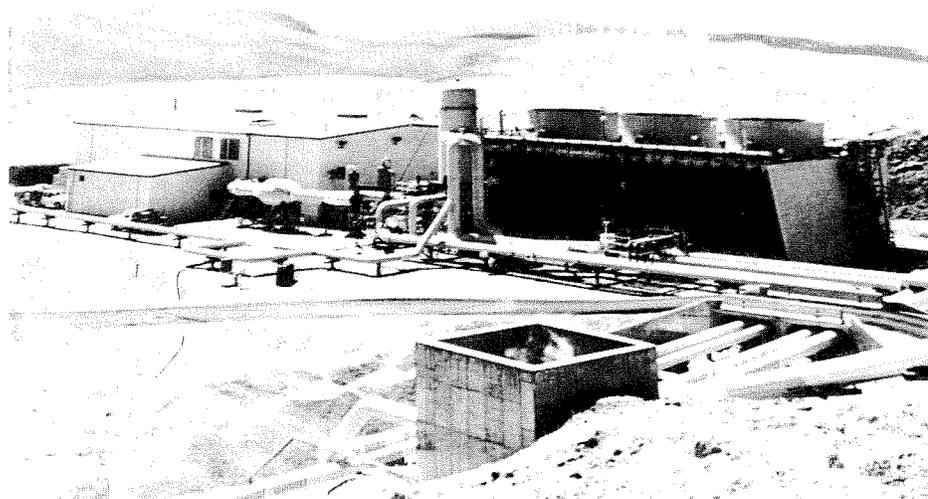
Steamboat
(Farwest, Inc.)

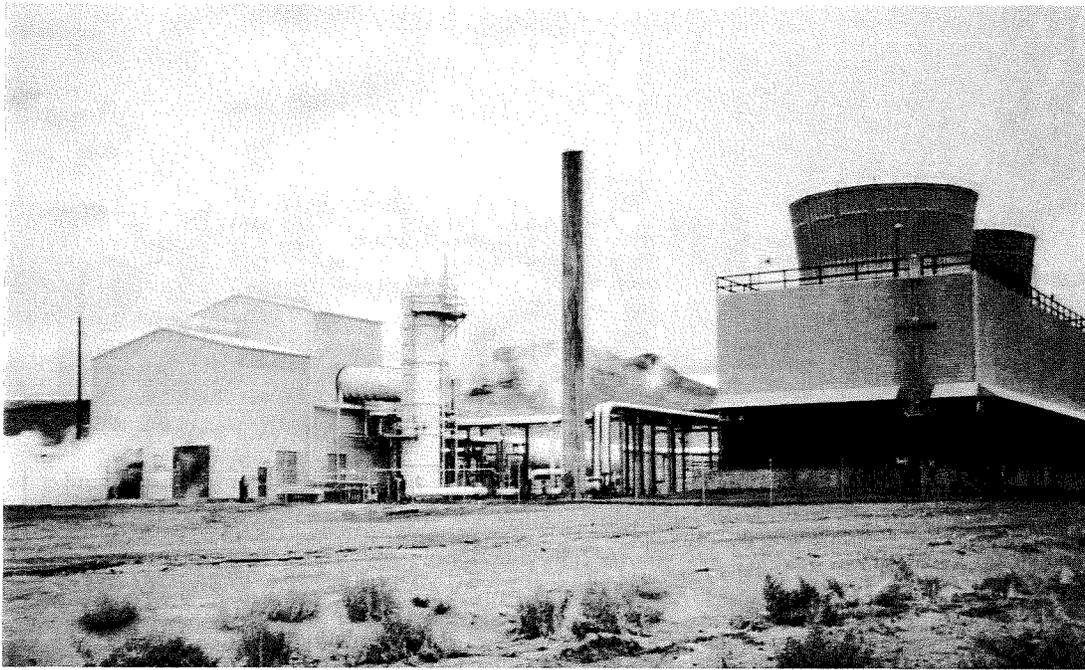
Soda Lake
(Ormat Energy
Systems, Inc.)



Empire
(Ormat Energy
Systems, Inc.)

Steamboat
(Caithness Geothermal, Inc.)

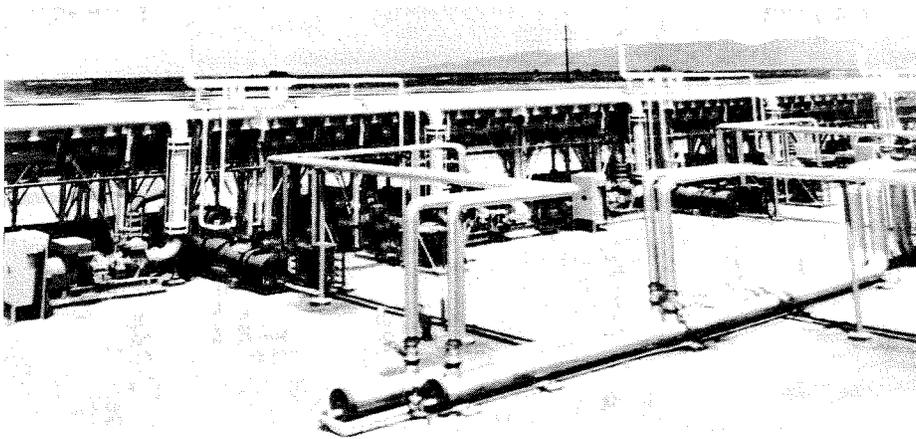




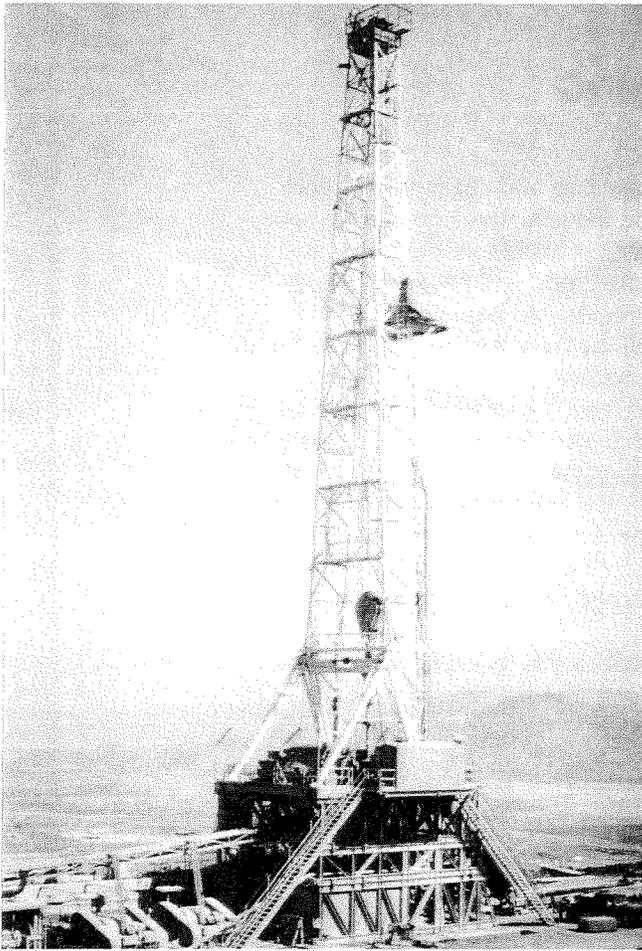
Desert Peak
(Chevron Resources).
Larry Garside photo.



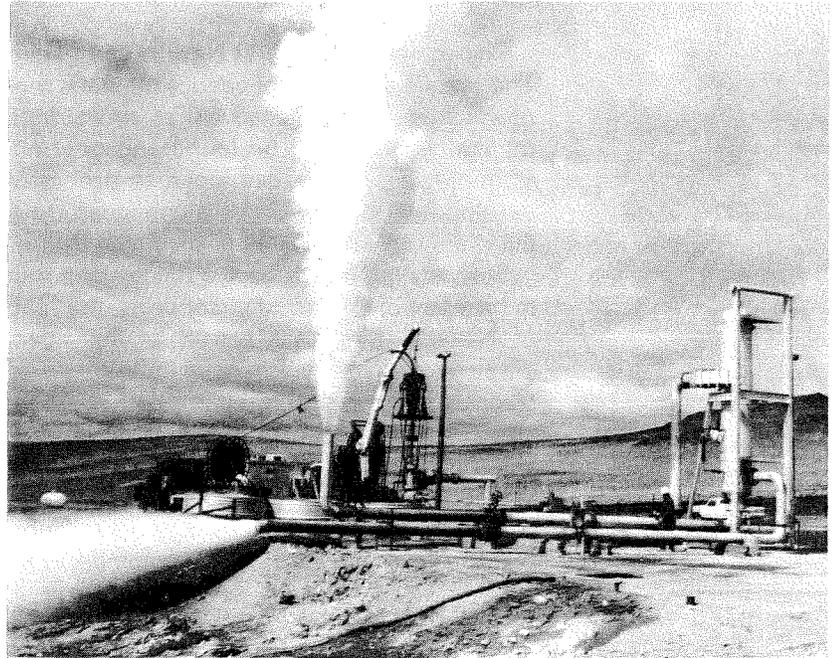
Dixie Valley
(Oxbow Geothermal Corp.)



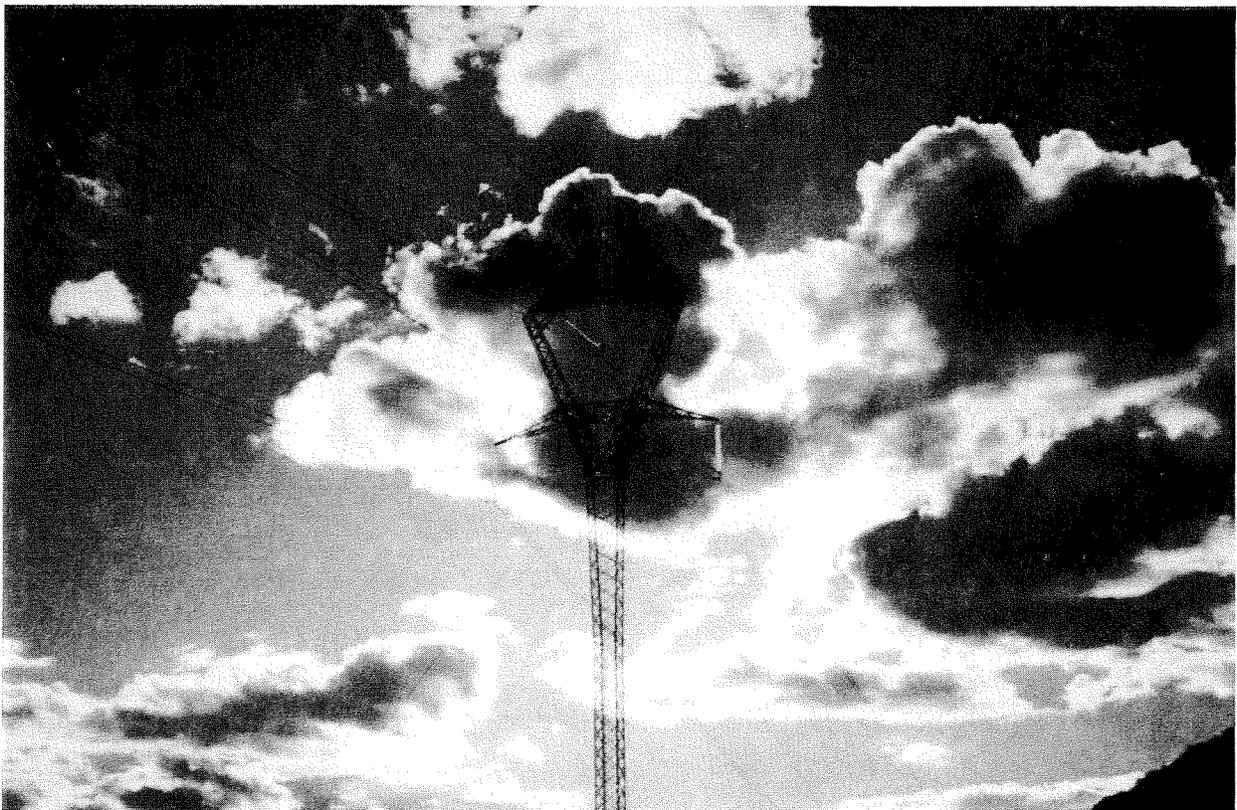
Stillwater
(Ormat Energy
Systems, Inc.)



◀ Geothermal drilling rig.



Geothermal well flow test.



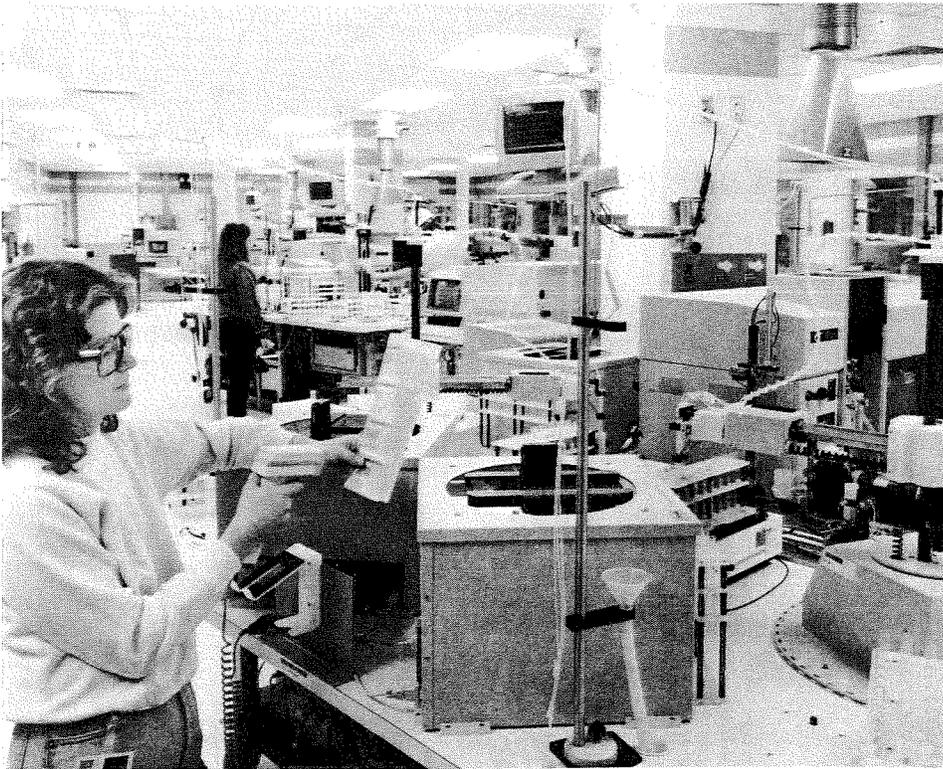
Electric power from geothermal energy.

FUTURE OF MINING

The mineral industry in Nevada can expect an exciting and challenging future. The price fluctuations of various minerals makes the industry very competitive and progressive. With the advent of more sophisticated exploration methods, new mineral deposits will be found and new mining methods and recovery-process technologies will be developed to process the ore. As the exploration for and development of new deposits continues, so too will the need for individuals to fill the many occupations associated with the mineral industry.

Students in Nevada have a unique opportunity to learn the various skills needed to be a part of this industry. For years, the Mackay School of Mines at the University of Nevada, Reno has served as the educational center for many individuals employed in Nevada's mineral industry. In addition, the University of Nevada, Las Vegas and the various community colleges throughout the state offer the necessary curricula (earth sciences, engineering, computer science, and economics) to provide students with the perfect blend of knowledge needed to pursue careers and fill positions in this dynamic industry.

People, machinery, ideas, and dedication are vital to this industry. With them, Nevada's mineral industry will continue to thrive long into the future.



Newmont's robotic assay laboratory.
Newmont Gold Co. photo.

GLOSSARY

- assay** To determine the proportion of metal in an ore by means of chemical testing.
- basalt** A dark volcanic rock composed of microscopic grains of augite, feldspar, and olivine. Some basalts have many holes that give the rock a swiss-cheesecake appearance. As the lava cools, gases escape, leaving holes of different sizes. The rocks at Lunar Craters in southern Nevada are composed of basalt.
- base metal** A more common and chemically reactive metal. Copper, lead, and zinc are examples of base metals.
- beneficiate** Improve the grade of ore by milling, flotation, or other processes.
- bonanza** An exceptionally large and rich body of ore or a rich part of a deposit.
- calcine** Heated to temperature of dissociation; for example, heat gypsum to the temperature where the water of crystallization is driven off.
- carbon-in-leach** A method of recovering gold and silver from cyanide solutions by adsorbing them on granules of activated carbon.
- colors** A showing of visible particles of gold in a pan or in a rock.
- conglomerate** A rock composed of larger, rounded rock fragments in a matrix of very small rock particles.
- countercurrent decantation** A method of leaching in which the ground ore moves through a series of washing and settling operations while the cyanide solution moves in the opposite direction.
- disseminated gold** A scattered distribution of very small, sometimes microscopic, gold particles in a rock.
- doré** A mixture of gold and silver in cast bars.
- fault** A fracture or fracture zone along which the rocks on one side have been displaced relative to those on the other side.
- fluid-bed roaster** A autoclave used to oxidize sulfide ores to facilitate recovery of gold and silver. A mixture of ground ore, water and sulfuric acid are heated under pressure and exposed to high-purity oxygen to oxidize the sulfides.
- fossil** The naturally preserved remains, trace, or imprint of a plant or animal.
- fracture** A general term for a break in a rock.
- granite** A light-colored plutonic igneous rock made up of interlocking grains of glassy or milky quartz, white or pink feldspar, and specks of dark mica or hornblende. The Sierra Nevada is made up of granite and similar rock types.
- headframe** A steel or timber structure with a pulley and cable system at the top used to hoist miners and materials in and out of underground mines.
- high-grade ore** Ore that contains a higher than usual concentration of valuable minerals.
- horn silver** A white, pale yellow, or gray waxlike mineral that darkens on exposure to light (silver chloride).
- hydrothermal deposit** A mineral deposit formed when hot, aqueous solutions fill fractures or other open spaces in rocks or along faults. The minerals crystallize as the solutions cool.
- igneous rock** A rock formed by the solidification of molten materials (magma). The rock is *extrusive* (or volcanic) if it solidifies on the surface; *intrusive* (or plutonic) if it solidifies beneath the surface.
- industrial mineral** Any rock or mineral substance (with the exception of metals, fossil fuels, and gemstones) of economic value.
- limestone** A sedimentary rock composed of the mineral calcite. Shell fragments are common in many limestones. When chemical conditions are right, some calcite crystallizes in sea water and settles to the bottom to form limestone.
- lode** A mineral deposit consisting of a zone of veins.
- metal** A naturally occurring opaque substance that has a high luster, conducts electricity, and is usually ductile. Examples of metals are iron, copper, gold, aluminum, and zinc.
- metallurgy** The science and technology of separating metals and metallic minerals from ore by mechanical and chemical processes.
- metamorphic rock** A sedimentary or igneous rock that has been changed by pressure, heat, or chemical action.
- mill** The process or a place where ore is crushed and treated to separate the valuable commodities from the waste material.
- mineral** Any naturally occurring inorganic material with an orderly internal arrangement of atoms and specific physical and chemical properties.
- mining district** An area of land with described or understood boundaries within which mineral deposits are found. Historically, mining districts were set up by miners for the purpose of administering and governing their activities.
- nonmetal** A rock or mineral that does not have metallic properties.
- ore** Rock or mineral material from which minerals can be extracted at a profit.
- orebody** A continuous, well-defined mass of ore.
- outcrop** A solid, in-place exposure of rock at the surface.
- overburden** The nonvaluable rock material, either loose or consolidated, that overlies a mineral deposit.
- placer** A deposit of heavy minerals such as gold or platinum concentrated in stream or beach gravels.
- precious metal** A general term for gold, silver, platinum or other relatively scarce, valuable metal.
- quartz** The most common rock-forming mineral. It is made up of silicon dioxide (SiO₂). Quartz crystals may be glassy or opaque (milky quartz) and exist in a variety of colors including white, rose, smoky gray, and purple.
- quartzite** A hard metamorphic rock made up of interlocking quartz grains that have been cemented by silica.
- refractory ore** Ore difficult to treat for recovery of valuable substances; sulfide precious-metal ores are refractory.
- rhyolite** A light-colored volcanic rock composed primarily of microscopic grains of quartz and feldspar.
- rocker** A long, rectangular box mounted on two rocker arms. A screen inside the box separates the finer gold-bearing sands from the larger gravels. The sands are rocked back and forth in water to separate out the heavier gold.
- sedimentary rock** A rock formed by the compaction and cementation of microscopic- to large-sized broken rock fragments or fossil debris. Some sedimentary rocks are the result of chemical reactions in water that allows the minerals to form directly. Many sedimentary rocks show distinct layering, which is the result of different types of sediment being deposited in succession.
- silica** Silicon dioxide (SiO₂). It occurs in crystalline (quartz), amorphous (opal), or impure (silica sand) forms.
- square-set stoping** An underground mining method used in areas of relatively soft or unstable ground. Notched timbers are wedged together in square, box-shaped patterns to support the ground.
- stamp mill** Equipment (or the building that houses it) that is used to pulverize rocks by crushing them with large, heavy, cylinder-shaped pestles called stamps.
- stope** An underground excavation formed by the extraction of ore.
- stripping ratio** The amount of waste that has to be removed to mine a specific amount of ore.
- tailings** The part of processed ore that is uneconomical to treat further and is usually discarded.
- vein** A mineralized filling of a fault or fracture in a rock.

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