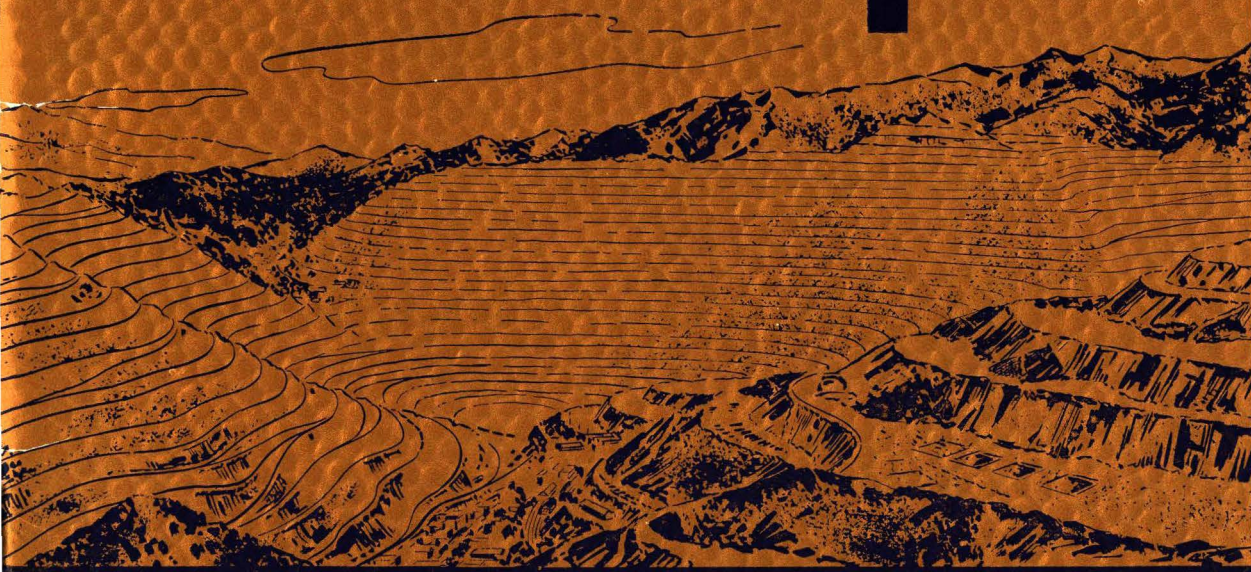
50TH Anniversary



The Utah Copper Story

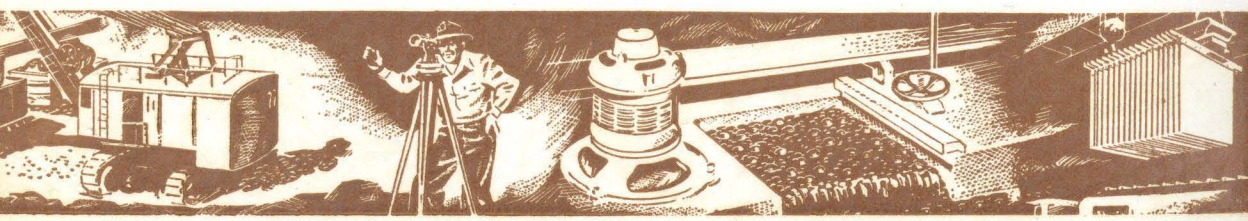
UTAH COPPER DIVISION • KENNECOTT COPPER CORPORATION

KENNECOTT COPPER CORPORATION

UTAH COPPER DIVISION

Kearns Building, Salt Lake City, Utah

1954



FOREWORD

August, 1954, marks the 50th anniversary of the Utah Copper Division of Kennecott Copper Corporation.

The first year was a dramatic turning point in mining history. It brought confirmation of Daniel C. Jackling's revolutionary idea that the low-grade copper ore at Bingham Canyon could be profitably handled by large scale production.

An industrial organization's only real measure of achievement is its contribution to the economic health of the nation. The growth of Utah Copper through 50 years, with the far-reaching benefits its operations have brought to all Utahns, is typical of the vast contribution of the American business system to the well-being of the American people.

The anniversary is an opportune time to say how greatly we appreciate the privilege of doing business in Utah. We have had fine neighbors and, in turn, have tried to be a good neighbor. Our endeavor has been to manage and develop the operation so it would continue to be a source of state-wide benefits—as expressed in payrolls, supply purchases, tax payments and other expenditures.

We acknowledge our gratitude to Utah Copper employees, past and present. Theirs has been a great contribution to the success of the organization. We sincerely thank business firms for their cordial cooperation in aiding us with services and supplies.

To the people of this area, we express our thankfulness for the understanding of our problems, many of which have been difficult to explain and difficult to solve.

Looking back across the last half century, we feel both proud and grateful that we have had the opportunity to live and work in Utah!

L. H. Petit

General Manager
Utah Copper Division

Bingham was a typical western mining town at the turn of the century. It was a busy town, too, with mining activity directed toward gold and lead-silver ores. Very little copper was produced until Utah Copper started work in 1904.

In 50 busy years, Kennecott's Utah Copper Division has become one of the world's largest copper producing units. It has a productive capacity of more than one-half billion pounds of copper per year. Normally, it provides about 30 per cent of the newly mined copper in the United States, and approximately 10 per cent of the world's reported primary production.

Historically, the Utah Copper story begins much more than 50 years ago. It was in 1863, only 16 years after the first pioneers settled in Utah, that Bingham Canyon first was actively prospected.

The first prospectors were soldiers of the Third California Infantry, stationed at Fort Douglas, immediately east of Salt Lake City. Many of them had prospected in the California gold fields before joining the army. Their commanding officer, Colonel (later General) Patrick

E. Connor, credited with being the "father of Utah mining," encouraged his men to spend their leisure in the search for metals.

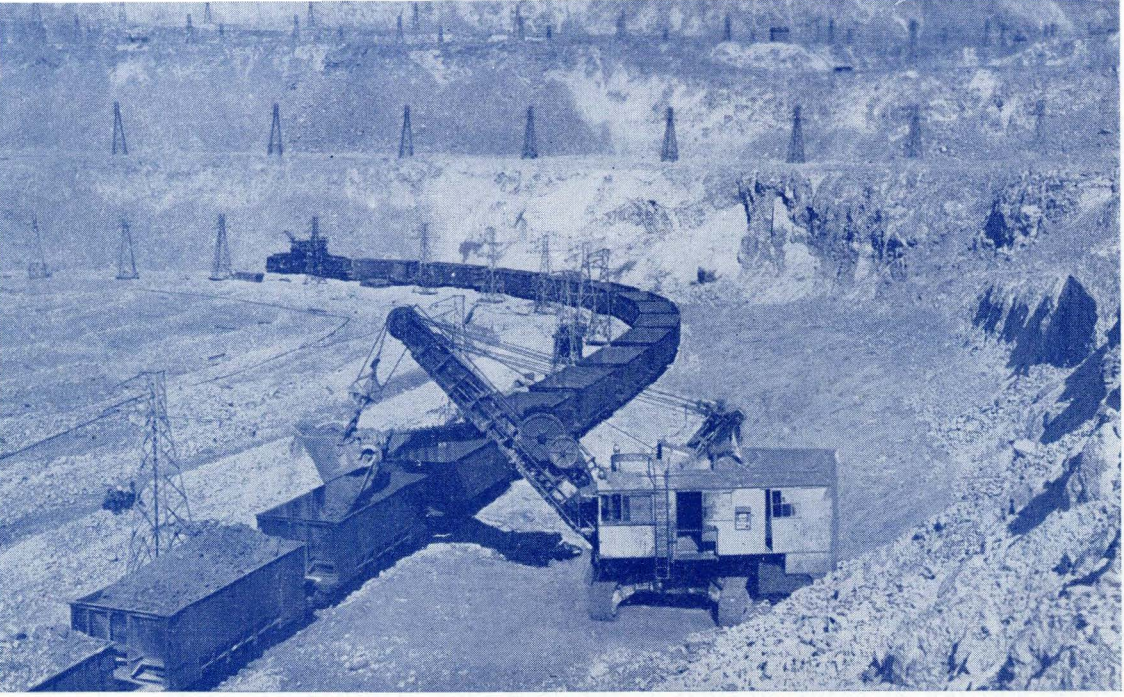
In the fall of 1863 fragments of lead ore were found in Bingham Canyon. Three months later, following a period of active prospecting, the state's first mining district was organized under the name of West Mountain. Gold was discovered in the canyon in 1864. Many promising mineral deposits were located, but development of them was slow because of lack of a railroad.

The first mining at Bingham was prompted by the silver-lead ore that outcropped on the hillsides, by the gold found in the gravel along the canyon bottom, and also by the gold found in underground ore. At first the copper deposits were overlooked because they were of low grade and not as easily smelted as the lead ores. Until after 1900, Bingham Canyon was essentially a lead-silver-gold mining camp.

When Colonel Enos A. Wall first visited Bingham in July, 1887, it was a typical young mining camp. Wooden shacks were crowded against the steep hillsides along the canyons; mine workings dotted the hills.

Entering an abandoned mining tunnel, Colonel Wall took some samples of promising-looking rock and had them assayed. The assays showed 2.4 per cent copper over a distance of 60 feet. There were other indications that an unusually large mass of low grade copper ore existed.

Colonel Wall promptly staked two claims. During the next 10 years he persistently added to his holdings. He located a few new claims and acquired others by purchase. By 1900 his property consisted of all or part of 19 claims covering 200 acres. In the meantime, he had driven more than 3,000 feet of tunnels and drifts. These ex-



This is how the ore is removed from the Utah Copper mine in Bingham Canyon today. The huge electric shovel loads about 10 tons of ore each time the dipper swings. The ore is taken to the concentrating mills in these 100-ton capacity cars.

ploratory operations added to the evidence that the copper-bearing mass was very large.

Colonel Wall financed these explorations through various mining transactions, including the sale of the Brickyard Mine in Mercur, Utah, to Captain Joseph R. De Lamar.

Colonel Wall interested Captain De Lamar in the Bingham Canyon copper property. From 1895 through 1899, the Captain made several examinations of the property, his enthusiasm for it fluctuating in direct proportion to the fluctuations in the price of copper. Finally, in 1899, he purchased a one-fourth interest in the property.

At this time, Daniel C. Jackling was metallurgist in charge of building a cyanide mill at the Golden Gate mine in Mercur for Captain

De Lamar, and Robert C. Gemmell was the mining engineer. The Captain assigned Mr. Gemmell to take charge of sampling the Bingham property and estimating the tonnage, and Mr. Jackling was placed in charge of the concentrating tests. They made a number of tests, and were favorably impressed with possibilities of the property.

Their final report, the first comprehensive analysis of a mining enterprise based on ore containing as little as two per cent copper, envisioned radical developments in copper mining procedures that are still in use today.

Shortly after making this report, Mr. Jackling went to the State of Washington where he built a mill for Canadian mining interests. Mr. Gemmell went to Mexico. Hartwig A. Cohen, general manager of Captain De Lamar's properties, and Colonel Wall were unsuccessful in attempting to find financial backing to develop the property.

Mr. Jackling at this time was 31 years old. Born on a farm near Appleton City, Missouri, he was orphaned as a boy. He worked his way through school and was graduated from the Missouri School of Mines with a metallurgical engineering degree in 1892.

He taught at the Missouri School of Mines for a year, worked briefly at the Argentine Smelter near Kansas City, then went to various mining camps as miner, assayer, mill hand and metallurgist, until he became construction and metallurgical superintendent at Captain De Lamar's mill at Mercur.

During the tests on ore from the Wall property, Mr. Jackling became convinced it could be worked economically through application of mass methods of mining and milling. In the ensuing years his enthusiasm remained high. While working in various mining camps

in the west, Mr. Jackling endeavored to raise capital for his proposal for operating the copper property. His ideas were such a departure from the then accepted mining methods that no one cared to risk either his money or reputation in supporting the untried plan. Many successful mining men of that era, in fact, ridiculed Mr. Jackling's plan. One man, approached for financing, remarked scornfully that the ore Mr. Jackling was proposing to handle contained a smaller percentage of copper than the waste from the copper mills in Butte.

After completing the mill in Washington, Mr. Jackling went to Colorado Springs, where he became associated with Charles M. MacNeill of the United States Reduction and Refining Company. For this company, Mr. Jackling did metallurgical work, and rebuilt and managed a small smelter at Canon City in 1902.

He told Mr. MacNeill and his associates of the possibilities of the Bingham property and they indicated some interest. Late in 1902, while in Salt Lake City on other business, Mr. Jackling attempted to get an option to purchase it. Colonel Wall refused. Eventually, with the aid of Mr. Cohen, he obtained an option and took it to Mr. MacNeill in Colorado.

In May, 1903, Mr. MacNeill and Spencer Penrose went with Mr. Jackling to look over the property at Bingham. Mr. MacNeill and Mr. Penrose, with Charles L. Tutt, had ownership control over the United States Reduction and Refining Company. Also in the group were two of the firm's advisors, K. R. Babbitt, legal counsel, and R. A. F. Penrose, geologist and mining consultant.

Traveling to Bingham in a buckboard, the five men walked over the steep slopes of Bingham's main canyon to view the mining claims and the prospective pit. Later in the day, they drove down the canyon to inspect the site of the proposed Copperton Mill.

When the old Bingham & Garfield Railway ran passenger trains to Bingham the passengers left the train at the station high on the canyon side and rode the little tram cars down to the center of town on the canyon floor.

None of the group had committed himself during the day-long discussion. As the day drew to a close, Mr. MacNeill announced that he had made up his mind to back Mr. Jackling. Thus, the Utah Copper Company was born.

On June 4, 1903, The Utah Copper Company was organized under the laws of Colorado. An experimental mill of 300 tons a day capacity was built at Copperton, a few miles below Bingham. This mill started operating in August, 1904. Its capacity was gradually increased, so that it was treating 1,000 tons daily when it was closed in 1910.

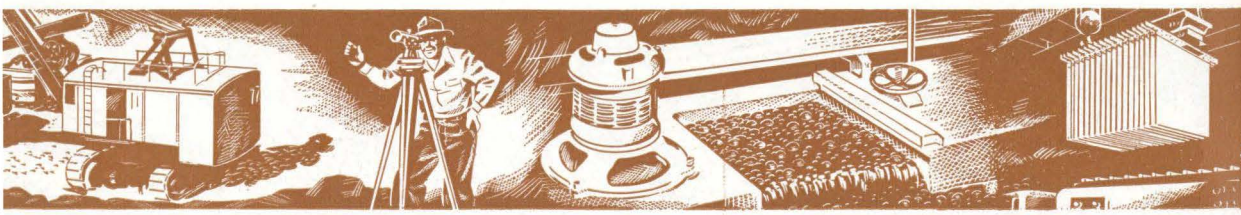
The company still needed working capital to buy equipment and build a larger mill. The mine and mill made such an effective showing during 1904 that the Guggenheim brothers agreed to underwrite a bond issue, provided an examination proved the worth of the property. Seventeen engineers spent seven months completing the work. The report was favorable and led the Guggenheims to underwrite a $3,000,000 bond issue and to aid in the sale of 232,000 shares of stock to provide additional funds.

Construction of a 6,000-ton concentrator was started early in 1906 at Magna where adequate water was available. The plant went into operation in August, 1907. At the mine, meanwhile, operations had been confined to underground mining, contrary to Mr. Jackling's belief that strip mining would be more advantageous. The infant company did not have the necessary capital to start stripping operations.

Early in 1906, Mr. Gemmell returned to Utah and became general superintendent. He and Mr. Jackling visited the Mesabi Iron Mines in Minnesota to observe the methods of steam shovel mining employed there. They hired J. D. Shilling as mine superintendent. Shortly after his arrival in the summer of 1906, the first steam shovel started work.

New equipment was added gradually until by the end of 1908 the mine equipment consisted of eight steam shovels and 17 steam locomotives. By then two-thirds of the ore was derived from open-cut operations. The worthless overburden, lying on top of the ore body, was being moved away as fast as possible so that underground mining could be abandoned.

By this time the company appeared to be over its principal hurdles. However, the upper group of claims on the mountain was owned by the Boston Consolidated Mining Company. This company started out

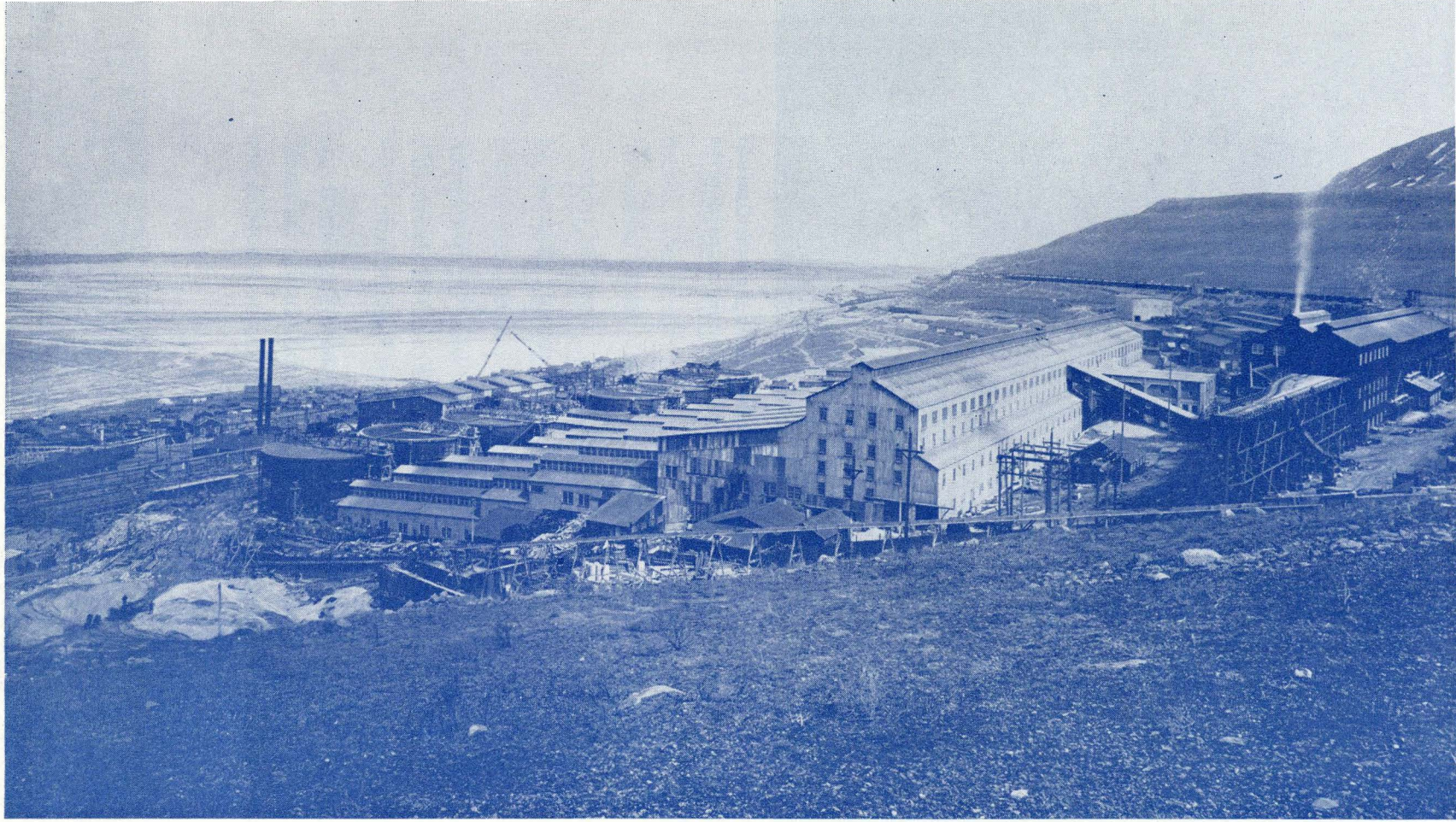


This was the first ore train to run over tracks of the old Bingham & Garfield Railway Co., a subsidiary of Utah Copper. The 20-mile railroad, connecting the mine with the mills and smelter, was completed in 1911.

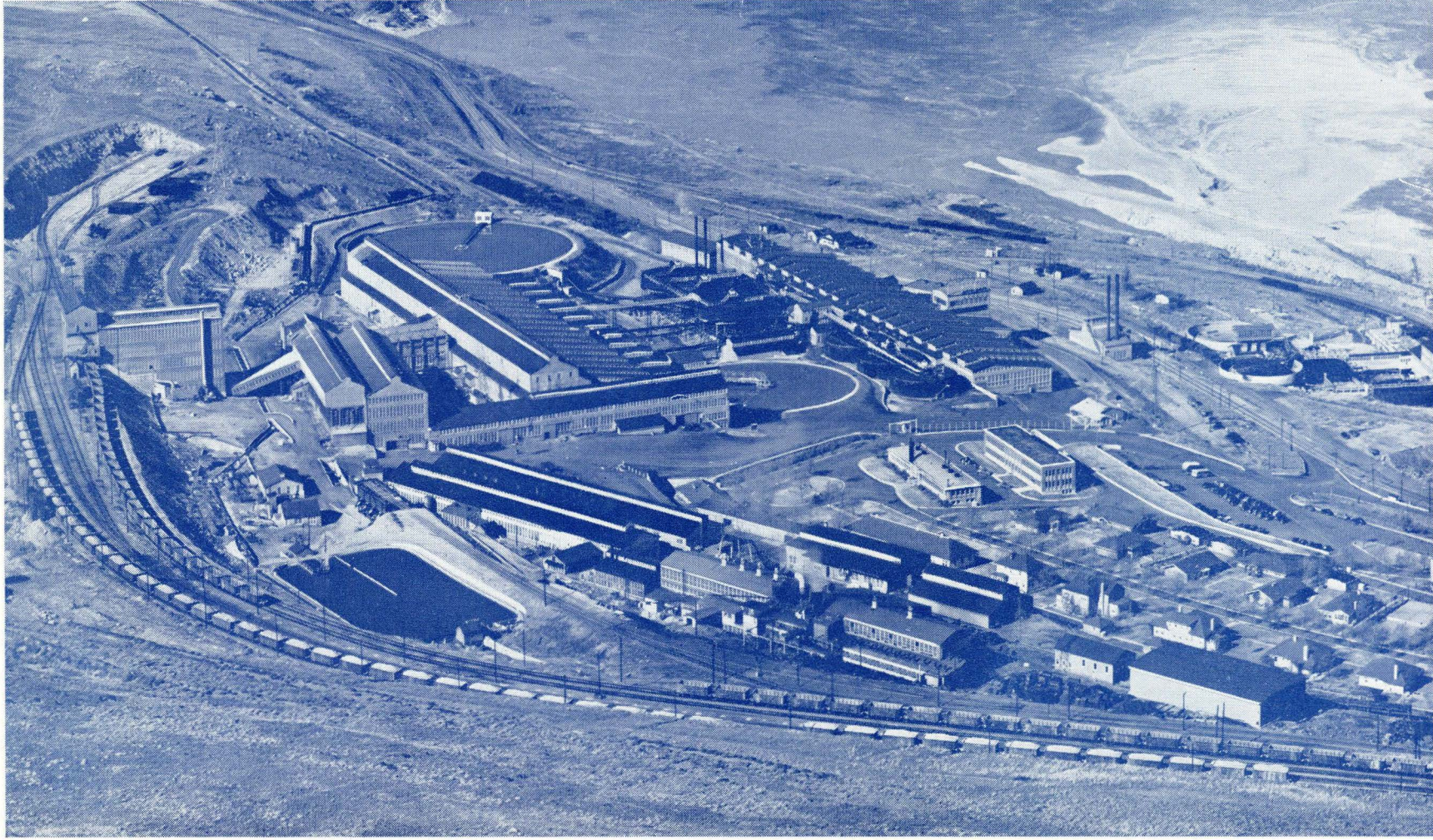
as a gold producer, but failed to make a success of it. Then the owners, Samuel Newhouse and Thomas Wier, turned to mining deposits of higher grade copper ore.

After Mr. Jackling had pioneered the way with Utah Copper, Boston Consolidated also started mining low grade ores. The company built a mill at Garfield, near Utah Copper's Magna concentrator.

Mr. Jackling early realized that it would be advantageous if the properties could be consolidated. Through negotiations he initiated, the companies were merged in 1910.



The Arthur ore concentrating mill looked like this about 1915, a few years after Utah Copper merged with Boston Consolidated Mining Company. It since has been modernized several times and its capacity increased greatly.



A recent view of the same mill. It has a normal capacity of 40,000 tons of ore per day. Both the Arthur and Magna mills exceeded this tonnage during World War II and again during the fighting in Korea.

During the time the Copperton mill was operated, much experimental work was done on equipment and processes for milling the low-grade ore. Improvements, growing out of this experience, were incorporated in Utah Copper's Magna concentrator. After the consolidation, the Boston mill was remodeled along the lines of the Magna mill.

The Magna plant capacity had been increased from 6,000 to 10,000 tons a day, and new sources of ore were needed to keep both mills in operation.

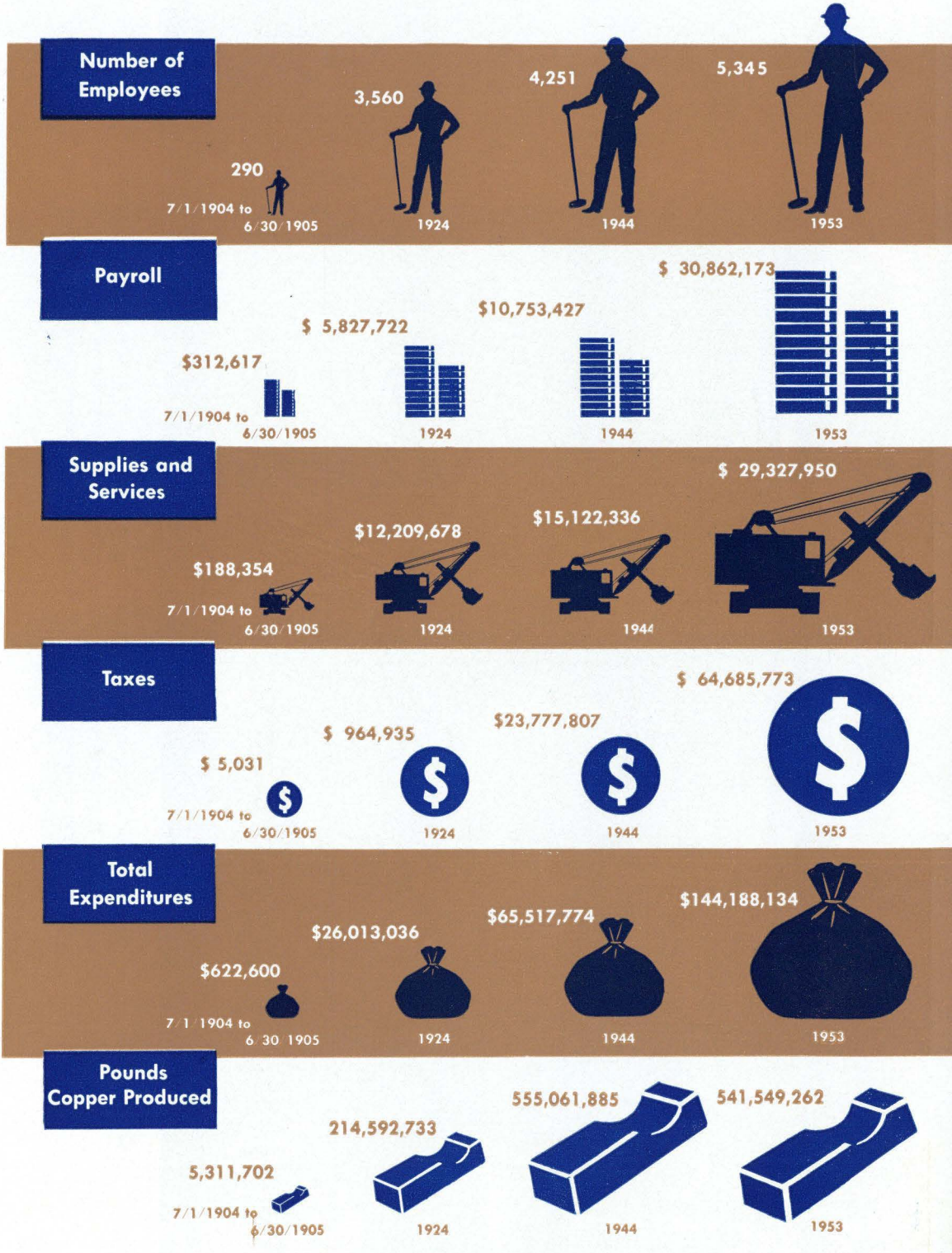
Tonnage from the Boston underground workings was increased and continued at a high level until March, 1914, when underground mining was discontinued and the entire property converted to open-cut methods.

During 1910 and 1911 Utah Copper constructed its own 20-mile railroad, the Bingham and Garfield Railway, to connect the mine with the mills and smelter.

As the mining operations broadened, so did the mechanical department. The first wooden dump cars with a capacity of six cubic yards were replaced by 12-yard steel dump cars, and these were succeeded by 30-yard and 40-yard steel cars. The first steam shovels operated on railroad tracks. Later, they were equipped with tractor-type treads. During the 1920's the power drive of the shovels was changed from steam to electricity.

From the very beginning, the concentrating operations at the mills were studied and experiments were conducted with the aim of making them more efficient. The early concentrating operations all involved gravity processes. In 1914, experiments with flotation processes showed enough promise that a combination of the two was used. The

GROWTH OF UTAH COPPER



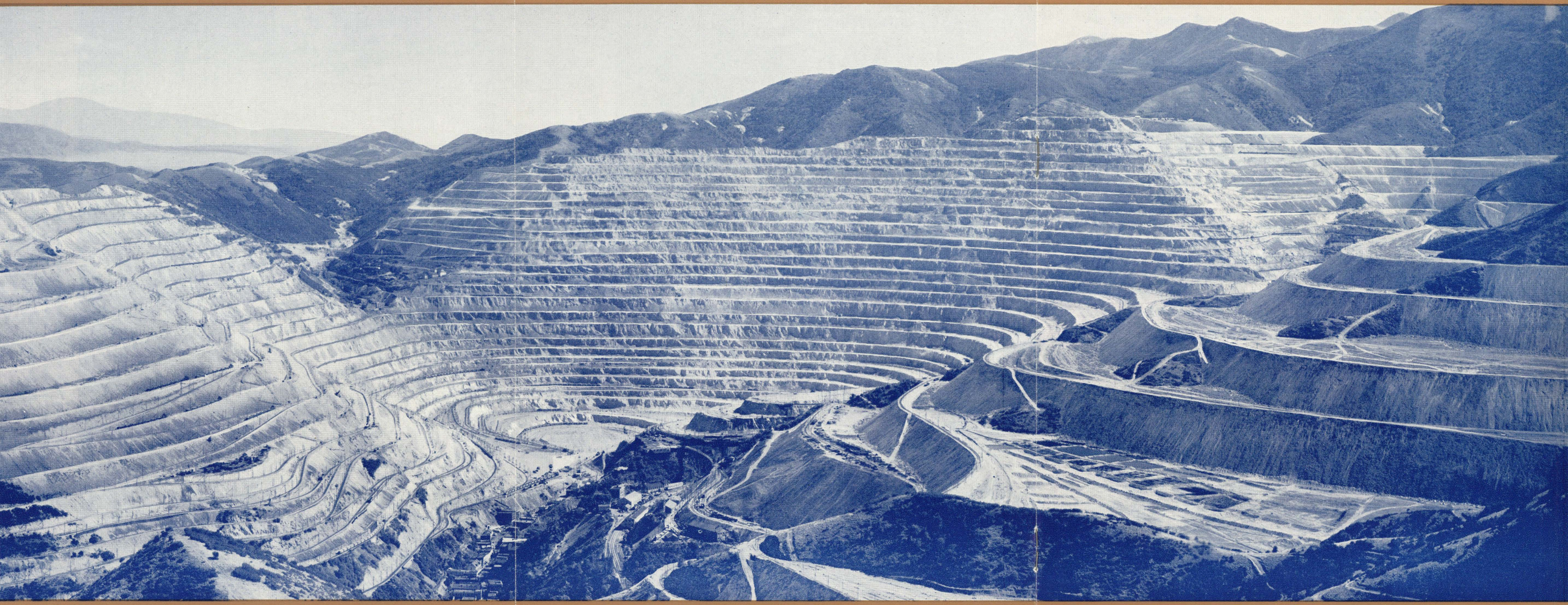
Utah Copper's Magna ore concentrating mill about 1915. At this time, experiments with the flotation process of metal recovery were being conducted. These and other experiments resulted in a far greater percentage of metal recovery.

A recent picture of the same mill. In the left background is part of the 6,000-acre tailings pond which receives the waste material after the ore has been milled. Circles in left foreground are thickener tanks for floation feed.

This is how the Utah Copper mountain looked in 1903, before surface mining was started. Through the years, the mountain has been cut into an amphitheater as millions of tons of ore and waste have been blasted loose and taken away.

By 1909, the pattern of the first few levels on the mountain had been established. Utah Copper operations are the lower ones; the levels near the top of the mountain were cut by the old Boston Consolidated Mining Company.

By 1919, the entire face of the mountain was cut into benches. Underground mining had ceased by this time, and all ore was being obtained from surface operations. Waste dumps were located on both sides of the mine.



This is the world-famed Utah Copper Division mine of Kennecott Copper Corporation at Bingham Canyon, Utah. It is considered an outstanding engineering achievement.

The operating area covers 956 acres, and the mine consists of a series of levels with connecting switchbacks. The vertical distance from the bottom level to the top level on

the west side is 2,010 feet. The mining area contains about 168 miles of standard gauge track, most of which is moved continually to meet operating needs.

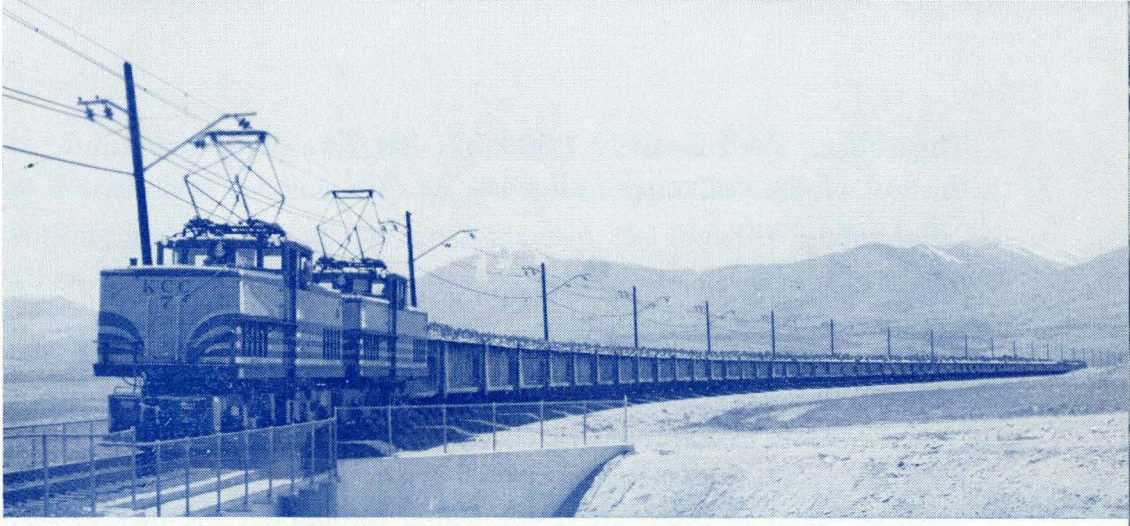
flotation system was developed rapidly to a higher degree of efficiency, and after 1920 it came into full use. Recovery of metal by the old methods was only about 60 per cent. Constant research has improved it until now it is more than 90 per cent.

The first power plant was started in 1906 near the Magna mill. After six years of operation, this steam plant of 8,500 kilowatts became inadequate for the increased demands of the mine and mills, and the company began to buy power from commercial power companies. In the 1940's the company built a new 100,000 kilowatt plant at Magna capable of supplying all the power required by the mine, mills, refinery and electric railroad.

THE MINE

The Utah Copper mine is located at Bingham Canyon, Utah, an historic prosperous mining town of 3,000 people, situated 30 miles southwest of Salt Lake City, in the heart of the Oquirrh mountains. Oquirrh is an Indian name meaning "West Mountain." The center of operations is at the upper end of Bingham. Miles of standard gauge haulage tracks line both sides of the canyon, giving the impression that the mine completely surrounds the narrow town along the canyon bottom. These tracks are used for transporting ore and waste material overlaying the ore body. For every ton of ore mined, 1.6 tons of waste must be removed and disposed of in the nearby gulches.

Mining of more than 1½ billion tons of ore and waste has left a large amphitheater-like pit at the mine, the sides of which are cut into giant steps or benches. The 11 sublevels average 50 feet and the upper levels 70 feet in height. Their minimum width is about 65 feet. There are 22 levels on the west side and 15 on the east side of the mine and 11 sublevels covering an operating area of 956 acres. The bottom



Once the copper-bearing ore is mined, it is sent to the mills for treatment. Above is a modern train powered by two 125-ton electric locomotives.

level is at an elevation of 5,790 feet above sea level and the top level on the west side of the mine is 2,010 feet higher. Future operations contemplate additional levels at 50-foot intervals as the mine is opened up at depth.

COPPER PRODUCTION

As disposal areas near the mine become filled, the waste must be hauled farther and farther, constituting an ever-increasing expense.

Last year, about 136,000 tons of waste was removed daily, which permitted mining an average of 83,000 tons of ore per day. Copper production last year was in the neighborhood of 45,000,000 pounds per month.

VEHICULAR TUNNEL

To replace a section of the county highway which at one time ran directly over the ore body, a vehicular tunnel between Bingham Canyon proper and the community of Copperfield was completed in 1938.

This tunnel, approximately 7,000 feet long, was driven in an arc to the east of the ore zone. Following its completion it was deeded to Salt Lake County.

GEOLOGY

The ore body is a porphyry deposit. Copper minerals are scattered through the rock, which is granite-like in composition. Copper is present chiefly in the minerals chalcocite and chalcopyrite, composed, respectively, of copper-sulfur and copper-iron-sulfur. These minerals, black or brassy in color, are disseminated throughout the rock as tiny crystals or as seamlets or coatings on fractures. The ore contains less than one per cent copper, plus small amounts of molybdenum and minute amounts of gold and silver. Only the large size and uniform mineralization of the ore body, allowing large-scale highly-mechanized operation, make it economically possible to recover valuable metals from such low-grade material.

MINING METHOD

Ore and waste are broken for loading on the mine levels by drilling 24- to 28-foot holes at 15- to 20-foot intervals into the toe of the bank. The holes are charged with gelamite powder. Approximately 2,200 tons of material is broken per hole.

Waste is loaded by electric shovels into 30- and 40-yard side-dump cars and hauled for disposal to nearby gulches by electric locomotives, usually in trains of seven cars.

Similarly, ore is loaded into railroad cars of 100-ton capacity and hauled in trains of 13 to 21 cars by mine electric locomotives to the Copperton main assembly yard at the mouth of the canyon. Here, trains are made up for movement to the Arthur and Magna concentrating mills. Maximum grades on the mine transportation switchbacks are four per cent.

Full revolving shovels with dippers of 4½ to 7 cubic yards capacity are used for loading ore and waste material. Each shovel, when working in ore, loads an average of about 6,350 tons per 8-hour shift. When working in waste material, a shovel handles an average of about 5,550 tons in a shift.

ALL-IMPORTANT CUT-OFF POINT

Over the years, Utah Copper's management has been striving to lengthen the life of the ore body and thus extend over the longest possible period of time the widespread benefits resulting from the operation of the property.

Operating under sound engineering principles, with good equipment and highly competent employees, there is a point below which it is economically impossible to mine even large tonnages of waste and low-content copper ore at a profit. This point is the "cut-off" point.

Years ago the cut-off point was 8/10ths of one per cent, or 16 pounds of copper per ton of ore. Material containing 16 pounds or more was sent to the mills as ore, and material containing less copper had to be placed on the waste dumps. Constant and forward-looking planning, research and plowing back into the property of millions and millions of dollars for new facilities, equipment and processes have vastly changed the picture over the years. Increased efficiency has permitted a reduction of the cut-off point and has literally turned into ore millions of tons of material that once would have been waste, thus greatly lengthening the life of the mine. Now, ore containing 4/10ths of one per cent, or 8 pounds of copper per ton, is shipped to the mills. Material below that grade is unprofitable to mill. With such extremely low grade material, an increase in costs of even a few cents per ton

This is part of the flotation department of the Arthur concentrating mill. With the aid of chemical reagents, finely ground mineral particles attach themselves to bubbles, ride them to the surface and float off the sides of the cells.

may make it necessary to raise the cut-off point. When this is done, the life of the ore body is shortened.

MINE-TO-MILLS ORE HAULAGE

The old Bingham & Garfield Railway was replaced six years ago by the Mills Ore Haulage Department. Loaded and empty ore cars are moved between the mine and mills by this department over a 16-mile trackage system with an average grade of 1.35 per cent.

Up to 90 cars can be handled in a single train powered by two 125-ton, 3,000-volt electric locomotives operating as a single unit. This Department also handles the movement of copper concentrates from the Arthur and Magna mills to the Garfield smelter, as well as rail traffic to and from the refinery.

MILL OPERATIONS

The Arthur and Magna mills each has a rated operating capacity of 40,000 tons of ore daily, although during long periods of World War II up to 50,000 tons daily was treated at each mill.

At these mills, a series of crushing and grinding operations reduces the ore to a very small size in order to separate the desired mineral particles from the worthless material surrounding them.

This is done first by a gyratory crusher which reduces the ore to a six-inch size. Next it goes through cone crushers in which it is reduced to ⅞ of an inch, thence to 48-inch rolls where water is added and the ore is reduced to a size that will pass through an 8-mesh screen (64 openings per square inch).

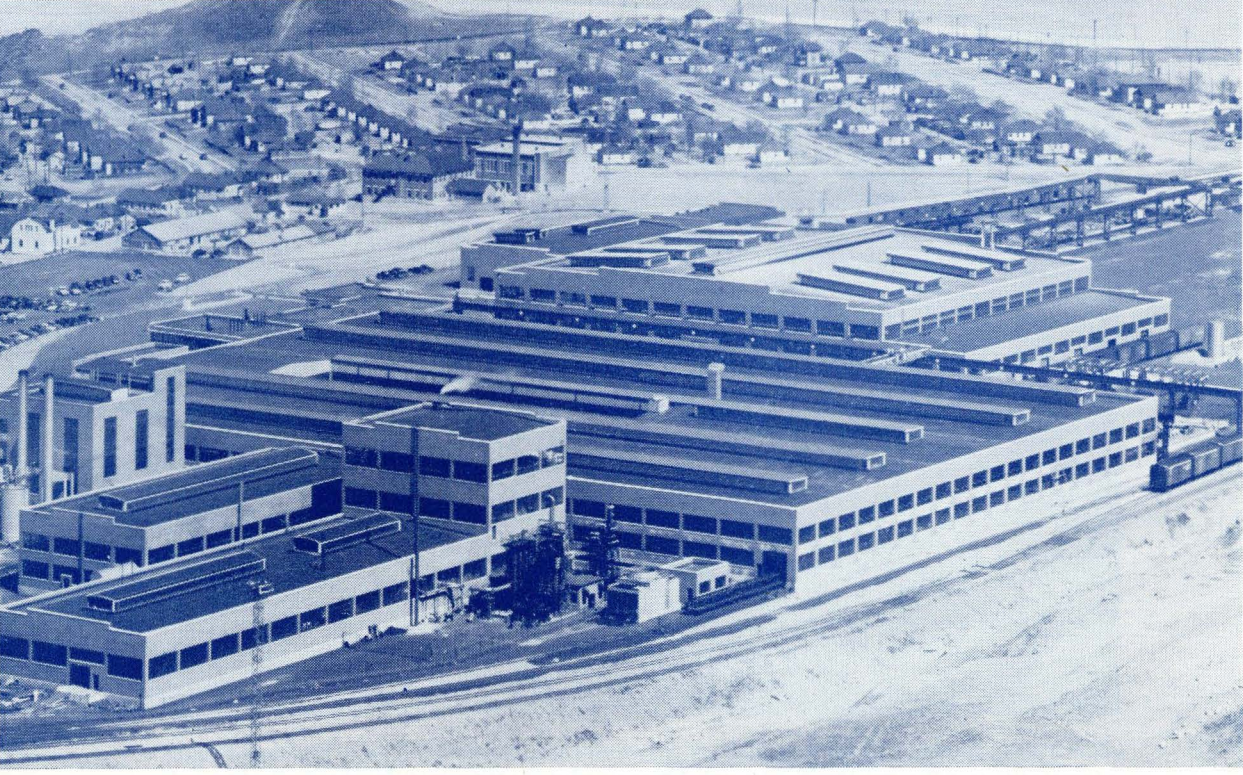
BALL MILL BATTERIES

The material then goes through two batteries of 7- by 10-foot ball mills, which are half filled with 2-inch cast iron grinding balls, and revolve at a slow speed. The Magna plant has 24 primary and 36 secondary mills; Arthur has 26 primary and 39 secondary mills. These mills reduce the ore to a powdery state, completing the grinding process. More than 80 per cent of the ore will now pass through a screen with 10,000 openings per square inch.

Next, the material goes to the flotation department. Chemical reagents are added, some of which help to create froth in the watery flotation feed, and others coat the desired mineral particles, giving them an affinity for the bubbles. These mineral particles attach themselves to the bubbles, ride them to the surface and float off the sides of the cells.

This product is a copper mineral concentrate containing about 31 per cent copper, approximately 1½ per cent molybdenite and small quantities of gold and silver.

The entire concentrate is then treated for the recovery of molybdenite by a combination of differential flotation and heat treatment.



The electrolytic refinery at Garfield is the first in the state's history. Copper produced here is 99.96% pure. Part of the town of Garfield, jointly owned by Kennecott and American Smelting and Refining Company, is in the background.

This is accomplished in sections which were added in both mills in 1937, following years of research on equipment and processes. A high grade molybdenite concentrate is produced, containing more than 90 per cent molybdenite, a small percentage of copper and practically no gold or silver. The molybdenite concentrate is sold in that form mostly to steel companies for the manufacture of alloy steels.

Copper concentrate, after its flotation treatment and separation from the molybdenite, contains considerable water. The next step is the removal of water from the concentrate. This is done by decanting and by vacuum disc filters which take out nearly all the water.

The final copper concentrate, which contains approximately 31 per cent copper and small amounts of gold and silver, is then shipped

in carload lots to the nearby Garfield smelter of the American Smelting and Refining Company. After smelting, the metal is cast into anode shapes containing more than 99 per cent copper.

THE REFINERY

Kennecott's electrolytic copper refinery, located just south of the town of Garfield, built at a cost of more than $17,000,000, began operating in the fall of 1950.

The plant has a capacity of 16,000 tons of refined copper per month. This tonnage, ready for market, is cast mostly in the form of wire bars, although a small quantity is sold in the form of cut cathodes and ingots.

The refinery receives copper anode shapes from the nearby Garfield smelter in carload lots. These anode shapes, placed in lead-lined electrolytic tanks filled with a solution of copper sulfate and dilute sulphuric acid, are alternated with cathode starting sheets made of refined copper.

Through the process of electrolysis, copper transfers from the anodes to the cathodes. The impurities, including small amounts of gold and silver, and some other by-products, remain behind in the anode mud or are dissolved in the solution.

This is the first time in the history of Utah that electrolytically refined copper has been produced here. Now the complete cycle of four primary operations (mining, milling, smelting and refining) necessary to produce copper ready for sale is performed in Utah.

COPPER — 99.96% PURE

Approximately 29 days are required to consume an anode and about 14½ days to produce a cathode. During the process the cathodes become progressively thicker and the anodes progressively thinner until about 15 per cent of the original anode remains. Cathodes are removed from the cells about every two weeks, washed and sent to an adjacent building where they are melted in electric furnaces. The copper, 99.96

per cent pure, is then cast into marketable shapes and shipped to the customer. The refinery is unique in its successful large scale use of electric arc furnaces.

The anode mud is flushed out and pumped to another department, where precious metals and other by-products are recovered.

EQUIPMENT

Because of the magnitude and the unique problems encountered in the mining and treatment of large quantities of low grade ore, extensive equipment is necessary. In addition, the mine, both mills, and the refinery must maintain large shops for maintenance and repair work.

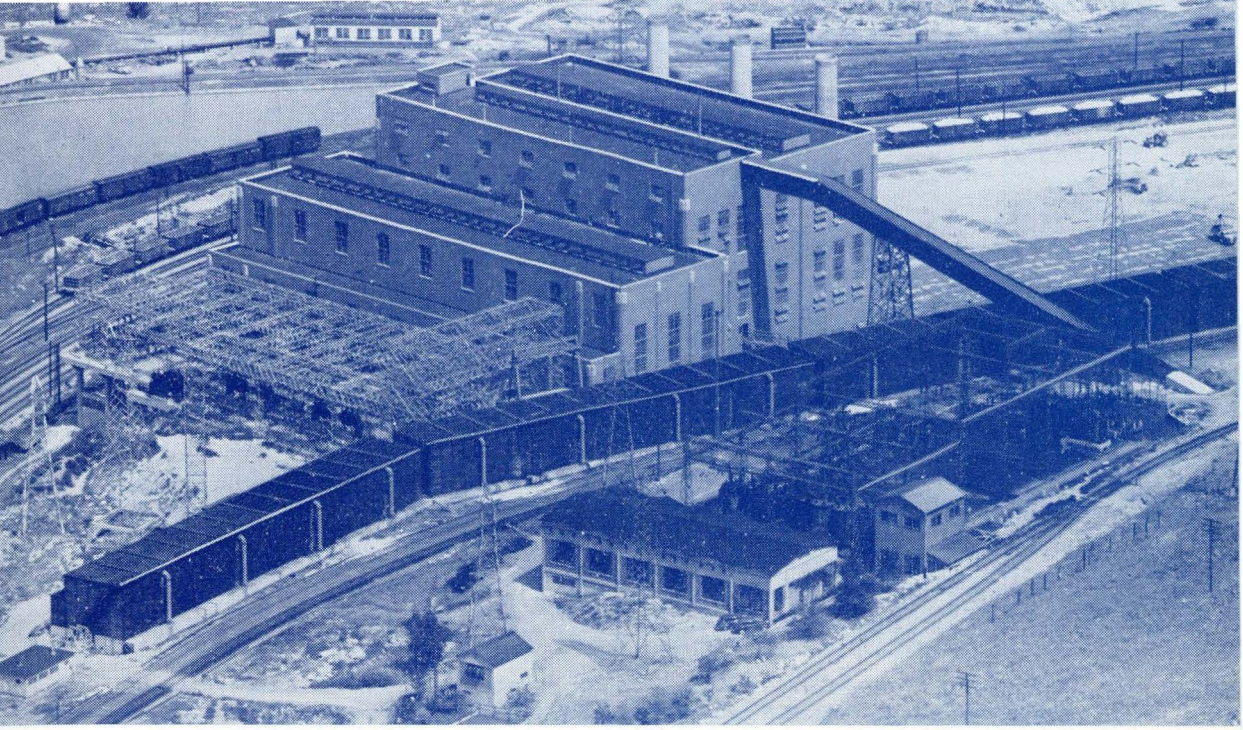
Principal items of mine equipment include 44 electric shovels. Thirty-three are the full revolving type — twenty-seven with 5-yard, two with 6-yard and four with 7-yard dippers. The other 11 are older shovels and are equipped with 4½-yard dippers.

Other mine equipment includes sixty-four 85-ton, two 80-ton, one 100-ton, and four 125-ton electric locomotives; nineteen bulldozers; nine mobile drill units equipped with compressors; eight hundred and twenty-five 100-ton capacity ore cars; two hundred and eight 40-yard and thirty-seven 30-yard capacity side dump cars; two electric churn drills; six spreaders for leveling dumps and for snow removal; and four diesel- and three steam-powered cranes.

The electrified mine track system includes level tracks, dump tracks and connecting switchbacks totaling 168 miles of standard gauge 90- and 132-pound track. To support the transmission and trolley lines there are 3,460 portable steel transmission towers, which are continually being moved to meet new track alignments as the mine levels are changed.

To move the track into new alignments 17 track shifters are used. These machines lift sections of track and ties and move them into new positions.

The company's foundry located at the Arthur Plant is one of the largest in the Intermountain states and furnishes about 21,000 tons



Electrical energy for mining, milling, ore haulage and refinery needs is supplied from Utah Copper's power plant located southeast of the Magna mill. It has a rated output of 100,000 kilowatts, sufficient to supply a city of 100,000 people. Both Utah coal and natural gas are used in generating power.

of grinding balls and 160 tons of brass castings per year for use throughout Utah Copper Division operations.

A modern lime plant situated near the Magna Mill supplies approximately 29,000 tons of burned lime per year for use in the flotation process.

For other activities, offices, warehouses, emergency hospitals, housing and club facilities are provided at the mine, mills, and the refinery.

It is interesting to note that the investment to make a job for one man in the mining and processing of ore at Utah Copper is approximately $32,000. The average investment to create one new job in the United States for manufacturing is $12,000, according to 1953 reports of the National Association of Manufacturers.

Kennecott's ultra-modern Research Center, where experiments designed to improve mining, milling and refining methods will be made. Said to be one of the best equipped laboratories of its kind, the building was completed this year.

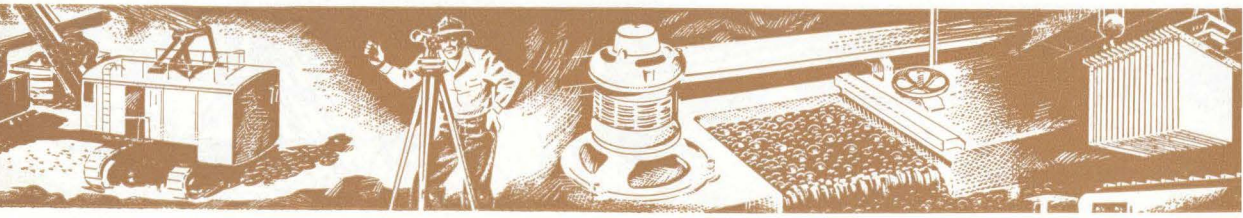
MODERN RESEARCH CENTER

Kennecott Copper Corporation this year completed a new research laboratory on the University of Utah campus. Modern research facilities are being installed to conduct both fundamental and applied research. A well-qualified staff that eventually will number about 50 is being built around a group of key scientists and technicians, who carried on their work in temporary quarters for a year and a half.

Several projects important to Utah Copper are underway. One concerns the use of micro-organisms in improving the leaching of copper from waste dumps.

The scientists and technicians hope to find better processes and methods that will lengthen the life of the Bingham ore body. That, in turn, will extend for a longer period the benefits accruing to all Utahns from the Utah Copper operation.

The building was constructed and equipped at a cost of $1,250,000, and has 40,000 square feet of floor space.



UNION REPRESENTATION

Utah Copper is one of the largest employers in the state. Approximately 5,300 are on its payrolls. To represent employees there are 16 bargaining units comprised of the following labor organizations:

MINE
Office Employees International Union
International Association of Machinists
International Union of Operating Engineers
International Brotherhood of Electrical Workers
Brotherhood of Locomotive Firemen & Enginemen
International Union of Mine, Mill & Smelter Workers

MILLS
System Federation No. 155
Non-Ferrous Clerical & Technical Workers
International Brotherhood of Electrical Workers
International Union of Mine, Mill & Smelter Workers

MILLS ORE HAULAGE DEPARTMENT
Order of Railway Conductors
Brotherhood of Railway Carmen of America
Brotherhood of Locomotive Firemen & Enginemen

REFINERY
United Steelworkers of America
Non-Ferrous Clerical and Technical Workers
International Brotherhood of Electrical Workers

THE NEW ERA IN SAFETY

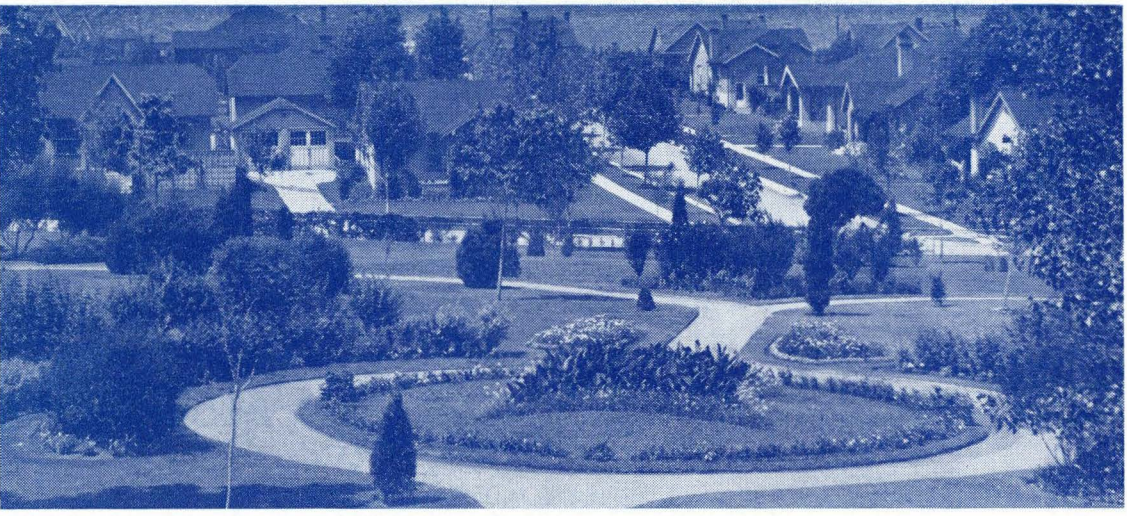
Employees and management cooperate in a vigorous and well planned safety program, supervised by safety committees and competent safety engineers.

At the mine in 1953 there were only 26 lost-time accidents during the 6,015,576 man hours worked, which, theoretically, means that one man working 40 hours weekly would have to work 111 years before having an accident.

The Arthur mill in 1953 had 5, the Magna mill 4 and the refinery 9 lost-time accidents. Theoretically, an employee would have to work 241 years at Arthur, 351 years at Magna and 95 years at the refinery before experiencing a lost-time accident.

Utah Copper employees were more than three times as safe at work as they were in their own homes. The National Safety Council recently reported one in 36 persons suffered accidents in homes. At the mine, only one in 97 persons was involved in an accident on the job. At the mills, one out of 254 employees met with on-the-job accidents and at the refinery the number was one in 81.

Including the Arthur Row (above) some 976 company owned residences are provided in the Bingham, Magna and Garfield areas for occupancy by employees. In them reside a cross section of employees. The rent averages $18.30 per month. Recreational opportunities are varied, including lighted baseball diamonds, club houses, golf course, tennis courts, swimming pool, Duck and Fish Club, and parks. Recreational facilities are provided by the company and managed by employee-elected boards of directors, with nominal membership dues.



Copperton, in the entrance of Bingham Canyon, is a company-owned townsite of 228 residences, occupied by a cross section of mine employees. Most of these houses have roofs, screens, gutters and downspouts made of copper.

STATISTICAL DATA

Totals from beginning of operations to December 31, 1953

Taxes	$ 462,856,954
Payrolls	342,196,128
Purchases of Supplies and Services	460,136,412
Smelting, Freight and other payments	402,087,800
Total	$1,667,277,294

(This sum would purchase a $15,000 home for every family in Utah residing outside Salt Lake County.)

Waste overburden removed at the mine	846,000,000 tons
Milling ore mined	682,000,000 tons
Copper produced	12,163,314,847 pounds

* * *

Average grade of ore now being mined	0.92% copper
Investment per employee, approximate	$32,000
Annual powder purchases	more than 7,000,000 pounds

During 1953 Utah Copper's expenses for payrolls, taxes, supplies, freight and other items were slightly in excess of 144 million dollars — a major factor in the prosperity of Utah and her people.

EMPLOYEE INFORMATION (Mid-June, 1954)

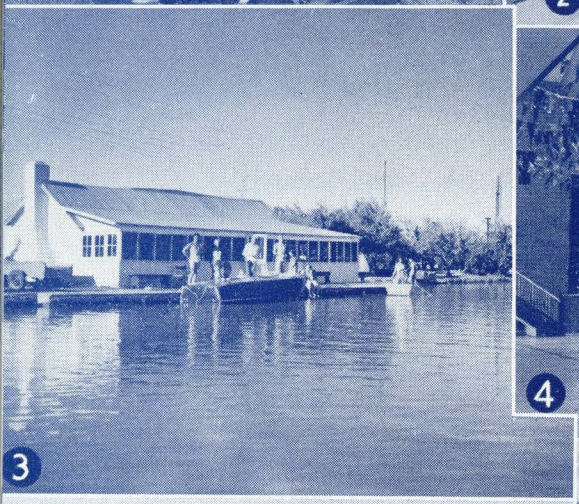
	Mine	*Mills*	*Refinery*	*Total*
Number of employees	2,345	2,030	810	5,345*

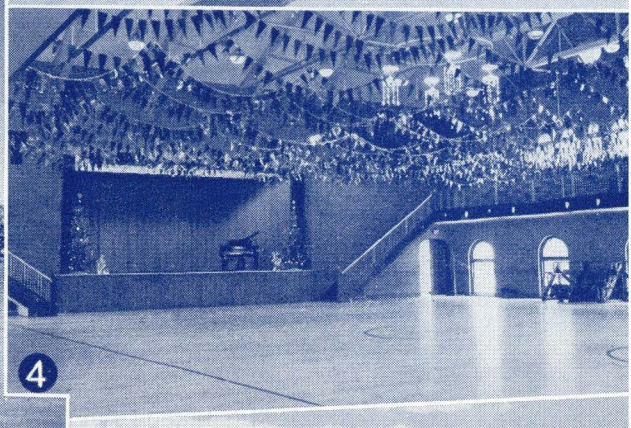
	Approximate percentages
Employees living in vicinity of mine, mills, and refinery	42%
Employees living in other areas of Salt Lake County	55%
Employees living in Tooele, Davis or Utah Counties	3%

COMPANY GROUP LIFE INSURANCE

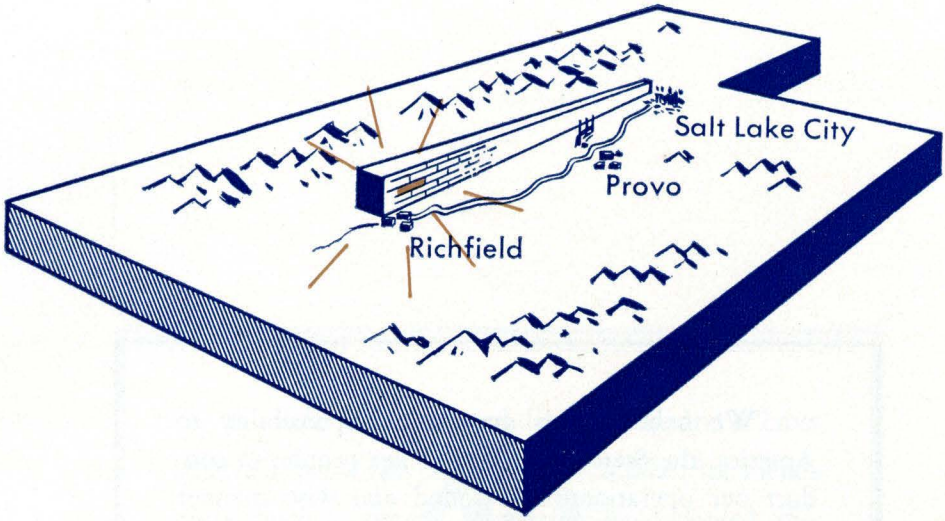
Eligible employees insured	99.12%
Cost to employee per month for $1,000 of insurance (company pays remainder of premium)	60c
Average coverage per insured employee	$4,475
Total insurance in force	$25,184,145
Employees with 30 or more years service	452 or 8.5%
Employees with 20 or more years service	815 or 15.2%
Employees with 10 or more years service	2,473 or 46.3%
Fathers and Sons among employees	963 or 18.0%

*Including 160 employees in the Salt Lake Office and Research Center.





Recreational facilities for the 5,300 members of the Utah Copper family include: (1) R. C. Gemmell Memorial club at Bingham. (2) Bowling alleys at the Utah Copper Club house at Arthur. (3) Utah Copper Duck and Fish Club east of Magna. (4) Auditorium and Gymnasium at Gemmell clubhouse. (5) Lighted ball park at Magna. (6) Swimming pool at Garfield. There is also a 9-hole golf course at Magna and a lighted baseball diamond at Bingham.



Mining and treating Utah Copper's low grade ore is a difficult and expensive process. It takes modern equipment, skilled workmen, forward looking management, and the annual reinvestment of millions of dollars in the mine, mills and refinery.

Complexity of the process is caused by the low grade ore which, on the average, contains:

Copper - - - - - - - -	92/100ths of 1 per cent
Molybdenite - - - - - -	6/100ths of 1 per cent
Silver - - - - - - - -	117/1,000ths of 1 ounce per ton
Gold - - - - - - - -	20/1,000ths of 1 ounce per ton

That is just part of the story. To mine a ton of ore, it is first necessary to move more than 1½ tons of waste material which lies over the ore. Then comes the problem of recovering metal from ore, which is made more difficult by inevitable losses during the milling, smelting, and refining processes.

Because of the low grade of the ore and the losses which occur, 309 pounds of waste and ore must be moved to obtain one pound of copper. To obtain one ounce of gold, 6 million ounces of ore and waste must be moved.

Or, to put it another way, suppose we mine enough material, ore and waste, to make 46,531,098 ordinary bricks. With these bricks a wall 10 feet high and 133½ miles long could be built. On a straight line such a wall would reach from Salt Lake City nearly to Richfield.

Yet out of this wall of millions of bricks there would be recovered just 41,722 bricks of copper, 4,379 bricks of molybdenite, 14 bricks of silver, and a single brick of gold! A grand total of 46,531,098 bricks . . . 46,116 of them useful . . . 46,484,982 of them waste!

HOW KENNECOTT GOT ITS NAME

Almost 100 years ago, Dr. Robert Kennicott was named to lead an expedition for the Western Union Telegraph Company to run a line across Alaska. Dr. Kennicott, because of his work in the Alaska territory, had considerable influence in the exploration and development of that vast country. He spent much time in the area and after he died in Alaska in the summer of 1866, a district, K-E-N-N-I-C-O-T-T, was named for him. A mine was located and put into production in the newly named district. This was the original operation of what is now the Kennecott enterprise. A clerical error changed the spelling from K-E-N-N-I-C-O-T-T to the now accepted K-E-N-N-E-C-O-T-T, thus bringing about a difference in the spelling of the original Kennecott Mines Company and the district in which the mine was located. It is interesting that Dr. Kennicott's assignment was to run a telegraph line across Alaska, a project that would use quantities of copper. And it is fitting that one of the greatest copper companies in the world obtained its name because of a desire of another company to run a strand of copper wire across the then vast untamed peninsula.

FAR FLUNG BENEFITS OF COPPER

Kennecott Copper Corporation is the world's largest producer of copper. It operates copper mining properties in Utah, Nevada, New Mexico, Arizona

Chase Brass has two plants at Cleveland, Ohio, one of which produces brass and copper sheet and the other brass and copper rod and tube. At Waterbury, Connecticut, the Chase metal works plant products brass and copper sheet, rod and tube, and the company's factory, also located at Waterbury, makes literally thousands of finished brass and copper products.

The Kennecott Wire and Cable Company plant at Phillipsdale, Rhode Island, manufactures a general line of bare and insulated copper wire and cable.

Kennecott is a typical American business from ore mining through processing, fabricating and sale of its metal to customers. The company provides an essential product to a free people whose lives are made better because of such business enterprises as Kennecott.

A TYPICAL AMERICAN ENTERPRISE

Kennecott Copper Corporation is owned by some 90,000 shareholders. About 73,000 of them are individual men and women. This means that perhaps the person living next door to you or the grocer, or maybe the teacher who instructs your child, or the man who leads the singing at your church on Sunday, or the farmer who supplies your food may be one of the owners of Kennecott. The 73,000 individuals who own Kennecott do business every place that Kennecott operates. Right here in Utah, for example, they pay taxes, wages, freight charges, they buy supplies and services.

Many Kennecott owners possess a small number of shares. The company is a good example of American business enterprises that have had tremendous increases in number of shareholders. Back in 1916 Kennecott only had 18,000 shareholders. Today's 90,000 shareholders represent an increase of nearly 400% in the last 32 years. Seventy per cent of them own less than 50 shares each. These people living across America have banded together to do business under one name, Kennecott Copper Corporation.

The shareholders, the company's management and employees constitute a team that has made Kennecott operations successful. This success has resulted in benefits for us as individuals as well as for our country.

and Chile. The important by-products include molybdenite, gold, and silver. Subsidiary companies operate brass mills in Connecticut and Ohio, a wire and cable mill in Rhode Island, and an iron-titanium mine and ore treatment plant in Quebec. Kennecott also has substantial interests in gold mining properties in South Africa, where uranium will be recovered as a by-product.

In Utah, the operations comprise an open-cut copper mine at Bingham Canyon, two ore concentrating mills at Magna and Arthur and an electrolytic copper refinery at Garfield.

The Nevada Mines Division operates an open-cut copper mine at Ruth. Additional nearby copper ore bodies are being developed for mining. An ore concentrating mill and smelter are located at McGill.

In Arizona, the mine is located at Ray. For many years it was an underground mine but is being converted to an open-pit operation. The Division also operates an ore concentrating mill at Hayden.

The Chino (New Mexico) Division consists of an open-cut copper mine and an underground zinc mine at Santa Rita and an ore concentrating mill, smelter, and refinery at Hurley.

Kennecott's Chilean Division (Braden Copper Company) operates a large underground copper mine, an ore concentrating mill, a smelter and refinery in Chile.

The Quebec Iron and Titanium Corporation (two-thirds interest owned by Kennecott and one-third by New Jersey Zinc Company) operates an open-cut iron and titanium mine at Lac Tio, Quebec. The ore deposit is the largest of its kind known in the world. The company also operates a treatment plant at Sorel, Quebec.

Kennecott Sales Corporation sells the metals that Kennecott produces. Part of Kennecott's copper output is used by two manufacturing companies which are part of the Kennecott family — Chase Brass and Copper Company, Inc. and Kennecott Wire and Cable Company.

Chase Brass has two plants at Cleveland, Ohio, one of which produces brass and copper sheet and the other brass and copper rod and tube. At Waterbury, Connecticut, the Chase metal works plant products brass and copper sheet, rod and tube, and the company's factory, also located at Waterbury, makes literally thousands of finished brass and copper products.

The Kennecott Wire and Cable Company plant at Phillipsdale, Rhode Island, manufactures a general line of bare and insulated copper wire and cable.

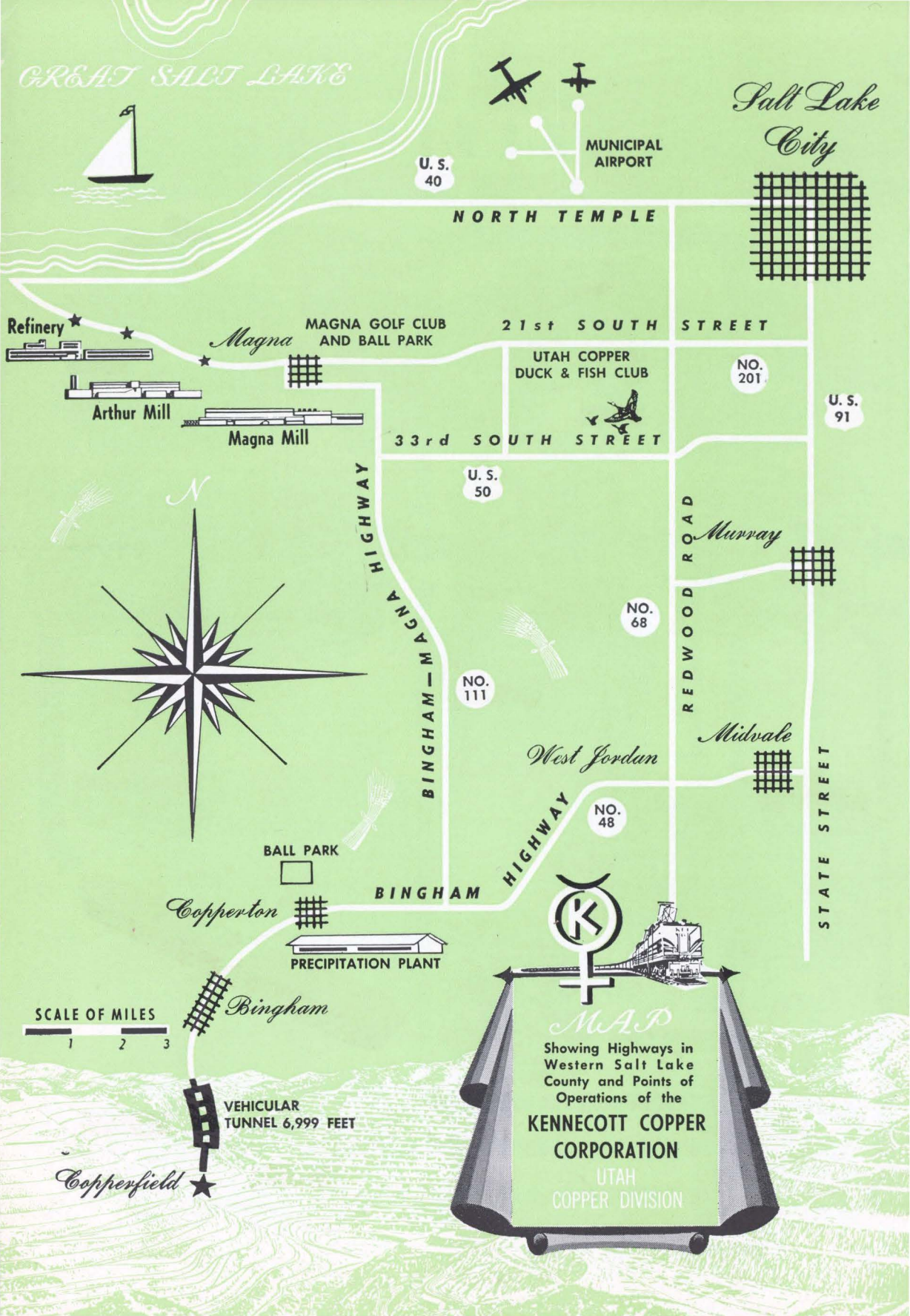
Kennecott is a typical American business from ore mining through processing, fabricating and sale of its metal to customers. The company provides an essential product to a free people whose lives are made better because of such business enterprises as Kennecott.

A TYPICAL AMERICAN ENTERPRISE

Kennecott Copper Corporation is owned by some 90,000 shareholders. About 73,000 of them are individual men and women. This means that perhaps the person living next door to you or the grocer, or maybe the teacher who instructs your child, or the man who leads the singing at your church on Sunday, or the farmer who supplies your food may be one of the owners of Kennecott. The 73,000 individuals who own Kennecott do business every place that Kennecott operates. Right here in Utah, for example, they pay taxes, wages, freight charges, they buy supplies and services.

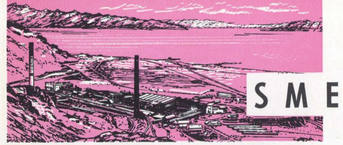
Many Kennecott owners possess a small number of shares. The company is a good example of American business enterprises that have had tremendous increases in number of shareholders. Back in 1916 Kennecott only had 18,000 shareholders. Today's 90,000 shareholders represent an increase of nearly 400% in the last 32 years. Seventy per cent of them own less than 50 shares each. These people living across America have banded together to do business under one name, Kennecott Copper Corporation.

The shareholders, the company's management and employees constitute a team that has made Kennecott operations successful. This success has resulted in benefits for us as individuals as well as for our country.


GREAT SALT LAKE
Salt Lake City
MUNICIPAL AIRPORT
U. S. 40
NORTH TEMPLE
Refinery
Magna
MAGNA GOLF CLUB AND BALL PARK
21st SOUTH STREET
UTAH COPPER DUCK & FISH CLUB
NO. 201
U. S. 91
Arthur Mill
Magna Mill
33rd SOUTH STREET
U. S. 50
N
BINGHAM—MAGNA HIGHWAY
REDWOOD ROAD
Murray
NO. 68
NO. 111
Midvale
West Jordan
STATE STREET
NO. 48
BALL PARK
BINGHAM HIGHWAY
Copperton
PRECIPITATION PLANT
Bingham
SCALE OF MILES
1 2 3
VEHICULAR TUNNEL 6,999 FEET
Copperfield
MAP
Showing Highways in Western Salt Lake County and Points of Operations of the
KENNECOTT COPPER CORPORATION
UTAH COPPER DIVISION

MINING

MILLING



SMELTING

REFINING

DRILLING & BLASTING

ORE LOADING

ORE CARS ASSEMBLY YARD

WASTE & OVERBURDEN REMOVAL

WASTE DUMPS

COPPER PRECIPITATE PLANT

COPPER PRECIPITATE TO MARKET

ORE HAULAGE SYSTEM TO MILLS

CAR DUMPER

PRIMARY CRUSHER

SECONDARY CRUSHERS

FINE GRINDING

WATER

REAGENTS

FLOTATION

COPPER & MOLYBDENITE SEPARATION

FILTERS

WASTE

CLASSIFIERS

MOLYBDENITE TO MARKET

COPPER PRECIPITATE

COPPER CONCENTRATE

LIME

SILICA

BEDDING BINS

FUEL

ROASTERS

GASES

STACK

PLATE TREATER

ROASTER CALCINE

REVERBERATORY FURNACES

SLAG DUMP

GASES

WASTE HEAT BOILERS

FUEL

AIR

GREEN POLES

COKE

MATTE

SLAG

ACID PLANT

SILICA

PLATE TREATER

GASES

CONVERTERS

BLISTER COPPER

HOLDING FURNACE

SKIMMINGS

POLING FURNACE

ANODE COPPER

ANODE CASTING WHEEL

ANODES TO REFINERY

ANODE MUD

CATHODES

ELECTROLYTIC CELLS

SHEARS

SHEARED CATHODES TO MARKET

CATHODES

ARC FURNACES

SKIMMINGS & SKULLS TO SMELTER

SLIMES TREATMENT PLANT

SELENIUM, TELLURIUM & PRECIOUS METALS TO MARKET

DORE SLAG TO SMELTER

SCRAP

CASTING WHEELS

INSPECTION

SCALPER

REFINED COPPER TO MARKET

KUE

PURIFIED ELECTROLYTE

ANODE SCRAP

SULPHURIC ACID

ELECTROLYTE

ARC FURNACES

ANODE CASTING WHEEL

BLACK ACID

IMPURE CATHODES

ELECTROLYTE PURIFICATION

CRUDE NICKEL SULPHATE TO MARKET

RESIDUE & SLUDGE TO SMELTER

LEGEND OF BASIC OPERATIONS

MINING

MILLING

SMELTING

REFINING

PRIMARY FUNCTION

SECONDARY FUNCTION

The Four Phases Of the Copper Cycle In Utah

The four phases of the copper cycle in Utah are graphically described on this flow sheet.

Phase number one is mining—the daily removal of an average of 83,000 tons of ore containing less than 1% copper and 136,000 tons of overburden, or waste material.

Phase number two is milling. The Ore Haulage Department transports the ore from the mine to the mills where copper concentrate is produced by the flotation process. The concentrate contains about 31% copper, small amounts of molybdenum, gold and silver and still smaller amounts of some other metals. Molybdenum is separated by a second flotation process and recovered as molybdenite concentrate.

Phase number three is smelting. The smelter, owned by American Smelting and Refining Company, processes, under contract, concentrates produced by Kennecott Copper. The smelter produces copper anodes, 99.4% pure.

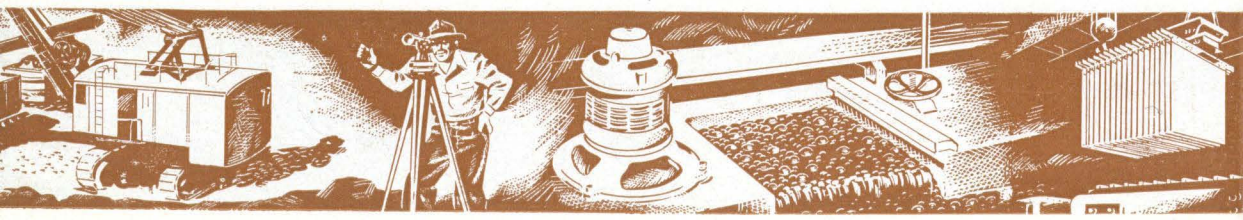
Phase number four is refining. Anodes produced by the smelter are processed at the refinery emerging as 99.96% pure copper. In the form of ingots, ingot bars, wire bars and cut cathodes, the metal is shipped to fabricating plants and other customers. It is at the refinery that gold, silver and other by-products are removed from the copper and recovered.

Combined efforts of 6,900 workmen are required to complete the copper cycle in Utah.

KENNECOTT COPPER CORPORATION
UTAH COPPER DIVISION

"We believe it is our basic responsibility to America, the State of Utah, and her people, to conduct our operations in a sound and wise manner that will maintain Utah Copper as a major metal producer. By doing this, Utah Copper operations will provide maximum employment, freight shipments, tax payments and purchases, resulting in greater benefits for everyone."

UTAH COPPER DIVISION
and the 5,300 members of
the Utah Copper Family.



A circle with a curved line on top and a cross attached below has been used as a symbol for metals since ancient times. Kennecott has adopted this symbol as its trade mark, with the addition of the letter "K". Kennecott not only is the world's largest producer of copper, but is also a leader in the production of many other metals, including molybdenum, brass, titanium, gold, silver and selenium.

Listen to Utah Copper's radio program, "This Business of Farming," broadcast Monday through Friday, 12:15 to 12:30 p.m. over radio station KSL in Salt Lake City and KSUB in Cedar City, Utah.