BRIGHAM YOUNG UNIVERSITY

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# GEOLOGY OF THE SOUTHERN WASATCH MOUNTAINS AND VICINITY, UTAH

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**Brigham Young University Geology Studies**

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# Geology of the Southern Wasatch Mountains and Vicinity, Utah

*a symposium*

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*Extra copies of map available at $1.00 each.*

# Contents

# Geology of the Southern Wasatch Mountains and Vicinity, Utah

## INTRODUCTION

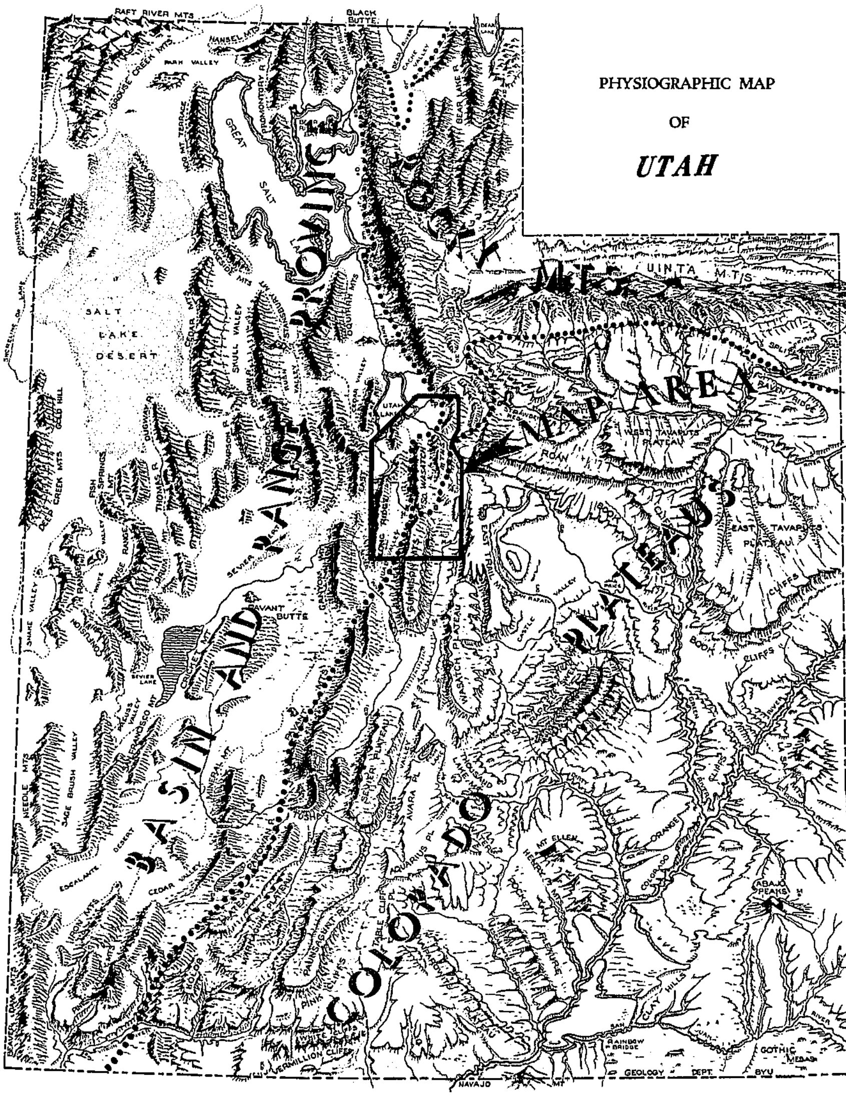
Utah is blessed with geologic features of unusual interest and great variety. The Canyon Lands, the Henry Mountains, the San Rafael Swell, the High Plateaus, the features of Lake Bonneville, the famous mining districts of Tintic, Bingham, and Iron Springs, the magnificent stratigraphic sections exposed in the Book Cliffs and in the Basin Ranges, all have revealed to geologists the tremendous sweep of geologic history and have been made classic through the writings of such pioneer geologists as C. E. Dutton, William M. Davis, C. D. Walcott, and G. K. Gilbert. So complex is Utah's geologic history and so numerous its problems that further detailed work, using improved procedures, continues to increase our understanding of this fascinating area. Each year some aspect is clarified and we wonder why it did not seem more obvious to us before.

In this light we embark on a summary of the current knowledge of the geology of the Southern Wasatch Mountains. The area lies at the junction of three major physiographic divisions: the Middle Rocky Mountains, the Colorado Plateaus, and the Basin and Range Province. It includes sedimentary, igneous, and metamorphic rocks ranging in age from Precambrian to Quaternary, and representing dominantly marine deposits of the Early Paleozoic Cordilleran miogeosyncline, the later Paleozoic Madison and Oquirrh Basins, the Cretaceous Rocky Mountain exogeosyncline, and Cenozoic deposits in freshwater lakes. The area has been involved in major structural deformation in Precambrian time, in folding and thrusting in Late Cretaceous (Laramide) time, and in block faulting in later Cenozoic time. In all, a greater variety of geologic features can scarcely be found in so limited an area.

The area is part of what is sometimes referred to as the "transition zone" in Utah. The transition involves more than the change from Basin and Range landforms to those of the Plateaus, it also involves older transitions from Cretaceous orogenic elements on the west to depositional sites on the east, from Paleozoic cratonic deposition on the east to geosynclinal behavior on the west. Two previous guidebooks have discussed the transition zone in Utah: to the north the Intermountain Association of Petroleum Geologists 10th Annual Field Conference in 1959 considered the Wasatch-Uinta Mountains transition area; to the south the Utah Geological Society 4th Annual Field Conference in 1949 traversed the transition between the Colorado Plateaus and the Great Basin in central Utah.

## GEOLOGIC MAP

The geologic map accompanying this report was compiled from a great many sources, most of them published and unpublished theses by graduate students of Ohio State University and Brigham Young University (see "Index to sources of data" printed on the map). The original mapping was done on a variety of base maps, some prepared by plane table, some from air photos, and some on U.S.




INDEX MAP.—Shows Southern Wasatch map area in relation to physiographic provinces.

Geological Survey topographic quadrangles. In transferring the mapping from these diverse bases to the common base used innumerable minor adjustments were made in order to fit the original mapping to the new base as well as possible. Air photos aided in making the transfer for it was sometimes necessary to transfer data from the original map to the photos and thence to the final map in case the original map was too distorted to use directly.

In addition, in cases where adjacent mappers disagreed, the compiler has attempted to resolve their differences as best he could in order to eliminate map boundary faults. Many problems, yet to be solved, became apparent during the compilation and it is hoped that the present map may serve as a means of pointing out these problems in their regional setting for the benefit of future students of this complex and interesting area.


## ACKNOWLEDGMENTS

Although many famous pioneer geologists such as William M. Davis and G. K. Gilbert had made reconnaissance observations pertaining to the Southern Wasatch Mountains, the first modern areal mapping in the area was done by Armand J. Eardley in the early 1930's. All later workers are indebted to the perspicacity of his observations.

Impetus for further work in the area came from Professor Edmund M. Spieker who extended his earlier interest in the Mesozoic problems of central Utah by directing Ohio State University graduate students in areas surrounding that of his initial work with the U.S. Geological Survey. Under him, S. L. Schoff's work in the Cedar Hills in 1937 was followed by that of many others of whom the following did work in the area of the present report: Dorothy Taylor, H. D. Zeller, R. E. Hunt, S. J. Muessig, R. E. Metter, A. C. Fograscher, J. E. Cooper, M. A. Khin, R. E. Mase, J. D. Hayes, and G. E. Thomas. Professor George E. Moore, Jr., of Ohio State University acted as graduate thesis advisor for some of these students.

For the past 25 years Professor Harold J. Bissell has been involved in problems relating to Utah Valley and the adjoining ranges. He has inspired a number of students to work in the West Mountain-Long Ridge-Southern Wasatch area and has served as adviser to most of the following Brigham Young University graduate students who have worked in this area: W. O. Abbott, R. S. Brown, R. S. Clark, L. C. Demars, J. H. Elison, D. R. Foutz, P. W. Gaines, R. W. Gates, T. A. Gwynn, H. D. Harris, R. A. Hodgson, K. D. Johnson, J. W. Madsen, D. F. Mecham, C. H. Peacock, H. N. Petersen, D. J. Peterson, D. O. Peterson, R. P. Peterson, J. R. Price, R. R. Rawson, J. A. Rhodes, S. F. Schindler, G. K. Sirrine, C. V. Smith, J. W. Swanson, and B. O. White.

Arthur A. Baker of the U.S. Geological Survey has mapped in the Wasatch Range from Spanish Fork Canyon northward and his work and advice have served as a guide to many of the above listed workers. In addition to the many people whose field work has made the present compilation possible, I wish to acknowledge the efforts of the authors of the papers in the present volume. I also wish to thank Professors Clyde T. Hardy and J. Keith Rigby for help in preparing the road log, and Mr. Colbeth Killip for drafting the geologic map.

*The Editor*

# Economic Geology of North Central Utah

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Metallic minerals in the area of this report are of minor importance in comparison with the nearby Tintic, Bingham, or Park City Mining districts. A review of the metallic minerals produced is primarily of historic rather than of commercial interest. However, nonmetallic minerals in this area have been more important and have greater potential. Numerous sand and gravel pits in the Lake Bonneville sediments along the flanks of the Wasatch Mountains presently represent some of the largest commercial properties, but because of their geologic simplicity they need no further consideration here. Limestone and dolomite are quarried for flux by the Columbia-Geneva Steel Company. Clay, lime, gypsum, and building stone operations have existed in past years. One of the most important local resources in the area is surface and underground water.

Three metallic mining districts of small production, two nonmetallic properties, and one unusual mining venture are considered below.

## GYPSUM DEPOSITS

Considerable gypsum production has come from the Arapien Shale in Salt Creek Canyon near Nephi and Chicken Creek Canyon near Levan. Large-scale production began about 1890 and continued for over three decades. Annual production normally ranged from 7,500 to 10,000 tons during the active years. A small amount of salt has also been produced from pits in the North Fork of Salt Creek Canyon (Eardley, 1933, p. 333).

The Arapien Shale is a sequence of red to gray shale, siltstone, fine-grained sandstone, salt, limestone, and gypsum-bearing strata, the total thickness aggregating several thousand feet. The Arapien Shale forms the foothills along the southern and southwestern base of Mount Nebo and extends southward to Chicken Creek and beyond on the western side of the Gunnison Plateau.

Arapien Shale is highly contorted by both folding and faulting. Repetition, omission, and thickening and thinning of beds are common. A true thickness probably cannot be determined because of its complicated structure. Johnson (1959) measured a gypsum bed 80 feet thick on Mining Ridge, whereas in the gypsum quarry at the mouth of Salt Creek the gypsum strata measures 250 to 300 feet thick. Discontinuous outcrops and variable thickness of the gypsum strata along the western front of the Gunnison Plateau is due primarily to folding and faulting.

The Salt Creek and Chicken Creek gypsum occurrences form the main deposits in north central Utah. The chief property near Nephi is located one mile east of the city, near the mouth and on the south side of Salt Creek Canyon. It was patented in 1882 as the Juab Plaster and Mining Claim. In 1888 the company was incorporated and a mill erected (Boutwell, 1903). The property was later worked by the Nephi Plaster and Manufacturing Company and the United States Gypsum Company. The gypsum strata are 250 feet thick at the bottom of the quarry, but widen to 300 feet or more above. Its exposed length is 700 feet. The property has been developed by a 400-foot high quarry, glory holes, and underground mining. Gypsum rock was loaded into a tram car which descended to the mill and pulled up an empty car. The mill output included land plaster, casting, finishing, hard wall, and dental plaster. It was also used as an ingredient of Portland cement, Keene's cement, and special colored plasters.

For many years the United States Gypsum Company mined large quantities of gypsum from vertical strata at Rowley's Mine, 1½ miles northeast of Nephi, and from the property at the mouth of Salt Creek. More favorable mining properties were developed in Chicken Creek and operations were transferred to the properties near Levan. The mill in Salt Creek was finally dismantled during the summer of 1959, although production had ceased many years before.

The Chicken Creek gypsum deposits occur 1½ miles east of Levan. This property originally was operated by Utah Consolidated Plaster (Stone, 1920), but is presently owned by the United States Gypsum Company. Gypsum is exposed in an outcrop about 200 feet high and 250 feet thick, and has been strip-mined. This deposit is similar in geologic occurrence and physical properties to the Salt Creek deposits. Gypsum strata cannot be traced continuously over the eleven miles between the mines, although it does crop out a number of places in between. Gypsum from the Chicken Creek Mine was transported to a nearby mill and processed. Several other gypsum outcrops have been prospected in Chicken Creek Canyon.

## KEIGLEY LIMESTONE QUARRY

Keigley Quarry lies two miles northwest of Santaquin, at the southern end of West Mountain and the northern end of Long Ridge. Cambrian limestones and dolomites are being quarried by the Columbia-Geneva Steel Division for use as fluxes and refractories at the Ironton and Geneva Works.

Sedimentary rocks in the immediate area of Keigley Quarry include over 6,800 feet of Paleozoic strata (Elison, 1952) with some Quaternary and Recent sediments flanking the bedrock. Cambrian, Devonian, and Mississippian formations lie within the Keigley Quarry properties.

Paleozoic strata at the quarry are part of a large thrust sheet, having been displaced from the west or southwest an unknown distance. The general attitude of the strata conforms to an east-west to northeast-southwest strike, dipping from 45 to 80 degrees to the south and southeast. Beds become progressively younger toward the south and southeast. The trace of the overthrust is essentially east-west. Cambrian strata are in juxtaposition with Upper Cambrian, Devonian, and Mississippian. Recent drilling operation found a second thrust plate to underlie the quarries in which Cambrian strata are displaced about 500 feet to the south. Several normal and tear faults are present, having magnitudes ranging from a few inches up to 200 feet.

Production at the Keigley Quarry began in December of 1943. In eighteen years of operation approximatey 8,000,000 tons of stone have been quarried. Current annual production is about 360,000 tons. At the present rate of consumption, and by introducing stripping operations, the quarry reserves are adequate for another 50 years or more. A branch of the Denver and Rio Grande Western Railroad extends through Goshen Gap and transports the crushed stone to the steel mills at Ironton and Geneva. Some crushed stone is sold for use as road gravel. The fines are used for fluorine control at the Geneva Works and to keep dust down in the Carbon County coal mines.

Commercial stone is quarried from the carbonate Cambrian section, which includes in ascending order the Teutonic Limestone, Dagmar Dolomite, Herkimer Limestone, Bluebird Dolomite, Cole Canyon Dolomite, and Opex Dolomite.

Three different sizes of crushed stone are processed at the Keigley Quarry Plant, with varying silica content of one to five per cent. (1) Blast furnace fluxing stone ranges in size from 5/8 to 2½ inches diameter. A maximum silica content of five per cent allowable. This type of stone is quarried from the Teutonic Limestone, Cole Canyon Dolomite, and the lower 100 feet of the Herkimer Limestone. (2) Open hearth fluxing stone ranges from 2½ to 9 inches in diameter. The Herkimer Limestone with a silica content of 2.2% is the main rock used, although recently the lower Teutonic has also been used. (3) Open hearth refractory stone is dolomite crushed to 3/16 to 5/8 inches, and has a maximum silica content of two per cent. It is used as a refractory lining of the open hearth furnaces. The Bluebird Dolomite and some Cole Canyon and Opex Dolomite are used for this purpose, the Bluebird being the principal producer of commercial dolomite. In general, limestone and dolomite with a silica content over 2 per cent is used in the blast furnaces whereas dolomite and limestone with silica under 2 per cent goes to the open hearth furnaces.

## PROVO MINING DISTRICT

The Provo Mining District lies northeast of Provo in the Rock Canyon area. It was organized in 1871. The area has been actively prospected, but only the Monarch (Buckley) Mine, located in Rock Canyon in 1902, has shipped ore. Shipments of 8 tons of lead-silver ore were officially reported; however, according to Johnathan Buckley, part owner, about 50 tons had been shipped from the Monarch Mine up to the year 1913 (Butler, 1920).

Rocks exposed in Rock Canyon include Precambrian, Cambrian, Devonian and Mississippian sedimentary strata totaling more than 4000 feet in thickness and disposed in an anticlinal structure which is overturned to the east.

This mine is on the upper north slope of Rock Canyon near the mountain front. It is opened by upper and lower adits, about 130 feet apart in elevation, each with drifts, crosscuts, and inclines. The mine lies in the Deseret Limestone. The mined ore was conveyed to the bottom of the canyon by a long, narrow chute, then hauled by wagon to the railroad at Provo.

The upper workings are along two fissures, one trending N. 25° E. and the other N. 20° W. The workings on the latter extend 400 feet from an intersection with the former and have furnished most of the ore shipped. The ore occurs as replacements of limestone in small bunches and pockets ranging from a few pounds to several tons in weight. Replacements are restricted to coarse textured beds that are cut by the fissures, and to places of pronounced shattering.

The primary mineralization consists of calcite, dolomite, pyrite, galena, and possibly argentite. Oxidation has been so thorough, however, that most of the primary minerals have been altered. The ore mined was principally cerussite and limonite-hematite, with some residual primary galena. The ore averaged about 9 ounces of silver to the ton, 35 per cent lead, and 36 per cent iron.

The Monarch mine property is regarded as an epithermal replacement deposit in origin. There are no intrusive igneous rocks exposed in the mining district. The mineralization is typical of lead deposits formed at considerable distances from their sources. There is little promise of further mining development in the Provo District.

## MT. NEBO DISTRICT

The Mt. Nebo district is located on the western slope of Mount Nebo, northeast of Mona, Utah, and was organized in 1870. Production from this district from 1870 to 1917 was valued at $190,760 (Butler, 1920). The total value of ore production to date has been less than $400,000. The chief metals have been lead, zinc, and silver.

The oldest rocks exposed in the Mt. Nebo district are about 1,000 feet of argillite, phyllite, quartzite, and pebble conglomerate of Algonkian age. These are overlain by Cambrian strata consisting of 950 feet of Tintic Quartzite, 180 feet of Ophir Shale, and 2,000 feet of limestone and dolomite. The overlying Mississippian section measures over 3,000 feet, and is of special interest since the principal ore deposits are associated with limestones of this age. The Pennsylvanian-Permian strata fashion the upper half of Mt. Nebo and are more than 20,000 feet thick.

The structure of the northern half of Mt. Nebo district is homoclinal, with a northeast-southwest strike, dipping 40 degrees southeast. In the southern half of the district the beds are near vertical to overturned (Johnson, 1959). The entire Mt. Nebo range has been associated with regional folding and thrusting (Eardley, 1934). Tear faults, and numerous high-angle faults of varying ages are present. The most important faulting in the Mt. Nebo district is the Wasatch fault system, which is responsible for the present topographic expression.

The only intrusive igneous rocks exposed in the area are lamprophyre dikes and sills of questionable age that cut the Mississippian strata. Extrusive igneous rocks are of two ages. A Cambrian diabase flow (Bullock and Abbott, 1951; Abbott, 1951), averaging 30 feet in this district, lies 160 feet above the base of the Tintic Quartzite. Tertiary volcanic rocks cover much of the back slopes of Mount Nebo from the head of North Canyon eastward.

The main ore deposits of the Mt. Nebo district can be geographically related to four canyon drainages along the northwestern slopes of Mt. Nebo; these are, north to south, Mendenhall, North, Pole, and Bear Canyons. The Big Nebo mine is one of the northernmost of Mt. Nebo district mines that produced ore. It lies at the mouth of Mendenhall Canyon near the base of the range. The ore occurred along a vein striking N. 25 degrees W. and dipping 60 to 80 degrees east. It cuts Cambrian Teutonic Limestone. The ore consisted of cerussite carrying some silver, and had an average value of $36.00 per ton. Only limited production came from this property.

The Santaquin Chief and Santaquin King mines occur near the head of Mendenhall Canyon (Foutz, 1960). The Santaquin Chief Mine forms a pipe-like body in Cole Canyon Dolomite at the junction of north-south and east-west fissures. It has been explored to a depth of 210 feet. Fine to coarse-grained galena formed the chief ore mineral; it had been partly altered to cerussite. A little sphalerite was reported. Quartz and massive calcite formed the gangue minerals. The Santaquin King adit, 80 feet long, lies on the slope above the Santaquin Chief. Traces of galena and cerussite were found in fissures trending to the southeast in the Gardison Limestone.

The Eva and Highland mines are situated on the north slopes of North Canyon. The Eva Mine, more recently called the Privateer Mine, lies at an elevation of 8,200. It has been the most productive metallic mine covered in this report. The main ore body was discovered in 1911. During the following one and one-half years lead, zinc, and silver ore worth nearly $100,000 was mined from a single stope. Then as quickly as it had flourished, the Eva Mine became unproductive. Mineralization is in three encrinal beds near the top of the Deseret Limestone, but only the uppermost bed has been stoped. This bed is somewhat dolomitized and is called the Eva Dolomite (Phillips, 1940). Small lenses of ore were traced down dip along an inclined shaft until the main ore body was discovered. A vertical shaft was then sunk near this ore body, which contained about 2,000 tons of ore assaying 30 per cent lead and 10 ounces of silver per ton. The ore was composed of fine to coarse-grained galena, cerussite, smithsonite, calamine, and some silver ore. Calcite and dolomite formed the gangue minerals. The ore terminated against the Eva fault. This fault trends from north-south to 25 degrees east and dips steeply west. It has a displacement of 320 feet at the mine. Hydrothermal ore solutions have followed along fault channelways. Localization of ore has been due to favorable limestone host rocks, fissuring and fracturing of limestones, and possibly some control of solutions by lamprophyre dikes and sills that cut the limestone. The property has been developed by a series of open cuts,inclined and vertical shafts, adits, drifts, and stopes. The Highland Mine lies about one-half mile north of the Eva Mine. The workings occur on a jagged spur of Deseret Limestone. The ore has been mined principally on an open cut. The ore minerals are galena and sphalerite, the gangue is calcite. Only limited production came from this property.

A small copper prospect occurs at the bottom and near the mouth of North Canyon. Traces of chalcopyrite, pyrite, azurite, and malachite are found in the Tintic Quartzite immediately above the interbedded Cambrian diabase flow. Similar copper showings are also found in higher sections of Tintic Quartzite. Copper mineralization also has been found in the carbonate rocks near Bear Canyon. No copper production has come from the Mt. Nebo district.

The Ajaxto No. 2 prospect is located on the south side of North Canyon. The claim is located over a lamprophyre dike that cuts the Deseret Limestone. Low grade mineralization of galena and possibly sphalerite occurs adjacent to the dike. Ajaxto No. 1 prospect lies on the north side of Pole Canyon southwestward over the ridge from Ajaxto No. 2. Slight mineralization cutting Deseret Limestone occurs on this property.

Mining production near the mouth of Bear Canyon has been of some importance. Metal production reached its first peak in 1907 and again during World War I. The area was abandoned in 1929; then in recent years some further development work has been done. The Eureka Leasing and Mining Company first operated claims on the south side of Bear Canyon and more recently by the Temple Mountain Uranium Company (Smith, 1956). Three properties have been developed in the Deseret Limestone. The Freddie lode is a fissure replacement in coarse-grained limestone. The ore and gangue are similar to the Eva property, although some sphalerite is present. The Syndicate tunnel is a replacement deposit along favorable bedding in the limestone. Galena and cerussite were the main ore minerals, with some silver present. The Blackett tunnel lies 200 yards northeast of the Syndicate portal. The ore follows an east-west fissure and occurs as bunches in the vein and small replacements in the limestone. Galena and silver have been the main ore minerals. The Burriston and

Spider properties occur on the north side of Bear Canyon. Similar ores were found, but production was very limited.

## SANTAQUIN DISTRICT

The Santaquin district was organized in 1871, and occupies the mountain area east of Santaquin known as Dry Mountain. From 1910 to 1917 the district produced 470 tons of galena ore, yeilding 3,499 ounces of silver, 208 pounds of copper, and 206,522 pounds of lead, whose total value was $11,639 (Butler, 1920). Since 1917 an additional 200 tons of ore have been produced from the properties near Spring Lake.

The oldest rocks exposed in this district are a Precambrian complex of granite-gneiss and schist of Archean age that are cut by occasional pegmatite and lamprophyre dikes. These are overlain by 1230 feet of argillites, phyllites, and quartzites of Proterozoic age. The overlying Cambrian strata are over 2,800 feet thick and are overlain by about 3,000 feet of Devonian and Mississippian strata that fashion the top half of Dry Mountain.

Limited copper mineralization has been prospected in the Precambrian granite-gneiss and schist complex, and in the Cambrian quartzite and shale. The Sally Ann. It has been prospected by a short adit. The wall rock is shattered mineralized fissure zone in granite gneiss. It strikes N. 15 degrees E. and is bounded by two well-defined slickensided walls about 15 feet apart. It is crossed by an east-west fault. The walls carry stringers of chalcopyrite, malachite, and cuprite. The Black Balsam vein outcrops near the crest of the spur east of the Sally Ann. It has been prospected by a short adit. The wall rock is shattered gneiss cut by a three foot lamprophyre dike. The vein lies close to the dike and trends northeast and dips about 70 degrees southeast. The vein minerals are calcite, fluorite, with some chalcopyrite, pyrite, and malachite.

The Copper Bullion prospect lies in the bottom of Magee Canyon and follows a shear zone in the granite gneiss that is parallel to the northeast dip of the foliation. Occasional malachite mineralization occurs along the shear zone. The Santaquin Central adit lies on the upper north slope of Magee Canyon. A small quartz vein follows a slickensided fissure in a shale member of the Tintic Quartzite, and contains small amounts of chalcopyrite and pyrite. Copper production has been practically nil.

Lead mineralization in the Santaquin district occurs as veins and replacements in coarse-grained limestone. The only productive mine to the year 1917 was the Union Chief Mine east of Santaquin, located in the Teutonic Limestone. The property has been developed by upper and lower workings, separated 150 feet in elevation, by adits, raises, winzes, drifts and stopes. Several steeply inclined and intersecting fissures cut the property. The ore all came from the upper workings and from small replacement pockets and fissure fillings at fault intersections. One bedded replacement in coarse-grained limestone has been stoped over an area of 20 feet square. Some silicification of the limestone has taken place. The main minerals are calcite, barite, galena, cerussite, and some silver ore.

The Blue Eagle and White Dragon prospects lie on the southern end of Dry Mountain in the black, cherty Deseret Limestone. The ore occurs as local enlargements of small northeast trending fissures, and consists of cerussite and calcite. No production has come from these properties.

The northwest end of Dry Mountain has experienced considerable prospecting and mining development since 1917. The two largest ventures have been the Nelson and Syndicate mines. The Nelson prospect lies about one-half mile east of Spring Lake near the mouth of Picayune Canyon. It has produced about 60 tons (DeMars, 1956) of galena and pyrite ore with traces of silver and gold. The adit has been cut in the Cambrian Teutonic Limestone. Limonite gossan occurs on the ridge above the Nelson Mine. The Syndicate Mine lies one and one-half miles south of Spring Lake, about midway up Yellow Rock Canyon. Over 5,000 feet of underground development work has been accomplished. Ore minerals include galena, secondary lead and zinc, and some silver. Limonite and barite form the gangue minerals. Seventy tons of high grade ore have come from the Teutonic Limestone. Although prospects and mines are numerous in this area, the total production to date is less than 200 tons of ore.

## THE DREAM MINE

*The Relief Mine,* better known as *The Dream Mine,* is an integral part of the history and development of mining activities in central Utah. This mining venture was instituted by John H. Koyle of Spanish Fork. He was founder and president of The Koyle Mining Company which promoted and operated this property from 1894 to 1949.

John H. Koyle had a remarkable facility of foretelling events from dreams. On one occasion in August, 1894, he dreamed of an ancient mine in the mountain east of Salem. He dreamed that he was guided by a heavenly messenger on an adventure into the stony mass of the mountain itself. They followed a cream-colored leader down through the mountain. This marked the line of procedure he was to follow in the mine. This led down more than 1000 feet to a very hard capstone, beneath which was a large body of rich, white quartz containing leaf gold. Then continuing on from this capstone some 175 feet down through this chimney of ore, they came into a vast body of ore containing nine large caverns that had been excavated ages ago by a vanished civilization. The rooms contained many relics of their civilization in the form of implements, ornaments, artifacts, records, and other treasures of gold. These treasures had been sealed up for two millenniums by a caved-in tunnel that his guide conducted him through to Water Canyon on the south.

Koyle was to open this mine, not by way of this old tunnel, but down through the mountain according to directions given him. Additional valuable ore deposits were to be reached; and certain ideal social conditions were to be achieved before the mine was to become productive. Koyle visualized that the big, rich deposits of ore he had seen would not be reached and released to him until a time of great world crisis. At this time the people would sorely be in need of relief; hence it was to be named *The Relief Mine.*

A few days later on September 3, 1894, Koyle and his trusted friend, Joseph Brockbank, set off to the designated spot. When they had climbed about one hour Koyle asked his friend if he could see anything unusual in the area just ahead of them. Brockbank replied that he could see a spot of ground with what seemed to be a halo of light over it. Koyle then told his friend to walk to the exast spot. Brockbank walked over and struck his pick into the ground in the center of the lighted spot, and it loosened some black rocks on the surface.

"There," said John. "We'll dig on that spot, and if we do not find a cream-colored formation within three feet of the surface then there is nothing to my dream" (Pierce, 1958).

They dug, and at eighteen inches a cream-colored formation was found. They were convinced. On September 7th Koyle and five friends staked seven claims. On September 17, 1894, they came back with equipment to mine, and started three shifts going around the clock, two men to the shift. Then followed long years of arduous toil as the mining shaft gradually sank.

In 1909 the property became incorporated as a stock company under the name of *The Koyle Mining Company.* Eventually, ninety claims were deeded to this company. Stock was sold to finance the project and to pay the miners, although most miners were willing to work for stock alone. Stock sold for $1.50 a share; and has sold for as much as $10.00 a share during a platinum excitement of 1929. Koyle imbued his followers with the idea that when the mine became productive stock values would increase a thousand-fold in value. Each family was encouraged to purchase at least 100 shares in the mine. There are more than 6,000 stockholders today.

In twenty years the shaft was sunk 1,400 feet using jack hammers, hand drills, and powder. Muck was raised to the surface by a series of eleven hand-operated windlasses. On January 14, 1914, a tunnel (adit) was begun at the base of the mountain just below the levelof the shaft bottom. The mine, however, was closed down in June, 1914, and did not reopen again until September, 1920. By 1949, at the time of Koyle's death, the tunnel had been excavated in a straight line for a distance of 3,400 feet, and includes a 285 winze and a side drift. In 1932 an impressive reinforced concrete mill was built near the tunnel portal. An electric power line linked the mill with the Spanish Fork power plant. Some milling equipment was installed.

Koyle was a member of the Mormon faith (The Church of Jesus Christ of Latter-day Saints), and rose to the rank of bishop of the Leland Ward. He and his devoted followers used Church influences to promote the Dream Mine, which led to the mine shut-down from 1914 to 1920, and ultimately to his excommunication. The pattern used to promote the Dream Mine has been one fashioned after real or imaginative dreams and distorted historical facts, flavored with scriptures and doctrinal concepts. Weekly Thursday night meetings were held at Koyle's home. Fund raising, until recently, has been limited primarily to members of the Mormon faith.

*The Dream Mine* venture has been a million-dollar or more extravaganza. Promoters and loyal supporters and their families have devoted their own substance and time to the venture; Koyle himself died a poor man after spending his life chasing his dream. Some of Koyle's close associates have promoted other mining schemes in the State, each following a dream-mining pattern. The Dream Mine saga, however, has not ended. Apostate groups from the Mormon faith are now currently promoting the mine, and stocks are available to the curious.

*The Dream Mine* is located on the west side of Loafer Ridge between Flat Canyon on the north and Water Canyon on the south. It lies about two miles east of Salem.

Only sedimentary rocks occur in the immediate area of the Dream Mine property. Approximately 7,000 feet (Rawson, 1957) of Oquirrh Formation, Pennsylvanian and Permian in age, are exposed. The strata strike nearly north-south and dip 25 to 35 degrees to the east. These east-dipping strata form the

Wasatch front, and also form the west flank of a large syncline. The Wasatch Fault fashions the Western front, and is composite. This is shown by two down-faulted blocks of Pennsylvanian-Permian strata north of Flat Canyon, and a large down-faulted block of Oquirrh Formation south of the Dream Mine, each representing two or more thousand feet of displacement.

The lithology of the Oquirrh Formation characteristically alternates between limestone and quartzite, with a few shale beds. The limestones are light blue-gray to dark-gray and are fine-grained and crystalline in texture. In the upper part of the formation the limestones are sandy and have a quartzite appearance on a weathered surface. The quartzite beds become thicker and are predominant in the upper 3,000 feet. The quartzites are gray-brown to buff, fine-grained, and well cemented. They are typical orthoquartzites.

About 5,000 feet of drifting and shaft development work has been accomplished on the Dream Mine properties in the Oquirrh formation. Fabulous reports have been circulated about the metal content of the mine, including rumored platinum. A careful examination of this property has shown no metallic minerals, and even ubiquitous pyrite is scarce. Petrographic and chemical analysis of ore samples and mill concentrates indicate only minerals common to limestone and quartzite.

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