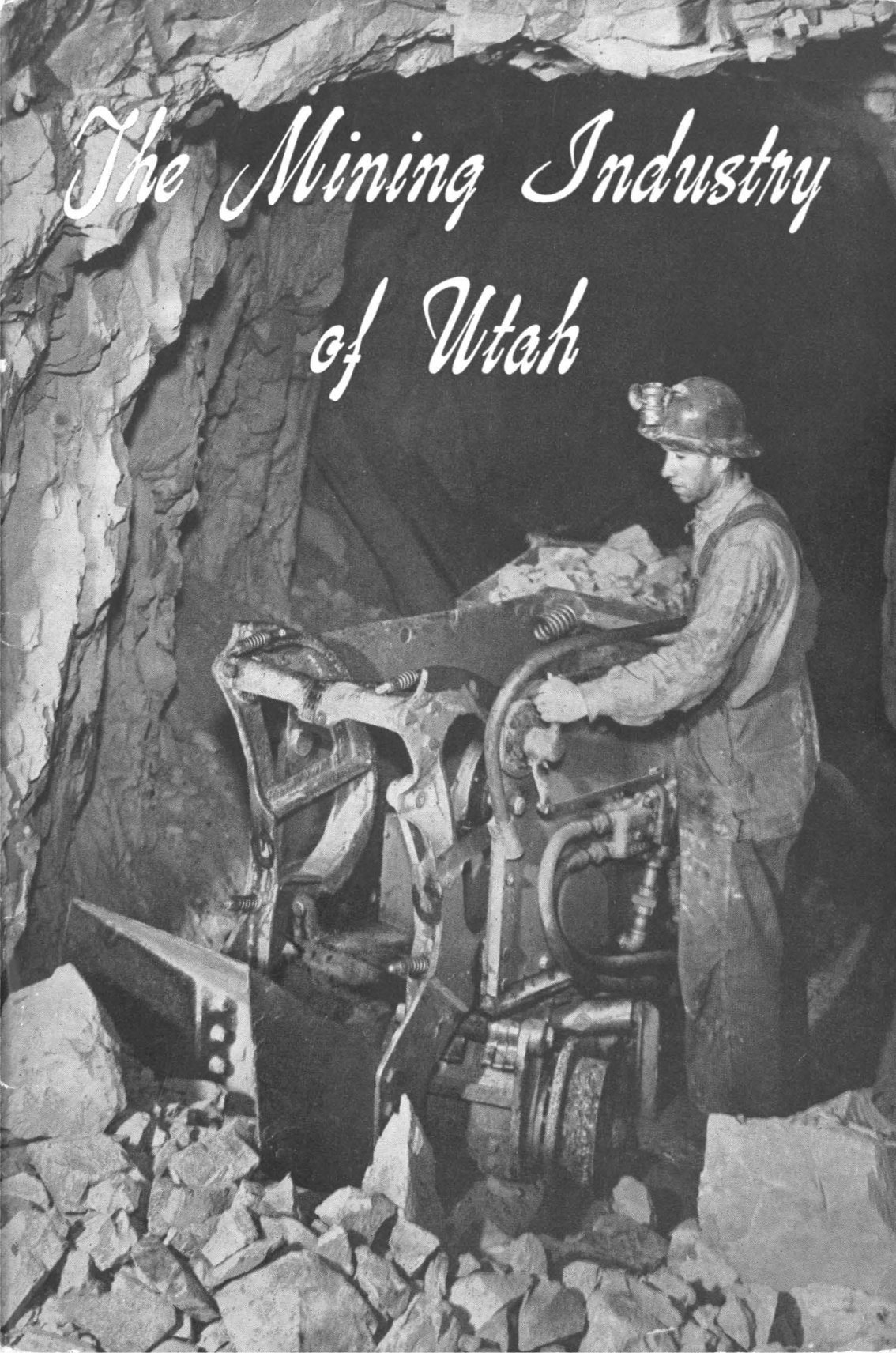
The Mining Industry of Utah



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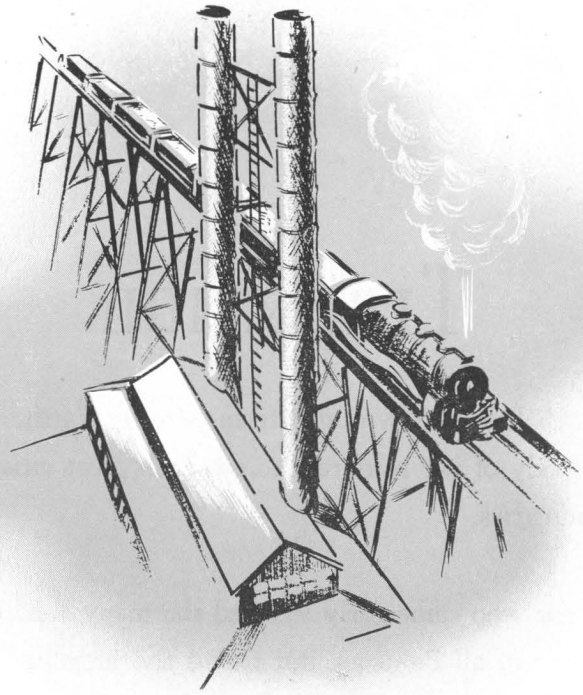

The Mining Industry Of Utah

Some day industry must come to the source of supply.

Based upon this premise a new surge of industrialization is sweeping the Western United States, and it is being established upon the firm foundation of natural resources.

Much of this movement is predicated upon Utah's resources. Her copper, lead, zinc, gold, silver, coal, iron, and steel and the vast array of nonmetallics provide the nucleus for Western growth.

The Mining Committee of the Salt Lake City Chamber of Commerce in sponsoring this booklet does so with the aim of better acquainting the people of the State with its resources, potentialities and opportunities. We hope that you find it interesting and informative.

THE CHAMBER OF COMMERCE
MINING COMMITTEE
Salt Lake City, Utah
1947

(Additional copies may be obtained at no cost by sending requests to the above address.)

Transition

Much has been wrought from Mother Earth. She has given freely of her resources to establish great cities, towns and industries.

Those who came early suffered the many hardships and privations of all Pioneers, but found the metallic resources with comparative ease, on and near the surface. Sensational strikes were made and booms followed. There were the bonanza days of Virginia City, Tonopah, Goldfield, Leadville, Pioche and many others.

But the rich ores did not last. The ghost camps of the West with their scarred hills bear silent witness to this fact.

Mining, today, necessitates delving deeper and deeper into Mother Earth, and it is now the low grade ores that yield the metals of our time. Today mining calls for greater knowledge, greater expenditures and greater risk.

Foreword

By DR. A. RAY OLPIN

President, University of Utah

DR. OLPIN

This is the Centennial Year for the State of Utah. We can look back on a century of progress, take stock of our strengths and weaknesses, and build for the next hundred years on the foundation already laid.

For the first three-quarters of the past century, Utah was a gathering place for migrants from all parts of the United States and Northwestern Europe. Most of these new citizens engaged in agricultural or service industries for their sustenance. During the last quarter of the century the youth of Utah have been migrating from the State in considerable numbers, seeking opportunities for gainful employment not afforded within the State. The agricultural possibilities of the area had been developed to near potential capacity; the manufacturing and mineral industries were not expanding; and the service industries could not expand, for the numbers employed as doctors, teachers, lawyers, merchants, etc., are always determined by the numbers engaged in the primary and secondary industries.

The great need for the State as we look ahead is, therefore, the development of basic industries offering employment to larger numbers of individuals. It is natural to assume that most of these basic industries will be concerned with the extraction and processing of the mineral resources which exist in such variety and abundance in this intermountain territory. It cannot be accomplished if the raw materials are extracted from the ground and shipped elsewhere to be processed and fabricated into products for sale.

The development of mineral industries, or any industries, in this area, will require: (1) Courage and vision on the part of our manufacturers, and willingness to risk capital and effort in the development and utilization of the natural resources; (2) Intelligence and competence on the part of our scientists and engineers who must provide the technology necessary to transform the existing raw materials into useful products; (3) Diligence, sympathetic understanding, patience, and a desire to cooperate on the part of those who will furnish the labor.

The institutions of higher learning in Utah are in a position to contribute greatly to the success of any program for future development. They must train the men to do the job, each well qualified in his own field and understanding in his attitude toward those in other fields.

The pioneers of the past century have been instrumental in developing a pleasant and comfortable environment in which to live. The pioneering must continue throughout the next century, but in the future the pioneering must be along the line of developing new industries to provide opportunities for an ever-increasing population.

Industrial World Depends on Metals

By DR. FRANKLIN S. HARRIS
President, Utah State Agricultural College

THE prosperity of any nation or region is greatly influenced by a few fundamental resources which determine the type of industry that can be developed in the area. Agriculture is certainly fundamental the world over since most food and clothing are obtained from this occupation. It is evident, however, that from agriculture alone, it would be impossible to establish an industrial community, no matter how furtile the soil might be.

DR. HARRIS

The modern industrial world depends primarily for its development on the products of the mining industry. Iron, steel, copper, coal, lead, zinc, silver and many of the rarer metals are so intimately associated with all industrial development that it would be impossible to build the complex society of today without the easy availability of these fundamental materials.

The agriculture of Utah is largely limited by available water. The small area of the State that can be cultivated has an excellent agriculture, but the area that can be developed into farms is necessarily very limited. This State however, is very fortunate in having minerals, both metallic and non-metallic, widely distributed over many sections. Coal of excellent quality is abundant; vast deposits of iron are available; copper is being produced in unparalleled quantities; silver, lead, zinc, gold and other metals are abundant; and, a number of hydro-carbons are found in large quantities.

This means that the mining industry will always be important in Utah, and even more significant will be the manufacturing that is made possible by the products of mining. Up to the present time the State has been occupied with the development of the primary mineral resources, but from now on the industries growing out of these resources will doubtless form a large part of the industrial activity of the State.

History

NATURAL FORCES THAT LIMITED AVAILABLE LAND WERE CAUSES OF MINERAL DEPOSITION

LASHED by prehistoric waters and carved by glacier and wind, Utah was moulded into a state of natural beauty and natural resources. Some of these resources have been developed to provide metals for a nation and industry for a state. Others, including a vast storehouse of nonmetallics, remain untouched for future industrial expansion and future generations.

Topographically, Utah is a land of mountains and desert, sparingly sprinkled with fertile valleys and upland reaches. The Wasatch Mountains and their extension form the backbone. In the northeastern section, just below the Wyoming line, run the Uintahs, and south are scattered mountains and deserts with here and there a fertile plot. To the northwest is found old Lake Bonneville, and westerly, rising up from the general level of the terrain, are the north-south ranges of mountains typical of the Great Basin. In moulding this area, nature left a book—a record of the rocks—which tells of the things she has done that have made this region what it is.

If we open this record to the chapter entitled Mesozoic Era, we find that most of the area now occupied by the Rocky Mountains and extending eastward from the Wasatch Range was covered by water. A great bay or gulf extended northwesterly to Alaska, joining the Arctic Ocean to the Gulf of Mexico; thus dividing North American into two continents. The western continent was a land of high rainfall, marshes and rivers, which in turn became the habitat of luxuriant plant life. For tens of thousands, possibly hundreds of thousands of years, these plants grew and died; became packed down to be succeeded by later generations of vegetation. Thus were formed the great Cretaceous coal beds of the West.

With the end of this period the record tells of the beginnings of the Rocky Mountain uplift; of the formation of the Great Basin and how its rock strata were being squeezed and faulted and contorted between the Wasatch on the east and Sierra Nevadas on the west; of how fissures and cracks were formed to allow the penetration of metal-bearing solutions and of how in places the surface of the earth failed and the molten material underneath surged up causing rhyolite flows and porphyry and monzonite intrusions, some of which, as in Bingham, carried enough mineral to become valuable as ore. Yes, much of Utah literally rose out of the water to share her resources with mankind.

And then came the ice ages. As the last great glacier of the ice age melted away there was formed in Utah a tremendous fresh water lake known as Lake Bonneville and in Nevada another one that has been called Lake Lahontan. The markings of Lake Bonneville can easily be seen on the flanks of the various mountain ranges. From these benches its configuration is easily determined. But it too has passed into geological history. The great Sierra Nevada Mountains formed a barrier for the warm, moisture-laden winds of the Pacific, causing them to drop their moisture before they could pass. So this area, hemmed in by the Rockies and the Wasatch on the east and the Sierras on the west, was deprived of its normal amount of rainfall and the region became more or less arid.

First came the savage and then the civilized man. The Pioneers began the colonization of the Valley soon after their arrival July 24, 1847. They turned the water from the mountains to the soil of the fertile valley and thus developed modern irrigation. The early comers adopted a policy of making themselves self sustaining as to food, raiment and housing.

Within the next 50 years farming and kindred industries grew up. The agricultural land of the state, a pitifully small portion, amounting to two and three-quarters per cent of its total area came under cultivation, compared to a national average of 20 per cent.

But the natural barriers that restricted the amount of arable land in the state were fundamental in the deposition of minerals. When the present mountain ranges were being pushed up to shut out the moist winds from the area, their very lifting was creating the ore deposits of Alta and Park City in the Wasatch mountains, of Bingham, Ophir, Stockton and Mercur in the Oquirrhs, of Tintic a few miles south and Milford and Frisco and many others. The great beds of coal, which were mentioned earlier, had their inception prior to this era.

As the hot, dry summers were drying up Lake Bonneville they were forming the salt brines of the Great Salt Lake, a potential source of many valuable materials in addition to common salt. By proper attention to the future development of these natural resources and seeing to it that those already developed are not allowed to slip backward, Utah can support a population of at least three times the present and provide a livelihood for all.

The westward trek of the Mormon people from Illinois, which had its beginning in 1846, is closely associated with the beginning of the development of the resources of the West. By the time these Pioneers had reached Council Bluffs, war with Mexico had broken out. A number of the Pioneers went on ahead to California to join the American forces and fight for their Country. Two of these men were with Jim Marshall when he made this discovery of gold at Sutter's Creek, California, in 1849.

News of Marshall's discovery spread like wildfire and soon the gold rush was on. From across the plains, over the swamps and around the Horn, gold seekers flocked to California. It became one of the greatest gold rushes in all history. Some stayed in California and others fanned out to other parts of the Western United States, to blaze new trails and make new discoveries.

An old iron bell, which now rests in the museum of Cedar City, is mute testimony of the first discovery of metals in Utah. Iron was discovered by a company headed by Parley P. Pratt, that was exploring the area surrounding Cedar City in 1849-50 at the request of Brigham Young. When President Young received news of the discovery, he encouraged Mr. Pratt, in a letter, to do all he could to develop the claim for the welfare of the people.

One of the first recovery furnaces built was that of Isaac Grundy, who in cooperation with others, built a crude plant at Minersville, Beaver County, in 1858. This was near the old Lincoln mine which was discovered in 1852. Like all frontiers some trouble was experienced with the Indians and metal was needed for the production of bullets. "According to accounts," says one writer, "something in the lead made it too hard for that purpose; that 'something' was later found to be silver."

In 1854 the Territorial Legislature offered a reward of $1,000 for the

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Copper

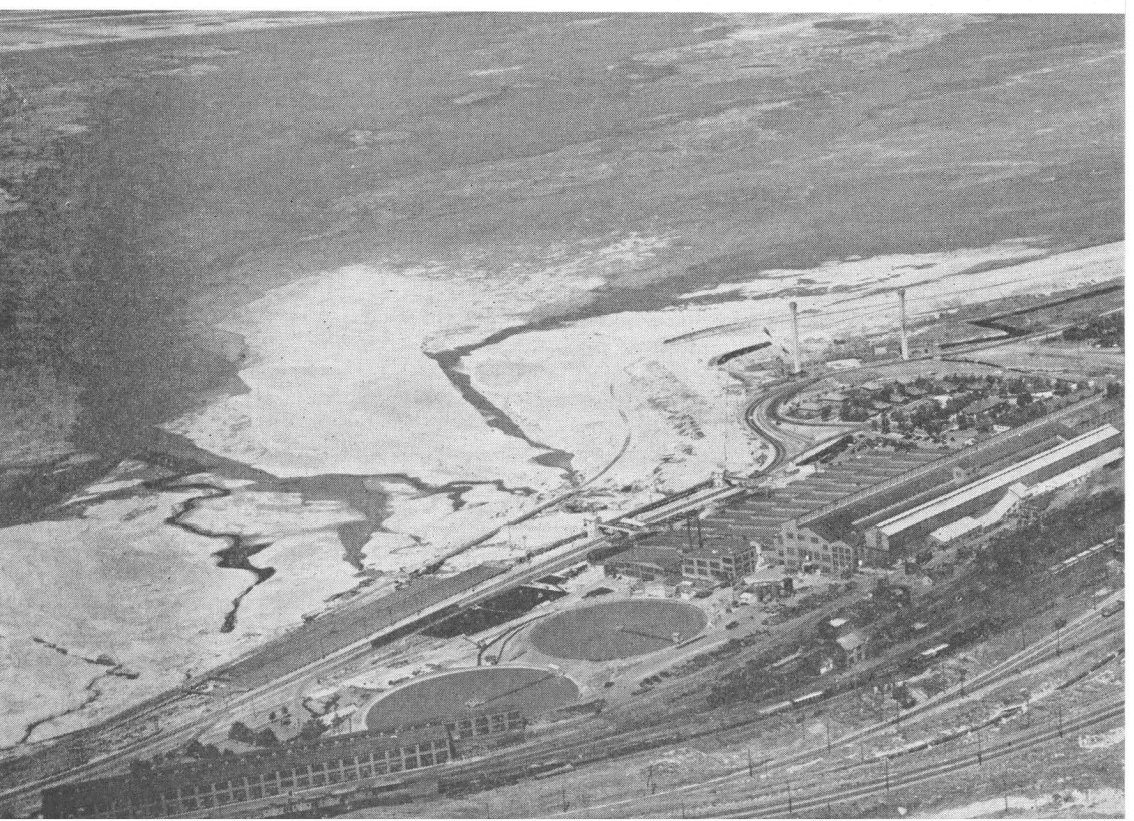
THE EVERLASTING METAL
SHAPES UTAH INDUSTRY

Historians have divided the progress of civilization into three great eras; the Stone Age, the Bronze Age, and the Iron Age. The Bronze Age could more appropriately be called the Copper Age.

Archeologists differ somewhat as to the dates of the various ages, due perhaps to the slow transition from one to another. This is not of particular importance, however, but it is significant that civilization emerged when man began to use metals and has progressed as he has put them to use and to work for him.

One historian approximates that the Age of Copper began about 8000 years B. C., and it gave way to the Age of Iron about 1000 years B. C. The Iron Age did not replace the Copper Age, but rather supplemented it as down through time the production and utilization of copper has increased.

Today, copper is a guage of the standard of living, as it is found in so many objects in daily use, objects which lighten and facilitate daily liv-



ing. As an example in the United States during a peace time year consumption was 14 pounds per capita, with per capita consumption throughout the rest of the civilized world less than half this amount.

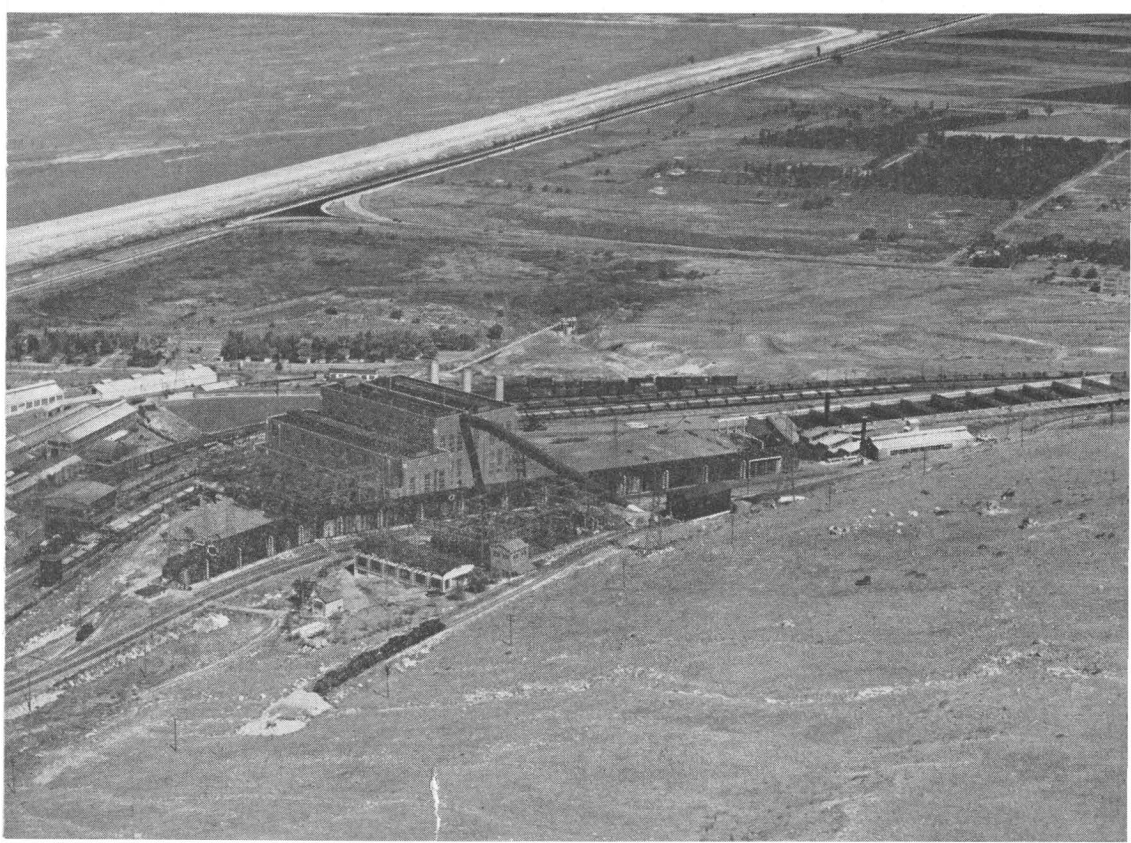
Paradoxically, the first useful manufacture of copper was for spearheads, arrows, knives and battle axes. Today the red metal has just emerged from its greatest role, that of supplying the arsenal of democracy wth some of its greatest weapons, a role in which Utah had an important part. Known as the "war metal," copper also is known as the "everlasting metal," and once again has assumed its place in a thousand and one articles for modern living.

Utah emerged as an important producer of copper shortly after the beginning of the Twentieth Century. While some copper was produced largely as a by-product prior to 1900, it was the development of the Utah Copper Division of Kennecott Copper Corporation at Bingham Canyon in 1904 that gave Utah its leadership as a copper producing state.

Virtually since its beginning this open cut mine has been the world's leading copper producer, normally providing about 30 per cent of America's newly mined copper. In normal

ONE OF UTAH'S GREAT INDUSTRIAL PLANTS

Indicative of the money ploughed back into Utah industry by mining is this huge concentrator and adjoining electrical plant of Kennecott Copper's Division at Magna. This is one of the two mills operated by this company near the south shore of Great Salt Lake, which together have a rated capacity of 70,000 tons daily. The new power plant is being completed at a cost in excess of $10,000,000.



times the operation employs 4000 workmen, 2000 at the mine and 2000 at the Magna and Arthur concentrators, which combined have the largest capacity in the world.

Such a mining operation naturally has been a powerful force in the building of Utah's economy, and has brought much industry and new wealth into the state.

Thus the story of copper mining in Utah hangs largely on the Utah Copper Division of Kennecott. Ohio Copper Company of Utah is the only other single copper producer and some small quantities of the red metal are produced as a by-product of the underground mines.

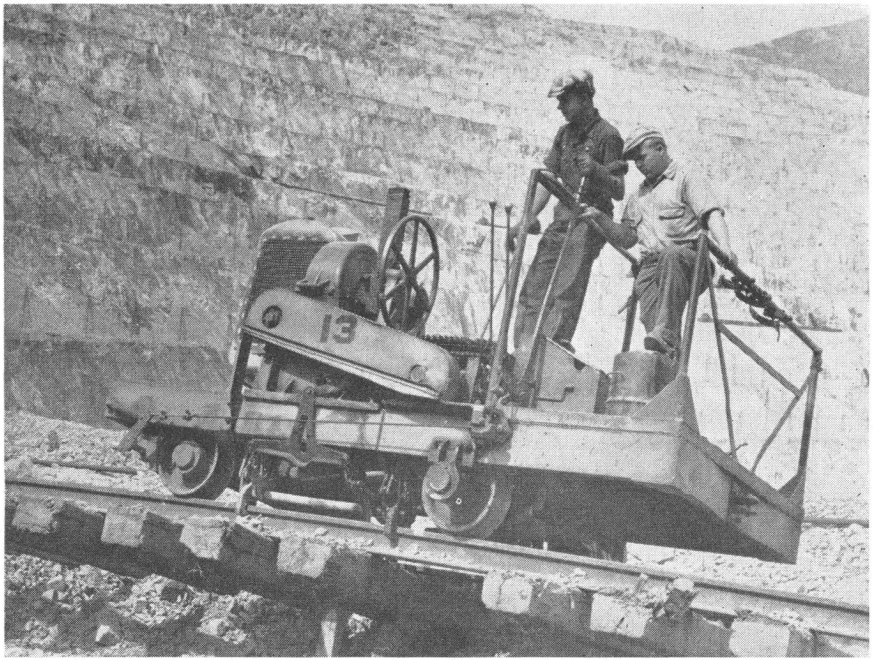
The Utah Copper mine had a humble beginning characteristic of most great mines. While the presence of a huge monozonite porphry (rock resembling granite) had been known for 15 years prior to 1900, it was passed up as worthless due to the small copper content. Means had not been devised to successfully mine the porphyry and early operators tunneled into the Bingham area seeking other base and precious metals.

In 1896, Daniel C. Jackling, then a young eingineer, made a preliminary examination of the Bingham area and in 1898 made his report which was to revolutionize the copper world. Jackling based his report for success upon the underlying principle of mining, transporting, and milling of large tonnages or ore.

When the young engineer set about to finance the company it was looked upon as a poor mining risk. He offered Utah Copper stock all the way from Salt Lake City to Glasgow, Scotland, and found no takers. At first

CUTTING AWAY A MOUNTAIN

When nature moulded the Oquirrh range, a small amount of Copper was disceminated through the rocks at Bingham, Utah. This striking picture shows how Utah Copper Division of Kennecott Copper is whittling down the mountain to reclaim the metal, which averages less than 1 per cent copper.



MOVING A RAILROAD

This is a daily job at Bingham Copper pit where Kennecott's Utah Copper pit where Kennecott's Utah Copper division operates 130 miles of trackage—a fair sized railroad operation. Tracks are moved in this manner as mining progresses back into the mountains.

the public was wary and larger companies were skeptical of his revolutionary program. Finally Jackling's old friends, Charles MacNeill and Spencer Penrose of Colorado, agreed to speculate on the venture and succeeded in financing initial operations.

In 1904 construction was begun on a mill of 1000 tons daily capacity at Copperton, near the mouth of Bingham Canyon. During the first two years underground methods of mining were employed, primarily to check the sampling, and in 1906 the first steam shovel and was put into opration.

Contrast this picture with today's operation. The company now employs a battery of 41 electrically powered shovels, each capable of handling about 6500 tons in an eight-hour shift; operates 131 miles of standard gauge railroad at the mine; operates the Magna and Arthur concentrating mills, having a rated capacity of 70 thousand tons per day and supplies a large percentage of the tonnage for the Garfield Smelter.

The Utah Copper ore is low grade. Success of the company originally was predicated upon a copper content of two per cent. Mining and milling methods have been improved until at the present time ore being milled contains on an average less than 1 per cent copper, of which 17 pounds are recoverable from each ton of ore. At times ore running as low as one-half of one per cent copper is mined, depending on costs, leaving a profit of less than 5 cents per ton.

A huge bowl has been carved out of the Oquirrh range at Bingham. The excavation area covers approximately 830 acres and there are 43 levels, averaging 67 feet in height and from 70 to 250 feet in width. Each time a ton of ore is mined it is necessary to remove a ton of waste or overburden to reach the ore. To date 570 million

tons of waste have been removed and 485 million tones of ore mined, yielding 8½ billion pounds of copper.

After the ore is broken up by blasting it is loaded into 100-ton railroad cars by electric shovels and transported 17 miles northward to the Magna and Arthur mills, situated on the south shore of Great Salt Lake. Here the ore is reduced to concentrate containing about 33 per cent copper.

The process at the Arthur and Magna concentrators for separating the copper from the waste part of the ore is interesting. These two plants, which have the largest combined milling capacity of any in the world and cover some 1500 acres, are built on the low foothills that rim Great Salt Lake on the south, so that a gravity flow can be obtained for the ore as it goes from one step to another through the mills.

After the ore trains arrive at the mill yards above the plants, the cars, which contain 100 tons of ore each, are pushed one at a time by small switch engines onto a rotary dumper. As soon as the cars are locked in place they are turned bodily up side down and the ore is sent roaring into a huge gyratory crusher.

The first crushing process reduces the pieces of ore to not more than 6½ inches. Conveyor belts then take this ore to the next step in crushing process where it is broken into finer pieces. Step by step down the mill terrace the ore becomes progressively finer, the last step being large cylinder like ball mills filled with 2 inch iron balls which tumble over each other as the mills revolve. Water has been added at this step, so that the ore now resembles a muddy stream.

When the grinding is completed the ore has been crushed so fine that 80% of it will pass through a screen having 10,000 openings to the square inch.

Chemical reagents are added and the "feed" then goes to the flotation department, which consists of long rows of 10 flotation cells each. The flotation cell is box-like with a motor at one end which turns an impeller that extends down into the box. The rapidly turning impeller agitates the flotation feed, and with the assistance of one of the chemicals which has been added produces a froth of bubbles. Another chemical coats the small particles of copper, which causes them to attach themselves to the bubbles and float over the lip of the box-like flotation cells. This watery product then goes through a process to reduce its water content and the final product, which is called copper concentrate, contains 35% copper. The worthless material in the ore settles to the bottom of the flotation cells and flows into the tailings pond.

The copper concentrate is then shipped to a smelter, where most of the remaining waste is removed and a product called blister copper is made, which contains approximately 99% copper.

Who shares the benefits of this large scale mining operation? A few years ago the company built a model community at Copperton at the mouth of Bingham Canyon to provide suitable housing for those who work at the mine. A power generating plant is now being completed at Magna at a total cost in excess of $10,000,000. During the next year the company will spend $4,000,000 in the laying of new industrial trackage between Bingham and the mills.

Thus, millions of dollars must be spent yearly to maintain efficiency and to keep the mine and mills abreast of ever changing economic conditions. Moreover, millions are spent yearly in the regular maintenance of the present plants and equipment, in which more millions of dollars have already been invested. For each employee, it is estimated that in excess of $16,000 has been spent, and additional thousands must be ploughed back into the operation each year to keep open his job.

Each normal year the corporation pays taxes of approximately $2400 per employee. Due to a strike, 1945 was the last full year of operation, and during that year Utah Copper Division's taxes in Utah totaled $3,245,813, or an average of $1206 per employee. Federal taxes are normally about the same as state taxes, making the total taxes for a year like 1945, 6½ million dollars, or $2400 per employee.

Mankind has benefited to a substantial degree from operations of the Utah Copper, principally because it opened the way for low priced copper. This has reduced the cost of a multitude of manufactured products and services in which copper plays a part, and in a measure has been responsible to a degree for the impetus given the electrical era that has helped to place man upon a higher standard of living, particularly in America.

The people of Utah have benefited from the mine's operations because of the large purchases from within the state, its large payroll, and the substantial part of the load it carries of the cost of providing government, which otherwise would have to be borne by remaining business and the people of the state.

During the 10 year period from January 1, 1936 to December 31, 1946, Utah Copper division paid $83,173.550 in wages, $111,552,805 for smelting freight and refining, $146,261,974 in taxes and $141,001,419 for supplies and other equipment.

Thus, the dream, foresight and courage of a man nearly a half century ago has proved to be one of the truly great dreams of American industrial history, an achievement that has added much to the material, economic and social wealth, not only of Utah but the nation as well.

Utah's other single copper producer is Ohio Copper Company at Bingham, an interesting and unique operation. Here leaching in place is practiced. The process of leaching in place is accomplished by pumping water to the surface and permitting it to percolate through the disseminated mass of low grade copper ore. As the water passes through the ground it picks up a small amount of copper, which is carried to a tunnel where long troughs filled with scrap tin are maintained. As the copper bearing water passes over the scrap the copper in solution adheres to the metal and is extracted from the water.

In addition the Ohio Copper Company operates a tailing retreatment mill near Lark, a few miles west of Bingham, where a taining pond is being retreated for the small amount of copper remaining as a result of an early day reduction operation when milling practices were less efficient. This operation yielded 2,208,305 lbs. of copper in 1946.

During World War II, Ohio Copper expanded its operations, reopening the Big Indian property at LaSal, Utah. This operation is now yielding about 1,000,000 pounds of copper yearly.

LIQUID METAL

Here dross is being removed from kettle of molten lead at one of Utah's smelters. This is last steps in the long process of separating waste from metal.

Smelting

RESEARCH IN METALLURGY BROADENS SCOPE OF MINING

Utah's smelting industry is represented by plants of the United States Smelting and Refining Company at Midvale, American Smelting and Refining at Murray and Garfield, International Smelting and Refining Company at Tooele and Combined Metals Reduction Company at Bauer, Utah. Lead smelters are located at Murray, Midvale and Tooele, and copper smelters at Garfield and Tooele. In addition a zinc slag fuming plant erected during the World War II at Tooele, helped relieve the shortage of this critical metal during the early stages of the conflict.

Naturally mining and smelting go together. One compliments the other, and together they are fighting the battle of increased costs inherent in progressively deeper mining and lower grade ores. Smelting has become an industry separate and distinct from mining. There was a time during the early stages of mining in Utah when many companies built their own smelting plants. Such operations were not too successful, and they were eventually replaced by the custom smelting plant.

The custom plants were able to spread the benefits of large scale operations to prospectors and producers small or large. Step by step metallurgical practice has advanced, and out of the pyrometallurgical operations in this district have come improvements that have virtually revolutionized mining generally, permitting the producer to mine ores that were formally regarded as worthless. Thus the mineable resources of the state have been stretched and expanded many times through the science of metallurgy as applied in Utah's smelters.

Research departments at the various plants are at work continuously

seeking out better ways to blend the different types of ores from many different mines into smelting charges best adaptable to the producer. Geological departments assist the independent operator with mapping and geological work. Often the smelters assist the small producer, advancing capital for equipment or development work.

Both through subsidiary companies and directly, smelters have become engaged in the devolopment of Utah resources, which has resulted in opening of a number of producing mines.

The smelting industry in Utah had its beginning in the latter days of the Civil War, many years before the completion of the transcontinental railroad. Ox teams were still bringing their companies of more prosperous Mormon Pioneers across the plains to the valley of Great Salt Lake and those in lesser circumstances were still pushing their handcarts over the same roads to the valley chosen by them.

The first smelters were of the crudest fashion and erected at the mines they were to serve. Built of adobe brick, or stone, they could treat only a few tons per day of carbonate or oxidized ores, and used fuel charcoal made from the wood of juniper and aspen gathered on the nearby hills.

The early seventies saw the introduction of water jackets at the old Winnimuch smelter at Bingham, and at the Sultana smelter in American Fork Canyon. It was not until the eighties that smelting really began to take form as an industry distinct from mining.

This was after the miner felt the full force of the demonetization of

OVER THE DUMP

Metallurgical science has so improved metal recovery that practically nothing is now lost to slag pile.

silver (which occurred in 1873) and the seekers of silver were becoming seekers of lead and other base metals, and large lead plants were needed to handle the increased tonnage of ore.

In the early nineties the Germaina smelter was erected, which included complete smelting and refining departments and was one of the first complete metallurgical plants in the country. All these efforts were devoted to lead smelting, as copper ores in the district had not made their appearance in large quantities and the red metal associated with lead was shunned, just the same as zinc was shunned and lost to the slag dumps.

Development of copper in the Highland Mine at Bingham was followed by the erection of a copper smelter in the nineties and the introduction of copper metallurgy as it was practiced elsewhere. Then came development of Utah Copper which supplied ore at times for six different smelters and which was culminated early in the twentieth century with the building of huge concentrators at Magna and Arthur and a smelter near Garfield.

In this period was seen development of the copper blast furnace and the beginning of reverberatory operations upon a large scale. At first the blast furnace had the advantage but was supplanted more and more on account of the increasing amount of concentrates and decreasing amount of crude ore that required smelting.

A survey of the progress in the nonferrous smelting industry in Utah in the last 35 years would constitute a fair cross-section of the developments of the industry generally. Bag-

INDUSTRIAL MAGNET

Ores originating in Utah and all over the west are shipped to this mill and smelter of United States Smelting Refining and Mining Company for treatment, thereby bringing much industry to Utah.

houses for catching of lead fume and flue dust made their appearance in the early years of this century and developments of roasting went forth. Hand roasters were superseded by mechanically rabbled furnaces and rotating furnaces, which in turn gave way to the present day multiple hearth roasting arm type. The catching of volatile fumes brought about the saving and recovery of such volatile materials of which arsenic is the principal product.

The sintering process, earlies applied to both lead and copper smelting, was later made unnecessary in copper work by the large use of the reverberatory furnace.

Growth of Utah into the largest concentrating and smelting center in the world has brought much industry to Utah in the form of ores from outside which are shipped by rail, and trucked into the State from mines in all parts of the West.

To more easily visualize the reduction of a ton of ore to a few pounds of metal, let's follow the flow sheet through one of Utah's copper smelters. The smooth, precision-like operations of the giant plant almost compels one to overlook the magnitude of the operation, and the industry it represents within the State.

As an example, average yearly figures show that 1,500,000 tons of ore and concentrates are smelted. The tonnage originates in Utah, Colorado, Nevada, Idaho and California. In smelting this ore 5,800,000 cubic feet of natural gas are consumed. A total of $3,1000,000 is paid in wages and salaries to approximately 1200 workers. Expenditures for supplies and the equipment amount to $2,000,000 and $2,500,000 is paid to railroads for freight on ores and supplies. These figures represent one company's operation, so multiply this several times to get the picture of Utah's total smelting operation.

TOOELE SMELTER

Besides being an ideal farming community, Tooele Valley is the home of this International Smelting and Refining copper and lead smelter.

Initial operation at a smelting plant takes place at a fair sized railroad yard, where ores and concentrates are constantly received. They are weighed and sampled and then blended to provide an easy-smelting charge. This charge ,which is made up of 5,000 ton batches is first subjected to a roasting operation that does not melt the charge but drives off all moisture and oxidizes a portion of the sulphide materials. Roasting is done in furnaces containing six to eight hearths or floors. The ore is fed in at the top of the furnace and is gradually raked across the successive floors until it is discharged at the bottom as calcined material.

The reverberatory furnace is the second major step in the process. After the charge is subjected to the roasting operation, the calcined material is then sent to a gas-fired reverberatory furnace having a temperature of from 2,200 to 2,800 degrees Fahrenheit. As the charge melts the copper, iron and sulphur combine to form a heavy liquid which settles at the bottom, while the gangue waste materials form a slag which floats on top. The slag is drawn off and poured into round cone-like cars and transported to the slag dump.

The copper-iron-sulphide product, which is called copper matte, is drawn off the reverberatory furnace and transferred to copper converters. This transfer from the reverberatory to converter is interesting to watch. The red molten metal is drawn out into a small ditch, not unlike a drainage ditch, which is lined with silica. After traveling about 50 feet the molten stream trickles into a huge ladle. The

COPPER SMELTER

Garfield plant of American Smelting & Refining Co., on south shore of Great Salt Lake through which passes Utah's huge copper output and other copper ores from western U.S.

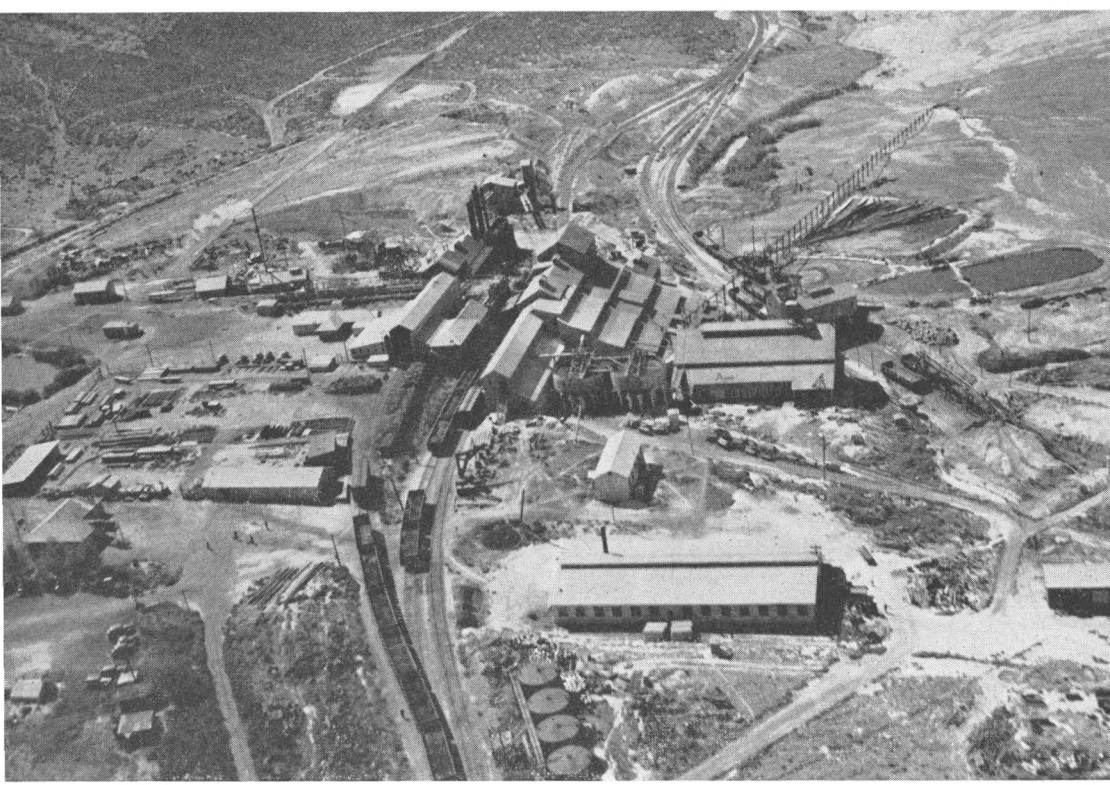
ladle is then picked up by a huge overhead crane and dumped into the converter. All through this process skilled workers move quickly and surely to their various tasks.

The third major step is the treatment of the copper matte in the converter. These converters consist of steel cylinders 30 feet long and 13 feet in diameter, lined with refactory brick. There is a battery of eight converters in this plant and their belching is a convincing spectacle of industry at work.

When the converter has received a charge of copper-iron-sulphide product of copper matte from the reverberatory furnace, siliceous ore is added and air is blown in through pipes or tuyeres. The iron in the matte and the silica combine to form an impure slag which is skimmed off and recharged to the smelting furnace. The crude copper is then withdrawn and cast into cakes called blister copper, which are then shipped to a refinery where the other metals are seperated and the finished metal produced.

BAUER CONCENTRATOR

Combined Metals Reduction Plant at Bauer which is fed by ores from Utah and other Western States.



Lead - Zinc - Gold - Silver

YEARS OF PRODUCTION FORCE MINES TO DEEPER LEVELS

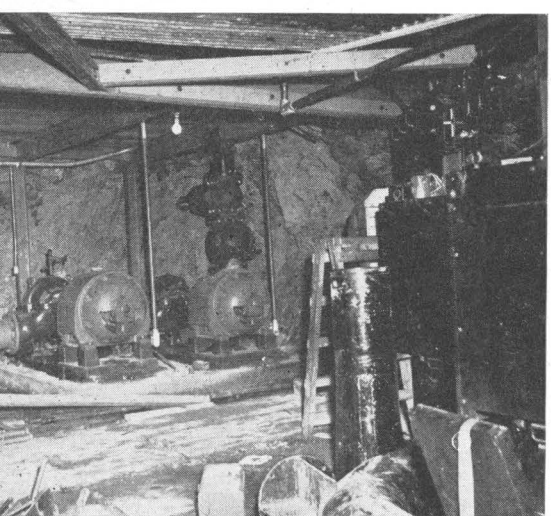
METAL mining in Utah has undergone three periods of transition.

Throughout these periods the state has been one of the leading metal producing areas and today holds the distinction of being the leading mining and smelting center of the world, due to production of mines within its boarders and the ores attracted here from other western states, and at times from foreign countries, for milling and smelting.

In 1945, the last full year of production (much production having been lost due to a strike in 1946) the state ranked first in the production of gold, third in silver, second in copper, third in lead and seventh in zinc. Besides these nonferrous metals, there is a staggering array of others— a total of 210 useful minerals found within the state.

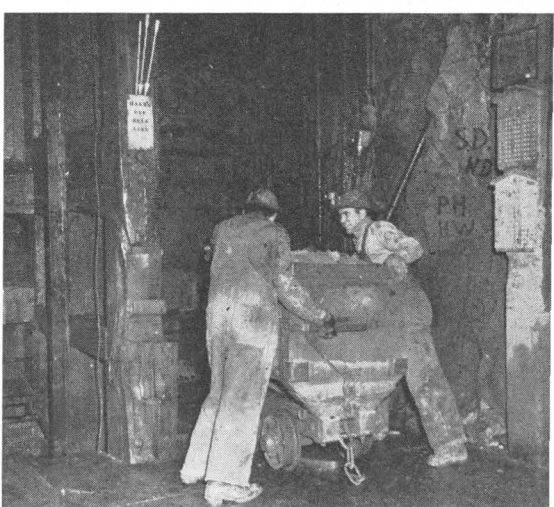
Total value of Utah's 1945 nonferrous metal production was $90,018,614.00 consisting of 279,979 fine ounces of gold, 6,106,545 fine ounces of silver, 452,752,000 pounds of copper, 81,634,000 pounds of lead, and 67,260,000 pounds of zinc.

First Utah had its bonanza days, the era when rich near-the-surface discoveries were made. Gold was discovered in Bingham gulch; rich silver ores were found at Alta, Park City, Eureka, Silver Reef and in Beaver County. Before the advent of smelters in Utah, some of these



DEEPER AND DEEPER

Nineteen hundred feet below the surface this massive pumping equipment is lifting a steady flow of water to permit mining of ores on the 1950 level of Silver King Mine. When brought to the surface the water is made available for crop irrigation.



LOOK OUT ABOVE

Onto the cage and up goes a mine car of Utah milling ore.

ores were so rich that they were shipped to San Francisco and around Cape Horn to Wales for smelting, and they could well stand the shipping and smelting costs.

The high grade ores did not last and the bonanza days of Utah were short lived. They served the state well, however. Their richness attracted outside capital to Utah for the development of additional resources and they led the way to the more plentiful oxidized ores and the low grade sulphide ores.

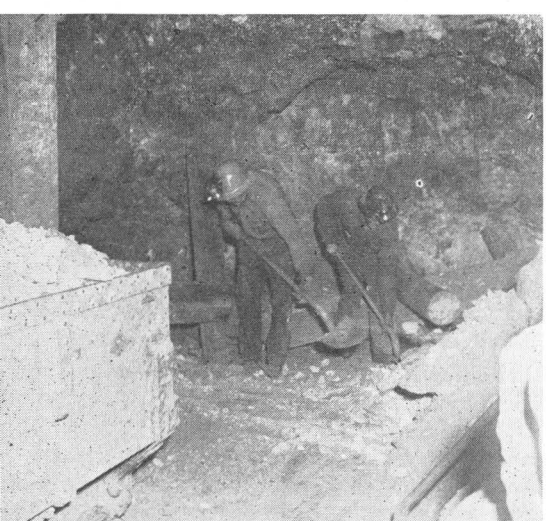
The second period was the mining and smelting of the oxidized ores. During this time which lasted from the early sixties until after World War I, Utah rose to its eminence in the mining and smelting world.

At the close of World War I, the State was faced with a serious situation that threatened the life of industry. Most of the easily oxidized ore reserves had been depleted during the war, and smelters were forced to close due to the lack of sufficient production.

Mining had progressed to deeper levels and the existence of sulphide ores was known, but the costs inherent in deep mining and the penalty and loss of zinc in lead ores in smelting practices existing then, made their production prohibitive.

A solution was found in the development of selective flotation in 1922, which ushered in the third phase of Utah's mining history. Selective flotation opened the way for the extraction of zinc, the hitherto scourge of the prospector and on outcast of the miner, suddenly became the companion of gold, silver, lead and copper. Flotation provided for the separation of lead and zinc into two types of concentrates before smelting.

By 1924, flotation mills were added to the smelting facilities at Midvale, Tooele and Bauer, and sulphied ores originating in Utah and throughout the western mining region began to flow into Salt Lake valley for treatment.



WHERE INDUSTRY BEGINS

While most underground mining is done mechanically now, there is still some triming and hand work to be done. These men start ore on its long industry making journey.

WHAT IS BEYOND DRILL?

Miner preparing to blast out a round at one of Utah's mines. Note ore in face of drift but what will next blast show?

During World War II, history was repeated. The manpower shortage and the urgent need for metals required that vitrually all workmen be employed in ore production. Good mining practice requires that the development of additional ores for mining in future years be carried on continually along with current mining. Since ore development was neglected during the war, the industry found its known ore reserves seriously low. This condition was aggravated by high taxes and federal controls over metal prices which left little funds at the war's end to finance ore development. A period of rehabilitation is necessary and every encouragement is needed to restore the industry to a normal balanced operating basis.

During the state's eighty odd years of production, a total of two and one half billion dollars has been mined, and 90 cents out of each dollar gross value of ore mined is spent in Utah. The 10 cents expended outside the State represents federal taxes, dividends and miscellaneous expenditures.

Besides being the leading copper producing area, the West Mountain Mining district, Bingham, is one of the leading producers of gold, silver, lead and zinc ores. Surrounding the open-pit operations of Utah Copper, are Bingham's underground mines. During the early days of the camp there were numerous companies that mined the oxidized and the sulphide ores of the upper levels, but as mining progressed toward deeper levels under the water table, many of the smaller companies were forced to give way to the increased costs encountered.

As a result numerous consolidations were effected and mining operations concentrated into fewer, better financed companies. Principal producers of the district now are the United States Smelting Refining and Mining Company, Combined Metals Reduction Company and the National Tunnel and Mines Company.

Operations of the United States Smelting Refining and Mining Company are concentrated principally at Lark, south and east of Bingham, where the company supports a community of about 500 persons. In addition the company also operates through the Niagara tunnel at Bingham, which is one of the district's large producers.

Combined Metals operates the old Park Bingham and Lavagino groups through the Butterfield tunnel, and is one of Bingham's large producers.

The Western rim of the Bingham district has been acquired by the National Tunnel & Mines Company, where every effort is being made to develop a profitable producer at depth. A consolidation of the old Utah Apex, Highland Boy, and Utah Metal & Tunnel properties, the National Tunnel has spent about 12 years and approximately $3,000,000 in sounding out the lower levels of these old producers. A tunnel was driven from the Tooele side of the district, a distance of 4½ miles, connecting with the Rood shaft of the Utah Apex at a depth of 2500 feet. While the properties yielded considerable ore during the war, principally copper, the project has not yet encountered the ore bodies expected. However, a systematic program of exploration is progressing into the alphabetical limestones and hope is held out that these porperties will again be added to the list of Utah's important producers.

Virtually since the discovery of the Ontario mine in the spring of 1873, mines of the Park City district have been major producers of silver, lead and zinc ores which carry some gold and copper. Several properties have been in continuous production from the time of their discovery, except for brief intervals.

Park City has never been a boom camp. Its growth has been steady and

its ore bodies have perisited to great depth, where, in recent years, the pumping of water has greatly increased the cost of production. Its mines were the type which every prospector sought and their history exemplifies the creative power of mining.

They built communities, churches, supported mills and smelters, created freight and markets for the farmer and formed the basis for so many service industries and workers. Several buildings that form the skyline of Salt Lake City, among them the Walker Bank Building, the Kearns Building, Tribune-Telegram Building, Judge Building and the Governor's Mansion, owe there existence to men who helped found the district.

The Park City district lies on an anticline, the apex formation of which is quartzite with limestone and shales flanking. Early day operators found ore on both sides of the anticline, but the Ontario lode, which during its life, was one of the great mines of the Nation, made in the quartzite on the crest of the fold. For many years prospecting centered largely around the Ontario in the quartzite.

However, there were miners who prospected the flanking limestone formations on the west limb, where large producers were later developed. Among these was the Silver King Coalition, Daly the Daly Judge and Daly West properties.

The eastern limb of the anticline was brought back into its own in about 1915 with the formation of the Park Utah Consolidated Mines Company. Later the Park City Consolidated Mines Company and the New Park Mining Company developed producers in that end of the district.

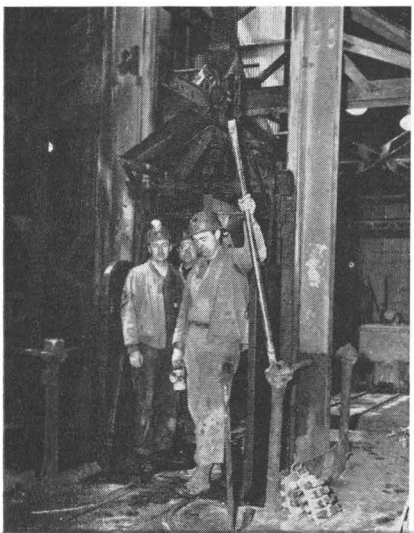
Park Utah Consolidated is a consolidation of the old Ontario, the Daly West, Daly Judge and Park City Mining and Smelting properties. When George W. Lambourne organized the company to explore the east limb at depth it was a gamble that required large expenditures of capital. It was one of the most ambitious deep exploration programs undertaken in the state up to that time, and to raise sufficient capital it was necessary to go to eastern financial centers.

The search was long and costly. A heavy flow of water was encountered and the installation of expensive pumping equipment was necessary. But ore was struck and the eastern end of the district was established as an important economic factor in the welfare of the state.

Despite its many years of production and the fact that some of the properties were among Utah's pioneer producers, the Park Utah Consolidated Mines Company today is one of the state's leading producers of metals. It is a typical mine operation, and an analysis of operations is interesting. During the four years ended December 31, 1946, the company produced gold, silver, copper, lead, zinc ores valued at approximately $5,000,000. A total of 93.7 per cent of this was diverted to the business and industrial channels of Utah in the form of payrolls, taxes, and for the purchase of equipment and supplies.

During the four year period the company paid two dividends aggregating $418,000, one third of which was paid to stockholders in Utah and two thirds to stockholders outside the state. The company has 10,400 stockholders, one third of whom reside in Utah.

The Park Utah operates the Ontario Transportation and Drainage Tunnel at Keetley, and controls approximately 4,400 acres in the district. The company employs approximately 250 men.



TECHNICAL GUIDANCE

The Engineer returns from inspection trip underground. Through constant study and research the life of the mine and the mineable resources are extended.

Indicative of the hundreds of thousands of dollars that are sometimes paid out in mining operations without return to stockholders, is the Park City Consolidated, which operated properties for many years in the eastern end of the district. It is truly Utah's hard luck mine.

Discovered in 1928, chiefly through the help of eastern financing, the mine produced from 1929 to 1941 when it was forced to close down due to the mounting costs brought about by the war. During that period the company produced silver ores valued at $3,788,255.61 of which $2,021,727.86 was paid in wages, compensation insurance, social security and unemployment taxes; $1,270,000 was spent for supplies, equipment, power and insurance; $387,842.47 was paid in freight and umpire on ore sales and $120,000 was paid in taxes.

Prior to this, $424,211.60 was expended in the development of the property before ore was encountered. Park City Consolidated was one of Utah's leading producers during the 12 year period of production, and it is hoped that economic conditions will again prevail that will permit operation of the property.

One of the state's newest producers is the New Park Mining Company which controls properties in the southeastern end of the district. A spasmodic producer on a small scale over a period of 25 years, it was not until 1938 that the New Park entered the ranks of the state's leading producers.

During 1946, the company produced 61,785 tons of ore, having a gross value of $1,551,668. Operating costs were $1,124,704, leaving a net profit of $276,476.

As early as 1900 prospectors were probing the hills of the Glenallen, the Star and the Park Galena, now a part of the New Park, but it was W. H. H. Cranmer who effected consolidation of the properties and launched deep exploration of this part of the district through the Mayflower tunnel.

Renewed interest in the eastern end of the district has been stimulated by the acquisition of control of the East Utah Mining Company by the Newmont Mining Company, one of the nation's largest mining companies. The Newmont has started a prospecting campaign at East Utah which will require the expenditure of approximately $200,000. Another operation in the eastern end of the district is the Park City Utah Mines which is mining and developing on a small scale on properties between the New Park and Park Utah Consolidated.

On the west limb of the Park City anticline, the Silver King Coalition Mine continues on its sturdy way. One of the world's leading producers of silver-lead-zinc ores for nearly 70 years, the "daddy" of Utah's pro-

ducers has been handicapped during recent years by lack of manpower and its full scale production has been sorely missed.

During normal times Silver King Coalition employed around 650 men, but during the war period the number dropped to 250.

Discovered in 1886, the properties now under its control have been in continuous production, except for brief intervals. Normally the average monthly payroll was $85,000 and the power bill per annum amounted to $110,000. From 1886 to 1947, the company produced gold, silver, copper, lead and zinc valued at approximately $135,000,000 of which about $95,000,000 has been spent in Utah in the form of wages, and for freight, supplies, and taxes.

The Silver King ore bodies occur as replacement beddings and in fissures. Some of the ore is shipped direct to Salt Lake Valley smelters, while the lower grade product is milled at the company's milling plant at Park City. Recent development work has proved ore on the 1900 foot level, where work is now being concentrated.

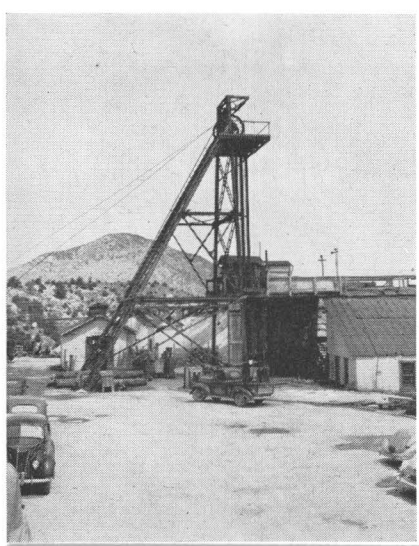
The Tintic mining district, about 100 miles southwest of Salt Lake City has long been one of Utah's major metal producers. Discovered in the early sixties, extensive development of the district did not begin until nearly a decade later. Silver has been the chief product of the camp since its start and for many years it was one of the leading silver producing areas of the nation. Of its total production of roughly $250,000,000, approximately half of the value of the camp's metal production has been the white metal.

The mineralized area of the Tintic district is broad and ores are found in a syncline striking north and south.

First discovered were the Mammoth zone and a parallel channel in which was located the Grand Central, Victoria, Eagle & Blue Bell, Little Chief, Centennial Eureka, Eureka Hill, Bullion Beck and Gemini, large producers of former days.

In the early nineteen hundreds, activity shifted to the east where the Iron Blossom vain was discovered and developed for two miles. Along this single ore channels the Iron Blossom, Colorado, Beck Tunnel, Sioux and Dragon mines discovered and mined the ore.

Ten years later activity had drifted two miles further east where the Tintic Standard was discovered, which was followed by discovery of the North Lily, Eureka Standard and Eureka Lilly, the main source of production from the district in recent years.



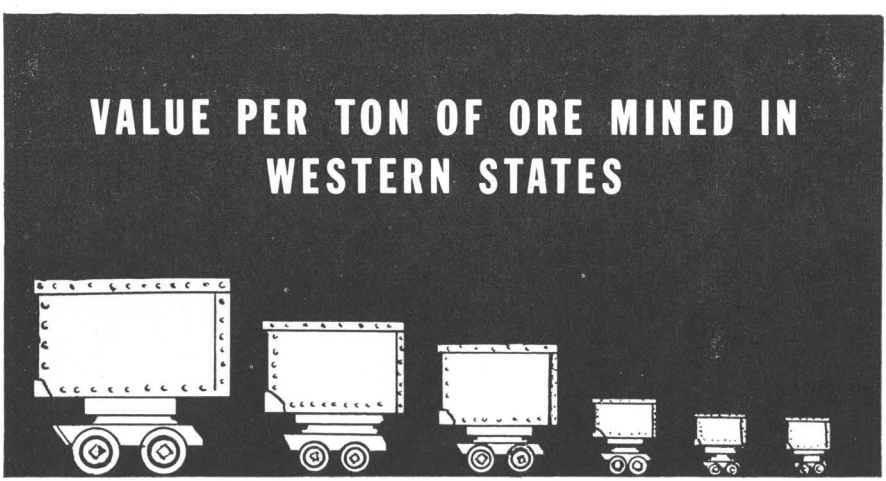
A SMALL BEGINNING

This mine in Tintic District, Utah, was once a prospect. All large producers had small beginning and those who develop need encouragement.

Tintic Standard was discovered in 1916 after one of the classic prospecting campaigns in the history of Utah mining. For 10 years prior to 1916, Captain E. J. Raddatz worked his claims on the east side which were slightingly referred to as "goat pasture." Throughout the trying search, Raddatz was forced to call upon his stockholders 19 times for assessments to continue the shaft down through the rhyolite flow to the 1000-foot level and ore. Discovery of the Tintic Standard proved of great economic value to the state and from 1916 to the present time, has been one of its major producers.

Then there is the more current side of the story. While the old Tintic Standard No. 1 mine is still in production, efforts of the company are centered on development of other constructive enterprise. Jointly with the North Lily, the Eureka Lilly (a subsidiary of Tintic Standard) is developing an area of Eureka Lilly and Twentieth Century ground. Some ore has been developed in this program. In addition, the company is operating the Cougar fluorspar mine in Beaver County and is interested in development of other property.

In recent years, the old Chief Consolidated has staged a comeback. Reopened during World War II, the old Chief No. 1 Mine has been rehabilitated and placed in regular production. The ore runs have been extended below the old workings and further work has been projected to greater depth. The underground hauling system has been converted to electrical operation, replacing the old mule hauling method.



The Chief is also reopening its Plutus property, once one of the leading producers of the district. In addition the exploratory program of Chief includes the sinking of a 500 shaft together with 2000 feet of lateral work on the Evans group of claims in an effort to prove a parallel ore channel.

In the Southern end of the district, the company's Apex Standard property is under lease to the Newmont Mining Company, and the latter has completed all preliminary work, and development is in full progress.

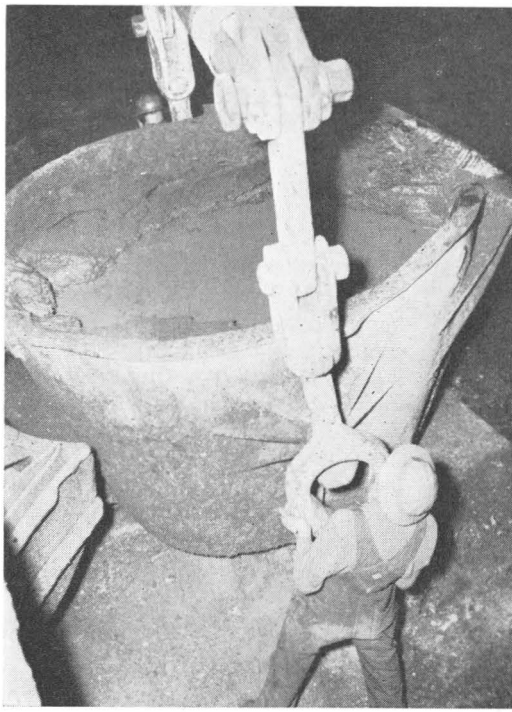
Under a program of systematic development, adequately financed, the old Horn Silver Mine in the San Francisco Mining District, Beaver County, one of the State's famous early day producers, is again responding. Property of the Horn Silver and adjacent territory is under lease to a Pacific Coast group known as Metal Producers, and during the past two years has produced considerable ore.

The management reports that new ore discoveries continue to show persistence and are considered important in view of the fact that they were made in the geologically important limestone formations to the northwest in virgin sections of the mine below the 900-foot level.

During the past two years a program of geological and geophysical exploration has been conducted on properties of the Tintic Lead Mining Company in the San Francisco district, including the King David, Cupric, Magnolia Lead and Plumbic properties, which has given rise to a hope that the old district will be reestablished as one of Utah's leading metal producers.

The old Hickory property and adjacent ground in the San Francisco district is under operation by the New Majestic Mining Company, and some shipments are being made from that section of the camp.

The hope of reviving an old mining camp never dies in the hearts of man. There are those old-timers who cling to their determination that someday, somehow new ore will be found and then there is the new crop of mining engineers and geologists anxious to follow every lead to its end or an ore body.



THE "BRMMING" CUP OF INDUSTRY

The mining, milling and smelting of this molten metal is now about to be cast for shipment to refinery where it will be made into some of the thousand and one articles that people use daily.

Such is the case at Alta, once one of the roaring mining camps of the West and now internationally famous as a ski resort. The old timers "know" that all the ore has not been mined and now young engineers are sounding out geologists theories. Rehabilitation is in progress at the Alta United properties and small operations are being conducted at the Wasatch Mines property. Preparations are in order to reopen the old Cardiff mine and efforts are being made to refinance the Columbus Rexall and West Toledo properties.

Metals Go To Market

FROM MINE TO MERCHANT
THEY CREATE INDUSTRY

Agriculture is the highest safeguard of all civilization, and then comes mining as the greatest creator of civilization, commerce and industry.

In Utah we have these two basic industries that largely support those who do not produce, namely the storekeeper, lawyers, teachers, doctors, railroad men and all others vital to the welfare of the community.

A recent survey reveals that 47.7 per cent of nearly one half of the population of the State is dependent directly or indirectly upon mining, and that 178,000 or approximately one third was dependent directly or indirectly upon agriculture, and the remainder upon manufacturing, etc.

Be that as it may. The fact remains that the two great basic industries of the State compliment each other. One produces the products necessary to life and the other provides a market for products of the farm. It is estimated that the mining industry consumes approximately one-third of the products grown within the State, in addition to the countless other products that are required in removing the ore from the ground and then separating the minerals from the waste.

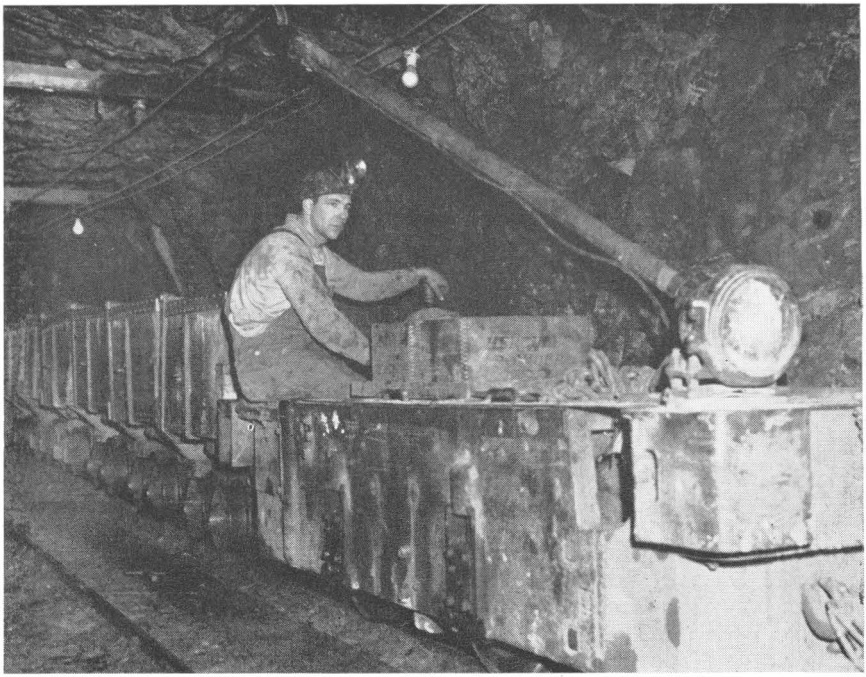
With each blow of the miners' pick a chain of new industry is created, and its ramifications are widespread.

Mining begins nowdays with the driving of a tunnel, the sinking of a shaft or driving a drift or crosscut from the shaft. These are prospect shafts, necessary because easily found surface deposits have long since been mined. Such work is costly as it requires powder for blasting, steel, drill steel and heavy drilling machines such as liners; timber, iron for rails and mine cars. Sometimes mucking machines are used. Utah's mines use fifty thousand dollars worth of such materials daily.

Sometimes ore is found and sometimes the tunnel drift or crosscut comes to its end in barren rock. When ore is found it is first assayed, and the chemist determines what width of the ore body the operator will be able to mine under existing metal prices and prevailing costs. It may be direct smelting ore, or it may be ore that must first be milled before being sent to the smelter. This depends upon the character of the ore; it may be sulphide, oxidized or siliceous, or various other types of complex ore. Particular attention must be paid to the grade and character of the ore constantly and most operators find it necessary to set up their own assay labratories.

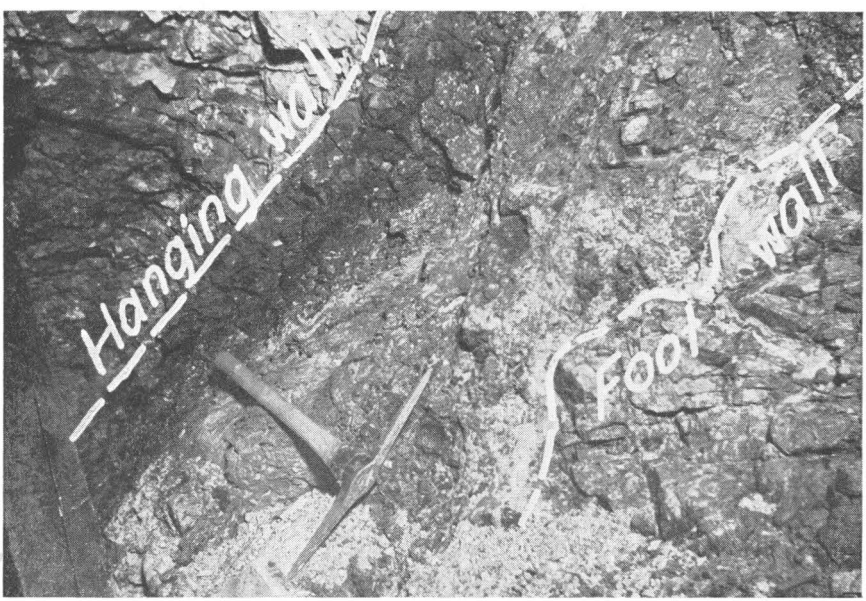
Here we come to the tradegy of low grade ore, ore that must be left in the mine as it will not bear the cost of mining milling and smelting. If this ore is left in the mine, it is usually lost to mankind forever. That is why it is so important to mine or "sandwich in" as much low grade ore as possible because it is not only a loss to the operator, but a loss to the state in mineable resources. That is why it is so important to keep costs and taxes on an economic basis so that more of the State's resources will become mineable.

One of the first concerns of the operator today is the life of the mine. So, when all costs are determined and weighed in the light of metal prices, he balances his pro-



UNDERGROUND RAILROAD

Chain of cars loaded with ore which is starting its long journey to the finished metal product.



PAY DIRT

This is what every miner wants to see—a vein of ore between the foot and hanging wall. Picture taken at Alta United property in Alta Mining region.

duction to take in all the low grade possible, and starts to produce.

For the moment we are not concerned with ore that goes direct to the smelter, Let us see first what happens to the low grade sulphide ores, from which most of the state's production of gold, silver, lead and zinc is claimed today.

First, much of the ore now is mined from below the water level, which requires the installation of expensive pumping equipment or the driving of extensive drainage tunnels. After it is mined, it is shipped by railroad to one of Utah's four custom selective flotation plants. Flotation is a method of separating the wheat from the chaff, or the metal from the most of the worthless rock or gangue. These plants are located at Tooele, Midvale and Bauer, where ores not only from Utah but from all over the West are shipped for treatment.

At the flotation plant the crude ore is first fed into a giant crusher, or ball mill. The ball mill employs steel balls about the size of an ordinary soft ball which virtually pulverizes the ore in its swift revolutions. In the ball mill water is added as the ore is crushed to a fineness that will permit it to pass through a wire screen having 40,000 openings to the square inch.

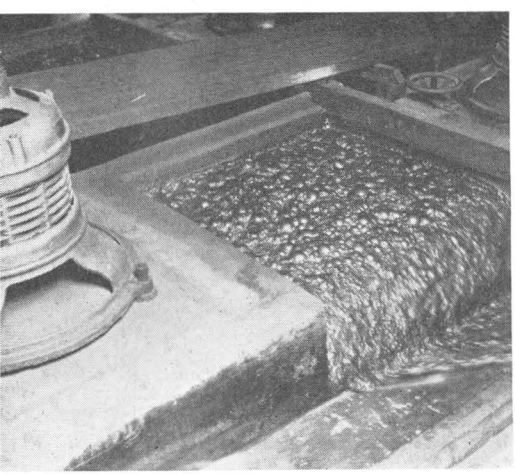
This mill feed is then diverted to the flotation cells where certain chemicals and oils are added. By agitation a froth is produced from the chemicals and oils in the flotation cells. The metal particles in the finely ground ore are attracted or adhere to the chemical or oil froth and thus are flotated to the top of the flotation cell. The waste rock does not "stick" to the froth and therefore sinks to the bottom of the cell and is discharged as waste.

Flotation is exactly the reverse of gravity. The heavier metals are floated to the top while the lighter rock sinks to the bottom of the cell. Gossip has it that the process was first recognized by the wife of a miner, who, in washing her husbands work clothes found that the mineral particles in the clothing were picked up by the soap froth created during the agitation of washing.

In the process of flotation, a lead concentrate is made first, then by a similar process and the addition of other reagents, the zinc in the lead

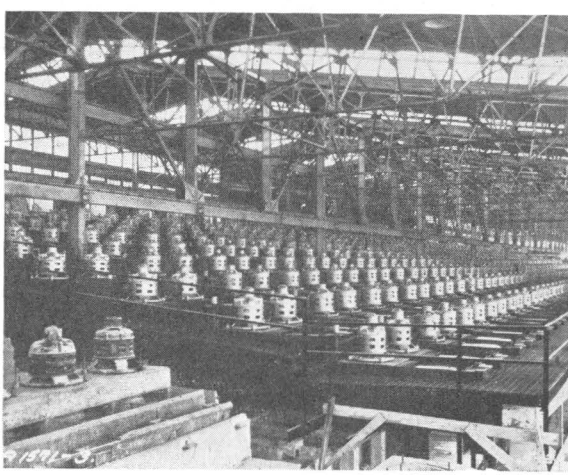
BUBBLES AT WORK

These bubbles are floating mineral particles off the top of flotation cells. The lighter rocks do not adhere to bubbles and sink to bottom.



ACRES OF FLATATION CELLS

One of Utah's milling plants where hundreds of cells are separating waste from mineral.



concentrate is floated away from the zinc and a zinc concentrate is created. The gold and silver in the ore remains with the lead concentrate.

The froth becomes the concentrate and bubbles over the top of the flotation cell and is carried off in a trough to large vacuum filters where the excess water and chemicals are removed. The lead concentrate is then shipped to a lead smelter, while the zinc concentrate is shipped direct to a zinc refinery.

The lead concentrate is about 60 per cent metal and about 40 per cent waste. At the smelter heat is applied and the remaining waste is removed.

The lead concentrate from the flotation mill is sometimes mixed with direct smelting ores to create a suitable smelting batch. First the ores and concentrates are roasted and sintered to produce a pourous product for smelting in a blast furnace. The roasted product is called sinter which is fed into the blast furnace with coke and fluxes and the entire furnace charge is liquefied by the intense heat produced in the furnace. The fluxes must be in proper amount to give good liquefaction.

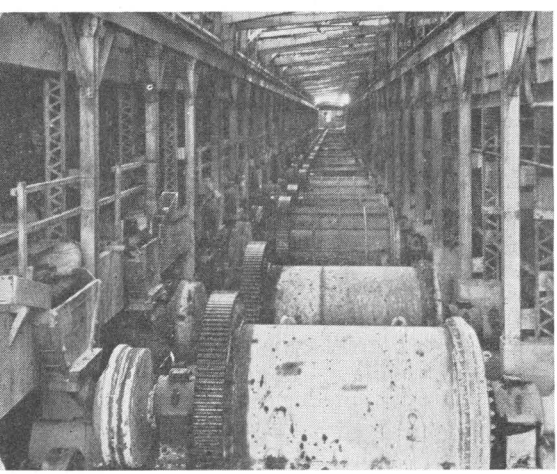
The lead becomes molten along with the rest of the furnace charge, but being heavier than the other material trickles to the bottom of the furnace, collecting the gold and silver and most of the other metals in the charge. The waste material and fluxes for a slag which floats on top of the lead; and thus the separation of the valuable and the worthless is accomplished.

The metallic lead is drawn off the bottom of the furnace and cast into slabs. The slabs, known as lead bullion due to their content of gold and silver, are shipped then to a lead refinery, where the bullion is again refined electorlytically for commerical ly pure lead, gold and silver. Electrolytic zinc plants refine the zinc concentrate into its chemically pure state.

Thus the metals are ready for the market, and the product that left the mine as tons, becomes a few pounds or ounces. From the sale of these few pounds or ounces of refined metal there must be enough to pay the producer, the stockholder, the worker and all of the various costs attendant to each step from mining to shipping to milling to smelting and refining.

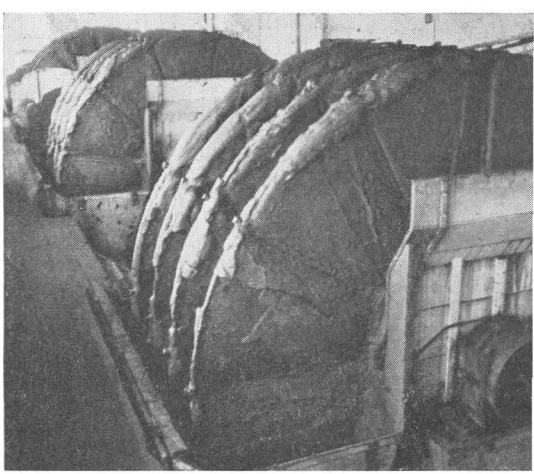
BREAKING ORE DOWN

When ore enters the mill it is first crushed so fine that it will pass through a screen having 40,000 openings to square inch.



REMOVING MOISTURE

Filtering is a part of milling. After concentrate is removed from flatation cell moisture is removed by huge filters.



ONE OF UTAH'S NEWEST PRODUCERS

Surface plant of New Park Mine, situated in the southeast end of Park City Mining region, only new major producer added to Utah's list in last 17 years.

Silver

WITHOUT IT LEAD, ZINC PRODUCTION WOULD BE SMALL

Silver was widely known and highly prized before the dawn of civilization, and has been valued next to gold as a medium of exchange, except in the Orient where it rules supreme as the average person there never possesses enough wealth to obtain a gold coin.

The white metal, as it is commonly known, has been the principal factor in the development of many great mining districts of the West.

Utah ranks third in the production of silver with a total of 718,774,066 ounces, including the 1946 production.

The discovery and development of high-grade silver ore near the surface resulted in the ultimate development of our great copper, lead and zinc mines. Silver has also paid its share in the production of these metals. In the Park City District it amounted to 7 cents per pound of

lead. In the Tintic District 10 cents per pound of lead and in the Bingham District, excluding the silver produced by the Utah Copper Company, it amounted to nearly 3 cents per pound of lead. These districts have produced over six billion pounds of lead. The average price of lead has been lower than the cost of production so that silver has paid the bill and given to the consumer lead at a cheaper price than would have been possible had substantial amounts of silver not been present in the ores.

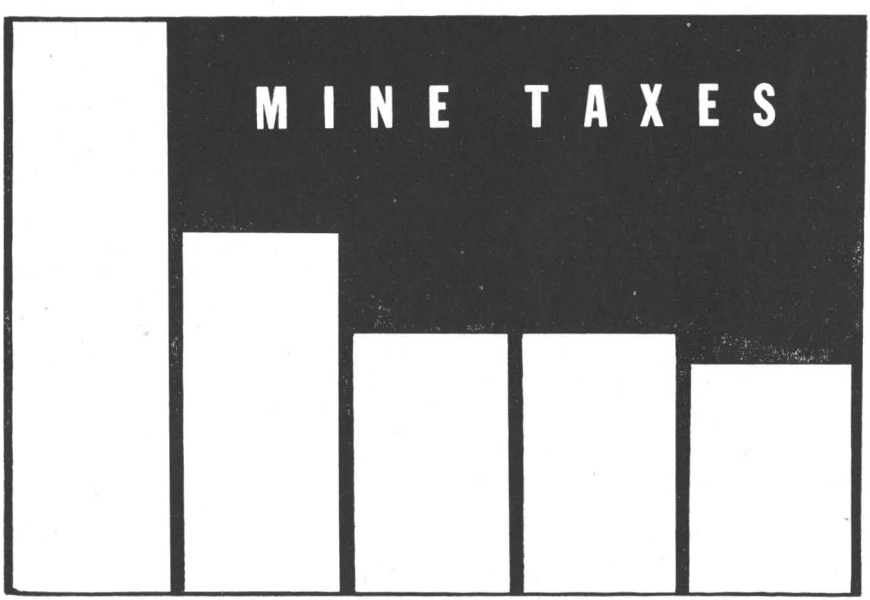
Little Cottonwood District, which includes the famous ski resort at Alta, was discovered by General Connor's soldiers in 1864. The great Emma Mine was discovered in 1868. The ore body was struck the following year and by August, 1871, 12,000 tons of ore had been shipped, assaying 100-200 ounces silver per ton and in addition the ore contained from 33% to 60% lead.

The Big Cottonwood District, which embraces Brighton a now popular summer and winter resort, was organized in July 1871. This district also produced high-grade silver-lead ore.

Between 1867 and 1917 both districts produced $25,722,553.00. Silver accounted for $13,2,5,139.00 or over 50% of the total production.

During recent years both districts have become summer and winter playgrounds for the people of Salt Lake Valley. They have become nationally famous and further development will bring visitors from throughout the world.

The Park City District was discovered in 1872. Samples from a small outcrop assayed from 100-400 ounces of silver. This outcrop lead to the development of the Ontario Mine, which ultimately produced over 40,-000,000 ounces of silver and is still producing. From 1872 until 1917 the district produced ore having a metal value of $169,814,024.00. Silver ac-



counted for $99,202,826.00 or 58.4% of the total value of the ore. Since that time silver has accounted for from 25% to 35% of the gross value of the ore. The district is still a producer. The reason for taking the years 1872-1917 is that during that period lead, silver and gold were the principal metals paid for. During the latter part of this period some zinc was recovered but it was not until a later date that it became an important metal.

The first claim was located in the Tintic District in December of 1869, but it was not until 1878 that the district became important as transportation was a problem until the railroad reached a point within five miles of the district. The early mining was done on high-grade oxidized silver-lead ore. The Mammoth Mine was one of the first important producers in the district and is still producing. From 1869 until 1917 the district produced $180,401,804.00 worth of metals. Silver accounted for $83,343,232.00 or 46.2% of the total production. The mines of this district are still operating and the silver content of the ore amounts to over 25% of the total value.

Bingham—(West Mountain District): The first claim at Bingham was located in 1863. The district was organized as the West Mountain Mining District in December of that year. The ore found in this district was lower in grade than the other silver-lead districts in the State, so that development was backward. From 1865 until 1900, ore having a value of $29,118,684.00 was produced. Silver accounted for $12,522,020.00 or 43% of the total value of the ore produced. The copper production did not have any importance until 1896 when considerable copper was produced from underground operations at the Highland Boy Mine. Large scale operations were started by the Utah Copper Company in 1907.

During 1946 the value of the metals produced in this district amounted to $55,427,860.00 and of this amount silver accounted for $3,348,000.00 or 6% of the total production.

From the beginning it can easily be seen that silver is one of the most important metals produced in the State. Without silver none of the mines, except the Utah Copper Company's open-pit mine at Bingham, could operate. For decades there has been a fight to maintain the price of silver so that the mines could operate and produce lead and zinc, which at present are in great demand. Under present laws, the Government pays 90½ cents per ounce of silver to the mine and the Government takes the difference between that and $1.29—or 38½ cents per ounce profit. The recent increase in price from 71 cents per ounce has been a great help to the lead-zinc producers. If the miner received the full $1.29 per ounce for silver he would be able to produce more lead and zinc from low-grade ores. It would also stimulate the searching for new mines. It has been pointed out above that the great metal producing districts of Utah all started while the price of silver was high, and the first ores were produced on account of the high silver value.

Gilsonite

RARE SUBSTANCE FINDS PLACE IN MANY FIELDS

Utah's Uintah basin, the land of giant dinosaurs, where huge reptiles and animals roamed in prehistoric time, is the scene of new industry.

Here a long known resource has literally sprang into prominence in the last few years due to the many unique places that scientific study has found for the substance in industry.

The resource is Gilsonite, first discovered in Utah in about 1885 by a prospector by the name of Sam Gilson. At first not even the Greeks had a name for the product. It was something new to the mineral world. Someone suggested that it be called Gilsonite after the man who discovered the glittering black stuff. The name stuck.

Gilsonite is a rarity. It is found only in one area in the world, an area roughly 90 miles long and 30 miles wide in the Uintah basin of Utah, a small part extending across the line into Western Colorado.

It looks for all the world like coal, but is harder and more brittle and won't burn like coal. Its melting point is much higher. Gilsonite is mined in much the same manner as coal and can be made into coke. The unique material occurs in vertical fissures but to date has not been found in beddings replacing limestone or in pools.

Development of gilsonite mining was slow and spasmodic as only few uses were found for the product. For many years hand methods were employed to mine enough to supply the known markets.

But when science took a hand expansion became rapid. In 1942 the Standard Oil Company of California entered the gilsonite business, joining forces with the Barber Asphalt Company in formation of the American Gilsonite Company.

The American Gilsonite Company having at its command the extensive research and sales development facilities of the Standard Oil Company soon turned production of the black bitumen into a major industry. The mine at Bonanza, about 50 miles southeast of Vernal, has been completely mechanized and the expansion program is still under way. The town of Bonanza has grown from a handful of people to a community of 250 persons. Last year 50,000 tons were mined in the district and it is estimated that American's holdings also contain more than 20,000,000 tons of the product. Other companies operating in the region also have expanded their activity.

The product is very versatile, being water proof and acid proof, making it a perfect insulator. The largest single use at present is in battery cases, electrical parts, and other of the moulded articles. It forms an ingredient of varnishes, enamels, asphalt plastics, acid and weather resisting paints, goes into floor tile, building paper and roofing. It is also used in several kinds of wax, printing inks, sound proofing and insulating compounds, in mastic floor and pipe coverings. Recently its use has been expanded to certain road oils and as a rubber extender.

Other Metallics And Non-Metallics

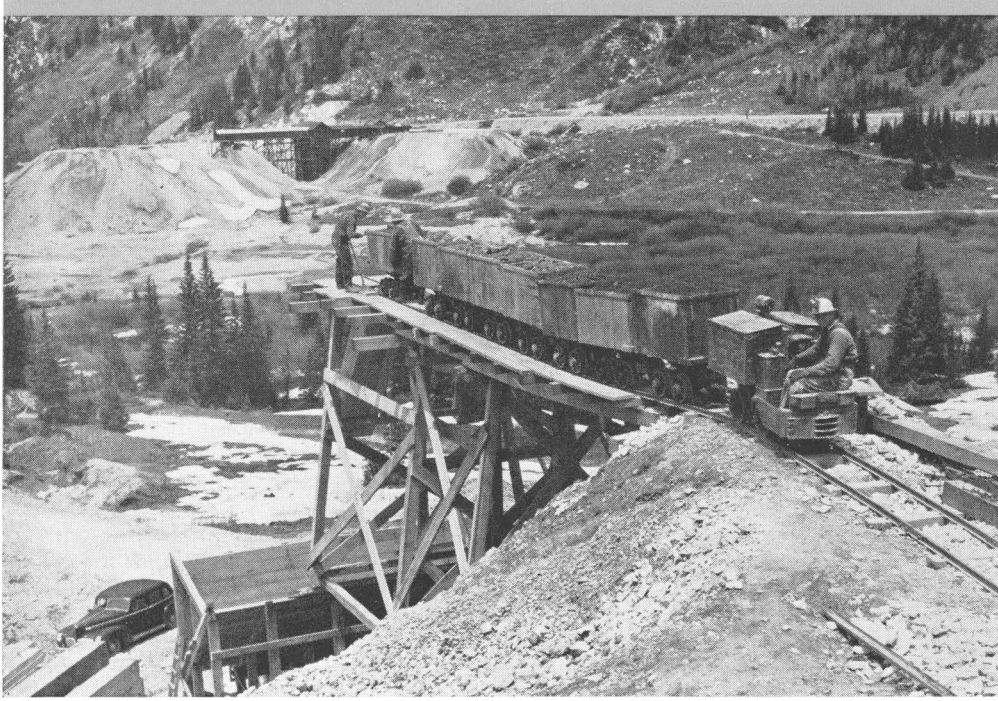
Development of Utah's Varied Resources Gradually Expands

When the nation looked to its hole card—(metals—both metallic and non metallic)—during World War II, it turned to Utah and was not left wanting. The seventeen metals usually regarded as most vital to a war program are iron, manganese, nickel, tungsten, molybdenum, vanadium and uranium, chrominum, aluminum, magnesium, copper, zinc, tin, lead, mercury, anitomy, and beryllium. All of these minerals with the exception of nickel, chromium and tin are known to exist in Utah along with about 195 other metallics and non-metallics.

The bits of metal that burst upon Japan in that first terrible explosion of the atomic bomb and rocked the Japanese into submission were from Utah. These bits of metal were uranimum and vanadium, two of the radio active ores that form the base for atomic energy, are mined in Southeastern Utah and Southwestern Colorado, one of the few places in the world they are known to exist.

ORE READY FOR MARKET

High in Utah's Wasatch Mountains this ore train pushed by Battery Trammer is ready for ore bins from where it will be hauled by truck to smelter.



These metals occur in a canary-yellow mineral, known as carnotite, and until the war this ore had been developed only to a small degree.

An abundance of magnesium, a metal lighter than aluminum and of importance in aircraft construction, exists in Utah. The brines of Great Salt Lake contain about 2.3 per cent magnesium, and while drilling for oil near Thompson, Utah, salt beds and brines rich in the mineral were discovered. The brine from one of these wells analyzed over 16 per cent magnesium.

Alunite, a sulfate of Aluminum and potassium from which aluminum can be derived is found in abundance near Marysvale. A plant was built for its extraction during the war, but was subsequently closed.

Tungsten, a metal used in the hardening of steel for more perfect tools and materials, sprang to importance domestically during the war when the foreign supply was cut off. Deposits were found in the Mineral range west of Beaver, Alta, and in the Gold Hill districts.

The expansion of the steel industry in Utah in recent years has brought about a demand for flourite, a flux used in smelting steel. Ample deposits of flourite are known to exist in Tooele, Beaver, and Iron counties. Utah's steel industry has also stimulated the search for manganese and deposits are known to exist in the Tintic District, the Drum Mountain district, northwest of Delta, and in the plateau region near Moab and elsewhere in Southern Utah.

The discovery of oil at Rangely, Colorado, just east of Utah's Uintah Basin, has revived the search for oil in commercial quantities in Utah. Wildcat wells are being drilled on the Gordon Creek structure near Price in Southeastern Utah and near Vernal in northeastern Utah.

Salt mining is one of Utah's important industries, and constitutes one of the state's large resources. Yearly hundreds of tons are "harvested" from the brines of Great Salt Lake.

Oil shale, which some day may become a valuable source of petroleum, covers immense areas in the Uintah basin. It probably will not be extracted until after the pools of natural petroleum have been more fully utilized.

Rock asphalt is quarried near Thistle, near Vernal and near Sunnyside, Utah. During 1946, a total of 26,000 tons of rock asphalt, which is used extensively in road construction, was mined in Utah.

Ozokerite, a mineral wax used as the chief source of ceresin wax for cathedral candles, dictaphone records, and hydrofluoric acid containers, is found near Soldier Sumit, one of the few known deposits in the world. Utah's 1946 production of this substance amounted to 23,400 tons.

Carbon dioxide, or "dry ice," is being produced from the Farnham Dome, about 1 mile southeast of Price. The gas is piped to Wellington where about 25 tons of "dry ice" are made daily. Additional carbon dioxide wells have been discovered in Emery, Grand and San Juan Counties.

Helium gas, noted for its lightness and its non-inflamable character, was discovered near Woodside in Emery County a number of years ago. The deposit has been withdrawn and is now held by the government as a reserve.

Natural gas has been discovered on the Last Chance structure in the southwestern corner of Emery County. The discovery well was reported to have had an initial production of 51,000,000 cubic feet per day, but later tests show that the flow has dimished to around 3,000,000 cubic

feet per day. No doubt this development would be commercial if a nearby market were developed.

Bismuth, a metal having a low melting point, and used in certain medicinals, has been discovered in the Alta mining district.

The manufacture of cement is one of Utah's major industries. Plants and quarries are located at Parley's canyon and at Devil's Slide in Weber Canyon. The industry has an investment of over $5,000,000 in Utah and production approximates 5,000 barrels per day.

Utah is favored with large supplies of a great variety of building stones, including granite of superior quality and pleasing appearance; marble of high quality, excellent texture and wide range of color; travertine which is to be had in wide range of color and markings; onyx which is one of our best known materials of construction; limestone which is somewhat generally distributed and has had a considerable application as a structural material; oolitic limestone which has the appearance of white sandstone, but the particles of which are minute spherical concretions of lime, and standstone which is found in every portion of the state in an extremely wide range of color, texture and quality.

In various portions of the state lava rock, schist, quartzite, gneiss, traprock and calcareous tufa are used for construction purposes, and for walls, rock gardens and other special purposes, and there are several commercial deposits of slate.

Due to the wide distribution of limestone deposits, a considerable number of the communities of the state are supplied with kilns for the burning of plastering lime. Limestone is quarried also for use by sugar factories in the production of beet sugar, by smelters and other industrial plants as a flub and by cement plants in the production of Portland cement.

Utah possesses several important deposits of calcite, a pure calcium carbonate, which has various uses, but at present largely employed in the poultry industry, where it is an important factor in the production of the famous Utah milk-white eggs.

Whole mountains of gypsum occur in several localities in Utah and three areas are being exploited at present, plants being located at Nephi and Levan in Juab County, Sigurd in Sevier County and Cedar City in Iron County, where dental, casting, lava, finishing, acoustical, and hard plaster, and Keene cement are produced. Raw product is supplied to Portland cement plants in Utah and elsewhere and is also shipped to California for the manfacture of stucco and plaster products.

Clay is widely distributed in Utah and is to be found in numberless varieties. Rarely is it residual, however, and for this reason there has been but little exploitation for ceramic uses of the finer order.

Deposits of clay usually represent alluvial deposition of eroded materials, and in many cases have proved satisfactory for the production of heavy clay ware. The clay products industry, therefore, has to do largely with common tile face brick and hollow building tile, although sewer pipe and drain tile production are important items. Other structural products are platform paving brick, flue lining, wall coping, roofing tile, clay shingle, floor tile, art tile, and promenade tile. With respect to face brick it should be said that Utah is praticularly favored by reason of the bewildering variety of colors, shades, and textures that are to be had. Few localities can compare with this state in this respect.

The total investment in the score of clay products plants of the state is at

least $5,000,000 and the normal annual output is valued at about $1,000,000. Utah's clay deposits are being studied and it is confidently expected that the future will witness an extensive exploitation of the clay resources and the development of an extensive ceramic industry, including porcelain, white ware, colored pottery, and other finer examples of the ceramic art, as well as paving brick, terra cotta and fire brick.

Kaolin is found in several locations and there is one enormous deposit of material having the same chemical combination as kaolinite.

Fuller's Earth has been marketed from several deposits and recently a clay resembling Fuller's Earth but having superior properties for clarification purposes has been exploited. This clay is mined and refined near Aurora in Sevier County and is sold largely to oil refineries.

In many localities clays have been consolidated into shales and find use in secondary road construction.

Utah's silica represents a most important resource. Not only are there many deposits, some of enormous proportions, located in various portions of the state, but tests indicate that Utah silica possesses certain distinct advantages for glass manufacture. In the first place it melts at a temperature of 100° C. less than Belgium silica, and in the second place only three-fourths the usual proportion of soda ash is required as a flux.

Utah is ideally situated to become a glass producing center. Its exclusive trade zone warrants the installation of container and pressed ware plants while its central position in the group of eleven western states points to the feasibility of the establishment of a great plate glass plant.

At present silica is used largely as a flux and in the manufacture of refractories, although it has a market in the crude state for a number of other uses. Large out-of-state shipments are made.

Potash is available for the enormous alunite deposits in central Utah and from the brines of Great Salt Lake and the salt flats in the western portions of the state. Present production from the latter area is 80,000 tons per annum, valued at $400,000.

Utah has served commercial deposits of sulphur, chief among them being one at Sulphurdale in Beaver County, and one in San Rafael Canyon in Emery County, which is as yet undeveloped.

The Sulphurdale deposits, the largest in the state covers a square mile of territory and represents the impregnation of decomposed rhyolite by sulphurous water from deep subterranean sources.

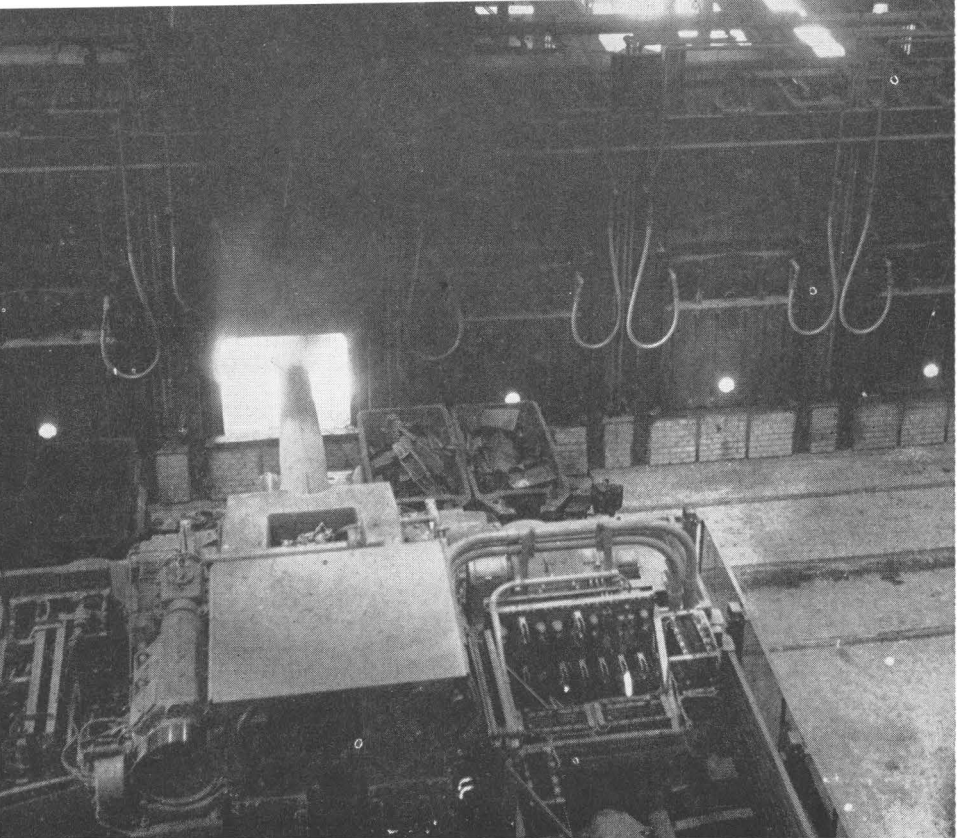
The Uintah Basin is noted for its enormous deposits of asphalts and related bitumens. In this region are found gilsonite, elaterite and ozokerite. They are residues of petroleum and have important uses in the manufacture of asphalt and high class varnishes, japans, insulation, mineral rubber, acid-proof paints, ceresine wax, which is the base for floor polishes, electrotyper's wax, and water-proofing compounds.

Elaterite is found in both Carbon and Wasatch Counties, in the vicinity of Strawberry Creek.

Volcanic ash, basalt, and pumice are found throughout a considerable area of the state. The latter has been utilized in the manufacture of mechanic's soap and in the preparation of an abrasive cleaning compound. Alumite is the base for a nationally known polishing cleanser.

Phosphate rock is reported in several of the northeastern counties.

Utah has deposits of feldspar, fluorspar, talc, mica, mirabilite, petrified wood, and many, many other useful substances.



Charging machine charging scrap metal in one of nine open hearth furnaces at the Geneva Plant of Geneva Steel Company, U. S. Steel subsidiary.

Steel Builds the West

The most critical need of the Allies during the early part of the war to keep open the vital life line of shipping from America, the Arsenal of Democracy, to the battle fronts of a global conflict. American shipbuilders met the challenge with the greatest construction record in all history—building the mightiest Navy and largest merchant fleet that ever sailed the seas under the flag of one nation.

Pacific Coast shipyards played a glorious role in establishing that great record. The largest share of merchant vessels constructed during the war years slid down the ways of Western shipyards. One thing that made this feat possible was a sufficient supply of steel ship plates, and thereby hangs a story—the story of the Geneva steel plant.

Because of mounting demands for steel for ships being built in West

Coast yards, the Government called upon U. S. Steel to construct and operate a giant new steel plant at Geneva, Utah, 40 miles from Salt Lake Ctiy. This site was chosen because the three essentials of steel-making—iron ore, coal and limestone — are found abundantly in the surrounding Utah mountains. Water was also available. Thus it was that the largest, complete steel mill west of Chicago, covering 1,500 acres, was built by Columbia Steel Company, U. S. Steel subsidiary, for the Government, without fee or commission, amid the towering peaks of Utah mountains.

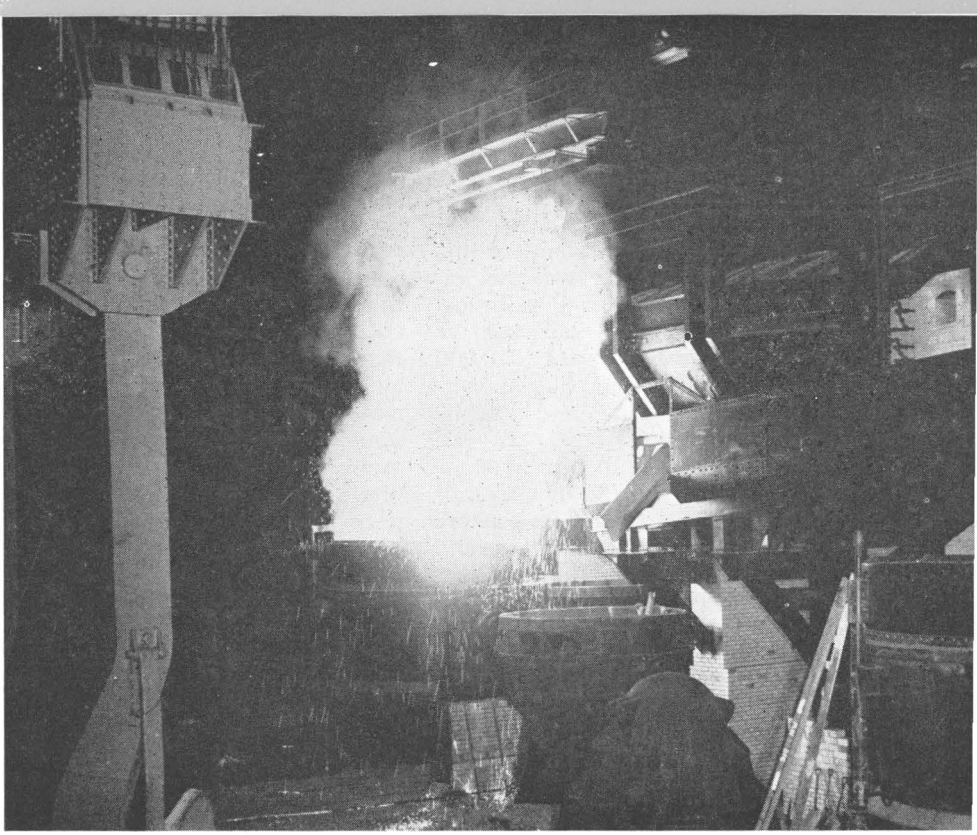
The Defense Plant Corporation supplied the money and U. S. Steel formed a new subsidiary, Geneva Steel Company, to operate the plant during the war, also without fee or profit, and assigned its veteran vice president in charge of operations, Dr. Walther Mathesius, to boss the job.

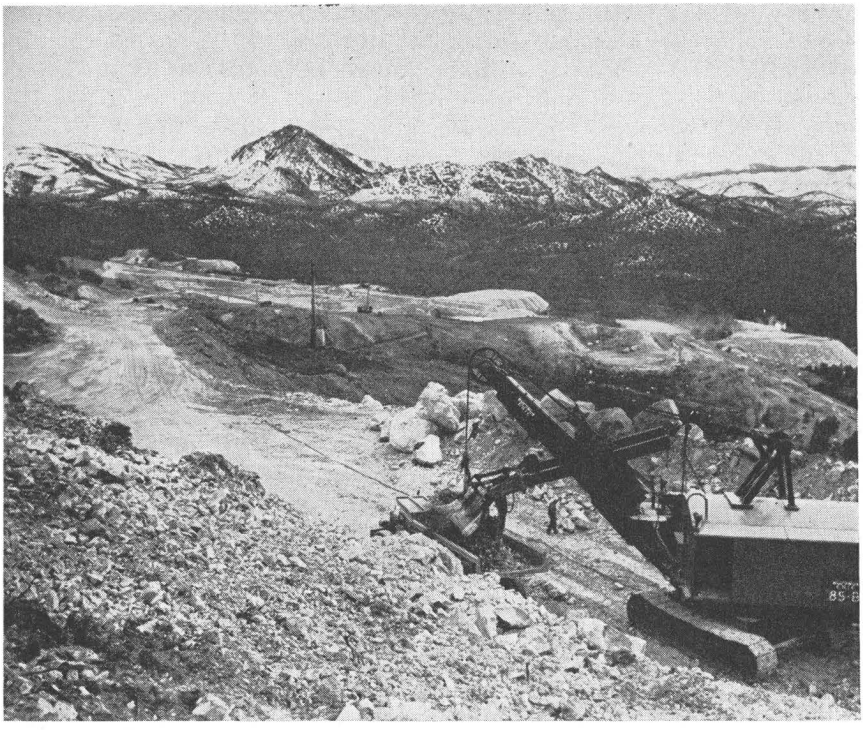
In March, 1942, ground was first broken at the Geneva plant site, and less than two years later the first trial run of plates was made.

The Geneva steel plant has been described as an engineer's dream. It is one of the most modern steel plants in the world. One of its features is a huge reversible electric motor which drives the rolls in the plate mill. This motor is the largest of its kind ever built by the General Electric Company and cost over $1,000,000.

Manufacturing facilities of Geneva Steel Company include: four batteries of coke ovens at the Geneva plant, two batteries at the Ironton Plant; three blast furnaces at Geneva and one blast furnace at Ironton; nine open hearth furnaces; slabbing and blooming mill; plate mill and structural mill. The Geneva and Ironton

Tapping 225 tons of molten steel from one of the nine open hearth furnaces at the Geneva Plant of Geneva Steel Company, U. S. Steel subsidiary.





COLUMBIA IRON MINING COMPANY, IRON MOUNTAIN, UTAH

This open pit mine covers approximately 3200 acres. Iron ore is supplied from here to Geneva Steel Company's Geneva and Ironton Plants four blast furnaces.

plants have an annual potential capacity of 1,350,000 net tons of pig iron and 1,283,400 tons of steel ingots. Geneva Steel's rolling mills now have potential rolling capacities of 858,500 net tons of slabs, 220,000 net tons of blooms and billets, 700,000 net tons of plates and 200,000 net tons of structural shapes. To manufacture these products at capacity operation 2,100,000 net tons of coal, 2,485,000 net tons of iron ore and 723,000 net tons of limestone and dolomite are needed. These are supplied from Geneva Steel Company's mining operations in Utah, namely; Geneva and Columbia Coal Mines near Price, Utah; the Columbia Iron Mining Company ore mine, near Cedar City and the Keigley Quarry near Payson, Utah.

In the months following V-J Day, as the nation turned its thoughts and energies to reconversion for peacetime production, national interest centered in the disposal of this Government-owned steel plant. Western states, particularly, foreseeing a postwar era of industrial expansion, expressed a desire to see the plant continue to operate in peace time. On May 1, 1946, in response to requests made from time to time by representatives of the Government, U. S. Steel submitted a bid to the War Assets Administration for the purchase of the Geneva plant and inventories for $47,500,000 in cash, with a pledge

to spend not less than $18,600,000 additional of its own funds for the reconversion of the plant to peace-time production. The reconversion was to include installation of equipment for the annual production of 286,000 tons of hot rolled coils, suitable for production into cold reduced sheets and tin plate at a modern cold reduction mill to be erected in California by Columbia Steel Company at an estimated cost of $25,000,000. The total cost to U. S. Steel would thus amount to $91,100,000.

On May 23, 1946, General E. B. Gregory, Administrator of the War Assets Administration, issued findings to the effect that the bid of U. S. Steel for the Geneva plant met the applicable objectives of the Surplus Property Act, and on June 17, 1946, Tom C. Clark, Attorney General of the United States, officially ruled that the sale of the Geneva plant to U. S. Steel did not violate the anti-trust laws.

Peace-time steelmaking at the plant, by Geneva Steel Company, U. S. Steel subsidiary—Utah's newest and largest industry with an annual payroll approximating $15,000,000—began in July 1946, when a portion of the open hearth department was brought into production. Geneva Steel Company's operations in Utah employ approximately 5,000 at capacity production.

Utah Coal

WHAT IT MEANS TO PEOPLE OF STATE

Utah now approaches a state of industrial greatness, by reason of its vast wealth of natural resources comprising, as it does, vast areas of metalliferous ores from which come copper, lead, silver, zinc, also with its great wealth of iron ores, and of clay, limestone, salt, gypsum, sand and gravel, all of which go to make up Utah's great mineral resources, with a great proportion of our state's annual production being coal, Utah's place in the field of raw materials is recognized throughout the world.

The quantity and quality of Utah's coal place this state in high rank among the States and its potential production assures great industrial development for Utah and the West.

Utah coal is used in industry for power to run machinery, and heat for homes, schools, hospitals and many similar types of institutions. Because of the abundance of coal near at hand in Utah, the industrial minerals are not sent out of the state to be sold in their raw state but are processed here at home with many of the resultants contributing in turn to other manufacturing processes being established within the state. This integration of our mineral resources and manufacturing is and will continue to develop Utah's prosperity.

Since Utah coal is used to power our factories, burn our bricks, heat our houses, light our buildings and streets, and provide motive power for

our railroads, we should know more about this great Utah resource—how much we have (and the amount is large)—how it is produced and prepared for market—and how best to use it to the advancement of Utah's prosperity and economical advantage.

The story of the discovery of coal in Utah and the early attempts to mine it are somewhat obscured by the glamour and excitement incident to the discovery of gold in California as the events occurred at about the same time.

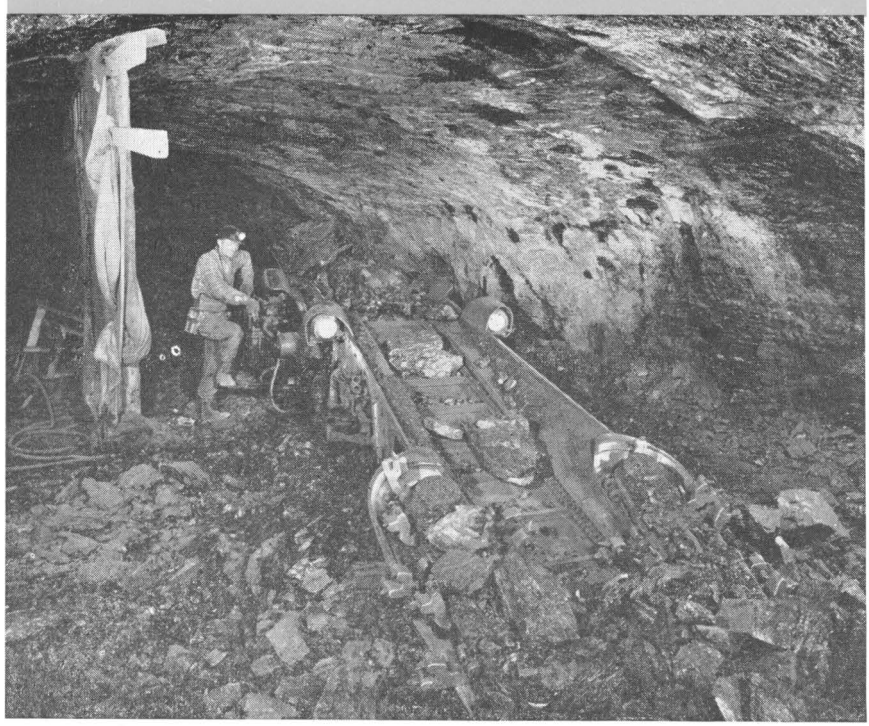
Father Escalante may have seen coal in what is now Utah in 1776 while crossing this region in search of an easy route to the Pacific Coast. From an economic point of view coal was first utilized by the early Mormon settlers in Sanpete Valley in 1849 and 1850.

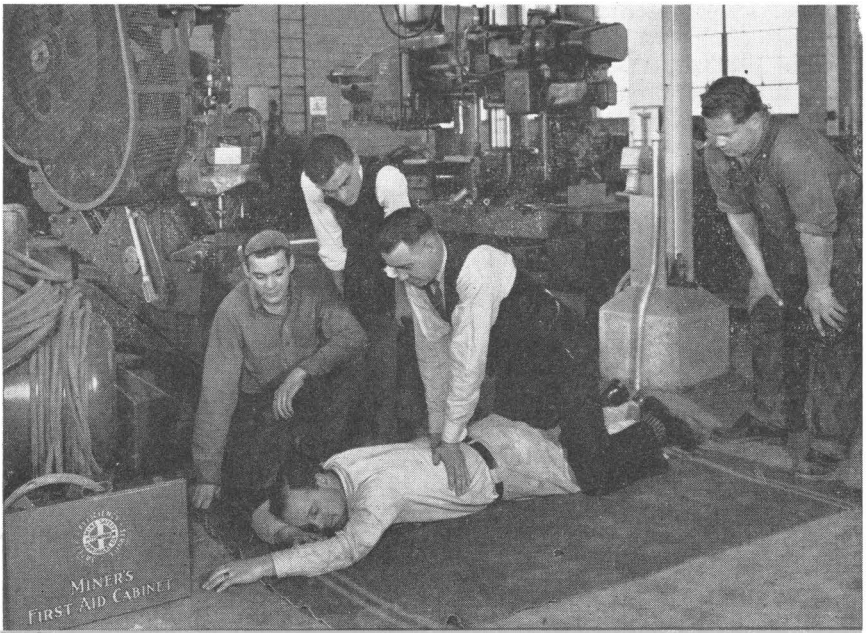
Utah historians report that the pioneers had no sooner settled in the Great Salt Lake Valley than they began a search for coal and iron. This search was stimulated not alone by the need for fuel but also by the realization that simple tools and hardware had to be made by the settlers themselves if the great expense and time of tarnsporting heavy commodities across the plains from Missouri River points were to be avoided. This made it necessary to find and develop iron ore and suitable coal deposits. Prizes were offered to encourage the search and an abundance of coal was discovered by the close of 1850.

The Wales Mine in Sanpete County had the distinction of being the first coal mine to be opened in the State. It is said that this mine opened in 1855.

MINING MECHANIZATION

Present day coal extraction calls for this type of equipment.





SAFETY A WATCHWORD IN MINING

Crews are trained constantly in mining industry to give first aid to injured men.

In about 1684 or 1865 the first serious attempts were made to develop the precious metal deposits of the State and this led to a demand for coal as a source of power. There was also an ever increasing demand for coal for domestic use and for forge and iron ore for smelting. From this time on and with the building of railroads the coal industry in Utah began to expand. During the succeeding years other coal deposits were discovered. There are ten known coal fields in Utah which, according to the United States Geological Survey, cover 13,130 square miles of land containing coal. The Wasatch Plateau coal field and its extension east of the Price River known as the Book Cliffs field are commonly referred to as the Carbon County Coal Fields. Together they form the largest and most productive coal area in Utah. All of the large commercial mines presently operating are in these fields.

How Utah Mines Its Coal

Coal seams in Utah generally lay upon an inclination of 5 to 10% from horizontal. Entrances to the mines are by drifts or slopes. As operations progress penetration becomes deeper and deeper into the seam so that in many of our larger mines the passageways are miles in extent. A map of the interior layouts of Utah mines resembles a city map. The main passageways are like the principal streets. These are intersected by the smaller passageways and on either side of these "streets" like the lots in a city subdivision are the "rooms" from which the coal is removed. Mining operations in a "room" begin with undercutting or overcutting of

the coal seam. Electrically operated machines cut out a "kerf" or thin layer of coal about six inches thick across either the top or bottom of the seam and extending horizontally into the coal seam from six to nine feet. Then holes are bored at intervals for shooting or blasting.

Mine ventilation is important. Many millions of cubic feet of fresh air are pumped into Utah coal mines during every shift. The air in many mines today is actually, by chemical tests, fresher than the air in city offices. Circulation of fresh air underground is impelled by huge electrically driven fans and directed through a labyrinth of air passages. This continuous flow of fresh air dilutes and expels mine gases sometimes called "fire damp" or "marsh gas" wherever these prevail. Coal mines are warm in winter and cool in summer, the normal temperature approximating 55 degrees.

Constant inspection by the Mine Foreman and his assistants for possible danger spots in roof conditions, the continued use of ingenious gas detectors, "permissible" explosives only, and the forcing of incombustible dust onto walls and tunnels to absorb coal dust and to prevent explosion—these are in continuous and daily use throughout Utah mines. There is also the intricate telephone system providing intercommunication throughout the entire mine and to all points above ground. In Utah mines there are highly perfected organizations which constantly preach and teach safety to miners. All of these looking towards the reduction of accidents.

Mechanization

90% of Utah's coal is undercut or overcut and loaded mechanically.

This mechanization is quite comparable to what has happened in the modern manufacturing plant when compared with the hand labor of years ago. Machines are used to cut the coal loose from the seam, with cutting machines operated electrically, thus enabling the miner to increase very greatly production per man.

Mechanical loading machines, some of them able to load a 5-ton car in less than a minute, now move in, and do the work which used to take a miner several hours of back-breaking labor, years ago to do.

Miniature electric locomotives, propelled by motors ,haul the loaded coal cars in trains of varying length, according to the haulage conditions, starting their journey to the main line portal. Upon reaching the surface rotary dumps located at the tipple automatically turn the cars over, thus emptying the cars.

Once the coal reaches the tipple, which is actually the processing plant of the coal industry, the mechanical process continues. The coal is then thoroughly cleaned, inspected and graded into various sizes to meet the needs of its customers, foreign substances are removed and impurities cleared, especially of slag and slate. Shaker screens with various size meshes work automatically to separate the coal into the required sizes. Often the coal, after being so cleaned, may be sprayed also with oil, this for the purpose of rendering coal dust-free and to prevent freezing. Finally loading booms lower the prepared coal directly into the cars waiting on the railroad tracks below.

Transportation of Utah Coal Gives Large Employment to Many Hundreds of Railroad Men

Utah's coal production and distribution can best be visualized when consideration is given to its transportation, involving the use of over 115,775 freight cars annually and the operation of over 2,000 coal trains, together with the employment of the men required to maintain and operate these trains.

Utah

AN ALLURING GEOLOGICAL EXPOSURE

UTAH'S geology is unique in that there are outcropping stratas recording every phase of the geological history from Archaean to the present. The history has been one of sedimentation. In the earliest stage the State was covered by an epi-continual sea extending westward from what is now the eastern margin of the Wasatch mountains and plateaus. During the Protozoic and Paleozoic period, great thicknesses of sediment accumulated in this area. The areas of water and land were continuous, but went through a history of change, until, to the geologist, each chapter has its interpretation of the areas that were affected by the position of the water, because that area which was above the water was eroded and that which was below received additional sediments. It should be noted that these sediments accumulated to great thicknesses of many thousands of feet.

Where the sediments were thickest, the mountain chains were born. Periods of great disturbances occurred in the Ordovician period and again at the end of the Paleozoic during the Permain. These periods brought land to the surface which has not again been innudated.

During the Triassic and Jurassic periods the eastern half of Utah was part of a great sea, which extended far to the north and was increased in size during the middle Cretaceous period. So there are broad expanses of Triassic rock over which lies the Jurassic sandstones; and in the northern portion south of the Uintah mountains is the great expanse of the Cretaceous covered with the later, or Tertiary, deposits.

This brief description may be confusing to those not acquainted with the geological history, but it is these original processes which have brought the State of Utah into such an alluring geological exposure.

The later part of the Paleozoic history was the period in which great faulting took place. The Wasatch and Uintah mountains came into existence, although there had been a partial uplifting earlier. The Block mountains on the western desert have resulted, generally, from north-south faulting —faults that headed westward, so the dip of most of the strata is to the east.

The Uintah mountains came up as a great anti-clinal arch. These mountains are unique in that the major axis runs east and west. Only one or two other ranges have this distinction in the entire North America. The raising of the Wasatch mountains and the Block mountains to the West was associated with volcanic intrusions. This feature is fundamental in the mining history of the State, in that it produced the rising of magnetic solutions which precipitated the metalliferrous material which has been so remunerative to the State's mining industry.

Associated with the closing of the great Cretaceous period were shallow swamps which gave rise to tremendous growths of vegetation. Extensive and continuous peat bogs were formed in the closing of this period, which were later covered with the Mesa Verde sandstones and gave rise to the coal seams which make up the more than 80 billion tons of available coal in Utah.

The Permian strata which extend over northern Utah, western Montana, and eastern Idaho contain the

continuous stratum layers of tricalcium phosphate which assures to the United States a phosphate supply for years to come. More than 100 million tons of high grade phosphate rock are within the boundaries of Utah.

During the Tertiary a great inland or epi-continental sea appeared around the base of the Uintah mountains. Its position was not constant, but it occupied, at different intervals, the area on the north, the area on the east and the south, and extended down over what is now known as the Wasatch plateau. It is reported that the drainage of this great epi-continental sea through the Colorado river at a time when the great Kaibab-plateau was rising, produced the wonderful Colorado river gorge.

The Pleistocene, or recent period has left an important history in Utah. It was during this period that the great ice sheet appeared on the continent. Alpine glaciers occurred in the Wasatch and Uintah mountains and other high areas. The glacier in Little Cottonwood has become classic. The glaciers of the Uintahs ran into hundreds and it was the digging and erosive effect of the many glaciers that left the lakes, outstanding cirques and box-like canyons. At this period, the climate gave, tremendous increased rainfall, and this, with swollen streams from the melting ice produced a new body of water in the Great Basin, which has been written up and is known as Lake Bonneville. This was a fresh water lake that has played an important history in Utah's development.

Lake Bonneville had an area at its maximum of 19,750 square miles. It had a maximum depth of 1080 feet. Its high water level was approximately 5100 feet above sea level. It had an extensive broken shore line 2500 miles long. Terraces were cut by the waves of the lake, so it has left its own distinct history all around the basin. Deltas and gravel deposits were formed at the mouth of every river. Aparently it reached its high level during the continental Kansas glacial epoch. The lake was then tapped by the Snake river through the Portneuf, and the lake fell comparatively rapid to the level of the outlet, which is recorded at 4770 feet. At this stage it rested for a long period and the great terraces, in what is known as the Provo stage of the lake remained as a record of its position.

A climatic period developed in which the evaporation was greater than the rainfall and the lake began to shrink—not at regular periods, for resting stages are recorded on the sides of the shore lines, and Great Salt Lake is the remains of this lake. It should be noted that the shrinkage of the lake from the Provo stage to the present lake has been entirely by evaporation. The lake filled in the valleys between the mountains on the desert area, giving us the great western desert. In its shrinking it formed five lakes instead of one and today Sevier lake, White Valley, Salt Beds, Utah Lake and others record the low places in old Bonneville. It is in this old lake bed which was once covered with hundreds of feet of water where most of the people in Utah live. These old lake deposits form the most important agricultural lands containing rich alluvial soils washed down from the mountains.

The old lake beds have produced the unique effect of a level valley with block mountains projecting upward—almost like islands above the sea. In no other area except in the Great Basin do we have such a phenomenon. The fantastic weathering of Triassic, Jurassic, Cretaceous and Tertiary rocks have given us the unique relief which has resulted in the outstanding scenic attractions of Utah.

Zion's canyon is just a fantastic cutting through the Jurassic and Triassic stratums. The light colored stone on the top of the Great White Throne is Jurassic while the rock below is Tri-

assic. The greatest exposure of this rock not only recorded the sediment but also the life and the climate. The unusual display of cross bedding is interpreted as wind deposits, and actually gives a record of the wind blowing in that period, and the cross bedding may be interpreted as fossil dunes.

Bryce's canyon and Cedar Breaks are fantastic and unique weathering of Tertiary deposits. Bands of slightly more resistant rock are found abundantly and this material will protect a cliff or column for centuries. Frost and rain have played an important part to produce the unique weathering.

In the southeastern part of the State is found a phenomena which occurs only in a few places in the world. It is what is known as laccolith or laccolith mountains, where the volcanic lava from underneath has pushed up through but did not come all the way to the surface. It forced up and formed a mass similar to a great mushroom, bending part of the strata in a high arch over the instrusion. The San Rafael swell, the Henry mountains, the La Sal mountains, the Abajo mountains and the Navajo mountains are examples of this phenomena. Peaks have been pushed up by the process to a high elevation. Peaks in the Henry mountains and in the La Salles are above 11,000 feet. The ancient Triassic and Jurassic sandstone has weathered into most fantastic forms. The Natural Bridges, Rainbow bridge and the unusual weathering found in the eastern part of Wayne and Garfield counties and in the Kaiparowits plateau are of this type.

If one drives from the northern part of the State to the South, he may easily observe along the road strata as old as pre-cambrian in Box Elder county to as young as Tertiary in Kane county; and then drift again to the south from Kane county to the Colorado river and view the outcrop of strata which covers the period from the youngest to the oldest from the Cedar Breaks, which is tertiary, to the granite gorge in the Grand Canyon, which is Archaean.

The high peaks of the Uintah with their beautiful lakes, natural meadows, extensive cirques, glacial moraines and the type of topography which develops from such association is probably the most attractive spot in the West. Only a few who have been willing to face the rugged effort of visiting these areas without roads and many times poor trails, have a real picture of what the area affords.

The high points of the State are Kink's peak, where the mountains go up to 13,496 feet, and where the glacial basin will allow only partial description. The peaks in this area are higher than 13,000 feet. The scenic area is alluring—it is beautiful! It is the height to which people wish to climb when they go to see the West. The high mountains and the river gorges represent the superlative of what is. A trip down the Green and Colorado rivers will be an invitation for many years to come to all those who want excitement and romance.

In the interest of mining, it is the area of magnetic depositions which are portrayed clearly in the State of Utah, and it is this geology that has given to the State the outstanding mines of the period. The rich areas of the Wasatch, the Tintic, the Oquirrh, Iron Springs, and the Tushare's have had special attention, and have enjoyed life longer than is common for metal mines. But the discoveries have not all been made. There will yet be new strikes and rich mines, and many new camps and fortunes will come from the earnest effort of the prospector, the geologist and the mining engineer.

(*Cont. from page 9*)

discovery of coal near Salt Lake City. The first vein of coal was discovered near the little town of Wales in Sanpete County in 1854. The next discovery was near Coalville, Utah, in 1859. In 1869 Coalville became a thriving coal producing area and since 1885 Carbon County has been the main center for the production of coal. In fact, southeastern Utah is underlain with more coal than the great Ruhr valley in Germany and possesses one of the largest reserves in the world today.

The great discoveries of gold, silver, copper and lead did not come until the early sixties. Those who came to Utah early turned their attention to reclaiming the soil. They were compelled to do this or perish, and in doing so laid the foundation for an imperishable state.

Prospecting really received its impetus in Utah with the arrival of a regiment of soldiers from California under the command of General Patrick E. Connor, who founded Fort Douglas in 1862. General Connor's regiment was made up in California largely of men who had been exposed to the lure of gold, and he encouraged his men to prospect for metals during their spare time.

They scoured the hills and vales, but concentrated on Bingham gulch, where they discovered and panned gold. First a gold camp, Bingham later became one of the great copper-lead districts of the world.

The discoveries made by the soldiers attracted the attention of others and mining development was fast from then on. As a result, General Connor became known as the "Father of Mining in Utah."

It was George P. Ogilvie who made the first lode discovery and filed the first mining claim in Utah. On September 17, 1863, Ogilvie, who was hauling logs from Bingham Canyon, came upon a nob of galena. He posted notice of his discovery and recorded the claim calling it the Jordan, after a small river that connects Utah Lake and Great Salt Lake.

Ogilvie and his associates formed the Jordan Silver Mining Company and included other adjacent ground. This was the nucleus for a larger succeeding company which has been in almost continuous production from the Bingham district since that time.

In December, 1863, the West Mountain Mining district was organized under the laws of California, and from the district were shipped the first ores of the Territory.

During succeeding years Bingham Canyon was the scene of more or less profitable mining. Siliceous gold ore and silver bearing lead ores were sought in the early days. Until 1900, Bingham remained essentially a lead-silver mining camp. Smelters had been built at Murray and Bingham Junction, now called Midvale, near the Jordan river, 12 miles below Bingham, and a substantial part of the intake of these plants came from between 15 or 20 comparatively small mines in Bingham Canyon. All operations were underground mining and there was little visible to intimate that within a few years Bingham was to be the theater of the biggest mining excavation, measured in cubic yards of material moved, in the world.

First came E. A. Wall, miner, trader, inventor, freighter and claim owner, who had been operating throughout Montana, Colorado and Idaho. He was a true Pioneer. When Wall first visited Bingham in July, 1887, it was a typical young mining camp. The canyon was littered with wooden shacks hunched up against the canyon walls to permit room for

ore wagons up and down the narrow ravine.

On his first visit to Bingham he noted the usual signs of copper mineralization, the green stains on the rock resulting from migration of the copper bearing solutions. Then he entered an old tunnel, driven by the early day soldier prospectors in their search for gold. Assays indicated the presence of an unusually large mass of rock impregnated with copper carrying 2.4 per cent.

Inquiry revealed that much of the area was open for re-location because former owners had failed to perform the necessary assessment work. It indicated that the former owners had little regard for the low grade copper and were searching for precious metals. During the next 10 years Colonel Wall added to his holdings.

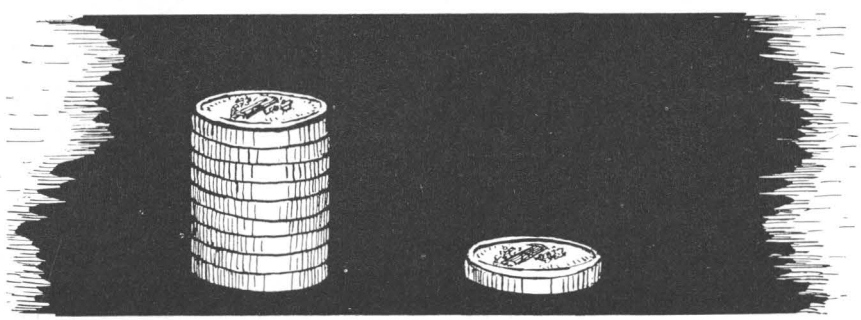
Captain Joseph R. DeLamar became interested in Wall's property, early in the 1890's and it was through DeLamar that Wall met D. C. Jackling. After an examination of the property, Jackling and his associates, R. C. Gemmill, envisioned Bingham as it is today—the greatest copper mine in North America.

In 1896 Jackling and Gemmill wrote their report, finally succeeded in buying an 80 percent interest in Wall's holdings, and then formed the Utah Copper Company. Later they financed its development and the erection of a milling plant.

Such was the beginning of Utah Copper, the age of the copper porphyrys which meant so much to the world and the industrial status of the State of Utah.

After the discoveries at Bingham, interest in Utah's resources spread rapidly and attracted the attention of veterans from the Mother Lode in California and the Comstock in Nevada. Development of Alta, Stockton, Camp Floyd, Dry Canyon, Park City, Frisco and Eureka followed in rapid succession.

The first discovery after Bingham was by prospectors who flocked to the Wasatch range of mountains and discovered the famous Emma mine at Alta. Four men, Woodman, Chisholm, Woodhull, and Reisch, sank a shaft through the hard rock on the north rim of the now famous Alta ski basin and after ten months struck a rich vein of ore. This was in 1868 and the ore was so rich in silver that



NINETY CENTS OF EVERY DOLLAR'S WORTH OF ORE MINED IN UTAH IS SPENT IN UTAH

it was dragged down the precipitous Little Cottonwood canyon on hides. From there it was shipped to Ogden by ox-team where it was routed around Cape Horn to Sawnsea, Wales, for smelting.

The Emma gained fame in more ways than one. During its heyday, the mine was sold to a British syndicate for $5,000,000. Our Ambassador to Great Britain was involved in the deal and shortly after the sale was completed the rich ore body was cut off by a fault. The British investors immediately raised the cry of "swindle," and a congressional investigation followed.

The old Emma has had her boom years and her lean years, the same as all the mines of Alta. At one time the district had a population of 5,000 persons and a hundred business buildings. Saloons and breweries flourished and the district possessed all the "qualities" of a roaring frontier mining boom town. Legend has it that gun battles took almost as many lives as the snow slides. The latter took their toll many times during the winter months, and in the old Emma is a huge underground chamber where men would sleep during the hazardous periods rather than risk their lives at the bottom of the precipitous slopes that virtually enclose the district.

Alta poured out its wealth with a lavish hand. Since the early days it has produced more than $37,000,000, largely from rich shallow deposits. But the high-grade days are gone and Alta like all other mining districts is seeking the lower-grade ores farther beneath the earth's crust.

Spurred by the discoveries at Alta, prospectors swarmed over the mountains to Park City on the east and American Fork Canyon on the south where new mines were discovered.

While the first discoveries at Park City are the subject of some controversy, the location of the Walker and Webster claims by Rufus Walker were among the first. This was in 1869 and by 1872 numerous other claims had been staked out. The story of Park City brings out the names of men which are household names today in Utah. They were not rich men in those days; in fact, they knew want and privation and sacrifice. Among them were Messrs. Keith, Kearns, Walker, Judge, Ferry, Ivers, Hearst and Lambourne.

The incident that really stirred Park City to life as a mining district did not come until 1872. Hearing reports of ore discoveries near Salt Lake City, a group of California mining men sent one of their number here to investigate. His name was George Hearst. Taking a horse, Hearst rode over the section at the head of Empire Canyon, which is now being mined by the Park Utah Consolidated.

Hearst went into the region to examine a property in McHenry Canyon. After a brief examination, he turned the mine down due to a water problem that was evidenced in the shallow shaft. On his return to Park City, he headed his mount into Ontario Canyon. Near the upper end of the canyon he saw a group of men at work. It was late in the afternoon but he rode over to see what was going on.

The miners were Rector Steen, veteran soldier-prospector, who had roamed western hills for a number of years and whose name was written across a number of early Utah and western mining camps, and his three partners, Herman Baden, James H. Kane, and Augustus Dowell.

The men showed Hearst a small nob of silver ore that they had found on their claim which they called the Ontario. Hearst was impressed and took a 30-day option on the property for $30,000. A few days before the option expired, on August 23, 1872, he made a deal with Steen and his

associates whereby he purchased the Ontario for $27,000.

This was in the 'good old days' when the easy-to-find, near-the-surface ore bodies were to be had. Hearst's gamble proved a good one, rich ore bodies were soon opened up and by 1875 concentration plants were erected. Within the next 15 years the Ontario mine yielded some $15,000,000 and it formed the nucleus for the Ontario, Daily and led to other producers, including the Daly-Judge, Daly-West, Park-Utah, and others, which are still producing and which are now under the control of the Park-Utah Consolidated Mines Company.

It is interesting to note that George Hearst was the father of William Randolph Hearst, the journalist. George Hearst later became U. S. Senator from California and before he died launched his son, William Randolph Hearst, upon his journalistic career.

Shortly after the discovery of the Ontario, a new star was rising in the western end of Park City. This was the Mayflower and the beginning of the great Silver King.

Thomas F. Kearns and David Keith were not rich men in those days—they were mine workers. They struggled with a lease on the old Mayflower (later renamed the Silver King), working a shift for others and then another shift on their own lease. At times they managed to hire others. Tenaciously, desperately, they sank a shaft to the 700 foot level and ore.

Aside from the Ontario, Park City mines were not found at the grass roots. The mines had to be developed by long hard search under adverse circumstances. It is estimated that more than $20,000,000 has been spent in the unsuccessful search for ore in Park City, in addition to many millions spent in the successful mines.

Yes, the grass roots proved to be very, very long in Park City before pay ore was struck and each year they are becoming longer and longer in Utah mining.

News of these early discoveries spread rapidly and soon others came here to prospect and develop. They brought with them outside money for investment here and they made markets for the early settlers of the soil.

Discoveries at Eureka, Juab County, followed. "Uncle Jesse" Knight, prominent Mormon Pioneer, was among the first to discover ore in the Tintic district which surrounds the town of Eureka. In the early sixties he discovered the Humbug, and became one of the early captains of Utah industry.

The Tintic district has long been one of the most productive in Utah. Owing to poor transportation facilities, development of the district was not rapid until 1878, when the railroad from Salt Lake City reached Ironton, five miles from Eureka. Prior to that time, however, there was considerable mining of rich ores found near the surface which were shipped to San Francisco, California, to Reno, Nevada, Baltimore, Maryland, and even to Swansea, Wales. Later, most of the ores were shipped to Argo and Pueblo, Colorado, and to Salt Lake valley smelters.

A number of small smelters and milling plants were built in and around Eureka, but most of them were operated with little or no success, due to the complex character of the ores. It was the advent of the railroad and the building of custom reduction works in Salt Lake valley that gave Tintic its first real stimulus.

By 1899 the shipping mines were the Mammoth, Bullion Beck, Centennial Eureka, Grand Central, Gemini, Eureka Hill, Swansea, South Seansea,

Godiva, Humbug, Uncle Sam, Sioux, Sunbeam, Ajax, Start Consolidated, Four Acres, Treasure Hill, and Silver Peak.

Another Utah mining camp that possesses all the lore and romance of the roaring early days of mining in the West is the San Francisco mining district, located westerly from Milford in Beaver County. Much of this interest centered around the Horn Silver mine, reputed to have produced $54,000,000, and one of the truly phenomenal mines of the world.

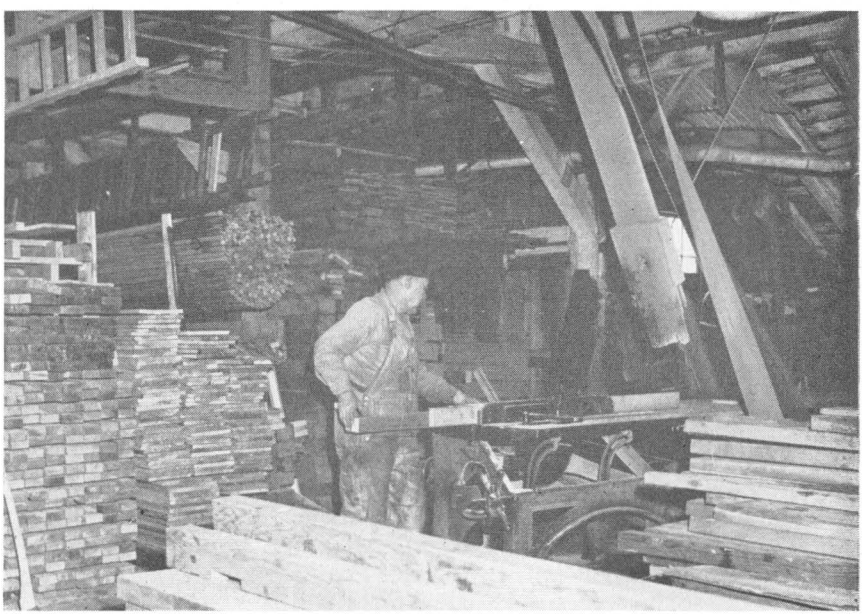
An old glory hole a few hundred feet off the old main Horn Silver shaft testifies to the palmy days of the past. The original Horn Silver ore body was discovered on the surface and persisted almost vertically to the 900-foot level. The ore body made on one claim and while the core was mined during its heyday, considerable ore has been produced from surrounding territory at intervals since then.

The Horn was discovered in 1875 by a man named Hawkes and Patrick Ryan, who also included on the location notice a man named Lynch who grubstaked them. After they had performed sufficient work to prove their claim they turned to a group of Salt Lake City men for financial help. They added Matt Cullen, Dennis Ryan and Allan G. Campbell to their group for an investment of $25,000.

After the expenditure of the $25,000 the project assumed larger proportions and needed more financing. Early records reveal that Jay Cook, early day financial wizard and railroad builder, then became interested in the Horn Silver through an

MINING SAW MILL

Not only do miners remove material from the underground, but they also consume much material below the surface. This view shows a part of the lumber plant at the Silver King Coalition Mines, Park City, Utah, showing lumber which will be used in the process of mining.



associate, Lycus Edgerton. Cook is believed to have raised $5,000,000 for development and equipment of the mine, and this investment brought him back into the limelight of eastern financial circles after he had been ruined in the panic of 1873.

At one time the Horn Silver supported a smelter and a community of 2500 persons. Other producers were discovered in the district, included the Shauntie, Shenandoah City, Elephant City and South Camp, but none rivaled the Horn. The Moscow, Hickory and Red Cloud also were pioneer producers.

Early in the twentieth century, Samuel Newhouse, prominent figure in early Utah mining history, spent a fortune at the Newhouse property about 30 miles southwesterly of the San Francisco district in an effort to find another Horn Silver, but he did not live to see the project through to completion. The Horn today after many idle years is once again yielding metals, this time from low grade ores possed up by former operators.

The old Silver Reef district in the eastern part of Washington County, and about 20 miles north of St. George, created a stir in Utah's early mining history. Silver was discovered there in 1869 by John Kemple, who found near the town then known as Harrisburg a piece of "float" which assayed $17,000. He filled up his small shaft and left the county returning with others to organize the district June 22, 1874. He worked his claims for a few months, but became discouraged and returned to Beaver County. The district owes its development to W. T. Barbee, who in 1875 discovered ore and shipped 10 tons of $500 per ton ore to Salt Lake Valley smelters. This caused a rush and by 1876 a total of 640 locations were filed in the district.

The Silver Reef district yielded silver annually from 1875 to 1897, when production ceased. Revived again in 1902, the region then was productive until 1909. From 1875 to 1909 a total of 7,211,463 ounces of silver were produced, having a value of $7,987,142. Since 1909, production has been small, despite several attempts to revive the area.

The Metals

Metals are indispensible. They are part of the comforts, the joys, and the necessities of people. Objects we touch and use daily in our homes, businesses, and industries contain metal.

Metals are indispensible to Utah. Their production and processing creates the base for industries that now support directly and indirectly nearly one half the population of the state.

The economic welfare of any empire depends upon the relative abundance of its raw materials and the extent of their utilization. Likewise, the ultimate growth and affluence of any state or nation depends upon the development and competitive position of its basic industries.

Thus a healthy, growing mining industry with its many social and industrial ramifications, means a healthy and prosperous Utah.

What Mining Means To Utah

Payrolls and Expenditures

The mineral industry's average annual disbursement in Utah for wages, freight and supplies amounts to $85,000,000.

The Payroll

of the industry is one third of the state's total, shown on the payrolls of the Industrial Commission.

The Supplies

The supplies purchased by the industry for company use average $50,000 a day.

Freight Tonnage

of the industry is 80% of the total originated by the railroads of the state. If delivered at one time, a year's mineral output of Utah would completely fill all of the tracks of the state.

The Employees

of the industry and those directly dependent upon it disburse in addition to the foregoing an average of

$15,575,000 for Food
$6,400,000 for Rent and Homes
$4,750,000 for Clothing
Annually

Food Products Consumed

Annually by persons engaged in and directly dependent upon the mining indutry of Utah (partial list only):

Meats

Beef, lbs.	4,332,372
Veal, lbs.	361,395
Pork, lbs.	1,068,436
Mutton, lbs.	581,033
Chickens, lbs.	444,403

Fruits

Apples, bushels	74,169
Peaches, bushels	18,157
Berries, quarts	334,142
Other Fresh Fruits, lbs.	1,398,329

Vegetables

Potatoes, lbs.	12,842,233
Cabbage, lbs.	1,021,183
Tomatoes, lbs.	1,518,211
Onions, lbs.	1,087,687
Carrot, lbs.	21,041
Turnips, lbs.	300,142
Other Fresh Vegetables, lbs.	597,659

Dairy Products

Fresh Milk, Quarts	6,624,128
Cream and Ice Cream, lbs.	146,133
Butter, lbs.	1,638,093
Cheese, lbs.	299,267

Other Food Products

Lard, lbs.	903,051
Eggs, dozen	1,267,697
Flour and Meal, lbs.	6,295,985
Bread, lbs.	6,652,984
Sugar, lbs.	2,921,791

The State's mineral production from 1864 to 1946, as recorded by the U. S. Bureau of Mines, includes:

10,464,445 oz. of GOLD

715,054,066 oz. of SILVER

4,786,157 tons of COPPER

4,388,329 tons of LEAD

954,719 tons of ZINC

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Metallurgical Treatment Utah Ores, Hydrocarbons, Oil Shales, Sulphur and Alumites, Bulletins 6 to 16, Utah Engineering Experiment Station, University of Utah, Salt Lake City, Utah.

The following papers from the Transactions of American Institute of Mining and Metallurgical Engineers.

Mining Districts and Their Relation to Structural Geology, by J. J. Beeson, No. 1500-I.

Notes on the Geology of East Tintic, by G. W. Crane, No. 1491-I.

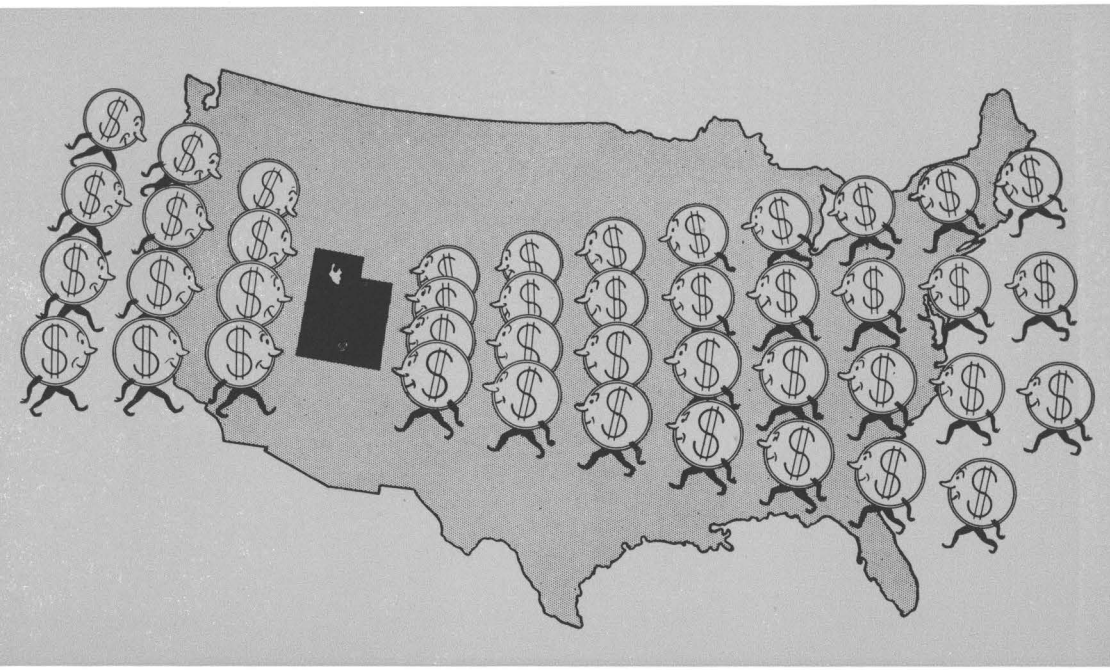
Iron Fields of the Iron Springs and Pinto Mining Districts, Iron County, Utah, by Duncan MacVichie, No. 1468-I.

Bulletins—The Industrial Commission of Utah.
Bulletins and Technical Papers of School of Mineral Industries, University of Utah.

Mineral Resources of U. S., by U. S. Bureau of Mines.

Further information concerning Utah as a mining state can be found in the booklets, "Utah, America's Great Mining and Smelting Center," and "What Mining Means to Utah," issued by the Chamber of Commerce. Copies of these booklets or additional copies of "The Mining Industry of Utah" can be obtained by addressing the Secretary of the Chamber of Commerce, Salt Lake City, Utah.

These Silver Men Mean Business



They are mining dolars—new dollars—that mean business to Utah. Each year millions of them are brought to Utah and exchanged for products of the mine. They are exchanged again and again many times within the State. Nine-tenths of every mine dollar brought to Utah in exchange for metals is spent in Utah.

THIS BOOKLET is gratefully dedicated to the Prospector whose courage, stoic determination, and faith have built in Utah an industry unparalleled in any like area in the world;

Whose work has resulted in the building of communities, homes, schools and churches, and whose initiative has provided and is still providing payrolls for the worker, markets for the farmer and security to a people.

May his kind never be extinct, either from natural causes, or because society destroys his initiative and stifles his courage.