UTAH'S *Mining* INDUSTRY

AN HISTORICAL

OPERATIONAL AND ECONOMIC REVIEW

of

UTAH'S MINING INDUSTRY

by

UTAH MINING ASSOCIATION—825 KEARNS BLDG.—SALT LAKE CITY, UTAH

Utah's Mining Industry

AN HISTORICAL, OPERATIONAL, AND ECONOMIC REVIEW
OF UTAH'S MINING INDUSTRY

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August, 1967

3rd Edition
Price $1.25

FOREWORD

The need for this book became apparent when a survey was made to find what material was available to give Utah citizens an account of their mining industry. Most of the available publications were found to be too technical to be useful to those not active in the industry.

We have attempted in the following pages to discuss all phases of mining in non-technical terms and to give as complete a picture of the mineral deposits and of the mining activity in Utah as time and effort permit.

Mining is but a part of our natural resource industries. It is of great basic importance, however, for it furnishes to our present civilization the materials from which our productive tools are made, as well as the fuels which create power for those tools. The products of mining also furnish the raw materials from which the innumerable articles vital to our everyday living are manufactured.

Section I presents the history of mining developments in Utah and discusses events that made mining possible and promoted its development.

Section II discusses operational practices and procedures.

Subheadings in this Section discuss the mineral and metal classifications, the factors which control mineral development, and the several basic functions of the mining industry such as prospecting, mining, refining and marketing.

Section III is an economic review of Utah's mining industry, presenting data on over-all statewide production, on Utah's position in the national mineral industry and on individual mineral production when such data are available.

This Section reviews the mineral industry of each individual Utah county.

Section IV is the appendix, which includes a description and a discussion of the use of each Utah mineral, a map of Utah showing location of mineral deposits and a bibliography of reference works.

The book should prove interesting and useful to Utah citizens, to students and teachers and thereby more than repay the effort in providing it.

We gratefully acknowledge the cooperation and help received from our many friends in the preparation of this book—particularly the Utah State Department of Employment Security and the Bureau of Economic and Business Research of the University of Utah, for valuable statistics and criticisms; also Mr. Edward C. Larsen, a member of the Weber College faculty, for his professional education criticisms at the time of publication of the first edition. These criticisms were critically needed to give the book maximum usefulness to students and teachers.

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NATURAL RESOURCES

Mining is described in the foreword as a "Natural Resource" industry. Natural resources have always been man's basic source of supply. To more clearly illustrate the basic importance of mining in obtaining supplies for industry, the following paragraphs define "Natural Resources" and give a brief history of their use by man.

The dictionary defines "natural" and "resource" as follows:

"Natural"—"Products of nature; the objects of the natural world; natural things or objects."

"Resource"—"That to which one resorts or on which one depends for supply or support."

A combined definition of "NATURAL RESOURCES" would then be: "PRODUCTS OF NATURE ON WHICH ONE DEPENDS FOR SUPPLY." Inherent in this definition is the idea that a real need of such supply exists; that the harvesting and processing of the needed supply, or natural resource, can be done with profitable return to the individuals or groups who risk their time and tools to make the needed product available. **A natural resource, therefore, becomes of value only when "need" provides a use and profitable harvesting and processing furnish the incentive to produce it.**

In the light of mankind's history the "need" for natural resources has expanded from a very few products of nature to the present, almost innumerable, list. During early nomadic times the only natural resources utilized by man **and which, therefore, were of real value to him,** were the wild animal herds, the native fruits, herbs and grains, salts, clays and flints. From these he satisfied his primitive needs for food, shelter and clothing. He later domesticated some of the animals and began to cultivate the food-bearing plants. Thus began the establishment of communities which created the need of timber, stone and some of the more readily available metals for homes, weapons and personal adornment. We are familiar with such terms as The Stone Age, The Bronze Age and The Iron Age in tracing man's first use of nature-provided minerals and metals.

All during the ancient and medieval history of man, development of natural resources was limited to their adaptation to man power and animal power use. The soil was cultivated with implements powered by hand or animals; transportation was by foot, horseback or sail. Productivity was low, and population was limited by productivity. **In fact, as late as the 18th century, right here in America, nine men out of every ten spent their time in agricultural production.**

The metallic and nonmetallic minerals, many of which are discussed in this presentation, are the natural resources that make the difference between a primitive economy and our great industrial economy of today.

The change in man's productivity and his increased use of natural resources came with the development of complex tools made principally of metal and with the invention of steam, electric and internal combustion power to operate those tools. With these new tools, the farmer began to produce more from each acre and for each man's work. Factories using the new tools and power machines increased the quantity and variety of goods at cheaper unit cost. The demands or "need" for natural resources grew in proportion to the increasing productivity.

In terms of present purchasing power of our money, a man in our country with only man and animal powered tools could produce 27c per hour in terms of

goods and services in 1850. In 1900, 54c per hour was the measure, and in 1950, it had increased to $1.44 per hour. Your car, radio, electric lights, refrigerator, plumbing, trains, planes, harvesters, tractors and many other items are the evidence of that productivity, all from "natural resources," the products of nature which we use for supply.

The basic natural resources include soil, air, water, timber, minerals, livestock and other animals, and agricultural products.

Truly, from the earth comes an abundant life for all.

SECTION I

HISTORICAL DEVELOPMENT OF UTAH'S MINING INDUSTRY

The history of Utah's growth from a desert wilderness to a thriving, populous commonwealth is a story of determined men subduing the earth and learning to use its treasures.

The earliest record of knowledge and interest in the minerals of Utah is noted in **The Great Salt Lake** by Dale Morgan. Mountain men who had trapped beaver in the valleys and streams around Great Salt Lake and Utah Lake told a group of Mormon pioneers wintering in 1846 in Pueblo, Colorado, that ". . . in a ridge of mountains running through the lake large quantities of precious minerals were found."

Agriculture, however, was the first area of conquest and Brigham Young urged the development of an agricultural home industry economy. This was dictated by the fact that sources for vital necessities were removed by hundreds of miles in distance and many months in time.

Prospecting for minerals (particularly gold and silver) during the time when agricultural development was so critically necessary to survival was strongly discouraged, primarily to prevent diversion of interest from agriculture and home industry.

Development of minerals and metals needed for the home industry economy was, however, actively pursued under direction of pioneer leaders. The iron ore deposits discovered by Parley P. Pratt's exploration party in Iron County in 1850 were the subject of active but unsuccessful attempts to produce iron, beginning in 1851. Lead was smelted for bullets by Isaac Grundy near Minersville in 1858 from the ore of the Lincoln mine. The unsuspected presence of silver in the ore prevented a successful enterprise. The resulting lead was hard and brittle. Salt was recovered from Great Salt Lake from almost the day of arriving in the valley in 1847. Building stone, sand and gravel, clay, and limestone for lime were used abundantly in homes and public building construction.

In 1854 the Territorial Legislature offered a reward of $1000 for the first discovery of commercial coal within 40 miles of Salt Lake City. By 1865 coal from Coalville, Utah was available in Salt Lake at $40.00 per ton.

Active search for minerals and metals which could be mined and marketed outside the pioneer-established economy began in 1863. The California Volunteers, led by Colonel (later General) Patrick Edward Connor, entered Utah October, 1862 and established Fort Douglas as their headquarters. Finding no need for active duty to fulfill his orders to protect the Overland Mail and Telegraph Line,* General Connor encouraged his troops to prospect the moun-

*Historians suggest that an underlying purpose was to place Utah under military surveillance during the Civil War.

tains adjacent to Salt Lake Valley. Whether General Connor or his troops in some way shared the knowledge of the mountain men is not known, but the first discovery of ore was made in the Oquirrh Mountains, described by the mountain men in 1846 as being mineralized. The first claim, the Jordan, was located by George P. Ogilvie, General Connor and others, September 17, 1863. The West Mountain Mining District was organized in September, 1863—Utah's first and still most prominent mining district. At a meeting, held at Gardner's mill on the Jordan River, Bishop Archibald Gardner, one of the first claim locators, was elected recorder.

Discoveries rapidly followed in the two Cottonwood canyons, American Fork Canyon, Rush Valley near Stockton, Park City, Tintic, and elsewhere. Mining districts were organized in each area following the discoveries of ore. The discoveries were followed by organization of companies, digging of shafts and tunnels to develop the ore and even construction of some smelters. Such efforts resulted in failure principally because of the great distance to markets and the high cost of transportation. By late 1866 all efforts to profitably work the ore bodies had ceased and it was not until 1868-69 that interest in mining was revived with the completion of the Union Pacific and Central Pacific railroads at Promontory, Utah, on May 10, 1869. Just seven months later the Utah Central Railroad was extended to Salt Lake and connecting lines were completed shortly to the mining camps.

Tullidge states that "The completion of the Utah Central Railroad to Salt Lake City in January, 1870, presented the long-looked-for opportunity of embarking with certainty in the business of mining." (P.701)*

The first shipment of ore from Utah was reported by Bancroft** to be "a carload of copper ore from Bingham Canyon, hauled to Uintah on the Union Pacific and forwarded by the Walker Brothers to Baltimore in June, 1868." Tullidge* states the first shipments of galena (lead) ore from the territory were small quantities from the Emma mine, Little Cottonwood Canyon, in July, 1868.

It is interesting to note a statement by President Abraham Lincoln—to some extent prophetic—for it was made prior to the time the mines became profitably active. Tullidge (P. 697)* quotes the President as saying:

"Utah will yet become the treasure house of the nation."

Tullidge* clearly describes the activity at that time: "From the summer of 1869 to the 25th of September, 1871, there were shipped from the Territory 10,000 tons of silver and gold ores, of the gross value of $2,500,000; of bullion, or pig lead, containing gold and silver, 4,500 tons, of gross value of $1,237,000; copper ores, 231 tons, of the gross value of $6,000. Salt has also been exported to the extent of 1,100 tons, of the value of $4,000; and silver bars, obtained by milling chloride ores, have produced $120,000. The annual product of gold from Bingham Canyon, by improved appliances for washing and sluicing, has been increased from $150,000 to $250,000. The number of districts by exploration and location has grown from two, as in 1868, to thirty-two in 1871. Since June, 1870, there have been erected eighteen smelting furnaces, built at an aggregate cost of $200,000, several of which are producing bullion.

"The above is a comprehensive history of the growth and development of the mining interests of Utah from the day when General Connor and his men first discovered the Old Jordan in 1863, until the time when mining was no longer an experiment, but had become one of Utah's chief industries."

*History of Salt Lake City, Edward W. Tullidge.
**Bancroft's History of Utah

A government publication* reports that in 1880 the following mineral operations existed in Utah:

535 deep mines (mines with shafts or tunnels)
1 placer mine (gold)
18 amalgamating mills (gold and/or silver)
34 smelting works
10 metallurgical plants (sampling, concentrating and leaching)

This source also reports Utah's mineral production for the year as $5,034,674 in gold and silver and 15,400 tons of lead.

Another interesting fact is that with practically no lead production up to 1870, Utah in that year mined 23.4% of the entire United States production; 45.5% in 1872, and above 25% until 1878, when it dropped to 23.8%. Other great western mining areas began to come into prominence during this period and reduced Utah's percentage of the total U. S. production, although Utah's volume of production continued to increase.

Brigham Young recognized the potential wealth in Utah's mineral resources, as well as the great need for outside capital to develop that wealth. Accordingly, in 1873 he wrote the editor of the New York Herald, calling attention to Utah's mineral resources and inviting eastern capital to provide the means of establishing mining and manufacturing enterprises. Development capital for mining and most of its manufacturing continued to come largely from out-of-state sources.

Gold, silver and lead were Utah's principal mineral products up to the period 1900 to 1905, when copper surged ahead toward its present leading position. Zinc did not become of real value to the state's mineral economy until 1925 when the new process of flotation made possible the separation of lead and zinc in the ore. Prior to that, zinc was an objectionable constituent of lead ore, for its presence interfered with the lead smelting process.

Up to and including 1905 all other minerals mined in the state (other than gold, silver, copper, lead and zinc) represented less than 10% of the total mineral production value. Coal, stone, sand and gravel, clay, salt and limestone were mined principally for use in local areas. "All other minerals" in 1905 were valued at $2,400,851, compared with a total value of $26,046,948 for the major nonferrous metals named above. By 1940 the "other minerals" represented 17% of the state's total production; by 1945 they had reached 30%; and in 1966 they constituted 67.6% of the state's total value of mineral production of $439,234,000. This development has been due to tremendously increased demand for iron, coal, gypsum, gilsonite, uranium, salt, and many other minerals from markets outside the state. Much of Utah's manufacturing growth has been in plants to process those minerals to compete for out-of-state markets.

The most recent major additions to Utah's productive minerals are uranium, oil and gas, and potash.

Uranium was first mined in Grand and San Juan counties in the early 1900s, but activity came to an end in the early 1920s. In 1950, two years after the Atomic Energy Commission announced an incentive purchase program, there were only 14 mines in Utah and one government-owned mill at Monticello, Utah. The industry passed through the highly promotional, speculative stage, similar in some respects to the early-day gold rush booms. By 1958 there were 392 producing mines located in 11 counties of the state. Uranium mining in Utah

*Statistics and Technology of the Precious Metals—a report of the Census Bureau to the Department of the Interior for the year ending May 31, 1880.

reached its peak that year, when 1,239,767 tons of ore was mined, containing 4,456 tons of uranium oxide (U_3O_8).

Similar production increases in other states, principally New Mexico, Wyoming and Colorado, resulted in a great over-supply for government needs. As the government was the only buyer of uranium, a curtailment program was initiated, which resulted in trimming Utah's production back to 761,180 tons of ore in 1964, containing 3,015 tons of U_3O_8. Preliminary data for 1965 and 1966 show further reductions. The government will continue to buy a limited amount of uranium through 1970. After 1970 sales will be made principally to private buyers. The great improvements in atomic energy power plants promise a substantially increased market for uranium by the mid-1970s. Exploration for uranium for these future markets has reached a high level and Utah's uranium mining industry will likely return toward its former high production levels.

Oil and gas have similarly progressed from a very minor role to one of major importance. A few prospecting wells were drilled in Utah over the past 50 years but no commercial oil discoveries were made until 1948. After that year, production of oil jumped from practically zero to a rate of 115,000 barrels per day in 1958. Numerous oil fields have been developed in Uintah, Duchesne and San Juan counties. Natural gas has been produced on a relatively small scale over several decades. New discoveries in central and southeastern Utah since 1953 have greatly increased natural gas reserves and have justified construction of pipelines to communities in Utah and from Utah fields to the northern Pacific Coast area; also to older lines from New Mexico and Texas for delivery of gas to California.

High cost potash was produced from the alunite deposits near Marysvale, Utah during World War I when potash shipments from Germany were cut off. In 1936 a potash plant was built near Wendover, Utah, to recover potash from salt brines. It has continued to operate since that time. Potash was discovered in a salt dome near Moab in southeastern Utah in the process of drilling for oil. Mine development and a milling plant designed to treat 4,000 tons per day went into operation in 1964 and began making shipments of potash early in 1965. Utah now ranks as a major potash producer with substantial reserves for future operations.

Utah's great and varied mineral reserves have made possible a progression through various phases of activity, each materially broadening the economic base of the state. In review those phases were:

1. Production by the pioneers of minerals suitable to their isolated, home-industry, agricultural economy—1847-1869.
2. Mining and smelting of lead, silver, gold, joined by copper and zinc in the latter stages—1869-1940—largely for export trade.
3. Mining and processing of metals and nonmetallic minerals to meet needs of rapidly growing Western States area—(iron, gypsum, phosphate, cement, salt, potash, clays, etc.)—1940 to present.
4. Uranium, potash and oil and gas development—1948 to present.

The fifth, or future phase, is the retention of the broad economic base furnished by Utah's highly varied mineral production and the addition to the list as markets, technology, and production costs permit, of our potential mineral production in oil shale, potash, various industrial clays, etc. . . .

Utah has gone a long way toward fulfilling Abraham Lincoln's prediction, "Utah will yet become the treasure house of the nation."

SECTION II

OPERATIONAL PRACTICES AND PROCEDURE IN UTAH'S MINING INDUSTRY

General Comments on Minerals and Metals in Industry

Minerals and metals are classed in several categories—each of which will justify brief comment to make its place more understandable in Utah's economy. The general categories are:

Definitions

I.—Metallic Minerals.
- A. Ferrous—those utilized for their iron content.
- B. Nonferrous—all metals other than those utilized for their iron content.

II.—Nonmetallic Minerals—includes all minerals excepting those from which metals are derived, or which are used as fuels.

III.—Mineral Fuels.
- A. Solid fuels—coal, lignite, peat, etc.
- B. Liquid fuels—oil, natural gas, natural gasoline, etc.

The minerals listed under each of the above general categories in the 1966 Utah production statistics of the United States Bureau of Mines are as follows:

Classification

"Metallic Minerals"	"Nonmetallic Minerals"	"Mineral Fuels"
Copper (nonferrous)	Asphalt and Related Carbons	Coal (solid fuel)
Gold (nonferrous)	Gilsonite	Natural Gasoline (liquid fuel)
Iron (ferrous)	Carbon Dioxide (natural)	Petroleum (liquid fuel)
Lead (nonferrous)	Cement	Natural Gas (liquid fuel)
Molybdenum (nonferrous)	Clays	
Silver (nonferrous)	Fluorspar	
Uranium (nonferrous)*	Gypsum	
Vanadium (nonferrous)	Gem Stones	
Zinc (nonferrous)	Lime	
	Perlite	
	Phosphate Rock	
	Potash	
	Pumice	
	Salt	
	Sand and Gravel	
	Stone	
	Sulphur	

Marketing Information

The metals, all except iron, are marketed freely over the nation because of their high or relatively high market value in relation to bulk. Most of them are processed in Utah to a refined or semi-refined state and then shipped to other areas. There is at present very little manufacturing of useful articles or consumer goods in Utah from the metals refined in Utah, excepting iron.

Most of the iron mined in Utah is smelted and converted to steel in Utah

*Uranium, although a metal, is increasingly used as a fuel in power plants.

plants. There is also a growing manufacturing industry producing structural steel, iron and steel pipe, etc., based on availability of iron and steel.

Some of the nonmetallics can be marketed throughout wide areas—potash, fluorspar and gilsonite being examples—**but most of them are low in value, must be processed close to their source and face strong competition for markets with plants in other nearby states** which are mining and processing the same minerals. Gypsum, cement, lime, etc., are examples. Sand and gravel and crushed stone are examples of minerals which can generally be marketed only in local areas and, therefore, are seldom exported from the state for sale.

Factors Controlling Mineral Development

Minerals play an important role as a base for industrial development, and therefore citizens of Utah are highly favored in the variety and abundance of the state's mineral resources.

Important Factors

There are several factors in mineral economics which must be favorable before development of a mineral deposit is justified. Basic among these factors are:

Location of the deposit in relation to transportation and marketing facilities.

Transportation facilities and cost.

The market for the product, its location and the volume of its demand for the product.

Nature's mineral deposits have no commercial value until the factors of transportation and markets become favorable for their development.

The location of manufacturing plants is determined primarily by the availability of the raw materials needed, the cost of transportation and the size of the markets. The locality in which they are to be placed is chosen after full consideration of these evaluable conditions. It is obvious, however, that mines can only be located where nature deposits the minerals and metals in the rocks of the earth's crust. The finding of a mineral deposit does not assure the development of a mine. There must be a market close enough to the deposit so that there is profit in mining the mineral products after paying the cost of transporting them to that market.

The critical effect of transportation is illustrated in Utah's history by the fact that mineral deposits had been found in Utah's famous mining areas before the railroad was completed to Utah in 1869. However, there was little mining other than for silver and gold. The lead, copper and other metals could not be profitably transported in wagon trains to eastern markets. Immediately after the railroad reached Salt Lake Valley in 1870, lead and silver mining became a major industry, and in 1872 Utah produced forty-five percent (45%) of all the lead mined in the United States.

Iron mining in Utah serves as an excellent example of relationship of mineral developments to markets. Although the Iron County deposits were discovered in 1850, there was no commercial development until 1922, when blast furnaces were built at Ironton to take advantage of a newly developed market on the West Coast.

The mineral deposits have always been present in Utah but they have been

slow in developing—a fact attributable partially to transportation, but principally to lack of markets. Many mineral deposits, like iron, have lain undeveloped for many years while waiting for markets to develop. The same is true of the nonmetallic minerals which generally require low cost transportation and relatively nearby markets.

Growing markets in recent years, both nation-wide and in nearby areas, have greatly stimulated the demand for Utah's minerals. Deposits of previously uneconomic minerals have been developed, production of other minerals and metals increased and many mineral processing plants established. Markets, particularly those in the nearby Rocky Mountain and West Coast states, promise continued rapid growth. Logically, the demand for Utah minerals and products made by Utahns from Utah's minerals and metals will share in that growth.

Basic Functions of the Mining Industry

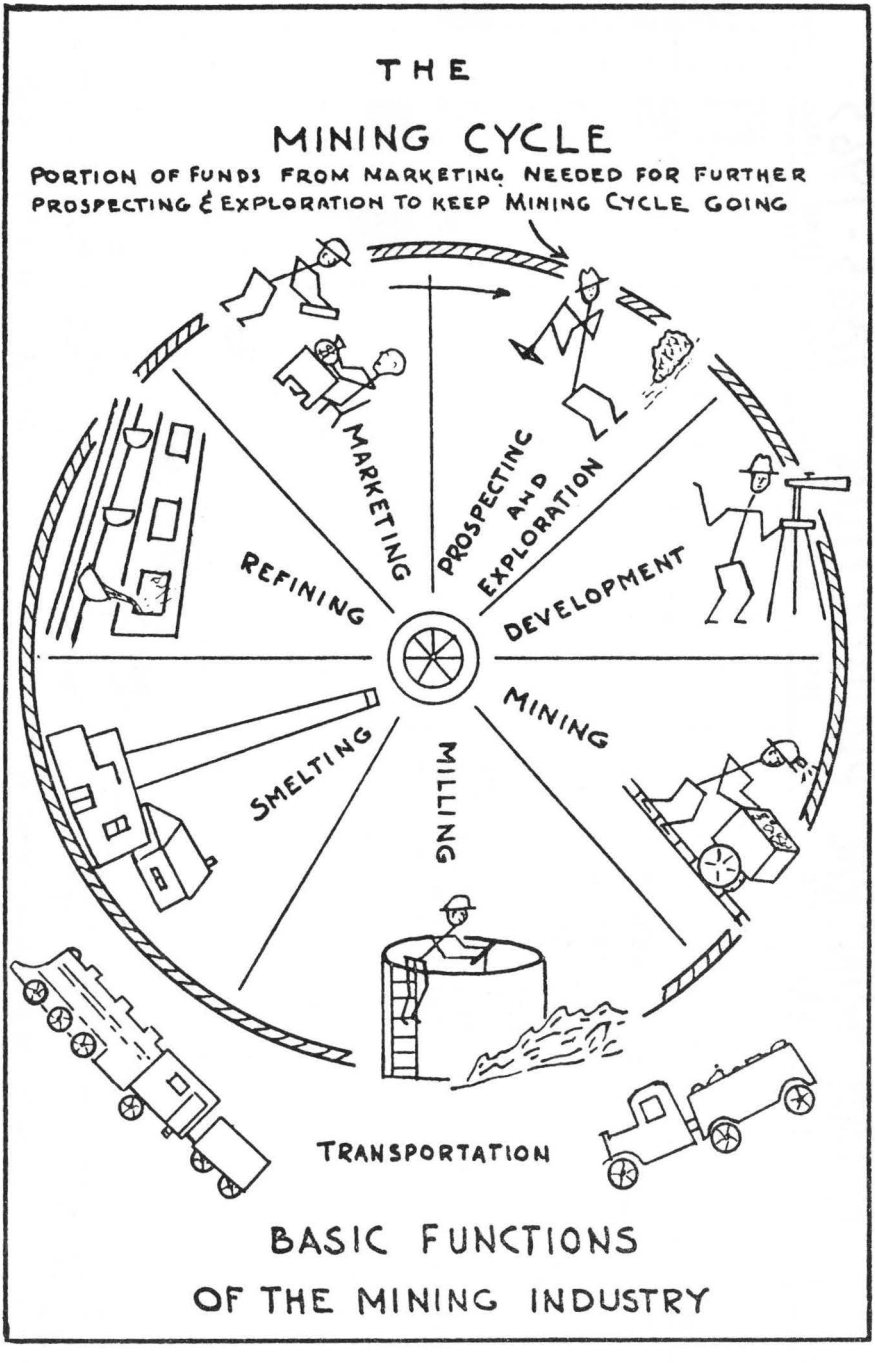
Mining is commonly assumed to be simply the process of extracting ore from the ground. It is much broader, however, in that finding, testing and developing of ore deposits precede the actual mining. Milling, smelting and refining follow after mining in order to separate the metals and minerals from worthless rock and put them in a usable form. A listing and brief discussion of the various phases of the mining industry is presented in the following paragraphs:

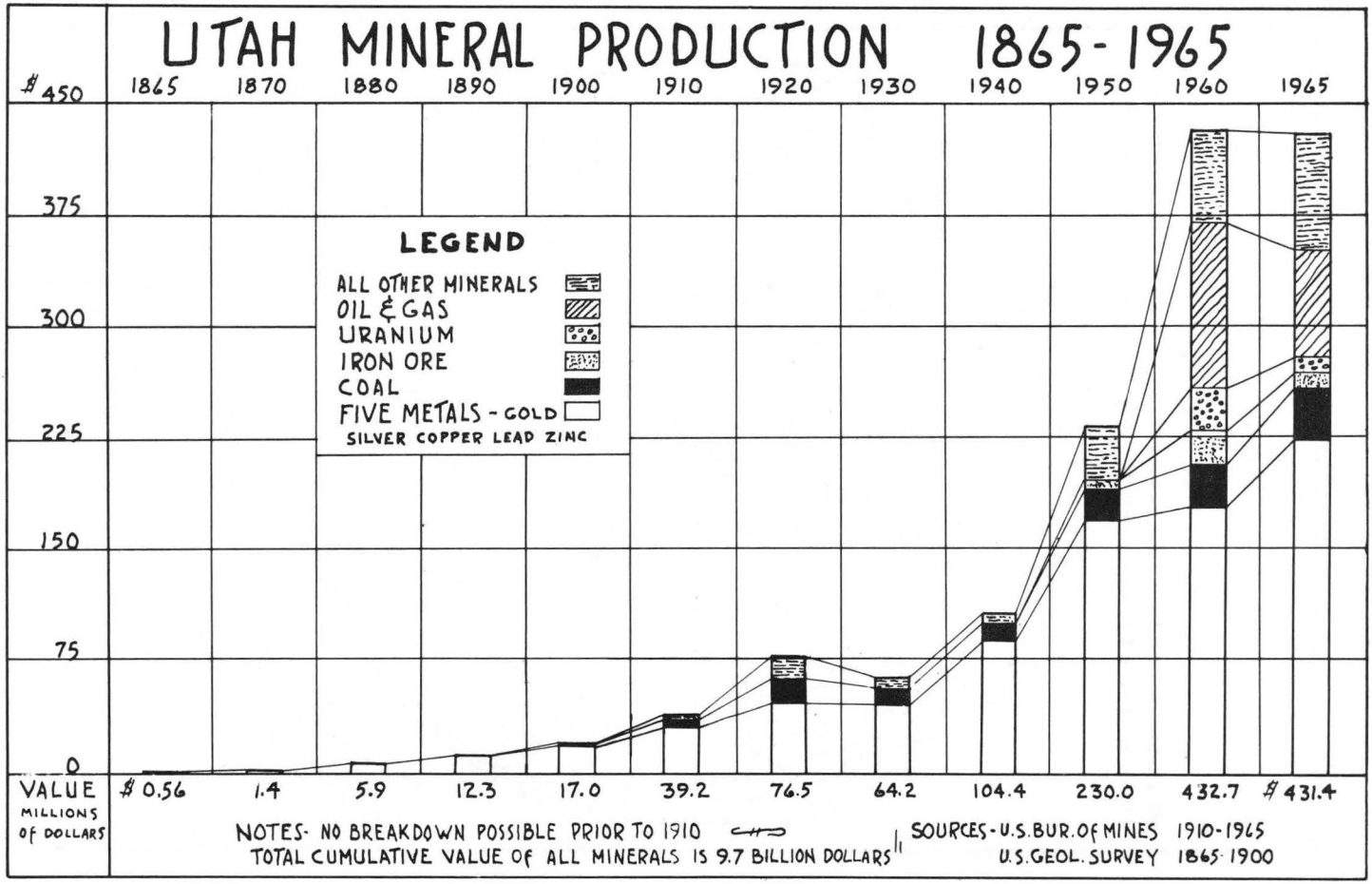
Prospecting and Exploration for Minerals and Metals

The earliest prospectors probably looked for stones of the right shape and size to perform simple jobs, or searched for certain types of stones which could be readily shaped and which were hard enough to wear well. Copper, tin, lead, gold, silver, iron, clays and certain building stones later became objects of the prospectors' search, as these minerals became useful and valuable coincident with man's increased know-how and skill. The Bible and other ancient records mention early use of these metals and minerals.

The present day prospector has a multitude of minerals and metals to look for in our highly specialized industrial era, and in our American free enterprise system those who prospect and explore for metals and minerals do so at the risk of their own money and effort. There are many failures for each success, but the rewards for success are often substantial. In drilling for oil it has been estimated that there are about nine "dry" or unproductive holes for each one which proves to be a producer. In metals it is not possible to make a statistical comparison of the successful and unsuccessful ventures. However, the risk nature of prospecting and exploration is illustrated by the fact that many prospects prove valueless; further by the fact that many mines are worked unprofitably in the hope that through continued digging, better grade ore and larger deposits will be found.

The mere presence of ore does not prove the existence of a profitable mine. The deposit must be explored through drill holes, sinking of shafts, or running of tunnels to determine size of the deposit, its grade and character and physical features affecting mining and marketing costs. If these factors are all determined favorably (up to this point all cost of prospecting and exploration has been a risk, for there is no salvage value in an uneconomic deposit), the next step is development, for exploration stops when a mineral deposit has been determined to have real economic value.


THE
MINING CYCLE
PORTION OF FUNDS FROM MARKETING NEEDED FOR FURTHER PROSPECTING & EXPLORATION TO KEEP MINING CYCLE GOING
MARKETING
PROSPECTING AND EXPLORATION
DEVELOPMENT
MINING
MILLING
SMELTING
REFINING
TRANSPORTATION
BASIC FUNCTIONS
OF THE MINING INDUSTRY


UTAH MINERAL PRODUCTION 1865-1965
$450
375
300
225
150
75
0
1865
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1965
LEGEND
ALL OTHER MINERALS
OIL & GAS
URANIUM
IRON ORE
COAL
FIVE METALS - GOLD
SILVER COPPER LEAD ZINC
VALUE MILLIONS OF DOLLARS
$ 0.56
1.4
5.9
12.3
17.0
39.2
76.5
64.2
104.4
230.0
432.7
$ 431.4
NOTES- NO BREAKDOWN POSSIBLE PRIOR TO 1910
TOTAL CUMULATIVE VALUE OF ALL MINERALS IS 9.7 BILLION DOLLARS
SOURCES - U.S. BUR. OF MINES 1910-1965
U.S. GEOL. SURVEY 1865-1900

Developing and Equipping Mines

Development of a proven economic mineral deposit consists of making the necessary underground openings and/or surface improvements to permit effective mining of the ore. The extent of the development varies with the type and size of the ore body. Some take several years of work to prepare the deposit for profitable mining. Large low grade deposits usually require the most time and the greatest investment to develop. In others, mining of the ore starts almost coincidentally with the beginning of development. Small high grade deposits usually follow this pattern.

Coincidentally with developing the mineral deposit, the mining plant and the necessary items of equipment are carefully planned, selected and installed, including hoists, air compressors, ore bins, repair shops, haulage systems, pumps, rock drilling machines, mechanized loaders for handling the broken ore, light, power and water systems, ventilation equipment, material storage yards, access roads and housing facilities for the workers if the mine is in an isolated area.

The expenditures in developing and equipping are made as an investment in the mineral deposit and are expected to be recovered from mining ore. Prospecting and exploration expenditures are also real costs. Profit is realized only after the mine has paid back all exploration and development costs.

Mining Ore Deposits

Mining in broad definition includes all processes for extracting minerals from the earth's crust, whether the mineral being extracted is solid, liquid or gaseous. Thus gas and oil wells, salt recovery through evaporation, open pit, quarry or underground operations all are mining activity.

However, we will not attempt to discuss here the details of each type of mining operation.

Most nonmetallic solid minerals of relatively low raw material value, such as sand and gravel, gypsum, limestone, cement rock, clays, rock asphalt and stone, are mined usually from quarries or pits. Some nonmetallics of relatively high market value, such as fluorspar and gilsonite, are mined by underground methods. Coal is mined in Utah almost entirely from underground mines. In some other areas "strip" coal mining (open pit) is used extensively.

The metals are mined by both open pit and underground operations. The iron mines of Iron County and the copper operation at Bingham are good examples of large tonnage open pit mines.

Underground mining is probably the most complex of all the mining operations. Mechanization is adaptable to only a limited extent in most underground mines. Therefore, a high percentage of the mining cost is for manual labor. In western underground mines, labor represents about 60% of the total mining cost.

Mining, or extraction of the ore, begins after the necessary mine openings have been made and the equipment installed in the development phase. The actual ore extraction operation is called stoping. In some mines the rocks encasing the ore are very firm and the ore can be removed without support. In others the encasing rock is fractured and requires support by timber or waste rock fill. Water is often a problem requiring pumps, water lines and much power to bring it out of the mine.

Basically, the ore extraction process involves drilling holes in the ore in which explosives are placed to break it, after which the broken ore is loaded and transported to the surface. Trains or hoists or a combination of the two are used.

The full process, however, is actually very complicated and requires careful planning. Many men and considerable equipment are required to supply timber, compressed air, powder, water, tools, etc., to the mine crews breaking, loading and transporting the ore and to others engaged in mine maintenance and repair.

In underground mines all movements of men, supplies, equipment and ore are handled through shafts or tunnels in which the hoists or trains operate. Proper ventilation must be provided throughout the working places in the mine to exhaust the gases created by the explosives and to furnish fresh air to the workman.

Planning and directing a mining operation, either underground or open pit, is a highly specialized business, requiring engineering training, practical experience and good judgment. The jobs in mining require men with skill in mining, timbering, equipment handling and a knowledge of the various ores and types of rock.

Mines do not compete against each other in the sense that each tries to produce a better and more salable product than the other. To illustrate: copper, lead, zinc, pig iron or steel ingots produced from the ore of any mine are refined to set standards of purity and are sold for industrial use on the basis of those standards. The competition of mines is against the price being paid for the metals they produce. Every mine contains ore of varying grades in terms of metal or mineral content, and gains in terms of efficiency and lower cost change some of the lower grade mineralized rock to minable ore. This principle is well illustrated in the fact that Kennecott's Utah Copper open pit operation at one time could not afford to send to the mills ore which carried less than 0.8% copper (16 pounds copper per ton). By constant improvements over the years they can now send to the mills ore which contains copper as low as 0.4% (8 pounds copper per ton). The average grade of all ore mined at present in the copper open pit is about 0.725% copper (14.5 pounds copper per ton), so it is obvious that most of the minable ore would have been exhausted and the mine abandoned long ago if substantial improvements in efficiency had not been accomplished over the years.

In mining operations development work is usually being done in areas extending outward and downward from the places where ore is being mined, for the mineralized area has not usually been fully developed when actual mining begins.

The life of a mine depends upon the efficiency of the operation and the success of the development work carried on while mining is in progress in finding new ore reserves. Price of the metals and minerals is also a great factor in determining the life of the mine, for it is readily apparent that a rise in price would permit the mining of lower grade ore and, conversely, a lowering of price would change some ore to unprofitable rock.

As an example of the effectiveness of the prospecting, exploration, development and mining cycle, Utah has, since lead mining began about 1870, produced about 5,000,000 tons of lead. However, during that 85-year period the mines, at any one time, have never had more than two or three years' supply of ore available as proven ore reserves. Exploration and development have been continuous and have succeeded in adding new reserves as the proven ore was mined out.

As a measure of the importance of exploration to the life of mining, "The President's Cabinet Committee on Minerals Policy," in its report to the President, Nov. 30, 1954, page 14, states:

"Today's mines are the result of exploration, development and risk taking over a period of many years. Exploration for mineral deposits often requires substantial venture capital . . . much of it a total loss."

Milling and Concentrating the Ore

As a general rule, the minerals, after being mined, must be separated from waste rock to make them usable to industry. However, there are a few, such as sand and gravel, natural gas, cinders, perlite, pumicite, coal and some of the brick clays, which are used as mined, although even with these materials, washing, crushing and/or sizing are sometimes necessary.

Complex processing is usually required for the metals because the minerals containing the metals are generally found scattered (disseminated) through hard rock from which the minerals have to be separated. Lead, zinc, copper, gold and silver are often found closely associated in the ore. So to recover the maximum amount of each such metallic mineral, they must be separated as completely as possible from each other and from the waste rock. This phase is known as milling and concentrating.

Transportation costs are important in mining economics, particularly in moving the ore from the mine to the mill and the concentrates to the smelter. The mill man's problem is to recover the maximum amount of mineral from the ore and to concentrate it into a small bulk for shipment to the smelter. He does a great deal of testing to determine the most economic balance of recovery and concentration of the minerals for the particular ore being treated, and testing is usually carried on during the entire operation to improve the recovery and to eliminate more waste. The effort to lower the cost in the competition against price is as important in the mill as in the mine.

Milling is essentially a physical process, one of separating valuable material from waste rock, and usually no chemical changes are made in the mineral particles. In the separation process one or more types of concentrates may be produced, depending upon the minerals present in the ore.

Briefly the milling process is as follows:

The ore is crushed to particles having a maximum size of about one-half an inch. The ore is then fed with water to ball or rod mills where steel balls or rods in a rotating, heavy steel drum grind the ore to the size necessary to free the mineral particles from the waste rock. The size to which the ore is ground is controlled by "classifiers" which receive the discharge from the grinding mills and which, through a raking action, keep the fine ore agitated. The particles too coarse to be carried over the classifier overflow are raked back and returned to the grinding mill. The desired size of the material in the overflow from the classifier can be very closely controlled through the amount of water used and the speed of the raking action.

The classifier overflow material is mixed with certain chemicals and oils (flotation reagents) which attract the mineral particles. While the finely ground ore (called pulp) is passing through the flotation machines, these chemicals and oils rise to the surface, gathering particles of mineral, and are there skimmed off as concentrates. The amount of reagents and the time allowed for contact of the reagents and the mineral particles in the flotation cells are the important factors controlling mineral recovery.

There are reagents which will attract but one specific mineral, so where two or more concentrates are to be made, one mineral is separated first by use of the proper reagent, then, as the "pulp" moves on through the flotation cells, other

reagents are added to separate the other mineral or minerals. The name "selective flotation" is descriptive of this process.

As a note of interest, the principle of flotation for separating minerals from waste rock was discovered only about forty-five years ago. Previously, gravity methods and certain chemical and electrical processes had been used, which were less efficient with many ores and which could not recover and concentrate others. Flotation was a tremendous gain. As an example, when zinc sulphide (sphalerite) was in mixture in the ore with lead sulphide (galena), the zinc could not be saved. Zinc was actually a waste material in Utah's mining, prior to 1925, when selective flotation made its recovery possible.

The concentrate or concentrates, after being skimmed off the flotation cells, are passed through filters to draw off the excess water, and the concentrate is then ready for shipment to the various types of smelters.

The concentrates, although composed principally of one mineral, still contain other valuable minerals and metals. For instance, a lead concentrate will carry some copper, silver, gold and zinc, if the original ore carried minerals of those metals. The physical separation, however, has been accomplished to the extent that it is practical with present available processes and reagents.

Smelting Concentrates

The smelting process, by effecting chemical changes in the composition of the minerals, separates the metallic elements from others with which they were combined. The separation is accomplished through melting the concentrates in furnaces of various types and draining the molten metals and the molten waste (slag) separately from various levels near the furnace bottom. The molten metals, being heavier, go to the bottom.

Coke or coal to promote combustion and various materials (called flux) are mixed with the concentrates before they are placed in the furnace. The fluxes serve to combine with the waste elements while the charge is melting to make chemical compounds and leaving the metals in a free molten state. The fluxes in most smelting operations consist of limestone, silica and iron or manganese, in such amount as is needed to make the necessary chemical change. The furnace operator must know the chemical content of the concentrates in order to add the proper character and amount of fluxing material. If the melting mass is not of the right chemical composition, separation of the metals is incomplete and there is considerable loss of metals in the slag.

Most ores and concentrates have a high sulphur content, which must be materially reduced before they can be placed in the smelting furnaces. They are mixed with coke and passed through mechanically operated roasting machines where flash heating drives off most of the sulphur. This process, in addition to driving off the sulphur, partially fuses the ore mass in a cake-like form called sinter. The sinter is then crushed and mixed with fluxing materials prior to placing in the smelting furnaces.

Each smelting plant has large pipes and brick conduits leading to a high, narrow building resembling to some extent a grain elevator. This building is the "bag house" and the pipes and conduits leading to it are used to collect gases given off in the roasting and smelting processes. These gases are treated to remove the dust and minerals which form as the gases are cooled. The solids recovered are then treated, and numerous by-products are recovered. At the Garfield copper smelter, about 1440 tons (rated capacity of plant) of sulphuric acid is made each day from the sulphur recovered as a by-product. Arsenic, antimony and bismuth are other important by-products of Utah's smelters.

The metal products of the smelter are still not pure enough to use for manufacturing purposes and must be treated further. The lead bullion and blister copper from smelters contain small amounts of other elements as well as the gold and silver which were melted out of the ore and concentrates. These elements require further treatment.

Utah has one active copper smelter at Garfield. Its principal source of concentrates is the Kennecott Copper Corporation's Utah Copper open pit mining operation. The lead smelter at Tooele is operated in conjunction with a zinc fuming plant, which extracts zinc from the hot slag being discharged from the lead furnace. Some of the cold slag in the old slag dumps is high in zinc and this material is also being processed for zinc recovery in the fuming plant. The end product is zinc oxide which is shipped to other points for further refining.

Utah is one of the most important nonferrous milling and smelting centers in the United States. Our many mines and mines in portions of Arizona, Colorado, California, Nevada, Idaho and Montana contribute to the ore supply of Utah's mills and smelters.

Refining Metals

Kennecott Copper Corporation's electrolytic refinery at Garfield, Utah refines the copper smelted from concentrates produced at the company's mills. The copper is first cast into anodes at the Garfield smelter. The following brief description from **The Utah Copper Story** outlines the electrolytic refining process:

> "The refinery, completed in 1950, produces electrolytically refined copper, the purest type. Anodes from the smelter are placed in lead-lined tanks containing copper sulfate and sulfuric acid. Then sheets of refined copper, called cathode starting sheets, are placed between the anodes. An electrical circuit is completed from the anodes through the copper sulfate and sulfuric acid solution to the starting sheets. As the anodes dissolve in the solution, the electrical charge transfers small particles of copper to the starting sheets. Impurities, including minute amounts of precious metals, fall to the bottom of the tank as mud. Precious metals are later recovered.
>
> "During the electrolytic action, the cathode starting sheets become thicker, the anodes become thinner, until about 15% of the original anode remains. The cathodes, now 99.96% pure copper, are removed, washed, and taken to electric furnaces for melting and casting into new shapes."

A plant addition to the refinery produces special products from some of the refined copper to supply western markets.

All the lead bullion produced in Utah lead smelting is shipped to eastern refineries for treatment. It is refined by either electrolytic or furnace methods to produce salable lead. The zinc oxide produced at the Tooele smelter zinc fuming plant is also shipped to eastern plants for refining.

The zinc concentrates produced in Utah's flotation mills are usually shipped to electrolytic zinc refineries in Montana. The zinc concentrates are "roasted" and the zinc then dissolved in sulphuric acid solutions. The other elements, including minor amounts of gold, silver and other metals, are precipitated out of the solution. The zinc is then precipitated from the solution in metallic form by electrolysis. It is now zinc metal, pure enough to be used in manufacturing processes.

After the refining of each of the metals—copper, lead and zinc—there are residue materials containing many other metals and elements. These are sub-

jected to further smelting type treatment for the recovery of gold and silver, cadmium, bismuth, antimony and many others.

The next problem is marketing of the recovered, processed and refined minerals and metals.

Marketing of Metals and Minerals

Basically different principles are involved in the marketing of metals and the marketing of nonmetallic minerals. There are exceptions, a few of which will be discussed, but the rule generally holds true.

Refined metals are salable as such over wide geographic areas, even crossing oceans when local supply and demand are out of balance. As metals are basic elements, it is possible to bring the refined metals to exact specifications of purity, which fact practically eliminates competition as to quality.

Nonmetallics are more available in nature than the metals and are usually more easily and cheaply mined. They meet competition close to home, so to speak, and therefore the economic value of any one deposit is governed to a great extent by the geographical relationship to other deposits and to the markets for the particular mineral. Nonmetallic minerals are usually used in the form in which they come from the ground and therefore the grade and purity also affect their usefulness and their marketability. Deposits of the nonmetallic minerals used in manufacturing are commonly owned and mined by the company engaged in the manufacture of the end products.

In the nonmetallics there are some notable exceptions. Some, such as coal, fluorspar and gilsonite, are mined in much the same manner as the metals, are sold to users independent of the producing companies and also move considerable distances to markets. Potash and phosphates are other nonmetallic minerals marketed over a wide range.

Sand and gravel is typical of the short marketing range of nonmetallics. Here in Utah almost every village has its own sand and gravel pit. High transportation costs, low mining costs and common occurrence prevent its being hauled for any great distance for sale.

Gypsum, cement rock and brick clay are typical of integrated industries based on the nonmetallics and of the competitive limits of marketing. Gypsum is quarried from very extensive deposits at relatively low cost near Sigurd, Utah. It is hauled a short distance to plants at Sigurd and made into plaster, rock, lath, wall board, etc. Its marketing area is limited by competition with similar plants in Colorado, southern and central California, Arizona, Washington, Oregon and Montana. Actually, the companies in each area sell as far from their plants as their cost of production and the cost of transportation permit; that is, to the most distant points where they can better or equal the offering price of a competitor. If the costs at any plant increase in relation to its competition, then that plant's competitive area shrinks and the competitor's gains.

The market for metals is based on a standard price and uniform quality at the principal marketing point for the metals; i.e., New York for lead, St. Louis for zinc, and the Connecticut Valley brass manufacturing centers for copper. Thus, as stated previously, the mine operator competes against price rather than against other mines. The metal miner can always sell his products, but whether he can do so profitably depends upon his ability to produce at a lower cost than the price which he receives.

Most metal mines sell their ore production to mills or smelters at the prevailing price for the metals contained in the ore, less metal losses in treatment,

costs of milling, smelting and refining, and transportation cost to the marketing center. Metal prices change from time to time, and the profit position of the mine operator obviously changes when the price changes. The uncertainty of future prices thus makes mining a gamble beyond the prospecting and exploration stage when effort and money are risked in trying to find a mine.

Iron is a notable exception to direct marketing of metals, in that a substantial portion of iron mining is done by companies which smelt the ore, make the steel and manufacture articles for use. The major copper companies are also tending toward becoming integrated industries, in that they have acquired manufacturing plants for making salable goods from the copper which they mine, smelt and refine.

The capital investments made in the mine openings—the excavations of an open pit, or the shafts, tunnels, drifts, raises, stopes, etc., in the underground operation—are all made on the premise that mining the ore will be profitable. If such does not prove true then such investment is a total loss, for the mine openings cannot be moved or sold and thus have no salvage value. The ore reserves are also valueless if mining costs prove greater than returns from sale of ore. This situation might be contrasted with business and manufacturing ventures, in that failures in these fields leave opportunity to salvage some of the capital investment because inventory, equipment, buildings and land are usually salable.

SECTION III

ECONOMIC REVIEW OF UTAH'S MINING INDUSTRY

Value of Minerals (Production Statistics)

The U. S. Bureau of Mines value for Utah's production of gold, silver, copper, lead and zinc as presented in the following pages is based on the market price of the metals which are actually recovered from the milling, smelting and refining processes. This is not the value received by the mines, for the cost of milling, smelting, refining, marketing and transportation to markets must be paid by the mines from the total value as determined by the market price.

Mineral values shown other than those listed above are the actual raw material values as the minerals are sold or as they enter the refining or manufacturing processes. The major portion of the "other minerals" is sold or is processed in the state.

UTAH MINERAL PRODUCTION (1)

(U. S. Bureau of Mines)

Value shown in thousands of dollars

Mineral	Unit	1964 Quantity	1964 Value	1965 Quantity	1965 Value
Carbon Dioxide (natural)	M cu ft	96,432	$ 7	86,201	$ 6
Clays (2)	M tons	1,127	330	149	332
Coal	M tons	4,720	33,184	4,992	31,811
Copper	tons	199,588	130,131	259,138	183,470
Fluorspar	tons	W	W	W	W
Gem Stones (3)			75		75
Gold	oz	287,674	10,069	426,299	14,921
Iron Ore	M long tons	2,082	14,306	2,139	14,229
Lead	tons	40,249	10,545	37,700	11,762
Lime	M tons	163	2,917	189	3,470
Natural Gas (marketed)	mil. cu feet	80,175	10,904	71,616	8,952
Perlite	tons	2,003	12	W	W
Petroleum (crude)	M bbls	28,575	74,867	25,298	66,045
Pumice	M tons	W	W	W	W
Salt	M tons	371	3,848	384	3,591
Sand and Gravel	M tons	10,218	10,405	10,032	10,464
Silver	M oz	4,552	5,886	5,636	7,287
Stone	M tons	3,105	6,930	2,158	4,552
Sulphur Ore	long tons			2,156	3
Uranium Ore	tons	761,180	26,385	377,989	9,014
Vanadium	tons	405	1,214	387	1,353
Zinc	tons	31,428	3,548	27,747	8,102
Value of items that cannot be disclosed: Asphalt (gilsonite), cement, clays (fire clay and halloysite), gypsum, molybdenum, natural gas liquids, phosphate rock, potassium salts, and values indicated by symbol W			40,867		51,939
Totals (4)			$391,430		$431,378

Footnotes:

(1) Production as measured by mine shipments, sales, or marketable production, including consumption by producers.

(2) Excludes fire clay and halloysite; included with "Value of items that cannot be disclosed."

(3) Weight not recorded.
(4) Total adjusted to eliminate duplication in the value of raw materials used in the manufacture of cement and lime.
W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."

Total Production of Utah Minerals from Earliest Record to End of 1965:

(Based on U.S. Bureau of Mines statistics, with a few estimates covering early years)

Period	Mineral	Unit	Production	Value
1864-1965	Gold	troy oz.	17,765,288	$ 522,012,000
1864-1965	Silver	troy oz.	833,437,000	634,172,000
1864-1965	Copper	short tons	9,271,898	3,883,743,000
1864-1965	Lead	short tons	5,272,599	727,166,000
1864-1965	Zinc	short tons	1,680,364	315,812,000
1870-1965	Coal	short tons	286,318,000	1,020,108,000
1906-1965	Iron Ore	long tons	72,273,000	341,935,000
1880-1965	Salt	short tons	7,925,000	49,699,000
1955-1965	Uranium Ore	short tons	9,659,000	279,612,000
All others				1,913,729,000
Total all-time mineral production value for Utah				$9,687,988,000

Utah's Ranking Nationally in Over-all Mineral Production

	Rank in Population	Rank in Value, Total Mineral Production	Percent of U.S. Total	Rank in Variety of Mineral Production	Number of Minerals Produced	Rank in % of Labor Force in Mining
1950	38	13	1.94	3	33	4*
1955	39	15	2.10	7	29	
1960	37	12	2.41	4	32	6*
1965	37	16	2.02	4	31	

Utah's Ranking Among the States in Production of Selected Minerals — 1965:

Gold	No. 2	Zinc	No. 9
Silver	No. 3	Iron Ore	No. 4
Copper	No. 2	Uranium Ore	No. 4
Lead	No. 3	Molybdenum	No. 2

Some Economic Data on Utah Mining

Number of firms engaged in mining Utah's minerals, 1965	408
Number of firms engaged in primary mineral processing, 1965	127
Average monthly number of workers in mining, 1965	11,860
Average monthly number of workers in primary mineral processing, 1965	12,443
Total annual payroll of workers in mining, 1965	$83,873,802
Total annual payroll of workers in primary mineral processing, 1965	$94,159,792
Total assessed value, all Utah property, 1965	$1,528,768,090
Total assessed value, all Utah mines, 1965	$265,687,213
Assessed value of mines as per cent of total assessed value	17.38

*Denotes figure available only in census years.

(Assessed value of primary mineral processing plants, such as smelters, refineries, is not included with the mines figures. If it were available, it would add a substantial amount to mineral industries' valuation.)

PRODUCTION BY COUNTIES

Everyone takes a certain amount of pride in the accomplishments of his home area. Utah is fortunate in having record of mineral production from every one of its 29 counties.

It is possible that the number of minerals produced and the volume produced will increase in the various counties as factors for mineral development become more favorable. For that reason it has been deemed important to list as fully as possible the known mineral deposits in each area of the State, regardless of whether or not they are now being actively mined.

In some cases, minor production of certain minerals mentioned in the text is not shown in the county production table. In these cases, production was not reported to the Bureau of Mines. The county production tables were all prepared by the Division of Mineral Industries, U. S. Bureau of Mines, Denver, Colorado.

Footnotes used in the county production tables are as follows:
[1]Cannot be disclosed. Included in County total.
[2]Weight not recorded.
[3]Less than 1 ton.
[4]Commodities concealed to protect individual company confidential data.
[5]Cannot be disclosed. Included in Undistributed for State total.
[6]Preliminary figure.
[7]Includes some clays, gem stones, sand and gravel, and vanadium in various years where breakdown by counties is not possible.
[8]Totals have been adjusted to eliminate duplication of raw materials used in the manufacture of cement and lime.

BEAVER COUNTY

Area: 2,660 square miles. **Population:** 1960 census, 4,331; 1965 estimate, 4,200. **Active companies, 1965:** mining, 16; primary mineral processing, 1. **Average number workers, 1965:** mining, 77; primary mineral processing . . .* **Annual worker payroll, 1965:** mining, $450,806; primary mineral processing . . .*

Minerals history: The old **Lincoln mine** was discovered in 1852. **Isaac Grundy,** with others, built one of the first recovery furnaces at Minersville in 1858 to produce **lead** for bullets to protect settlers against Indians. One writer says: "Something in the lead made it too hard for that purpose; that 'something' was later found to be silver." And silver made Beaver County famous.

The fabulous **Horn Silver** was discovered in 1875 and the San Francisco district west of Milford became a roaring mining camp. For many years it was a heavy producer of **gold, silver, copper, lead** and **zinc,** with some **tungsten.** Now the rich surface ores are gone, mining costs are high, and metal prices low, so the once-rich metal producing districts are largely idle. A notable exception is the open pit copper mine of the **American Mining Co.** near Milford.

*Denotes figure not available.

Sulphur has held great promise among the county's nonmetallic minerals. It was mined at Sulphurdale by the early settlers, who built small processing plants and used sulphur for powder and medicine. Several attempts to commercialize the extensive deposits failed, two of them in the 1950s. However, **Sulphurdale Chemical Co.** constructed a $250,000 mill in 1961-62 and began commercial output in 1965.

Organized Mining Districts

Antelope—3
Beaver Lake—6
Bradshaw—15
Fortuna
Gordon
Granite—45
Indian Peak—45
Lincoln—53
McGarry
Newton—67
North Granite—36
North Star—98
Pine Grove—75
Pruess (Newhouse)—79
Rocky—83
San Francisco (Frisco)—87
Star—98
Sterling—101
Washington—109

Mineral production, 1964-65:

		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	1	1	509	$ 17,815
Silver	oz	1	1	121,719	157,383
Copper	tons	1	1	1,861	1,317,446
Lead	tons	1	1	78	24,305
Zinc	tons	1	1	28	8,030
Gem Stones		2	1	------	------
Iron Ore	long tons	1	1	------	------
Perlite	tons	2,003	12,436	1	1
Pumice	tons	1	1	1	1
Sand and Gravel	tons	38,000	37,000	514,000	476,000
Stone	tons	------	------	148	296
Sulphur	tons	------	------	2,156	3,000
Uranium Ore	tons	1	1	1	1
Totals			$2,421,769		$2,073,217

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Beaver County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: Deposits are found in all Beaver County districts, but only in the Rocky district is there a significant volume of production. The **American Mining Co.** is mining copper ore by open-pit methods at the **Bwana** mine just west of Milford in the Rocky district and is operating a mill two miles south of the mine. The concentrates, containing 30%-40% copper and traces of gold and silver, are shipped to Douglas, Ariz., for smelting. The **Tintic Lead Co.** is doing exploration work at the famous Horn Silver mine and the Cactus mine in the San Francisco district. There has been exploration activity with occasional ore shipments in the last ten years at the Harrington-Hickory mine in the Star district, the O.K. mine in the Beaver Lake district, the Creole mine in the Lincoln district near Minersville, the Jay Jensen mine near Milford, the Smokey Joe claims at Minersville and the Beaver View mine.

BISMUTH: Found in the Granite district. Deposits are undeveloped. **IRON ORE:** Deposits are located in many areas: the central Wah Wah Range, the Iron Queen mine (Blonde Mountain), Iron Mine Pass, the Rocky district, the

Blue Mountain area, the Mineral Range and the McGarry district. **Utah Construction & Mining Co.** has done exploration work at the Crypto iron mine near Milford. In 1964 the **Majestic Oil & Mining Co.** shipped iron ore from the Bwana mine in the Rocky district. **MANGANESE:** Deposits of manganese are found in the Black Rock (Shotwell) mine in the extreme eastern part of the county; also in the San Francisco district and the Steelville and Spor mines, as well as the Black Jack (Skougard) mine in the western area.

MERCURY: There is an undeveloped mercury deposit about 15 miles due west of Lund. The **C. O. Katie Mining Co.** of Los Angeles is doing some development work at the Horace Carter mercury claims, but no production has been reported. **MOLYBDENUM:** is found in the Beaver Lake district; the Cactus mine, Preuss district; the Harrington-Hickory mine, Star district, and the Horn Silver Mine, San Francisco district. **SELENIUM:** Is present in the Golden Reef mine, San Francisco district. **TUNGSTEN:** Has been shipped from the Old Hickory mine, Rocky district, the Copper King mine in the Star district and the Cupric mine in the San Francisco Mountains; also from the Garnet and Pass Canyon mines on the east side of the Mineral Mountains and the Creole and Two R's mines on the southwest side of the same range. Unworked tungsten deposits exist in other areas also.

URANIUM: Deposits are found in the Rocky district and the Indian Creek, Pine Valley, Mineral Range, Beaver and other areas. As many as five operators have shipped ore to the mills. However, the principal producer has been and still is the Mystery Sniffer mine near Beaver.

Beaver County's Nonmetallic Mineral Deposits and Operations

ALUNITE: Undeveloped deposits are located 11 miles northwest of Beaver —estimated to contain about 2,000,000 tons, averaging 30-34% alunite. **BARITE:** This mineral, in small quantities, was shipped from the Horn Silver mine near Milford by **Heinecke Bros.** in 1960. Other deposits are found in the Antelope, Beaver Lake, Granite, McGarry, Newhouse and San Francisco districts. **DIATOMITE:** Unworked deposits of diatomaceous earth lie near Milford and southwest of Beaver.

FIRE CLAY: Reserves of fire clay with commercial possibilities are located south of Frisco. **FLUORSPAR:** Was produced, chiefly during World War II, from the Indian Peak, Pine Grove and Star districts. Low-priced Mexican imports have lowered prices and temporarily forced the closing of Beaver County mines. **GEM STONES:** (Mainly quartz crystals and obsidian) have been collected commercially in the county. **NITRATE:** Deposits lie in western Beaver County, near Wildcat Canyon.

PERLITE: Is produced from several quarries in the county. Chief among these is the North Pearl Queen operated by **Henry Edward Schoo Co. Melvin Bradshaw & Sons** of Milford and **Thompson Block Co.** of Cedar City, Iron County, operate perlite quarries intermittently. **PUMICE:** Is quarried by **Melvin Bradshaw & Sons** near Milford. Other deposits in the same general area are owned by **Whitmore Oxygen Co.** and **Dr. Eugene Davies** and have produced intermittently. **SAND AND GRAVEL:** Is produced in Beaver County for local consumption, most of it being used for road construction. **Wiseman Ready Mix Co.** is a commercial producer of sand and gravel and ready-mix concrete. **SILICA:** A silica deposit in the northwest area of the county has good potential. Plans of **Western Minerals, Inc.,** a Nevada firm, announced in 1960, to commercialize the deposit and build a mill at Milford, have not materialized.

STONE: Crushed marble is produced by **Henry Schoo** and used for building chips. A large undeveloped deposit of white magnesian marble is found on the west slope of the San Francisco Mountains. Limestone, cut to dimension, is quarried intermittently at Beaver and Greenville. **SULPHUR:** Extensive sulphur deposits at Sulphurdale have been worked at various times for many years. Attempts to commercialize this native sulphur by **Chemical Corp. of America** in 1952 and **American Sulphur & Refining Co.** in 1955 were unsuccessful. However, a mill was built by **Sulphurdale Chemical Co.** in 1961-62, and the first production was reported in 1965. The property was shut down in 1966 when **E. L. Lewis,** owner of Sulphurdale Chemical, died. The firm has been acquired by **Gordon Ford** and **Dave Hoover & Associates,** who have announced they will increase mill capacity from 100 to 500 tons per day and begin an extensive drilling program. **VOLCANIC GRITS:** Have been produced at various times from deposits in the northeastern area.

BOX ELDER COUNTY

Area: 5,444 square miles. **Population:** 1960 census, 25,061; 1965 estimate, 29,000. **Active companies, 1965:** mining, 4; primary mineral processing, 5. **Average number workers, 1965:** mining, 12; primary mineral processing, 93. **Annual worker payroll, 1965:** mining, . . .*; primary mineral processing, $563,943.

Minerals history: Most ore deposits in Box Elder County are small and many are of low grade. The Box Elder mining district was organized Oct. 2, 1880, near the old railroad station of Bakers. A tramway and copper mill were constructed at Mineral Ridge, but no production was ever reported. However, there has been production of **gold, silver** and **copper** from other parts of the Box Elder district. Probably the best known mine in the county is the Vipont Silver mine in the Ashbrook district. A mill was completed in 1920, and for several years the mine was the fifth-ranking silver producer in Utah, employing 300 men in mine and concentrator. Limited mining has been done in the Willard and Sierra Madre districts, located in the mountains east of Willard, for **copper, lead, zinc** and **iron ore.** The Lucin district also has been an intermittent producer of nonferrous metals. Now attention is turning to exploitation of the brines of the Great Salt Lake and the recovery of **magnesium, lithium, potash** and other minerals from these brines. If development plans of major companies are realized, a rich new era for mining will open up in Box Elder County.

Organized Mining Districts

Ashbrook—5	Newfoundland—66	Rosebud Creek—84
Box Elder—14	Park Valley—73	Sierra Madre—92
Lucin—57	Promontory—71	Willard—115

Mineral production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Clay	tons	[1]	[1]	-----	-----
Lime	tons	13,325	$151,005	14,780	$267,374
Salt	tons	[1]	[1]	[1]	[1]
Sand and Gravel	tons	669,000	757,000	807,000	708,000
Stone	tons	364,064	938,845	2,463	99,195
Totals			$1,938,430		[5]

(For explanations indicated by bracketed numbers in the above table, see page 24.)

*Denotes figure not available.

Box Elder County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: There has been very little activity in recent years. Since 1950, occasional shipments have been made from the Copper Mountain mine, Lucin district; also from the Lakeview Carbonate, Vipoint Silver, Sunset, Tecoma, Delight, Skord and Silver Belle mines, most of it being silver-copper-lead and silver-lead-zinc ore. In 1966 the federal **Office of Minerals Exploration** gramted a $59,100 loan to **Thomas P. Miller** of Salt Lake City to assist him in a search for silver ores in the county.

ANTIMONY: Was shipped from the Dry Lake mine during World War II. **BISMUTH:** Has been discovered in the Newfoundland district, but no development work has been done. **IRON ORE:** Is found in the Lucin and Willard districts. **Thorndyke Corp.** shipped 6,337 tons of limonite-type iron ore in 1953 from an open pit at the Copper Mountain mine near Lucin. **MOLYBDENUM:** Has been located in small quantities in the Lucin district.

MAGNESIUM AND LITHIUM: These minerals loom large in Box Elder County's future economy. They promise to replace sand and gravel and stone as the leading minerals of the county. Several well-known companies and partnerships have obtained or applied for leases on lands exposed by receding waters of the Great Salt Lake with the avowed intention of developing industries for extraction of magnesium, lithium, potash and other minerals from lake brines. Among these are **Lithium Corp. of America,** in partnership with **Chemsalt Corp.; Great Salt Lake Chemical Co.; Dow Chemical Co.; Phillips Petroleum Co.; Stauffer Chemical Co.,** and **Corbin J. Robertson,** Texas oil developer. The Lithium-Chemsalt partnership has let a $7,250,000 contract for construction of 12,000 acres of solar evaporation ponds in the Bear River Basin. In addition, they plan to spend $16,750,000 for construction of facilities and purchase of equipment to produce magnesium, lithium, sodium sulfate, potash and salt.

TUNGSTEN: Deposits are located in the Rosebud and Grouse Creek districts; also in the Desert Peak area of the Newfoundland Range. The Grouse Creek area, first worked during World War I, has yielded about 6,000 units of Wo3, principally from the Lone Pine mine and the Magnitude and Rocky Pass mines. About 400 tons of ore was shipped from the Newfoundland Mountains in 1955-56. Tungsten developments were discontinued when the government's stockpile program expired in the late 1950s. **URANIUM:** Was discovered in the county about 1954, but there was only one small shipment, made in 1955.

Box Elder County's Nonmetallic Mineral Deposits and Operations

BARITE: Is found in the Rosebud district, but has not been commercialized. **BENTONITE:** Deposits lie in northwestern Box Elder County, but are too low grade for utilization at this time. **CLAYS:** Brick clay is produced intermittently near Mantua by **International Pipe and Ceramics Corp.** for use in its brick plant near Ogden. **GEM STONES:** Variscite and gypsum crystals are the chief gem stone materials collected in commercial quantities. **LIMESTONE:** is quarried and converted into quicklime by **Utah-Idaho Sugar Co.** for use in the refining of beet sugar at Garland.

LIQUID ASPHALT: A substance known by this name—also by the name of "Rozelite"—is obtained from springs in an area of several hundred acres on the north shore of the Great Salt Lake. Some of the springs were drilled years ago and the asphalt marketed in barrels for use in tempering rubber. The properties were especially active in the mid-1920s. Considerable of the material has been used in paving mixtures. Two wells were drilled in the Rozel area in 1964

and four more in 1965, but they yielded only a small quantity of oil and all of them have been shut in. The **Utah Oil and Gas Conservation Commission** lists five wells as "producible." **OIL AND GAS:** Since 1899 there has been limited and unsuccessful exploration for oil and natural gas in the county, mainly between the north arm of Great Salt Lake and Bear River Bay; also in the north and east areas. In the middle 1950s, several companies drilled for natural gas near the Brigham Bird Refuge, but without success.

OOLITE: There is a deposit of commercial-grade oolitic sands near Saline that produced at one time several hundred tons for experimental use as a flux at Geneva Works, but it is now inactive. **POTASH:** Is present in the brines of Great Salt Lake and on the salt flats in unlimited quantities. Development of these reserves seems imminent (see explanation under Magnesium and Lithium, above). **PUMICE:** An inactive deposit is located near Corinne, owned by **D. B. Green** of Tremonton. **SALT:** Small quantities of salt have been produced along the north shore of the lake, for many years. The only active producer at present is the **Lake Crystal Salt Co.**, Promontory Point, owned by **Milton G. Pence Feed & Grain Co.**, Ogden.

SAND AND GRAVEL: There is consistent production for commercial purposes and for road building. Active pits are operated by **Fife Rock Products Co.** and **Parson Red-E Mix and Paving Co.**, both of Brigham City; **Ray Holdaway** and **Dale's Red-E-Mix**, Tremonton, and **Thorn Construction Co., Inc.**, Springville. Another pit which produces intermittently is owned by **Hunsaker Sand & Gravel Co.**, Brigham City. **SILICA: General Refractories Co.** of Murray produced small quantities of silica sand in Box Elder County in 1956 for making refractory products.

STONE: This is one of the leading minerals of the county in volume of production. **The Southern Pacific Railroad Co.** has quarries at Lakeside and Saline where millions of tons of crushed rock has been produced for railroad ballast and riprap*. Limestone has been quarried for dimension stone near Mantua, onyx marble near Honeyville and granite at Willard. Lustrous green, white and light-brown quartzite and quartz schist have been produced for ornamental use from the Raft River and Grouse Creek ranges. From Park Valley deposits come green, buff, gray and brown-and-gray quartzite; also turquoise building stone. White marble is produced from a deposit near Groome, at the north end of the Newfoundland Range. **Fife Rock Products Co.** and **John H. Bott & Sons Co.** of Brigham City both quarry dimension stone.

CACHE COUNTY

Area: 1,164 square miles. **Population:** 1960 census, 35,788; 1965 estimate, 40,900. **Active companies, 1965:** mining, 1; primary mineral processing, 6. **Average number workers, 1965:** mining, 12; primary mineral processing, 57. **Annual worker payroll, 1965:** mining, . . .*; primary mineral processing, $295,625.

Minerals history: The history of metal mining in Cache County is a story of small high-grade pockets of ore, quickly mined out. It is reported that a sheep herder found the first ore in the La Plata region, southern Cache County. It was a large boulder consisting principally of galena. Unfortunately, shaft

*A foundation or sustaining wall of stones thrown together without order, as in deep water or a soft bottom, is called riprap. Stones used for this purpose bear the same name.

*Denotes figure not available.

sinking and drifting failed to disclose an ore body at that location. The La Plata area, however, proved to be the county's chief producer in the 1890s. Small shipments of ore from the Paradise, Hyrum, and La Plata districts sometimes ran as high as 46% **lead**; others 28% **zinc.** Ore has been shipped from the Richmond, Smithfield, Logan, Hyrum, Paradise and La Plata areas. No metal production has been reported from Cache County for many years.

Organized Mining Districts

Hyrum area	Logan area	Richmond—81
La Plata area	Paradise—72	Smithfield area

Mineral production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Lime	tons	1	1	1	1
Sand and Gravel	tons	290,000	$ 335,000	652,000	$764,000
Stone	tons	695,973	1,794,375	220,443	585,064
Totals			5		5

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Cache County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: There are no active operations at the present time, although there is potential for future development should conditions become favorable. **IRON ORE:** There is a deposit of iron ore at Mineral Point, near the head of Little Bear River. The property was active for a short period years ago, and the surface plant remains. Another deposit lies about five miles north of the old La Plata district.

Cache County's Nonmetallic Mineral Deposits and Operations

CLAY: Cache County contains a number of good deposits of clay for industrial use. One property, in Dry Canyon, near Smithfiled, has produced brick clay intermittently for the **Smithfield Brick and Tile Co.** plant. **LIMESTONE AND DOLOMITE:** There are several deposits of these minerals in the county that show promise. Limestone, quarried in Providence Canyon by **LeGrand Johnson Corp.,** is converted to lime and used by **Amalgamated Sugar Co.** in sugar refining.

OIL AND GAS: The record shows that two test wells were drilled west of Smithfield and Richmond many years ago, without success. Several companies have drilled in the county since 1950. Four wells, drilled in the 1956-60 period —one at Newton and three in the Amalga area—brought a good flow of water, which is being used for irrigation purposes.

SAND AND GRAVEL: Cache County is a consistent producer for commercial use and for road construction. Commercial producers, most of whom have screening and sizing plants and furnish ready-mix concrete, are: **Johnson Ready Mix Concrete Co., LeGrande Johnson Enterprises** and **Kloepfer Sand & Gravel Co.,** all of Logan; **Leonard M. Peterson,** Tremonton; **Savage Ready Mix Concrete Co.,** Hyrum, and **Cove Concrete Co.** at Cove. Several construction firms also produce sand and gravel when their work requires use of these materials.

CARBON COUNTY

Area: 1,487 square miles. **Population:** 1960 census, 21,135; 1965 estimate, 18,000. **Active companies, 1965:** mining, 22; primary mineral processing, 5. **Average number workers, 1965:** mining, 1,234; primary mineral processing, 27. **Annual worker payroll, 1965:** mining, $7,849,118; primary mineral processing, $149, 806.

Minerals history: When Carbon County was created in 1894, it was so named because of the immense deposits of coal and hydrocarbon shale in the area. It is one of two Utah counties in which no significant traces of metallic minerals have been found. **Coal** was discovered in 1849 and used for fuel by the early settlers. Carbon County's readily accessible coal has promoted the growth of many industries in Utah. The county has consistently produced about 75% of the state's output.

In 1923 **oil** and **gas** exploration began. The first carbon dioxide well was brought in on Jan. 8, 1924, and several additional wells have come into production since that time. **Byrd-Frost** discovered a large natural gas reservoir in the Clear Creek area in 1951, and that field has since become an important producer. There are promising showings of oil in wells recently drilled in many areas of the county. It appears that oil and gas may team with coal to make Carbon County, despite a complete lack of metallic minerals, an increasingly important raw materials producer for Utah and the nation.

Mineral production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Carbon Dioxide	M cu ft	96,432	$ 6,750	86,201	$ 6,112
Coal	tons	3,752,354	27,872,569	3,779,041	25,917,184
Natural Gas	mil cu ft	.....	.....	3,883[6]	547,000
Petroleum	M bbls	2	5,300	2	5,000
Sand and Gravel	tons	.....	.....	33,000	31,000
Undistributed[4]			1,368,000	.....	.....
Totals			$29,252,619		$26,506,296

(For explanation indicated by bracketed numbers in the above table, see page 24.)

Carbon County's Nonmetallic Mineral Deposits and Operations

BARITE: Was produced from a Carbon County deposit in 1959 for shipment to the **Custom Milling & Supply Co.** of Salt Lake City, but there is no record of the exact location of the property. **BITUMINOUS SANDS** (Rock Asphalt): Extensive deposits are found near Sunnyside, estimated by one source to total 725 million barrels of contained petroleum. They were worked every year from 1930 to 1952, inclusive, as a source of asphalt. The last year of production saw an output of some 30,000 tons, valued at $6 per ton. The quarry was closed in 1952 because it was no longer economic to compete with manufactured petroleum asphalt. However, these bituminous sands may yet be the basis for a thriving industry. **Shell Oil Co.** in 1965 began a project designed to use steam injection for recovery of oil from the sands. **Signal Oil Co.** and a partnership of Salt Lakers—**J. H. Morgan Sr., J. H. Morgan, Jr.** and **Clarence Justheim**—have also taken steps toward use of steam injection on claims they control in the Sunnyside area.

CARBON DIOXIDE: Natural carbon dioxide gas occurs in the Farnham Dome and Gordon Creek fields. The Gordon Creek field has been shut in since

its discovery in 1948. The **Mariani Air Products Co.** (formerly **Carbon Dioxide & Chemical Co.**) owns three of the producers and leases one from **Equity Oil Co.** The gas is piped to a plant at Wellington, where many tons of "dry ice" are made daily. The company also sells bulk and cylinder gas.

COAL AND ITS DERIVITAVES: Vast deposits of coal stretch through the county from east to west. Coal is by far the major mineral raw material produced in Carbon County. Output declined following World War II, due to competition from natural gas and fuel oils. Annual production now runs between three and four million tons, compared with about five and one-half million tons in 1944. However, optimism is mounting in the industry with increasing demands for coal to be burned in huge steam electric plants in the West.

Coke was the chief coal derivative produced in the county for many years. However, the **Kaiser Steel Corp.** in 1956 closed its 300 coke ovens at Sunnyside and there has been no production since. A very important derivative of coal is the **coal resins** collected by the **U. S. Fuel Co.** in a flotation plant at Hiawatha for shipment to Bauer, Tooele County, for further processing. **United States Resin Corp.** has a resin extraction plant at Spring Glen, Carbon County, with capacity of 30 tons per day.

Large tonnages of coal are shipped to **U. S. Steel's Geneva Works** in Utah County, where coke is produced for the company's iron smelting and steel making operations. U. S. Steel has immense coal washing and drying facilities near Wellington which blend and "up-grade" coking coals for immediate use in the blast furnaces. Few Utahns are aware that the quality of coke made from Utah coal is improved by adding small amounts of low-volatile bituminous coal and anthracite. In 1962 Utah imported 268,000 tons of such coal from Colorado and 169,000 tons from Arkansas and Oklahoma.

Active Carbon County Coal Firms—1966
(Utah Industrial Commission listing)

Carbon Fuel Co.....	Helper	Premium Coal Co.....	Wellington
Columbine Coal Co.....	Scofield	Spring Canyon Coal Co.....	Spring Canyon
Independent Coal & Coke Co.....	Castle Gate, Clear Creek, Kenilworth	U.S. Fuel Co.....	Hiawatha
Kaiser Steel Corp.....	Sunnyside	Western Coal Mining Co*.....	Mutual
Liberty Fuel Co*.....	Latuda		
Plateau Mining Co.....	Carbonville		

*Scheduled to close in 1966.

HELIUM GAS: Discoveries have been made in the south-central area of Carbon County. However, private interests are not permitted to develop this mineral. It is entirely under government control. **NATURAL GAS:** The Clear Creek field in western Carbon County is a major producer and there are producing wells in the Nine Mile Canyon, Peters Point and Stone Cabin fields. Production in 1965 was little more than half of the 1963 output. The 1965 production for the county totaled 3,883,000,000 cubic feet, worth $547,000.

OIL: The first drilling was done in 1923 and resulted in discovery of carbon dioxide. Prior to 1948 only nine oil and gas wells had been drilled in the county, most of them carbon dioxide. Exploration has been stepped up considerably since the oil boom began in 1948, with 38 wells (oil and gas) having been drilled between Jan. 1, 1954 and Dec. 31, 1963. Reports from the Utah Oil and Gas Conservation Commission show that in 1964-65 four wells were drilled in the county. Three of these were "dry" and have been plugged and aban-

doned. The other well had a showing of natural gas and is now shut in. In September of 1966 there were three producing wells in the county—all of them in the Jack's Canyon field. The Commission reported four "producible" wells in Jack's Canyon and one in the Grassy Trail Canyon area.

OIL SHALE: The vast oil shale deposits of the Uinta Basin stretch into Carbon County. They are undeveloped, but constitute a resource for future petroleum product needs. Over the last 20 years, research in extracting oil from these shales has developed processes which are close to being competitive with oil well production. **SAND AND GRAVEL:** A number of Carbon County deposits are utilized for road construction and commercial purposes. An active commercial producer is **Eastern Utah Development Co.** of Price. Users of sand and gravel in Carbon County are **Beacco Block Co., Carbon Ready Mix Co.** and **Steel Concrete Products Co.,** all of Price.

DAGGETT COUNTY

Area: 850 square miles. **Population:** 1960 census, 1,164; 1965 estimate, 700. **Active companies, 1965:** mining, 2; primary mineral processing, 0. **Average number workers, 1965:** mining, . . .*; primary mineral processing, 0. **Annual worker payroll, 1965:** mining, . . .*; primary mineral processing, 0.

Minerals history: There is no record of metallic mineral production in Daggett County, although some **copper** deposits are to be found in the south-central part of the county, particularly in the Red Canyon area. Associated with the copper ores are several other metallics, such as **gold, silver** and **iron.** Iron ore deposits are found in the Spring Creek, Birch Creek and Red Canyon areas.

The county's major nonmetallic mineral is **natural gas.** The first well was drilled in 1924. Earliest reported production was in 1929. By 1948 an even dozen wells had been drilled in the county, all by the **Mountain Fuel Supply Co.,** in the Clay Basin field. It was not until 1937 that connection was made with a transmission system which could carry the gas to populous consuming areas. Occasional exploratory drilling between 1954 and 1963 was unsuccessful. However, out of eight wells drilled in the county during the 1964-66 period, five produced gas and are now shut in; the other three were plugged and abandoned.

Mineral production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Natural Gas	mil cu ft	[5]	[5]	[5]	[5]
Petroleum	M bbls	1	$ 2,600	2	$ 5,000
Sand and Gravel	tons	85,000	79,000	37,000	39,000
Stone	tons	.....	.....	20,000	40,000
Undistributed[1]			384,900		357,000
Totals			$589,500		[5]

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Daggett County's Metallic Mineral Deposits and Operations

GOLD, SILVER AND COPPER: Undeveloped copper deposits are found in the south-central area, particularly in Red Canyon. Gold and silver are assoc-

*Denotes figures not available.

ciated with copper ores. **IRON ORE:** There is an occurrence of hematite in Red Canyon. One vein in particular is reported to be significant. Additional deposits are found in the Spring Creek and Birch Creek areas. **URANIUM:** Early prospectors found traces of carnotite in some of the Red Canyon deposits. There was considerable prospecting in the early 1950s and some 700 claims were filed. The Yellow Canary deposit in Red Canyon was explored with assistance of a government loan. However, no commercial production has been reported.

Daggett County's Nonmetallic Mineral Deposits and Operations

COAL: The Henry's Fork coal field lies on the north flank of the Uinta Mountains in Daggett and Summit counties. Some coal is exposed along the Green River north of Flaming Gorge. These bituminous deposits have not been commercialized.

NATURAL GAS: There is consistent production from a number of wells in the Clay Basin field, all owned by the **Mountain Fuel Supply Co.** The gas is piped to northern Utah centers for consumption. Value of 1965 production is estimated at more than a third of a million dollars in value. In the period 1954-1963, seven new wells were drilled, but did not produce. They have been plugged and abandoned. Five out of eight wells drilled in the 1964-66 period, however, were successful. **OIL:** There is minor production each year, in the form of natural gasoline, which is distilled from natural gas in a chilling plant at Manila, owned by **Mountain Fuel Supply Co.** However, there are no crude oil wells in Daggett County.

PHOSPHATE ROCK: The belt of phosphate rock deposits found in Wyoming and Rich County extends into the northern and central areas of Daggett County, but there has been no commercial production. **SAND AND GRAVEL:** Production in the county is intermittent, most of the output being used in building roads. **STONE:** For several years, a substantial tonnage of crushed sandstone has been used in road construction.

DAVIS COUNTY

Area: 275 square miles. **Population:** 1960 census, 64,760; 1965 estimate, 83,800. **Active companies, 1965:** mining, 5; primary mineral processing, 9. **Average number workers, 1965:** mining, 44; primary mineral processing, 556. **Annual worker payroll, 1965:** mining, $280,000; primary mineral processing, $4,611,710.

Minerals history: There is only one nonferrous metal mining district in Davis County—the Farmington district, to the east of Farmington and Centerville. The most promising deposits were found in the late 1800s on the north side of Parish Canyon, about three miles from its mouth, and in the Morning Star group of claims due east of Farmington. Some development work was done on the Parish Canyon properties, but evidently no shipments were made to smelters. The ore contains **copper, lead** and **silver.** Around the turn of the century, a shaft was sunk on the Morning Star claims and some tunneling was done.

Sand and gravel and **stone** are the county's chief minerals. They have been used from early pioneer days.

Mineral production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Sand and Gravel	tons	938,000	$698,000	441,000	$430,000
Stone	tons	668	6,715	[1]	[1]
Totals			$704,715		[5]

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Davis County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER AND LEAD: The Farmington district ore deposits are generally small and the metal content is discouragingly low. Major production is unlikely unless new and larger deposits are discovered. The only activity reported to the Bureau of Mines in the last decade was a small shipment of development ore in 1958, containing lead and a few traces of silver.

LITHIUM AND MAGNESIUM: Leases have been granted or applied for covering most of the mud flats next to the Great Salt Lake. Major companies are doing experimental work which they hope will lead to large-scale production of lithium, magnesium and other minerals from the lake brines. It is impossible to tell at this stage what impact these developments will have on Davis County's economy.

URANIUM: About 300 claims were filed in Davis County during the 1950s, but there was only one commercial development—and it was short-lived. **Kaysville Uranium Co., Inc.** built a 500-tons-per-day mill on the foothills due east of Kaysville and stockpiled some ore in the mountains above Farmington. There was minor production on an experimental basis, but the project was finally abandoned.

Davis County's Nonmetallic Mineral Deposits and Operations

GEM STONES: The Bureau of Mines reported that gem stones were collected in 1961 for commercial purposes. **OIL AND GAS:** About 20 test wells have been drilled near the lake southwest of Farmington since the first one was put down in 1895. Some non-commercial showings of both oil and gas have been found. The county is widely known, however, for its concentration of oil refineries, built to process oil brought by pipeline from Colorado and from Utah's Uinta Basin fields. Three companies have plants and tank farms in the southern part of the county: **Beeline Refining Co., Standard Oil Co. of California** and **Phillips Petroleum Co.** Another plant, at Woods Cross, which produces lubricating oils and waxes, was recently purchased by **Frontier Refining Co.** from **Petroflex Corp.**

POTASH: Is contained in the brines of Great Salt Lake. Recovery of this mineral is part of the plans outlined under Lithium and Magnesium, above. **SALT:** This is another mineral which may be taken in large quantities from the lake. There are operations to the north and south, but none in Davis County. **SAND AND GRAVEL:** This is Davis County's most substantial mineral industry. Major producers listed by the State Industrial Commission in 1966 were: **Axtell Construction Co., Foss Lewis Sand & Gravel Co.** and **Lewis-McNeish Construction Co.,** all of Bountiful. Other pits, active when needed, are operated

by **Dayton & Miller Red-E Mix, Gibbons & Reed, Don W. Stuart** and **Wasatch Sand & Gravel.**

SILICA: There are deposits of commercial grade silica in the mountains to the east, but they are not producing at this time. **STONE: Utah Quartz and Rock, Inc.** is a consistent producer of crushed sandstone from the Opal Quarry. **Utah Concrete Pipe Corp.** has produced crushed limestone in Davis County for the **U. S. Bureau of Reclamation.**

DUCHESNE COUNTY

Area: 3,266 square miles. **Population:** 1960 census, 7,179; 1965 estimate, 6,700. **Active companies, 1965:** mining, 5; primary mineral processing, 1. **Average number workers, 1965:** mining, . . .*; primary mineral processing, . . .* **Annual Worker Payroll, 1965:** mining, . . .*; primary mineral processing, . . .*.

Minerals history: Very few metallic mineral deposits have been discovered in Duchesne County. A little **iron ore** near Moon Lake is about the only significant deposit of record.

The **gilsonite** industry in the county was developed by the **Ravan Mining Co.** which had its center of operations in Roosevelt. Prior to 1905 this firm controlled all of the gilsonite in the Uinta Basin. When the area was thrown open to white settlers, the government reduced the company's holdings to 100 claims. In 1934 a number of leases were granted to other firms, and since that time several companies have operated in Duchesne County's Castle Peak (19) mining district. Consolidations have reduced the number to two active producers.

Prior to 1948, the history of **oil** exploration in the county was a brief one. There is record of only two test wells having been drilled before the Uinta Basin boom began that year—one in 1928 in Duchesne and one in 1947 near Myton. The Myton well had a showing of oil and gas, but there was no production. Since 1948 there has been extensive drilling in the southeast area of the county, and small but consistent production of **oil** and **gas** has resulted.

Mineral production, 1964-65:

		1964		1965	
		Quantity	Value	Quantity	Value
Gilsonite	tons	1	1	1	1
Natural Gas	mil cu ft	27	$ 3,000	45[6]	$ 6,000[6]
Petroleum	M bbls	70	183,400	166	435,000
Sand and Gravel	tons	5,000	5,000	.....	.....
Totals			5		5

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Duchesne County's Metallic Mineral Deposits and Operations

IRON ORE: There are unworked iron deposits near Moon Lake. **URANIUM:** Some discoveries were reported in the 1950s, but none of the deposits was worked commercially.

*Denotes figures not available.

Duchesne County's Nonmetallic Mineral Deposits and Operations

CLAY: There is a promising deposit of fire clay in the Red Creek area. **COAL:** The Blacktail (Tabby) Mountain coal field runs eastward through the western part of Duchesne County to join the deposits of the Vernal field in Uintah County. It is not mined commercially.

GILSONITE: The Uinta Basin gilsonite deposits extend into eastern Duchesne County. The original mine was located south of Duchesne Township. There has been consistent production for many years. **The Ziegler Chemical & Mineral Corp.** has been the big producer in recent years from its Castle Peak mine. The **Standard Gilsonite Co.** has a plant south of Myton which uses a special patented process for preparing gilsonite for market. Standard ships intermittently.

NATURAL GAS: Discovery of natural gas in Duchesne County was announced in 1962. In 1966, only one well was producing—the Blue Bell, owned by **Humble Oil Co.** Total output in the county from the first natural gas discovery until September, 1966, was 396,391,000 cubic feet. **OIL:** Duchesne County has become a small but consistent producer of oil, but many of its wells are temporarily "shut in." In September of 1966 there were 24 producing and 32 "producible" wells. Production came from the Blacktail Ridge, Castle Peak, Duchesne and Campbell fields; also the Ute Tribal wells of **Gulf Oil Corp.** and **Shamrock Oil Corp.** Cumulative total of oil production in the county had reached 587,961 barrels by the end of September, 1966, and output of natural gas from oil wells had reached 87,493,000 cubic feet. In the 1964-65 period, 32 wells were drilled, of which 19 were producers.

OIL SHALE: Extensive oil shale fields are found in the county, but there has been no development as yet. The Meads Peak **PHOSPHATE ROCK** deposits are exposed along the south flank of the Uinta Mountains in the western half of Duchesne County, but no attempt has been made to commercialize them. **SALT:** Unworked rock salt deposits are located in southeastern Duchesne County, near the Uintah County line. **SAND AND GRAVEL:** Are produced as needed, chiefly for road construction. The **Directory of Utah Manufacturers,** 1965-66 edition, lists one commercial producer—**Roosevelt Sand & Gravel & Ready Mix Concrete Co.**

WURTZILITE: Extensive deposits lie in a relatively narrow area of southeastern Duchesne County, about 45 miles long, between Avintaguin and Antelope Canyon. Mining began about 1900 and continued, intermittently, until 1950. No production has been reported since 1950. Difficulties in determining ownership of the properties, rather than lack of a market, have caused cessation of mining activity. Total cumulative output since 1900 is estimated at about 25,000 short tons.

EMERY COUNTY

Area: 5,453 square miles. **Population:** 1960 census, 5,546; 1965 estimate, 5,900. **Active companies,** 1965; mining, 18; primary mineral processing, 0. **Average number workers, 1965:** mining, 259; primary mineral processing, 0. **Annual worker payroll, 1965:** mining, $1,612,039; primary mineral processing, 0.

Minerals history: Little is known concerning the first prospecting in the San Rafael mining district, which lies southwest of Green River. **Copper** deposits were found in several places along the east side of San Rafael Swell, and early reports indicate they were known before 1910. Evidently no ship-

ments were made. The Emery district, 10 miles west of Woodside, was organized in 1883 and produced small amounts of **gold, silver, copper** and **lead** in the early days. Very little history is obtainable concerning the Cedar Mountain district. It is known that the same metals found in the Emery district were produced there in small quantities.

Uranium and **vanadium** were discovered about 1910-11. The **Radium Co. of America** began production of these ores in 1912 from their claims about 12 miles west of Green River, and other companies shipped from the Temple Mountain area about the same time. There was occasional production until after World War II, when the government's uranium ore purchasing program started a prospecting boom which resulted in the filing of more than 48,000 claims and in the discovery of many good commercial properties in the county. The best known of these deposits is the Delta mine, which was sold in 1954 for more than $9,000,000. Mining of uranium ore is a major Emery County industry.

Oil and gas well drilling in the last eighteen years has resulted in the discovery of substantial reserves of oil and natural gas, and the county is now a consistent producer.

Coal was found by the early pioneers and mined for a hundred years. Emery County is second only to Carbon County among Utah's coal producers.

Organized Mining Districts

Emery (Lost Springs)—28 San Rafael—88 Cedar Mountain

Mineral production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Coal	tons	847,521	$4,684,585	1,100,714	$5,319,259
Natural Gas	mil cu ft	.....	.....	560[6]	79,000[6]
Petroleum	M bbls	24	62,900	25	66,000
Sand and Gravel	tons	29,000	29,000	[1]	[1]
Stone	tons	11,348	28,370	41,900	83,800
Uranium Ore	tons	38,648	715,468	28,314	437,912
Vanadium	tons	.....	.....	[1]	[1]
Undistributed[4]			128,076	.....	.....
Totals			$5,648,399		$6,073,845

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Emery County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: The extent and quality of reserves are still largely unknown. The gold, silver, copper, lead and zinc ores of the Emery and Cedar Mountain districts are in small deposits and give little promise of further development under present conditions. The only shipment in recent years was a small amount of silver-copper ore, with a value of only $64. **MANGANESE:** Deposits which thus far have not been worked, lie in the Muddy River area and east of Rochester in the western part of the county; also in the Cedar Mountain area east of Castle Dale and near the Green River in the southeastern part of the county.

URANIUM: During most of the 1950's, Emery County ranked second among the counties of Utah in uranium output. However, with lower prices and the pinching out of the Atomic Energy Commission's purchase program, the county's

production has declined considerably. In 1960, Emery County produced more than 94,000 tons of ore, valued at $1,913,850, compared with 1965 output of 28,314 tons, worth $437,912. However, the AEC now predicts greatly increased activity in uranium within a few years, and prospecting by major companies is increasing. Emery County could see a substantial increase in uranium production by 1975. **VANADIUM:** Associated with uranium ores and produced along with them.

Emery County's Nonmetallic Mineral Deposits and Operations

BARITE: A deposit of barite in central Emery County has produced occasionally. It is operated by **Barium, Inc.** **BENTONITE:** Unworked deposits occur southwest of Green River.

COAL: Coal has always been the leading commercial mineral in Emery County. Reserves are tremendous in the west and northeast, giving promise of substantial production for many years to come. Records of the Utah State Industrial Commission show there were 10 companies active in the county during 1966:

American Fuel Co.	—Huntington	Browning Coal Co.	—Emery
Helco Coal Co.	—Huntington	U. S. Fuel Co.	—Near Hiawatha
Heiner Coal Co.	—Horse Canyon	Larsen & Rigby Coal Co.	—Huntington
Co-op. Mining Co.	—Huntington	Sun Valley Coal Co.	—Emery
Cooperative Security Corp.	—Orangeville	Earl J. Robertson	—Emery

GALLIUM: This mineral is contained in large shale deposits in Emery County. One of the major reserves is found along the Green River on properties owned by **Joseph Forrester and Sons** of Price. New processes are being developed which may lead to commercial production in the near future. **GEM STONES:** Agate and dinosaur bone have been collected in commercial quantities. **GYPSUM:** West of the railroad between Wellington and Green River are deposits of gypsum that show promise for future development. **English Oil Co.,** while drilling for oil on the west flank of the San Rafael Swell, discovered gypsum deposits of remarkable thickness, purity and areal extent.

HELIUM GAS: Was discovered near Woodside in 1925, but it could not be commercialized because it was withdrawn by the U. S. Government as one of its helium reserves. The U. S. Interior Department secretary on August 4, 1964, issued an order which could lead to opening of Utah helium deposits to private development. However, the state of Utah has a preferred right of application to select the lands. **NATURAL GAS:** Has been discovered in several areas of the county. In 1966, there were eight producing wells in the Ferron field and three in the Flat Canyon field. Cumulative production from gas wells since the first discoveries were made now amounts to about 1,812,895,000 cubic feet.

OIL: Drilling for oil commenced as early as 1899. But it was not until the late 1950s and early 1960s that commercial wells were brought in. In 1966 there were two producing wells in the Ferron field and three in the Grassy Trail field. The Utah Oil and Gas Conservation Commission reported in September, 1966 that there were also six "producible" wells in the county. Considerable exploration work is being done. In the period 1964-65, 19 wells were drilled, of which five oil wells and one gas well were producers.

SAND AND GRAVEL: Emery County is a small but consistent producer of

sand and gravel, most of it coming from pits operated by the state and county for road construction and maintenance. **STONE:** There is occasional production of crushed stone in Emery County. 1965 output totaled 41,900 tons, valued at $83,800. **SULPHUR:** There are deposits of native sulphur on the San Rafael River, on a wash tributary to the Price River and at Mexican Bend, 6-8 miles northwest and up river from deposits at the mouth of Black Dragon Canyon. The San Rafael Canyon reserve is 18-20 miles west of Greenriver and the Black Dragon Canyon deposit is on the San Rafael River, 14 miles west of Greenriver. There has been no commercial production.

GARFIELD COUNTY

Area: 5,234 square miles. **Population:** 1960 census, 3,577; 1965 estimate, 3,200. **Active companies, 1965:** mining, 6; primary mineral processing, 0. **Average number workers, 1965:** mining, 11; primary mineral processing, 0. **Annual worker payroll, 1965:** mining, $62,547; primary mineral processing, 0.

Minerals history: The best-known nonferrous metal mining district in Garfield County is the Henry Mountain, reportedly discovered in 1889 or 1890 by **J. C. Sumner** and **Jack Butler,** who developed the Bromide mine, a **copper-gold** deposit, and built a small stamp mill. The Oro (Kimball-Turner) mine was discovered shortly thereafter and some of its ore was treated in a mill constructed on Crescent Creek. Copper-gold mineralization was found in other properties of the district, but these claims did not produce commercially. In the 1880s and the 1890s, a great deal of **placer gold** mining was done in the Henry Mountains and along the river itself, at the base of the mountains. Occasional activity continued until World War II.

Altogether, there was very little metal mining in Garfield County until the **uranium** rush, which began about 1948, and soon reached the Circle Cliffs and Henry Mountain areas. More than 22,000 claims were filed in the county and many commercial-grade deposits were discovered. Severe cutbacks in the AEC's ore purchasing program have resulted in the closing of many mines. However, industrial demand for uranium is picking up rapidly and exploration work has begun in anticipation of a better market. Garfield County will probably share in the economic benefits.

Organized mining districts: Antimony—23 (antimony only)
Colorado River—21
Henry Mountain—43

Mineral production, 1964-65:

		1964		1965	
		Quantity	Value	Quantity	Value
Petroleum	M bbls	50	$131,000	126	$331,000
Sand and Gravel	tons	25,000	25,000	[1]	[1]
Uranium Ore	tons	1,587	56,707	1,615	45,071
Vanadium	tons	[1]	[1]	[1]	[1]
Totals			[5]		$420,902

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Garfield County's Metallic Mineral Deposits and Operations

GOLD, SILVER AND COPPER: Placer gold is still to be found in wide areas of the Henry Mountains and along the streams emptying into the Colorado River. Thousands of claims are still held by residents of Garfield and Wayne counties, but little work has been done in recent years. The last production reported to the Bureau of Mines was four ounces in 1958, valued at $140. So little development work has been done on the copper-gold-silver deposits of the Henry Mountains that it is difficult to assess their extent and value.

ANTIMONY: Near Antimony are the deposits that gave the town its name. They have produced at intervals since 1880, total output probably running into several hundred thousand dollars in value. Very little systematic mining has been done, however. The higher grade ore has been exploirted, and what remains is chiefly low grade. **MANGANESE:** Unworked deposits of manganese are found near Fullmer in the central area of the county and in Hutch Pasture and east of Boulder Mountain in the north central area.

URANIUM: Discovery of commercial deposits of uranium-vanadium ore brought Garfield County a new industry in the 1950s. Principal deposits are in the Henry Mountains and the Circle Cliffs area. High transportation costs make much of the ore uneconomic. Minor production was reported from 19 different operations in 1964, with 14 of the properties accounting for less than 100 tons of ore each. Largest producers were: **Tri-Cities Mining Co.; General Utilities & Industries, Inc.; Denver Realty Co.; Vanadium Corp. of America,** and **Shootering Creek Mining Co. VANADIUM:** Is associated with the uranium ores of several Garfield County areas and is extracted at the mills.

ZIRCONIUM: An undeveloped deposit of zirconium ore is located on the Kaiparowits Plateau in north-central Garfield County, near the Kane County line. The 11 mining claims are owned by **Kenneth Pratt** of Salt Lake City and **William Christensen** of Escalante.

Garfield County's Nonmetallic Mineral Deposits and Operations

BENTONITE: Deposits of commercial grade ore are found near Henrieville, Cannonville and Tropic. **American Mud & Chemical Co.** constructed a $75,000, 40-tons-per-day plant at Cannonville for processing the bentonite into material used as drilling mud in oil exploration. With the recent decline in oil exploration activity, there has been very little demand for drilling mud, and the company has discontinued production at Cannonville for the time being.

COAL: Part of the vast Kaiparowits Plateau coal field lies in Garfield County. The coal is of high volatile C bituminous rank. The construction of Glen Canyon dam has given the field new importance. Considerable exploration work has been done in the last few years. Definite plans are on the drawing boards for use of part of the coal lying in Kane County, and new developments in electric power generation may follow in Garfield County. No commercial production has been reported from the county's coal fields.

DIATOMITE: Several good deposits of this mineral lie near Panguitch, but they have not yet been developed because of remoteness from eastern and coastal markets. **FIRE CLAY:** The Barney deposit of fire clay in north-central Garfield County is considered by some authorities to be the highest grade material in Utah. **GEM STONES:** In 1958, 1959 and 1960, Garfield ranked high among the counties of the state in gem stone production. The most common stones collected were agate, jasper, dinosaur bone and petrified wood. Most of the volume came from the vicinity of Escalante and the Henry Mountains.

GYPSUM: Deposits of this mineral are found on the border of Kane and Garfield counties, near Cannonville.

OIL: In the last twelve years, some thirty wells have been drilled in Garfield County. Seven of these were producing oil wells. The others were plugged and abandoned. All producing wells are in the Upper Valley field. In September of 1966 three were producing consistently and four were classed by the Utah Oil and Gas Conservation Commission as "producible." Cumulative output from the county to September, 1966 totaled 319,841 barrels. Production of oil has become Garfield County's leading mineral industry.

SAND AND GRAVEL: There is intermittent production in the county, chiefly for road construction and maintenance. The county has no continuously operating commercial producer. **STONE:** Bulletin 73 of the Utah Geological and Mineralogical Survey says: "Translucent green onyx has been quarried at Hatch in southwestern Garfield County. Large flawless blocks have also been mined on Mammoth Creek, 1½ miles south of Hatch." A quarry 10 miles north of Panguitch produces green, red and white building and ornamental stone. At last report, it was operated by **Earl Dowdell.**

GRAND COUNTY

Area: 3,692 square miles. **Population:** 1960 census, 6,345; 1965 estimate, 7,600. **Active companies, 1965:** mining, 40; primary mineral processing, 1. **Average number workers, 1965:** mining, 663; primary mineral processing, . . .*. **Annual worker payroll, 1965:** mining, $4,994,830; primary mineral processing, . . .*.

Minerals history: Earliest discoveries in the La Sal Mountains were made in 1866, the first location filed in 1888, and the first mining done in 1898. The La Sal mining district was organized in 1897, the Miner's Basin district in 1898. After discovery of the Tornado deposit in 1897, a small stamp mill was built in Miner's Basin but was closed after processing 100 tons of **copper** ore. In the late 1800s and early 1900s, some placer **gold** mining was done in the gold-bearing gravels of Miner's Basin, Wilson Mesa and the La Sal Mountain areas. Copper deposits were discovered on both sides of Salt Wash Valley during that period, some of them, particularly in the area of the Old Indian Trail, containing a small amount of **silver.**

Little information is available concerning the first discoveries of **uranium-vanadium** ores in the county. However, the U.S. Geological Survey issued reports as early as 1905 and 1906, calling attention to deposits near Richardson; on Pack Creek northwest of Lone Plateau, and in the area near Courthouse, northwest of Moab. Development work was done in the last three areas mentioned.

From 1901 to 1906, and again during World War I, the **Colorado Fuel and Iron Co.** produced **manganese** from the Little Grande district, west of Arches National Monument. Good deposits are also found in the Wheeler Desert district southwest of Floy.

Grand County's important nonmetallic mining industries—**oil, natural gas** and **potash,** are comparatively new developments. Their story is told later in this chapter.

*Denotes figures not available.

Organized Mining Districts

La Sal—50
Little Grande
Miner's Basin—60
Wilson Mesa—113
Colorado River area—35
Salt Wash Valley area—80

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Natural Gas	mil cu ft	[1]	[1]	13,133[6]	$1,852,000
Petroleum	M bbls	267	$699,500	209	548,000
Potassium Salt	tons	[1]	[1]	[1]	[1]
Sand and Gravel	tons	35,000	29,000	[1]	[1]
Uranium Ore	tons	15,578	318,254	21,256	565,722
Vanadium	tons	[1]	[1]	[1]	[1]
Undistributed			1,903,269		[1]
Totals			$2,950,023		$3,169,534

(For explanations indicated by small numbers in the above table, see page 24.)

Grand County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER AND LEAD: Most deposits containing gold-silver-copper lie in La Sal, Miner's Basin and Salt Wash Valley areas. They are too small, as presently developed, to expect large-scale production. Placer gold mining has ceased to be profitable in the Colorado River, Wilson Mesa and La Sal Mountain regions. Several shipments of silver-copper and silver-lead ore were made in 1956-57, but no production has been reported to the Bureau of Mines since that time.

MAGNESIUM: This metal is found in the carnallite and sylvite salt deposits near Crescent Junction. There has been no commercial development. **MANGANESE:** There are manganese deposits in the Wheeler Desert and Little Grande mining districts; also the area around Floy. They have been worked during brief periods of heavy demand and high prices, but mining is not profitable under normal conditions. Five of the nine active properties in Utah during 1957, before the end of the government's carlot purchasing program, were in Grand County. **L. W. Smith** and **Gene F. Tom** were the chief producers.

SELENIUM: **Yosemite Uranium Co.** discovered a deposit of selenium in association with uranium-vanadium ores on a group of claims near Cisco in 1956. **TUNGSTEN:** There is some scheelite (tungsten ore) at the Ryan Creek prospect near the Colorado line.

URANIUM: Many commercial deposits have been discovered in the Green River, Thompson, Gateway, La Sal, Yellow Cat, Cane Creek, Beaver Mesa, Polar Mesa and other areas in Grand County. Although volume of production has declined considerably since the AEC curtailed its ore purchasing program, uranium mining is still a half-million-dollar per year industry in the county. A mining directory published by the Utah Geological and Mineralogical Survey in 1966, covering 1964 operations, listed 24 active uranium mining operations. Among the chief producers were: **James R. Lammert, Airborne Prospectors, Thornburg Mining Co., Climax Uranium Co.** and **Utah Alloy Ores, Inc.** With increasing industrial demand for uranium, coming mostly from construction of new nuclear power plants, an orderly, scientific prospecting and exploration program has been started by several large mining firms, and stepped-up production can be anticipated within the next decade. **VANADIUM:** Is associated

with the uranium-bearing ores of most Grand County districts and is extracted at the mills.

Grand County's Nonmetallic Mineral Deposits and Operations

BENTONITE: Undeveloped deposits of bentonite occur in the county, near Green River. **BITUMINOUS SANDSTONE:** U.G.M.S. Bulletin 73, dated 1964, reports that "the PR Springs bituminous sandstone (rock asphalt) deposits and the Evacuation Creek deposits occur on the southeast flank of the Uinta Basin, Uintah and Grand counties . . ." The deposits have produced only a few hundred tons. **BRINES:** The **Moab Brine Co.** produces an artificial brine from the salt underlying Moab Valley, and this brine is used by the oil industry for drilling through the salt deposits in the Paradox Basin.

COAL: The Book Cliffs coal field extends generally south from Sunnyside to the Green River, then east and northeast to Colorado. The Grand County coal does not rank so high as the Carbon County deposits, and as a consequence, it has not been commercialized extensively. The last production reported to the Bureau of Mines was in 1953. **FLUORSPAR:** There is a deposit of this mineral about 15 miles east of Cisco, from which a few tons were shipped in 1948. **GEM STONES:** Agate, dinosaur bone, geyserite, jasper and smoky quartz are some of the stones collected from time to time for commercial purposes. **GYPSUM:** There are outcroppings of gypsum in the salt anticline region of southern Grand County and northern San Juan County, particularly in the bottoms of the Salt, Onion Creek, Castle and Moab valleys. They remain undeveloped.

HELIUM GAS: Helium was discovered in Harley's Dome, north of Cottonwood. However, the government declared the deposit a federal reserve and there has been no commercial production. The Interior Department in 1965 handed down a decision described as a declaration of intention to grant rights to private companies for development of helium reserves. However, the state of Utah has priority rights to the helium lands. Several firms have shown interest in establishing a natural gas gathering and transmission system that would bring gas to Crescent Junction, where a chemical-industrial complex would be constructed to separate helium, butane, propane and fuel gases from the natural gas and to manufacture fertilizers and chemicals. Unfortunately, none of these proposals has materialized to date.

NATURAL GAS: Oil exploration activity in Grand County brought natural gas discoveries of great importance. The county now has two major fields: the San Arroyo, with 27 producing wells, and the Westwater, with 11 producing wells; also one minor field, the Stateline. Total output in 1966 was 9,083,416,000 cubic feet. Cumulative production since natural gas was discovered is 55,625,228,000 cubic feet. **OIL:** The September, 1966 report of the Utah Oil and Gas Conservation Commission showed that there were five producing wells in the Agate field, one in the Big Flat field, three in the Salt Wash field, one in the Long Canyon field and two in the Sieber Nose field. In addition, the Commission listed 17 wells in the county as "producible." Cumulative production from the beginning of the county's commercial oil industry totaled 1,214,774 barrels by the end of 1966. Gas from oil wells showed a large volume—6,178,990,000 cubic feet.

POTASH: This mineral underlies a vast area in Grand County southeast of Green River. Existence of the potash has been known for many years, but there was no commercial development until **Texas Gulf Sulphur Co.** acquired the interests of the **Delhi-Taylor Oil Co.** and began in 1961 the construction of a $40 million potash mining and milling complex at Dead Horse Point, on the San

Juan-Grand County line. How much of Texas Gulf's production will come from Grand County is not known. Delhi-Taylor did extensive drilling northwest of Moab, in the Seven-Mile Anticline area, and blocked out a reported 10,000,000 tons of "proved and probable" reserves. So the potential for future potash developments in the county is encouraging. Exploratory drilling has been done on large acreages of potash land in the last five years by such companies as **San Jacinto Petroleum Corp.** (at Salt Valley Anticline, some six miles north of Seven Mile Anticline), **Continental Oil Co.** (8,000 acres of potash leases and permits in the vicinity of Crescent Junction) and **Midwest Oil Corp.** (3,200 acres of state-owned leases north of Moab).

SAND AND GRAVEL: Grand County is an active producer of sand and gravel, chiefly for road projects. The UGMS Directory of the Mining Industry of Utah, 1965, lists one commercial producer—**Clarence Engstrom** of Moab. **SILICA:** The County has several deposits of commercial grade. One of these has produced intermittently for the **Murray Refractories Co.** (now INTERPACE), Murray. **STONE: Utah Granite and Marble Co.** has a hard sandstone quarry at Indian Rock which was productive years ago, but which has been inactive for some time.

IRON COUNTY

Area: 3,256 square miles. **Population:** 1960 census, 10,795; 1965 estimate, 10,800. **Active companies, 1965:** mining, 8; primary mineral processing, 2. **Average number workers, 1965:** mining, . . .*; primary mineral processing, . . .*. **Annual worker payroll, 1965:** mining, . . .*; primary mineral processing, . . .*.

Minerals history: Iron ore was first discovered by an exploration party headed by **Parley P. Pratt** in 1849-50. A crude foundry was built by the pioneers at New Harmony in 1852 and began producing in 1853. It was soon abandoned. The ore deposits remained undeveloped because of distance from markets, transportation difficulties and lack of adequate treatment plants in the West. The Iron Springs district was organized in 1871 and reorganized, 1879. The Pinto district was organized in 1868, a few miles southwest of Iron Springs. A crude furnace and foundry were erected by the **Great Western Milling & Mining Co.** in 1868. They produced about 400 tons of pig iron before closing in 1876 or 1877.

The Ironton blast furnace of **Columbia Steel Corporation** (purchased by the **U.S. Steel Corporation** in 1930) near Springville and the **Los Angeles and Salt Lake Railroad's Iron Mountain-to-Cedar City branch line** were completed in 1923-24, and commercial scale mining of the Iron Mountain deposits began. The Columbia Steel Corp.'s operations were the first to successfully use coke made from Utah coal. The **U.S. Defense Plant Corporation** built the Geneva Steel plant in Utah County during the 1942-44 period, and the Iron County ore reserves assumed new importance. The plant was taken over by **U.S. Steel Corp.** in 1946. Although Iron County's iron ore production has decreased since U.S. Steel began shipping pelletized iron ore to the Geneva Works from Atlantic City, Wyoming a few years ago, the output is still sufficient to give Utah fourth place in the ranking of iron-producing states.

The county's nonferrous metal mining districts—the Stateline and Gold Springs—produced some **gold, silver** and **lead** in the 1890s and early 1900s. The

*Denotes figures not available.

Stateline was organized in 1896. Date of organization of the Gold Springs district is unknown. New discoveries in these districts in 1896 caused a short flurry of exploration and development work. Two mills were erected, one in 1896 and the other in 1901, but neither remained active more than a few years. Only occasional shipments from sporadic development work have been made in recent times. However, the Holt silver mine, six miles north of Enterprise, is now coming into production and is expected to make a substantial contribution to the economy of the county.

Some **coal** has been mined in the county from early pioneer days, and minor tonnages of **uranium** ore were shipped in the 1950s. Development of other minerals has been very limited.

Organized Mining Districts

Pinto Iron (Silver Belt)—56 Stateline—100
Gold Springs—34 Iron Springs—46

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	.....	.....	2	$ 70
Silver	oz	.....	.....	2,748	3,553
Copper	tons	.....	.....	[3]	212
Coal	tons	53,747	$250,142	36,101	161,494
Iron Ore	tons	[1]	[1]	2,138,674	14,228,989
Pumice	tons	.....	.....	2,740	6,440
Sand and Gravel	tons	342,000	337,000	396,000	371,000
Stone	tons	[1]	[1]	375	3,976
Totals			$14,900,549		$14,775,734

(For explanations indicated by small numbers in the above table, see page 24.)

Iron County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER AND LEAD: Iron County's potential in these nonferrous metals is limited. The Gold Springs, Pinto and Stateline districts all have deposits that could produce commercially under more favorable conditions. For several years the **Escalante Silver Mines Co.**, a joint venture of **Chief Consolidated Mining Co.** and **Armet Co.**, has been doing development work at the Holt silver mine six miles north of Enterprise. This operation is now producing and promises to put Iron County on the nonferrous metal production map once more.

IRON ORE: Large areas in the southern part of the county are underlain with iron deposits. Most of the good commercial grade ore occurs in disconnected masses in a belt about 20 miles long and $1\frac{1}{8}$ miles wide, stretching from northeast to southwest along the eastern and southern slopes of Three Peaks, Granite Mountain and Iron Mountain. Bureau of Mines experts in 1957 estimated the Iron Mountain area reserves at 350,000,000 tons. Of this total, 100 million tons was classified as recoverable at this time, and the Bureau predicted greater reserves of high grade ore at deeper levels. Efficient mining and low cost concentration will be required to develop the remaining 250 million tons.

The richest discoveries have been made in the Iron Springs, Iron Mountain and Pinto districts and in these localities there has been the heaviest production.

All-time output to 1965 was 72,273,000 tons. The **U.S. Steel Corp.** mines its own iron ore for shipment to the Geneva plant in Utah County. The **CF&I Steel Corp.** properties furnish ore for the Pueble, Colo. steel plant of CF&I, the actual mining being done by the **Utah Construction & Mining Co.** Utah Construction also has its own Iron County properties from which it ships ore to **Geneva Works** in Utah, to Pueblo, Colo., to **Kaiser Steel Co.'s** Fontana, California plant and sometimes to foreign countries. Utah Construction completed a $1,300,000 plant at its Iron Springs open pit mine for upgrading the low grade ores of the area. Some iron ore and concentrates are shipped to cement plants in Utah, Idaho and the Pacific Northwest, where it is used to impart special properties to cement.

ANTIMONY: There are unworked deposits of antimony in the county, but no development work is expected on these claims in the near future. **MERCURY:** Several of the mines in the Gold Springs district produced small quantities of mercury in the early days; none in recent times. **MANGANESE:** Deposits in the county, all undeveloped, are the Black Hawk and Joe Louis, in the eastern part of the county and the Modena in the western part, near the Nevada line. **SELENIUM:** Occurs with gold and silver ores in the Gold Springs and State Line districts. **TELLURIUM:** Is associated with these same ores. **TUNGSTEN:** The county has several tungsten deposits, but conditions have not been favorable for mining them. **URANIUM:** Uranium mineralization has been found in the Iron Springs district and in the Escalante Desert and other areas, but there has been only minor production. The last shipments reported to the Bureau of Mines were made by the **Teton Mining Co.** from the Desert View mine in 1958-59.

Iron County's Nonmetallic Mineral Deposits and Operations

BARITE: Is found in the Iron Springs district but has not been commercialized. **COAL:** This mineral was first mined in Utah back in 1854 from the Kolob Terrace field near Cedar City. There are substantial reserves in the southeastern part of the county. Bulletin No. 79 of the Utah Geological and Mineralogical Survey lists three commercial producers in 1964: **Tucker Coal Co.** (the Tucker mine), **Grant C. Tucker** (Koal Kreek No. 2 mine) and **Louis Webster** (Webster No. 2 mine), all of Cedar City.

FLUORSPAR: There are several unworked deposits in the western part of the county near the Nevada line. **GEM STONES:** Are collected on a commercial basis from time to time, with most of the production coming from the Iron Mountain area and consisting chiefly of agate, petrified wood and quartz. **GYPSUM:** Gypsum deposits near Parowan are inactive. A mill once operated near Cedar City. Since 1960, the Cedar City Chamber of Commerce has been trying to secure more favorable freight rates to centers of population so the deposits can be exploited.

NITRATE: There is a nitrate deposit in Escalante Valley near Beryl Junction. Some development work has been done and pilot plant research undertaken, but to date there has been no commercial production. **OIL AND GAS:** There has been very little exploration activity in Iron County. Two wells were drilled many years ago north of Cedar City and west of Parowan, but results were discouraging. The only drilling reported by the Utah Oil and Gas Conservation Commission since 1960 was a well put down in the Little Salt Lake area. This attempt brought no oil and the well was converted to a water well. **PUMICE:** The U. S. Bureau of Mines reported 2,740 tons of pumice produced in Iron County during 1965 but did not give the location of the deposit.

SAND AND GRAVEL: These minerals are produced consistently in the county, some for commercial purposes, but chiefly for road construction and maintenance. The only commercial producer listed in the Directory of Utah Manufacturers for 1965-66 is the **Parry Sand & Gravel Co.** of Cedar City. **SILICA:** In the Parowan area are good deposits of silica sand. There has been intermittent production for Pacific Coast markets, but freight rates are high and the transportation factor has kept the deposits idle most of the time in recent years.

STONE: Willard B. Thompson produces green, red, yellow and white crushed sandstone that is used as roofing granules and marketed in California and the Salt Lake City area. He also produces crushed limestone for landscaping material. He operates the Shamrock Quarries in Bear Valley and has a plant at Parowan. Building and ornamental stone is abundant in the county. Freight rates and remoteness from markets are the big problems. There has been intermittent production from quarries near Cedar City and from the Bear Valley quarries near Parowan, both producing colored stone of good quality. **Utah Green Stone Co. (W. L. and V. H. Rasmussen)** of Parowan quarries and ships green sandstone to out-of-state markets. **Grant L. Nebeker** and **Utah Stone & Coal Co.** have also taken dimension sandstone from the Rasmussen quarries.

SULPHUR: Iron County has several undeveloped deposits of native sulphur. One deposit lies about 15 miles west of Lund, straddling the Beaver-Iron County line. **VOLCANIC ASH:** There are volcanic cinder deposits south of Parowan. They constitute a large potential source of lightweight aggregate. Some of this material has been mined and used by **Thompson Block Co.** in its Cedar City plant.

JUAB COUNTY

Area: 3,401 square miles. Population, 1960 census, 4,597; 1965 estimate, 4,700. **Active companies, 1965:** mining, 12; primary mineral processing, 0. **Average number workers, 1965:** mining, 209; primary mineral processing, 0. **Annual worker payroll, 1965:** mining, $1,704,609; primary mineral processing, 0.

Minerals history: Gold, silver, copper, lead and zinc were discovered in the Tintic and other Juab County districts in the 1870s. Rich surface ores were shipped to such distant points as Swansea, Wales and Baltimore, Maryland for smelting. Later a few mills and small smelters were constructed near Eureka, but they were not active for long, due to the complex nature of the ores. In 1878, the railroad reached the Eureka district, and ores were hauled to the Salt Lake Valley smelters, greatly stimulating Juab County's nonferrous mining. By 1899 there were 18 producing operations, and Eureka became a thriving community.

Today, most of the mines in the Eureka area are closed, due to high costs, low metal prices and the problem of mining at great depth. The last of the major producers—**Chief Consolidated Mining Co.**—closed on June 15, 1957. There is minor production from a few lead-zinc properties, most of them operated on a lease basis. In the 1940s and 1950s, considerable siliceous ore was shipped from various mines to the copper smelter at Garfield, to be used as a flux. Gold, silver and copper content was credited to the shippers. However, when **Kennecott Copper Corp.** acquired the smelter from the **American Smelting & Refining Co.**, KCC used flux from its own properties in the Bingham district and purchased but little from outlying areas.

Bear Creek Mining Co., a subsidiary of **Kennecott Copper Corp.**, is conducting an extensive exploration program involving properties of several companies near Eureka.

In 1936 **Chad** and **Ray Spor**, Delta brothers, discovered **fluorspar** in the Topaz Mountain district. The establishment of the Geneva Steel plant gave great impetus to fluorspar mining and substantial tonnages were shipped to Geneva and to points outside Utah until 1953, when competition from Mexican fluorspar all but closed down Juab County mines.

There are many other metallic and nonmetallic minerals in the county, but none has developed into a major industry with the exception of **halloysite** mining in the Tintic district, now a $1,000,000-plus business. The mineral with the greatest potential for future production is low-grade **beryllium** ore, which has been discovered in abundance in the county, particularly in the Topaz-Spor Mountain area.

Organized Mining Districts

Deseret (Desert Mtn.)—24
Detroit—25
Fish Springs—30
Granite Creek
House Mountain (Notch Peak)
Johnson Peak (Trout Creek)—47
Juab—48
Leamington—51
Mt. Nebo (Timmins)—65
Spring Creek—97
Tintic—104
West Tintic—112

Mineral Production, 1964-65:

		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	306	$ 10,710	83	$ 2,905
Silver	oz	18,749	24,242	5,772	7,463
Copper	tons	12	7,824	3	2,407
Lead	tons	.....	.....	2	593
Zinc	tons	.....	.....	6	1,723
Clays	tons	1	1	1	1
Fluorspar	tons	1	1	1	1
Sand and Gravel	tons	14,000	14,000	.....	.....
Stone	tons	1	1	43,411	138,166
Uranium Ore	tons	1	1	1	1
Totals			$1,135,630		$1,512,000

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Juab County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: The only major producer in Juab County during the last two decades—the **Chief Consolidated Mining Co.**—was forced to close down in 1957 as a result of low metal prices and high mining costs. Most block leasing operations in old mines of the district have ceased. Such once-famous mines as the Mammoth, Dragon Consolidated, Iron Blossom and Plutus are now idle except for occasional leasing activity. For several years in the early 1960s, **New Park Mining Co.** conducted an extensive exploration program, and several good discoveries of gold-silver ore were reported. However, the project was closed temporarily in December of 1965. One of the big problems faced by New Park is that of transportation costs on the ore, which would have to be shipped to Tacoma, Washington or El Paso, Texas for smelting.

A large-scale exploration program by **Bear Creek Mining Co.**, Kennecott's exploration subsidiary, has resulted in the discovery of a large reserve of high-grade lead-zinc-silver ore in the East Tintic Unit on the Utah County side of the Juab-Utah County line, but the same company's program in the West Tintic district, which includes a large acreage in Juab County, has not yielded substantial commercial discoveries.

ANTIMONY, ARSENIC AND BISMUTH: Are present in ores of many mines in the Tintic district. They are associated with lead, zinc, copper, gold and silver. **BERYLLIUM:** Discovery of low-grade berllium ores in the Topaz-Spor Mountain, Trout Creek, Honeycomb Hills, Calleo and Goshute Indian Reservation areas of Juab County ignited a prospecting boom in the early 1960s. The excitement has now subsided. The claims cannot be exploited until demand for beryllium for space-age and other uses exceeds the volume of imports from foreign sources. Reserves in the Spor-Topaz Mountain area alone are estimated at somewhere between three million and five million tons of ore. Major claim holders in the county are the **Brush Beryllium Co.** and **The Anaconda Co.**

IRON ORE: In 1959, the **Lynn Mining Co.** shipped brown iron ore from the Iron Blossom mine in the Tintic district for use in manufacturing dead-burned dolomite. Undeveloped iron ore deposits are found near Levan. **MAGNESIUM:** In the south central and western areas of the county there is some occurrence of magnesium, but it is not minable under present conditions. **MANGANESE:** During the first World War and again in the 1950s, sizable quantities of manganese concentrates were shipped from several Juab County districts. Chief producer was the Detroit district, with most of the ore coming from the Abraham Hot Springs and the Black Boy mines, where cumulative output from the beginning totals some 90,000 tons. In the Tintic district, the Apex Standard, Iron Blossom, Empire, Trotter, White Cloud and Black Jack (Winberg) mines have produced small amounts. The Black Ledge mine in northeastern Juab County and the Erickson district in the north-central area, near the Tooele County line, have yielded small shipments. Another area with promise is the extreme southeastern corner of the county, next to the Sanpete County line, where the Orme and Black Jack (Kendall-Duvall) mines have produced small tonnages.

MOLYBDENUM: Some occurrences of molybdenum-type ores have been reported from the Tintic district, but no attempt has been made to exploit them. **TUNGSTEN:** Deposits of this metallic mineral are found in the Tintic, West Tintic and Trout Creek areas. In the West Tintic district, at the south end of the Sheeprock Mountains, the Tintic Western (Desert Tungsten) mine produced 7,198 tons of ore containing 6,734 units of tungsten. A tungsten mill erected in the Tintic district by **Spider Uranium Co.** is standing idle. There has been no production reported from Juab County since the federal government ended its purchase program for the national stockpile in 1957. **URANIUM:** The prospecting rush of the early 1950s brought several discoveries in Juab County, including some of commercial grade. The only producer in recent years has been the **Topaz Uranium Co.**, from the Yellow Chief mine in the Topaz Mountain area.

Juab County's Nonmetallic Mineral Deposits and Operations

ARAGONITE: Has been discovered in association with oxidized zinc ores of the Tintic and West Tintic districts. **BARITE:** Deposits are found in the Mount Nebo district and in the Box Tweed, Carissa, Centennial Eureka, Gold Chain, Grand Central, Iron Blossom, Mammoth and Opohonga mines of the

Tintic district. The only commercial producer in recent years was the Garrick mine, near Trout Creek, operated by **D. J. Garrick.**

CLAY: There are commercial clay deposits in the Jericho area that produce intermittently. Fire clay is produced at the Eureka pit by **International Pipe & Ceramics Corp. FLUORSPAR:** In the late 1940s and early 1950s, fluorspar mining in the Topaz Mountain district was a major Juab County industry. Competition from Mexican producers forced prices below economic levels in 1954, when output in Juab County dropped to only 4,400 tons. From 1955 to 1957 there was a revival of activity, due to the government's stockpile purchasing program, but when stockpile acquisitions were discontinued in 1957, production dropped to a very low level. The producing mines are the Fluorine Queen and the Lost Sheep, operated by the **Chesley & Black** partnership and **Willden Bros.**, respectively.

GYPSUM: Cox Bros. Construction Co. of Manti has produced small quantities of gypsum rock in recent years at a quarry near Levan. **HALLOYSITE CLAY:** Produced from an excellent deposit in the old Dragon Consolidated mine. The deposit is still owned by Dragon but is operated by **Filtrol, Inc.** of Salt Lake City. Filtrol processes the clay in preparation for use as a catalyst in oil refining. The annual output averages about 60,000 tons, valued in excess of $1,000,000. Another deposit of this clay lies one mile north of Eureka. It has produced substantial tonnages since 1961. The clay is used with other clays in making light-colored brick.

LIMESTONE AND DOLOMITE: Good commercial deposits of these minerals lie near Leamington, close to the Millard County line. Limestone crushed at Leamington, which is in Millard County, was produced by **Richard Moody** from the **George H. Chaffin** quarry for use as a flux and for manufacture of lime. A large deposit of high-grade limestone lies 44 miles south of Delta. It is owned by **Warren G. Alsop** of Midvale and **Eldon Eliason,** a Delta attorney. **U. S. Steel Corp.** recently had an option on the properties, but gave it up because freight rates were excessive. Some 20,000 to 25,000 tons of limestone from the Chaffin quarry is used each year by **Utah-Idaho Sugar Co.** in the manufacture of quicklime for use in its Garland and Salt Lake City sugar refineries.

OIL AND NATURAL GAS: There has been very little exploration for oil and gas in Juab County. Only two wells have been drilled since 1953—one near Levan, the other near the Sevier Reservoir. Both were dry holes and were plugged and abandoned. **PHOSPHATE ROCK:** There are substantial deposits in the East Tintic Mountains, but their extent and value remain unknown. **POTASH:** There is probably some potential in the old beds of the Great Salt Lake, which extend into the county from the north. **SALT:** Deposits of rock salt are found in the Salt Creek area east of Nephi, where there was some activity many years ago.

SAND AND GRAVEL: This mineral is produced intermittently by construction and maintenance crews of the Utah State Road Commission and private contractors engaged in highway construction. **SILICA:** Commercial grade deposits are found in the Eureka district and near Jericho. **General Refractories,** Lehi, has a crushing and loading plant about two miles northwest of Jericho. The Eureka pit has been operated at various times by **D. J. Garrick** and others. **STONE:** Crushed sandstone is produced by **General Refractories** at its Jericho quarry and used for ganister. The **Aggregate Supply Co.,** Salt Lake City, produces a chocolate onyx from a deposit near Nephi, and the **National Stone Suppliers,** also of Salt Lake City, occasionally produces green onyx, white marble and brown-and-white marble from a property five miles west of Nephi. Chief

use is for stone facings and simlar decorative concrete products. **Thomas Peck** of Lehi produces quartz from a quarry near Jericho.

KANE COUNTY

Area: 4,215 square miles. **Population:** 1960 census, 2,667; 1965 estimate, 2,600. **Active companies, 1965:** mining, 3; primary mineral processing, 1. **Average number workers, 1965:** mining, 5; primary mineral processing, . . .*. **Annual worker payroll, 1965:** mining, $17,373; primary mineral processing, . . .*.

Minerals history: There has been little mineral development in Kane County. In the early days there was some **gold** mining activity in the Paria region, but production was insignificant. In a report published by **A. C. Lawson** in 1913, we find this comment: "The clays . . . require only to be sprinkled with water to cause them to promptly disintegrate and flow freely with the water. It is this behavior with water that has led to schemes of extracting their gold content by hydraulic methods." Traces of **copper** and **uranium** were discovered in the Paria and other regions of the county in the first decade of this century, but there has been little development work done. Considerable prospecting for uranium took place in Kane County in the 1950s, resulting in a number of discoveries, but no commercial production has been reported to the Bureau of Mines since 1956.

Nonmetallic minerals existing in commercial quantities are **coal, sand and gravel, silica, gypsum, stone, volcanic grits** and possibly **oil.** Small amounts of coal have been mined since pioneer days. Now the use of Kane County coal for a proposed 10,000,000 kilowatt coal-burning electric generating plant near Lake Powell looms as a major mineral development within the next few years. Sand and gravel is used generally in small quantities in the county, chiefly for road work. Under ordinary conditions, transportation is a serious problem in the marketing of nonmetallics from Kane County.

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Coal	tons	1,883	$ 10,047	1,802	$ 9,737
Sand and Gravel	tons	36,000	41,000	47,000	23,000
Totals			$ 51,047		$ 32,737

(For explanations indicated by small numbers in the above table, see page 24.)

Kane County's Metallic Mineral Deposits and Operations

COPPER: Traces are found in many areas of the county, particularly in the Paria region. **GOLD:** Associated with the clays of the Paria and other regions. Has been mined by panning and hydraulic methods, chiefly in the early 1900s. No significant production. **MANGANESE:** There are several promising deposits in the county. **King Manganese Co.** operated its mine and mill 35 miles east of Kanab for several years in the early 1950s and shipped some high grade concentrates. No output was reported in the 1955-1965 period.

*Denotes figures not available.

URANIUM: During the uranium rush of the 1950s, some promising deposits were found in the Paria and Kanab regions; also the Cock's Comb district. There was minor production from development work in the years 1955-56, but none since that time.

Kane County's Nonmetallic Mineral Deposits and Operations

COAL: Extensive coal deposits, chiefly low grade, are found in many areas of Kane County. The only active mine in recent years is the Alton, near Kanab, which has been producing between 1,000 and 2,000 tons per year. However, the construction of the Glen Canyon Dam has focussed the attention of utility companies on the volatile bituminous deposits of the Kaiparowits Plateau. A great deal of mapping, exploration work and filing for prospecting permits has been done in the last five years. There have been several proposals for construction of large coal-fired steam-electric generating plants near Lake Powell.

The plan which gives greatest promise of ultimate fulfillment was developed by three large power companies—**Arizona Public Service Co., Southern California Edison Co.** and **San Diego Gas and Electric Co.**—through a subsidiary, **Resources Co.** If announced plans reach fruition, initial construction will involve two 750,000-kilowatt units. Later construction would build capacity to 10,000,000 kilowatts. Such a plant would probably be the largest single industrial investment in the state's history—some $1,500,000,000. It would consume an estimated 50 million tons of coal annually, about seven times Utah's present output. It is also estimated that the project would spawn a community of 25,000-plus population, with 2,300 employees in the mines and 150 in the plants.

GEM STONES: Agate, petrified wood and septarium nodules are among gem stones collected in commercial quantities at various times. **GYPSUM:** Undeveloped gypsum rock deposits lie 11 miles west and three miles southwest of Orderville; also three miles east of Glendale and near Cannonville, on the Kane-Garfield county line. **LIMESTONE:** Produced occasionally in Kane County, but there has been no substantial output since 1951.

OIL AND NATURAL GAS: Since 1953 only eight wells—all dry holes—have been drilled in Kane County. Three of these were in the Mt. Carmel area; two in Rees Canyon, and one each in the Soda Springs, Kaibab Gulch and Kanab areas. **SAND AND GRAVEL:** The only commercial producer listed in UGMS' **Directory of the Mining Industry of Utah, 1965** is **Boyd's Rock, Sand & Gravel Co.** at Kanab. The state has a pit south of Mt. Carmel Junction that produces occasionally for road construction and maintenance work. There was a temporary upsurge in production during construction of the Glen Canyon Dam, however, and output reached 4,049,200 tons in 1962.

SILICA: Deposits lie near Kanab. Several shipments were made in the early 1950s from the Moki Cave north of Kanab to **U.S. Steel's Geneva Works,** but no production has been reported in recent years. **STONE:** The county has an abundance of commercial-grade sandstone. One quarry in the hills east of Kanab produces occasionally, furnishing a good quality building stone. **VOLCANIC GRITS:** Found east of Glendale. Have been used now and then in the making of cement blocks.

MILLARD COUNTY

Area: 6,561 square miles. **Population:** 1960 census, 7,866; 1965 estimate, 7,500. **Active companies, 1965:** mining, 4; primary mineral processing, 3. **Average number workers, 1965:** mining, . . .*; primary mineral processing, . . .*. **Annual worker payroll, 1965:** mining, . . .*; primary mineral processing, . . .*.

Minerals history: The earliest recorded mining history began in 1872, when the Detroit mining district was organized 30 to 35 miles north-northeast of Oasis. Some rich surface ores were found with high **gold, silver** and **copper** content. At first these were shipped to Chicago and even to Wales, but in 1888 a small blast furnace was constructed at Hot Springs, 11 miles north of Abraham. 130,000 lbs. of copper bullion was shipped before the plant burned down several years later.

The Leamington district was organized in 1880, and a small smelter was built near Leamington in 1895 to treat ores from this and the Detroit district. Shipments were confined almost entirely to **silver-lead** ores, although **gold, copper** and **zinc** were found in the district. Production was small. The Gordon, Cricket Mountain, Mineral Mountain and Saw Buck districts have also contributed some nonferrous metals output. Occasional shipments are still made from development work on claims in the Gordon and Detroit districts.

With **nonmetallics,** such as **fluorspar, perlite, pumice** and **sand and gravel** coming into greater demand, the future of the minerals industry in Millard County appears to be tied to these industrial minerals.

Organized Mining Districts

Cricket Mountain
Detroit—25
Gordon—35
Leamington (Oak City)—51
Mineral Mountain
Saw Buck—91

Mineral Production, 1964-65:

		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	3	$ 105	.....	.....
Silver	oz	428	553	67	87
Copper	tons	1	359	.....	.....
Lead	tons	2	576	1	265
Zinc	tons	2	585	8	2,292
Sand and Gravel	tons	357,000	343,000	63,000	51,000
Totals			$345,178		$ 53,644

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Millard County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: These nonferrous metals are still potential contributors to the county's economy. However, the rich surface ores are gone, prices are low, and it is not economic at present to mine the low grade ores. Only an occasional shipment is made from development work or from old mine dumps. Over the last six years, very limited production of lead and

*Denotes figures not available.

zinc, with some copper, gold and silver, has come from the Blue Bell dump in the Gordon district, worked intermittently by **G. J. Rowley** of Fillmore.

IRON ORE: There is some iron ore in the southeastern area, near the Sevier County line. **MANGANESE:** Manganese deposits are found in the Little Drum area, 34 miles west of Delta, where rich reserves have been estimated at 250,000 to 350,000 tons; also in the Detroit district. The ore is of poor quality, containing too much zinc. The last reported shipments were made by **Willden Bros.** to the GSA depot at Butte, Montana, during the government's stockpile purchase program in 1955-56.

TUNGSTEN: There are several promising deposits in the county, principally in the House Mountain area. In 1956, at the height of the government's stockpile procurement program, the House Mountain, Treasure Mountain, Pine Peak and other areas in Millard County produced 67% of the value of total tungsten output in Utah. When the government program ended, these deposits could not compete in the world market. The mines were closed and two mills—one at White Valley, 70 miles west of Delta, and another at Treasure Mountain—were idled.

Millard County's Nonmetallic Mineral Deposits and Operations

ASBESTOS: A deposit of asbestos was discovered in the Antelope Mountain district by **Harold** and **Max Nielson** of Richfield and the **Glenny-Cutler Mining Co.** of Salt Lake City in 1961. It has not been commercially developed. **BENTONITE:** There are several deposits in the county, but no shipments have been made. **CALCITE:** Commercial grade calcite is found northwest of Cove Fort, but the deposit has not been developed. **DIATOMITE:** Deposits of diatomaceous earth have been reported south of Sevier Lake.

FLUORSPAR: The Rain Bow mine in southeastern Millard County produced some fluorspar in 1947. In the 1957 and 1958 period there was considerable development work done at the Bell Hill mine. The **Quo Vadis Mines, Inc.** began construction of an acid-grade flotation mill at Delta, but the venture never did reach the production stage. The Bureau of Mines has not reported any output in the county since 1947. **GEM STONES:** Fossils, jasper, obsidian, snowflake obsidian, agate and petrified wood are often collected in Millard County for commercial purposes, with the value running as high as $12,000 in one year. However, no production was reported to the Bureau of Mines in 1964 and 1965.

GYPSUM: The gypsum sand dunes west of Fillmore furnished gypsum for use in making cement during World War II. The deposits are now inactive. **LIMESTONE AND DOLOMITE:** The **George H. Chaffin** quarry at Leamington produces substantial tonnages of limestone every year. The operation is on the Juab-Millard County line. Some of the limestone is used in sugar refining and some for manufacture of lime; also for a fluxing agent. The **Cricket Limestone and Dolomite Co.** has a quarry in the Cricket Mountains north of Black Rock which produces occasionally, and there are other promising deposits in the county, including a property north of Cove Fort. **NITRATE:** Deposits in the Fillmore-Kanosh region are still undeveloped.

OBSIDIAN: Not only is this volcanic glass collected in Millard County by rock hounds and gem dealers, but it is also produced commercially for use in stone facings and other concrete products. Most of Utah's obsidian comes from southern Millard County, where considerable quantities have been produced near Black Rock since the early 1940s. This locality is especially well known for flowering or snowflake obsidian, a black variety with bluish-gray

spots composed of radiating needle-shaped crystals in clusters called spherulites. At White Mountain, near Black Rock, are found both black and red varieties, separately and mixed.

OIL: There has been some exploratory drilling, but no discoveries. The first well was drilled in 1902 in the Fillmore area, others later near Fillmore and in the Pruess Valley, Black Rock and San Francisco Mountain areas. Since Jan. 1, 1954, only three wells have been drilled, all of them dry holes. One is near Delta, one at Baker Creek and one in Sunset Canyon. **PERLITE:** Good commercial deposits are found in the southern area, east of Bloom, north of Milford, and some near Pumice Station, north of Black Rock. Several properties produced substantial tonnages between 1947 and 1958, but most of them are now inactive, due to the closing of several expanding plants in the Salt Lake City area.

PUMICE: A number of commercial properties lie in central and southern Millard County. The first development took place back in 1897, when the **Chicago Pumice Co.** produced 158 tons. There is excellent potential for this industry, given favorable conditions. Production in the past has come from the Black Rock, Crum, Pumice and Delta areas. The only output reported by the Bureau of Mines during the last ten years, however, is volcanic grits (scoria), which is classified as a form of pumice. It is discussed in a separate paragraph.

SAND AND GRAVEL: Several pits are scattered over the county, most of them producing occasionally for road construction and maintenance. The **Utah Directory of Manufacturers** 1966 lists the following producers and users: **Bunker Concrete Co.** and **Delta Ready Mix Co.**, Delta, and **East Millard Ready Mix**, Meadow. The year of biggest output in the last decade was 1964, when the county produced 357,000 tons, valued at $343,000. **STONE:** There has been intermittent production of sandstone and Colorado marble (travertine) for building and ornamental purposes. A Colorado marble quarry south of Meadow has been operated in recent years by **Utah Calcium Co.** of Salt Lake City. Most of the production is shipped to other states and some shipments have been made overseas, as far as Italy. Onyx marble is produced occasionally from vein deposits near Fillmore.

SULPHUR: The Beaver County sulphur deposits, centered at Sulphurdale, extend northward into southeastern Millard County. **Sulphurdale Chemical Co.** has a few claims near Cove Fort. The Millard County deposits have not been developed.

VOLCANIC ASH (SCORIA): West of Fillmore, Meadow and Kanosh is a large volcanic area, rich in possibilities. Volcanic ash has been produced from this area intermittently for many years. Chief producers have been **Central Utah Block Co., Christensen Construction Co., Ralph Memmott** and **Ray Hiatt.** Mr. Hiatt, who headquarters at Payson, is now the major producer, quarrying large quantities and trucking the material to the **Prince Block Co.** and other firms in Salt Lake City. It is used as a lightweight aggregate in the making of building blocks and other products. Some of the ash is used for roofing granules. Through some oversight, production of volcanic ash over the last two years was not reported to the Bureau of Mines and consequently does not show in the production table near the beginning of this chapter.

MORGAN COUNTY

Area: 625 square miles. **Population:** 1960 census, 2,837; 1965 estimate, 3,100. **Active compafies, 1965:** mining, 1; primary mineral processing, 3. **Average num-**

ber of workers, 1965: mining, . . .*; primary mineral processing, . . .*. **Annual worker payroll, 1965:** mining, . . .*; primary mineral processing, . . .*.

Minerals history: Active mining operations began in the Argenta district, six miles north of Peterson, in 1905, when the Carbonate-Hill property made a small shipment. Three properties in the area produced occasionally until about 1913. In 1907 and 1908 the Chicago-Utah and other properties in the Morgan district, near the town of that name, shipped small quantities of **gold-silver-copper** ore. There has been very little activity in these districts in the last 40 years. The **lead-zinc** mines of the Argenta district contain very little gold and silver to help pay mining costs. On the other hand, the ores of the Morgan district, while showing a very good gold and silver content, are low-grade copper.

The Hardscrabble, or Mill Creek district, was noted in the early days for its **iron ore.** It was organized in 1893. However, as early as 1879, shipments of 56-65% iron ore were made from claims of the **Norway Iron Mining & Mfg. Co.** An experimental iron furnace was built in Ogden during the 1880s, and some of the Hardscrabble ore was treated. There is no record of tonnage produced. No shipments have been reported in recent years.

The real minerals history of Morgan County began in comparatively recent times with the establishment of the **Ideal Cement Co.'s** plant at Devil's Slide. Production value of **cement rock** produced each year doubles or triples the value of all other Morgan County minerals combined.

Organized Mining Districts: Argenta—4
Morgan—63
Hardscrabble (Mill Creek)—41

Mineral Production, 1964-65:

		1964		1965	
		Quantity	Value	Quantity	Value
Cement	378# bbls	1	1	1	1
Sand and Gravel	tons	1	1	115,000	$134,000
Stone	tons	1	1	1	1
Totals			5		5

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Morgan County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: There is still some potential in the Argenta, Hardscrabble and Morgan districts, should conditions become more favorable. Only occasional shipments are made from these districts. Last production was a small tonnage mined from the Morgan Argentine property in 1960 by **Continental Exploration Co.** It was lead-zinc-silver ore, worth approximately $1,000.

IRON ORE: The iron ore deposits of the Hardscrabble district produced small quantities in the 1880s and 1890s, but they have been inactive now for many years. **MOLYBDENITE, THORIUM AND URANIUM** have been discovered in a prospect on the Arthur Fork in Morgan County, but there has been no production from the claims.

*Denotes figures not available.

Morgan County's Nonmetallic Mineral Deposits and Operations

BARITE: There are unworked deposits of barite in the Carbonate Hill mine in the Argenta district. **CEMENT ROCK:** Is quarried at Devils Slide and processed into cement at the big **Ideal Cement Co.** plant nearby. This is by far the county's major mineral industry. Production value runs into several millions of dollars each year. Vast reserves of rock suitable for cement assure continued production for many years to come. It is interesting to note that the cement plant uses substantial tonnages of iron concentrates from Iron County and gypsum rock from Sevier County in the preparation of its products.

CLAY: Good brick clay is found in Morgan County, but production is not steady. The last shipments reported to the Bureau of Mines were made by **Interstate Brick Co.** to their Salt Lake City plant in 1960. **COAL:** There are occurrences of coal in the Lost Creek area of Morgan County. It is of sub-bituminous rank and is relatively high in ash content. There has been no production reported for commercial purposes. **PHOSPHATE ROCK:** The county contains large deposits of phosphate rock. Some metallurgical grade rock was processed at one time by **Utah Phosphate Co.** at a mill in Morgan, most of the product going to the **Garfield Chemical & Manufacturing Co.** at Garfield. No production has been reported in recent years.

SAND AND GRAVEL: Significant quantities of sand and gravel are produced each year in Morgan County, chiefly by the **Utah State Road Commission** and by private contractors engaged in highway work. Biggest production in the last decade was 314,500 tons, valued at $284,000 in 1959. A commercial user of sand and gravel is **Ephrata Pre-Mix,** Morgan. **STONE:** The **Ideal Cement Co.** quarries some sandstone for processing of its cement rock, along with certain shales. Crushed sandstone is also produced occasionally for the **Bureau of Reclamation.**

PIUTE COUNTY

Area: 763 square miles. **Population:** 1960 census, 1,436; 1965 estimate, 1,400. **Active companies, 1965:** mining, 6; primary mineral processing, 1. **Average number workers, 1965:** mining, . . .*; primary mineral processing, . . .*. **Annual worker payroll, 1965:** mining, . . .*; primary mineral processing, . . .*.

Minerals history: The Ohio, or Marysvale district was organized in 1868. Webster and Bullion, located within the area, became important mining camps. Bullion was once the county seat of Piute County, with approximately 200 inhabitants. A small mill was constructed in the district in 1872, but proved a failure. Another, built in 1882 in Bullion Canyon, also failed to meet expectations. All-time production of this district would probably not exceed a half-million dollars in **gold, silver, copper, lead** and **zinc.**

The Gold Mountain district, straddling the Sevier-Piute County line, was organized in 1889 and became a substantial producer of gold and silver, the value running into millions of dollars. Several mills were constructed, one on the famous Annie Laurie property. The Mount Baldy district, adjoining the Ohio district on the north, became a good producer of gold, silver, copper and lead. It was organized in 1878, and the well known Deer Trail mine was discovered in September of that year. Most of the mines in the county are now idle because conditions are unfavorable for exploiting the deeper, low-grade ores. A few

*Denotes figures not available.

developments have been made during the last decade from various mining properties. The only volume producer has been the Deer Trail mine.

Alunite and **mercury** have been produced in the Ohio district at widely spaced intervals since early days, but there has been no sustained output.

Uranium in commercial quantities was discovered shortly after World War II in the Durkee district near Marysvale. A uranium ore buying station located at Marysvale for several years was closed in March, 1957. The Durkee district ores are now shipped to mills outside of the county.

Organized Mining Districts

Gold Mountain (Kimberly)—33
Mount Baldy—64
Ohio (Marysvale)—69
Durkee

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	1	1	1	1
Silver	oz	1	1	1	1
Copper	tons	1	1	1	1
Lead	tons	1	1	1	1
Zinc	tons	1	1	1	1
Sand and Gravel	tons	2,000	2,000	.....	.....
Uranium Ore	tons	1	1	1	1
Clays	tons	.....	.....	1	1
Totals			$506,341		5

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Piute County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD and ZINC: Piute County's three nonferrous mining districts are idle with the exception of development work. Low-grade ores, the high cost of mining at depth, and low metal prices make operations uneconomical. In recent years the Deer Trail lead-zinc mine, operated by the **Arundel Mining Co.**, has been a consistent but small producer from extensive development work. Occasional shipments are made from the Shamrock and Bully Boy mines in the Ohio district.

IRON ORE: There are unworked deposits of iron ore near Circleville. **MANGANESE:** Piute County has at least four good manganese deposits awaiting development. Some ore was shipped from the Marysvale area during the First World War. The last reported shipment was in 1955, during the federal government's stockpile purchase program. It was a manganiferous type ore from the New Day mine. Other deposits are found in the Blackbird, Blue Miami Moon No. 1, Dry Canyon and Gilbert mines.

MERCURY: The Ohio, or Marysvale district was once a producer of mercury. The **Richmond Quicksilver Co.** operated the Lucky Boy mine from 1881 to 1887 and produced more than 200 flasks of mercury. Other occurrences of this mineral have been reported near Marysvale in the gold-bearing Ohio and Mount Baldy districts. **MOLYBDENUM:** This metal occurs in association with uranium ores in several deposits in the Ohio district, but the molybdenum content is low. **SELENIUM:** Occurs with gold and silver ores in the Bully Boy and Webster

mines in the Ohio district. **TELLURIUM:** Is another metal associated with the ores of these two mines and with ores in the Lucky Boy mine in the Mount Baldy district.

URANIUM: Always ranking either first or second in quantity and value of production in Piute County is the autunite ore of the Marysvale area. Marysvale's Durkee district has been one of the state's most consistent producers. The major properties in recent years have been the **Bullion Monarch Mining Co.'s** Farmer John claim, the Freedom-Cloys claims belonging to **Pratt and Ethel Seegmiller,** the **Golden Cycle Corp.'s** Potts Fraction mine and the Prospector claims, owned by **Vanadium Corp. of America** and others. VCA has done most of the actual mining in the county for these min owners.

Piute County's Nonmetallic Mineral Deposits and Operations

ALUNITE: This mineral has long offered a challenge to investment capital, but efforts to develop it have not been encouraging. There are extensive deposits in the Marysvale area. Reserves are estimated by the **Bureau of Mines** at 30,000,000 tons. An industry spokesman stated that more than half of the reserves are high grade. The **Calunite Corporation** of San Francisco constructed a 60-tons-per-day crushing plant at Marysvale in the 1950s and shipped considerable alunite to fertilizer mixing plants in Utah and nearby states. The **Alunite Corporation of Utah** also built a crushing and bagging plant at Marysvale. Part of their product was sold direct to farmers and some to fertilizer mixing plants. These enterprises were not successful, however, and there has been little activity in the last six years. **Empico Alunite Co.** has done some small-scale mining and milling during the 1960s. Efforts have been made to commercialize the pure aluminum sands in alunite ore, but without success.

FIRE CLAY: A fire clay deposit near Marysvale is a potential source of commercial clay. **FLUORSPAR:** There are numerous fluorite veins in the Marysvale uranium area, but there has been no exploitation of these deposits, with the exception of a small shipment from the Bullion Monarch uranium mine in 1949. **POTASH:** This mineral is associated with the alunite ores of the Marysvale district. Some of these ores run approximately 16% potash. Attempts were made during World War I to recover potash from alunite to replace supplies shut off from Germany.

SAND AND GRAVEL: The county is an intermittent producer of sand and gravel, most of it being used for road construction and maintenance. The most recent output reported to the U.S. Bureau of Mines was in 1964, when 2,000 tons, valued at $2,000, was produced.

RICH COUNTY

Area: 1,631 square miles. **Population:** 1960 census, 1,685; 1965 estimate, 1,500. **Active companies, 1965:** mining, 1; primary mineral processing, 0. **Average number workers, 1965:** mining, . . .*; primary mineral processing, 0. **Annual worker payroll, 1965:** mining, . . .*; primary mineral processing, 0.

Minerals history: Rich County's metallic mineral deposits lie on the eastern slope of the Bear River Range in the Swan Creek, or Garden City district. They were first discovered and prospected around the turn of the century. However, the **gold** and **silver** content of the **lead** and **copper** ore is almost negligible, and

*Denotes figures not available.

inasmuch as the deposits discovered to date are small, little development work has been undertaken.

Rich County's mineral history is woven around the extensive phosphate rock deposits in the northern and eastern areas of the county. The deposits in the Crawford Mountain, Laketown and Woodruff Creek areas were known and prospected in the early 1900s, but there was very little production. A 1937 report says that up to 1930 the total output of phosphate rock in Utah was only 18,047 long tons. The establishment of a large phosphate plant at Garfield, Salt Lake County; the more recent construction of a 1,000-tons-per-day beneficiating plant by **San Francisco Chemical Co.** at Leefe, Wyoming, and the expansion of Pacific Coast fertilizer plants have stimulated Rich County production. Mining of phosphate rock is now a major industry. Chief producer is the **San Francisco Chemical Co.**

Organized Mining District: Swan Creek (Garden City)

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Phosphate Rock	tons	1	1	1	1
Sand and Gravel	tons	4,000	$2,000	57,000	$70,000
Totals			5		5

(For explanation indicated by bracketed numbers in the above table, see page 24.)

Rich County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER and LEAD: Are found in small quantities in the Swan Creek, or Garden City district, stretching from the Idaho line to the vicinity of Woodruff, in the Bear River Range. The hills are dotted with prospects. However, deposits are small and the gold-silver content exceptionally low, which makes it uneconomical to mine them under present conditions. No production has been reported. **IRON ORE:** Discovered in the southern part of Swan Creek district. No development work has been done. **MANGANESE:** Manganese ore is found in the Lakeview district. Three hundred forty seven tons were produced in 1959 by **Minerals of Utah** and shipped under the government's carlot purchase program for the national stockpile.

Rich County's Nonmetallic Mineral Deposits and Operations

BARITE: There are unworked deposits of barite in the Swan Creek district. **FLUORSPAR:** Rich County has inactive deposits of this mineral.

PHOSPHATE ROCK: Great beds of commercial-grade rock stretch through the northern and eastern areas of Rich County. Reserves in the Crawford Mountain deposits alone have been estimated at 90,000,000 tons. Production prior to 1953 probably averaged around 500 tons per month. Idaho and Wyoming rock had received most development up to that time. Rich County's output has grown rapidly, however, since 1953. **San Francisco Chemical Co.** is the major producer. The Cherokee and the Benjamin properties of this firm probably produce between 3,000 and 4,000 tons of rock per day. The broken rock is shipped to the company plant at Sage, Wyo. for grinding. **The FMC Corp.** is the only other producer reporting to the Bureau of Mines in recent years. Several other companies did intermittent mining of phosphate rock in Rich County during the 1950s.

SAND AND GRAVEL: Private contractors, working on State Road Commission contracts, occasionally produce small amounts of paving gravel. There are no commercial operations. Biggest production in many years was 57,000 tons in 1965.

SALT LAKE COUNTY

Area: 756 square miles. **Population:** 1960 census, 383,035; 1965 estimate, 445,000. **Active companies,** 1965: mining, 95; primary mineral processing, 51. **Average number workers,** 1965: mining, 6,724; primary mineral processing, 4,153. **Annual worker payroll,** 1965: mining, $49,653,000; primary mineral processing, $29,010,000.

Minerals history: Some minerals such as **stone, clay, salt, sand** and **gravel** have been used since colonization in 1847. Metals history really began in 1862, with arrival of General Connor and his California Volunteers at Fort Douglas. Most of these soldiers were prospectors, and they were soon scouring the hills for outcroppings. It was they who first panned **gold** in Bingham Canyon. The first Utah mining claim was staked in this canyon Sept. 17, 1863, by **George P. Ogilvie,** who came across an outcrop of galena while hauling logs. Mineral locations were made rapidly thereafter and underground mining of **lead-silver** ores began. However, it was not until the railroad reached Salt Lake City in 1870 that metal mining became a major industry. **Gold, lead** and **silver** became the principal products exported from Utah.

The low-grade Bingham **copper** ore was largely ignored at first, until **E. A. Wall** became interested and acquired several claims, increasing his holdings to about 200 acres by 1900. It remained, however, for a young metallurgist named **Daniel C. Jackling** to effect the change from unprofitable underground mining of copper to profitable open pit operations. Backed by substantial capital, he acquired Wall's interests and organized the **Utah Copper Co.** (now a division of **Kennecott Copper Corp.**). A milling plant was soon developed and erected, and mass production methods of open pit mining introduced. From that humble beginning, the Utah copper pit has become the largest open pit copper mine in the United States, furnishing about 18 percent of the nation's output.

The district continued to be a big producer of lead and silver. Numerous smelters were built in the 1880s and 1890s. Large custom smelters were constructed in the early 1900s, and Salt Lake became the world's largest nonferrous smelting center for lead, copper, gold and silver particularly.

Soon after the Bingham discoveries in 1863, strikes were made in Big Cottonwood and Little Cottonwood canyon areas. Alta, with its famous Emma mine, became a roaring mining camp of 5,000 population. In 1870 the Hot Springs district was organized north of Salt Lake City. It produced small quantities of silver and **iron,** but was never extensively developed.

Salt Lake County ranks first in Utah's mineral production, with **gold, silver, copper, lead, zinc,** and **molybdenum** being the major items.

Organized Mining Districts

Big Cottonwood—7
Hot Springs (including Adams)—44
Little Cottonwood (Alta)—54
Lower Placer—56
Smelter District—99
West Mountain (Bingham)—111

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	251,635	$8,807,225	379,042	$13,266,470
Silver	oz	3,139,953	4,059,959	3,868,595	5,002,093
Copper	tons	194,996	127,137,359	255,945	181,208,918
Lead	tons	26,812	7,024,809	21,605	6,740,776
Zinc	tons	18,415	5,008,744	13,323	3,890,185
Cement	378# bbls	[1]	[1]	[1]	[1]
Clays	tons	[1]	[1]	[1]	[1]
Lime	tons	[1]	[1]	[1]	[1]
Molybdenum	M lbs	[1]	[1]	[1]	[1]
Salt	tons	[1]	[1]	[1]	[1]
Sand and Gravel	tons	4,625,000	4,841,000	4,139,000	4,400,000
Stone	tons	[1]	[1]	52,293	64,749
Totals			$177,714,520		$242,641,518

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Salt Lake County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD and ZINC: Despite low prices for lead and zinc which closed some of the lead-zinc mines in Salt Lake County, the West Mountain (Bingham) district is still producing in large volume and Salt Lake leads all other counties in production of these important metals. The U.S. and Lark mine of the **United States Smelting Refining & Mining Co.** in the West Mountain district is responsible for approximately half of the lead-zinc ore tonnages in the state each year. This mine ranks third in lead production in the nation and is among the biggest-volume zinc producers. The Butterfield mine in the same district—owned and operated for many years by the **Combined Metals Reduction Co.** and until 1955 the second largest lead-zinc producer in the county—was sold to **Kennecott Copper Corp.'s Utah Copper Division** in 1955 and is now idle.

Leasers have been making small shipments occasionally from other mines in the West Mountain district and from Big and Little Cottonwood. Since 1960 more than $1,200,000 worth of lead-zinc ore has been produced by **Cardiff Industries** and the **Grand Deposit Mining Co.** from the Alta district. There is still great potential in Big and Little Cottonwood districts.

The only **copper** mine in Salt Lake County is **Kennecott's Utah Copper pit** at Bingham, largest producer in the country, furnishing about 18% of the nation's output of raw copper. Although only about 14.5 pounds of copper are recovered from each ton of ore, 1965 production was 253,728 tons, valued at $181, 079, 000.

Primary processing plants for nonferrous metals in Salt Lake County are the **MIdvale flotation mill of U. S. S. R. & M. Co.,** which handles ores from the company's U.S. and Lark mine and also buys lead-zinc ores from mines in Utah and other western states; the **Bonneville Concentrator,** the **Magna and Arthur Mills** and the **precipitation plant** of Kennecott near Magna, and the **copper smelter** and **electrolytic copper refinery** operated by Kennecott at Garfield. **U. S. S. R. & M. Co.'s lead smelter** at Midvale was closed down in 1958 and later dismantled. Lead concentrates from the company's mill are processed at the **International smelter** near Tooele.

Kennecott Copper Corp. is just completing a $100 million expansion program at its **Utah Copper Division,** which will increase copper production to 300,000 tons per year.

ANTIMONY: Deposits of this mineral are found near Brighton in Big Cottonwood Canyon, where there was some production during World War I; also in the Little Cottonwood (Alta) district, where the South Hecla mine produced 3,866 pounds during 1944-45. **ARSENIC:** Small amounts of arsenic were produced from the Sells Tunnel in the Little Cottonwood district in 1920. This mineral was a by-product of lead smelting at the Midvale plant of **U.S.S.R.&M. Co.** until the smelter was abandoned in 1958. **BISMUTH:** Has been produced intermittently in the Little Cottonwood district. At one time the South Hecla mine was one of the major sources of this mineral in the United States. Between 1912 and 1925, the output was 18,000 lbs; in 1944-45, 11,861 lbs.; in 1947, 3,494 lbs. The Sells Tunnel produced 8,917 lbs. from copper-silver ore in 1920. There is minor production of bismuth as a by-product of the Bingham porphyry copper ores.

IRON ORE: There are deposits of iron ore in Big Cottonwood Canyon and in the Hot Springs district just north of Salt Lake City. Small shipments were made from Hot Springs claims many years ago, but no development work has been done there for several decades. In the late 1950s there was a flurry of interest in deposits lying east of Lake Mary in the Brighton area of Big Cottonwood Canyon, owned by **Great Western Mines, Inc.** and the **Miller Hill Mining Co.** Bog iron ore is found in the Albion Basin of Little Cottonwood. Leasers have experimented with this mineral as an organic soil additive.

MANGANESE: Big Cottonwood Canyon contains manganese deposits. The last reported shipments were made during World War I. **MOLYBDENUM:** Is found in the low-grade copper ore at Bingham and is produced by **Kennecott** as a by-product. Recovery in commercial quantities began in September, 1936. Production figures are not published, but Utah ranks second in the nation each year in molybdenum output. Kennecott constructed a $3 million molybdic oxide plant near the Garfield smelter in 1965-66 to facilitate processing of this metal. Other molybdenum deposits are found in the Little Cottonwood district. The Continental-Alta mine and the Alta-Gladstone mine contain deposits, and a small amount—about 100 pounds—of molybdenum was produced in 1916 from the City Rocks mine. **MERCURY:** Native mercury is associated with lead ores of the Bingham district, but no commercial production has been reported.

PALLADIUM: There is minor production of this metal as a by-product of the Kennecott Copper Mine at Bingham. **PLATINUM:** Is another metal by-product of the same mine. It is produced in very small quantities. **RHENIUM:** Molybdenite, a by-product of the Bingham copper ores, now goes to a newly constructed molybdic oxide and rhenium recovery plant near the smelter, where it is roasted to produce molybdic oxide. During the roasting, vapor from the oxide is captured and undergoes a complex process to produce ammonium perrhenate. The perrhenate is then shipped to **Kennecott's** subsidiary, **Chase Brass and Copper Co.,** in the east, where it is processed into rhenium, a metal with a melting point of 5,732 degrees F. and with important uses in space capsules, rocket nozzles and other space-age equipment. In 1964, total production of rhenium in the U.S. was 2,000 lbs. Kennecott now will produce 4,000 lbs. of ammonium perrhenate, from which rhenium is made. To produce one pound of rhenium metal requires the handling of about 84 million pounds of copper ore and waste material at the Bingham mine.

SELENIUM: Is another metal by-product of the Bingham copper ore. **TELLURIUM:** Is recovered from the slimes after other metals are removed from these residuals of electrolytic copper refining at Kennecott's Garfield plant. The company constructed a small tellurium processing plant in connection with the refinery in 1964-65. **TUNGSTEN:** Scheelite, one of the tungsten ores, occurs

in the Big Cottonwood district, notably in the Great Western and Big Cottonwood tunnels of the Mountain Lake mine and in the South Hecla mine, but has not been produced commercially. Small quantities of tungsten are currently being produced in Salt Lake City at a plant constructed during the early 1950s by the **Salt Lake Tungsten Co.** to process custom ores. **A. Wesley Hardy** is recovering tungsten from the mill tailings left by the original owner.

Salt Lake County's Nonmetallic Mineral Deposits and Operations

CEMENT ROCK: A quarry in Parley's Canyon, operated by **Portland Cement Co. of Utah,** supplies the needs of the company's Salt Lake City cement plant. Production figures are not available for publication. However, the capacity of the plant is 6,000 bbls. per day. **CLAY:** Produced intermittently from several Salt Lake County deposits, including a fire clay deposit at the mouth of Big Cottonwood Canyon and a brick clay deposit on Salt Lake City's East Bench, above the Holladay Gun Club. Most of the clay used by Salt Lake County brickyards and clay products manufacturers is imported from Summit, Tooele, Sevier and Utah counties. Firms using these clays are **Interstate Brick Co., Intermountain Pipe & Ceramics Corp.** and **Rockymountain Refractories,** all of Salt Lake.

GEM STONES: The U. S. Bureau of Mines reports that gem stones are collected in commercial quantities in Salt Lake County. There was production in the 1958-61 period and again in 1963. Names of the stones, quantity and locations were not revealed. **LIMESTONE:** Except for consistent production of cement rock and oolite, both of which are forms of limestone, Salt Lake County produces limestone only intermittently. However, there are limestone quarries in several areas which produce small tonnages at irregular intervals.

OIL AND NATURAL GAS: The first two test wells were drilled in 1927 and 1931 on the lake beds northwest of Salt Lake City. The second one had a showing of natural gas, but no oil was found. There has been mild interest in this same area at various times since. However, only two wells have been drilled since 1954—one near Saltair in 1956 and the other near the Salt Lake Airport in 1959. Both were dry holes. **OOLITE:** There are deposits of oolitic sands in the Magna-Garfield area, near the Great Salt Lake, owned by **Kennecott Copper Corp's Utah Copper Division.** They supply oolite for use as a flux at the Garfield copper smelter.

PHOSPHATE ROCK: In Dry Canyon, northeast of Salt Lake City, there are extensive deposits of medium and low grade phosphatic shales. The outcrop is reported to run about seven miles up the canyon. No development work or production has been reported. **POTASH:** There is unlimited potential for potash recovery from the brines of Great Salt Lake. **Inland Crystal Salt Co.** built a potash plant in 1915, and by 1918 there were several plants in the county. Resumption of imports from Germany and development of potash mines in New Mexico following World War I made local operations unprofitable. There has been no development work in the county since that time.

QUARTZITE: A deposit near the mouth of Big Cottonwood Canyon, owned by **International Pipe & Ceramics Corp.,** has been idle for years. **SALT:** Most extensive development of Great Salt Lake as a source of minerals has occurred in Salt Lake County. The salt industry was established a few days after arrival of the pioneers in 1847, and it has grown until production is currently running over $1,500,000 per year for Salt Lake County alone. The largest plant in the state is located near Saltair. For many years it was operated by **Royal Crystal**

Salt Co. and **Morton Salt Co.**, but early in 1958 Royal Crystal was dissolved and Morton is now sole operator.

SAND AND GRAVEL: Salt Lake County is Utah's biggest producer of this mineral. It supplies enough for its own requirements and ships to many other counties and into neighboring states as far as freight rates will permit. There are numerous pits north of Salt Lake City and along the East Bench to the Point of the Mountain. Top producer is the **Utah Sand & Gravel Products Corp.** At least ten other firms have crushing, screening, sizing and loading plants, in addition to state, county and city road construction operations. Sand and gravel has developed into a multi-million dollar industry in the county, the 1965 production being 4,139,000 tons, valued at $4,400,000.

Producing sand and gravel companies, as listed in **A Directory of the Mining Industry,** 1965, published by the **Utah Geological and Mineralogical Survey,** and in **State Industrial Commission** records, are as follows:

A-1 Sand & Gravel Co.
A & L Concrete Co. (Ready Mix)
Beehive Sand & Gravel Co.
Big Cottonwood Sand & Gravel Co.
Breitling Bros. Construction Co.
Brimhall Sand & Gravel Co.
Dan H. Fogle Red-E-Mix
W. W. and W. B. Gardner, Inc.
Gibbons & Reed Construction Co.
Harper-Jackson Sand & Gravel Co.
P. C. Kimball
Frank Naccarotto
Marvin Nowell
Prince Block Co.
James Reed
Reynolds Sand & Gravel Co.
Salt Lake County Roads Dept.
Sorenson Construction Co.
Southeast Sand & Gravel Co. (Ready Mix)
Thomas Sand & Gravel Co.
Union Pacific Railroad Co.
George A. Wood
Utah Sand & Gravel Products Corp. (Ready Mix)

SILICA: Silica has been produced at various times from deposits in Mill Creek Canyon, in the Draper area, and in the Hot Springs district north of Salt Lake City. **Interstate Brick Co.** quarries silica and processes it on its Salt Lake City properties. The product is used by Interstate and also sold to firms in the area that consume refractories. A substantial tonnage goes to **Kennecott** for use as a fluxing material at the Garfield copper smelter. A large volume of silica comes from the Rideout quarries near the Point of the Mountain, in the Draper area. The **Utah Sand & Gravel Products Corp.** has an inactive quarry in North Salt Lake. Most of this firm's production comes from the Kearns area southwest of Salt Lake City, where the regular sand deposits are more than 90% silica.

SLAG: Slag from the old smelter properties in Murray and Midvale and from **Kennecott's** copper smelter is used as a concrete aggregate, as an ingredient in road mixes and mineral wool and in the processing of cement in Utah cement plants; also for sand-blasting material and railroad bedding.

STONE: Building stone of good quality is found in the canyons of the Wasatch Range on the eastern border of the county—sandstone in Parley's, Emigration and Red Butte canyons; granite in Little Cottonwood. There are quarries in Parley's and Little Cottonwood that produce intermittently. A number of quarries that produced in volume when building stone was a more popular construction item are now inactive. It was Little Cottonwood Canyon that furnished the granite for the building of the famous Salt Lake Temple. **Wilford H. Hansen Stone Quarries, Inc.,** Sandy, produces granite for building stone, and crushed sandstone has been produced in Parley's Canyon in recent years by **Aggregate Supply, Inc.** for use in precasting. Marble (Parley's buff) is also quarried in Parley's Canyon by **Rocky Mountain Aggregates, Inc.** and furnished

to **Style-Crete, Inc.**, Salt Lake City. The **Aggregate Supply, Inc.** has also produced quartzite in the county for use in the manufacture of cast stone products, but the location of the quarry is not generally known. **R. Whitmore** of Salt Lake City quarries granite intermittently at the Temple Granite Quarry in Little Cottonwood Canyon and crushes it for use as poultry grits.

TAILINGS: The **Great Salt Lake Authority** and **Kennecott** are currently conducting a joint venture to determine whether large-scale diking of the Great Salt Lake with tailings from the Garfield copper smelter and the use of these tailings in the construction of roadbeds would be feasible. In 1966, a 2,600-foot peninsula was extended into Great Salt Lake, not far from the smelter, by use of 400,000 tons of tailings. Engineers will study the effects of wind and water to determine if the tailings will make a good "fill" material.

Minerals Produced Elsewhere and Processed in Salt Lake County

ARAGONITE: The **Utah Calcium Co., Inc.** quarries select rock from Aragonite, Tooele County, and crushes it for use as roofing grits and as an important ingredient in poultry and livestock feeds. It is also used in the making of cast stone. **Custom Milling & Supply Co.** purchases aragonite from Utah Calcium and pulverizes it for use in the marking of football fields, grass tennis courts, etc. Unlike hydrated lime, which is also used for this purpose, it makes a clear white line without burning the grass. The pulverized product is also used for paint filler and in making plastics.

ASBESTOS: Small quantities of asbestos are imported from Canada's Quebec Province by **Vermiculite Intermountain, Inc.** for use in making high temperature insulating cement and acoustical plaster. **BARITE: Custom Milling & Supply Co.** buys this mineral from an operation near Battle Mountain, Nevada and sometimes from California and Idaho for use in the making of drilling muds for the oil drilling industry. **BAUXITE: Rockymountain Refractories** imports bauxite from countries outside of the U. S. for use in the making of refractory products. **BRUCITE:** Also brought into the county by **Rockymountain Refractories** from a deposit in Nevada and used as an ingredient in making some of its products.

CHROMITE: Is imported from the Philippines by **Rockymountain Refractories. CLAYS:** All clay used in ceramics and art work by Utah manufacturers is imported because Utah clays do not have the high degree of purity required for these uses. An extremely white clay is brought in from Georgia by **Bennetts** for use as a paint filler. Brick clay for use by such firms as **Interstate Brick Co., International Pipe and Ceramics** and **Rockymountain Refractories** and used in the manufacture of bricks and other clay products is imported from Henefer, Summit County; Sevier, in Sevier County; the Clinton Pits west of Lehi, and the Five Mile Pass deposits in Utah County; the Five Mile Pass area in Tooele County; other properties west of Utah Lake; a deposit near Evanston, Wyoming, and from Colorado. **Rockymountain Refractories** brings in kyanite clay from as far away as Virginia.

GYPSUM: Wasatch Chemical Co. of Salt Lake City uses some of this mineral from Sevier County in the manufacture of chemicals; **C. P. Curtis'** staturary and art goods plant in Salt Lake City makes use of it in statuary and other art objects; **Vermiculite Intermountain, Inc.** processes gypsum rock and resells it to cement plants for use in the manufacture of Portland cement. During World War II, when the regular rock could not be secured, Vermiculite Intermountain used gypsum from the dunes west of Fillmore in Millard County.

HALLOYSITE CLAY: Produced by **Filtrol Corporation** from the Dragon Consolidated mine, Tintic district, and processed at the company's Salt Lake City plant for use as a catalyst in oil refining in the Salt Lake area and on the Pacific Coast. Input capacity of the plant is about 60,000-70,000 tons of clay per year. **LIME AND LIMESTONE:** Most of the crushed and pulverized limestone used in Salt Lake County is imported from Tooele County quarries. Salt Lake County is the state's biggest producer of lime. The largest plant is a part of **Kennecott Copper Corporation's Utah Copper Division** operations. Crushed limestone from **Utah Lime Division of the Flintkote Co.**, which operates in Tooele County, is hydrated to milk of lime in the Kennecott plant and consumed by the company in the treatment of copper ore. The company also sells small quantities of quicklime to other consumers. Kennecott's output usually accounts for about two-thirds of Utah's lime production. **Utah-Idaho Sugar Co.** uses about 5,000 tons of limestone from Juab County each year for manufacturing quicklime at its Salt Lake City sugar refinery. The quicklime is used in the sugar refining process.

OIL: While Salt Lake City is widely known as an oil refining center, only one refinery actually operates in Salt Lake County. The others are all north of the Davis County line. The **American Oil Co.'s** plant refines oil piped from the Rangely Field in Colorado and from the Uinta Basin in eastern Utah. This is one of the county's major industries. **PERLITE:** In the 1950s there were three perlite expanding plants in Salt Lake City. One burned down and one closed for economic reasons. **Acme Lite-Wate Products, Inc.** is the only firm in the county with expanding facilities. It uses perlite from the North Pearl Queen Quarry of **Henry Schoo** in Beaver County and from Nevada properties. The expanded product goes into the manufacturing of building plaster, concrete aggregates and soil conditioners. **Vermiculite Intermountain** uses perlite from Beaver County in the making of insulating materials.

PHOSPHATE ROCK: Processing of phosphate rock, once chiefly from Wyoming, but with a steadily increasing volume from Utah's deposits, is one of Salt Lake County's new industries. **Stauffer Chemical Co.'s Fertilizer Division** is operating a large plant at Garfield, with a production capacity in excess of 200,000 tons per year of treble superphosphates, phosphoric acids, ammoniated phosphates and other products. A large percentage of the ammonia from **U. S. Steel's** nitrogen plant in Utah County and the sulphuric acid produced at Garfield is consumed by Stauffer. Phosphate rock for the operation comes from Rich County (via a Wyoming processing plant) and Uintah County, with most of it being furnished by the Vernal operation of **San Francisco Chemical Co. PUMICE:** This mineral is imported from central Utah counties, from Idaho and other states for use as a lightweight aggregate by **Buehner Block Co., Otto Buehner Concrete Products Co., Prince Block Co.** and **Rockymountain Refractories.**

RESINS: Fossil resins processed at Bauer, Tooele County, by **Combined Metals Reduction Co.** from waste coal fines from **U. S. Fuel Co.'s** Hiawatha, Carbon County mines, are sometimes used in small volume for paint manufacture by **Bennetts. SHALE:** Expanded shale quarried and processed in Summit County has found a large market in Salt Lake County as a lightweight aggregate for manfacture of concrete bricks, blocks, etc. Some of the major users are **Prince Block Co., Utah Concrete Pipe Co.** and **Buehner Block Co.** This mineral has largely replaced pumice for these uses.

STONE: Some of the major importers of stone in Salt Lake County are: **National Stone Suppliers**—Black marble, pink travertine, cream travertine and snuff-colored onyx from a deposit at Pelican Point, Utah County; green onyx, white marble and brown-and-white marble from a quarry five miles west of

Nephi, Juab County; black obsidian from a property 25 miles northeast of Calleo, in Tooele County; white dolomite and white quartz from a deposit 16 miles west of Wendover, in Nevada; pink and cream combination marble from Low, Tooele County; buff jasper and red jasper from a quarry west of Alpine, Utah County; green marble and yellow marble from Table Top Mountain, Tooele County; quartzite in gray, green and brown-and-green from Park Valley deposits in Box Elder County, and sandstone (picture rock) and brown marble from the Vernon area, Tooele County.

Utah Calcium Co.—Aragonite from Tooele County, travertine from Meadow, Millard County and quartzite from the Park Valley area on the Utah-Idaho border.

Dura-Crete, Inc.—Chocolate onyx from Nephi, Juab County; light tan and beige stone from Weber Canyon, quarried by **Clarence Waterfall Co.**, and quartzite from Skull Valley, Tooele County.

Aggregate Supply, Inc.—Crushed marble from the Creme Travertine Quarry, Utah County, and from Box Elder and Tooele counties.

American Stone Co.—Limestone building blocks from a quarry near Ephraim, Sanpete County, considered highly unusual for their whiteness.

Otto Buehner Concrete Products Co.—Obsidian from a quarry near Nephi and crushed marble, granite, sandstone and jasper from various sources. This firm also has secured tonnages of crushed red, green, yellow and white stone from Thompson's Quarry, Iron County.

Skyline Building Supply Co.—Onyx and agate from several sources and quartz from a quarry in Box Elder County, to furnish stone chips for cast stone products.

Wilford H. Hansen Stone Quarries, Inc.—Sandstone from Wasatch County for dimension stone and flagstone.

Intermountain Stone & Marble Co.—Dimension stone from various sources in Utah and outside the state.

VANADIUM: During the 1962-64 period, **Vitro Minerals & Chemical Co.**, a subsidiary of **Vitro Corp. of America**, converted its Salt Lake City plant from uranium to vanadium production. The raw material consists of slags from elemental phosphorous furnaces in Idaho, containing significant quantities of vanadium. The company is producing 3,000,000 to 3,500,000 pounds of vanadium pentoxide annually, most of which is used as an alloy in steel making.

VERMICULITE: Obtained from Libby, Montana and processed by **Vermiculite-Intermountain, Inc.**, Salt Lake City, into an insulation material sold throughout the intermountain area. **VOLCANIC GRITS (Cinders)**—Imported from the Fillmore area of Millard County and used as an ingredient in lightweight aggregates for making concrete blocks, bricks, and ornamental concrete products.

SAN JUAN COUNTY

Area: 7,761 square miles. **Population:** 1960 census, 9,040; 1965 estimate, 8,000. **Active companies, 1965:** mining, 66; primary mineral processing, 1. **Average number workers, 1965:** mining, 330; primary mineral processing, . . .*. **Annual worker payroll, 1965:** mining, $2,147,306; primary mineral processing, . . .*.

Minerals history: Copper and **copper-silver** ores were discovered in the La Sal district as early as 1886, and the first location was made in 1888. Little mining was done until 1896-97, when the Tornado deposit was found and a small stamp mill installed in Miners Basin. There was only token production, however, and the mill closed permanently within a short time. Considerable prospecting and development work was done under the stimulus of high copper prices just prior to the decline of 1907. It was during this period that the Big Indian

*Denotes figures not available.

copper mine was developed. A mill to process the Big Indian ore was not constructed until 1917. This mine became the biggest producer for San Juan County. In its last year of production, 1947, the output was 58,667 tons of copper-silver ore, worth nearly $200,000. The Lisbon copper mine and deposits in the Blue Mountain (Monticello) and White Canyon districts have produced occasionally. There was once a small reduction mill at Hite, near White Canyon.

A promising copper project has been undertaken by the **Micro Copper Corp.** at the Blackbird mine, near Lisbon Valley, south of Moab. This firm has constructed a mill that produces metallic copper powder and oxides from the low-grade ore. Many of San Juan County's uranium deposits contain substantial amounts of copper. The red metal is recovered in a special unit of the uranium processing plant of **Atlas Minerals,** near Moab, Grand County.

Placer gold and **gold in sandstone** were found in the San Juan River region in 1892. A stampede followed, with some 1,200 prospectors suffering hardship, privation and some bloodshed before they found the gold was too fine to be worked on a small scale. In a few months the area was abandoned. However, considerable gold was taken from the placer deposits in and around the Colorado, San Juan, Green and Grand rivers—also from their tributaries—over a period of many years.

Uranium-vanadium ores were found about 1898, and the first shipment was made to Buffalo, New York in 1904. Numerous small shipments were made in the decades that followed, but it was not until the invention of the atomic bomb in the 1940s that San Juan County's uranium came into its own. The county for many years has been Utah's biggest producer. The Big Indian district is the site of the fabulous Mi Vida mine, discovered by the world's first uranium millionaire, **Charles A. Steen.**

Oil and gas production is San Juan County's biggest industry. There had been intermittent prospecting and exploration activity since the first well was drilled in 1908, but beginning with 1948 the search intensified and several commercial fields were discovered, including Boundary Buttes, Desert Creek and the Big Aneth field. Beginning with these discoveries, an unprecedented exploration boom hit the county, with the result that San Juan soon took over the leadership among Utah counties in oil production. A decline in both exploration and production during the last few years has halved the output of crude oil, and natural gas production has decreased slightly. However, the value of the two minerals still runs close to $50,000,000 annually.

Organized Mining Districts

Blue Mtn. (Monticello)—12
Big Indian—8
Monumental—62
White Canyon—114

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Silver	oz	1	1	1	1
Copper	tons	1	1	1	1
Liquid petroleum gases	M gals	1	1	1	1
Natural gas	mill cu ft	32,044	$4,752,000	30,702	$4,329,000
Natural gasoline	M bbls	1	1	1	1
Petroleum	M bbls	20,554	53,852,100	17,077	44,576,000
Sand and Gravel	tons	121,000	116,000	53,000	53,000
Stone	tons	200	4,000	.....	.....
Uranium Ore	tons	686,998	25,003,423	314,186	7,812,738
Vanadium	tons	1	1	1	1
Totals			$87,530,925		$60,494,254

(For explanations indicated by bracketed numbers in the above tables, see page 24.)

San Juan County's Metallic Mineral Deposits and Operations

COPPER: There are deposits with some potential in the Blue Mountain, La Sal, White Canyon and Big Indian districts. However, it is uneconomic to mine and process them with conventional methods. The **Ohio Copper Co.** closed the Big Indian mine in 1947, after total production had exceeded $2,000,000 in value, because it was losing money on the operation. In the last 15 years there has been minor production from the Climax No. 1 and No. 2 mines in Lower Lisbon Valley and the Four Aces mine in the White Canyon district. In 1958 the **Valley Metallurgical Processing Co.** of Essex, Conn., developed a process which recovers metallic copper powder and oxides directly from ore. The **Micro Copper Corp.,** which had instigated Valley's research, constructed a 400-tpd mill at the Blackbird mine in Lisbon Valley and has used this process successfully for several years. They are now contemplating construction of a much larger mill.

Copper-bearing uranium ores are common in the county. In 1965 **Atlas Minerals** added to its uranium mill near Moab, in Grand County, an additional ore-recovery unit, designed to recover sulphide copper from copper-bearing uranium ores mined in Monument Valley, Red Canyon and other areas. The copper concentrates are shipped to smelters outside Utah.

GOLD: Traces of gold are found in the bar sands of the rivers and in the sandstones of many areas in the county. There is also some gold associated with the copper ores of the Blue Mountain, La Sal and White Canyon districts, although in very small amounts. Greatest production has come from placer operations along the streams. There has been no activity in recent years.
SILVER: Is found in association with San Juan County's copper ores. Copper concentrates derived from uranium ores originating in Monument Valley and Red Canyon contain up to 1.5 ounces of silver to the ton.

URANIUM: Deposits have been found in most areas of the county, but the Big Indian district is by far the leading producer. In 1965, San Juan County produced 83% of the state's output. The leading company for a number of years has been **Atlas Minerals, Division of Atlas Corp.,** which consolidated a number of the best properties in the county. This firm recently acquired **Charles A. Steen's Mi Vida mine,** famous as the first major discovery in the state. Operators producing more than 2,000 tons of uranium ore in San Juan County during 1965 are listed below:

Allied-Mission Oil, Inc., La Sal Creek area.
Atlas Minerals, Big Indian and White Canyon districts.
Bullseye Uranium Corp., Spook mine.
Climax Uranium Co., Monticello district.
Even Odds, Inc., Montezuma Canyon area.
Ward Guthrie, White Canyon district.
Homestake Mining Co., Big Indian district.
Industrial Uranium Co., Elk Ridge district.
Red Rock Development Co., Lisbon Valley area.
Rice Development Co., Paradox Basin area.
Harris Shumway, Springwater mine.
Shumway Bros., Cottonwood and Elk Ridge areas.
Shumway & Dade Mining Co., Geneva, Gillman, Midvale, Windfall, Black Hat mines.
Shumway & Perkins Mining Co., Cottonwood area.
Stocks & Gramlich, La Sal and Paradox areas.
Texwood, Big Indian district.
Woodmont, Inc., Big Indian district.
Yuba Development Corp., White Canyon district.

Only one uranium mill is operating in San Juan County at the present time. In fact, it is the only active mill in Utah—the **Atlas Minerals** concentrator at Moab, Grand County. It is to this mill that most of the San Juan County ores are shipped for processing. A mill once operated by the **Atomic Energy Commission** at Monticello and a mill constructed by **Texas-Zinc Minerals Corp.** at Mexican Hat, San Juan County, have been closed down.

Due to lack of a market when the government curtailed its purchase program for uranium oxide, uranium ore production in the county dropped from 1,109,000 tons in 1958 to 314,000 tons in 1965. Industrial demand, however, which is chiefly concerned with construction of atomic power plants, has exceeded expectations. As a result, several major companies are undertaking substantial prospecting and development programs in San Juan County, and a revival of production is anticipated by the early 1970s.

VANADIUM: Is found in association with most of the uranium ores of the county and is recovered from these ores.

San Juan County's Nonmetallic Mineral Deposits and Operations

COAL: The San Juan River coal field, although it has not been developed, contains lenses thick enough to permit mining on a small scale. The coal is of high volatile bituminous rank, but is high in ash content. **GYPSUM:** There are outcroppings of gypsum rock along the canyon of the San Juan River and in areas close to the Arizona border, but they are not economically important. **GEM STONES:** Agate, dinosaur bone, fernwood, petrified wood and volborthite are among the gem stones collected in commercial quantities in San Juan County.

NATURAL GAS: The extensive activity in oil exploration brought natural gas discoveries of great consequence in San Juan County. Output in 1966 was nearly 33 billion cubic feet, slightly under Uintah County's production. Most of this natural gas came from oil fields, with only about 5.5% being produced by the Boundary Butte and Chinle Wash gas fields. The **El Paso Natural Gas Co.** owns and operates a multi-million dollar natural gasoline plant at Aneth Field and a complex gathering system to gather and process natural gas for recovery of natural gas liquids. A 6″ pipeline carries these products to New Mexico, thence to Texas refineries. Paralleling this line is the **El Paso-New Mexico** 16″ line which carries natural gas to southeastern U.S. markets. **The Pacific Northwest Pipeline Co.** constructed a large 26″ transmission line that enters San Juan County from Colorado just east of Monticello, passes near the Lisbon oil field, then runs north past Moab and reenters Colorado northeast of Cisco, Grand County. It transports natural gas to Idaho and the Pacific Northwest.

OIL: It is believed that Utah's natural petroleum was first used in San Juan County. Oil seeps were discovered in the Bluff area and the oil used for various purposes by early settlers. The first well was drilled in 1908 by the **San Francisco-San Juan Oil Co.** Immediately thereafter, a large number of wells were drilled. There were few showings of oil. By 1948, 146 wells had been put down. Discovery of the rich Aneth field by the **Texas Co.** in January of 1956 triggered a huge exploration boom that soon made San Juan the leading oil producing county of the state.

Production statistics of the **Utah Oil and Gas Commission** reveal that in 1966 the county produced 15,940,375 barrels of crude oil, compared with 7,366,840 barrels for the next high county, Uintah. Among the producing fields were: Akah, Big Wash, Bluff, Boundary Butte, Broken Hills, Desert Creek, Gothic Mesa, Aneth, McElmo Creek, Ratherford, White Mesa, Cahone Mesa, Hatch,

Ismay Flodine, Ismay, Lisbon, McElmo Mesa, Recapture Creek, Shafer Canyon, Tohundadla, Turner Bluff and Yellow Rock. Exploration activity in the county revived somewhat in 1966, after a slow year in 1965. In 1966, 44 wells, with a total footage figure of 278,879, were drilled. This compares with 30 wells and 182,295 feet of drilling in 1965.

Two export pipelines—one of 70,000 bbls. per day capacity, constructed by **Four Corners Pipeline Co.** from the Aneth area to the Los Angeles refining district, and one of 50,000 bbls. capacity, built by **Texas-New Mexico Pipeline Co.** from Aneth to Jal, New Mexico—are in operation. There is also a 10″, 69-mile crude oil pipeline constructed by **Ute Pipeline Co.** to transport oil from the Lisbon field north of Monticello to Aneth field, where it connects with export lines.

POTASH: The rich Cane Creek potash deposits now being commercialized by **Texas Gulf Sulphur Co.** at Dead Horse Point near Moab lie in both Grand and San Juan counties. Current production is coming from Grand County, but ultimately activity will extend into San Juan County. In addition, there are several other known deposits, including a discovery by **Superior Oil Co.** in the southwest portion of Lisbon Fault and a deposit found by **Richfield Oil Corp.** south of Cane Creek.

QUARTZ: Deposits of commercial value are located in the Wilson Mesa area. There was some production in the early 1900s. **SAND AND GRAVEL:** The county's sand and gravel output is used chiefly for road construction and maintenance. The only commercial producer and user is **Youngs Concrete Products** at Monticello. **STONE:** There is a huge sandstone potential in San Juan County, but hauling charges and remoteness from markets present problems. There is occasional production of crushed sandstone for the Bureau of Indian Affairs; also intermittent output of dimension sandstone by **Harris Shumway,** of Moab. **Gilbert and Lyman Shumway** of Blanding produce crushed limestone now and then from a quarry at Mexican Hat. Dimension limestone has been quarried at Grayson.

Minerals Produced Elsewhere and Processed in San Juan County

SULPHUR: Atlas Minerals, Division of Atlas Corp., has a small plant at Mexican Hat which produces sulphuric acid for use in the uranium milling industry of the region. The feed material is sulphur imported from **Texas Gulf Sulphur Co.'s** Canadian operations.

SANPETE COUNTY

Area: 1,616 square miles. **Population:** 1960 census, 11,053; 1965 estimate, 11,100. **Active companies, 1965:** mining, 1; primary mineral processing, 1. **Average number workers, 1965:** mining, . . .*; primary mineral processing, . . .*. **Annual worker payroll,** mining, . . .*; primary mineral processing, . . .*.

Minerals history: Sanpete is one of five Utah counties where there is so little metallic mineralization that no metal mining district has ever been organized. There have been rare and very small shipments of **lead-zinc-silver** ore, but not enough to qualify the county as a commercial producer.

*Denotes figures not available.

Coal was found in the county in 1854 by the early settlers, but production has been minor and intermittent. **Natural gas** was discovered in Joe's Valley in November, 1955 and has contributed substantially to the county's mineral production value. **Building stone, crushed limestone, Azomite, salt** and **sand and gravel** are the nonmetallic minerals produced in the county—and these only in comparatively small quantities.

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Lead	tons	.....	.....	3	$ 951
Silver	oz	.....	.....	44	57
Zinc	tons	.....	.....	9	2,643
Clays	tons	5,120	$57,400	1	1
Natural Gas	mil cu ft	.....	.....	96	14,000
Salt	tons	1	1	1	1
Sand and Gravel	tons	1	1	79,000	79,000
Stone	tons	.....	.....	130	10,250
Totals			$130,400		$176,952

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Sanpete County's Metallic Mineral Deposits and Operations

LEAD, SILVER AND ZINC: Very few metallic mineral deposits have been found in Sanpete County. There have been only very rare shipments from prospect holes. Small quantities of lead-zinc-silver ore were shipped from the Santobar mine by the **Santobar Mining Corp.** in 1962 and 1965, the total value being less than $5,000.

Sanpete County's Nonmetallic Mineral Deposits and Operations

ARAGONITE: Grits made from this mineral and known by the trade name of Azomite are quarried and processed at Sterling, where **Azome Utah Mining Co.** has a portable crushing and screening mill. They are sold as turkey and poultry grits, the shapes and sizes reportedly being perfect for grinding media in poultry gizzards. This mineral is classified under "Clays" in **Bureau of Mines** production reports. **BENTONITE:** A substantial quantity of bentonite is produced each year from the Bosshardt mine for use in pond and ditch lining, for roofing, and for use in the oil drilling industry. The mine is operated by **Redmond Clay & Salt Co.**

COAL: This mineral was discovered in Sanpete County in 1854 by two former Welsh coal miners, who founded the town of Wales in 1857. They delivered coke by ox team to Salt Lake City in 1858, but the project was short-lived. The Mount Pleasant coal field was drilled during World War II in a search for coking coal. It was found, however, that the coke was inferior to that produced from coal mined in Carbon County's Sunnyside district, so no development work was done. There has been no commercial production reported to the **Bureau of Mines** for nearly a decade. **Alvin Rigby** of Fairview produced some coal in commercial quantities in the early 1950s.

FULLERS EARTH: An undeveloped deposit of this mineral is found near Mayfield. **GYPSUM:** There are outcroppings of gypsum rock along the south side of Twelve Mile Creek which have never been commercialized. **NATURAL**

GAS: Three States Natural Gas Co. discovered the Joe's Valley natural gas field in November of 1955. Joe's Valley produced substantial quantities of gas for several years. Depletion soon took its toll, however, and output has dropped from 1,176,000,000 cubic feet, valued at $180,000, in 1958 to 96,000,000 cubic feet, with a value of $14,000, in 1965. The gas from Joe's Valley is piped to the Clear Creek field, where it joins a transmission pipeline that carries it to consumers in northern Utah areas.

OIL: The first exploratory well was drilled near Mt. Pleasant in 1918. Three or four others were drilled later in the Ephraim and Redmond areas. In the 1950s, in addition to the drilling in Joe's Valley, which led to discovery of natural gas, dry wells were sunk in the Gooseberry, Mt. Pleasant, Moroni, Ephraim Creek, Gunnison and Musinia areas. No commercial oil discoveries have been reported. **OIL SHALE:** This mineral is found in one locality in the San Pitch Mountains. **SALT:** Rock salt from underground mines operated by **Redmond Clay and Salt Co.** and **Albert Poulson** just north of the Sevier County line is shipped to feed dealers and stockmen throughout the Intermountain west.

SAND AND GRAVEL: Is produced chiefly for road construction and maintenance. However, **U. S. Bureau** of Mines reports show commercial production in recent years by **Cox Bros.** and by **Hales Sand & Gravel Co.**, Redmond. **SILICA:** There is an unworked deposit in the Moroni area. **STONE:** An exceptionally white oolitic limestone known commercially as "Manti Stone" and "Sanpete Stone" is found at Ephraim, Manti and Indianola. Its chief use if for building stone. It was used in the interiors of the Utah and California state capitol buildings. **American Stone Co.** of Salt Lake City quarries this white limestone near Ephriam and markets it in a wide area. **Poulson Bros. Salt Co.** (recently acquired by **Redmond Clay and Salt Co.**) has produced large tonnages of crushed limestone for use by **Utah-Idaho Sugar Co.** in its sugar refining plants. **Azome-Utah Mining Co.** at Sterling occasionally produces miscellaneous crushed stone for use in road building and as a concrete aggregate.

SEVIER COUNTY

Area: 1,978 square miles. **Population:** 1960 census, 10,505; 1965 estimate, 10,000. **Active Companies, 1965:** mining, 6; primary mineral processing, 5. **Average number workers, 1965:** mining, 35; primary mineral processing, 242. **Annual worker payroll, 1965:** mining, $229,822; primary mineral processing, $1,512,150.

Minerals history: The Henry metal mining district was organized in 1883, near the southern border of the county. An old report says: "Between 1902 and 1911 there were shipped from the district 1,500 tons of ore containing $8,583 in gold and 28,316 ounces of silver, valued in all at $24,289. Some **iron** flux was shipped to Salt Lake smelters." The Salina Creek district, east of Salina, has some mineralization, but the Lead Hill mine is the only one from which shipments of ore have been reported. **Copper, lead** and **zinc** ores were produced, chiefly in the period between 1908 and 1912, but very little since that ime. In the mid-1950s there was activity at a lead-zinc property in Monroe Canyon, but low metal prices made the operation unfeasible. A small shipment of **gold-silver** ore was reported in 1959.

Gypsum has always been Sevier County's most important mineral. Reserves at Sigurd are conservatively estimated at some 12,000,000 tons of gypsum rock. The first processing of this mineral was done at Sigurd in 1908. There are now two active operations. Input and production statistics are not available, but

it is estimated that close to $800,000 worth of rock is quarried each year. **Coal** has been mined from early pioneer days in substantial quantities. **Clay, salt, sand** and **gravel** are other commercial minerals producing wealth for the county's economy.

Organized Mining Districts: Gold Mountain (Kimberly)—33
Salina Creek—86
Henry—43

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Clays	tons	1	1	1	1
Coal	tons	47,000	$285,760	61,427	$342,766
Gypsum	tons	1	1	1	1
Salt	tons	3,483	24,381	2,500	12,500
Sand and Gravel	tons	1	1	85,000	97,000
Stone	tons	6,352	8,234	------	------
Undistributed[4]			904,513		835,533
Totals			$1,222,888		$1,287,799

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Sevier County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: There is still good potential for gold and silver production in the Henry district, should conditions become more favorable. Shipments are made occasionally, the last one having been reported in 1959, with a value of less than $500. There is copper in the district, as well, but no development work has been done for many years. The copper, lead and zinc deposits of the Salina Creek area have been idle for a long time. A property in Monroe Canyon produced small quantities of lead-zinc-silver ore in 1955-56.

IRON ORE: The Krotki (Iron Cap) iron mine in the Antelope Range remains undeveloped. There are idle iron ore deposits in the Henry district, from which some ore was shipped in the early days for use as a smelting flux. **MANGANESE:** There are inactive deposits of manganese in southwestern Sevier County, near the Piute County line, where the Yellow Hornet, Noonday, Georgia and Jumbo mines are located. **URANIUM:** The Marysvale uranium district of Piute County stretches northeastward into Sevier County, and there is mineralization in the southeastern part of the county, near the Emery County line. The last shipments were small ones from the Helms No. 2 mine and the Flat Tire group in 1958-60.

Sevier County's Nonmetallic Mineral Deposits and Operations

ALUNITE: There are deposits of this mineral near the Piute County line, but the only record of production is a small amount mined by **Denzel Utley** of Joseph in 1965 and shipped to the Northwest for use in fertilizers. **BENTONITE: Western Clay and Metals Co.** mines this mineral from deposits near Redmond and processes it in a plant at Aurora. It is used in manufacturing refractories, in rotary-drilling muds; also for ditch and pond lining and roofing material. The Bosshardt pit has been operated intermittently by **Bosshardt Bros.** in the same general area.

CLAY: **International Pipe & Ceramics Corp.** quarries brick clay from the Fullmer pit near Sevier for use in its Salt Lake City plant. **Interstate Brick Co.** of Salt Lake City also produces clay for brick making at the Clear Creek and Kimberly pits. **COAL:** Coal fields extend several miles into Sevier County from the Emery County line. The Salina Canyon field, best known in the area, is in the drainage of Salina Creek. Coal mining was once a major industry in the county, but production has declined until there is only one major commercial producer, the **Southern Utah Fuel Co.** of Salina. The **Manti Livestock Co.** owns miscellaneous claims that are worked occasionally. The Sun Valley mine, 40 miles east of Salina, was recently sold to **James Dickert, Boyd Anderson** and others by **Paul Anderson.** The latter retains the coal yard in Salina.

DIATOMACEOUS EARTH: There is an inactive deposit of this mineral in southwestern Sevier County. **EMERY:** An unworked deposit of this abrasive rock has been found in the county, but its exact location is not known. **FLUORSPAR:** Sevier County has several deposits of fluorspar which have not been commercialized. **FULLERS EARTH:** Is produced by **Western Clay and Metals Co.** at its Aurora pit and processed at its plant there for use in mineral filters and as a decolorizing agent. **GEM STONES:** Are collected intermittently in commercial quantities. Agate and wunderstone are the most common.

GYPSUM: There are huge reserves of commercial-grade gypsum rock at Sigurd. Two open pit mines and two large plants in that community belong to **U. S. Gypsum Co.** and the **Bestwall Gypsum Division** of **Georgia-Pacific Corp.** Operations are on a large scale, and the industry is a great boon to Sevier County. Reserves of high-quality gypsum rock near Sigurd are estimated at 12,000,000 tons. The two mills produce in excess of 11 miles of wallboard daily, according to **Utah's Changing Economic Patters—1954 by Dr. ElRoy Nelson** and **Osmond L. Harline.** In addition, they produce plaster of several kinds and ship raw gypsum to a wide market for various uses, including the making of cement. It is interesting to note that perlite imported from Beaver County and from Caselton, Nevada is used in the processing of gypsum at Sigurd.

LIMESTONE AND DOLOMITE: Are produced intermittently near Redmond for the making of lime. **OIL AND GAS:** Very little exploratory drilling has been done in Sevier County. A test well was drilled in the Redmond area many years ago, and later on, drilling was done in the Last Chance Creek district (1948). In the last ten years, eight wells have been put down in the county—in the Salina, Sigurd, Porcupine Ridge, Acord Lakes, Emery, Richfield and Paradise Lake areas, but all are dry holes.

SALT: Deposits of rock salt lie near Redmond and are mined consistently in small quantities by **Redmond Clay and Salt Co.,** which recently acquired the properties of **Poulson Bros. Salt Co.** The **Gunnison Valley Salt Co.** claims near Gunnison are inactive at present. They once produced in quantity. **SAND AND GRAVEL:** This mineral is produced in greatly fluctuating volume, chiefly for road construction and maintenance. Commercial producers are **Herring Sand & Gravel Co.** of Richfield and **Hales Sand & Gravel Co.** of Redmond. **H. & S. Concrete Products Co.** of Richfield is a user of this mineral. **STONE: Hales Sand & Gravel Co.** occasionally produces miscellaneous crushed stone for use in concrete products and as roadstone. This firm has just completed a hot mix plant near its gravel pit to furnish material for roads, parking areas, etc.

SUMMIT COUNTY

Area: 1,870 square miles. **Population:** 1960 census, 5,673; 1965 estimate, 6,000. **Active companies, 1965:** mining, 3**; primary mineral processing, 1. **Average number workers; 1965:** mining, 31**; primary mineral processing, . . .*. **Annual worker payroll, 1965:** mining, $175,482; primary mineral processing, . . .*.

Minerals history: The exact date of the earliest discoveries in the Uinta (Park City) district is not known, but finds by **Rufus Walker** and **Ephraim Hanks** in 1869 were among the first. The earliest ore shipment was 40 tons in July, 1870. First claim purchase was made August 21, 1872, when **George Hearst** (father of **William Randolph Hearst**) and **J. B. Haggin** paid prospectors **Hector Steen, John Kain** and **Gus McDowell** $27,000 for Ontario Claim No. 37, reportedly one of the few spots in the district where outcroppings showed on the surface. The Ontario mine ultimately produced more than $15,000,000 in **gold, silver, copper, lead** and **zinc.**

Eastern capital began flowing into the district in the late 1800s and enabled **John J. Daly** to develop the Daly Judge and Daly West mines; **David Keith** the Silver King Coalition Mines Co., and **George W. Lambourne** the eastern end of the Park City district. The old Ontario, the Judge, the Daly-West and other properties were later merged to form the **Park Utah Consolidated Mines Co.** The **Park City Consolidated** was discovered in 1928 and was active until 1941, when high operating costs eliminated profits. Since World War II the Park City district mines have been forced to close several times, due to low metal prices, caused by a flood of cheaply produced foreign imports.

Park Utah and Silver King were consolidated in the 1950s to reduce costs, and the new company, **United Park City Mines Co.,** is now producing substantial tonnages of ore. The Silver King mill, only reduction facility to operate in the county in the last two decades, is inactive.

Summit County has minor production of nonmetallic minerals, chief among them being **oil, coal, clays, expanded shale, sand and gravel,** and **stone.** The recent discovery of a producing oil field in the county, near the Wyoming line, opens up new possibilities for Summit County.

Organized Mining Districts: Marble—59
Uinta (Park City)—107

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	1,620	$ 56,700	2,586	$ 90,510
Silver	oz	466,685	603,424	611,397	790,536
Copper	tons	130	84,467	199	140,397
Lead	tons	6,169	1,354,226	5,143	1,604,678
Zinc	tons	5,804	1,578,729	6,578	1,920,703
Clays	tons	[1]	[1]	[1]	[1]
Coal	tons	17,338	81,199	12,918	60,918
Sand and Gravel	tons	3,000	2,000	725,000	749,000
Stone	tons	2,601	42,533	9,968	19,936
Undistributed			87,062		100,041
Totals			$3,890,340		$5,476,719

(For explanations indicated by bracketed numbers in the above table, see page 24.)

*Denotes figures not available.

**The Utah Department of Employment Security is currently reporting all employment and payroll of United Park City Mines Co. under Wasatch County,

Summit County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: There are still large reserves of ore containing these metals in the Park City district. Low metal prices and high mining costs have closed down most of the mines. The only major operator at the present time is the **United Park City Mines Co.** There has been some production from properties of the **Keystone Mining Co.**, resulting from a joint exploration venture by United Park City and Keystone. **Wortley Co.** and **McFarland & Hullinger** have moved large tonnages of fluxing ore to Kennecott's Garfield smelter in recent years from the old dumps of the Daly West and Ontario mines. These ores contain all five metals.

ANTIMONY, ARSENIC AND BISMUTH: Are associated with the gold-silver-copper-lead-zinc ores of the county, but are not being recovered in commercial quantities. **IRON ORE:** A magnetic type of iron is found in several places in the Park City district, and there is hematite iron ore across the Summit County line from the Brighton area. **MANGANESE:** There are unworked deposits of manganese in the county, but information on exact locations is lacking.

Summit County's Nonmetallic Mineral Deposits and Operations

BARITE: There are inactive barite deposits in the Park City district. **CLAY:** Some of the best brick clay in the state is produced consistently in Summit County, chiefly from the Henefer area, where rich red clay properties owned by **Chas. Anderton, Interstate Brick Co.** and **International Pipe & Ceramics Corp.** are active. **COAL:** There are extensive deposits in the northwestern part of the county, with the best properties near Coalville and Upton. All mines are now reported closed except the property operated by the **Chappell Coal Co.** of Coalville. **FLUORSPAR:** There are unworked deposits in the county, awaiting more favorable conditions for development. **GEM STONES:** Agatized coral is one of several gem stones occasionally collected in commercial quantities.

OIL AND GAS: The first test well was drilled in the Coalville area in 1924. In the last fifteen years, tests have been made in the Coalville, Chalk Creek, Widdop Peak and Park City areas, but without success. However, early in January, 1966, **Phillips Petroleum** brought in a producing well on its Bridger Lake prospect on the south flank of the Green River 95 miles east of Salt Lake City, near the Wyoming line. By the end of that year, this well had produced 220,086 barrels of crude oil. Phillips now has three producing wells in the new field.

PHOSPHATE ROCK: At Franson Canyon near the western margin of the Uinta Mountains there are low-grade phosphate rock deposits in excess of three feet in thickness. For economic reasons, these have never been commercialized. **SHALE:** In the hills between Peoa and Wanship, the **Utelite Corp.** has constructed a $300,000 plant and is mining, crushing and expanding shales that are especially amenable to the expansion process. The product is an aggregate for use in making lightweight blocks and pre-stressed concrete beams and shapes. It is also used extensively in ready-mix concrete and for high-rise buildings.

SAND AND GRAVEL: Production from Summit County pits fluctuates a great deal, depending on construction and maintenance programs of the Highway Department. The only commercial producers are **Wortley Co.** and **Peoa Ready Mix. STONE: Wilford H. Hansen Stone Quarries** of Sandy operates a granite quarry at Peoa. The **Rocky Mountain Quarries** produces dimension sandstone and

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because the company mine office is at Keetley, Wasatch County, and employees enter the mine through the Keetley portal.

sandstone flagging. There are sandstone quarries near Snyderville and Park City which produce occasionally, and a light-gray to yellow-gray sandstone of good quality is quarried in the upper Weber Valley. The county is also reported to contain marble deposits, but their exact location is not known. **SULPHUR:** Some sulphur was produced many years ago from a deposit 25 miles east of Coalville, but there has been no activity at this property for several decades.

TOOELE COUNTY

Area: 6,849 square miles. **Population:** 1960 census, 17,868; 1965 estimate, 22,000. **Active companies, 1965:** mining, 8; primary mineral processing, 4. **Average number workers,** 1965: mining, 105; primary mineral processing, 471. **Average worker payroll, 1965:** mining, $794,987; primary mineral processing, $2,677,729.

Minerals history: Tooele County has more metal mining districts than any other Utah county—22 in all. First districts organized were the Rush Valley (Stockton), on June 12, 1864, and the Ophir, Aug., 1870. Both became heavy producers of **gold, silver, copper, lead** and **zinc.** The original discovery in Rush Valley was made in April, 1864, by members of the California Volunteers, sent to guard stock on a military reservation in the area. A concentrator was built in Rush Valley district soon after mining began, and the county's first smelter—the Jacobs—was constructed at Stockton in 1872. The Chicago smelter was built in the following year on the shore of Rush Lake, but it operated for only a few years.

The Camp Floyd district was discovered in 1870 and a mill constructed in 1872. After the rich surface deposits of silver ore were gone, however, the district was practically abandoned until revived by discovery of gold ore, which was successfully treated by cyanidation in 1891. Mercur, now a ghost town, had a population in 1900 of 2,351. Other Tooele County districts likewise had their "boom and bust" days.

The Honorine and Calumet mines and a concentrator at Bauer, owned by **Combined Metals Reduction Co.** were closed down in 1959, after producing substantial tonnages of ore for many years. During the last decade, the only major producer has been the Ophir Unit of **U. S. Smelting Refining & Mining Co.,** operated by **McFarland & Hullinger** of Tooele. Production has been discontinued in many mines where good reserves still exist, pending the return of higher prices. Development work and some mining by leasers in old diggings still produce small shipments occasionally. The lead smelter of **International Smelting & Refining Co.** near Tooele processes concentrates from **USSR&M Co.'s** Midvale concentrator and does some custom smelting.

Among Tooele County's nonmetallic minerals, **potash** takes first place. **Bonneville Ltd.** started experimental work in 1937 near Wendover on an entirely new process of extracting potash from the old salt beds. The firm shifted to production in 1939, when about 6,000 tons were produced. No accurate figures are available for recent years, but rough estimates place output at 12 to 15 times that amount. The operation has changed hands several times. It is now operated by **Bonneville Ltd. Division, Kaiser Chemical Co. Limestone** and **salt** are other substantial nonmetallic industries of Tooele County.

Organized Mining Districts

Black Crook (Erickson)—9
Blue Bell—10
Bolter (Boulder)—13
Camp Floyd (Mercur)—17
Clifton (Gold Hill)—20
Columbia—22
Dugway—26
Free Coinage—31
Granite Mountain—37
Grantsville (Third Term)—38
Greeley (So. of Camp Floyd)—39
Lakeside—49
La Cigale
North Tintic—68
Oasis (Caledonia)
Osceola (So. of Camp Floyd)—71
Ophir—70
Rush Valley (Stockton)—85
Silver Islet—93
Tooele—105
West Mountain (Bingham)—111
Willow Springs—116

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	120	$ 4,200	130	$ 4,550
Silver	oz	220,826	285,528	198,037	256,062
Copper	tons	216	141,191	177	125,104
Lead	tons	2,300	602,705	2,202	687,071
Zinc	tons	1,628	442,789	1,653	482,588
Clays	tons	[1]	[1]	[1]	[1]
Lime	tons	[1]	[1]	[1]	[1]
Potash	tons	[1]	[1]	[1]	[1]
Salt	tons	212,660	1,868,864	[1]	[1]
Sand and Gravel	tons	207,000	223,000	[1]	[1]
Stone	tons	270,287	943,516	278,789	935,336
Totals			$8,192,701		$8,467,887

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Tooele County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: The higher grade, readily available deposits in Tooele County have been mined out, leaving remaining known deposits of generally low grade. High costs and low prices have reduced many old-time mining camps to ghost towns. **U. S. Smelting Refining & Mining Co.** discontinued mining a decade ago in its Hidden Treasure and Gold Hill leases—once very productive properties. **Combined Metals Reduction Co.** was forced by low metal prices to do the same with its Honorine and Calumet mines. The latter firm's concentrator at Bauer is idle. The Tooele smelter of **International Smelting & Refining Co.** is the only remaining lead smelter in the state. The concentrator section of the smelter is shut down, and ores that it would have processed a few years ago are concentrated at USSR&M Co.'s Midvale mill and the concentrates shipped to Tooele for smelting.

There are occasional shipments of ore from development work in several of the Tooele County districts. The **Mecca Mining Co.** produced small tonnages in the 1961-63 period from its mine in Fry Canyon. During the last ten years intermittent shipments have been made by leasers from the Lion Hill, Wandering Jew, Treasure Hill, Calumet, Argent and Rainbow mines.

ANTIMONY: Is associated with cinnabar south of Gold Hill, at the southern end of the Deep Creek Mountains. **ARSENIC:** The Clifton (Gold Hill) district ores are high in arsenic content. It is reported that between 1920 and 1925 about 9,000 tons of metallic arsenic was recovered from processed ores. Many

thousands of tons have been recovered since that time, but the mines are now closed. **BISMUTH:** This mineral was shipped from the Wilson Consolidated mine in the Clifton district in 1914-17. It is present in several mines of that district, all inactive at present.

BERYLLIUM: Beryllium-type ores are found in the Sheeprock Mountains, the Gold Hill Area, Granite Mountain and Skull Valley. The largest deposit is in the Sheeprock Mountains, where **RanRex Beryllium Corp.** of Bountiful controls an acreage of claims which geologists believe contains some three million tons of ore. With help of eastern capital, RanRex did considerable development work in the early 1960s. However, their plans for construction of a mill must await the development of greater demand for beryllium metal.

MAGNESIUM AND LITHIUM: These two minerals are found in abundance in the brines of the Great Salt Lake. For a number of years, **Key Minerals Corp.** of Salt Lake City has extracted about 25 tons of magnesium annually at a plant on the lakeshore in Tooele County for use in livestock feed and chemical compounds. Now, with settlement in sight of the long controversy between the U. S. Government and the state of Utah relative to ownership of the lands around the lake from which the water has receded since statehood, intense interest has developed in the extraction of these two minerals from the lake's brines. The **Magnesium Project,** a joint undertaking of the **Hogle-Kearns** interests of Salt Lake City and the **National Lead Co.** of New York, has leased all of the available lakeshore in Tooele County and is preparing plans for an extensive evaporation pond system and two extraction plants—one for anhydrous magnesium chloride and the other for potassium sulfate fertilizer.

MANGANESE: Manganese was produced in limited quantities from the Ophir district during World War I. Several mines were active during the 1950s and shipped ore to the Geneva Works in Utah County and to various depots outside of Utah during the government's carlot purchase program. The Black Hawk and Kramer mines were the most consistent producers. Manganese deposits are also located in the Deer Trail, Black Jack, Black Rock and Indian Boy mines of the Erickson district. **MERCURY:** Most famous of the state's mercury deposits is the Sacramento mine in the Camp Floyd (Mercur) district, from which more than 3,000 flasks of this mineral were extracted between 1903 and 1907. In 1907 the ore body was exhausted. Since then, most of Utah's 200-flask output has come from the Probert (Cougar Hill) mine in the southwestern corner of the county, but this deposit, too, has been inactive for a long time. There are several low-grade deposits in the Camp Floyd district that have not been developed. A recent discovery in the Stansbury Mountains near the head of Timpie Canyon remains undeveloped.

MOLYBDENITE: Occurs in small amounts in the contact gold deposits of the Clifton (Gold Hill) district. There is record of small production from the Reaper mine. **TUNGSTEN:** The Clifton district contains a number of commercial-grade tungsten deposits. This district has been Utah's best producer, with an output of some 12,500 units. The greatest activity was during World War II. A few mines were reactivated temporarily in the 1954-56 period, when the government was purchasing tungsten for the national stockpile. The **Star Dust Mines Co.'s** tungsten mill at Gold Hill is idle.

Tooele County's Nonmetallic Mineral Deposits and Operations

ARAGONITE: This mineral, similar to calcite, but of greater density, is found near the locality named after it—Aragonite. The **Utah Calcium Co.** has a

600 tons-per-day crushing and grinding plant at Delle, near the mine. The company, in addition to furnishing poultry grits and powdered aragonite for poultry feeds (a long-time use of this mineral), produces aragonite for building stone, as a roofing aggregate, an architectural and landscaping gravel of extreme whiteness and for sand urns used as ash trays in commercial hotels and buildings. Other specialties include sale to the chemicals trade requiring a high analysis calcium carbonate. **Custom Milling & Supply Co.** of Salt Lake City occasionally purchases aragonite from Utah Calcium and pulverizes it for use in the marking of football fields, grass tennis courts, etc.; also for use in the making of plastics and as a paint filler.

BARITE: There are deposits of barite in the Blue Bell district (Morgan mine), Clifton (Gold Hill) district (Christmas, Garrison Monster and Reaper mines), and in the Ophir Canyon, Buffalo and Chloride Point mines. **CLAY:** Good deposits of brick clay and clays for general use are found in the Camp Floyd district and the Five-Mile Pass and Skull Mountain areas. **Interstate Brick Co.** and **International Pipe & Ceramics Corp.** are consistent producers. **DIATOMITE:** There are unworked deposits of diatomaceous earth west of Great Salt Lake.

FLUORSPAR: The county has several fluorspar deposits, one of which is located in the Wild Cat Mountain area. The Silver Queen (Wildcat) mine in Central Tooele County produced about 1,200 tons at one time. All deposits are now idle. **GEM STONES:** Bureau of Mines records show frequent collections, in commercial quantities, of agate, green quartz and quartz crystals. **GUANO:** There is guano on Bird Island, owned by **Utah Fertilizer Co.** The deposit has been worked occasionally, but on a very small scale. **GYPSUM:** A series of dunes south of Great Salt Lake, near Knolls, contain a reported 65% gypsum crystals. However, the impurities restrict use of this gypsum except as a soil conditioner for local applications. **HALLOYSITE CLAY:** There are two promising deposits of this industrial clay in the Silver Islet district.

LIMESTONE, DOLOMITE AND LIME: Tooele County is second only to Salt Lake County in the manufacture of lime. The **U. S. Lime Division** of **The Flintkote Co.** has a plant near Grantsville that is a consistent and substantial producer from stone quarries nearby. This firm's operations at Dolomite and Flux, northwest of Grantsville, are the biggest in the state. They furnish the limestone for **Kennecott Copper Corp.'s** large lime plant in Salt Lake County. U. S. Lime Division has its own crushing, screening, sizing and pulverizing facilities. It furnishes crushed limestone for use in the smelting of nonferrous metals, in sugar refining, for "sweetening up" of cement by Portland cement manufacturers, as riprap*, etc. Pulverized stone is sold for an additive in asphalt black-top road mix, as rock dust for coal mining, as a water purifier in water treatment plants, and for fluorine gas control at the **Geneva Works** in Utah County. The **Utah Marblehead Lime Co.** has a $3 million dolomite plant near Delle which furnishes "deadburned" dolomite for the open hearth furnaces at the Geneva Works.

OIL AND GAS: The first test well was drilled near Burmester in 1917, another near Grantsville in 1948. Three more were sunk in the same general area in the 1955-56 period, and one on the Salduro Salt Flats in 1956. All were dry holes. **OOLITE:** Deposits on Stansbury Island are owned by the **U. S. Smelting Refining & Mining Co.** and the **International Smelting & Refining Co.**

*A foundation or sustaining wall of stones thrown together without order, as in deep water or a soft bottom, is called riprap. Stone used for this purpose bears the same name.

The last-named company still uses these oolitic sands as a smelting flux. There is also a deposit at Lake Cove, owned by **Lorenzo Price and Associates.**

POTASH: The operation owned by **Bonneville Ltd. Division, Kaiser Chemical Co.,** on the Salduro Marsh near Wendover has proven to be a successful one. Huge trenches—filled by seepage—stretch for miles over the flats and collect the salty brines, which are pumped into evaporating ponds, producing a mixture of salt and potash. This is harvested and processed by flotation for recovery of the potash from the salt. Tooele County should enjoy the benefits from this million-dollar industry for a long time to come, for the potential supply of source material on the salt flats is almost unlimited. **PUMICE:** This volcanic mineral is found in several localities. The only deposit reported active in the last ten years is the **Harborlite Corp.'s** property near Faust, from which pumice has been shipped to the company's San Diego, California plant for use in the manufacture of filter and filler materials; also in making soap. There has been no report of production since 1958.

SALT: The production of salt is a thriving Tooele County industry. The **Manistee Salt Works Division** of **Hardy Salt Co.** at Lake Point and the **Solar Salt Co.** near Grantsville have substantial evaporation pond systems and processing facilities which produce a large volume of salt for shipment to chemical manufacturers in the Northwest; also stock salt, and salt for highway ice control, industrial and home water softeners, and the metals refining industry. **Utah Salt Co.** has a processing plant near the facilities of **Bonneville Ltd. Division, Kaiser Chemical Co.,** to recover salt from residues of the potash operation.

SAND AND GRAVEL: Commercial production depends largely upon the county's fluctuating demand for road construction and maintenance programs. **England Construction Co.** produces commercial sand and gravel from the Stockton pits, as does **Morley T. Atkin** from the Atkin pits. **Ajax, Inc.** uses sand and gravel in the making of ready-mix cement and concrete building blocks. **SILICA:** A silica deposit at St. Johns Station is owned and operated intermittently by **International Pipe & Ceramics Corp.**

STONE: Black marble which takes a high polish has been reported five miles southwest of Fairfield, and there is a large marble deposit at Ibapah; also a pink and creme combination marble near Low, quarried by **National Stone Suppliers.** Onyx marble, or travertine, is produced in the Cedar Mountains, 55 miles east of Wendover. It is found in white, pink, lavender and yellow. Cream marble and yellow marble are produced from Table Top Mountain, near Calleo, in Tooele County, by **National Stone Suppliers,** which also quarries sandstone (picture rock) and brown marble from the Vernon area and black obsidian from a deposit 25 miles northeast of Calleo. There is a quarry of variegated travertine near the south end of Skull Valley, which has been operated occasionally by **Nephi E. McLachlin** of Salt Lake City. The county also produces dimension limestone and sandstone for architectural uses. These are quarried by **Utah Quartz & Rock Co.** and **Aggregate Supply, Inc.** The **American Aggregate Corp.** has a quartz quarry southeast of Timpie.

Minerals Produced Elsewhere but Processed in Tooele County

PERLITE: Perlite from Nevada is expanded in the **Combined Metals Reduction Co. plant at Bauer.**

RESINS: Fossil resins (from coal waste fines) collected in a flotation plant at Hiawatha, Carbon County, are shipped to Bauer for processing in a plant operated by **Combined Metals Reduction Co.** The resins are marketed for use in the making of paints, varnishes, inks, chewing gum, adhesives, fabrics, etc.

UINTAH COUNTY

Area: 4,294 square miles. **Population:** 1960 census, 17,868; 1965 estimate, 22,000. **Active companies:** mining, 49; primary mineral processing, 0*. **Average number workers, 1965:** mining, 884; primary mineral processing, 0*. **Annual worker payroll, 1965:** mining, $5,936,922; primary mineral processing, 0*.

Minerals history: Early records show that **copper-silver** ore was known to exist in the Brown's Park area as far back as 1876, the same type ore on Willow Creek in 1877, and **iron** ores—20-25 miles northwest of Vernal—in 1879. In fact, some iron ore was shipped in '79. The Dyer mine, 25 miles north of Vernal, is the only Uintah County mine that has produced copper in quantity. From 1887 to 1899, several hundred tons of ore were shipped, averaging about 50% copper, 26 oz. of silver and $6 worth of **gold** per ton. A small blast furnace was installed near the mine in 1899 and operated for about two years on ore averaging 33.5% copper.

Other discoveries were made in the Carbonate district, near the Dyer mine—including Red Creek, Jessie Ewing and Willow Creek canyons—and some development work was done, but no shipments made. Copper ore was also discovered near Ouray and a leaching plant was operated there. (Several tons of high-grade copper-silver ore were shipped from a prospect in the Little Split Mountain area of eastern Uintah County.

Gilsonite was Uintah County's chief mineral until oil began to challenge its leadership in the early 1950s. This rare and interesting hydrocarbon, produced only in Utah, was discovered in the Uinta Basin about 1885 by a prospector, **San Gilson** (see under Duchesne County for some of the early history). **American Gilsonite Co.,** largest producer, with mines and a plant at Bonanza, was organized in 1942 and began extensive development work. Several of the smaller operations were purchased a few years later by **G. S. Ziegler & Co.** (now **Ziegler Chemical & Mineral Corp.**). Production figures are not available, but it is known that gilsonite mining has become a multi-million dollar industry in the county.

The county's first **oil** well was drilled near the Grand County line, north of Brown Cliffs, in 1900 by John Pope. There was no showing of gas or oil. 40 wells were drilled from 1900 to 1948, with minor production in 1908-1910, but no good commercial discoveries were made. The first real commercial producer, **Equity Oil Co.'s** No. 1 in Ashley Valley, started a Utah oil boom in 1948 that has continued up to this writing. Prior to 1958, Uintah County was the state's leading oil producer. However, the completion of two crude pipelines connecting San Juan County with Texas and California refining centers boosted that county into first place. Discovery of **natural gas** in Red Wash field ultimately brought Uintah County into second place as a gas producer also.

Organized Mining Districts

Carbonate—18
Brush Creek
Green River (Cub Creek)—40
Uteland Knoll (Ouray Region)

*The Utah Department of Employment Security classifies the beneficiation, or milling process under mining. Consequently, the gilsonite plant at Bonanza, the phosphate mill at Vernal and the two natural gasoline plants are included in the mining figures.

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Gilsonite	tons	[1]	[1]	[1]	[1]
Natural Gas	mil cu ft	17,974	$2,620,000	31,635	$4,460,000
LP Gases	M gals	[1]	[1]	[1]	[1]
Natural Gasoline	M bbls	[1]	[1]	[1]	[1]
Petroleum	M bbls	7,607	19,930,200	7,691	20,079,000
Phosphate Rock	tons	[1]	[1]	[1]	[1]
Sand and Gravel	tons	328,000	298,000	467,000	461,000
Stone	tons	240	600	67,930	106,060
Totals			$29,967,141		$31,770,751

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Uintah County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: Copper is the most widely distributed nonferrous metal in Uintah County, being found in wide areas of the Carbonate district, north of Vernal, and the Uteland Knoll district (Ouray region). The rich surface ores, which often ran over 50% copper, have been mined out; properties are accessible only by long, rough and dangerous roads, and most deposits are comparatively small. Silver-lead-zinc ores are found in the Brush Creek district near Vernal, where the Little Alta mine has occasionally been active. The last shipment reported from the county by the Bureau of Mines was in 1958—a quantity of copper-lead-zinc-silver ore valued at about a thousand dollars.

IRON ORE: The deposits 25 miles northwest of Vernal, near the Dyer copper mine, are reported to be of good quality, but insufficient prospecting has been done to determine their size. The Woodside prospect, in a branch of Ashley Canyon, 20 miles northwest of Vernal, is a rich hematite, but development to date suggests it is a comparatively small deposit. Some fluxing ores were shipped from both areas in the early days. **URANIUM:** A number of promising deposits have been located, particularly a few properties 12 miles north of Vernal, others six miles east of the same city and in the Brown's Park and Carbonate districts. The Bureau of Mines reported one producing mine in Uintah County in 1956 and two in 1957, but none since.

Uintah County's Nonmetallic Mineral Deposits and Operations

BITUMINOUS SANDS: Near Vernal lie huge deposits of bituminous sands, or native asphalt, which have the natural appearance of newly-placed oil and mix. In the past, the properties have produced some asphalt for road-building, and the **City of Vernal** owns a number of claims for utilization as asphalt paving. Geologists estimate the oil reserves in this deposit are in excess of 250,000,000 barrels. Another deposit at White Rocks, 20 miles north of Roosevelt, is estimated to contain 125 million barrels. There are also reserves at Peor Springs, southern Uintah County. Considerable drilling was done at Asphalt Ridge in the late 1950s by **Sohio Petroleum Co.** Several large firms have made feasibility studies on the Ridge. **Husky Oil Co., Rivera Oil Co.** and **Daniel S. Meyers and Associates** are among the companies showing interest in these bituminous sands within the last two years. In addition to conventional methods of mining, steam injection and underground atomic explosions are being considered as possible means of exploiting the oil reserves.

COAL: Coal deposits are found in the northwestern, central and southeastern areas of the county. The Vernal field lies on the south flank and near the east end of the Uinta Mountains. No production has been reported since 1954, when **Lawrence Wardle** operated the Wardle mine near Vernal. **FULLERS EARTH:** Unworked deposits of this mineral are reported near Vernal. **GEM STONES:** Agate and petrified wood are among the gem stones occasionally collected in the county for commercial purposes.

GILSONITE: Is found in vertical veins, varying in width from a few inches up to 22 feet and averaging four to six feet. Depth is anywhere from 100 to 2,000 feet. Deposits extend diagonally across the county from the west central area to the northeastern corner. Reserves are estimated to exceed 40,000,000 tons in the Basin and most of this is in Uintah County. The **American Gilsonite Co.** at Bonanza is the leading producer, with a processing plant and both underground and open pit mining operations. A large volume of gilsonite is carried from the mine in slurry form through a 70-mile pipeline to a plant near Grand Junction, Colo., where it is converted to coke and high octane gasoline. The firm ships large quantities of bulk gilsonite as well as its insulation materials, known as Gilsulate and GilsoGard, not only to many parts of the United States, but also to Belgium, West Germany, Holland, Switzerland, France and Northern Italy. The **Ziegler Chemical & Mineral Corp.** ships bagged, mine-run gilsonite to plants outside of Utah. Other operators shipping gilsonite occasionally are: **Standard Gilsonite Co., Arthur Boren** and **Alva L. Hatch.**

GYPSUM: Beds of gypsum have been found along the Whiterocks River and in the Steinaker Draw east of Leota. These reserves contain many impurities, however, and as a consequence have not been utilized. **NATURAL GAS:** First production of natural gas in Uintah County was from the Ashley Valley anticline in 1925. Gas was delivered to the Vernal area until the reserve was depleted in 1941. In 1955 gas was discovered in the Red Wash field, and since that time many successful natural gas wells have been drilled in other areas, including the Bitter Creek, Bonanza, Buck Canyon, Chapita Wells, East White River, Horseshoe Bend, Island, Oil Springs, Ouray-Bitter Creek, Powder Springs, Red Wash and Rock House fields. Chapita Wells is the leading producer. There is also heavy-volume production of gas from the county's oil fields. **Mountain Fuel Supply Co.** and **Utah Natural Gas Co.** constructed a $10 million pipeline transmission system to bring Uinta Basin gas to the Salt Lake City area. **California Oil Co.** and **Warren Petroleum Corp.** are operating plants in the Red Wash and Wonsits Valley fields, respectively, to strip natural gasoline and gas liquids from the gases produced in those areas.

OIL: The oil industry has taken first place among the raw materials industries of Uintah County. Since the boom began in 1948, extensive exploration has been accomplished and is still going forward. Some 16 or 17 fields are actively producing in the county. At the end of 1966 there were 321 producing wells, and another 352 "producible." Biggest producers are the Wonsits Valley, Red Wash, Ashley Valley and Walker Hollow fields, in that order. The **Uinta Oil Refining Co.** operates a 1,200-bbls.-per-day refinery at Jensen. Crude oil from Uintah County fields is transported to Salt Lake Valley refineries by means of a pipeline with a capacity of 72,000 bbls. per day.

OIL SHALE: Vast fields of oil shale stretch through Uintah County. Undeveloped as yet, they give promise of future exploitation as methods of extracting oil are perfected by the government and private enterprise. The federal government is now encouraging private development of this mineral through a proposal to lease small tracts of government-owned shale land for research and development. Many prominent oil firms already have thousands of

acres of shale land under lease in Uintah County from the state of Utah and private owners.

PHOSPHATE ROCK: There are vast deposits of phosphate rock in the northern part of the county. In 1959 **San Francisco Chemical Co.** purchased the Humphreys deposit 15 miles north of Vernal and began intensive development work. A concentrator was constructed at the open pit mining site in 1960. Output of phosphate concentrates is now approximately 300,000 tons per year, all of which is trucked to the Union Pacific railhead at Phoston, Wasatch County, where a pulverizing plant further reduces the material. From that point, a substantial amount goes to **Stauffer Chemical Co.'s** fertilizer plant in Salt Lake County and the rest to widely-scattered custom fertilizer plants in the West.

SALT: There are undeveloped salt deposits in the southwestern part of the county. **SAND AND GRAVEL:** Uintah County has a number of gravel pits which are operated intermittently, chiefly for road construction and maintenance. The only commercial producer of record is the **Intermountain Concrete Co.** of Vernal, which runs a ready-mix operation. **SILICA:** Excellent silica sand has been found in Uintah County, but the properties remain idle. **STONE:** There are a few stone quarries in the county capable of producing good quality cut and crushed stone. Volume of production fluctuates considerably, due mainly to occasional use of crushed limestone by the **Bureau of Reclamation** in dam construction and maintenance.

UTAH COUNTY

Area: 2,034 square miles. **Population:** 1960 census, 106,991; 1965 estimate, 117,700. **Active companies, 1965:** mining, 13; primary mineral processing, 17. **Average number workers, 1965:** mining, 193; primary mineral processing, 5,236. **Annual worker payroll, 1965:** mining, $1,335,504; primary mineral processing, $45,835,254.

Minerals history: Earliest discoveries were in the Tintic mining district, which straddles the Utah-Juab county line (see under Juab County for historical comments on this district). The American Fork district, at the head of American Fork Canyon, was organized in 1870. Here the famous Miller mine was found that same year. It was sold in 1871 for $120,000. The Sultana smelter was erected in 1872 and a narrow-gage railroad built up the canyon to within four miles of the smelter. The Miller mine produced many hundreds of thousands of dollars worth of **gold, silver** and **lead.** The Wild Dutchman made history for the district, too. A dozen other mines were discovered and produced **gold, silver, copper, lead** and **zinc** in small quantities until the early 1950s.

The Spanish Fork and Payson districts were organized in 1871-72 and some mineralization was found, but the only shipments recorded were low grade silver-lead ores from the Payson area. Several mines were developed in the 1870s on Santaquin Ridge in the Santaquin district. In the Provo district, organized in 1871, the Monarch mine shipped ore, perhaps a hundred tons, containing lead and silver. Small quantities of gold, silver, lead and zinc have come from the mines of the Silver Lake district, organized about 15 miles east of American Fork.

The richest part of Utah County's mineral history began with the establishment of the Ironton blast furnace in 1923-24, an operation that became the property of **U. S. Steel Corp.** in 1930. The **Geneva Steel Plant** was constructed by the government on the shores of Utah Lake in 1942-44, and Utah County became the second largest processor of mineral raw materials in the state, exceeded only by Salt Lake County. In 1948 the Geneva Works was sold to U.

S. Steel. The establishment of the steel plants resulted in the quarrying of **limestone** at Keigley Quarry near Payson for use as a flux at the Geneva Works. The **iron and steel products** of U. S. Steel's operations have justified the building in nearby areas of many independent manufacturing plants. U. S. Steel increased its activity during the 1950s through construction near the Geneva Works of a large steel pipe plant and a nitrogen products plant which utilizes coke oven gas from the Geneva Works for production of anhydrous ammonia, ammonium nitrate and nitric acid.

Organized Mining Districts

Alpine—1	Payson—74	Spanish Fork (Cook)—96
American Fork—2	Provo—78	Tintic—104
Camp Floyd—17	Santaquin—90	Utah (eastern Tintic)—104
Lehi—52	Silver Lake—94	Utah Lake—108

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	[1]	[1]	[1]	[1]
Silver	oz	[1]	[1]	[1]	[1]
Copper	tons	[1]	[1]	[1]	[1]
Lead	tons	[1]	[1]	[1]	[1]
Zinc	tons	[1]	[1]	[1]	[1]
Clays	tons	33,713	$ 90,351	21,481	$ 62,183
Lime	tons	[1]	[1]	[1]	[1]
Sand and Gravel	tons	982,000	1,057,000	377,000	460,000
Stone	tons	842,054	1,228,309	[1]	[1]
Totals			$2,775,745		$3,953,085

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Utah County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: There are unquestionably some good reserves left in the Tintic and American Fork districts that might be developed under more favorable conditions. In other districts of the county ore deposits are small and of low grade for the most part, and their potential is limited. The possibilities of the East Tintic district, which lies largely in Utah County, were demonstrated when the **Bear Creek Mining Co.**, exploration arm of **Kennecott Copper Corp.**, made a major discovery in 1958 of lead-zinc ore, rich in silver content. When development work was completed, operation of the mine was turned over to **Kennecott's New Mines Division.** Much of the ore was of a grade high enough to justify shipment directly to smelters. The lower grade ores have been stockpiled. These and part of the smelter-type ores will soon be concentrated in a 500-tons-per-day mill which Kennecott will construct near the mine.

In the Tintic district, leasers, selecting the high grade ores, have operated occasionally during the last 15 years since most of the mining firms discontinued company operations. Until the late 1950s, a number of siliceous mines in the Tintic area had shipped substantial quantities of fluxing ore to the Garfield copper smelter, but after **Kennecott** took over the smelter in the late 1950s and began using materials from its own Bingham open cut mine for fluxing material, very few shipments were made from Utah County. Among the mines producing small tonnages of lead-zinc and siliceous ores from the Utah County

side of the Tintic district are: Iron Blossom, Colorado Consolidated, Tintic Standard, North Lily and Eureka Standard Consolidated. **Bear Creek Mining Co.** is continuing its search for commercial ores in the Tintic district.

ANTIMONY, ARSENIC, BISMUTH AND CADMIUM: Antimony and arsenic are associated with the nonferrous ores of the Tintic district. The North Lily mine in the East Tintic district contains appreciable amounts of bismuth and cadmium. There has been no development of these minerals. **IRON ORE:** There are unworked deposits of iron ore in the Tintic district, chiefly in the Spalding, Queen of the West, Dragon and Black Jack mines. The **Miller Hill Mining Co.** has a deposit of iron ore in the region above Alpine Lodge. **Utah Development Co.,** a subsidiary of **Utah Construction & Mining Co.,** did exploration work on these claims in 1960.

MANGANESE: Is found in the Wildcat mine, Elberta area, and there are a few deposits in the North Tintic district, which straddles the Utah-Tooele County line. **TUNGSTEN:** 77 tons of tungsten ore were shipped in 1943 from the Mayday Extension claims of **Metals Coalition Mining Co.** on Deer Creek, north of American Fork.

Utah County's Nonmetallic Mineral Deposits and Operations

BARITE: There are unworked deposits of barite in the Bog, Dutchman and Pacific mines of the American Fork Canyon district and the North Lily mine in the East Tintic district. **CALCITE: Cedarstrom Calcite Co.** owns a good grade calcite deposit near Pelican Point, 15 miles southwest of Lehi. The rock is treated in a plant near the quarry. The crushed product is sold for chicken grits, and the finely ground calcite is used in the preparation of cattle and poultry feeds. Another calcite deposit is owned by **Santaquin Calcite Co.**

CLAY: Utah County is a heavy producer of fire clay, brick clay and miscellaneous clays. Producers in recent years are: **Roger Cedarstrom Fire Clay Co.,** at Pelican Point; **International Pipe and Ceramics Corp.** from the Clinton, Five-Mile Pass and Saratoga pits; **Shirlef L. Powell** from the Powell pits; **Lloyd Stubbs** from the Blue Clay, Northeast, North, South and Lake Mountain pits; **R. D. Wadley Clay Co.** from the Powell pit, and **Western Fire Clay Co.** from the Fawn mine.

DIATOMITE: There is a diatomaceous earth deposit in southwestern Utah County which remains undeveloped. **FLUORSPAR:** Several deposits of this mineral have been discovered, but all are inactive. **FULLERS EARTH:** Unworked deposits occur in the northeastern area of the county. **GEM STONES:** Birdseye marble, honey onyx and variscite are among gem stone collected in commercial quantities. **GYPSUM:** The county has one undeveloped deposit of gypsum rock, but its exact location is not known. **HALLOYSITE CLAY:** At the south end of the Lake Mountains, west of Utah Lake, deposits of this industrial clay have been located and have produced a small volume for brick making. Halloysite has also been found in the North Tintic district and in the mountains east of Santaquin.

LIMESTONE, DOLOMITE AND LIME: The crushed limestone industry is Utah County's greatest nonmetallic mineral producer. There are good commercial-grade deposits of limestone in various districts, particularly near Payson, at Pelican Point and in the Tintic district, where **Chief Consolidated Mining Co.** owns properties. Largest operation is the **U. S. Steel Corp.'s** Keigley Quarry near Payson, which supplies crushed limestone for the Geneva Works, to be used as a fluxing material in the making of steel. This project averages about 300,000

tons per year. The **Lakeside Lime & Stone Co.** has quarries and a crushing plant at Pelican Point which not only make slack and lump lime, but furnish some fluxing material to Geneva and supply the coal industry with quantities of rock dust. The crushed rock is also used for whiting, roadstone and lime production. **Thorn Rock Products Co.** produces crushed limestone for commercial purposes from a quarry east of Provo. **George Chaffin** of Provo also owns a quarry near Pleasant Grove.

LIMONITE-MOSS: This oxidized iron ore, associated with peat and similar organic substances, was produced at the old Bog mine in American Fork Canyon during the 1950s for use as a soil conditioner. **OIL:** The first exploratory well was drilled in 1920 near Thistle, and another two years later in the same area. Several test wells were sunk in the Diamond Fork area in the 1920s, but without success. There is record of seven wells being drilled since 1954, in the West Lehi, West Portal, Diamond Fork, Pondtown Creek and Soldier Summit areas. All were dry holes.

OIL SHALE: The great Uinta Basin oil shale fields touch Utah County's southeastern border. **OZOKERITE:** Is found near Soldier Summit, next to the Wasatch County line. The deposits were first developed in 1886. In 1914 there were 17 small mines and prospects. Demand fell off, however, and the mines were closed down. One mine was active in the 1930s and 1940s, but has since closed.

PHOSPHATE ROCK: There are medium and low grade deposits in the Spanish Fork and Thistle areas. In 1941-42, 1946-48 and 1953, **Garfield Chemical & Manufacturing Co.** produced more than 16,000 tons of medium grade rock for shipment to the Utah County steel plants and to fertilizer companies. There has been no activity in the last decade. **PUMICE: Prince Block Co.** has a property near Cedar Valley. **QUARTZITE:** There is one quartzite property in the county which produces intermittently. **ROCK ASPHALT:** Deposits lie south of Thistle. There has been minor production for road surfacing.

SAND AND GRAVEL: Is produced in the county for commercial purposes and for road work. There are currently 11 commercial producers and 11 pits that supply state and county road departments. The commercial firms are: **Alvie's Ready-Mix Concrete Co.**, Payson; **Ford Construction Co., Inc.**, Provo; **Salt Lake Valley Sand & Gravel Co.**, Jordan Narrows pit; **Strong Co.**, Springville; **D. Tyler Sand & Gravel, Co.**, Provo; **Thorn Rock Products Co.**, Provo; **Valley Ready Mix Co.**, Spanish Fork; **Warburton Sand & Gravel**, Pleasant Grove; **R. E. Tyler Sand & Gravel Co.**, Provo; **Lee Rock Products**, Provo Canyon, and **J. E. Murray, Inc.**, Springville (pit and plant in Orem).

SLAG: The **Heckett Engineering Co.** is operating a slag preparation plant near the Geneva Works which crushes, sizes and loads some 15 different grades of slag for shipment throughout the United States. The slag is used for chemical, ceramic, glass and agricultural products, in addition to road building. U. S. Steel Corp. markets the product.

STONE: Building stone is found in several areas. Dimensional limestone is produced near Thistle and Hobble Creek for building purposes and has been widely used in the United States. It takes a high polish and is adapted to interior uses. "Birdseye" marble and "Golden Travis" are quarried five miles south of Thistle and used in wainscots, sills, stair risers and interior facings. It can be seen in the Utah State Capital and many public buildings in other states. A black marble which also takes a high polish is found at Pelican Point. Nugget sandstone has been quarried in Diamond Fork Canyon and at Thistle. Gray sandstone from Kynne Station near Colton was used in the old

City and County Building and the Cathedral of the Madeleine in Salt Lake City; also in many other buildings inside and outside Utah. Crushed marble has been quarried in recent years at the Creme Travertine quarry by **Aggregate Supply, Inc.**, Salt Lake City, for use as a terrazo aggregate.

Minerals Produced Elsewhere but Used or Processed in Utah County

COAL: Coking coal is shipped from Carbon County to the ovens of the Geneva Works for production of coke consumed at the big steel plant. By-products of coke manufacture are coke breeze, tars and ammonia. The latter is produced at an $18 million nitrate plant adjacent to the Geneva Works which uses coke oven gas for manufacture of anhydrous ammonia, ammonium nitrate and nitric acid.

FLUORSPAR: Many thousands of tons of fluorspar from the Topaz Mountain area of Juab County and the northern area of Millard County have been used as a flux in steelmaking at Geneva Works. However, the volume of Utah-produced fluorspar used at Geneva has declined in recent years, and the bulk of this fluxing material is brought in from outside the state. **GYPSUM:** Some of the gypsum produced at Sigurd, Sevier County, is used by the **General Food & Chemical Co.**, Pleasant Grove, in the preparation of fertilizers.

IRON ORE: Millions of tons of ore are supplied by Iron County's mines for the huge furnaces of Geneva Works. The volume of Utah iron consumed at Geneva has diminished substantially since **U. S. Steel Corp.** began the importation of iron ore from its new taconite mining and milling complex near Atlantic City, Wyoming. Other industries stem from the primary processing of iron ore, such as the iron foundries—**Backman Foundry, Cox Foundry** and **Pacific States Cast Iron Pipe Co.**, Provo, and the **Spanish Fork Foundry** in Spanish Fork; also a big steel pipe plant owned and operated by **U. S. Steel** near the Geneva Works.

PHOSPHATE ROCK: Some imported rock is used by **General Food & Chemical Co.**, Pleasant Grove, in the manufacture of fertilizers. **PUMICE, PERLITE AND EXPANDED SHALE:** These lightweight aggregates are obtained from various sources in Utah and nearby states for use in the making of building blocks, brick and other concrete products by **Lehi Cinder Block Co.** at Lehi and **Central Utah Block Co.**, Provo.

WASATCH COUNTY

Area: 1,167 square miles. **Population:** 1960 census, 5,308; 1965 estimate, 5,400. **Active companies, 1965:** mining, 6; primary mineral processing, 1. **Average number workers, 1965:** mining, 455; primary mineral processing, . . .*. **Annual worker payroll, 1965:** mining, $2,879,533; primary mineral processing, . . .*.

Minerals history: The only major mining district in Wasatch County is the Blue Ledge, generally considered a part of the Park City district. Its output is always included in the Park City production statistics. The Blue Ledge was organized in May, 1870. Early producers, none of them outstanding mines, were the McHenry, discovered about 1873; the Valeo, about 1891, and the Glencoe, about 1873. A concentrating mill was erected at the Glencoe properties in 1891, but operated for only a year or so before it was dismantled and moved to

*Denotes figures not available.

Bingham Canyon. Another larger mill was built in 1908 and operated only one season.

The Blue Ledge district came to life in the 1930s when **W. H. H. Cranmer** consolidated a number of claims that had produced intermittently for three decades, formed the **New Park Mining Co.**, completed the famous Mayflower tunnel and succeeded in developing one of the state's major nonferrous metal mines, matching in richness the best of Park City's fabulous properties. The Mayflower mine is now operated under lease from New Park by the **Hecla Mining Co.**

The Snake Creek and Elkhorn districts, organized in 1871 and 1875, respectfully, have not been important producers.

Organized Mining Districts

Blue Ledge (Park City)—11 Rhodes Plateau—82
Elkhorn—27 Snake Creek—95

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Gold	oz	32,653	$1,142,855	42,714	$1,494,990
Silver	oz	441,767	571,205	436,578	564,495
Copper	tons	661	431,298	674	477,228
Lead	tons	4,811	1,260,534	4,756	1,484,106
Zinc	tons	4,803	1,306,443	3,848	1,123,820
Sand and Gravel	tons	14,000	13,000	120,000	131,000
Stone	tons	70,327	186,572	3,083	19,833
Totals			$4,911,907		$5,295,472

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Wasatch County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: The experience of **New Park Mining Co.** has proven that Wasatch County should not be "sold short" as to its metal reserves. The Blue Ledge district will probably be a major producer for many years to come, at least during periods when metal prices are at a reasonable level. In 1961 **Hecla Mining Co.** leased the Mayflower mine and took over its operation from New Park. The following year Hecla constructed a concentrator near the mine portal at Keetley with a capacity of 400 tons of ore per day. The Mayflower has become Utah's third largest lead-zinc producer. The Revelator and West Quincy mines in the Snake Creek district have made occasional small shipments from development work during the last 20 years.

IRON ORE: Is found at the head of Soapstone Creek on the Rhodes Plateau (Woodland area). Early writers reported use of the ores for paint by the Indians. About 500 tons were shipped to Park City in 1879-80 to be used as a smelter flux. The quality of the ore is reported to be excellent, and this red hematite may some day be exploited with the advent of better roads into the region. **MANGANESE:** There are undeveloped deposits of this mineral on the Rhodes Plateau.

Wasatch County's Nonmetallic Mineral Deposits and Operations

BARITE: A deposit has been located in the Strawberry region, but it has not been sufficiently explored to determine its quality and extent. **COAL:** The Blacktail (Tabby) Mountain coal field extends into the southern end of the county. No production has been reported officially for many years. **HALLOYSITE CLAY:** Promising deposits of this industrial clay have been discovered in the workings of the Mayflower mine, Blue Ledge district. Quality of the deposits is good. However, the veins are rather small and the ore has iron oxide content which makes the use of a reducing agent necessary. Several hundred tons were shipped in the 1950s to **Filtrol, Inc.**, Salt Lake City, at a time when a strike had closed the Dragon Consolidated mine in the Tintic district, Filtrol's regular source of supply.

OIL AND GAS: There has been some test drilling in the county. Since 1954, wells have been sunk in the Doe Knoll, Soldier Summit and Strawberry Ridge areas. All were dry holes. **OZOKERITE:** The only known deposits of this mineral wax in the United States are located in the Soldier Summit area of Wasatch and Utah counties. Competition from other mineral and vegetable derivatives has forced the closing of the mines and refiniery, at least temporarily. There has been no output reported officially since about 1950. Production for many years was substantial, often more than 20,000 tons per year.

PHOSPHATE ROCK: Phosphate rock occurs in the northwestern part of the county. There is a deposit north of Midway, and it is reported that some rock has been produced from an area near Park City, to be used as a catalyst. Although Wasatch County does not now produce phosphate rock, hundreds of thousands of tons of phosphate concentrates are shipped from **San Francisco Chemical Co.'s** mill near Vernal, Uintah County, to be processed at the firm's Phoston pulverizing plant, 12 miles north of Heber City. From this point in Wasatch County, the phosphate, now reduced to various sizes, is trucked to **Stauffer Chemical Co.'s** Salt Lake County fertilizer plant or shipped from the railhead at Phoston to many fertilizer mixing plants throughout the West.

SAND AND GRAVEL: Production depends largely upon demands for road construction and maintenance. The only commercial producer and user listed in available directories is **Heber Ready Mix. SILICA:** Some silica has been produced from Wasatch County deposits, but no production has been reported in recent years.

STONE: Contractors for the **U. S. Bureau of Reclamation** produce crushed sandstone and granite in greatly fluctuating quantities. Currently active dimension stone producers are **Eugene Tuckett Flagstone Quarry** (limestone from Crooks Quarry) and **Wilford H. Hansen Stone Quarries** (sandstone from the Wasatch Quarry). Occasional, but now inactive producers of crushed granite are: **Ivan W. Ashby,** from the Charleston, Vallejo and Victory quarries and **E. V. Chettle** and **Ford Construction Co.** from the Victory Ranch quarries. **Rocky Mountain Stone Quarries** and **DeReice Balls** have intermittently produced building stone and crushed stone from various quarries in the county.

WASHINGTON COUNTY

Area: 2,465 square miles. **Population:** 1960 census, 10,271; 1965 estimate, 10,500. **Active companies, 1965:** mining, 4; primary mineral processing, 0. **Average number**

workers, 1965: mining, . . .*; primary mineral processing, 0. **Annual worker payroll, 1965:** mining, . . .*; primary mineral processing, 0.

Minerals history: The Bull Valley district, 28 miles south of Modena and about 16 miles southwest of Enterprise, is chiefly an iron ore district, but some **gold** was found in the early days. The Goldstrike area to the south is sometimes considered a separate district. Some development work was done in the iron ore deposits, but there is no record of commercial production. Silver Reef district, which includes the town of Leeds, was organized in 1874. The first ore was discovered in 1869 by **John Kemple,** who found a piece of float near Harrisburg that assayed $17,000. There was a big rush to Silver Reef in 1876, and a number of producing mines were developed. Five different reduction mills were built in the district, 1877-78. Total output was close to $4 million. There has been very little activity in recent years.

The Santa Clara district, 10 miles west of St. George, was organized in 1880. Many locations were made and some development work done in the years that followed, but it is doubtful if any shipments were made. At that time several districts—the Volcanic, Gunlock, and others—existed near St. George and Santa Clara, but the deposits were not commercial and the districts are no longer recognized. Tutsagubet district, organized in 1883 west of St. George, became a good producer, with all-time output running into several millions of dollars worth of **gold-silver-copper-lead** ores. The Dixie or Apex copper mine became the biggest operation. It produced small tonnages almost every year until 1962.

Washington County has long been considered a potential oil producer. The **Virgin River Oil & Development Co.** brought in the first well in July, 1907. It was reported to have a capacity of 225 bbls. daily. A minor oil boom followed, and in 1908 two more wells were reported to be pumping. However, transportation to refineries was a problem, and the oil produced was used for fuel by the operators. The boom soon died. There has been occasional test drilling over the years, and numerous showings of oil have been announced. A small refinery was constructed at Virgin years ago, but it has known very little activity.

Organized Mining Districts

Bull Valley—16
Harrisburg (Silver Reef)—42
Santa Clara—89
Tutsagubet—106

Mineral Production, 1964-65:		1964		1965	
		Quantity	Value	Quantity	Value
Silver	oz	3,750	$ 4,849	.....	.....
Copper	tons	9	5,900	.....	.....
Zinc	tons	1	299	.....	.....
Sand and Gravel	tons	631,000	631,000	78,000	$82,000
Stone	tons	191	2,339	9	2,015
Total			$644,387		$84,015

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Washington County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: There are possibilities for production in the Harrisburg, Santa Clara and Tutsagubet districts. Higher

*Denotes figures not available.

metal prices and technological improvements in mining and concentrating of ores could bring new developments in nonferrous metals in Washington County. The most consistent producer over the last 20 years has been the Apex, or Dixie mine, owned by **Emerald L. Cox** of St. George. Prior to 1959, the ore could be shipped to the Garfield copper smelter in Salt Lake County for treatment, but in 1959 **Kennecott Copper Corp.** decided not to treat custom ores. Since that time, copper ores have had to go all the way to El Paso, Texas for processing. For this and other reasons, there has been no production from the Apex mine since 1961. During the late 1950s, **Western Gold & Uranium Co.** produced substantial tonnages of ore from the Silver Reef and Big Hill mines of the Harrisburg district and processed them in a small mill they had constructed near the mines. Occasional shipments have been made from the Old Holt and Blue Jay claims. The Silver Reef mine in the Bull Valley district is an intermittent producer.

ANTIMONY: Small deposits of antimony ore (stibnite) are found in an area west of Gunlock. The only record of production is a few tons shipped in 1918. **ARSENIC:** Is found in the Bull Valley district—the arsenic minerals, realgar and orphiment, being present in outcrops in the streambed of Arsenic Canyon. **IRON ORE:** There are many promising deposits throughout the northern and northwestern areas of the county—extensions of the Iron County ores. Boosters of the county have long tried to interest outside capital in development of the deposits, and some exploration work has been done in the last twenty years, but no commercial shipments have been made.

MANGANESE: Undeveloped deposits of manganese are found in the Wallace mine, which is in the northeastern part of the county, and the Black Beauty No. 1 mine in the east-central area. **SELENIUM:** Is associated with ores in some mines of the Silver Reef district. An analysis of silver ores in that district about 1881 showed an average of 0.23 percent selenium. **TUNGSTEN:** A little tungsten ore (scheelite) is found on the southwest side of the Beaver Dam Mountains. **URANIUM:** Significant discoveries have been made in several areas of the county, including the Harrisburg (Leeds) district, Pine Valley, Short Creek, Ash Creek and Smith Mesa. Production, however, has been very limited, and all mines are now closed. **Western Gold & Uranium Co.,** in the 1956-58 period, made minor shipments from the Chloride Chief and Silverton #2 mines. The **Noy-Burn Milling & Processing Corp.** of St. George constructed a small upgrading mill at Washington, but there is no record of any commercial production from the plant.

Washington County's Nonmetallic Mineral Deposits and Operations

COAL: The Harmony coal field lies in both Iron and Washington counties, about four miles northwest of New Harmony. The coal has a high ash content and a fine texture. Consequently, no mining has been done. The Kolob Terrace field also extends into Washington County, but the deposits have not been commercially developed. **GEM STONES:** Alabaster and selenite are mong the gem stones collected occasionally in commercial quantities. **GYPSUM:** Beds of white gypsum are exposed near Virgin Canyon, a half-mile south of La Verkin; pink gypsum in the Kaibab a few miles south of St. George, and white gypsum on the eastern edge of the Pine Valley Mountains, northeast of Toquerville, in the Kaibab and on the east flank of Pine Valley Mountains.

HALLOYSITE CLAY: Deposits have been found in the Bull Valley district, but little is known of their extent and quality. **KAOLIN:** A variety of kaolin is produced intermittently by **Rocky Mountain Refractories** from a quarry near St. George owned by **Mineral Mountain Mining Co.** It is used for making re-

fractory brick. **OIL:** Encouraging showings of oil in the Virgin River area of southwestern Washington County since 1907 have inspired intermittent exploratory drilling. In 1957 the first official reports of commercial production were made. From that year until 1961 the Bureau of Mines reported minor production, the biggest volume coming in 1959, when the output was 4,000 barrels, valued at $11,440. In 1966 there was output of 961 barrels from a well drilled by the **Midway Oil Co.** in the Virgin field. This well was shut in that same year, however, and is listed as the one "producible" well in the county. 39 wells were drilled in Washington County between 1954 and 1966.

PERLITE: There is a good commercial deposit near Enterprise, from which Utah's first production came in 1947. This property is now inactive. **SAND AND GRAVEL:** There is a commercial pit on the Indian Reservation and a crushing, screening and washing plant at St. George. The Road Commission has several pits and produces a widely fluctuating volume for road construction and maintenance. **SILICA:** Deposits of this mineral, worked only occasionally, are located near Hurricane and between St. George and Veyo.

STONE: Washington County is noted for good quality sandstone, but production is limited by long haulage distances to markets. There is consistent production, but on a very small scale. Biggest producer is **Utah Scenic Stone Corp.**, which produces sawed sandstone for building purposes from the Picture Stone quarry. Crushed sandstone is used intermittently for road construction. **SULPHUR:** Undeveloped sulphur deposits lie near the Virgin River south of Toquerville.

WAYNE COUNTY

Area: 2,475 square miles. **Population:** 1960 census, 1,728; 1965 estimate, 1,600. **Active companies, 1965:** mining, 0; primary mineral processing, 0.

Minerals history: There is little record of mining history in Wayne County. The **copper** deposits of Miner's Mountain, southwest of Fruita and a few miles southeast of Torrey, were prospected occasionally in the early 1900s. Some development work was done and a few shipments of high grade ore went to smelters. **Gold** has been found in small quantities in the Giles-Hanksville region, but all-time production probably would not exceed $5,000. Some **placer gold** has been taken from the stream beds running into the Colorado River and along the river itself.

The Rabbit Valley area was the scene of early prospecting for **uranium** and **vanadium.** Many discoveries were made and there was some production from the head of Grand Wash, near Fruita. Only with the prospecting boom in the early 1950s, however, was county-wide prospecting for uranium done on a large scale. Several good discoveries were made and there was small but consistent production during the 1955-62 period.

Mineral Production, 1964-65:

		1964		1965	
		Quantity	Value	Quantity	Value
Sand and Gravel	tons	2,000	$2,000	22,000	$27,000

Wayne County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: The true extent of the copper deposits of Miner's Basin is not known. More development is needed to

determine the size and value of the properties. There is some lead in the district, and traces of zinc. The last shipment reported to the Bureau of Mines was a small tonnage of ore containing copper, silver, lead and zinc from the Osborn mine in 1960. In the 1950s, small quantities of copper-silver ore were made from the Old Faithful mine and the Wonder copper mine; also from the T. R. Lode No. 1 mine in the Torrey area. No production of placer gold has been reported in recent years.

URANIUM: During the 1950s, Wayne County was the scene of extensive uranium prospecting. Promising mineralization was found in many areas, including the lower Muddy River, Hanksville and Noton Bench. Production began in 1955, but never did reach a substantial volume. Biggest year was 1956, when output totaled 1,793 tons of ore. At one time seven mines were producing simultaneously. A drastic reduction in purchasing of uranium oxide by the AEC resulted in the closing of all Wayne County mines. **VANADIUM:** Is associated with the county's uranium ores.

Wayne County's Nonmetallic Mineral Deposits and Operations

COAL: The Henry Mountains coal field lies in both Wayne and Garfield counties. At the north end of the basin it has been mined on a very small scale for local use, but there has been no commercial production. **GEM STONES:** Gem stones are collected once in a while for commercial purposes, including jasper and opalite. **GYPSUM:** Deposits of gypsum rock have been found on Muddy Creek, at Last Chance Gulch and in the wall of a canyon northwest of Caineville. **OIL:** The first test wells were drilled near Hanksville in 1913, others in 1924 and 1929 in the Barrier Creek region. Drilling in 1948-49, near Teasdale, caused considerable excitement, but, although there were showings of oil, no commercial discovery was made. From Jan. 1, 1954 through Dec. 31, 1966, 34 exploratory wells were drilled in Wayne County. All were plugged and abandoned except one, which was converted to a water well.

SAND AND GRAVEL: Wayne County has a number of sand and gravel pits. Most of them produce for road construction and maintenance. **STONE:** There are good deposits of sandstone and other commercial types of stone in Wayne County, but transportation costs to markets are a barrier to development. The only production reported to the Bureau of Mines in the last decade was 16,279 tons of limestone produced in 1961 by **Whiting & Haymond Construction Co.** under contract with the **Bureau of Public Roads.** It was used for protecting road banks.

WEBER COUNTY

Area: 541 square miles. **Population:** 1960 census, 110,744; 1965 estimate, 121,700. **Active companies, 1965:** mining, 4; primary mineral processing, 7. **Average number workers, 1965:** mining, 53; primary mineral processing, 228. **Annual worker payroll, 1965:** mining, $363,751; primary mineral processing, $1,436,418.

Minerals history: The Weber mining district, first known in 1860 as the Junction district, was organized in 1876. It lies a few miles north of Ogden. **Iron ores** of the district were mined and processed in a furnace at Ogden which operated for only one week in 1876. **Copper-gold-silver** ore was found in the Cold Water Canyon east of Ogden, but there is no record of shipments. An old

report says that between 1901 and 1905, 205 tons of gold-silver-copper ore was produced in the Sierra Madre district, about 11 miles north of Ogden. The Fremont Island district, which includes all of Fremont Island in the Great Salt Lake, was organized in 1871. Some development work was done there in the 1870s by the **Utah & Nebraska Mining Co.** However, the small size of the veins, carrying **gold, silver, copper** and **lead,** was evidently discouraging and the project was abandoned.

Organized Mining Districts: Fremont Island—32
Sierra Madre—92
Weber (Junction)—110

Mineral Production, 1964-65:

		1964		1965	
		Quantity	Value	Quantity	Value
Sand and Gravel	tons	253,000	$287,000	528,000	$612,000
Stone	tons	5,117	12,544	64,461	128,922
Totals			$299,544		$740,922

(For explanations indicated by bracketed numbers in the above table, see page 24.)

Weber County's Metallic Mineral Deposits and Operations

GOLD, SILVER, COPPER, LEAD AND ZINC: The size and quality of the ore bodies in the three Weber County mining districts do not give much hope for major developments. **IRON ORE:** There is some potential in the Weber district deposits, but commercialization is unlikely as long as the Iron County deposits produce abundantly.

MAGNESIUM AND LITHIUM: Lithium Corp. of America and **Chemsalt Corp.** have a huge acreage of land on the shore of Great Salt Lake in Weber and Box Elder Counties under lease with the announced intention of producing magnesium chloride and lithium from lake brines. They have just signed a $7,250,000 contract for construction of 12,000 acres of solar evaporation ponds in the Bear River Basin about 20 miles west of Ogden. This is only part of a planned investment of $24 million in facilities and equipment. It is not yet known to what extent Weber County will profit from these developments.

MANGANESE: In the late 1950s, the Bureau of Mines reported minor production of manganese ore from the Payday mine in northeastern Weber County.

Weber County's Nonmetallic Mineral Deposits and Operations

BARITE: There are undeveloped barite deposits in the area just across the Weber County line from Morgan County's Argenta district. **CLAY:** The county has good commercial deposits. **International Pipe & Ceramics Corp.,** which bought the operations of the **Harrisville Brick Co.,** quarries brick clay from a deposit near the plant site at Harrisville; also from a deposit near Pleasant View and a pit in West Ogden. **FLUORSPAR:** A high grade fluorspar mine just above the large white "W" on the mountain east of Ogden furnished ore in 1958 to the Clearfield Naval Supply Depot on a government contract.

PHOSPHATE ROCK: In 1964, the **U. S. Geological Survey** released a preliminary report announcing discovery of medium-to-low grade phosphate rock

deposits at Dry Bread Hollow, 50 miles northeast of Ogden. It was reported that about 28 million short tons of medium-grade rock had been revealed in a one-square-mile area. The report led to a prospecting rush in Weber, Morgan and Salt Lake counties. Well known firms such as **Bear Creek Mining Co., Kern County Land Co., Kerr-McGee Oil Industries, Inc.** and **Phillips Petroleum Co.** participated. No development work has been announced.

SAND AND GRAVEL: This is Weber County's leading mineral industry. Large quantities are used for building and for road construction. Principal commercial producers are: **Holley Ready Mix Concrete Co., Douglas B. Stephens Co.** and **Clarence Waterfall Sand & Gravel Co.** Others reporting production in recent years are **Miya Bros., Fife Rock Products Co., Ideal Rock Products, Hisfield Gravel Co.** and **DeReice Balls Sand & Gravel Co.** The **International Pipe & Ceramics Corp.** uses blow sand from a deposit west of Ogden in place of the usual silica sand in making brick at its Harrisville plant.

SILICA: The **Rockymountain Refractories Co.** of Salt Lake City has an inactive deposit of good quality silica in North Ogden Canyon. **STONE: Clarence Waterfall Sand & Gravel Co.** has recently quarried light tan and beige stone from Weber Canyon. Commercial granite has been produced near Ogden. Crushed limestone is used by private contractors working for the **U. S. Bureau of Reclamation.**

APPENDIX

UTAH MINERALS

Alunite: ($K(AlO)_3(SO_4)_2 3H_2O$)*—A hydrous *sulphate of aluminum and potassium, sometimes called Alum Stone. Usually resembles dull limestone. Both potash and aluminum can be extracted from it, but processes are expensive. Generally used in calcined form as fertilizer ingredient. Utah alunite has been used to produce aluminum in small quantities. Is now mined for use in fertilizers and soil conditioners.

Antimony: (Sb)—A tin-white element of metallic appearance and crystalline structure, hard and brittle. Used as an alloy in cast printing type; in shrapnel bullets, bearing metals, lead storage battery plates, lead sheet and pipe for the chemical industry, lead roofing and gutter for buildings, lead-coating for pipes and fittings, lead cable sheathing and collapsible lead tubes. Alone, it has few uses, chief use being for metal trimmings of coffins. But as an alloy or in compounds it is widely used. Antimony is most commonly alloyed with lead and serves to harden it.

Aragonite: ($CaCO_3$)—Calcium carbonate. Resembles calcite, with same chemical composition, but effervesces less easily with acids. Found in several Utah counties. Quarried near Aragonite, Tooele County and near Sterling, Sanpete County. It is ground for use as poultry grits. Considered by some authorities to be an ideal grinding agent for poultry gizzards.

Arsenic: (As)—A solid brittle element, tin-white to steel-gray, with metallic luster. Occurs free or with various minerals. Noted chiefly for its poisonous qualities. Used extensively in insecticides and poison gases. Chief metallurgical uses: to help form perfect spheres in making of lead shot, to increase corrosion and erosion resistance in copper (arsenical copper), and to improve mechanical properties in bearing metals. Arsenic from Utah's Gold Hill area was used by the Government during both world wars in the manufacture of poison gas, which was stored for use if necessary.

Asbestos: The common mineral is amphibole, white, gray, or gray-green in color and fibrous in texture. Its fibrous, flexible structure allows it to be woven into cloth, felt, etc., and its incombustibility and slow conductivity of heat make it invaluable for fireproofing and for insulating against heat and electricity. Sometimes used as ornamental or building stone. Pure asbestos is chemically stable and can be used for making chemical filters.

Barite: ($BaSO_4$)—Sulphate of barium. Also called Heavy-spar, from its high specific gravity. Used as a white pigment and inert mineral filler for paper, rubber, cloth, linoleum, oilcloth, etc.; also as a filler in artificial ivory and buttons, in ceramic glazes and enamels and some types of glass. Used in printer's ink, face powder, optical glass, flat paint and many barium chemicals.

Bauxite: ($Al_2O_3 2H_2O$)* Hydrated alumina. The principal ore of aluminum.

Bentonite: A bedded plastic clay which swells greatly upon wetting. Consists essentially of hydrous aluminum silicate, with some alkalies. Used in mak-

*Water included in the composition of the mineral, indicated by H_2O in the chemical formula.

ing medical dressings, as a retarder in gypsum wall plaster, and a filler for paper, soap, drugs and candies; also as a bleach in oil refining, a drilling mud in the oil industry, a lining for ponds, ditches, basement houses, and some roofs and as a fire retarder for use in fighting fires.

Berryllium: (Glucinum—G1) a silver-white malleable metal occurring only in combination in a few comparatively rare minerals, as beryl, chrysoberyl. Uses: making of beryllium-copper alloys with high endurance limits, great thermal stability and high corrosion resistance; beryllium-nickel alloys with remarkable tensile strength, as high as 225,000 psi; ticonium alloy for dentures; and other alloys used in watch-making.

Bituminous Sands: Natural asphalt having the appearance of newly-placed road mix. Used for surfacing of streets and highways. Other possible uses await further experimentation. Extraction of crude oil from the bituminous sands near Vernal is considered a potential industry.

Bismuth: (Bi)—One of the elements. A brittle, reddish-white metal. Found alone or with other metals. Has numerous pharmaceutical uses. Also used in the making of solders and alloys having low melting points and in the ceramics, paint and plastics industries. Alloys containing bismuth are especially valuable for punches and dies, for electroforming cores, for precision casting and master pattern making.

Brucite: ($MgO.H_2O$). Hydrated magnesium oxide. A soft, waxy, translucent mineral, resembling, but slightly harder than various types of talc. An almost ideal material for carving. Used for making candlesticks, cups, plates and various ornaments.

Cadmium: (Cd)—A tin-white, malleable, ductile metal, capable of high polish. Used to provide electrochemical protection to steel. Also used to produce superior bearings when hardened by addition of nickel or copper and silver. Its low melting point (321 deg. C) is useful in the production of fusible metals and special solders.

Calcite: ($CaCO_3$)—Calcium carbonate, containing 56% lime. Transparent, translucent, and opaque, from white through nearly all colors to black. Used for making a variety of products, from blackboard chalk to the finest of optical instruments. Utah white calcite, quarried near Aragonite, Tooele County, is ground into a powder known as Calcium Carbonate Whiting and used as a paint filler and an ingredient in glazier's putty.

Carbon Dioxide: (CO_2)—A colorless, noncombustible gas about $1\frac{1}{2}$ times as heavy as air. In liquid form, it is used as a carbonator to give sparkle and "fizz" to beverages; as a safe, slow-acting explosive and as a refrigerant in mechanical refrigerators. Compressed into "dry ice," its chief use is for refrigeration of ice cream, meats, fruits and vegetables. Also used for chilling aluminum rivets, shrinking cylinder liners, preparing blood plasma, making penicillin and synthetic rubber; also experimentally for dispelling fog at airports and for rainmaking.

Carnallite: ($KMgCI_36H_2O$)—A massive, granular, greasy, milk-white, soluble, hydrous, magnesium-potassium chloride, crystallizing in the orthorhombic system.

Cement Rock: A low-magnesium clay containing lime. It approaches the ideal combination of lime, alumina and silica for the making of good cement. Utah cement rock is used in the production of Portland cement by Utah plants.

Chromite: ($FeO—Cr_2O_3$)—A chromate of iron. The ore mineral of chromium.

Cinders: See Volcanic Ash.

Clay: A term used generally for certain earthy materials having great plasticity when wet. They vary widely in chemical composition. Colors include yellow, pink, red, brown, green, gray and black. Bentonite, Fuller's Earth, and Hallysite clays are discussed elsewhere in this list. Utah clays contain too much iron for use in the ceramics industry. Brick clay is the variety used most widely in the state, large tonnages being quarried for use in the making of building brick, refractory brick, sewer pipe, drain tile, flue lining and wall coping.

Coal: A solid, stratified, carbonaceous substance formed from remains of vegetation by decomposition and pressure. It is brittle, combustible and varies in color from dark brown to black. Utah's coal is either bituminous or subbituminous. Uses: industrial fuel; household heating; making of coke, organic chemicals, medicines, drugs, ammonia, gas, benzine, tuluol, xylene, tar, tar derivatives, light oils, nepthalene, pyridine, etc. Crude oil can also be extracted from coal but the process is too expensive under present conditions. Utah's coal is unusually high in its crude oil content and should be in high demand when processes are found to extract the oil, gasoline and other by products profitably.

Colorado Marble: See Travertine.

Copper: (Cu)—A common metal of reddish color, ductile, malleable, tenacious, and an excellent conductor of heat and electricity. Utah produces nearly one-fifth of the U. S. output, and the state now mines, mills, smelts and refines most of its copper. Uses: Electrical equipment, light and power lines, telephones and telegraphs, copper wire, automobile parts, construction items, casting, railway equipment, cooking utensils, making of brass and other alloys.

Diatomite: A hydrous or opaline* form of silica consisting of fossil remains of plants known as diatoms. Commonly called diatomaceous earth. Colors: white, cream, gray, tan, brown, greenish to nearly black. Uses: filtering agent in scores of refining and purifying processes, such as sugar, wine, distilled liquors, beer, fruit juices, municipal and industrial waters; insulation for industrial heat and cold equipment, building materials, etc.; a filler and absorbent in many products; and an ingredient in glazes, enamels, poultry litter, etc.

Dolomite: ($CaMgC_2O_6$)—A carbonate of calcium and magnesium. Also called Magnesian limestone. Normally colorless, but often tinted pink or brown. Uses: generally the same as limestone (see Limestone). There is no substitute for dolomite, however, in the making of dead-burned dolomite refractories and in preparation of basic magnesium carbonate used in heat-insulating material. Also used in manufacture of epsom salts, known as "Epsomite."

Emery: An impure form of corundum ($A1_2O_3$), which is a naturally crystallized oxide of aluminum, hardest natural mineral known, next to the diamond. Emery is a mixture of alumina with iron oxides and varying amounts of other impurities. Uses: making of grinding wheels, emery cloth and paper, pastes and compositions; also as a non-slip wear-resisting component in concrete floors.

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*Opal-like luster.

Fluorspar: (CaF_2)—Calcium fluoride. Colors: purple, green, white, gray, yellow, or blue-tinted. Metallurgical grade used chiefly for a flux in making of steel, ferro-alloys, nickel, brass, and basic refractories; also in refining of several nonferrous metals. Acid grade used in making of hydrofluoric acid. Also has some fluxing uses. Optical quality fluorspar used in correcting color and spherical abberration errors in lenses of microscopes and small telescopes.

Fuller's earth: A fine earth resembling clay, characterized by lack of plasticity, high water content and foliated structure. Color and texture are highly variable. Uses: oil refining filter, rotary drilling mud and insecticide ingredient; also a filter and bleacher for mineral, animal and vegetable oils, such as naphthas, fuel oils, lubricating oils, waxes and greases, cottonseed, soybean, linseed, coconut and palm oils and tallow.

Gallium: (Ga)—A rare metallic element found combined in some zinc ores. Can also be extracted from certain shales. White, hard and malleable, resembling aluminum. Remarkable for its low melting point, 86 deg. F., 30 deg. C. A substitute for mercury in thermometers and dental amalgams. Combined with phosphorus, it forms a heat-resistant metal used in making electronic parts for missile nose cones.

Gilsonite: A form of solidified petroleum made up chiefly from the heavier hydrocarbons. Brilliant black, very brittle. Found only in Uinta Basin, Utah and Colorado. Used in making asphalt tiles, storage battery cases, paints, varnishes and lacquers, inks, automotive undersealing compound and sound deadening materials, building paper, underground steam pipe insulation, molded articles and brake linings. Most of Utah's gilsonite production in recent years has gone into the making of metallurgical coke and high-octane gasoline.

Gold: (Au)—A metallic element of yellow color. Most malleable and ductile of all metals. One of heaviest substances known. Uses: for coinage; for making of gold alloys used in jewelry, all kinds of gold plating, foil and leaf for decorative purposes; "liquid gold" for making patterns on porcelain, china, and similar articles; and in dentistry for fillings, inlay castings and dental wire.

Grits: Rough, hard particles of rock, small and angular. The only grits produced in Utah in addition to Volcanic Grits and Aragonite, treated elsewhere in these pages, are produced from crushed marble or sandstone, marble being preferred because of its hardness. Used as a coating for tar-base roofing.

Guano: A substance composed chiefly of bat or wild-fowl excrements. Rich in phosphates and nitrogenous matter. Found in commercial quantities on some islands of the Great Salt Lake. Used for nitrate fertilizer.

Gypsum: ($CaSO_4 + 2H_2O$)—Hydrous calcium sulphate, containing about 20% water. After dehydration and grinding to powder, it tends to resume former rock-like structure upon addition of water. Colorless to white, but impurities may give it gray, green, red or pink shades. Utah's gypsum is used for wallboard, lath, sheathing, blocks, plaster, partition tile and roof decks, Keene cement, agricultural land plaster and cement retarding. Additional general uses: yeast accelerator, crayon making, water hardener, making of novelties, statuary, relief maps, dies, casting molds, etc.

Halloysite clay: ($Al_2O_3SiO_2$)—An aluminum silicate, crystalline, fine grained, resembling kaolinite, but amorphous* and containing more water. Color:

*Without crystal structure.

white, like talc. Used in large quantities since 1948 as a catalyst in oil refining. Is also a good refractory type clay, but is too expensive to mine for this purpose.

Helium: (He)—A colorless, absolutely intert, odorless, tasteless, nonpoisonous, nonflammable gaseous element. Predominant use: lifting medium for balloons and airships. Mixed with oxygen, it mitigates caisson disease ("the bends") in deepsea diving. Also used in treating asthma. Experiments now in progress for possible use in metallurgical work, for medical purposes and in scientific studies. The U. S. Government is the only large producer and consumer.

Hematite—One of commonest iron ores ($Fe2O_3$), containing, when pure, about 70% metallic iron and 30% oxygen. Readily distinguished by red streak and powder.

Iron: (Fe)—A silver-white metallic element, malleable and ductile,* readily oxidized in moist air and attacked by many corrosive agents. Average iron content of Utah's commercial ore is 53%. Ores occur as irregular mixtures of hematite and magnetite. Uses: Making steel and cast iron. Some used in cement making to give a water-holding characteristic to the concrete while it is setting up. Uses are multiplied almost to infinity through alloying steel with numerous other metals to produce the ferroalloys.

Jasper: An opaque, impure variety of quartz, breaking with a smooth surface and admitting of high polish. Red, yellow and other dull colors—usually due to iron content. Used, when polished, for vases, seals, novelties, etc. Utah jasper is crushed into fine particles and used as a coloring and beautifying agent in cement blocks, tile and concrete products, both ornamental and utilitarian.

Kaolin: A clay, mainly hydrous aluminum silicate. Used in making porcelain, china, whiteware, pottery and high-grade tile; also used in paper manufacture.

Lead: (Pb)—A metallic element, heavy, pliable and inelastic. Bright, bluish color, easily tarnished to dull gray. Galena is the most common ore mineral (Pbs) but also found as a carbonate or a sulphate in near surface portion of ore deposits where the ore has been oxidized. Utah's lead usually found in association with zinc and small amounts of gold and silver. Major uses: paints, storage batteries, cable coverings, plumbing, ammunition, architectural and ornamental items, tetra ethyl lead for use in gasoline, burial caskets, printing type, glass, industrial floor coverings, etc.

Limestone: Sedimentary rock occurring in practically inexhaustiable quantity in nearly all parts of the world, composed essentially of calcium carbonate ($CaCO_3$). Uses: as a flux in smelting iron, steel, ferroalloys and some nonferrous metals; in making lime and agricultural limestone; as crushed stone for road and railroad construction, riprap and rubble; as building stone; in pulverized form as substitute for chalk whiting in putty, paint, rubber, etc.; as terrazzo, stucco dash, concrete block facings; for sugar refining, insecticides, rock dust for use in coal mines, etc.

Limonite: Brown, hydrous oxide of iron containing, when pure, 85.6% iron and 14.4% water. Earthy or irregular form, never in distinct crystals.

Limonite-moss: An oxidized iron ore associated with peat and similar organic substances. Used as a fertilizer and soil conditioner.

*Capable of being drawn, as into wire.

Liquid Asphalt: A natural asphalt in liquid form that oozes from the earth near the north shore of the Great Salt Lake in Box Elder County. Has been used as a tempering agent in manufacture of rubber. Contains small amounts of a valuable medicinal ingredient, ichthyol, or fish oil, for which a synthetic substitute is now being made.

Lithium: (Li)—A soft, silver-white metallic element of the alkali group, the lightest metal known. Used in aluminum alloys and in metallurgy as a scavenger for other metals. Especially adapted to ceramic and dehumidifying uses. Lithium hydride is a source of hydrogen for inflating baloons.

Magnesium: (Mg)—A silver-white metallic element, malleable, ductile and light. Can be shaped and worked by practically any method. Uses: to produce brilliant light in signaling, photography or pyrotechny; as an alloy to deoxidize, desulphurize and improve the structure of other metals; as a corrosion preventive in batteries and an aid in formation of organic compounds in chemistry. Used as a metal with various alloys in aircraft, commercial highway and passenger automobiles, and making of industrial machinery, tools, equipment and consumer goods where light weight is important.

Magnetite: ($FeO.Fe_2O_3$)—Magnetic iron oxide. Contains 72.4% iron.

Manganese: (Mn)—A hard, brittle, metallic element, grayish-white, tinged with red. Rusts like iron; nonmagnetic. Used chiefly for steel-making alloys. Makes steel tough, hard, extremely wear-resistant for making of machinery parts subjected to extreme wear and abrasion, such as railroad rails, steam shovels, gears, crusher liners, safes. Manganese-copper used as deoxidizer in gunmetal and for making manganese bronze. Other alloys: manganese-aluminum, copper-manganese-aluminum, manganese-copper-nickel, etc. Alloy of 36% silver, 9% manganese and balance copper was used during World War II in place of nickel-copper for our 5c coin.

Mercury: (Hg)—A heavy, silver-white, liquid, metallic element, popularly called quicksilver. Has more than 3,000 uses. Used in pharmaceutical, dental, cosmetic and agricultural preparations; in control instruments—thermometers, barometers, flowmeters, weightometers, marine and air navigation systems; in electrical apparatus; as a cathode; in making pure caustic soda; in making mercury-vapor boilers for power generation; in ship's paint, photography, precision casting, atomic reactor cooling, etc.

Molybdenite: (MoS_2)—Sulphide of molybdenum, a metallic element of the chromium group. Resembles iron in its white color, malleability, and difficult fusibility. Uses: to increase hardenability of wrought engineering steels used in autos, machine tools, and aircraft; to increase corrosion resistance of wrought stainless steels, improve strength and creep resistance of steels at eleavated temperatures, supply red-hardness to high-speed steels and increase toughness of cast iron; in making of pigments for printing inks, paints, dyestuffs, etc.

Natural gas: a variable mixture of gaseous hydrocarbons* found in underground rock formations. Colorless, odorless, lighter than air, inflammable. Uses: as fuel for furnaces, space heaters, ranges, refrigerators, water heaters and incinerators; also as a fuel in many businesses and small industries, such as laundries, restaurants, and dry cleaning shops. Used in Utah for large industries, including smelters and power plants, on an interruptible basis, depending upon seasonable supply. Useful as raw material in some industries

*One of a class of compounds that contain hydrogen and carbon only.

not yet established in Utah, such as making of plastics, solvents, certain kinds of fertilizer, etc.

Natural Gasoline: Also known as casing head gasoline. A volatile gasoline obtained by recovering the butane, pentane and hexane hydrocarbons present in small proportions in certain natural gases. It is used in blending with heavier materials to produce a finished gasoline with adjusted volatility.

Nitrate: Natural deposits of nitrogen-rich earth and clay consisting principally of the salts of sodium and potassium. Very rare in U. S. in commercial quantities. Uses: Making of explosives, fertilizers, dyestuffs, chemicals, nitric acid, sulphuric acid and glass.

Obsidian: A pure, solid, natural volcanic glass, almost completely without crystal grains. Jet-black, gray, Indian red or rich brown. Has bright luster, like artificial glass. Used frequently by primitive peoples to make knives, spearheads, etc. Uses: making of jewelry items, statuary, novelties, antiques. Also used in small quantities for making of artificial pumice, chiefly in Germany.

Oil (petroleum): A natural oil, found in upper strata of the earth, consisting of a variable, complex mixture of hydrocarbons. Dark brown or greenish, inflammable liquid. Uses: making of motor oils, fuel oils, gasoline, kerosene, paraffin, waxes, refrigerants, anaesthetics, solvents—such as naphtha and benzine—and illuminants, carburetants, etc. Residues from refining of crudes are used as road surfacing oils and in making of asphalt paving mixes.

Oil shale: Shale rock containing such a proportion of hydrocarbons as to be capable of yielding mineral crude oil on slow distillation. Used for extraction of crude oil in some foreign countries for 100 years. Experiments in U. S. conducted at Rifle, Colo., by federal government and Union Oil Co. Uses: for crude petroleum extraction, resulting in ultimate yield of all products listed under "Oil (petroleum)."

Oolite: A variety of limestone consisting of round grains like a fish roe; hence the popular name "egg-stone." Grains vary in size from minute to large as peas. Utah oolite used solely as a smelting flux, having higher availability of lime than ordinary crushed limestone.

Ozokerite: A waxlike hydrocarbon, believed derived from paraffin-base petroleum through a change of the molecular structure of the paraffin. Feels greasy. Soldier Summit deposits in Utah vary from a transparent yellow or white solid to a hard, dark, resinous substance. Greatest recent use: in making of carbon paper and typewriter ribbons. Also used in making ceresin (a substitute for beeswax), candles, etc.

Palladium: (Pd)—A rare metallic element of the platinum group. Silver-white, ductile, malleable. Uses: Essentially the same as Platinum. See under Platinum.

Perlite: An acidic volcanic glass, containing 2 to 5 per cent water. When suddenly heated, crushed ore expands 10 to 20 times original volume. Waxy to pearly luster. Color range: gray to red to black. Uses: lightweight building aggregate, replacing sand in plaster and concrete; for loose fill insulation and building blocks; as industrial filtering agent and ingredient in pipe coverings, roofing tile, abrasive compounds, foundry sands and powdered silica for paint making.

Phosphate rock: ($Ca_3(PO_4)_2$)—A sedimentary rock containing calcium phosphate. Vitreous luster and red, green, violet, white or yellow color. Usually

listed in terms of available phosphoric acid (P_2O_5). 90% of output used in making super-phosphates and other compounds for fertilizer. Increases root growth, hastens maturity, improves quality, increases disease resistance. Other uses: making elemental phosphorus for chemical industries; in making powders, water softeners, rustproofing compounds and glass making; also in ceramics, beverages, dental cements, photography, fireproofing compounds, sugar refining, etc.

Platinum: (Pt)—A heavy, almost silver-white metallic element, ductile and malleable, but very infusible and resistant to most chemical reagents. Melting point, about 1,710 deg. C. Uses: Making contacts for telephone equipment, manufacturing of spark plugs, electrical equipment, dental supplies and jewelry; also as a chemical catalyst.

Potash: (K_2O)—Oxide of potassium. Not an independent compound, but used as basis of comparison for all potash minerals and artificial salts. Potassium content of minerals is always recalculated to its equivalent of K_2O and expressed as "potash." Uses: fertilizer ingredient to improve plant health and quality; also in dyeing and tanning, making glass, pottery, soap, matches, fireworks, explosives, and many potassium compounds for the chemical, pharmaceutical, and manufacturing industries.

Pumice: An excessively cellular, glassy lava, generally of rhyolite composition. Whitish or light gray. Floats on water. Uses: as lightweight concrete and building block aggregate; as abrasive for cleansing and scouring compounds and hand soaps; for acoustic plaster, insulation, insecticides, brick-making, filtration, solvents, plastics, paint fillers and absorbents.

Pumicite: See Volcanic Ash.

Quartzite: A metamorphosed quartz sandstone with silica cement, in which original grains are usually not easily identified. Used in scouring and polishing soaps and powders, sandpaper, sand-blast work, tube-mill and acid-tower linings; making silica fire brick and other refractories, silicon, ferro-silicon and silicon alloys of metals, such as copper; as flux in smelting basic ores; as a mineral filler in insecticides, rubber, molded goods, phonograph records, etc.

Resins: Fossil gum, yellowish to brown, found mixed with coal in Huntington Canyon and Hiawatha areas, Emery and Carbon counties, Utah. Actually fossilized pitch from pines or conifers, and resembles pine pitch. Believed to be the only product of its kind anywhere. Forms portion of coal dust. Concentrated at Hiawatha and at Bauer, Tooele County. Mixed with hexane and smelted at Bauer. Used in making paints, varnishes, inks and adhesives; and for reinforcing of heavy-duty paper bags.

Rhenium: A hard, extremely rare, silver-colored, corrosive-resistant metal with exceptionally high quality conductivity. Melting point, 5,756 deg. F. Uses: principally in the making of electrical contacts and relays; also used in protective nose cones of space capsules and liners of rocket nozzles.

Rock Asphalt: Limestone or sandstone containing a substantial percentage of bitumen.* Utah's Carbon County rock asphalt contains 9.5 to 10.0 pct. of bitumen. Found in huge bed of Tertiary sandstone 1300 feet thick, outcropping for 12 miles along upper sides of Sunnyside Canyon. Used for surfacing streets and highways, playgrounds, tennis courts, etc.

Rock dust: Powdered residue from crushing of limestone. Used for "dusting" coal mines.

*A native mixture of hydrocarbons.

Salt: (NaCl)—Halite, or sodium chloride. A soft, water-soluble mineral occurring as granular, crystalline or fibrous, often cleavable, masses,; white, gray, brown, blue or red. Most Utah salt produced by solar evaporation of Great Salt Lake brines. Rock salt occurs in several counties. Salt uses: culinary purposes; meat packing; curing and packing fish; making ice cream and artificial ice; treating gold and silver ores; salting stock; curing hides; in making pickles, ceramic glass, oleomargarine, dyes, soaps, water softeners and medicines, removing scale from sheet steel in rolling mills and ice from steps and sidewalks in winter.

Sand and gravel: Sand is any hard, granular rock material finer than gravel and coarser than dust. Gravel is a loose mixture of small stones and pebbles or a mixture of sand and small stones. Commercially, both are screened and sized. About 75% of production used in making concrete for building construction and for road mixes of various kinds; 15% for railroad ballast, and remainder for fill, filtration, etc. Special types of sand used in glass making; sand molds; for grinding and polishing purposes; as a flux in furnaces, etc.

Selenium: (se)—An element widely distributed in the earth's crust, though present in amounts so small they match the relatively small order of occurrence of gold. Found in volcanic sulfur, iron pyrites, lead sulfide and large copper and copper-nickel deposits. Used in making photoelectric cells; rectifiers for the electroplating and electrochemical industries; glass; rubber; cadmium sulfoselenide pigments; and protective coatings for aircraft metals and alloys, cathode-ray tubes, television screens, lamps, etc.

Shale: A fine-grained, fissile, argillaceous, sedimentary rock characterized by rather fragile and uneven laminae and commonly a somewhat splintery fracture. Often incorrectly called "slate."

Silica: (SiO_2)—Silicon oxide. Most abundant constituent of earth's crust. Type commercialized in Utah is silica sand—sand meeting requirements of uniform size or shape of grains, purity from alumina, iron, or other metals. Utah silica sand used in metals industries for molds in casting and as a flux in steel making and some nonferrous smelting. Other uses for special grades and types: Making abrasives, refractories, chemicals, fillers, insecticides, glass, insulation, optical goods, decorative materials, etc.

Silver: (Ag)—A white metallic element, sonorous, ductile, very malleable, capable of a high degree of polish. Whitest of all metals. Utah silver is associated with copper, lead-zinc and gold ores. Seldom found alone. Uses: coinage; making of sterling silver and silverware, electrical, photographic, and chemical industry equipment; as an antiseptic in surgery and sanitation; in dentistry; for making of silver alloys and solders, etc.

Slag: The vitreous mass separated from the fused metals in smelting ores; the dross of a metal. Used like woolrocks in the making of mineral wool—sometimes called "slag wool"—for insulating purposes; also for railroad ballast and road topping.

Stone: A general classification embracing all stone not considered separately. Includes dimension stone for building and ornamental purposes and precious, or gem stones used in jewelry and art. Utah's dimension stone: marble, granite, sandstone, travertine, picture stone, etc. Other than sandstone (flagstone) Utah's dimension stone is generally too costly compared with other building materials. Production comparatively small. Utah's precious stones: agate, amethyst, azurite, chalcedony, garnet, malachite, silvinite, opal, rock

crystal, topaz, turquoise and varicite. Can be used for gems, carving and structural purposes.

Sulphur: (S)—A nonmetallic element. Native, it occurs in yellow crystals, in masses, crusts and powder. Often of volcanic origin, as in Beaver County. Chief use: making sulphuric acid; also sulphuric dioxide for the paper, chemical, refrigerator and fumigant industries; in agricultural fertilizers, insecticides and fungicides; in the rubber industry; in making carbon disulphide for solvents, insecticides and fire extinguishers; and for making acidproof cements, etc. Utah's product used chiefly for insecticides; also for gunpowder and "sulphur and molasses."

Sylvite: (KCl)—Native potassium chloride.

Tailings: The worthless slimes left after the valuable portion has been separated by dressing or concentration of ores.

Talc: ($H_2Mg_3(SiD_3)_4$)—Hydrous magnesium silicate. Color: pure-white, silvery-white, gray, various shades of green, to nearly black; other colors when impure. Utah produces no talc. Montana product is crushed and ground at Ogden. Some used as a paint filler by Bennett's, Salt Lake City. Other uses: crayons, asphalt paper roofing, rubber making, soap, foundry facing, wire-insulating compounds, lubricants, linoleum and oilcloth, wall plasters, cotton textile making, leather dressing, ceramic purposes, dusting agent in candy, chewing gum, etc.

Travertine: ($CaCO_3$)—Calcium carbonate, deposited from solution in ground and surface waters. When solid, banded, and susceptible of a good polish, it is known as Colorado Marble, Mexican onyx or onyx marble. Travertine forms the stalactites and stalagmites of caves.

Tungsten: (W)—A rare element of the chromium group found combined in certain minerals such as wolframite and scheelite. A hard, brittle, white or gray metal. Uses: as a hardening agent in high-speed steels; for making lamp filaments and alternating electron tubes; cathodes and other parts for fluorescent and high-pressure mercury lamps; contact points for ignition systems: X-ray targets and cathodes; making of cemented tungsten carbide for carbide-tipped tools, hard facing of steel parts, molds and plungers for compacting metal powders, etc.

Uranium: (U)—An element of the chromium group found in combination, never native. Reduced, it is a heavy, hard, nickel-white metal. All uranium minerals contain radium. Chief Utah types: carnotite (with vanadium), uraninite and autunite. Uses: making of atomic, hydrogen and cobalt bombs; as fuel in atomic power plants for submarines; radioisotopes for use in medical science to treat such diseases as leukemia and cancer; extraction of radium; and in a myriad of potential industrial roles of tomorrow, such as creating electrical energy, powering locomotives, ships, aircraft, autos, factories, etc.

Vanadium: (V)—Usually occurs in nature as V_2O_5. Reduced to a metal, it is a grayish white metallic powder. In Utah, associated with carnotite ores containing uranium. Used as an alloying metal to impart fine grain size and improved mechanical properties to steel, particularly high-speed tool steels. Used occasionally in nonferrous alloys.

Vermiculite: A micaceous, hydrated silicate. Splits readily into thin sheets, soft, pliable and inelastic. Colors: amber, bronze, reddish brown, dark green and black. Luster, pearly to greasy. Water in crystal literally explodes the mineral when it is heated, causing it to expand from 8 to 12 times its

original volume. Not mined in Utah. Montana product processed in Salt Lake City plant of Vermiculite-Intermountain Inc. Used as loose-fill insulation for homes and industrial and farm buildings; in low and high-temperature industrial plaster; and in horticultural work, to improve soil qualities.

Volcanic ash: Sometimes called Pumicite, or Tuff. A sedimentary rock composed of fine material explosively ejected from a volcano. Resembles ashes in color, texture and general appearance. Volcanic ash in Fillmore area, Millard County, is reddish color. Used, like pumice, as light weight aggregate in concrete, concrete products and building blocks.

Wurtzilite: Commercial name, "Elaterite." An asphaltic pyrobitumen, jet-black by reflected light, deep-red in thin plates. Softens in hot water, toughens and becomes more elastic. In candle form, burns with bright flame. Found only in Utah's Duchesne County. Uses: as binder for tile; in making of paints and coatings for weatherproofing and corrosion prevention; for electrical insulation; for blending with rubber, etc.

Zinc: (Zn)—A bluish-white, crystalline, metallic substance. Sphalerite is the most common ore mineral of zinc (ZnS), but occurs also as an oxide, a carbonate or a silicate in near surface portions of an ore body. In Utah associated with lead in lead-zinc ores. Uses: making die castings; combining with copper to make brass; galvanizing of iron and steel; in roofing; dry cells, photoengraver's plates, lithographer's sheets, zinc coating for cathodes, weather strip, addressing machine plates, eyelets for a myriad uses, automobile carburetors, white paint, etc.

Zirconium: (Zr)—A rare element found in combined form only. A grayish crystalline metallic substance. Zirconium metal has high corrosion resistance with good structural strength. Considered the best all-around structural metal available for nuclear reactors. Also used in making hydrochloric acid condensers and boilers and containers for rocket fuels that have fuming nitric acid as an ingredient. Zirconium has found use also as a "getter" for scavenging residual gases in various electronic tubes, especially in the more expensive power (transmission) tubes.

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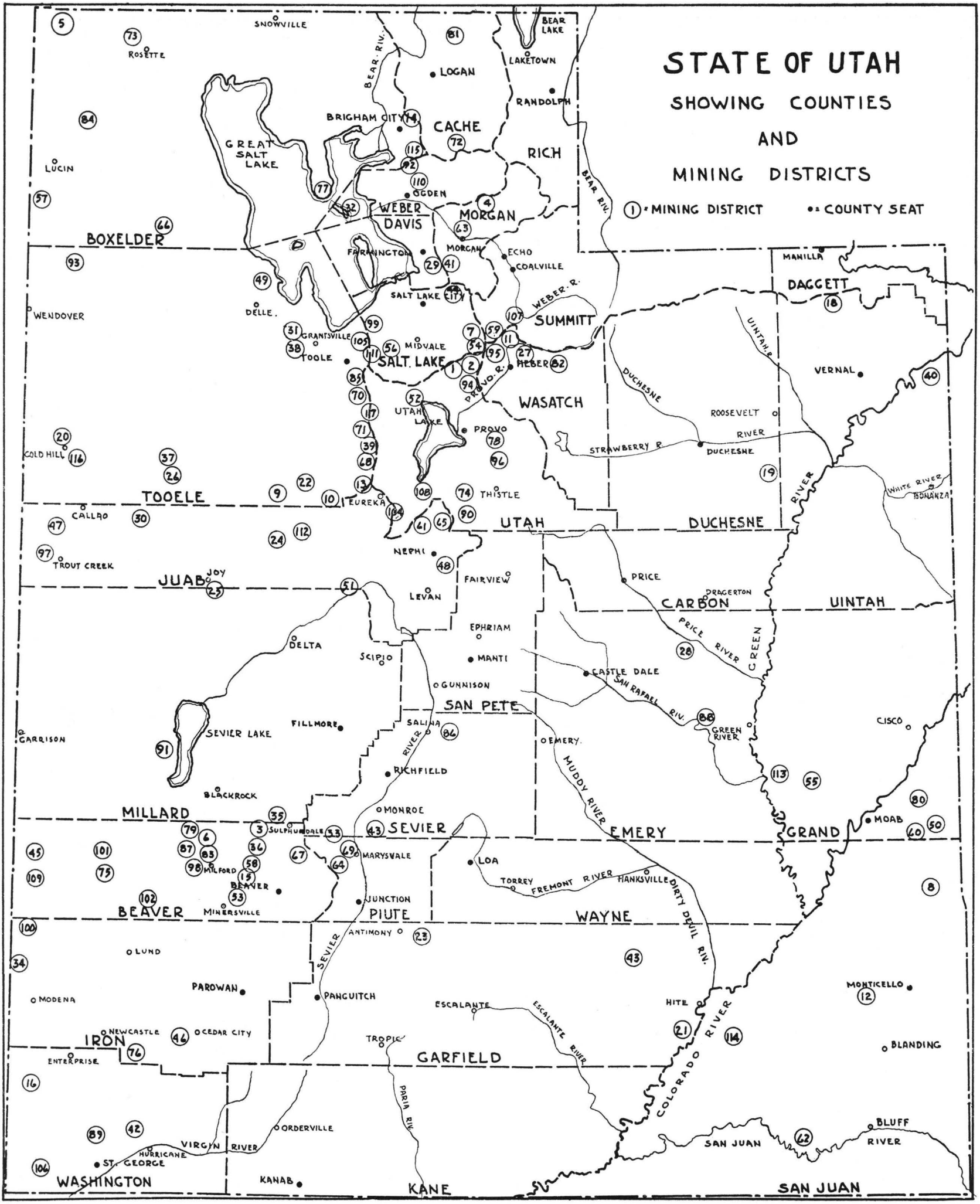
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SHOWING COUNTIES
AND
MINING DISTRICTS
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• = COUNTY SEAT
SNOWVILLE
ROSETTE
LUCIN
BEAR RIV.
BEAR LAKE
LAKETOWN
LOGAN
RANDOLPH
BRIGHAM CITY
CACHE
RICH
GREAT SALT LAKE
OGDEN
WEBER
DAVIS
MORGAN
BEAR RIV.
BOXELDER
FARMINGTON
MORGAN
ECHO
COALVILLE
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