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Geology and Mineral Resources

of Elko County, Nevada

(Prepared cooperatively by the United States Geological Survey)

Part II

Mineral Resources

by

Roscoe M. Smith



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# ELKO COUNTY GENERAL ITEM 93

Geology and Mineral Resources

of Elko County, Nevada

(Prepared cooperatively by the United States Geological Survey)

Part II

Mineral Resources

by

Roscoe M. Smith

# ORIGINAL

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Geology and Mineral Resources

of Elko County, Nevada

(Prepared cooperatively by the United States Geological Survey)

Part II
Mineral Deposits

By Roscoe M. Smith
Abstract

Of the 66 named mining districts in Elko County, 56 have been productive of one or more of 19 different commodities: 11 metals--copper, gold, silver, lead, zinc, mercury, tungsten, manganese, iron, uranium, and antimony; 8 nonmetals--sand and gravel, stone, barite, diatomite, gems, oil shale, volcanic ash, and clay. In addition to the commodities produced, at least 5 others--beryllium, molybdenum, tin, phosphorite, and petroleum, occur in amounts sufficient to warrant exploration. The other 10 districts have been explored but no production has been recorded.

Total value-when-sold of production recorded through 1969 was nearly \$91 million; actual production was considerably greater, especially if sand and gravel, barite, and other nonmetallic products before 1953 are included. In value of metals produced, the five highest districts are Mountain City (\$26 million), Tuscarora (\$11 million), Jarbidge (\$10 million), Aura (\$6 million), and Railroad (nearly \$5 million). The Rio Tinto copper mine in the Mountain City district yielded \$21 million. Of the 17 districts that produced nonmetallic minerals, Bootstrap is the largest producer, containing the Rossi mine, one of the two largest barite mines in the United States.

Most of the metals produced came from veins and replacement deposits in limestone or dolomite near granitic stocks; exceptions are manganese and mercury, which are not associated with known or inferred stocks; mercury is further excepted because it occurs in volcanic rocks, as do a few deposits of the major metals. The largest deposit—the Rio Tinto lode—was a combination of fissure filling and replacement along a bedding—plane shear zone 150 feet wide and 1,200 feet long in carbonaceous shale of the Valmy Formation; this deposit is apparently older than the Mountain City stock and its mineralization may be related to Paleozoic mafic volcanism later than a major fault, inferred to underlie the area at a depth of about 5,000 feet.

Most of the nonmetallic minerals mined were sedimentary bedded deposits, but mica was mined from pegmatite deposits, and turquoise from both placer and hydrothermal deposits.

The largest known reserves of metals (1973) are of porphyry copper in the Dolly Varden district, and gold in the Bootstrap district. Reserves of barite also are presumed to be large.

The greatest potential for future production of metals, notably copper and gold, appears to be in the known districts or extensions of them and peripheral to deposits that are related to known or concealed plutons and thrust faults. Potential resources in deposits too low in grade to be worked profitably at the present time include all commodities that have been produced and, in addition, known deposits of beryllium, molybdenum, tin, and phosphorite. Speculative resources in undiscovered deposits may reasonably be predicted to include all known commodities as well as others that are unsuspected. Petroleum may yet be produced from the Elko Formation, and geothermal energy from the Ruby Valley and Elko areas.

#### Introduction

Mineral deposits in Elko County were described in Nevada Bureau of
Mines Bulletin 54 (Granger and others, 1957), which included descriptions
of individual mines in the principal mining districts. As this earlier
bulletin is available in most university and large public libraries, mine
descriptions are omitted here except for the Rio Tinto mine in the Mountain
City district, for which supplementary data are now available.

The purpose of this report is to provide an inventory of all mining districts in the county and, for each district, to indicate its currently known extent, to list the names of all mines for which production is recorded, and to summarize the geologic setting as it relates to ore controls. The inventory includes several small and old districts not included in former lists.

Acknowledgments

I am indebted to the authors of Part I of this bulletin for their frequent and information on the geology of most of the mining districts consultations, and to the many authors whose names appear in the list of references for the publications from which much of this report was compiled.

The earliest published reports on mining in Elko County, other than articles in newspapers and trade magazines, are those of the Nevada State Mineralogist, which cover only the years 1866 through 1878 (the area was a part of Lander County before March 5, 1869). Those reports were combined and condensed by Myron Angel, and the summaries included in History of the State of Nevada, published by Thompson and West (1881, reproduced by Howell-North Press in 1958). Of many subsequent reports, one by Emmons (1910) and one by Hill (1916), together with annual volumes of the Mineral Resources (U.S. Geol. Survey) and Minerals Yearbook (U.S. Bur. Mines), are the main sources of compilations by Lincoln (1923) and Granger and others (1957).



#### Insert A

Members of the staff of Nevada Bureau of Mines and Geology reviewed the manuscript; their many helpful suggestions are gratefully acknowledged.

(on P.3)

composition, occur in the Vet area near the east edge of the Gregg Canyon quartz monzonite, and each is associated with brecciation or a breccia pipe. One of the plugs cuts the quartz monzonite, and so is later, and another cuts a fault thought to be a spur from a range-front fault; so it could be quite young – say late Tertiary. A similar light gray dike and a possible plug occur on the contact of the Preble and the Valmy in the center of Map No. 1, and related dikes follow fracture zones also occupied by narrow veins in the same area. These intrusives might be genetically related to the mid-Tertiary latite porphyry sequence described below, but they are deeper eroded and hence are thought to be older.

A swarm of quartz latite plugs and stubby dikes punctuate the Granite Canyon sector and they seem especially abundant in the most altered phases of the quartz monzonite and the breccia. This might be because of the softness of the rock in these areas, but on the other hand, the dikes and plugs themselves may have effected some of the alteration, particularly argillization. The rock consists of a gray glassy matrix which weathers brown, crowded with crystals of orthoclase and plagioclase, some of which are embayed and sausseritized. The crystals are as much as 1 or 2 inches long in the center of masses, but they are progressively smaller toward borders. A 2- to 4-foot zone of black glass is common on the walls.

These quartz latite intrusives were the feeders for the massive cliffs of porphyritic rock that crop out and obscure the earlier rocks in the area north of the Adelaide breccia pipe, and one can actually follow several of the dikes upward through pre-Tertiary rock and observe where it broke out into domes or flows. These "flows" however were probably sill-like intrusives into a formation of volcanic ash beds and gravels which covered much of the surface at the time of the extrusion, and tuff beds can be found both below and above the quartz latite which have chilled borders of black glass on both upper and lower walls. Gilluly (1967) called these "flows" welded ash flow tuffs and gave a radiometric age of 15.3 ± .8 m.y., which corresponds to Silberman and McKee's youngest intrusive epoch (Roberts, et al., 1971).

The thickness of the quartz latite and associated ash beds and gravels was reported by Gilluly (1967) to be on the order of several thousand feet, but I can account for only 1,200 to 1,500 ft. in the Adelaide area. I think they may be only 500 to 700 ft. thick in the area just north of the breccia pipe.

The youngest igneous rock in the Adelaide area is a basalt flow probably of Pleistocene age. This occupies part of Rock Creek Valley a few miles north, but it might be represented at Adelaide by two narrow outcrops of scoriaceous basalt a half a mile and a mile south of the Adelaide mine. They are probably connected under alluvium, but I cannot determine whether they are a dike or a narrow gully-fill. A steep angle basalt dike was intersected at 1,100 ft. in hole AD-2.

#### Mining districts

Mining districts, as they were first established, were not restricted by boundary lines, since the full areal extent of mineralization is rarely known. In this report, as a convenience to the reader, they are delineated by townships and sections: the arbitrary boundaries of the 66 districts shown on figure 1 and plate 2 approximate the extent of mineralization as it is now known.

Most mining districts have been known by different names at different times. The various names found in the literature and in production records are indexed in table 1; names currently in use are those in bold-faced type.

#### Commodities

Natural resources of Elko County include 32 mineral commodities as well as large amounts of sand and gravel, substantial water resources, and potential resources of petroleum and geothermal energy. Of the 32 mineral commodities, 19 have been produced commercially. Small or low-grade deposits of the 13 others have been discovered, 5 of them (beryllium, molybdenum, tin, phosphorite, petroleum) in amounts large enough to warrant exploration.

Sand and gravel deposits are not inventoried in this report. They are plentiful throughout the county but most of them are outside the mining districts.

Water is defined as a mineral, but water resources are not included in this report because estimates are not available for many of the valleys.

Petroleum, although not a mineral, is part of what is often called the Mineral Kingdom, so a summary is included herein. Exploratory oil wells drilled before 1974 are listed in table 2; they are shown on figure 2 and plate 2.

Geothermal energy is not a mineral, but its source is mineral and its use is dependent upon water. Geothermal resources have not been fully evaluated, but one Known Geothermal Resource Area (KGRA) has been designated in Elko County (see Elko district), and 10 areas have been classified as prospectively valuable (fig. 3). Sulfur Hot Springs (sec. 11, T. 31 N., R. 59 E.) has an estimated subsurface temperature of as much as 191°C and may be a source of geothermal power. None of the areas had been drilled as of January 1974 (Garside, 1974), but subsurface temperatures, estimated by four different methods from the chemical composition of the water (table 3) were reported (Hose and Taylor, 1974).

Distribution of the 32 commodities by district is shown in table 4.

France 3, tople 3, table 1, 218

#### Production

Of the 66 named mining districts in Elko County, 56 districts (table 5) have yielded nearly all of the recorded production. No production has been reported from the other 10 districts explored, but a small production has come from isolated deposits outside the named districts and is included with "Undistributed." Also included in "Undistributed" is unidentified production from the Ruby Mountains (see Ruby Mountain Range district).

From the time of the first discovery of coal in the Carlin district in 1859 through 1969 (table 6), the total value-when-sold of the 19 commodities produced was more than \$90 million. The largest annual production was in 1937 most of it from the Rio Tinto copper mine in the Mountain City district. This one mine accounts for 28 percent of the total metal production of the county. Largest production of a nonmetallic mineral, excluding sand, gravel, and water, has been of barite, mostly from the Rossi mine in the Bootstrap district.

Figures 1, 2, and 3 near here

TABLES 1 THROUGH 6 NEAR HERE

The source of both the tin and the lead-silver mineralizing solutions is considered by Slack (1972, p. 138) to be the Early Pliocene(?) rhyolite porphyry "intrusives(?)" exposed in the area of Granite and Mill Creeks. He rejected the possibility of a zonal relationship of the lead-silver deposits to the Indian Springs stock. A third possible source could be a concealed intrusive near the lead-silver deposits.

Delker

District

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
W½	29	62	Elko 2°	Delkar district

The Delker district covers all of West Buttes (Delker Hill), an isolated north-trending ridge 7 miles long which is 3 miles east of Delcer Buttes and rises about 1,600 feet above Dry Lake Flat east of Franklin Lake. Both buttes were called Franklin Buttes by geologists of the Fortieth Parallel Survey, and both were later known as Delker Buttes (Hill, 1916, p. 66).

Copper ores were first discovered about 1894 near the north end of Delker Hill, and a little prospecting was done annually thereafter. The only production records are for 1916 and 1917 when 791 tons containing 94,434 lb of copper was shipped from the Delker (Copper Belt, Delkar) mine.

#### Geologic Setting and Ore Deposits

Limestones and interbedded quartzites of the Permian Park City group are intruded by quartz monzonite which is porphyritic in many places and which forms the main bulk of West Buttes and Delcer Buttes. The exposed limestones are diversely metamorphosed; lime silicate zones are developed along parts of the contacts with the intrusive rocks.

The ore bodies that have been mined and prospected are contact metamorphic copper deposits. Chrysocolla, malachite, azurite, and minor chalcocite occur with lime silicate minerals and jasperoid near the contacts and also in a few veinlike deposits along fractures in the intrusive (Hill, 1916, p. 67). Average grade of the ore shipped was 6.2 percent copper.

Divide District

## Location and History

Sections (Approx.)	Twp. Rge. N. E.	Quadrangle name (7½ or 15 minute)	Other district names
N <sup>1</sup> / <sub>2</sub>	40 50	Mt. Blitzen	

The Divide district covers the drainage divide of the Tuscarora Mountains for about 4 miles northwest of McCann Creek Mountain. The Divide mine, the only mine in the district, is on the east slope near the summit of the range 8 miles airline northwest of the town of Tuscarora. A small production of silver-gold ore was reported for 1918. Subsequent production in 1929 was recorded for a Divide mine in the Rock Creek district, but in this report it is credited to the Divide district. Total value for both years is less than \$5,000.

Average grade of the total production was about 0.46 oz gold and 291 oz

Dolly Varden <u>District</u>

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
S-1/3	30	66	Elko 2°	
E-1/3	29	65	Elko 2°	
A11	29	66	Elko 2°	Mizpah
30,31,32	29	67	Elko 2°	Dolly Varden
E-1/3	28	65	Elko 2°	
A11	28	66	Elko 2°	Granite, Granite Mountain
W-1/2	28	67	Elko 2°	Dolly Varden

The district covers all of the Dolly Varden Mountains, about 14 miles long from north to south and 11 miles wide, including many small outcrops of intrusive rock in the lower foothills on the east side. Land Office records are listed under Granite Mountain district.

Silver-lead ores were discovered near Dolly Varden (Hicks, Last Chance)

Spring in the southeastern part of the district in 1869 (Hill, 1916, p. 80),

copper ore at the Victoria mine in 1872, and gold-bearing veins near Mizpah

Spring in 1905. Intermittent production was reported during the 1870's,

1908-45, and in 1956, most of which came from the Victoria mine during

1941-45. No production was reported for the years 1957 through 1969.

During 1973, the Victoria mine was being developed by The Anaconda Company as an open pit. A concentrator to treat 1,000 tons of copper-gold-silver-bismuth ore per day was scheduled for completion in 1975. Concentrates will be shipped to Anaconda, Montana, where a hydrometallurgical plant will treat the high-bismuth ores by the Arbiter process.

#### Geologic Setting and Ore Deposits

Limestones and limy and cherty shales of the Pequop Formation overlain by two small erosion remnants of limestone of the Park City Group, all of Permian age, are intruded by a stock about 4 miles across of quartz monzonite and by dikes as much as half-a-mile wide and 2 miles long of quartz monzonite, aplite, and diorite. Southeast of the stock in the southeast foothills small outcrops of quartz monzonite indicate a second stock mostly covered by Tertiary volcanics and alluvium. Near the main stock the limestones are metamorphosed to skarn and the shales to argillite.

The sedimentary and intrusive rocks are tilted gently to moderately eastward and displaced along two north-trending thrust faults and along many steep normal faults which strike generally northward or eastward.

Of the three types of ore bodies mined--copper ores in contact metamorphic rocks, lead-silver replacement and fissure deposits in limestone, and gold-bearing quartz veins in quartz monzonite--the copper deposits at the Victoria mine were the largest (table 17).

TABLE 17 NEAR HERE

Table 17. -- Dolly Varden mining istrict, mines through 1969

[. main product; o, by-product; x, occurrence]

	Le, marii produ	product; o, ny-product; x,	Dr.oanc	L, X,	3	1	occurrence	7			1	
Index no.	Mine or prospect	Location (MDBM)	n (MDB	( W	3010		Co	Commodity	ity			
on Plate .2	(A mine may have several names; production is cumulative)	Sec.	T. N.	교	Go1d	Silver	соррет	Lead	Sinc	Thorium	Bismuth	Total value when sold (in thousands of dollars)
	Anchor						×					
	Atlas						×					
	Belleview					0	•					<b>^</b> 2
	Bi-Metallic						×					
	Butte group						×					
8	Dolly Varden (D. V. Queen)	14	28	99	0	0	0		0			<5
	Eugenia (Eugene)	#	28	99			×					Small
	First Chance						×					
	Franklin (Iron Duke)						×					
	Garnet group				0	0						<b>\</b>
	Hidden Treasure											Sma11
	Iron Duke (Franklin)						×					
	Keystone	12,13	28	99		0						Sma11
	Lewis						×					
1	Mizpah Consolidated	18,19	29	99	×		×					
	Mud Springs (see Mud Springs dist.											
	Red Hill prospect						×					
	Tenderfoot	18	29	99			×					
2	Victoria	2	28	99	0	0		0			×	5-100
	White Horse						×					
	Lead-silver oxidized ores		28	99		100			×			
-	Southam group		29	99		EI C		- 6		×		
							À				The same	

All the copper deposits are near the main stock but their size and shape were not reported. Chrysocolla, malachite, a little chalcocite, and residual chalcopyrite and bornite occur in a gangue of jasperoid, quartz, garnet, biotite, tremolite, actinolite, epidote, calcite, much limonite, and a little pyrite.

Average grade of the ore shipped was about 6 percent copper. The outcrop area of highly altered quartz monzonite resembling a leached porphyry copper reported by Hill (1916, p. 82, 87) may be the Red Hill prospect (table 17). The Victoria copper deposit to be mined by Anaconda is reported (Nevada Mining Assoc. NewsLetter, July 15, 1973) to contain 3.5 million tons averaging 2.45 percent copper.

Lead-silver deposits are localized along north-striking fractures in the limestone and in irregular replacements along the bedding adjacent to the fractures. Argentiferous cerussite, anglesite, a little wulfenite, and residual kernels of galena occur with limonite and residual pyrite.

Gold occurs with chalcopyrite, pyrite, bornite, bismuthinite, and their oxidation products, in quartz veins a few inches to 2 feet wide along steep northward-trending fractures in the quartz monzonite east of Mizpah Spring.

Thorium and a little uranium occur with iron oxides, and in at least one place with chrysocolla, along fractures in pegmatite, in rhyolite, in quartz monzonite, and in the contact metamorphic zone of the main stock. A sample contained the following percentages: thorium 5.95, eU<sub>3</sub>0<sub>8</sub> 1.5, cU<sub>3</sub>0<sub>8</sub> 0.128, rare earth oxides 0.35 (Davis, 1954, p. 17).

Edgemont District

#### Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
W½	44	52	Bull Run	Centennial, White Rock
NW <del>1</del>	43	52	Bull Run	Bull Run, Centennial

The district covers the west slope of the Bull Rum (Centennial) Mountains north of Bull Rum reservoir. Its east boundary is approximated by a north-south line through the summit of Porter Peak. Site of the early town of White Rock is in the northwest corner of the district, and Edgemont is near the west center. Land Office records are listed under "Centennial (Bull Rum) district."

Production through 1949 was reported in Granger and others (1957, p. 53).

Since 1949, the Echo Canyon, Edgemont, Burns, and
Burns tungsten mines were operated on a small scale (table 18 ). No production

TABLE 18 NEAR HERE

was reported for the years 1965-69.

Table 18.--Edgemont mining district, mines through 1969
[•, main product; o, by-product; x, occurrence]

Index no.	Mine or prospect	Location	Location (MDBM)	M)			3	MIMO	Commodity		1	E
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	T. N.	E. R.	Сода	Silver	Copper	Lead	Sinc	Tungsten	muinsau	iotal Value when sold (in thousands of dollars)
	Arrowhead (see Aura dist.)											
	Astor					0						<5
	Big Bob	30	#	52								
	Big Four (Lucky Girl)				0	•	0	0				5-100
	Blue Jacket (see Aura dist.)											
	Bull Run	4,5	43	52	•	0						>100
	Burns	5,20,	#	52	0	0			0			<5
*	Eagle Rock (see Aura dist.)	67,07										
	Echo Canyon (Elko Canyon				•	0	0		0			2-100
	Edgemont (Lucky Girl)	31	#	52	•	0	0	0				<5
1	Gold Dollar (Aura dist.?)				•	0						\$
	Little John				•	0						<b>&lt;</b> 5
	Lucky Boy (see Lucky Girl)	0										
	Lucky Girl group	31,32	#	52	•	0	0	0				>100
	Montana Lucky Girl				•	0						<5
	Nevada	20	##	52								
	Paddison				•	0		0				<b>\$</b>

Table 18. -- Edgemont mining district, mines through 1969--Continued

THE WORLD	Mine or prospect	Location (MUBM)	MDBM)			Commodity	dity		Total value
on Plate 2	Ll names; ttive)	Sec. N	T. R.	Gold	Silver	Copper	Sinc	Antimony Tungsten Uranium	when sold (in thousands of dollars)
	Red Cloud				0	•			<5 <5
	Richelieu			•	0				<b>^</b> 2
	White Rock				0	0	•		5-100
	White Rock G.M. Co. placer (Aura dist.)	dist.)							
	Blue Ribbon (Ried)	c							
2	Birms (Blacket)								<b>&lt;</b> 5
	Unnamed prospects	07	70					•	S 0

#### Geologic Setting and Ore Deposits

Prospect Mountain Quartzite more than 4,200 feet thick in the southern part of the district is overlain to the north by Cambrian through Post-Devonian slates, phyllites, and limestones more than 18,000 feet thick, which crop out along the north limb of the Bull Rum Basin anticline. These overlying rocks are intruded by the White Rock diorite stock about 6,000 feet across and to its east by five smaller stocks most of which are in the adjoining Aura district. The intrusives are estimated (Decker, 1962, p. 42) to be Cretaceous in age. Along their contacts the limestones are metamorphosed to tactite, the shales to hornfels.

The sedimentary rocks and the stocks are cut by steep normal faults of a few feet to perhaps 2,000 feet displacement that strike north to northeast. Some of these faults are premineral in age, others postmineral. A steep normal Basin-Range fault, the Owyhee fault of Miocene or later age, borders the west edge of the Bull Run Mountains.

The ore bodies are gold-bearing quartz veins along north- and northeast-trending faults in Prospect Mountain Quartzite, zinc-bearing veins in the White Rock stock, and tungsten-bearing tactite near one of the smaller stocks. Radioactive anomalies of two or three times background were prospected along the southwest border of the White Rock stock, and along a fault between Prospect Mountain Quartzite and Cambrian limestone near the border, but no radioactive minerals were identified.

The largest ore bodies mined were in quartz veins in the quartzite.

The Bull Run, Lucky Boy, Lucky Girl, and Big Bob quartz veins were developed by about 6 miles of workings for as much as 3,200 feet along the strike and 900 feet down the dip; they ranged from a few inches to about 7 feet in thickness. The veins are offset in several places as much as 60 feet by post-mineral normal faults (Emmons, 1910, p. 75-80).

Gold, the main ore mineral, and silver occur with pyrite, galena, arsenopyrite, and rarely chalcopyrite or their oxidation products in ribboned quartz. Near the veins the quartzite wall rock contains a little sericite. Grade of the ores averaged about 0.25 oz gold per ton, but one 7-ton shipment contained 74 oz.ces.

Elk Mountain

District

#### Location and History

Sections (Approx.)	A PENNSON MARKET	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
5 //2	47	61	Elk Manstalo	
N 72	246	61	21	SVV and of Elk Mauntains
			STANCE OF SEVER	Line to the State of the State
S1/2	47	61	Elk Mountain	
N <sup>1</sup> / <sub>2</sub>	46	61	Elk Mountain	SW. end of Elk Mountains

According to Schrader (1912, p. 154), copper minerals were found in the district at least as early as 1890. At the time of his visit in 1910, all the prospects listed in table 19 were known. Since then, little work has

TABLE 19 NEAR HERE

been done, and no production is recorded for the district through 1969.

Table 19.--Elk Mountain mining district, mines through 1969
[x, occurrence (no production)]

Total value	when sold (in thousands of dollars)	0	0	0	0	0	0
Commodity	Gold Silver Copper Lead Antimony Molybdenum Tungsten	×	×	× × ×	×	× × ×	×
Location (MDBM)	Sec. N. E.	19 94	3,4 46 61	19 94 4	19 94	19 94 4	0,10 46 61
Mine or prospect	(A mine may have several names; production is cumulative)	Austeon	Estes	Gold prospect	O'Neil	Red Elephant	Robinette (June, Pyramid)
Index no.	on Plate 2	1	က	2		1	#

#### Geologic Setting and Ore Deposits

Quartzites overlain(?) by shales and limestones all of Cambrian age have been domed and intruded by a stock of granodiorite of Cretaceous(?) age about 2 miles in diameter. Near their contacts with the granodiorite the limestones are locally metamorphosed to tactite. The sedimentary rocks, the tactite, and the granodiorite are cut by mineralized veins and veinlets of quartz or calcite. This entire assemblage is partly covered by older and younger rhyolite flows and tuffs(?) of Tertiary age all of which has been subsequently cut by faults that strike northeast and offset by later faults that strike northwest. Most of the stock is exposed by erosion.

The ore bodies are veins along faults in the granodiorite, limestone, and quartzite, and contact metamorphic deposits in tactite. Quartz veins as much as 6 feet wide contain pyrite, iron oxide, oxide copper minerals, native copper, stibnite, argentite, and gold. Assays of 3 percent copper and 0.35 oz gold per ton have been reported.

The largest tactite body is 1,500 feet long and at least 50 feet wide. Contact metamorphic mineral deposits as much as 14½ feet wide contain malachite, azurite, chrysocolla, chalcopyrite, bornite, and a little molybdenite, scheelite, gold, and silver in a gangue of silicated or garnetized limestone, or in quartz veinlets in the tactite. Assays as high as 16 percent copper were reported (Schrader, 1912, p. 156). At the Robinette prospect (pl. 2), particles of scheelite and molybdenite are scattered throughout the tactite, but only small portions contain as much as 0.25 percent WO<sub>3</sub> and 0.2 percent MoS<sub>2</sub>(D. M. Lemmon, written commun., 1948).

Elko District

# Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
A11	34	54	Hunter, Elko West	Phosphorite, oil shale
A11	34	55	Elko West, Elko East	Oil shale, stone
W1/2	34	56	Elko East	Oil shale

The Elko district includes the south ends of the Adobe Range and of the Elko Hills (Elko Mountains, pl.  $^2$  ).

Oil shale and interbedded lignite were discovered in the Elko Hills about 1870 and were explored by the Central Pacific Railroad Co., Southern Pacific Co., and others until about 1920. The oil shales were developed through inclined shafts and several thousand feet of drifts. Several types of distillation plants were tried during the years 1914 to 1920. Shale oil valued at \$1,920 was produced during 1917 and 1918, and about 15,000 gallons was produced in an experimental plant in 1919 (Buwalda, 1923, p. 101). Lignite was prospected in numerous pits and shafts in hope of obtaining good fuel for locomotive and domestic use but without success.

Conglomerate was quarried in the Elko Hills 2-1/2 miles south of Elko from the Diamond Peak Formation for use as building stone prior to 1923 (Winchester, 1923, p. 93).

A copper prospect about 5 miles north of Elko was explored by trenching during 1957.

Phosphorite deposits were noted (Ketner, 1970, p. B108) in the southern Adobe Range.

The oldest rock formation exposed in the Elko district is the Diamond Formation comprising Peak sandstone, conglomerate, and shale of Mississippian age, which crops out in the Elko Hills and in the southern Adobe Range.

In the Elko Hills the Diamond Peak Formation is overlain unconformably by the predominantly shalyElko Formation of Eocene-Oligocene age which covers an area of about 30 square miles southeast of the Humboldt River.

Small patches of rhyolite tuff and andesite tuff of the Indian Wells

Formation of Oligocene age overlie the shales (Smith and Ketner, 1975) in press).

Northwest of the river in the vicinity of Elko the shales crop out in a few places, but part of the formation is covered by rhyolite. The shale beds range in thickness from a few feet to a few tens of feet and are interbedded with sandstone strata as much as 30 feet thick, conglomerates up to 25 feet thick, numerous limestone beds less than 8 feet, rhyolite tuffs and sills(?) generally less than 2 feet, and several lignite beds a few inches thick.

The Elko Formation is tilted gently to steeply eastward, averaging about 30°, and is cut by two sets of normal faults, one that strikes about north and another that strikes northeast. Displacements along most of the faults could not be determined, but the shale beds are offset several hundred feet in some places.

Oil shale occurs in numerous beds throughout the Elko Formation.

A bed in the upper part of the formation (Burner Basin) is 6-10 feet thick but of low oil content (13 gal/ton). The best occurrences are in the lower part of the formation where five stratigraphic zones a few feet to about 60 feet thick each contain several beds of oil shale. These zones, labeled (Buwalda, 1923, pl. 14) from oldest to youngest A through F, strike northward and dip about 30° eastward in an area about 2 miles square. The greatest thickness of good oil shale in a single bed is a little more than 6 feet. Two beds of that thickness were mined, one in zone A at the Catlin incline and the other in zone C at the Norton incline. Other beds of rich oil shale are from 1 to 3 feet thick and are separated by barren shale too thick to warrant mining two or more of them together.

Oil content of the shale beds is as high as 86.8 gallons or more per short ton, but shale yielding over 70 gallons per ton commonly occurs in beds less than a foot thick. The shale that was mined contained about 50 to 70 gallons per ton. The ultimate reserves of the region were estimated (Buwalda, 1923, p. 97) to be about 7,219,000 tons of shale that will yield more than 15 gallons per ton of paraffin-base oil having a specific gravity of about 28°-36° Baumé.

Lignite beds not more than a few inches thick occur at several horizons in the Elko Formation. The lignite is light brown, and has the appearance of slightly compressed plant remains. It is markedly laminated and can be crushed in the hands.

In the southern Adobe Range the Diamond Peak Formation is overlain by limestone, sandy limestone, and conglomerate about 1,200 feet thick of Pennsylvanian-Permian age (Strathearn formation of Dott, 1955) which in turn is overlain by siltstone, limestone, chert, shale, and conglomerate of Permian age. Nearly all beds in the upper half of the Permian sequence contain phosphorite, which resembles that of the Phosphoria Formation. The richest beds do not crop out but are indicated by loose pieces scattered on the surface. Selected samples contained as much as 13 percent P<sub>2</sub>O<sub>5</sub> (Ketner, 1970). The general geology of phosphorite deposits is described under Pequop phosphate area.

The only Known Geothermal Resource Area (KGRA) in Elko County as of October 1974 is Elko Hot Springs. An area of about 8,960 acres includes secs. 14-17, 20-23, 26-29, 33 and 34, T. 34 N., R. 55 E., and is so classified by the U.S. Geological Survey in accordance with the Geothermal Steam Act of 1970. Nine other areas in the county are classified as having prospective value for geothermal resources (fig. 3).

Elko Hot Springs has been used for bathing. Surface temperatures range from 150° to 192°F (66°-89°C). Subsurface temperatures can be determined only by drilling, but estimates can be made from the chemical composition of the water. Estimates by four different methods (table 3) range from 113° to 380°C (Hose and Taylor, 1974).

Table 20. -- Elko mining district, mines through 1969

[Blank spaces, figures unavailable; •, main product; x, occurrence]

Index no.	Mine or prospect Location (MDBM)	Commodity	Total value
on Plate 2	(A mine may have several names; T. R. production is cumulative) Sec. N. E.	Copper Coal Stone Stone energy	when sold 1/ (in thousands of dollars)
	Basalt quarry	•	
1 - 2	Catlin and Norton inclines 27 and 34 55	•	>2
	Coal Canyon (see Coal Mine dist.)		
8	Conglomerate quarry 34 34 55	•	
	Humboldt Coal Co. (see Carlin dist.)		
	Lignite prospect SW. of Elko	×	0
	Ogilvie prospect	×	0
	Oil shale prospect NW% 2 34 54	×	0
	Pilot quarry (limestone) (see Pilot Peak dist.)		
	Elko Hot Springs 21 34 55		

<sup>1/</sup> Includes published figure, where the ever

#### Location and History

Twp.	Rge.	Quadrangle name	Other district names
28	69	Elko 2º	
28	70	Elko 2°	
27	69	Elko 2°	
27	70	Elko 2°	
	N. 28 28 27	N. E.  28 69 28 70 27 69	N. E.  28 69 Elko 2°  28 70 Elko 2°  27 69 Elko 2°

The Ferber district covers parts of Ferber and Whitehorse flats and extends eastward into Utah. The mining properties are on both sides of a low pass.

Copper-lead deposits were discovered in the Big Chief quartz vein by the Ferber brothers about 1880, and relocated by others about 1890.

Thereafter less than 100 carloads of ore was shipped before 1914 (Hill, 1916, p. 99). Production was recorded for the years 1910-17, 1940-42, 1947, 1950, and 1957. Total recorded production through 1969 is 1,498 tons (table 5), most of it from the Martha Washington claims. The possibility of a porphyry copper deposit is suggested by recent analyses of jasperoid samples which reveal anomalously high values for silver, arsenic, bismuth, copper, lead, tin, and zinc similar to geochemical anomalies in the Bingham and Robinson (Ely) districts (T. G. Lovering, written commun., 1972).

Limestones of Pennsylvanian-Permian age are tilted generally westward and intruded by a stock about a mile long from east to west and a quarter of a mile wide of quartz monzonite that is locally porphyritic, and by gabbro dikes. The limestones are domed around the stock and recrystallized or metamorphosed to skarn or tactite near and parallel with the contact.

The sedimentary rocks and the intrusives are cut by steep faults most of which strike either northward and dip west or eastward and dip south, but a few trend northeast or northwest.

The ore bodies are lodes along the steep faults. Most of them are in the contact metamorphic rocks, but one quartz vein, the Big Chief, is along a nearly vertical fault that strikes east in the quartz monzonite about 100 feet south of its north edge. The ore bodies at the Regent mine are along a shear zone which strikes N. 62° W. and dips 70° SW. in gabbro.

The ore shoots in the metamorphic rocks are as much as 10 feet wide but are lenslike and rather short. They have been mined to depths of 150 feet or more. The Big Chief vein is 2-8 feet wide, and the deepest shaft is about 75 feet deep; the Regent shear zone is 20 feet wide and was mined to the 300-foot level. These depths refer to development in 1916; the extent of mining in the 1940's and 1950's is not known.

The ore minerals are mainly copper and lead carbonates containing a little silver and very little gold. Chrysocolla and copper pitch are common at the surface, chalcocite and native copper at depths of about 40 feet, and a little residual chalcopyrite, bornite, and galena at greater depths. Plumbojarosite was also reported (Hill, 1916, p. 102). Lime silicate minerals, quartz, and iron oxides are the main gangue minerals.

Grade of the ore from the Martha Washington mine, which was the most productive (table 21 ), was said to average 12 percent copper in the

TABLE 21 NEAR HERE

early days, but the total recorded production averaged about 16 percent lead, 6 percent copper, and 14 oz silver per ton.

Table 21. -- Ferber mining district, mines through 1969

[Blank spaces, figures unavailable; •, main product:

Plate 2 (A mine may have several names; production is cumulative)  Ajax Big Chief Ferber  Martha Washington claims Red Cloud  Regent Salt Lake group Siddon claims		THE PARTY OF THE P	LOCALION (MDBM)	Commodity	Total value
	Sec.	T. N.	E R	old Silver Silver Sead	when sold (in thousands of dollars)
				5	
	4	27	70		
					\$
Red Cloud  Regent  Salt Lake group Siddon claims	5,8	27	70	0 0	<5
1 Regent Salt Lake group Siddon claims	8	27	70		00T-c
Salt Lake group Siddon claims	1,6		69.70	(	
Siddon claims	, o		70	) )	\$
			2	0	<b>^</b> 2
Shaffer					
Sidney		The state of	The state of	•	<b>~</b> 5

# Ferguson Spring District

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
A11	30	69	Ferguson Spring	Alleghany
N-1/6	29	69	Ferguson Spring	Alleghany

The district covers Ferguson Mountain, altitude 7,695, an isolated peak east of the Goshute Mountains (Toano Range) and part of Ferguson Flat south of the peak.

According to Hill (1916, p. 97), the copper-silver deposits were said to have been known in the late 1880's. Claims staked in 1910 and 1912 were recorded under the Allegheny— district; land office patents are recorded under

### Alleghany district.

Production was recorded for the years 1935, 1937, 1939, 1949, and 1953, a small part of which may have been credited to the Pilot Peak district.

<sup>-/</sup>Named for George Washington Mardis, an early Indian scout and prospector called "Old Allegheny."

Limestone and subordinate interbedded cherty limestone, shale, and quartzite strata of the eastern assemblage ranging in age from Devonian to Triassic are folded or tilted and displaced by many steep faults that strike either northward or eastward, and by at least one low-angle fault. No intrusive rocks are shown on plate 1, but Heyl and Bozion (U.S. Geol. Survey, 1972) reported two small stocks of quartz monzonite northwest of Ferguson. Zones of hydrothermally altered limestone, shale, and sandstone surround the stocks. Jasperoid and altered shale in places contain anomalous amounts of barium, arsenic, copper, tungsten, lead, strontium, silver, lanthanum, antimony, and traces of gold. Volcanic rock of Tertiary age covers some of the limestones on the east side of the district.

The mineralized bodies replace some of the limestone beds along and near two or more of the east-striking faults. The largest gossan is about 300 feet long and 30 feet wide; the deepest workings are about 50 feet below the outcrop. All of the ore mined was oxidized. Copper carbonates with a little silver occur in a gangue of limonite, barite, and quartz. Average grade of the ore shipped was about 6 percent copper and 1 oz of silver per ton.

TABLE 22 NEAR HERE

[Blank spaces, figures not available; •, main product; o, by-product] Table 22. -- Ferguson Spring mining district, mines through 1969

	Mine or to anim	Tocation (MDBM)	(MD)	3W)	Commod 1 +17	
Index no.	in projection in the control of the	TOCALTO	11	) H	Commontes	Total value
Plate 2	(A mine may have several names; production is cumulative)	Sec.	N.	R. E.	Gold Silver Copper	when sold (in thousands of dollars)
	Badger (see Pilot Peak dist.)					
	Bartus group				• 0	<5
	Bullion(?) (see Railroad dist.)					
	Copper Valley				•	<5
	Crazy Dutchman (see Pilot Peak dist.)	dist.)				
1	Dead Cedar	32	30	69	0	<5
	Elevated	28,29	30	69		
	Hank	29	30	69		
	Норо	28	30	69		
	Polly	29	30	69		
	Will	28,29	30	69		
					The state of the s	The state of the s

#### Gilbert Canyon area

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
N <sup>1</sup> 2	29	57	Jiggs	Pegmatite area

The Gilbert Canyon pegmatite area on the west slope of the Ruby Mountains east of Jiggs includes Gilbert and McCutcheon Creeks between Green Mountain, altitude 10,680 feet, and Mound Valley, altitude about 5,500 feet.

Two of several pegmatite dikes, one near each creek, were explored for beryl by small pits and trenches prior to 1942. One in Gilbert Canyon (SE% sec. 9) about 18 feet wide contains a very few scattered beryl crystals 2-3 inches across, and a little columbite-tantalite and uraninite. A fine-grained pegmatite on the north side of McCutcheon Creek (center sec. 4) contains a few green beryl crystals and a little columbite-tantalite. One sample of specific gravity 6.1 indicates about 30 percent Ta<sub>2</sub>O<sub>5</sub> (Olson and Hinrichs, 1960, p. 171). No production has been reported from the area through 1969.

The area covers the north end of the Harrison Pass stock in the westcentral part of the intrusive complex described under Valley View district. Gold Basin

District

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
S <del>1</del> 2	47	56	Rowland	Rowland
SW <sup>1</sup> / <sub>4</sub>	47	57		

The Gold Basin district includes the Bruneau River canyon north of Mink also ranch to the confluence of McDonald Creek and the mountainous area east of the canyon to Bearpaw Mountain.

Placer gold was discovered along the Bruneau River in 1869, but no production was recorded during the 1800's. Vanderburg (1936, p. 72) reported that "small-scale placer operations have been carried on intermittently for a number of years" prior to and during 1931, and that the gravel yielded less than \$1 per cubic yard.

Lode deposits were mined from 1930 through 1941 (table 23); part of the

#### TABLE 23 NEAR HERE

production may have been credited to the Island Mountain district. At the Bruneau (Elko) mine, two tunnels were driven along fissure veins, a mill was built, and a small amount of gold-silver-copper ore was produced from 1930 through 1940. No production is reported from the district since 1941.

[Blank spaces, figures not available; •, main product; o, by-product; x, occurrence] Table 23.--Gold Basin mining district, mines through 1969

Index no.	Mine or prospect	Location (MDBM)	on (MD	BM)	Commodity	0.1. et 1
Plate 2	(A mine may have several names; production is cumulative)	Sec.	H N	ж ы	Gold Silver Copper	when sold (in thousands of dollars)
2	Bruneau	29	47	99	0	2-100
1	Deep Creek	24	47	56	•	
	Dream		47	56	0	<5
	Elko (Bruneau)				0	<5
	Gold Hill (Jarbidge dist.?)				•	<5
	Longwill placer (Bruneau River)				•	Small
n	Mendive	31	47	56	0	Minor
	Never Sweat (see Hicks dist.)					
	North Star group (see Hicks dist.)					
	Unknown	22	47	56		
	Unknown	17	47	57	×	
	Rowland tungsten (see Jarbidge dist.)					

Limestones, schist, argillites, and phyllites about a mile thick

Paleozoic are exposed along the canyon walls of the Bruneau River

and Taylor Creek and on the slopes of Bearpaw Mountain. South of Bearpaw

Mountain they are intruded by the Deep Creek quartz monzonite stock about

3 miles wide north to south and 7 miles long of Cretaceous age. In the

rest of the district they are covered by Bieroth andesite flows or later

Idavada rhyolite tuffs and flows of Tertiary age (Bushnell, 1967, pl. 1).

The Paleozoic rocks are tilted to nearly vertical and cut by numerous faults that strike northwest, northeast, or east. Quartz veins along some of the faults in limestone near the north side of the stock yielded a little gold (Bushnell, 1967, p. 34). The Bruneau and Mendive quartz veins near Rowland are nearly 3 miles west of the stock and contained, in addition to gold, a little silver and copper. One of the veins was 18 inches wide. Average grade of all reported lode production was 0.30 oz gold and 0.68 oz silver per ton.

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name $(7\frac{1}{2} \text{ or } 15 \text{ minute})$	Other district names, Remarks
A11	39	46	Midas, Squaw Valley	Midas, Summit
			Ranch	
W 1/3	39	47	Squaw Valley Ranch	

The Gold Circle district covers the east end of the Owyhee Bluffs between Midas and Fraziers Creeks. The Eastern Star mine may be in R. 46 E. (sec. 13) or in R. 47 E.

Lode gold was discovered in several veins during the summer of 1907, and a gold rush occurred the same year. A town, first called Rosebud, then Gold Circle because the mines encircled it, and finally Midas because the postal department refused to name another office beginning with the word "gold," soon reached a population of 1,500. The excitement quickly subsided when the ores were found to require milling, so that by the end of 1908 only about 250 persons remained. Production reached a peak in 1916 (24,000 tons at 0.9 oz per ton), ceased in 1921 when the last of six or more mills burned, revived in 1928-29 (cyanide plant), again in 1939 (29,000 tons at 0.23 oz per ton), and ceased in 1942. From 1950 through 1965, intermittent prospecting and cleanup at millsites yielded 187 tons of ore containing 242 oz gold, 4,484 oz silver, 100 lbs. copper, and 200 lbs. zinc. No further production is reported through 1969.

TABLE 24 NEAR HERE

Table 24.--Gold Circle mining district, mines through 1969
[•, main product; o, by-product]

Index no. on Plate 2	Mine or prospect (A mine may have several names; production is cumulative)	Sec. N. E	on (MDI T.	3M) R. E.	prog	Silver Copper Copper Sinc	Total wher (in the	Total value when sold (in thousands of dollars)
	Banner (St. Paul)				•	0	<5	
	Belvoir							
	Big Chief				•	0	<5	
	Black Cloud	2 mi SE. of Midas	of Mid	las	•	0	<5	
	Blue Heaven	2			•	0	<5	
	Bobcat					0	<5	
	Buena (see Esmeralda)	27,34	39	94				
	Capitol				•	0	< 2 5	
	Circle Bird				•	0	<5	
	Colorado Grande				•	0	<5	
	Dixie Gold	½ mi SE. of Midas	39	94	•	0 0 0	< 5	
9	Eastern Star	13	39	94	•	0 0	5-100	00
1	Elko Prince-June Belle (Gold Circle group)	16	39	94				
7	Esmeralda (Buena)	27,34	39	9#	•	0	7	>100
	Gabbeart				•	•	<.5	
	Gibson							
	Gold and Silver Circle				•	0	<5	
	Gold CircleCrown				•		<5	
	Gold Circle group 1/				•	٠	7.	>100

Table 24. -- Gold Circle mining district, mines through 1969--Continued

Index no.						
on Plate 2	Mine or prospect (A mine may have several names; production is cumulative)	Locat Sec.	Location (MDBM) T. R.	R. E.	Cold Cold Copper Copper Lead Lead Sinc Sinc	Total value when sold (in thousands of dollars)
	Gold CircleQueen					5-100
	Gold Cloud				0	<5
	Gold Cloud placer				•	<5
	Gold Crown	16,21	39	9#		
	Golden Chariot claim				0	<5
	Golden Chariot placer					<5
2	Golden Circle				0	<5
	Grand and Golden Saphire				0	<5
	Grant Millsite (cleanup)				0	<b>&lt;</b> 5
	Hardscrabble	28	39	94	0	5-100
	Homestake				0	<b>&lt;</b> 5
2	Jackson	21	39	94		
	Judge				0	<5
	June Belle (Elko Prince)				•	5-100
	Kansas				•	5-100
	Last Chance				0 0 0	<5
	Link	21	39	9#	0	5-100
	Long Chance	17,20	39	94	0	<5
	Lucky Boy				0	<5
	Marion				0	<5
	Midas (Bamberger)	21	39	94	0	<5

Table 24.--Gold Circle mining district, mines through 1969--Continued

Total value	when sold (in thousands of dollars)	2-100	5-100	<5	<5		5-100	5-100	<5	<5	<5	<5	>100	<5	<5		<5	5-100	2-100	<b>4</b>
Commodity	Gold Silver Copper Lead Zinc	0 0	0 •	0	0 0		0	0.	0	0	0	0.	0	0 0 •	0		0 0 0	0	0	0
Location (MDBM)	T. R. N. E.	94 68					94 68						94 68	94 68	39 46			94 68	39 47	
Locat	Sec.	16					16						21	21	21			27,28		
Mine or prospect	(A mine may have several names; production is cumulative)	Miners Gold 1/2 mi N. of Midas	Missing Link (see Gold Circle)	Molly Lee	Nevada Gold	North Star	Old Judge	Queen	Queen placer	Rand and Massey	Reco	Regalia	Rex (Gold Circle group)	Ripsaw	St. Paul	St. Paul-Banner	San Juan	Sleeping Beauty	Tod Adams group (Gold Queen, Silver Queen)	Vidette
Index no.	on Plate 2		#					The state of the s					က							

Table 24. -- Gold Circle mining district, mines through 1969--Continued

Index no.	Mine or prospect	Locat	tion (	Location (MDBM)	Commodity	Total value
Plate 2	production is cumulative)	Sec.	H.	ж н.	Gold Silver Copper Lead Zinc	when sold (in thousands of dollars)
	Water Witch	20,17	39	94	0	<5
	Weston (Dick Weston)				0	< 22 < 52
	Wicks and Gebhardt				0	<5
	Miscellaneous (cleanup)				•	<b>&lt;</b> 5

1/ Circle, Elko Prince, Missing Link, Gold Crown, Reco, Rex.

Within the district only Tertiary volcanic rocks are exposed.

The oldest are rhyolite flows and tuffs which are overlain conformably by andesite flows interlayered with basalt and diabase flows. The andesite is overlain conformably by postandesite rhyolite which is partly eroded and unconformably overlain by Cougar Point Welded Tuff of Pliocene age several hundred feet thick.

The volcanic rocks below the welded tuffs are cut by three sets of premineral faults. One set that strikes eastward and dips steeply south is in places intruded by dikes of rhyolite or andesite as much as 100 feet wide and 600 feet long but is not itself mineralized. A second set strikes N. 30°-60° W. and dips steeply northeast or southwest. Some faults of this set are occupied by andesite dikes, others by quartz veins. A third set is represented only by the Reco No. 2 vein (Rott, 1931, pl. 1) which strikes N. 10° W. and dips steeply east.

A lamprophyre dike 1-3 feet wide is intruded along one of the veins, the Missing Link, and is younger than the vein. All three sets of faults have gouge and slickensides along them resulting from postmineral movement. Post-mineral faults offset the mineralized faults a few inches to several feet in a few localities, but the largest post-mineral displacements are along or parallel with the veins and are marked by slickensides and gouge. Where a post-mineral fault follows a vein, the gouge contains crushed ore identifiable by panning. Where the fault diverges from or is parallel with a vein, the gouge is barren.

Hydrothermal alteration is pronounced in the mineralized areas. Rhyolite is leached and bleached to a chalky white rock containing calcite, chlorite, adularia, sericite, and streaks of limonite stain. The basic rocks are altered to serpentine, calcite, quartz, chalcedony, and kaolin.

The ore bodies are quartz veins deposited in open fissures, sheeted zones, and breccia zones along the northwest- and northeast-striking pre-mineral faults in rhyolite or along the contact of Elko Prince rhyolite with andesite. Age of the mineralization is about 15.0 m.y. or middle Miocene (Roberts and others, 1971, p. 30). The fissure veins and sheeted zones range in width from a few inches to 3 or 4 feet, breccia veins from a few inches to 25 feet. Six main veins, Elko Prince, Gold Crown, Missing Link (Banner-St. Paul), Reco, Grant-Jackson, and Esmeralda (Gibson) have been traced by discontinuous outcrops for 2,800 to 5,000 feet along their strikes (Rott, 1931, pl. 1). The Elko Prince and Grant-Jackson veins terminate at their intersections with east-striking faults.

Ore shoots are localized along portions of the veins. The main ore shoot in the Elko Prince vein was 630 — 810 feet long, averaged 15 — 30 inches wide, and was mined from above the 270-foot level to below the 750-foot level. Other ore shoots in the district ranged from a high-grade seam 2 or 3 inches wide along the Gold Crown vein to low-grade mill ore as much as 25 feet wide, also in the Gold Crown.

The ore minerals are free gold and locally stromeyerite, cerargyrite, and native silver in the upper portions of the ore shoots, and gold, tetrahedrite, proustite, argentite, sphalerite, and chalcopyrite in the deeper levels. Sulfides occur within a foot or two of the surface in some places, but partial oxidation extends to depths of 70-150 feet.

Gangue minerals are mainly quartz, chalcedony, and pyrite with small amounts of calcite, chlorite, and adularia. In the oxide zone iron and manganese oxides are common.

Grade of the ore mined ranged from several thousand dollars a ton for the narrow seam in the Gold Crown vein to about \$5 a ton for mill ore during the later years of mining. Average grade of all production recorded through 1969 was \$10.18 a ton for 401,659 tons containing 0.317 oz gold and 4.1 oz silver per ton. The gold-silver ratio ranged from predominantly gold in the leached upper portions of the ore shoots to predominantly silver in the primary sulfides at depth, and averaged about 1 to 13. Small amounts of lead, copper, and zinc were recovered only from shipments in later years.

#### Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
All	41	49	Mount Blitzen	Aurora, Amazon

Two former districts, the Amazon and the Aurora, are now included in the Good Hope district. The Amazon district in the northeast corner of the township included the Amazon and Silver Brick mines where silver ore was discovered in 1873. The Aurora district in the west half of the township was organized in 1875, and included the Buckeye and Ohio, Snyder, and Page and Kelley mines. The area was renamed Good Hope, probably in 1878.

The Good Hope district "is said to have produced over \$100,000 in silver" (Emmons, 1910, p. 65), most of it from the Buckeye and Ohio during 1882-84. Very little mining has been done since 1903. A shipment of silver ore was made in 1921, and several thousand pounds of antimony was produced from the Buckeye and Ohio mine in 1950 (credited to the Good Hope mine). No further production was reported from the district through 1969.

TABLE 25 NEAR HERE

Table 25.--Good Hope mining district, mines through 1969
[•, main product; o, by-product]

Index no.	Mine or prospect	Locat	Location (MDBM)	BM)	Commodity	Total value
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	H.	ж. Б.	Gold Silver Antimony	when sold (in thousands of dollars)
1	Amazon	(SE社) 2	41	64	•	
က	Buckeye and Ohio	(Cen) 16	111	64	•	>100
	Buckeye and Ohio (Recorded under Good Hope)				•	\$
2	Good Hope	(NE%) 9	41	64	•	
	Midnight				•	<b>&lt;</b> 5
	Page and Kelley				•	
	Silver Brick	2	147	64	•	
	Snyder					

The oldest rock unit exposed in the district is quartzite of the

Valmy Formation of Ordovician age. It is overlain unconformably

by rhyolitic welded tuffs and andesite flows, dikes, and sills of

Eocene(?) age. These older volcanics are unconformably overlain by

erosion remnants of fresh-water limestone and by rhyolitic welded tuffs

and flows of Miocene(?) age. The older volcanics are locally mineralized

(Knox, 1970, p. 1-24).

The ore bodies are narrow quartz veins along faults that strike northward or northeastward and dip steeply in the older volcanics. The largest ore shoots mined were in the Buckeye and Ohio mine where two intersecting quartz veins as much as 5 feet wide contained pyrite, arsenopyrite, freibergite, stibnite, and dark ruby silver. A sample (Lawrence, 1963, p. 61) across 36 inches of vein material assayed 7.6 oz silver, 14.1 percent antimony, and a trace of gold. The depth mined is not known but probably did not exceed 100 feet.

Goose C	ree	k
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#### District

#### Location and History

Sections (Approx.)		Rge.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
All	47	69	Goose Creek	
All	47	70	Goose Creek	

Most of the Goose Creek district is in Idaho, but the mineralized formations extend southward in the Goose Creek drainage area into Utah and into the northeast corner of Elko County, Nev. A Goose Creek mining district mentioned by Whitehill (1875, p. 33) 25 miles north of Tecoma and 10 miles from the Utah line is evidently the Delano district.

There has been no production from the part of the district in Elko County.

Lignite and building stone have been produced for local use from the part in

Idaho, and bentonite has been prospected in Utah.

Limestone, marble, quartzite, and shale of Carboniferous age and older are exposed in the mountains on the west and northeast edges of the district. They are in places overlain by a large body of rhyolite of Tertiary(?) age exposed in the mountains bordering the district on the southeast. Unconformably overlying the rhyolite and the older rocks are two formations of Miocene-Pliocene ages that are exposed throughout most of the district. They include greenish-gray shale and white volcanic ash of the Payette(?) formation at least 900 feet thick, overlain by volcanic ash and welded rhyolitic tuff of the Salt Lake formation which is at least 2,300 feet thick. Both formations contain thin beds of carbonaceous shale and lignite, and numerous beds of sandstone and conglomerate. The formations are tilted generally eastward about 3° throughout most of the district, but in Elko County the prevailing dip is westward. The strata are locally displaced a few feet to as much as 900 feet along normal faults, most of which trend northward or northeastward (Maple and Hail, 1959, p. 217).

Lignite occurs in both the Payette and Salt Lake formations. Two main beds have been mined, a lower bed of better quality 3-5 feet thick and an upper bed 14 inches to 9 feet thick (Bowen, 1913, p. 257).

Building stone was quarried from the quartzite and marble beds in the older formations and from welded tuff and volcanic ash beds in the Salt Lake formation (Maple and Hail, 1959, p. 253).

Bentonite (montmorillonite) in lenticular beds up to 20 feet thick and several hundred yards or more long in the Payette and Salt Lake formations crops out in Idaho, Utah, and in Elko County (Maple and Hail, 1959, p. 253).

Uranium in concentrations of as much as 0.1 percent uranium occurs locally in lignite and carbonaceous shales in the lower part of the Salt Lake formation (Maple and Hail, 1959, p. 217).

Vanadium with a trace of selenium occurs in black shale in the Salt Lake formation; a single sample from Goose Creek Valley in Elko County assayed 0.2 percent vanadium (Davidson and Lakin, 1962).

# Halleck

### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
35, 36	35	59		Hawthorn placer
1, 2, 3(?)	34	59		Secret Creek area

The original reference to the Halleck district is by Whitehill (1875, p. 31). It is reproduced in full as follows:

"The district is situated on the northwestern slope of the Ruby range of mountains, about six miles from Fort Halleck. Several locations have been made here by the officers and soldiers from the Fort. But little work has yet been done. The district was organized during the summer of eighteen hundred and seventy-three, and a recorder was elected. Wood is scarce, but water is abundant. Gold is found in most of the veins, which also show silver from two dollars and fifty cents to sixty dollars per ton. The railroad is eighteen miles distant, from which there is a good road to the mines. Lamoile, one of the finest agricultural valleys in the State, is in the immediate vicinity."

The Hawthorn placer is the only patented claim in the district.

Production, if any, from the district has not been recorded.

# Harrison Pass District

# Location and History

Sections (Approx.)	Twp.	Rge.	Quadrangle name (7½ or 15 minute)	Other district names
W½	28	58	Franklin Lake SW	Ruby Valley

The Harrison Pass district is on the east slope of the Ruby Mountains and includes mines from Road Canyon southward to Lime Kiln Canyon. The Star tungsten mine near Harrison Pass Creek is near the center of the district.

Scheelite was discovered in 1916 and mined during the years 1941-44 and 1952-53. Five separate tactite bodies at the Star mine yielded most of the tungsten produced from the district--about 8,000 units of WO<sub>3</sub>.

TABLE 26 NEAR HERE

Table 26.--Harrison Pass mining district, mines through 1969.
[•, main product; x, occurrence]

x) 17 17 5, 6 6 18 18 18	Index no. on Plate 2	Mine or prospect (A mine may have several names; production is cumulative)	Locat Sec.	Location (MDBM) T. R. R. R. N. E.	R. E.	Commodity Beryllium Tungsten	Total value when sold (in thousands of dollars)
Campbell (New Deal)  Climax  Climax  Lakeview  Sliper  Star  Star  Star  Star Metal (see Island Mountain)  18 28 58  19 28 58  10 24  10 28 58  20 28  20 28  20 28  20 28  20 28  20 28  20 20 28  20 20 28  20 20 20 20  20 20 2		Baldwin Lease (Climax)				•	
Climax Lakeview 5, 6 28 58 6 Sliper Star Star Star Star Metal (see Island Mountain) 18 28 58		Campbell (New Deal)				•	
Lakeview 5, 6 28 58		Climax	17	28	58	•	2-100
Star Star Metal (see Island Mountain)  Star Metal (see Island Mountain)  18 28 58 **  • **  18 28 58 **	٦	Lakeview	5, 6	28	58	•	<5
Star Metal (see Island Mountain)  18 28 58 x •  Star Metal (see Island Mountain)  18 28 58		Sliper	9	28	58	×	
18 28	2	Star	18	28	28	• ×	>100
		Star Metal (see Island Mountain)	18	28	28		

Limestones and shales of the Pogonip Formation of Ordovician age crop out along the lower east slope of the Ruby Mountains in a belt about a mile wide and 6 miles long. They are intruded by the Harrison Pass granodiorite-quartz monzonite stock of Tertiary age which is about 7 miles wide and 10 miles long and forms the summit and west slopes of the range. The district covers the southeastern part of the stock (see also Valley View district).

Near the irregular east edge of the stock in a north-trending zone about 1,500 feet wide, the limestone is metamorphosed to marble and the shale to hornfels. Along the contact of the intrusive with both the marble and the hornfels, tactite bodies as much as 20 feet wide and 300 feet long crop out at intervals for a distance of about 4,000 feet. Scheelite and a little powellite occur in the tactite. Ore shoots range in width from 1 to 20 feet, in length from a few feet to about 100 feet, and were mined to depths of a little more than 65 feet. They tend to rake along the bedding; some are wider and higher grade opposite beds of hornfels, others opposite marble. The ore shoots are displaced 1 to 10 feet along many small faults.

Grade of the ore mined ranged from about 0.5 percent to 2.0 percent  $^{\mathrm{WO}}$ 3 and averaged about 1 percent.

Beryl occurs in the tactite bodies, in the granitic rock immediately adjacent to them, and in the pegmatites in and near the stock, indicating that emanations from the Harrison Pass stock were abnormally rich in beryllium. Of 18 samples (Olson and Hinrichs, 1960, p. 173), the highest grade was 0.056 percent BeO.

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
S <sup>1</sup> <sub>2</sub>	47	54½	Mountain City	
S//2	47	55	Mountain City, Rowland	
N <sup>1</sup> 2	46	541/2	Mountain City	
$N_{2}^{1}$	46	55	Mountain City, Rowland	

The Hicks district originally included only the Hicks and McDonnell mines, both near McDonald Creek. The exact location is indefinite, but the McDonnell lode and millsite claims (patent survey 37. 37) in the Hicks district may be the McDonald mine in sec. 8, T. 46 N., R. 55 E. The townships listed above include Hicks Mountain, Hicks Creek, and Enright Hill, which in some reports may be included in the Mountain City district, and in others under Gold Basin or Alder. Land Office records are listed under Hicks district.

TABLE 27 NEAR HERE

Table 27. -- Hicks mining district, mines through 1969

# [., main product; o, by-product]

Tildex IIO.	Mines or prospects	Location (MDBM)	n (MI	OBM)		Commodity	dit	٨	Total value
Plate 2	(A mine may have several names; production is cumulative)		T.	R.					when sold (in thousands
		• 0	z.	'n.	Gold	Gold	copper	Lead	of dollars
	Clipper Alder (see Alder district)								
	Hicks				0				
2	McDonald	80	94	55					
	McDonnell lode								
	Never Sweat - on McDonald Creek				0		0	0	<5
	North Star group - on McDonald Creek	ak Sek	47	55	•	0	0	•	2-100
	Silver King group - McDonald Creek claim	claim			0	0	0	0	<5

Hot Creek District

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
A11	39	59	Hot Springs Creek	

A Hot Creek mining district in the above township is mentioned in a list of thermal springs by Waring (1965, p. 33), who cites Gilbert (1875, p. 152); who also included the district in a list but did not specify its location.

Gilbert may have been referring to the Hot Creek (Tybo) district at the town of Hot Creek in the Hot Creek Range in Nye County. There are no mines in the above township in Elko County, but a group of warm springs are springs discharge into Hot Springs Creek.

# Huntington Creek District

### Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
SW <sup>1</sup> , 18	31	56	Lee	Mineral Soap mine

There is only one mine in this area, the Huntington Creek clay mine, which is 4 miles south of Twin Bridges along the lower slope of the ridge 150 feet high that borders the east side of Huntington Creek and is about 20 feet above the nearly level valley floor.

The clay deposit was discovered in 1875 (Thompson and West, 1881, p. 396) and was operated as the Mineral Soap mine until about 1900 (Patterson, 1801, 1964, p. 57). A few carloads were shipped to the West Coast in 1927, and some additional testing may have been done in 1940 (Papke, 1970, p. 19).

The mine consists of two parallel adits 25 feet apart driven southeastward about 50 feet and connected underground by a horizontal stope extending to the end of the adits. A 75-foot prospect adit 100 feet south and another short adit 300 feet north were apparently not productive.

The clay deposit is a discontinuous bed of swelling bentonite as much as 2 feet thick interbedded with 4-8 feet of sandy clay in a conglomerate stratum 50 feet thick of the Humboldt Formation of Miocene age. The beds dip southward at low angles or are locally horizontal. The bentonite is composed largely of montmorillonite but contains variable small amounts of feldspar, quartz, calcite, and mica. Selected samples have good plastic viscosity and swelling characteristics.

### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
36	45	55	Rowland	
14, 15, 16	45	56	Rowland	
S <sup>1</sup> <sub>2</sub>	45	56	Rowland	Wyoming
A11	44	55	Wild Horse, Mt. Velma	Gold Creek, Penrod
W 2/3	44	56	Mt. Velma	Gold Creek, Penrod

The Island Mountain district extends northeast and southwest from Island Mountain (Mt. Velma quadrangle) to include most of the drainage basin of Penrod Creek. Its northern border with the Alder district, however, is an east-west line through the summit of Tennessee Mountain except on the southwest slope where the Garnet Tungsten mine is considered to be in the Alder district (pl. 2). Its eastern border with the Charleston district is the drainage divide from Haystack Mountain through Cornwall Mountain, except on the northeast slope of Cornwall Mountain where the St. Elmo mine is in the Island Mountain district. Silver-, copper-, and antimony-bearing quartz veins were found in 1869 on the southwest slope of Silver (Rosebud) Mountain whereupon the Mardis claim the Diamond Jim mine, was located, and the Wyoming district was organized. A brief silver rush followed; the city of Bruno near sec. 28, T. 45 N., R. 56 E. on Crystal (Martin) Creek was established and hundreds of lots were sold; the Mardis mill was built on the west bank of the creek in 1875 population of Bruno had dwindled to 20 persons (F. W. Lewis, written commun., 1973).

The Island Mountain district was organized in 1873 to include placer deposits along Gold Creek and two of its tributaries, Hammond and Coleman Canyons. Placer claims were located also along Penrod, Big Bend, Poorman, Mill, and Martin Creeks. The placer mining camp of Penrod on the east side of Gold Creek (sec. 7, T. 44 N., R. 56 E.) flourished until about 1878, then declined to only a few buildings. "In 1896 the Gold Creek Mining Company—a New York stock corporation—was organized, the new town of Gold Creek [sec. 18, T. 44 N., R. 56 E.] surveyed and Platted on the other side of the ridge from the Penrod home, and a mad mining boom was under way \* \* \*"

(Murbarger, 1957, p. 18). The Sunflower reservoir was built to impound the waters of Gold Creek for hydraulicking, but the ditch to the placers was never completed, and the boom fizzled out early in 1898.

Production of placer gold from its discovery in 1873 through 1901 is estimated to be about 40,000 oz (Johnson, 1973, p. 97). From 1902 through 1958 recorded production is 740 oz of gold and 252 oz of silver. No placer production was reported during 1959-69. The most productive lode deposits, the Rosebud and Diamond Jim group, were not mined intensively until 1950 and 1954. Lode production of gold, silver, copper, lead, and zinc was first recorded in 1934; about 95 percent of the total was from the Diamond Jim and Rosebud mines (table 28) during 1954-69. Antimony was shipped during 1941-51 from the Star Metal (Gribble Antimony) mine. A 35-foot shaft has since been covered by bulldozing.

TABLE 28 NEAR HERE

Table 28.--Island Mountain mining district, mines through 1969

[0, main product; o, by-product; x, occurrence]

			L-C-4					1	100			
Index no.	Mine or prospect	Locati	Location (MDBM)	BM)	1		CO	Commodity	ty			Total value
on Plate 2	A mine may have several names; production is cumulative)	Sec.	n.	E 2	Go T q	Silver	Copper	Lead	Antimony	Tungsten	Barite	when sold (in thousands of dollars)
	Anna											
	Bertie Lee & Gold Pan placer				•	0						
	Blackbird group placer (tails)	Gold Creek	ak		•							2-100
7	Coleman	11(3)	##	55		0	0					<5
	Davenport	1, 2, 11,12	#	55								
#	Diamond Jim	34	45	99	0	0	0	0				>100
	Dream (see Gold Basin dist.)											
	Gold Centre				•	0	0	0				
	Gold Creek placers	5,8,32	44-45	26		0						2-100
	Golden Star											
	Gold Ore				•	0	0					<5
	Gold Pan placer	12	#	22	•	0						<5
	Groelm & French											
	Han Griff placer											
	Hope (Owyhee)											
	Island Mountain											
	Lonesome	Alder dist.	dist.									
	Mammoth	Mardis Mtn.	Mtn.									

# Carrect original fellows this Prable 28.--Island Mountain mining district, mines through 1969--Continued

Index no.	Mine or prospect	Locat	Location (MDBM)	BM)			Comm	Commodity	Y	-	Total value
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	H N	. E.	сота	Silver	Copper	Zinc	Antimony	Tungsten	when sold (in thousands of dollars)
	Mardis Elke (Diamond Jim)	34	45	95			0		0		
80	McGregor placer	13	#	55	•	0					
	Oro Fino				•	0	0	1			\$
	Oro Vista				•	0					<b>\$</b>
	Owyhee-Hope Consolidated										
9	Penrod (W. A. Penrod)	1,12	#	55							
φ	Penrod group placer	1, 7, 12,18 etc.	#	55-56							
	Rosebud		45	26	0	0	0	0			2-100
2	St. Elmo (Diamond Jim)	2,3	#	26	•	0					<5
	Silver Bell	Loray dist.	st.								
	White Gold				•	0					\$
	Garnet (see Alder dist.)										
8	Gribble Quartz	30	45	26						×	
1	Little Joe .	15	45	26						×	Few tons 3% ?)
. 2	Star Metal (Gribble Antimony)	29	.45	56					•		9-100
	Star Metal									•	<5
	Unknown (1958)									•	

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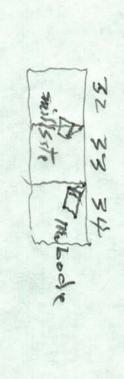


Table 28.--Island Mountain mining district, mines through 1969--Continued

Index no.	Mine or prospect	Locat	Location (MDBM)	JBM)			Commodity	dity		1	Total value
on Plate 2	(A mine may have several names:		T.	R.						u	when sold
	production is cumulative)	Sec.	N.	й	Солд	Silver	Copper	Sinc	nomitnA	Tungste	
	Mardis Elko (Diamond Jim)										
8	McGregor placer	13	#	52	•	0					
	Oro Fino				•	0					<5
	Oro Vista				•	0					<5
	Owyhee-Hope Consolidated		The state of								
9	Penrod (W. A. Penrod)	1,12	#	55							
ø	Penrod group placer	1, 7, 12,18 etc.	#	55-56							
	Rosebud		45	99	0	0	•	0			2-100
2	St. Elmo (Diamond Jim)	2,3	##	56		0					<5
	Silver Bell	Loray dist.	st.								
	White Gold				•	0					<b>~</b> 2
	a a										
	Garnet (see Alder dist.)										
က	Gribble Quartz	30	45	26						×	
1	Little Joe	15	45	99						×	Few tons 3%?)
2	Star Metal (Gribble Antimony)	29	45	99					•		2-100
	Star Metal										<5
	Unknown (1958)										

The oldest rock in the district is Prospect Mountain(?) Quartzite of Lower Cambrian age. It is overlain by conglomerates, sandstones, limestones, and shales of younger Paleozoic and Permian ages. All of these formations are intruded by a large stock of quartz monzonite (Coffee Pot stock) of Cretaceous(?) age, most of which crops out north of the district (see Alder district).

Between Hammond and Coleman Canyons, limestones and siltstones of the Hammond Canyon Formation (Permian) are intruded by a smaller stock about a mile across, also of quartz monzonite (Coash, 1967, pl. 1). Near the stocks they are also intruded by dikes of aplite and alaskite; the limestone is metamorphosed to marble or tactite and the shales to phyllite or argillite. Locally these formations are successively overlain by erosion remnants of the Bieroth andesite, Jarbidge Rhyolite of Miocene age, and the young American Gravel of later Miocene age, and by the Idavada Volcanics of late Miocene age (Bushnell, 1967). and/or early Placene

The pre-Tertiary rocks are folded and together with the older volcanics are displaced along two sets of steeply dipping faults. One set strikes northeast, the other northwest. Mineralized quartz veins occupy some of both sets of faults but only in the pre-Tertiary rocks.

The ore deposits are quartz veins along faults, tactite bodies near the intrusives, and placers in gravels of two different ages. The most productive quartz vein is along a northwest-striking fault contact which dips 45° SW. between a hanging wall of phyllite and a footwall of Prospect Mountain(?) Quartzite (Diamond Jim mine). "The ore consists of silver and lead sulphides in a quartz gangue which occurs as cavity fillings and minor replacements in small pockets, veins, stringers, and lenses, in a zone about 9 feet thick \* \* \* " (Bushnell, 1967, p. 34).

At the Star Metal mine, a stibnite-bearing quartz vein up to 4 inches wide was exposed in the shaft but could not be traced laterally. Small lenses of stibnite rarely more than 2 inches thick occur in the walls for 2 feet or more on each side of the vein. The vein is in a breccia zone 6-18 inches wide along a bedding-plane fault in a wide, steeply north-dipping shear zone in thin-bedded limestone and phyllitic shale of the Tennessee Mountain Formation of Pennsylvanian age. Three other faults in the same shear zone contain stringers of calcite and scheelite. The scheelite is white to tan grains completely surrounded by stibnite. One 1-x 2-x 6-inch pod contained almost 85 percent scheelite; closely spaced pods form ore shoots several feet long. Near the surface, white and yellow antimony oxides stain the stibnite-bearing stringers, and small amounts of the red oxysulfide are present. Fifteen tons of ore shipped in 1941-42 contained 41 percent Sb (Lawrence, 1963, p. 52).

Contact metamorphic deposits of tactite contain pyrite, chalcopyrite, scheelite, and molybdenite. They are similar to those in the Alder district but of lower grade.

Most of the older placer deposits, including all of the largest ones, are in the Young American Grave! as much as half a mile from and 50 feet higher than the present streams. They contain well-rounded quartz boulders 3 feet or more in diameter—too large to have been deposited by the intermittent streams in Hammond and Coleman Canyons, or by Gold Creek—and they cover areas several miles long and more than a hundred feet across—too extensive to have been deposited by those streams. The older gravels contain gold where they are relatively close to the Coffee Pot stock. Holocene placers are in and along the small modern streams. The gold was derived in part from the older placers and to a lesser extent from quartz veins in and near the stock.

# Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
A11	38	47	Squaw Valley Ranch	Battle Mountain
A11	38	48	Willow Creek Reservoir	Battle Mountain
A11	37	47	Rock Creek Ranch	Battle Mountain
A11	37	48	Willow Creek Reservoir SE	Battle Mountain

The Ivanhoe district includes the drainage basins of Ivanhoe and Little
Antelope Creeks in the Butte Creek Range about 45 miles by road north and a
little east of Battle Mountain.

Mercury ore was discovered in the district in 1915, and 20 flasks of mercury was produced from the Ivanhoe mine in 1916-1917. The next recorded production was from the Sheep Camp mine in 1928. Thereafter some mercury was recovered in nearly every year through 1947, more than a third of it in 1943 from the Silver Cloud mine. A few flasks were produced each year from 1957 through 1962 and a few in 1966.

The oldest rocks in the district--exposed near the Hatter and Redboy mines--are gray, thin-bedded to massive quartzite and chert (western assemblage) of the Valmy Formation of Ordovician age. They are unconformably covered throughout most of the district by volcanic rocks of Oligocene to Pliocene ages that are divided into two groups. The older group consists of platy rhyolites, basalt, rhyolitic ash, tuff, and fanglomerate, ranging in total thickness from a few feet to about 1,500 feet. The younger group, lying unconformably on the older, is composed of quartz-rich rhyolite, tuff, and ash about 1,000 feet thick (Bailey and Phoenix, 1944, p. 55-63).

The quartzites are tilted steeply, the older volcanics dip 10°-30° E., and the younger volcanics are nearly flat. All three formations are cut by normal faults, two sets of which are prominent. In one set the faults trend northward and dip west, in the other they trend eastward and dip either north or south. Displacements along the north-trending faults are as much as 300 feet. Near the faults the volcanic strata are folded, in some places quite sharply. Near some of the faults the tuff and ash beds of the older volcanics are opalitized and locally mineralized with cinnabar.

The mineralized bodies are veins along steep north-trending faults and disseminated deposits in opalitized rhyolitic ash and tuff beds near the faults. The ore shoots that have been mined are relatively flat blanket deposits of cinnabar-bearing opalite in and along folds in the volcanic strata. They range in thickness from 2 to 15 feet and are as much as 800 feet wide and 1,500 feet long.

The main ore mineral in the district is cinnabar; calomel and native mercury have been found in small amounts. The cinnabar occurs finely disseminated in opalite or coating the walls of pore spaces and fractures. Other gangue minerals are chalcedony, alumite, montmorillonite, and rarely sulfur, barite, and quartz.

Grade of the deposit at the Silver Cloud mine ranged from a trace to 20 pounds of mercury per ton and averaged about 5 pounds (H. K. Stager, written commun., 1969).

TABLE 29 NEAR HERE

Table 29.--Ivanhoe mining district, mines through 1969
[•, main product]

Index no.	Mine or prospect	Locati	Location (MDBM)	M)	Commodity	Total value
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	T. N.	R. E.	Wercury	when sold (in thousands of dollars)
	Amexco (see Homestead)	30	38	148	•	<5
	Bowers and Rand (see Butte)				•	0
2	Butte	32,33,	38,37	8#	•	2-100
	Cinnabar group (see also Homestead)	30	38	84		<5
8	Clementine	4	386	84	•	<b>\$</b>
	Clippper (see Silver Cloud)	25,26	37	47	•	0
	Coleman (see Midas)	35,36	38	47	•	0
#	Fox	32,33,	38,37	<i>F</i>	•	0
m	Governor group	25	38	47	•	2-100
	Halterman				•	<5
	Hatter	34,35	38	8#	•	0
	Homestead	30	38	84	•	2-100
m	Ivanhoe (see Butte)					0
	Lark (see Homestead)	30	38	84	•	<5
	Lucky Boy (see Homestead)	30	38	84	•	<5
	Mayflower (see Butte)				•	0

The locations as typed may be accurate

135

Table 29.--Ivanhoe mining district, mines through 1969--Continued

Sec.
35,36
25,26
32,33, 38,37 5,4
32,33, 5,4 38,37

1354

# Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
E½	46	57	Rowland, Jarbidge	
All	46	58	Jarbidge	Original discoveries
All	46	59	Jarbidge	
NE 3/4	45	58	Jarbidge	
All	45	59	Jarbidge	
E 2/3	44	58	Marys River Basin NE	Complete Water 35 N
All	44	59		Sun Creek district (sec. 20)

Schrader (1923, p. 1) defined the district to be "within an area about 14 miles square, extending a few miles west of the main Jarbidge River and east of the East Fork \* \* \*." He concluded, however, that mineral-bearing rocks (older rhyolite) comprise an area about 20 miles square. Mines as far south as the Young America (table 30) have been recorded in the district, which in this report includes the south two-thirds of the Jarbidge quadrangle (except the southwest corner which is in the Charleston district) and north one-third of the Marys River Basin NW, and NE quadrangles to the south. A small part of the east-central Rowland quadrangle is also included.

A few prospect pits may have been dug in the late 1860's, and the first specimen of gold-bearing quartz was found in 1904, but minable deposits were first found in 1909 in the Bourne, Pavlak, Buster, and Pick and Shovel veins. The Jarbidge gold rush of 1910 resulted from newspaper reports in February of that year that the Bourne mine had over \$27 million worth of gold in sight. By April a stampede of more than 1,500 people on snowshoes staked over 500 claims covering almost the entire area. It was soon learned, however, "that the reports of the Bourne property were grossly exaggerated, and accordingly, in May, a great exodus took place, the emigrants criticizing the country as they went out \* \* \*." (Schrader, 1912, p. 14-19).

The district went on to produce over \$10 million in gold and silver, most of it from the Long Hike, North Star, Starlight, and O.K. mines (Elkoro Mines Co.) during 1917-32, making it the third most productive district in the county and, in 1919, the largest gold producer in the state. Only about 10 oz of placer gold was produced (Johnson, 1973, p. 97). Since 1949 only the O.K., Payday, and Starlight gold mines were active. Tungsten ore was shipped from the Rowland mine during 1943; a few hundred units of WO3 was produced from the district between 1943 and 1956. During 1956 and 1957 barite was produced from the Wildcat mine in the Sun Creek part of the district (table 30). No production of metals was reported for the district for the years 1962-69.

TABLE 30 NEAR HERE

Table 30.--Jarbidge mining district, mines through 1969
[... main product; o, by-product; x, occurrence]

Total value,	when sold 1/ (in thousands of dollars)	>100		<b>&lt;</b> 5		2-100	>100	<5						<5	<5	<\$ \$			<b>~</b> 2
Commodity	Gold Silver Copper Tungsten Molybdenum Barite	0				0	0	0						0	0	0			0
DBM)	œ ei		28			58	58							28		28			
Location (MDBM)	T. N.		94			94	9#							94		45			A.
Loc	Sec.		26			22	21							15,22					
Mine or prospect	(A mine may have several names; production is cumulative)	Alpha (and Blizzard tailings)	Altitude	Barefoot (Bearfoot)	Ben Hur	Blizzard	Bluster	Bourne (North Star)	Buckeye	Bullion	Bull Run	Candy	Elkoro (see Starlight)	Flaxie	Florence	Forlorn Hope	Gold Hill	Gold Springs	Jarbidge Altitude
Index no.	on Plate (2					1	†												

Table 30.--Jarbidge mining district, mines through 1969--Continued

Mine or prospect   Location (MLBM)   Commodity				1			E Constitution of the Cons
22	Index no.	Mine or prospect	Locatio	n (MDE	(WS	Commodity	lotal value
22 46 58 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(A mine may have several names; production is cumulative)		. N	ж ы	Silver Copper Tungsten Molybdenum	when sold— (in thousands of dollars)
-August 7 3 & July 4 (tailings) 9 control caburna ttimate Cabin 16 46 58 0 0 clim (Rex, Blizzard) 16 46 58 0 0 clim (Rex, Blizzard) 21,22 46 58 0 0 cod th Star (Bourne) 16,21 46 58 11,22 46 58 11,22 46 58 124 45 58 124 45 58 125 46 58 125 46 58 125 46 58 126 47 127 46 58 128,33,34 46 58 0 0 139		Jarbidge Pavlak (May Day claim)				0	2-100
-August 7 3 & July # (tailings) 9 caburna 1 caburna 1 caburna 1 caburna 1 caburn 2 caburn 1 cabin 1 ca		Joy				0	<5
(tailings)  22		July-August				0 •	<b>\$</b>
22		July 3 & July 4 (tailings)				0	<5
11		Jumpers				0	<5
22 46 58 • 0  16 46 58 • 0  1ight) 16 46 58 • 0  izzard) 21,22 46 58 • 0  rme) 24 46 58  ight) 21,22 46 58  29 0  28,33,34 46 58 • 0		Kookaburra				0	2-100
light)  light)  loght)  loght)		Legitimate	22	94	28	0	\$
light) 16 46 58 • o c c c c c c c c c c c c c c c c c c		Log Cabin	16	94	58	0	<5
izzard)  21,22		Long Hike (Starlight)	16	94	58	0	7,833
rme)  16,21 46 58  24, 45 58  21,22 46 58  21,22 46 58  23,33,4 46 58		Martin (Rex, Blizzard)				0	<5
rme)  16,21 46 58  24 45 58  21,22 46 58  28,33,34 46 58		Mahogany	21,22	94	28	0	<5
rme) 16,21 46 58 24 45 58 21,22 46 58 0 0 28,33,34 46 58 0 0		New Hope					
rne) 16,21 46 58 24 45 58 21,22 46 58 0 0 28,33,34 46 58		New Star					
rme) 16,21 46 58 24 45 58 ight) 21,22 46 58 28,33,34 46 58 0		Nimrod				•	<5
ight) 21,22 46 58 • 0 28,33,34 46 58 • 0		North Star (Bourne)	16,21	94	58		
ight) 21,22 46 58 • 0 • 0 28,33,34 46 58 • 0		Norman	24	45	28		
28,33,34 46 58 • o		O.K. (see Starlight)	21,22	94	58		
28,33,34 46 58 • 0		Parlak (Pavlak)				0	<5
28,33,34 46 58 • 0		Payday				0	<5
		Pick and Shovel	28,33,34	94	28	0	<5

Table 30.--Jarbidge mining district, mines through 1969--Continued

Commodity Total value,	when sold* Copper Tungsten Molybdenum of dollars)			0 >100	2-100	\$ \	\$		S V	<5	<5	<5	ū					• x 15 STU	
· ŏ	Silver			0	0	•	0		•	0	•	•							
			58	58	58		58	58			59			58	57			58	
MDBM)	• 6													45	94			45	
Location (MDBM)	H.		94	94	94		94	94			#			#	7			7	
Locat	Se co		34	21,22	27,28		22	22			35			9	15			(4)9	
Mine or prospect	l names; lative)	Red Dike	Rex (Martin)	Starlight group	Success	Sunday (Sun Ray?)	Sunset	Tacoma	Wild Horse	Wonder Bar	Young America (location?)	Miscellaneous	Batholith (see Charleston dist.)	Coon Creek	Copper Queen prospect	Montana	New Chance	Rowland	
Index no.	on Plate 2		9		8						6			9					

1/ Includes published figures.

(P. 139 Follows)

The basement rocks in the Jarbidge quadrangle (Coats, 1964, p. M1) are Precambrian(?) schist, quartzite, and hornfels, Cambrian Prospect

Mountain(?) quartzite, Paleozoic(?) limestone, silty limestone, chert, phyllite, and quartzite intruded by Cretaceous quartz monzonite of the Coffee Pot stock. Near the stock the argillaceous rocks are metamorphosed to hornfels and the limestones to tactite. These formations are exposed only along the west side of the quadrangle, except for two fault slivers of Prospect Mountain(?) quartzite 1½ miles southeast of Jarbidge.

The eroded surface of the basement rocks is overlain by Tertiary tuffs, local conglomerates, and Jarbidge Rhyolite (older rhyolite of Schrader, 1923) which covers most of the south half of the quadrangle and is locally more than 2,000 feet thick. The older rhyolite is overlain unconformably by dacite flows and tuffs, local gravels, and by Cougar Point welded tuff (younger rhyolite), which covers most of the north half of the quadrangle and is as much as 1,500 feet thick. The younger rhyolite is locally overlain by basalt flows 105 feet thick or less. In a few places the Tertiary rocks are overlain by Pleistocene glacial deposits and by Holocene landslide, talus, and alluvial deposits.

The basement rocks are displaced along pre-Cretaceous faults,
largest of which is the Copper Mountain thrust inferred to
underlie much of the western half of the quadrangle at depths of 1,0006,000 feet (Coats, 1964, pl. 1). Cambrian and Precambrian rocks are thrust
over and rest upon the Paleozoic sedimentary rocks. The early Tertiary
volcanics and conglomerates are displaced along normal faults represented
by the Copper Creek fault, which dips gently east and places both Precambrian
and Tertiary formations on Prospect Mountain(?) quartzite. The Jarbidge
Rhyolite (Miocene) and all older formations are displaced along three sets
of faults that dip steeply: one set strikes northward, one northeast,
and one northwest. These three sets of faults are locally mineralized.
The Cougar Point welded tuff (late Miocene) is cut by a relatively few
faults which may have resulted from postmineral movements (Pliocene?) along
some of the premineral faults.

The ore bodies in the Jarbidge district are of three types and ages, contact metamorphic deposits of Cretaceous age, quartz-adularia veins or lodes of Tertiary age, and barite veins of Tertiary age. The contact metamorphic ore bodies are tungsten-molybdenum deposits in tactite zones as much as 100 feet wide near the Coffee Pot stock. About 4.5 tons of sorted tungsten ore consisting of coarse crystals of scheelite accompanied by molybdenite and powellite in garnet tactite contained 3.8 percent WO<sub>3</sub> (D. M. Lemmon, written commun., 1948).

gold-silver The principal ore bodies in the district are lodes or reefs, locally called "dikes" along all three sets of steep normal faults in the Jarbidge Rhyolite. Quartz veins along northwest-striking normal faults in the quartzite, limestone, and quartz monzonite are small and have not been extensively worked. The lodes consist of sheared and altered rhyolite in fault zones as much as 40 feet wide which contain stringers and veins generally less than 3 feet wide of calcite partly or wholly replaced by quartz and (or) adularia. The rhyolite is silicified as much as 100 feet on each side of the lodes, but within the shear zones (lodes) alteration is more intense. Postmineral movements resulted in highly sheared lodes accompanied by gouge which localized some of the secondary silver minerals and also faulted off some of the ore shoots. The ore shoots were a fraction of an inch to about 40 feet wide, as much as 1,000 feet long, and were mined 1,250 feet or less down the dip. Although the entire width of the lodes was mineralized in places, the highest grade ores occurred in pockets or veinlets along or across the lodes. One of the richest veinlets was in the Pavlak lode where "a more or less persistent streak about half an inch in width \* \* \* was said to range from \$5,000 to \$10,000 to the ton." (Schrader, 1912, p. 69)

Gangue minerals are quartz, adularia, chlorite-epidote,
halloysite and other clays, and smaller amounts of apatite, barite, calcite,
chalcedony, fluorite, hematite, hyalite, kaolin, leverrierite, limonite,
psilomelane, pyrolusite, marcasite, muscovite, opaline silica, orthoclase,
pyrite, sericite, and talc. As oxidation extends to depths of 800 feet or
more, supergene halloysite and other clay minerals are abundant.

Primary ore minerals in the lodes are free gold, electrum, argentite, chalcopyrite, pyrargyrite, and naumannite, but most of the ore mined was oxidized and was valued chiefly for its gold content. The gold particles range in size from microscopic to plates larger than a man's hand and as thick as a knife blade (Schrader, 1923, p. 31). Grade of the ore ranged widely to as much as 50 oz of gold and 90 oz of silver per ton, but the average was about 0.5 oz gold and 1.4 oz silver per ton. In the early days the ore was mined selectively and sorted in an effort to obtain a shipping grade of about \$1,000 per ton.

Barite was mined in only one locality in the district. At the
Wildcat (Sun Creek, Jensen and Steele, Hunter) mine, Coarsely crystalline
barite occurs in a vein a few feet to 25 feet wide in silicified argillite
of Ordovician age (Horton, 1963, p. 6).

Kinsley	District
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### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Remarks
$\mathbb{E}^{rac{1}{2}}$	26	67	Elko 2º	Elko and White Pine Counties
W1/2	26	68	Elko 2º	Elko and White Pine Counties

The Kinsley district covers the south half of the Kingsley Mountains, formerly called the Antelope Mountains, the southern end of which is in White Pine County. Silver-bearing lead-copper deposits were first discovered and the Antelope district organized in 1862, but the miners were driven out by the Mormons in 1863 before any ore was produced. The veins were rediscovered about 1865 by George Kingsley and the Kingsley district--known thereafter as the Kinsley district--was organized. Production, mostly from White Pine County was intermittent through 1955. Scheelite was discovered in the Elko part of the district in 19391342 and a few 10's of units of WO<sub>3</sub> was produced between 1942 and 1945. In 1966 a marble deposit high on the southwest slope of the range in Elko County was developed.

Most of the southern half of the Kingsley Mountains is composed of dolomitic limestone strata of Cambrian age which dip 5°-40° E. The north end of the range, north of the district, consists mainly of Pogonip limestone of Ordovician age in the upper plate of a thrust fault. The Cambrian limestones at the south end of the range are intruded by a stock about a mile across of quartz monzonite of probable Tertiary age and by radiating dikes of quartz monzonite and aplite. Near the stock the limestones are locally metamorphosed to tactite and at greater distances to lime silicates or marble.

The copper, lead, and silver ore bodies are contact metamorphic deposits in silicated limestone and veins and replacement deposits near the stock along steep north— and east—striking faults and in adjacent gently dipping limestone beds. The largest stope was 50 feet long and 18 feet wide, and the deepest shaft, the Morning Star (table 31 ), was 275 feet deep, but most

### TABLE 31 NEAR HERE

of the ore was in small pods. Cerussite, chrysocolla, malachite, azurite, chalcocite, and cerargyrite with a little residual galena and chalcopyrite occur in a gangue of quartz, limestone, tremolite, wollastonite, garnet, limonite, and pyrite.

Table 31.--Kinsley mining district, mines through 1969
[•, main product; o, by-product; x, occurrence]

	(A mine may have several names; production is cumulative)	Locat Sec.	Location (MDBM) T. R.	BM) R. E.	The second second	Ver	q Co	Commodity ybdenum ble	Total value when sold (in thousands of dollars)	
10					COT		reg	TOM		
-	Bessie Turner					0	0		<5	
_	Captain	19	26	89		0			<2	
	Doty Tunnel (Dotty)	19	26	89						17
	Kerong				0	0	•		<5	
457	Kinsley									
2.00	Kinsley Consol.	18	26	89			×			
	Morning Star	24,19	26	89,79		•	0	A. A. A.		
	Phalen					0			<b>&lt;</b> 5	
	Captain Jack	24,19,18	26	67,68				•	<5	
	Southam (Kerong)	18	26	89				× •	<b>~</b> 22	
	Western	13	26	67				•		

The tungsten ore bodies are all of contact-metamorphic origin. Largest of these, on the Kerong patented claim at the north edge of the stock, is a tactite body along a granitic dike. The tactite is 5 feet wide, 80 feet long and was mined to a depth of 30 feet or more. Scheelite and a little powellite occur in the tactite. About 7 tons of sorted ore was shipped (D. M. Lemmon, written commun., 1948).

Average grade of all the lead-copper-silver production recorded was about 1.24 oz silver per ton, 3.7 percent copper, and 8.1 percent lead, but the records do not include ore produced before 1886. About 20 tons of ore produced from the Morning Star mine dump in 1913 contained 28.7 oz silver per ton, 8.6 percent lead, and 3.42 percent copper (Hill, 1916, p. 92). Grade of the sorted tungsten ores ranged from 0.8 to 30 percent WO<sub>3</sub>.

Lafayette <u>District</u>

# Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
5, 6,	35	64	Snow Water Lake NE	
7, 8				

The Lafayette district includes the lower southeast slopes of the Wood Hills about 5 miles northeast of Tobar (Granger and others, 1957, p. 104). There is no record of production from the district.

Near the south end of the Wood Hills, marbleized limestones of Cambrian and Ordovician ages overlain by Eureka quartzite (Ordovician) crop out across the full width of the range. Along the southeast slopes they are overlain by dolomitic limestones of Ordovician, Silurian, and Devonian ages in the upper plate of a thrust fault. The Lafayette district covers part of the upper plate limestones.

The mineral deposits explored in secs. 6 and 7 are narrow veins along faults. In sec. 6 the north shaft 20 feet deep inclined 45° NE. in limestone exposes a quartz vein as much as 3 feet wide containing malachite, azurite, and limonite. In sec. 7 the 30-foot shaft inclined 60° NW. in limestone exposes a fault breccia about 4 feet wide containing mariposite, calcite, and iron oxides.

Larrabee <u>District</u>

# Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
A11	28	53	Pine Valley, Robinson M	See index map at County
				Recorder's office.

The district includes the drainage area of Pony Creek on the west slope of the Sulfur Spring Range north of Coffin Mountain.

A prospect shaft in sec. 16 and an unnamed barite mine at the common corner of secs. 5, 6, 7, and 8 are the only mines in the district. Small shipments of barite were reported (Horton, 1963, p. 8).

The unnamed district in T. 28 N., R. 55 E., listed by Lotz (1934, p. 18), may be the Larrabee district.

District

# Location and History

Lee

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
31, 32, 33	31	58	Lamoille	Ruby Mountain Range
4, 5, 6	30	58	Lamoille	Ruby Range district

The Lee district includes mines in Long Canyon and Segunda Creek canyon on the west side of the Ruby Mountains about 10 miles southeast of Lee.

The district was discovered in 1869 and ores containing lead, silver, and copper were shipped during 1871 and 1917-19 from the B.B. and American Beauty mines. Subsequent production is credited in official records to the Ruby Mountain Range district (1923-25) and the Ruby Range district (1947-58), much of it from the Knob Hill mine. Total production from the Lee district through 1958 is about 1,400 tons of lead ore containing some zinc, copper, silver, and a little gold. In this report production before 1920 is indicated in table 5 opposite Lee district and for 1923-58 it is included with "undistributed." No production was reported for 1959 through 1969.

The Munnamed district in T. 31 N., R. 57 E., listed by Lotz (1934, p. 18), may be the Lee district.

The oldest formation exposed in the Lee district is Prospect Mountain Quartzite. It is overlain by a thick series of limestones, also of Cambrian age. These formations are intruded by dikes, sills, and irregular masses of granite and granite pegmatite, and metamorphosed to quartz-biotite schists, recrystallized limestone, and marble (R. G. Reeves, written commun., 1951).

The ore bodies are quartz-calcite veins as much as 5 feet wide that strike northwest and dip southwest. They contain galena, sphalerite, and locally chalcopyrite, with small amounts of silver and a trace of gold. A shipment in 1949 of sorted ore averaged 29 percent lead and about 2 oz silver per ton.

TABLE 32 NEAR HERE

Table 32.--Lee mining district, mines through 1969
[•, main product; o, by-product]

	Commodity Total value	when sold when sold (in thousands of dollars)				<5				
	Commo	6old Silver	7 Page 18 18	0	(		(			
	Location (MDBM)	T. R.	31 58					30 58	31 58	31 58
	Locatio	Sec.	33			•		5,6		32
Mine or prospect	rooden to a cuit ()	production is cumulative)	American Beauty	B.B.	Fordham	Galena King (see Ruby Range district)	Giant	Hargrove	Knob Hill (Long Canyon)	Long Canyon (see Knob Hill)
Index no.	uo	Plate 2	1					б		2

Lime Mountain <u>District</u>

# Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names
1, 12	42	51	Bull Run	Independence, Deep Creek
6, 7	42	52	Bull Run	Independence, Deep Creek

The Lime Mountain district includes all of Lime Mountain, which extends northward from Deep Creek  $1\frac{1}{2}$  miles and is the southernmost peak of the Bull Run Mountains, formerly named the Centennial Range. The mines and millsite are on the east slope of Lime Mountain.

The district was discovered prior to 1908 (Emmons, 1910, p. 70), but production for the early years, mainly from the Eldorado mine, is not recorded. Intermittent production from 1918 through 1942 exceeds 18,211 tons which contained 8,423 oz of gold, 25,795 oznas of silver, 635,156 lb.mds of copper, and 28,319 lb.mds of zinc. About 95 percent of the ore came from the Lime Mountain mine.

No production is recorded from the district during the years 1943-69.93

TABLE 33 NEAR HERE

Table 33.--Lime Mountain mining district, mines through 1969 [... main product; o, by-product]

Index no.	Mine or prospect	Locat	Location (MDBM)	BM)	Commodity	Total value
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	T. N.	R. E.	Gold Silver Copper Zinc	when sold (in thousands of dollars)
	Eldorado (1931 only)	1	42	51	• 0 0	5-100
	Liberty (1918, 1927)				• •	2-100
1	Lime Mountain (1929-1942)	1	42	51	0 0 0	>100
				The state of the s		

#### Geologic Setting and Ore Deposits

Lime Mountain consists of sedimentary rocks of the eastern assemblage. Prospect Mountain Quartzite along the lower west slope dips eastward and is overlain by slates and phyllites (Pioche Shale equivalent) about 700 feet thick which are overlain by limestones about 3,200 feet thick that make up most of the mountain. Immediately to the north these Cambrian strata are concealed, covered by western assemblage cherts and argillites of Carboniferous(?) age in the upper plate of the Trail Creek thrust fault of Jurassic(?) age. The upper plate--and by inference the underlying concealed 2-mile diameter. lower plate -- is intruded by the Wilson plug about 2 miles across of andesite porphyry of Eocene(?) age which forms the summit and both slopes of the Bull Run Mountains on both sides of Wilson Canyon. East of the range at lower altitudes, both plates are overlain by marl, shale, oil shale, sandstone, conglomerate, chert, and tuff beds about 5,000 feet thick of the Humboldt Formation of Miocene age. On the east side of Lime Mountain, however, lower plate strata are in fault contact with Humboldt beds along a Basin-Range block fault, and on the west side, with Quaternary alluvium along the Owyhee block fault which has a normal dip slip exceeding 4,000 feet (Decker, 1962, pl. 1).

(1) Axelved, D. A. written communication, 1964

The mines and prospects in the district are on the east slope of Lime Mountain, in Cambrian limestones that are cut by north-trending faults, intruded by dikes of quartz porphyry, andesite, and diabase, and locally metamorphosed to coarse-grained marble. The ore bodies in the Lime Mountain mine are along a fault having postmineral movement. Pyrite, chalcopyrite, bornite, a little silver and gold, and some secondary chalcocite are intergrown with white and black mica, calcite, and quartz (Emmons, 1910, p. 71).

## Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
34, 35, 36	38	67	Loray	Cobrecite mine
S-1/6	38	68	Loray, Pilot Peak NW	Luray, Leroy, Montello, Cobre
$N_{\frac{1}{2}}$	37	68	Cobre SE, Pilot Peak NW	Luray, Leroy, Montello, Cobre, Castle Park

The Loray district covers the north end of the Toano Range south of Loray and east of Cobre, which are stations on the Southern Pacific Railroad a few miles southwest of Montello, and west of Castle Park well (pl. 2).

Copper-lead deposits of the Silver Star group were known in 1913 (Hill, 1916, p. 96), and intermittent production was reported from seven mines (table 34)

## TABLE 34 NEAR HERE

for the years 1917-21, 1934-46, and 1954-58. Production figures in table 5 are less than those reported by Granger and others (1957, p. 106) which included production from other districts. Volcanic ash (pumicite) was mined from three open cuts at the Cobrecite mine during the 1940's(?). Foundations of a sizing and bagging(?) plant still remain near the mine. A few tons may have been produced.

Table 34.--Loray mining district, mines through 1969
[... main product; o, by-product; x, occurrence]

	Min and an and an in	Toos	Toostion (MDRM)	M)		Commodity		
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	T. N.	E.			c sap	Total value when sold (in thousands of dollars)
					Gold	Copper	Zinc Volcani	
	Alabama					0		<5
2	Castle Park	1,36	37,38	89	0	•		<5>
	Lost Hope	14	37	89	0	•	0	<5
	May Bell (Maybelle)				0			2-100
	New Deal				0	• •		<5
	Silver Bell				0	•		<5
	Silver Star					0		
	Skootumpaw (Castle Park)				0	•		<b>&lt;</b> 5
1	Cobrecite	35	38	67			•	

## Geologic Setting and Ore Deposits

The north end of the Toano Range is composed of the normal eastern assemblage of sedimentary strata, mainly limestones, ranging in age from Perman Cambrian through the Pennsylvanian Grandeur Formation. The strata are intruded by a stock (T. 36 N., R. 68 E., between Loray and Proctor) about 3 miles long of granodiorite of Jurassic age, tilted generally about 30° W., and are cut by many faults, most of which strike either northward or eastward. On the west side of the range these Paleozoic formations are overlain by younger sedimentary rocks, mainly tuffaceous sandstone, of Tertiary age. In the area of the Cobrecite mine (pl. 2), a deposit of very light gray, friable pumicite (rhyolite vitric tuff) 100 feet or more thick strikes northwest and dips about 10° NE. A stratum about 20 feet thick that was mined consists almost entirely of slightly compacted but uncemented 50- to 325-mesh particles of rhyolite glass.

The metallic ore bodies are white opaline quartz veins along faults in nearly white crystalline limestone of the Pogonip(?) Formation of Ordovician age. Pods and veinlets of chrysocolla, malachite, azurite, copper pitch, carbonates of lead and zinc, and residual sulfides occur with limonite in and along the quartz veins. Grade of the ores shipped ranged from 0.5 to 90 ounces silver per ton, 0-9 percent copper, 0-9 percent lead, and 0-9 percent zinc.

## Location and History

Sections (Approx.)	COLUMN TO SERVE		Quadrangle (7½ or 15		Other district names, Remarks
A11	39	70	Tecoma,	Patterson Pas	s Elko County, Nevels
A11	7*	19 W.*	Tecoma,	Lucin	Box Elder County, Utah
A11	6*	19 W.*	Tecoma,	Patterson Pas	s Box Elder County, Utah

\*Salt Lake base and meridian

The Lucin or Buell district covers the north end of the Pilot Range south of Tecoma, Nevada, and Lucin, Utah, both of which are stations on the Southern Pacific Railroad. Most of the mines are in Utah, either on Copper Mountain near the crest of the range or on Tecoma Hill on the west flank near the state line. Part of the Tecoma mine property extends westward into Elko County.

Copper ores were discovered on Copper Mountain in 1871 and lead-silver ores on Tecoma Hill shortly thereafter. A 20-tpd lead-smelting furnace was built at Buel City in Elko County in 1871 and was operated until 1875 or 1876. The copper deposits were worked between 1886 and 1894. An aerial tram was built from the Copper Mountain mine to the west base of the range at Tuttle in 1900, where a rail spur constructed in 1906 connected with the main Union Pacific line at Tecoma. Copper- and lead-silver production reached a maximum in 1917, then declined to intermittent shipments of a few tons or a few hundred tons. Limonitic iron ores containing a little copper, lead, and silver were shipped in 1910, 1913, and 1920 for use as smelter flux, and again in 1930-31 to a California paint company. More than 2,000 tons of oxidized zinc ores were mined intermittently since 1917. The aerial tram and lead smelter were sold for scrap in 1941. About 9,000 tons of limonite ore from Copper Mountain was shipped to the Atomic Energy Commission at Richland, Wash:, in 1953.

Total production from the district through 1917 was estimated (Butler and others, 1920, p. 489) to be 152,495 tons containing 104 oz gold, 225,136 oz silver, 16,577,321 lb copper, 4,749,122 lb lead, and 34,680 lb zinc valued at \$3,256,193. Figures for much of the production since 1917 have not been published, but the district total through 1966 may exceed \$3.5 million.

Production was credited to the Nevada part of the district (tables 5 and 35) for the years 1874, 1916, 1925, 1935, 1953, 1965, and 1966.

TABLE 35 NEAR HERE

Exploration and development for open-pit zinc mining were reported in 1961 (Southern Pacific Co., 1964, p. 111).

Table 35.--Lucin mining district, mines through 1969
[•, main product; o, by-product]

Total value	when sold	(in thousands	OF dollars)	5-100	2-100	<5	2-100	<5	
Commodity		l aec aec	Gold Silv Copy Lead Zind		• 0 0	• 0 0	• 0 0 0	•	
Location (MDBM)	T. R.	000	N. E.	21 39 70			21 39 70		
Mine or prospect $\frac{1}{2}$	(A mine may have several names:	production is cumulative)		Black Warrior	Cunapah (in Utah)	Solidav	Тесота	Uneeta	Trails County production on it
Index no.	on	Plate 2		1			2		ייונט/ נ

1/Elko County production only.

### Geologic Setting and Ore Deposits

The geology of the Utah part of the district has been described by V. C. Heikes (Butler and others, 1920, p. 488-494) and by D. M. Blue (1960). Sedimentary formations of the eastern assemblage from the Eureka Quartzite upward through limestones of the Pequop Formation are tilted about 30° E., complexly faulted, and intruded by the Patterson Pass monzonite-quartz monzonite (locally porphyritic) stock about 8 miles long north-south and as much as 3-1/2 miles wide, of early Tertiary age. The sedimentary rocks are intruded also by dikes of aplite and diabase; dikes of quartz diorite intrude both the stock and the sedimentary rocks. Veins of coarse quartz containing sulfides occupy the same fissures as many of the aplite dikes.

On the north side of Tecoma Hill, east of Buell, dolomite and limestone strata are intruded by another small stock, about one-half mile across.

metamorphosed to lime silicate minerals. Contact metamorphic deposits of copper(?) have been prospected but were not mined.

In the Elko County part of the district the only eastern assemblage rocks that crop out are the Fish Haven, Laketown, and Simonson Dolomites. They are in fault contact with limestones, shales, sandstones, and conglomerates of the Salt Lake Formation of Miocene-Pliocene age which, at the northern end of the range, form the west foothills.

Most of the copper and iron ores were mined from ore bodies along northstriking fractures of the Copper Mountain fault zone about 1,000 feet wide
where it cuts massive limestone strata 850 to 900 feet thick which form
the basal member of the Guilmette Formation. The largest copper deposits occur as
were replacements of favorable limestone beds adjacent to the fractures.

The lead-silver-zinc ores in the area of Tecoma Hill are veins along faults that strike east or northeast and dip steeply southward, irregular replacement bodies in favorable limestone beds adjacent to the veins, and pipelike replacement deposits at their intersections with north-striking fractures. They are restricted to the lower limestone member of the Guilmette Formation, and the Laketown and Fish Haven Dolomites.

Ore minerals in the copper and iron deposits on Copper Mountain include malachite, azurite, chrysocolla, cuprite, tenorite, copper-stained clay minerals, native copper, goethite, limonite, and hematite.

Ore minerals in the lead-silver-zinc deposits in the Tecoma Hill area include anglesite, cerussite, smithsonite, hemimorphite, plumbojarosite, unidentified silver minerals, native silver, and a little native gold, residual galena, sphalerite, and chalcopyrite. Gangue minerals include calcite, clay minerals, and iron oxides. In the lower parts of the ore bodies wulfenite was abundant.

Hague (1877, p. 498) reported: "The molybdate of lead frequently forms so high a percentage of the lead ore as to interfere seriously with its treatment in the ordinary lead furnaces \* \* \*. The crystallized wulfenite from the Tecoma mine occurs in large masses, the faces of individual crystals having been observed from an inch to 1-1/2 inches in length." The source of the molybdenum is not known; descriptions of the stocks do not mention molybdenite.

Average grade of the copper ores for a few selected years ranged from 5 to 8 percent copper, limonite ores contained about 44 percent iron, some lead-silver ores shipped in the early years contained 45 percent lead and 35 oz silver per ton, and oxidized zinc ores contained 7-18 percent zinc.

The ores of the Lucin district, especially those on Copper Mountain, were almost completely oxidized. They were also shallow, mostly less than 60 feet; explorations below depths of about 200 feet failed to find ore. This type of occurrence suggests that they may be localized in the upper plate of a thrust fault, although thrust faults have not as yet been positively identified.

Merrimac 1	District
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## Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
S <sup>1</sup> / <sub>2</sub>	38	53	McDermitt, Wells	Lone Mtn. district
A11	37	53	Blue Basin, Singletree	Grand Junction district(?)
			Creek	

The Merrimac district includes all of Lone Mountain, a conspicuous ridge in the Independence Mountains west of Dinner Station on Nevada Highway 11, 24 miles north of Elko. In reports of the Fortieth Parallel Survey the mountain was called Nannies Peak, and this name is retained for the northernmost peak of the ridge. Land Office records include a South Merrimac claim; they are listed under Merrimac district.

Copper-lead-silver deposits were discovered in 1866, and the Lone Mountain district was organized in 1869 or 1870. About 1,000 tons of ore was produced through 1907. Granite, quarried about 30 miles north of Elko during 1907-13 for use in the town, probably came from this district. Part of the metal production during 1912-18 and all of it since 1924 are recorded under the Merrimac district. Most of the production from 1918 through 1954 was lead-zinc-silver ore from the Rip Van Winkle mine.

A barite deposit was explored prior to 1959. Molybdenite with pyrite in silicified rock was reported (Schilling, 1962a, p. 14) to occur on Fox Creek Ranch near Dinner Station. Tungsten was produced at the Lone Wolf and Open Pit (Lone Mountain) mines prior to 1963 (Schilling, 1963a).

Turquoise was reported (Morrissey, 1968, p. 5) from the Carlin Black Matrix mine, but the mine could not be located during a field check in 1965.

No production was recorded from the district for the years 1966 through 1969.

#### Geologic Setting and Ore Deposits

The oldest rocks exposed in the Merrimac district are sandstones, calcareous siltstones, cherts, and shales of Ordovician and Silurian ages (western facies), fault slices of which are in thrust-fault contact with and overlie limestones of Devonian and older Devonian (?) age (eastern facies). The older Devonian(?) limestone is invaded by five successive intrusives, each of a different composition A all of Tertiary age. Oldest of these intrusives is a stock 1-1/2 miles long north-south of biotite quartz latite exposed on the lower east flank of Lone Mountain, followed by a stock 2 miles long and a mile wide of diorite higher up the slope. The limestone is intruded by a dikelike body 3 miles long, one-third of a mile wide, dipping 70° W., of quartz monzonite porphyry called the Nannies Peak intrusive, exposed along the west slope and the ridge top. The limestone and the two older stocks at their south ends are intruded by a third stock 1.7 miles long quartz monzonite which is itself intruded by dikes of quartz porphyry as much as a mile long and 1,000 feet wide that trend northward and dip eastward. Small lenses of conglomerate locally overlie the rocks of the western facies and are overlain by welded tuffs a few thousand(?) feet thick that mantle the foothills on the north, west, and south sides of Lone Mountain; vitric tuffs and alluvium floor the desert valley on the east side (Lovejoy, 1959).

The ore bodies are veins along faults, replacement deposits in marbleized limestone, and contact metamorphic deposits in garnetized limestone.

Vein deposits at the Rip Van Winkle mine (Lovering and Stoll, 1943) are localized along a segment of a north-striking reverse fault that dips steeply west in cherty shales and shaly limestones (western assemblage) near their contact with granite porphyry and is bounded by steep east-dipping mineralized normal faults. The vein is more than 4 feet wide in places and was mined or explored for 600 feet along the strike to the 600 level. One of the east-dipping faults was explored to the 700 level (Granger and others, 1957, pl. 12, 13). Branch veins and bedded replacement bodies near the veins were also mined. The veins are stepfaulted a few feet along some of the east-dipping faults.

The primary ore minerals are sphalerite, chalcopyrite, and galena with some silver, and gold, in a gangue of quartz, altered wallrock, and pyrite, but most of the ore mined consisted of their oxidation products.

Much of the ore averaged about 2 percent lead, 1.5 percent zinc, 0.1 percent copper, and 7.5 oz silver per ton. Total recorded production of these metals from the district averaged about \$19 per ton.

Replacement deposits along the bedding in marbleized limestone near the veins contain a higher proportion of zinc than the veins.

Contact metamorphic deposits are localized in the garnet-actinolite zones. They contain pyrite, chalcopyrite, arsenopyrite, and locally scheelite, magnetite, and a little copper carbonate.

A few miles north of the Merrimac district, sulfur has been reported to occur with minor amounts of pyrite and ilmenite (1-1% percent TiO<sub>2</sub>) in black slates and shale on the west side of Gonce (Ganz?) Creek (Beal, 1963, p. 15). The sulfur is probably a surface alteration product of weathered pyrite.

TABLE 36 NEAR HERE

Table 36.--Merrimac mining district, mines through 1969
[•, main product; o, by-product; x, occurrence]

Tadou no	With	Toost	Tocation (MDRM)	RM)				100	Commodity	1	90				Total	Total value	1
on Plate 2	(A P	Sec.	. A	Б.	Silver Gold	Copper	Lead	Sinc	Iron	THE RESERVE THE PROPERTY OF THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TWO IS NAMED IN COLU	Tungsten muinstiT	Barite	Turquoise	anjing	when (in those of	when sold — (in thousands of dollars)	ds ds
	Annex				0	0	0	0								<5	KOTT
	Antelope				0											<5	
	Baltimore-Morgan	11	37	53	0	•	0									<5>	
	Coal Mine Canyon				0		•									<5	
	Copper Queen				0	•										2-100	
	Eagle (see Rip Van Winkle)	ო	37	53													
	Elfreda				0		•									<5	
	Gem				0		•									<5	
	Ironsides				0	•										<5	
	Jackpot (Tunnels)	NE 11	37	53	•											0	
	Lone Mountain				0	0	•									2-100	
	Malachite				0 0	•										<5	
	Monarch															0	
	Morgan (see Baltimore)																
	Open Pit	11	37	23	×												
	Pacific Consolidated				0	•	0									<5	
	Pine Ridge				0	0	•									<5	
2	Rip Van Winkle	3,34	37,38	53	0	0	•	•								>100	
	Silver Tip															<5	

Table 36.--Merrimac mining district, mines through 1969--Continued

Total value	when sold — (in thousands of dollars)	<5	<b>\$</b>		0					<>006>	
	anytns								×		
	esioupauT										×
	muinstiT Barite			×							
	Tungsten										
1	Molybdenum							×			
Commodity	Iron				×						
Ommo	Sinc	0									
o o	Lead		0								
	соррег										
	Silver	0	0								
	Gold										
	i ii	0		54	53		53	54	54		
Location (MDBM)	М Н			2	2		2	L)	ш,		
2	H Z			39	37		37	37	39		
tio											
oca	Sec.				13		11				
-					7		-				
100L	nes;										
Mine on mospect	(A mine may have several names; production is cumulative)	Top Lead group	Miscellaneous	Black Beauty	Iron Hood prospect (Pacific)	Lone Wolf	Open Pit (Lone Mountain)	Fox Creek Ranch	Black Beauty	Carlin Black Matrix	An.
Z	A mj	Le Le	sce1	ack	on H	ne M	en F	X Cr	ack	rlir	Unknown
		Tor	Mis	Bla	Irc	Loi	op	Fo	B1,	Ca	Ch
1	on Plate 2										
7	on On Plate 2				က	Н					
1 +	- A	1									

1/Includes published figures.

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(P.172 & Mous)

#### Montello phosphate area

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
SE½	39	67	Valley Pass, Loray	
SW <sup>1</sup> <sub>4</sub>	39	68	Loray	
1,2,3,4	38	67	Valley Pass, Loray	
W <sup>1</sup> 2	38	68	Loray	

The Montello phosphate area is along the crest and lower east slopes of Murdock Mountain south of Montello Canyon, north of Loray, and 5-11 miles west of Montello. The southern part of the area overlaps the north side of the Loray mining district.

Prospecting permits 1888 065997, 067058, and 067059 from the Conservation Division, U.S. Geological Survey, were in effect from December 1, 1965, to August 31, 1972. Exploration by trenching and drilling exposed faulted segments of phosphatic shale in five or more localities. The thickest interval sampled was 14 feet that assayed 15.77 percent P205. The highest grade found was 20.5 percent P205 across 5.5 feet. No production has been reported as of mid-1973.

The geologic setting of the Meade Peak Member of the Phosphoria Formation is summarized under Pequop phosphate area.

## Location and History

Sections (Approx.)	Twp.	1000	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
All	37	63	Moor Summit	
All	37	64	Moor Summit	

The Moor district covers the north end of the Wood Hills south of Moor Summit and the north end of Independence Valley south of Highway U.S. 40.

A test lot of 500 tons of limestone for use in sugar refining was quarried prior to 1964 from beds 3-8 feet thick in the SW4 sec. 7, T. 37 N., R. 64 E.

The limestone analyzed 97.18 percent CaCO<sub>3</sub>, 1.2 percent MgCO<sub>3</sub>, 1.35 percent SiO<sub>2</sub>, 0.13 percent Fe<sub>2</sub>O<sub>3</sub>, and 0.02 percent Al<sub>2</sub>O<sub>3</sub> (Southern Pacific Co., 1964, p. 128).

Deposits of decorative marble in secs. 13 and 21, T. 37 N., R. 63 E., deposits of silica in the S½ of the same township, and a lead prospect in sec. 13 were also reported by the Southern Pacific Co. (1964, p. 129, 137, 94).

The most recent work, about 1971, in the area was exploratory drilling, presumably of a thrust fault, near the lead prospect a mile southwest of Moor siding.

# Geologic Setting and Ore Deposits

The north end of the Wood Hills consists of sedimentary strata, predominately dolomites and limestones, ranging in age from Cambrian to Pennsylvanian and Permian(?) that are folded along northeast-trending axes and displaced along thrust faults in two localities, one near Moor Summit and the other in the west foothills 3-6 miles southeast of Wells. On the lower west slopes these eastern assemblage formations are overlain by sedimentary strata of Tertiary age; one outcrop of bedded chert and argillite is mapped as "western facies(?)."

Dumps at the "Mines" shown on the map of the Moor Summit quadrangle near Moor Summit are of shattered limestone cemented by many small calcite veinlets. Some of the dump rock may have been used for aggregate. Near Wadel Spring prospect shafts 5-10 10 feet deep explored quartz veins as much as a foot wide along the bedding in gently dipping limestone. Malachite, azurite, chalcocite, and iron oxides occur sparsely in the quartz.

The lead prospect in sec. 13, T. 37 N., R. 63 E., was explored for a length of 85 feet and a depth of 30 feet. Galena occurs in stringers and pods in an oxidized zone ½-3½ feet wide that strikes N. 70° E. and dips 30°-60° S. in brecciated limestone.

Iron prospects in sec. 24, T. 37 N., R. 63 E. were explored by several trenches, pits, and adits. Gossans to 6 feet wide strike northeast for several hundred feet and dip steeply in calcareous mylonite (Southern Pacific Co., 1964, p. 93).

## Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
25,26,35,36	46	53	Mountain City	Murray(?), Cope, Duck Valley Indian Reservation
All	46 45		Mountain City Owyhee, Mountain City	Fairweather, Sooner Cope, Marseilles (sec. 21) Van Duzer (S 1/3), Rio Tinto
All	45	54	Mountain City	Cope, Van Duzer (secs. 31,31)
1,2,3	44	53	Wild Horse	Van Duzer

The Mountain City district extends from Van Duzer Creek and the Wild Horse Range on the south to Winter Ridge (Pin Mountain?) on the north, and from the headwaters of Mill Creek on the west to Rough Mountain and Merritt Mountain on the east. It includes the following older districts:

Cope - California Creek (lode and placer), Hansen Gulch (placer), Grasshopper Gulch (lode and placer), and Mill Creek (Rio Tinto lode mine)

Murray - " \* \* \* in the northwest corner of the county, Cope joins it on the southeast." (White 1871, p. 61).

Sooner - " \* \* \* formerly known as Fairweather \* \* \* about ten miles east of Mountain City, in the Bruneau range \* \* \*." (Thompson and West, 1881, p. 395)

Marseilles (Mountain Laurel patent) - sec. 21, T. 45 N., R. 53 E.

Van Duzer - placers on Van Duzer and Cobb Creeks.

Land Office records are listed under Cope and Van Duzer districts.

Silver-gold lode deposits were discovered in 1869 in the Cope, Murray, and Fairweather districts. Those in the Cope district led to the founding of Mountain City and to a silver rush in 1870 when the new town grew to a population of about 1,000. Over \$1,000,000 in silver was produced prior to 1881 (Granger and others, 1957, p. 114). Gold placers discovered in 1893 in the Van Duzer district were worked intermittently (Emmons, 1910, p. 84) and yielded about \$150,000.

The district is best known, however, for the Rio Tinto Copper mine and the gratifying story of its discovery.— The mine produced \$21 million,

/Footnote near here

making Mountain City the leading district in the county. From its discovery in 1931 until the mine closed in 1947, the Rio Tinto deposit yielded 1,109,878 tons of ore averaging 9.7 percent copper, 0.3 oz of silver, and 0.006 oz of gold per ton. Of the 216,326,000 lb of copper produced, 92,460,238 lb was recovered from 177,043 tons of ore averaging 26.1 percent copper shipped directly to the Garfield (A.S. & R. Co.) and Tooele (I.S. & R. Co.) smelters in Utah. The remaining 932,835 tons of ore averaging 6.6 percent copper was concentrated at the mine (Coats and Stephens, 1968, p. 1077) and the concentrate shipped to the Tooele smelter. During much of its life the mine yielded the highest grade copper ore produced in the United States.

Manganese ore was produced from the Wicker mine in 1943.

Tungsten ores were produced from the Golden Ensign mine during the 1950's(?), but the major production was silver-gold ore.

"His stoic determination and faith in the property was manifested when he continued to seek funds and finally made a deal with Ogden C. Chase, local broker, to continue development of the property. Mr. Chase agreed to furnish \$50,000 for the work, but when the ore was struck only \$7,000 had been spent.

"The depression worked a hardship upon Mr. Chase and he had difficulty in raising the funds, so he instituted a new and unique method of financing. Mr. Chase gave the stock away with the agreement that stockholders would pay 5 cents per share in assessments. The fifth assessment had been levied when the ore was encountered and the stock has since advanced to around 20 cents a share." (Western Mineral Survey and Utah Statesman, v. 13, no. 30, July 22, 1932.)

Uranium was discovered in 1954, and by 1959 eleven or more prospects had been found, three of which resulted in commercial production (table 37).

#### TABLE 37 NEAR HERE

As of 1963, the largest uranium producer in the county was the Racetrack mine which yielded nearly 10,000 lb of U<sub>3</sub>O<sub>8</sub> (Schilling, 1963b). Exploration for uranium in the California Basin area was still in progress in 1971.

During 1970-71, development was in progress to prepare unmined portions of the Rio Tinto deposit for extraction. The Footwall ore body will be partly removed to permit block caving, and the broken ore will be leached in place through drill holes from the surface. Production is expected to be 4.8 million pounds of copper per year.

#### Geologic Setting

The oldest rocks exposed in the Mountain City area are two members of the Valmy Formation of Ordovician age. A lower siliceous member, possibly more than 10,000 feet thick, consisting of cherts and greenstone with at least two interbedded quartzite units and one phyllite unit, is overlain by an upper argillaceous member more than 1,100 feet thick, composed of black and gray well-bedded phyllite. The phyllite of the upper member, locally termed "Rio Tinto shale," is subdivided into five units based on color which are readily distinguishable underground but not on the surface. The lowest unit, a black phyllite (schistose shale) with chert layers near the base, is more than 100 feet thick; the second is thin alternating layers of gray and black well-bedded phyllite (Footwall shale) 450-710 feet thick; and the middle unit, which is the host rock of the Rio Tinto lode, is a black carbonaceous shale

Table 37.--Mountain City mining district, mines through 1969
[10]. main product; o, by-product; x, occurrence]

Location (MDBM)
Sec.
36
25
1,6
36

Table 37.--Mountain City mining district, mines through 1969--Continued

Total value	Molybdenum Tungsten Oreanium of dollars)	\$ >		0	5-100		K.	?	2-100	1,000	<		<b>~</b> 2	< 5	>100	<5	45	21,000
Commodity	Manganese														0			
Ommo	Lead	0						0	0	0				0	0			
0	Copper	0						0	0	0				0	0			•
	Silver	•						0	•	•	0		•	•	•	0		0
	Go1d	0			•		•	•	0	0	•		0	0	•	•		0
BM)	ж й	54			23	23	53	53	53	53,54		53			53		53	53
on (ME	i ż	45			45	1+5	45	45	45	415		. 45			94		94	45
Location (MDBM)	Sec.	9			34	SEN 2	1	1	21	1,12,6		2,10,11			35,36		35,36	2,10,1
Mine or prospect	(A mine may have several names; production is cumulative)	Mariposa	Mercury (see Mountain City Mercur)	Mill Creek(?)	Morrison-Knudsen placer	Mountain City Copper (see Rio Tinto)	Mountain City placer	Mountain City Mercur	Mountain Laurel	Nelson	Nevada placer	North Star group (Rio Tinto)	Pardner	Pioneer	Protection group	Protection placer - Maggie Gulch	Resurrection (1888-1892)	Rio Tinto (Mountain City Copper)
Index no.	on Plate 2				o	ω		7							1		က	

Table 37.--Mountain City mining district, mines through 1969--Continued

Trados no	Mine an another	Tocat	Location (MDBM)	BM)	K.		Com	Commodity	t			Total value	lue
on Plate 2	(A mine may have several names; production is cumulative)	Se co	H N	1	Cold Cold	соррет	Lead	Sinc	Wolybdenum Manganese	Tungsten	muinsaU	when sold1/ (in thousands of dollars)	ldl/ ands rs)
	Silver Banner (see Golden Ensign)	1,6	45	53,54									
	Silver Cougar placer											<5	
	Small Fry				0	0						<5	
ħ	Soft Snap (Soap)	36	94	53									
	Tea Kettle				0							<5	
	Walker Boy	36	94	53	0	0	0					<5	
	Woodward											<5	
	Wyoming placer	26	94	53	0							<5	
	Miscellaneous				0	0						<5	
	Miscellaneous				0	0	•					<5	
	Miscellaneous placer											<5	
	East Fork				*						•	<5	
	Garnet (see Alder dist.)												
	Golden Ensign (Banner)	1,6	45	53,54					×	0			
	Hawk	33	94	54									
	Hot Spot	7	45	53							•		

Table 37.--Mountain City mining district, mines through 1969--Continued

Index no.	Map or prospect	Location (MDBM)	ICM) uc	3M)	Commodity	Total value
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	. K	· ·	Gold Silver Copper Lead Zinc Manganese Molybdenum Tungsten Tungsten	when sold 1/ (in thousands of dollars)
2	Racetrack No. 1	31	94	54		5-100
	Rimrock	26	94	54		
	South Fork (Pixley)	36	94	54		<b>~</b> 5
	Tag	2	45	54		
	Wicker (W. side Merritt Mtn.)	¢.				< 2
	No name (1959) Gems (Petrified wood)	(poom pa				

1/ Includes published figures.

130-250 feet thick. The fourth unit is a well-bedded black phyllite (Hanging wall black shale) 110-250 feet thick, and the uppermost unit is a limy, gray, well-bedded phyllitic shale more than 370 feet thick.

South of the Mountain City area about 4 miles, bluish gray limestone with argillaceous members and thin quartzite lenses is in thrust fault contact with and underlies the Valmy Formation. It is part of the "Eastern assemblage" (see Part I of this bulletin) of predominately carbonate strata.

Overlying the Valmy unconformably are five other Paleozoic formations which may total 15,000 feet thick--Grossman conglomerate, Banner limestone, Nelson metavolcanics (amphibolites), Mountain City graphitic phyllite, etc., and the Reservation Hill siltstone, etc. (see Part I).

The Paleozoic formations are intruded by a stock of quartz monzonite, as much as 12 miles across, of late Cretaceous age. Unconformably overlying the stock and the Paleozoic formations are erosional remnants of four mutually unconformable volcanic formations and an interlayered mudflow, all of Tertiary age, which may total about 700 feet thick.

In parts of the Owyhee River valley the Paleozoic rocks are overlain by that gold-bearing quartzite gravels of Quaternary age occupy terraces at three different altitudes. These gravels are noteworthy for their coarseness-boulders as large as 17 feet--and evidently were transported by the Tertiary mudflow and reworked by the Owyhee River.

The Paleozoic formations are tilted moderately to steeply northward, and are cut by faults of at least three different ages.

Many steep normal faults and a few local thrust faults that

trend northwest and have relatively large horizontal components of are older than the quartz monzonite. They may be contemporaneous with the Roberts Mountain thrust fault of early Mississippian(?) age which is inferred to underlie the area at a depth of about 5,000 feet. Also older than the stock is an east-trending bedding fault along the middle unit of the Rio Tinto shale. Cutting the quartz monzonite and all older rocks, are steep normal that faults strike in various directions and have vertical displacements of not more than a few hundred feet. Some of these faults contain silvergold-bearing quartz veins. Later normal faults that trend northward to eastward and dip generally northwest displace the Rio Tinto ore body as much as 130 feet horizontally and the Tertiary volcanics 400 feet or more vertically.

## Ore Deposits

The mineral deposits are of eight different mineralogic types, manganese, copper, tungsten, molybdenum, gold, silver-gold, uranium, and placer gold. Each type resulted from different combinations of ore controls, and range in age from Paleozoic to Holocene. All types except molybdenum have been commercially productive.

Manganese deposits

Oldest of the eight types is a bedded deposit of rhodonite, rhodochrosite, and bementite. Several carloads of ore were shipped from the Wicker mine during 1943. The ore shipped contained about 40 percent manganese and was classed as high silica. Rio Tinto copper deposit

The Rio Tinto mine contains the only large deposit of high grade, predominantly copper-bearing ore in the district. The geologic setting of the Rio Tinto deposit is also unique.

The main Rio Tinto deposit is a tabular lode along a bedding plane shear zone 150 feet wide that strikes eastward and dips 65°-85° N. in black carbonaceous phyllitic shale of the middle unit of the upper member of the Valmy Formation. The lode contains both primary and secondary (supergene) copper minerals. The primary minerals are later in age than the Nelson Formation (Upper Mississippian) and apparently earlier than the quartz monzonite (Late Cretaceous). Coats and Stephens (1968, p. 1098) infer from inconclusive evidence that they may be related genetically to late Paleozoic mafic vulcanism, later than the Roberts Mountains thrust fault. Secondary enrichment, however, is of early Tertiary and Recent ages.

A subsidiary deposit in the footwall of the lode contains only secondary oxide and sulfide copper minerals derived from the weathered portion of the lode.

At the surface (altitude 6,100) and to a depth of about 200 feet, the Rio Tinto lode is represented only by a leached gossan. The surface exposure is about 400 feet long and 100 feet wide, but at the 200 level (altitude 5,880 feet), the gossan is more than 1,000 feet long and 40—80 feet wide. Below the gossan and above the water table at about 230 feet a thin discontinuous layer of oxide copper minerals was locally minable. Below the water table massive high-grade secondary copper sulfides in the chalcocite zone extend downward to a depth of 330 feet

interlayered with increasing thicknesses of massive primary ore. Below the massive secondary ore various mixtures of secondary and primary sulfides were found in irregular ground water channels to depths of 430 feet, below which only primary sulfides occur.

The lode is displaced by postmineral faults both along and across its strike. Breccia and gouge of those along the strike obscure the channel ways through which the ore-forming solutions were introduced. Northwest-dipping normal faults across the strike offset the ore body, cutting it into four main segments and several minor ones that rake down to the west.

The greatest horizontal displacement is 130 feet along the easternmost (No. 1) fault which separates the lode into two ore bodies, one above and the other below the fault. This fault also helped to localize the subsidiary supergene ore body in the footwall of the lode.

Three principal ore bodies yielded nearly all of the ore mined. Two of them, the 200 and the 600, named for the mine levels where they were discovered, two series of faulted segments of the main lode separated by the No. 1 fault. The third or Footwall ore body is the secondary deposit in the footwall of the lode.

The 200 ore body yielded over half the ore. It was about 1,200 feet long, as much as 92 feet wide, and extended 300 feet down the dip from the 200 level to the No. 1 fault. Four nearly contiguous segments were stoped to assay-walls for 1,060 feet along the strike and as much as 80 feet wide between the 200 and 500 levels. The largest segment was unbroken for 500 feet along the 200 level. The 200 ore body contained both primary and secondary (supergene) ore minerals.

The primary minerals in the ore are predominately quartz, pyrite, and chalcopyrite. A little galena was found in one locality and sphalerite occurs sparsely throughout. Grade of the primary ore rarely exceeded 10 percent copper and is estimated to have averaged between 6 and 7 percent before being enriched by secondary sulfides.

Oxide copper minerals are concentrated at the top of the "200" ore body in a blanketlayer 6 inches to 20 feet thick immediately above the water table where malachite, azurite, cuprite, native copper, and residual chalcopyrite constituted shipping ore in only one place. From this layer to the surface the oxide zone, including the surface gossan, is almost completely leached of copper minerals, and contains a porous mass of quartz, iron oxides, and seams of yellow-brown mud with only occasional specks of malachite, azurite, and cuprite. Below the oxide zone a little native copper was found as deep as the 400 level.

Secondary ore in the "200" ore body was in part massive and high grade, especially at the east end along and near its hanging wall. If the ore was bluish black in color, without metallic luster, and contained about 35 percent chalcocite, 35 percent chalcopyrite, 5 percent covellite, 1 to 5 percent oxide copper minerals, and 20 to 24 percent gangue, most of which was quartz, although gangue minerals were not evident in hand samples (Smith, A. M., 1932b, p. 5). The largest shoot of massive secondary ore was as much as 240 feet long, 75 feet wide, and extended 150 feet down the dip from the 200° level. Other parts of the ore body were interlayered masses or lenses of pyrite, chalcopyrite, and quartz partly replaced by chalcocite, bornite, and covellite. Grade of the massive secondary ore ranged from 25 to 55 percent copper.

The "600" ore body was stoped 300 feet along the strike between the 450 and 650 levels. It was explored down the dip to the 1000 level (altitude 5,077) below which only two small lenses persist. The "600" ore body contained only primary sulfides similar in mineralogy and grade to the primary ore in the "200" ore body.

Along the mineralized zone below and west of the "600" ore body, quartz, pyrite, and sphalerite persist for 2,500 feet intermittently along the 700 and 1000 levels.

The third or Footwall ore body is localized in the Footwall shale and the upper part of the underlying schistose shale south of the east end of the lode partly above but mostly below the No. 1 fault. It extends virtually at right angles from the lode southward for 700 feet attaining a width of 300 feet and a thickness of about 230 feet between depths below the surface of 220 and 450 feet. It is estimated to contain more than 600,000 tons, less than a third of which was mined. It contains only disseminated secondary copper minerals derived from the leached and eroded portions of the main lode and transported into the footwall. Elsewhere along the main lode, secondary solutions were confined within it by impervious clay alteration and gouge instead of being disseminated into the wallrock. In the upper part of the Footwall ore body, cuprite, native copper, malachite, and azurite predominate, whereas in the lower part chalcocite is more abundant. These secondary copper minerals replace metamorphic pyrite which is disseminated throughout the phyllite, or they fill small openings in the rock. Chalcocite occurs also in rods of dark-gray quartz which are common in the Footwall shales.

Average grade of the Footwall ore body was about 1 percent copper, but the unmined part may be somewhat lower.

massive The origin of the Rio Tinto (Mountain City), sulfide deposit is not known, but its characteristics conform closely to those postulated for volcanic-exhalative bodies deposited on and near the flanks of submarine volcanoes near a continental margin and above a subduction zone or a rift zone (Sillitoe, 1973, p. 1321; Hutchinson, 1973, p. 1223). In theory, volcanic heat activates the convection of fluids that rise along fractures to the sea floor, are cooled, and precipitate silica, barite, calcite, and sulfide minerals in low spots on the sea floor or along fractures below the sea floor. During the mineralizing process, which may last for thousands of years, massive sulfides are deposited during intervals of volcanic quiesence; disseminated deposits may form during eruptive or sedimentary intervals. Solutions may vary in composition from time to time resulting in layered deposits. Proximal deposits overlie the vent areas; distal deposits accumulate at distanceas great as 10 miles from the volcanic centers. Below proximal deposits alteration "pipes" are commonly silicified, chloritized, sericitized, and mineralized with disseminated and stringer ore to depths of as much as 3,000 feet. Outside the "pipes", veins and stringer deposits may form at various distances. The massive deposits may be covered by more volcanic rock or by marine sediments. Continued subduction or rifting uplifts, tilts or folds, metamorphoses, and fractures the host rocks, displacing and deforming the ore bodies. This interpretation implies that the Mountain City deposit is of Ordovician age and was transported eastward to its present location as a part of the Upper plate of the Q. major ARoberts Mountain thrust fault.

Tungsten deposits

Contact metamorphic deposits of scheelite in tactite occur near the quartz monzonite stock. The only recorded production is from the Golden Ensign mine.

Molybdenum deposits

Molybdenite occurs in quartz veinlets and disseminated in parts of the quartz monzonite. Traces of this mineral are found at the surface in many localities in the Granite Ridge area. Molybdenite also occurs with silvergold ores of the Golden Ensign mine, and with pyrite in quartz veins or disseminated in quartz monzonite at Huber Hill (Schilling, 1962a, p. 13). There has been no production of molybdenite from the district.

Gold-quartz veins

Gold-bearing pyritic quartz veins are found in the Paleozoic formations and in the quartz monzonite. They are considered to be of Cretaceous age (Roberts and others, 1971, p. 29). These veins are narrow and low grade, and have not been extensively mined or prospected, although they may have contributed gold to the placer deposits.

Silver-gold quartz veins

Silver-gold-bearing quartz veins occupy faults that cut only the quartz monzonite and older rocks. Rhyolitic tuffs of Tertiary age, however, are hydrothermally altered near some of these veins, suggesting that the mineralization may be any age less than middle Oligocene (Roberts and others, 1971, p. 29). These veins strike in various directions, the most common being northwest. They are brecciated, and many of them are cut off by normal faults both along and across their strikes. In a historical account of the silver mines, Smith (1932a, p. 7) reported:

7409H

"All the stories end the same way--the vein terminated against a fault \* \* \* at depths of less than 200 feet." Ore shoots in these veins are subsequently as much as 5 feet wide, 100 feet long, and have been mined as deep as about 600 feet. The primary ore contains pyrite, galena, sphalerite, tetrahedrite, arsenopyrite, chalcopyrite, argentite, and free gold. Nearly all the production, however, has come from oxidized ores which contain cerargyrite, pyromophite, lead and copper carbonates, chrysocolla, native gold and silver, pyrargyrite, and stephanite. These deposits were the first to be discovered and yielded virtually all the production before 1931. The largest are the Golden Ensign (Silver Banner), Protection, Resurrection, Nelson, and Mountain City. One of them, the Protection deposit, was reopened in 1946 and in a 3-year period produced 2,000 tons averaging about 40 oz sof silver and 0.75 oz of gold per ton (Roberts and others, 1971. p. 29).

Uranium deposits occur in Tertiary conglomerates and tuffs only where these rocks overlie the eroded surface of the quartz monzonite, which has a background radioactivity count above average, particularly where it is intruded by aplite dikes. The conglomerates are a few inches to several feet thick distributed erratically on the quartz monzonite. The tuffs overlie the conglomerates or rest directly on the quartz monzonite and are a few feet to several hundred feet thick. The uranium deposits are localized along porous or permeable layers generally within the basal 30 feet of the host rocks, although a few lenses are as much as 100 feet above the quartz monzonite. In at least one prospect, uranium minerals are disseminated in weathered quartz monzonite, and in another they are in an aplite dike.

The ore bodies are lenses a few inches to 25 feet thick and as much as 100 feet wide and 200 feet long. Lenses of ore grade (0.3 percent  $U_3 O_8$ ) as large as 1,400 tons were found during the 1950's.

Ore minerals occur as fillings in cracks and pore spaces in the rocks, or they partly replace fragments of lignitized or opalized wood. The most common ore mineral is autunite, but locally meta-tyuyamunite, uranophane, or torbernite may predominate. Grade of the deposits is commonly less than 0.25 percent U<sub>3</sub>0<sub>8</sub> (chemical assay), but a few exceeded 0.3 percent. One mineralized log assayed 0.5 percent U<sub>3</sub>0<sub>8</sub>. Placer gold deposits

Small-scale placer mining operations have been carried on intermittently along the Owyhee River, Grasshopper Gulch, and Hansen Gulch, a dredge was operated on Van Duzer Creek, and a dragline on Cobb Creek. Placer deposits were worked on both sides of the Owyhee River for several miles north of Mountain City, Grasshopper Gulch was profitably mined for about half a mile, Van Duzer Creek was mined by hydraulic monitor and dredge above the ranch lands for 2 miles, and Cobb Creek, a tributary of Van Duzer Creek, was mined for about 1½ miles starting a mile above Van Duzer Creek.

Largest of the deposits was along Van Duzer Creek where the gold-bearing gravel channel was 50-200200 feet wide and as much as 15 feet deep. The gold may have been derived in part from the Quaternary terrace gravels and in part directly from quartz veins.

Gold particles range in size from fine dust to nuggets weighing 5 or 6 oz (Emmons, 1910, p. 84). The gold content of gravels worked in 1948 and 1949 was 33¢ and 70¢ per cubic yard (Johnson, 1973, p. 21).

LIUU OPLILIE	Mud	Sp	rin	gs
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#### District

#### Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
A11	28	60	Elko 2°	Medicine Springs, Dead Horse,
				Butte Valley

The district covers the north end of the Medicine Range in south-central Elko County between Ruby Valley and Butte Valley. The range is about 12 miles long from north to south, 7 miles wide, and rises steeply from 6,000 feet to the three 9,000-foot High Bald Peaks.

Lead-silver ore was discovered in 1910 and the first shipments were to the United States Smelting and Refining Company smelter at Salt Lake City in 1915. A 100-ton flotation plant was installed in 1929, but only a small tonnage was treated and the plant was dismantled. A 60-ton wet concentrating plant (four tables) was installed in 1950 at Medicine Springs and about 1,300 tons from the Silver Butte mine was milled in 1950 and 1951. A few tons were produced from the Rainbow group in 1953 and the Johnnie 1 and 2 claims in 1956. No further production is recorded through 1969.

The Silver Butte mine, which yielded most of the ore from the district, is developed by a 600-foot vertical shaft and six levels from the 150- to the 400-foot level that total about 4,000 feet of workings (Granger, 1957, p. 124).

## Geologic Setting and Ore Deposits

The Medicine Range consists mainly of limestones, siltstones, dolomites, and cherts about 6,000 feet thick of Permian age, oldest of which is calcareous siltstone of the Riepetown Formation exposed only on the west side of the range. It is overlain successively by Pequop limestones, Loray siltstones, and the Park City Group (Kaibab limestone, Plympton chert-dolomite, Gerster siltstone-limestone-chert). Unconformably overlying these Permian formations in the northern parties, the range are interbedded sand, stones, chert conglomerates, limestones, and calcareous siltstones of these Thaynes Fermation of Triassic age. Thin lake beds of siltstone, sandstone, and limestone, flows of rhyolite ash, and remnants of basalt crop out locally in the pediment surrounding the range (Collinson, 1968).

The sedimentary formations are cut by many normal faults that strike north to northeast and dip steeply west or are vertical. Apparent displacement is more than 4,000 feet along the southwest front of the range, but at the north end of the range some major faults barely separate thin Triassic strata. The fault pattern in the Medicine Range resembles that of the upper plate of the Golconda thrust on Battle Mountain in Lander County (Collinson, 1968, p. 39). Between the faults the beds are tilted moderately east, forming north-trending ridges capped by beds that resist erosion.

Quartz diorite porphyry crops out along or near some of the faults, and fragments of dacite are found on the dump of the Silver Butte mine. The ore deposits are along faults in limestones of the Gerster and Thaynes Formations.

The ore bodies are narrow veins along shear zones as much as 50 feet wide and 2,000 feet long made up of many individual interlacing fault strands. The of vein material ore shoots are discontinuous overlapping lenses, as much as 3 feet wide, 60 feet long, and were mined to depths of 400 feet in the Silver Butte mine, where they are localized at intersections of major strands of a fault zone, although not all intersections contain ore.

Gangue minerals are barite with some quartz and calcite. Jasperoid crops out along some of the faults. The main ore mineral is argentiferous galena in veinlets up to 6 inches wide and in isolated pods in the barite. Cerussite, anglesite, and smithsonite with variable amounts of silver occur with the galena on the upper levels (Hill, 1916, p. 65).

Grade of the ore mined averaged about 4.3 percent lead and 4 oz of silver per ton, but locally the silver content was as high as 40 oz per ton. Concentrates averaged about 55 percent lead and 19 oz silver per ton.

TABLE 38 NEAR HERE

Table 38.--Mud Springs mining district, mines through 1969
[•, main product; o, by-product]

Index no.	Mine or prospect	Loce	Location (MDBM)	)BM)		Comm	Commodity	y	Total value
on Plate 2	(A min P	Sec.	T.	ж й	сотд	Silver	copper	Lead	when sold (in thousands of dollars
	Al Smith					•	0	•	<b>^</b>
	Black Metals				0	•	0	0	<5
	Dead Horse (Silver Butte)								
	Evening Star					0	0	•	<5
	Fasano					0			<5
	Johnnie 1 and 2	ţ,	27(?)	09	0	0	0		<5
	Monitor					0		•	<5
	Mud Springs					•			<b>&lt;</b> 5
	Rainbow group				0	0			<5
-	Silver Butte	24	28	09	0	0	0	0	2-100
	Silver Crown				0	•		0	<5
						-			THE CHARLES AND A SECOND SECON

## Pequop phosphate area

## Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
E 1 2	31	64	Spruce Mtn. 4	Boone Spring, southern Pequop Mts.
A11	31	65	Spruce Mtn. 4	Do.
NE <del>1</del>	30	64	Spruce Mtn. 4, Elko 2°	Do.
NW4	30	65	Spruce Mtn. 4, Elko 2°	Do.

The Pequop phosphate area includes the south end of the southern Pequop Mountains, east of and adjoining the Spruce Mountain mining district. Phosphorite is exposed in two elongate roughly parallel outcrops about 2 miles apart, one extending about 10 miles along the summit of the range and the other along the lower east slope (pl. 1).

Prospecting permits No. 064931, 064932, 066342, 067054, 067055, and 067056 from the Conservation Division, U.S. Geological Survey, were in effect from January 1, 1965, to August 31, 1972. Exploration, mostly along the summit of the range, by 9 trenches and several drill holes further exposed phosphorite in 15 or more localities. No production has been reported as of mid-1973.

## Geologic Setting and Ore Deposits

The phosphate deposits in eastern Elko County (see also Montello area, Elko and Coal Mine districts) are in the western fringe of the western phosphate field of Idaho, Montana, Wyoming, and Utah, consisting of interbedded locally phosphatic shale, mudstone, sandstone, chert, and carbonate rock deposited in an ocean basin—during

-/Ocean water is constantly moving, even on the bottom. Where deep, cold ocean currents impinge on a continental shelf, or on each other, they may be diverted upward to the surface where the water is warmed. Since the ocean is nearly saturated with phosphate, which is 30 times more soluble in cold than in warm water, the upwelling water becomes supersaturated and phosphate is precipitated in shallower water as pellets that accumulate with silt, chert, limestone, and organic material to form phosphorite.

the Permian period. Phosphorite occurs in all these strata but is more abundant in the shales. Phosphorite is not a very distinctive rock. Most

phosphorites consist of dark-colored sand-sized phosphatic pellets and nodules up to about 1-1/2 inches across in a matrix of shale, chert, sandstone, or limy rock. Organic matter, including petroleum, is so common that many deposits are black. High-grade phosphorite is fairly heavy, and may have a bluish-gray coating (phosphate bloom) on weathered surfaces. The average phosphorite is about 80 percent carbonate-fluor-apatite, 10 percent quartz, 5 percent muscovite-illite, 2 percent organic matter, 1 percent dolomite calcite, 1 percent iron oxide, and 1 percent other components (Gulbrandsen, 1966, p. 769).

<sup>—</sup> The terms "phosphorite" and "phosphate rock" both apply to any rock containing commercial amounts of phosphorus, but "phosphorite" is usually restricted to deposits of marine origin.

The phosphate mineral in the pellets and nodules is of variable composition. It is basically a carbonate-fluor-apatite of which 3 - 4 percent is fluorine, and in which uranium, thorium, vanadium, and other metals or nonmetals may substitute for calcium or phosphorus. All phosphorites contain uranium (0.005 to 0.05 percent), usually in amounts high enough to be detected by gamma-ray well logging and even by airborne radiation counters. Fluorine and vanadium have been produced as by-products; uranium, nickel, molybdenum, and chromium are potential by-products; and about 20 other metals commonly occur in trace amounts (Gulbrandsen, 1966, table 1).

In the western phosphate field, phosphorite occurs in three different
Permian formations, Phosphoria, Park City, and Shedhorn Formations; a little
occurs in some underlying Mississippian strata. The three formations are of
different compositions which interfinger or grade laterally into one another.
The Phosphoria cherts and shales and the Park City cherts, shales, carbonate
rocks, and sandstones comprise the main part of the field, but the Shedhorn
sandstone is found only in Montana and Wyoming.

The Phosphoria Formation in and near its type locality at Phosphoria Gulch, Bear Lake County, Idaho, is 250 - 450 feet thick; the formation thickens to about 1,300 feet in south-central Idaho. It consists of four members underlain by siliceous dolomite of the Grandeur Formation (Permian) and overlain by limy shale of the Dinwoody formation (Triassic). In one measured section the thickness of the oldest member, the Meade Peak Phosphatic Shale, is 200 feet; it is overlain successively by Rex Chert (156 feet), Cherty shale (67 feet), and the Retort Phosphatic Shale Member (30 feet).

The Park City Formation near its type locality in Big Cottonwood Canyon near Salt Lake City, Utah, is about 800 feet thick. It consists of three members underlain by a thin limestone bed at the top of the Weber Quartzite (Pennsylvanian) and overlain by red shales of the Woodside formation (Triassic). The oldest member, the Grandeur dolomite, is 278 feet thick; it is overlain successively by Meade Peak Phosphatic Shale (300 feet) and Franson dolomitesandstone-chert 235 feet thick (McKelvey and others, 1959).

The Meade Peak Member is the main source of phosphorite in the southern part of the western phosphate field; the Retort Member is mined in Montana. In some places the shales contain beds a few inches to 22 feet thick of nearly pure phosphatic material containing as much as 39 percent  $P_20_5$ . High-grade phosphorite contains over 31 percent  $P_20_5$  and is commonly mined from beds 2  $\rightarrow$  7 feet thick. Low- or furnace-grade rock averaging 24 percent  $P_20_5$  or more is mined from beds as much as 40 feet thick. Most phosphorite is mined from open pits, and production of a million tons or one a year is common.

Prices for most phosphate rock are based on the percent BPL (bone phosphate of lime), which is tricalcium phosphate,  $Ca_3(PO_4)_2$ . In the Western States, analyses are usually reported in percent  $P_2O_5$  (%  $P_2O_5$  x 2.184 = % BPL). "Spot" and contract prices are negotiated and are not quoted in trade journals, but averages for various grades are shown in Minerals Yearbook (U.S. Bureau of Mines).

In Nevada, the Phosphoria extends as far west as the Adobe Range in Elko County and reaches a maximum thickness of about 4,000 feet in northeastern Elko County, but the thickness of the Meade Peak member is only 25 to 100 feet. The Retort member grades laterally into the Cherty shale member or into bioclastic limestone which, in Elko County, are not phosphatic. The Park City Formation grades laterally westward into, or intertongues with, the Park City Group of three formations, the Kaibab Limestone (oldest), the Plympton dolomite-chert-mudstone-limestone-sandstone, and the Gerster Limestone (youngest). They extend as far south as the Schell Creek Range in White Pine County and in southeastern Elko County they total about 1,700 feet thick. The Plympton Formation is the partial equivalent of the Meade Peak member of the Park City Formation. In contrast to the Kaibab and Gerster it is nonfossiliferous and locally contains thin beds of phosphatic black chert and carbonate rock.

In the southern Pequop Mountains, the Plympton Formation (equivalent to the Meade Peak Member of the Park City Formation) is about 1,100 feet thick. It contains thin beds of phosphorite in the lower 200 feet, which is predominately cherty, and also in the middle 300 feet and upper 200 feet, which are mostly dolomitic (Yochelson and Fraser, 1973, p. 22). In the localities explored, the phosphorite beds are nearly vertical and extend for about 10 miles northeastward along the summit and also along the lower east flank of the range. The greatest thickness sampled was 36.2 feet that assayed 10.5 percent P<sub>2</sub>O<sub>5</sub>; the highest grade was 20.2 percent P<sub>2</sub>O<sub>5</sub> across 6 feet.

Pilot Peak District

## Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
A11	36	70	Pilot Peak, Shafter 1 NE	Pilots Peak district Pilot Mountain district

The district covers the south end of the Pilot Range south of Pilot Peak, altitude 10,704. Gold and silver mines and prospects are at altitudes of 6,000-6,200 on the lower southeast slopes.

A few tons of silver-copper-gold ore was produced in 1936 and a little gold-silver ore in 1936 and 1938.

#### Geologic Setting

Pilot Peak is composed mainly of sedimentary rocks, the oldest of which are argillites and conglomeratic quartzites of the McCoy Creek group (of Misch and Hazzard) of Precambrian age exposed at the west base of the peak. They are overlain by Prospect Mountain Quartzite of Cambrian age that extends to the summit. The lower south and east slopes are mainly east-dipping limestones of Cambrian through Pennsylvanian ages. These sedimentary formations are displaced a few feet to several thousand feet along normal faults that strike generally northward or eastward. Small outcrops of Tertiary intrusive rocks are shown on plate 1 along the east side of the range, and fragments of diorite and granodiorite were found on the limestone dump of the crosscut adit in section 20.

TABLE 39 NEAR HERE

Table 39. -- Pilot Peak mining district, mines through 1969

	[•, main	[. main product; o, by-product]	, by-	product]		
Index no.	Mine or prospect	Location (MDBM)	n (MI	(MBM)	Commodity	Total value
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	T. N.	В. Б.	Copper Silver Gold	when sold (in thousands of dollars)
	American Flag	20	36	70		
1	Badger	20	36	70	0	<b>&lt;</b> 5
2	Crazy Dutchman	20	36	70	0	<5
	Dead Cedar (see Ferguson Spring dist.)					
	Pilot limestone quarry (see Proctor dist.	dist.				

# Proctor <u>District</u>

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
A11	35	68	Shafter?	Silver Zone district
A11	34	68		Limestone
(?)	34	69		Placer claims

The district includes Silver Zone Pass in the Toano Range. Silver-copper deposits are about a mile north of Proctor, a station on the Western Pacific Railroad, and a railroad crosses a productive tungsten deposit about a quarter of a mile northeast of Silver Zone Pass.

Production of silver and silver-copper ores was reported for the year 1917 and of tungsten ore for 1942. Limestone was mined from the Pilot quarry half a mile west of Pilot siding by Utah Construction and Mining Co. during 1960; a sample shipment was made to an out-of-state lime plant. Land Office records are filed under "Unknown mining district." They include patent surveys of three placer claims listed in table 40 .

TABLE 40 NEAR HERE

Table 40.--Proctor mining district, mines through 1969

	Total value	when sold (in thousands of dollars)	<5			<b>~</b> 22		<5	5-100
currence	Commodity	Silver Copper Tungsten Stone				0	×		
, x, occ	JBM)	. i	89	69	69	89	89	89	89
oduct	on (MI	T. N.	35	34	34	35	35	34	35
o, by-pr	Location (MDBM)	Sec.	15(?)			15(?)	8,9,16	14,23	16(?)
[. main product; o, by-product; x, occurrence]	Mine or prospe	(A mine may have several names; production is cumulative)	Keystone (Nickel Duke, Del Duke)	Klondike King 1 & 2 placer	Mary Lou placer	Silver Hoard	Hice prospect	Pilot quarry	Rare metals
	Index no.	on Plate 2					`	£)	4

# Geologic Setting and Ore Deposits

Limestones and hornfels of Cambrian and Ordovician ages that dip about 35° eastward are intruded by a Jurassic granodiorite stock about 2 miles across,

which is exposed on both slopes of the range both north and south of the pass. The granodiorite is cut by steep faults that strike north, northeast, and northwest; a few of the north- and northeast-striking faults contain quartz veins as much as 10 feet wide. Some of the veins contain a little pyrite and argentiferous galena, and a few small lenses of scheelite ore, but over most of their lengths they are barren.

The tungsten deposits are scheelite-bearing quartz veins, four of them about a quarter of a mile northeast of Silver Zone Pass near and north of the railroad, and four others on the west side of the pass. Only one of the middle veins on the east side has been mined. It is a vertical north-striking vein 3 - 4 feet wide exposed for 650 feet north of the railroad and again for 50 feet about 150 feet south of the tracks. The vein is displaced as much as 40 feet by four transverse faults.

The ore shoot that was mined was about 300 feet north of the railroad. It contained scheelite crystals one-fourth inch across in a mineralized layer as much as 18 inches thick along the east wall of the vein for a length of 40 feet and a depth of 35 feet. It averaged about 1½ percent WO3; one shipment of 27 tons of sorted ore contained 8.5 percent WO3 (M. R. Klepper, written commun., 1942).

## Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
SE½	31	52	Carlin	Barite mines
S <sup>1</sup> <sub>2</sub>	31	53	Carlin, Dixie Flats	Bullion district
NE½	30	52	Carlin, Pine Valley	
$N_{2}^{1}$	30	53	Carlin, Dixie Flats,	Bullion district
			Pine Valley,	
			Robinson Mtn.	

The Railroad district, probably so named because it was only 12 miles from the Central Pacific (now Southern Pacific) Railroad at Palisade, has also been called the Bullion district, but the latter name is discouraged since there is a Bullion district in Lander County. Organized in 1869, the Railroad district included the silver-lead-copper mines and the nearby camp of Highland, all high on the slopes of Bullion (Bunker) Hill, a northtrending spur of Ravens Nest which is the highest peak (altitude 8,710) in the Pinon (Pinyon) Range.

During the early 1870's the district was called the Empire City district after the name of a mining company which erected a furnace of local sandstone having a smelting capacity of 15 tons of ore per day. The "Empire City district, J. M. Hussey, superintendent," was listed by Whitehill (1875, p. 164) in a table showing the net proceeds (\$17,470.50) of the mine for the year 1873.

By 1873, two smelters were in operation at Bullion City (Old Bullion) treating ores from the Standing Elk and seven smaller mines (Emmons, 1910, p. 89-95). Production continued through 1887, then ceased entirely until 1905 (Granger and others, 1957, p. 127) when the properties were consolidated and two low-level adits were started at the new camp of Bullion between Highland and Bullion City. The longer Davis Tunnel was driven to explore the projected downward continuation of the Standing Elk ore bodies 1,000 feet below the 600 level and 6,040 feet from the portal. (The target area was finally reached in 1959 but no ore was found.) The Webfoot Tunnel, sharing the same portal area and dump, has a 900-foot drift and several hundred feet of crosscuts below the Webfoot workings. Since 1910 most of the intermittent production is credited to the Aladdin mine which includes the Standing Elk group with more than 10,000 feet of underground workings. Of the total estimated production through 1968 valued at \$4,715,189 (table 5 ), only about \$1,734,000 is recorded (Ketner and Smith, 1963, p. B17).

Since about 1930, the district has included barite deposits on Dixie Creek and on the west slopes of Pine Mountain. The Dixie (Snow White) mine produced a few hundred tons of barite in 1955.

#### Geologic Setting

The Piñon Range in the area of Ravens Nest consists of sedimentary rocks (Ordovician-Mississippian) about a mile thick which have been folded, faulted, intruded by a granitic stock and by rhyolite porphyry dikes, and metamorphosed, hydrothermally altered, and mineralized near the stock. Most of the ore mined was along intersections of dikes and faults.

The sedimentary rocks along the crest of the range in a belt about a mile wide are predominately dolomite and limestone about 2,300 feet thick of the Lone Mountain, Nevada, and Devils Gate Formations. Along the west slopes of the range they are overlain by argillite and quartzite units and by black siliceous argillite about 3,000 feet thick of Mississippian age. The east slopes are covered by Tertiary volcanic rocks a few hundred feet thick (Ketner and Smith, 1963, pl. 1).

The sedimentary rocks are folded and locally overturned along the Piñon Range anticline, but in general the beds on the east side of the range dip east and those on the west side dip west. Along the west side of the anticline black siliceous argillite overlies the argillite-quartzite units, probably along a bedding-plane thrust fault younger(?) than the Roberts Mountains thrust of Late Devonian to Early Mississippian age. In the central part of the anticline the strata are complexly displaced along reverse and normal faults of all attitudes having displacements of a few inches to a thousand feet or more. Elsewhere in the Piñon Range, concealed faulted segments of Roberts Mountains thrust breccia are inferred between the Nevada limestone and the overlying siliceous formations.

A stock of quartz diorite-granodiorite-monzonite 4,000 feet across intrudes the limestone-dolomite-argillite strata near the axis of the anticline. Along the intrusive contact on the east side of the stock the limestone is metamorphosed to tactite in a zone 3,000 feet long and 100-400 feet wide, and at distances up to about 1,000 feet beyond the limestone is marbleized. The stock has a core 2,500 feet across of rhyolite (quartz) porphyry and dikes of similar rhyolite porphyry cut the rim of the stock, the tactite, and the surrounding strata within a mile of the stock. The largest of these dikes, 4,000 feet long and as much as 700 feet wide, trends northward about 4,500 feet east of the stock. Most of the ore deposits are between this dike and the stock.

#### Ore deposits

Three types of deposits have been mined: replacement and contactmetamorphic deposits of copper, lead, silver, and zinc in the Bunker Hill
area, and barite veins on the west side of Pine Mountain. Four other types,
gold-bearing quartz veins, disseminated copper-molybdenum, scheelitebearing tactite, and halloysite alteration deposits, are too low grade or
too small to be commercial as of 1971.

Most of the ore mined was from replacement deposits in the Standing Elk (Aladdin) mine. Here the ore bodies are pipelike replacement bodies in marbleized limestone along the Bunker Hill and other rhyolite porphyry dikes at their intersections with faults. The largest ore body was about 50 feet in diameter, extended through a vertical range of about 400 feet, and yielded more than 50,000 tons of oxidized ore containing 18.2 percent lead, 5.4 percent copper, and 19 ozoces of silver per ton. Oxidation is nearly complete to depths of about 500 feet. The ore minerals are cerussite, cerargyrite, copper pitch, duftite, malachite, azurite, chrysocolla, cuprite, and chalcocite, with some residual argentiferous galena, chalcopyrite, bornite, and sphalerite. The most abundant gangue minerals are quartz, calcite, kaolinite, iron and manganese oxides, halloysite, barite, and residual pyrite and pyrrhotite.

Contact metamorphic deposits of copper and iron sulfides in tactite were mined in the Sweepstakes (Delmas) mine. In some parts of the tactite, pyrite, pyrrhotite, chalcopyrite, bornite, galena, and sphalerite are intergrown with garnet, diopside, and other skarn minerals. Locally the sulfides are partly oxidized to copper carbonates and iron oxides or coated with chalcocite, but oxidation is not complete, even at the surface. Some shipments before 1908 averaged 70 oz silver per ton, 10.4 percent copper, and 2.8 percent lead (Emmons, 1910, p. 95).

Barite deposits were discovered on the west slopes of Pine Mountain about 1930 and nearly 2,500 tons was mined in 1931, 1956, and 1957. The deposits are veins in limestone of the Nevada Formation.

Deposits of the following commodities occur in the same or other types of deposits but are not of commercial size and (or) grade.

Beryllonite occurs in small quantities with duftite in the oxidized replacement deposits.

Gold occurs in quartz veins that cut the granitic stock. The largest vein, which is near the Delmas mine, is exposed here and there for 500 feet along the strike, is 2-4 feet wide, and was said to carry about 0.07 oz gold per ton (Emmons, 1910, p. 93).

Hematite occurs in replacement deposits in limestone near an intrusive contact on the Silver King and Sun claims (table 41). The exposures are 3-60 feet wide and a few feet to 200 feet long. Small lenses are of ore grade, but most of the material is estimated to contain less than 40 percent Fe (Shawe and others, 1962).

Table 41. -- Railroad mining district, mines through 1969

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	Mine or prospect  (A mine may have several names;	Location (MDBM)  veral names; T. R.	Location (MDBM) T. R	on (MI	BM) R.		STATE OF THE PARTY	Commodit	Commodity	ty	l et.	Total value when sold (in thousands
		S	Sec.	,	ь						Wollastoni	of dollars.
	Aladdin (Nevada-Bunker Hill)		4	30	53	0.57	TONS		•	1000		>100
	Bald Mountain Chief (see Hecla) 33	33		31	53							
	Blue Wing							0				<5
	Brodine											
	Bullion 4	#		30	53			0				<5
	Burke											
	Como (see Sweepstake)											
	33,34 Copper Bell	33,34		31	53	0	0	0				2-100
	Copper Creek 15	15		28	53		0					<5
	Copper Queen						0					<5
	Davis Tunnel											
	Delmas (see Sweepstake)											
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	E1k					0		0				2-100
23 23	Emmov					0	0					2-100
233	Gray Eagle											
<ul><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><li>•</li><l< td=""><td>Grey Eagle 4,9</td><td>6,4</td><td></td><td>30</td><td>53</td><td>0</td><td>0</td><td>•</td><td></td><td></td><td></td><td>2-100</td></l<></ul>	Grey Eagle 4,9	6,4		30	53	0	0	•				2-100
53 0 0 0	Hale and Peterson						0					2-100
• 0	Hecla and Bald Mountain Chief #	#		30	53	0	0					2-100
	Helen M					0	0					2-100

Table 41.--Railroad mining district, mines through 1969--Continued

	Total value when sold (in thousands of dollars)		2-100	<b>&lt;</b> 5	2-100	2-100	<5	2-100		<5		>100	<5		<5		<5	\$	<5		<.5
	ad ad and a side and a	Lea Tu Tu Ba		•	0	0	0	0				0 •	0					•	• •		0
The state of	Тубр	1	·	0	0	0		0		0		0					0	0			
	PT	05)		0	0	0		0				0	0						0		
	Location (MDBM)  T. R. ec. N. E.							30 53										30,31 53		30 53	
	Locat							4										4,33		3,4	
	Mine or prospect (A mine may have several names; production is cumulative)		Hula	Independence	Kentucky	Key	King Alfred	Lee (William S. Lee)	Mahogany	Mayflower	Mendota	Nevada-Bunker Hill (Aladdin)	Nevada Pine	Palisade	Phillipine no. 2	Red Bird	San Hone	Silver King	Siri	Sky Blue	Stafford
	Index no.											8									

Table 41.--Railroad mining district, mines through 1969--Continued

Total value	Total value when sold (in thousands of dollars)			>100		<5	2-100	2-100	2-100			<5						2-100	50 tons	
Commodity	ə		Gold Silver Copper Lead Zinc Iron Tungster Marite	0 0 0		0 • 0 0		0 • 0	• • • • • •			0 • 0 0	×	×	×	×	×	•		•
Location (MDBM)	T. R.	Sec. N. E.		4 30 53		33 31 53			33,4 31,30 53	4 30 53	4 30 53			SE 33 31 53		2 30 53			26,35,36 31 52	
Mine or prospect	(A mine may have several names;	production is cumulative)		Standing Elk (1886-1887)	Storm King	Sun (Sunshine)	Sweepstake - Como	Sweepstakes	Sylvania	Tripoli	Webfoot	Weston	Iron prospect	Silver King and Sun	Aladdin	Noonday prospect	Aladdin	Hijenks (Graves)	Pine Mountain (1931)	Snow White
Index no.	on Plate 2			m					က	က	m								1	

2126

Ilmenite derived from volcanic rocks occurs with magnetite in placer deposits in the Dixie Creek area (T. 31 N., R. 54 E.). A placer sample contained 5.9 percent ilmenite and 44 percent magnetite. Surface samples contained a maximum of 0.3 percent TiO<sub>2</sub> (Beal, 1963, p. 15).

Magnetite and some intergrown hematite occur with garnet and diopside in the contact metamorphic deposits.

Halloysite is abundant on the 500 level of the Standing Elk mine and in many of the mine dumps, but none was found on the Davis Tunnel level.

Molybdenite occurs with chalcopyrite disseminated in the rhyolite porphyry. Exploratory drill holes from the surface indicate increasing amounts with depth. Samples from one of the holes assayed 0.01-0.3 percent copper and 0.01-0.09 percent Mo (H. K. Stager, written commun., 1970).

Oil shale occurs in sedimentary rocks of Tertiary age along the east side of the Pinon Range (Ketner, 1970, p. Blos).

Scheelite-bearing tactite 2-3 feet wide is exposed for 30 feet in the Davis Tunnel about 3,000 feet from the portal. Assays ranged from 0.3 to 4.3 percent WO<sub>3</sub>. Tactite is also exposed in the Tripoli mine and on the surface 1,000 feet above the Davis Tunnel. A beryllium-rich mineral occurs in tactite at an unidentified location.

Wollastonite is abundant in large zones of intensely silicated limestone on the Davis Tunnel level.

## Robinson Mountain District

#### Location and History

Sections (Approx.)	Twp N.	. Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks					
NE4	29	52	Pine Valley	Ásphaltite					
$N\frac{1}{2}$	29	53	Robinson Mtn., Pine Valley	Barite					
S½?	29	53	Robinson Mtn., Pine Valley	Copper Canyon district?					

The Robinson Mountain area includes both slopes of the Sulfur Spring Range for about 3 miles north and south of Robinson Mountain. The part of the east slope south of Robinson Mountain, in the drainage area of Robinson Creek, is also known as the Copper Canyon mining district (county records), but the name Robinson Mountain is preferred because there are two Copper Canyons in Lander County.

Small shipments of barite from an unnamed prospect in sec. 2, T. 29 N.,

R. 53 E., is the only production reported from the district (Horton, 1963, p. 8).

A 9-inch bed of grahamite and other bitumens in a sandstone stratum in conglomerate is reported by Southern Pacific Co. (1964, p. 126) in the N½N½ sec. 1, T. 29 N., R. 52 E. The deposit contains over 0.1 percent vanadium (Schilling, 1962d, map 10), and some uranium (Schilling, 1963b, map 19).

Rock Creek <u>District</u>

## Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks						
E1/2	40	48	McDermitt 2°	Falcon district						
A11	40	49	Mt. Blitzen 15'							

The Rock Creek district is in mountainous terrain in the Rock Creek drainage area west of the main Tuscarora Mountains, between 10 and 20 miles west of the town of Tuscarora.

Silver ore was discovered in 1876, and the Falcon mine was worked from 1879 to 1881. The Ruby King mine produced 3 tons in 1922, the April Fool group 34 tons in 1928 and 14 tons in 1950, and the Silver Globe 7 tons in 1938. Cinnabar was discovered in the district as early as 1929; the Teapot and Horse Mountain 1 & 2 mines produced 81 tons of ore containing 23 flasks of mercury during 1954-57.

In 1964, an area along Rock Creek below the Teapot mine was explored by the Cordero Mining Company with 116 vertical churn drill holes ranging in depth from 6 to 96 feet. Traces of cinnabar were found in 38 holes, and mineralized rock of ore grade in 6 holes. The best assay was 9.7 15 mercury per ton for a width of 12 feet (Ed Hager, oral commun., 1973).

Geologic Setting and Ore Deposits
Sedimentary rocks of the Valmy Formation (Ordovician)

Permian) are overlain by andesite and rhyolite flows and silicic tuffs of Eocene age. These formations are intruded by the Mount Neva granitic stock just east of the district, and by two rhyolitic stocks, each about a mile across, just north of the district. The stocks are all of Tertiary age. Erosion remmants of rhyolite and tuffaceous sedimentary rocks of Miocene age overlie the intruded rocks. Silver deposits are in the eastern part of the district about 2 miles from the Mount Neva stock. Mercury deposits are in the western part of the district 4-5 miles from the rhyolite stocks.

At the Falcon mine, andesite is cut by a north-trending vertical fault along which a quartz vein 2-5 feet wide was mined for ruby silver. There is no record of the amount mined under that name, but later production under the name of the April Fool group averaged about 0.35 oz gold and 428 oz silver per ton.

At the Teapot (and Horse Mountain?) mines and at the Rock Creek prospect(?) andesite is cut by north-trending faults that dip steeply east.

Along the faults, cinnabar occurs with pyrite in quartz veinlets and disseminated in altered andesite. Some stibnite is said to accompany the cinnabar at the Rock Creek prospect (Bailey and Phoenix, 1944, p. 63). Average grade of the recorded production was 21.6 1b of mercury per ton of ore treated.

TABLE 42 NEAR HERE

Table #2.--Rock Creek mining district, mines through 1969
[•, main product; o, by-product; x, occurrence]

Total value	when sold (in thousands of dollars)	2-100				<5		<5			0	<5	0	<5		<5
Commodity	Gold Silver Antimony Mercury	• 0				• •		•			•	•	• ×	•		•
MDBM)	R.	64		64							64		84	to the	•	64
Location (MDBM)	T.	04		04							04		04	04		04
Locat	Sec.	13		13								ggs)	23	13,24	dist.)	13
Mine or prospect	(A mine may have several names; production is cumulative)	April Fool group (Ruby Silver)	Divide (see Divide dist.)	Falcon (April Fool)	Rock Creek (April Fool)	Ruby King	Ruby Silver (April Fool)	Silver Globe	いいわれていい。	Boston (see Teapot)	Horse Mountain (see Staggs)	Horse Mountain 1 and 2 (see Staggs)	Rock Creek prospect	Staggs and Quilici	Stampede turquoise (see Beaver dist.	Teapot group (Salet)
Index no.	on Plate 2	1											2			

Ruby Mountain Range District (1915-29)
Ruby Range District (1949-58)

These omnibus names have been used in official records since 1915 for about 20 mines in unknown or unnamed districts in the Ruby Mountains and East Humboldt Range. In this report the mines are distributed either to a named district or to Unknown districts (table 54) as indicated in tables 43 and 44.

Production credited to Ruby Mountain Range and Ruby Range is 5,662 tons of lead-zinc ores containing some copper and a little silver and gold valued at about \$201,000. This production is included with the figures for UNDISTRIBUTED production in table 5.

TABLES 43 and 44 NEAR HERE

Table 43.--Ruby Mountain Range mining district, mines through 1969 [. main product; o, by-product]

Assigned	district	Lee	Lee	Ruby Valley	unknown	Ruby Valley	Warm Creek	unknown
Commodity	Gold Silver Copper Lead Zinc	0 0 0	•	•	•	• • • • •	• 0 0 0	• 0 • 0
Location (MDBM)	Sec. T. R. N. E.	32 31 37				1 30 58	23 33 61	unknown
. Wine or prospect	(A mine may have several names; production is cumulative)	American Beauty	Fordham	Lead King	L. C. (L. and C.)	Michigan	Polar Star	No name (3)
Index no.	on Plate 2							

Table #4.--Ruby Range mining district, mines through 1969

[●, main product; o, by-product]

Index no.	Mine or prospect	Location (MDBM)	(MDI	3M)		ŏ	Ommo	Commodity		Assigned	med
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	F. N.	ж :	org	ilver	opper opper	inc	ungsten anganese		ict
	American Beauty	33	31	28	2		-00 N	200	M	Lee	1
	Betty				0	0	0	0		unknown	
	Errington & Thiel (Holiday)									unknown	
	Friday (Battle Creek)	9	30	59	0	0	0			Ruby Valley	Lley
	Galena King				0	0	0	0		unknown	
	Galente #2 (Battle Creek)	1	30	58	0	0	0	0		Ruby Valley	Lley
	Giant				0	0	0	0		Lee	
	Good Luck				0	0	0	0		unknown	
	Hairgrove (Hargrove)	2	30	28	0	0	0	0		Lee	
	Hogie				0	0		0		unknown	
	Knob Hill (Long Canyon)	32	31	58	0	0	0	0		Lee	
	Phill (Errington & Thiel)									unknown	
	Summit King	17	28	57						Corral Creek	heek
	Summit View	21	28	57			0			Corral Creek	heek
	Thiel (Errington & Thiel)									unknown	
	Manganese Mountain #2									unknown	
	Stormy Night								•	unknown	
							1				1

## Ruby Valley <u>District</u>

#### Location and History

Sections (Approx.)	The second secon	Rge. E.	Quadrangle name (7½ or 15 minute)	Other	district names, Remarks
NE4	30	58	Lamoille, Franklin	n Lake NW	Smith Creek, Ruby Range districts
6, 7, 18	30	59	Lamoille, Franklin	n Lake NE	

The Ruby Valley district covers the drainage areas of Battle Creek and Meyers Creek, including Smith Gulch, on the east slope of the Ruby Mountains opposite the north end of Franklin Lake. Smith Creek is on the opposite side of the range.

Lead-zinc-silver ore was discovered and the Short group of claims was staked in 1903. Production from the Friday (Battle Creek) group is recorded for intermittent years from 1908 through 1955 and from the district through 1967. Scheelite was mined at the Battle Creek mine during 1944-46.6.

The unnamed district in T. 32 N., R. 59 E., listed by Lotz (1934, p. 18), contains a Smith Creek and may be the Ruby Valley district.

#### Geologic Setting and Ore Deposits

The Ruby Valley district covers areas of Prospect Mountain Quartzite and marbleized limestones of Cambrian age intruded by granites of Jurassic and Cretaceous ages. These areas include the northeastern part of the intrusive complex summarized under Valley View district.

In the Ruby Valley district the mines are in a narrow belt of white crystalline limestone of Cambrian age which strikes about N. 60° E. and dips 45° to 60° N. The limestone has been intruded by biotite granite of Jurassic(?) age. Near or along the intricate contact the limestone is metamorphosed in places to lenses of lime silicate rock commonly parallel with the bedding. Some of these contact metamorphic lenses contain lead, zinc, and copper sulfides, their oxidation products, a little silver, and a trace of gold. In most of the ore bodies galena was the main ore mineral, but in others sphalerite predominated (Hill, 1916, p. 60).

Highest yearly average grades for ores shipped since 1949 were 55 percent lead and 14.2 percent zinc from the Battle Creek group, 2.7 percent copper from the Copper King mine, and 1.3 Ozocas silver per ton from the Noonday mine.

At the Battle Creek tungsten mine scheelite accompanied by a little quartz and pyrite occurs in two lenses of chlorite schist surrounded by granite and pegmatite. The largest lens has a maximum width of 10 feet and is 100 feet long. About 900 units of WO<sub>3</sub> was produced from ore that averaged 1.5 percent WO<sub>3</sub>. A similar deposit, the Fawn Creek prospect south of Meyers Creek, was estimated to contain 0.5 percent WO<sub>3</sub> but has not been productive (D. M. Lemmon, written commun., 1948).

TABLE 45 NEAR HERE

Table 45.--Ruby Valley mining district, mines through 1969
[. main product; o, by-product; x, occurrence]

										1
Index no.	Mine or prospect	Location (MDBM)	lon (M	DBM)		Comm	Commodity	y	Total value	
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	. N	ж <del>г</del>	Gold	Silver	resq	Zinc Tungsten Mica	when sold (in thousands of dollars)	_
2	Battle Creek group (Friday)	1,12,	30	58,59	0	0	•	0	2-100	
	Betty open pit				0	0	•	0		
	Copper King				0	0			<b>^</b> 5	
	Crescent (Friday)									
	Francis, Mariana, Rodges				0	0	•		<b>^</b> 5	
	Friday (Noonday)				0	0	•		2-100	
	Galente no. 2 (see Friday)				0	0 0	•	0		
	Lead King					0	•		< 5	
	Long Canyon (see Lee dist.)									
1	Michigan (Short group)	1,2	30	58	0	0	•		5-100	
	Noonday (Friday) group				0	0	•	0	5-100	
	Ruby Valley (see Battle Creek)					0	•		<b>&lt;</b> 5	
	Short group									
		í								
	Baldwin Lease (Climax) (see Harrison Pass dist.)	son Pass di	Lst.)							

Climax (see Harrison Pass dist.)

Table 45.--Ruby Valley mining district, mines through 1969--Continued

Total value	when sold (in thousands of dollars)				2-100				
Commodity	Gold Silver Copper Lead Zinc Tungsten Mica			×	•		×	×	
Location (MDBM)	Sec. N. E.				1 30 58				
Mine or prospect	(A mine may have several names; production is cumulative)	Lakeview (see Harrison Pass dist.)	Star (see Harrison Pass dist.)	Anna D	Battle Creek	Noonday (see Railroad dist.)	Stormy Night	Ruby Valley (C. W. Kennedv. 1939-41)	· · · · · · · · · · · · · · · · · · ·
Index no.	on Plate 2								

(Should be 224a)

(P. 226 Follows)

#### Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
E 2/3	32	63	Spruce Mountain	Many prospects
A11	31	63	Spruce Mountain	Main part of district
W 1/2	31	64	Spruce Mountain	Mines and prospects

The Spruce Mountain district includes Spruce Mountain (altitude 10,262), a somewhat isolated peak west of the axis of the Pequop Mountains, and Spruce Mountain Ridge which extends northward from the peak.

Lead-silver ores were discovered at the Latham (Killie) mine in 1869, and at the Juniper, Fourth of July, and Black Forest mines shortly afterwards.

Three original districts, the Latham, Johnson, and Steptoe, were combined to form the Spruce Mountain district in 1871. The principal settlements were Sprucement on the lower west slope of the mountain, and Black Forest on the upper east slope.

Two smelters, one of 35 tons-per-day capacity at Sprucemont and another of 50 tons in Independence Valley, treated the ores produced in the early days. After about 1903-06 most of the ores were shipped to newly built custom smelters in Salt Lake Valley, Utah; transportation charges on the ore amounted to about half its value. Another 50-ton smelter was built in 1917 to treat ores from the Bullshead and Black Forest mines but only a trial run was made.

Production from the district has been intermittent, most of it during the years 1869-73, 1885-87, 1899-1909, and 1915-49. The most productive year was 1920 (\$388,160--Lincoln, 1923, p. 56). No production was reported between 1961 and 1970269.

The mines are developed by several miles of underground workings including a 7,000-foot tunnel between the two deepest mines, the Black Forest (400 feet) and the Monarch (600 feet), which are on opposite sides of the mountain. The tunnel has a maximum depth of 800 feet. An aerial tram 6,800 feet long conveyed ore from the Killie and Black Forest mines to a truck-loading station. Pipelines more than 2 miles long from springs supplied water to Sprucement and the Monarch mine camp.

All the largest mines are on Spruce Mountain, but several small mines and many prospects are located along the west foothills of Spruce Mountain Ridge. The Atlantic tungsten prospect was discovered in 1954 near the Keystone lead-silver mine, and the Devaney and White Boy barite deposits, prospected in 1956, are "near Sprucemont."

## Geologic Setting

The oldest rock exposed in the district is blue limestone of the Pogonip Formation of Ordovician age which crops out on the summit and west slope of Spruce Mountain, generally in beds 1-4 feet thick. It is overlain or is in fault contact with limestones, dolomites, shales, and quartzites of Silurian through Permian ages (pl. 1; Hope, 1972). The sedimentary rocks are tilted gently to moderately eastward, displaced along the Spruce Mountain thrust fault, and cut by steep north-, northwest-, and east-trending normal faults. A dike of granite porphyry 500 feet wide extends northeastward completely across the ridge, and three or more small irregular stocks of granite porphyry and diorite are intruded along and near the crest (Hill, 1916, p. 69). A lamprophyre dike was noted in the upper tunnel of the Black Forest mine (Schrader, 1931, p. 8).

Within 500 feet of the intrusives, but generally less than 30 feet, the limestones are metamorphosed to a skarn of quartz, calcite, diopside, garnet, fluorite, actinolite, and other pyroxenes (Granger and others, 1957, p. 139). The largest metamorphic zone is on the west side of the range; it is 500 feet wide and half a mile long at the west end and north of the main dike. Between them there are two prominent knoblike outcrops of iron-stained quartz breccia called "blowouts," the larger of which is 500 feet in diameter. On the east side of the range the northeastward continuation of the zone of intrusives is marked by outcrops of jasperoid.

#### Ore Deposits

Two kinds of metalliferous ore bodies were mined, bedded replacement deposits in limestone and fissure deposits along all three sets of normal faults in limestone, skarn, quartz breccia, and granite porphyry. In addition to the metal mines two vein type(?) deposits of barite and one contact deposit of scheelite have been prospected.

The bedded replacement ore shoots are commonly a few feet thick, as much as 100(?) feet long, and extend 100 feet or less from the fissures into the limestone. Bedded replacement deposits yielded most of the early production.

Vein ore shoots are as much as 15 feet wide and 360 feet long, but one fissure zone in the Spruce Standard mine is 20 feet wide. In this zone of closely spaced mineralized fissures, sphalerite is the principal ore mineral (Schrader, 1931, fig. 7). In the Black Forest mine some ore shoots at fault intersections were pipelike or globular bodies 3 feet or more in diameter, and at the Ada H mine a stockwork at intersecting fissures is 1,800 feet or more in extent. In the Killie lode, ore was localized at intersections of the lode with many fissures or slips which strike in various directions. In 1930 the lode had a known extent of 450 feet down a 28° dip, a width of 100 feet, and a thickness of 40 feet or more, and was estimated to contain 50,000 tons containing about 10 percent lead, 10 percent zinc, 3 ozness silver per ton, and a little gold (Schrader, 1931, p. 17). The deepest ore shoot in the district was mined to the 520-foot level in the Monarch mine.

Different ore bodies contained different proportions of lead, silver, copper, and zinc, but most ore bodies were valued mainly for lead and silver. Ore bodies in which copper predominates occur along and near the intrusives but zinc decreases with nearness to the granite porphyry in the Nevada Lead mine (table 46).

#### TABLE 46NEAR HERE

Oxidation extends irregularly to depths of 200 feet or more, and most of the production was from carbonate ores, although sulfide ores were mined in the deeper parts of the Black Forest, Nevada Lead, and Spruce Standard mines.

The primary ore minerals are argentiferous galena, chalcopyrite, bornite, and sphalerite. Oxide ore minerals are mainly cerussite, anglesite, malachite, chrysocolla, and lesser amounts of wulfenite, calamine, smithsonite, chalcocite, melaconite, and a yellow oxidized lead or antimony mineral. The silver content of the oxide ore is much higher than of the sulfides. Gangue minerals are quartz, calcite, and either pyrite, arsenopyrite, or limonite and manganese oxides.

Table 46.--Spruce Mountain mining district, mines through 1969
[6, main product; o, by-product; x, occurrence]

	Le, main product;	it, o, by-product,	מדים ממכי	64	occurrence.	20110	7		100		
Index no.	Mine or prospect	Location (MDBM)	(MD) uc	BM)		Comm	Commodity	A		Tot	Total value
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	H.	ж . Э	gerg Gorg	Copper	Lead	Zinc Tungsten	Molybdenum		when sold (in thousands of dollars)
	Ada H	21	31	63	0	0					5-100
	Badger	14	31	63	3	•	0				
	Banner Hill	11	31	63		9					
	Big and Little Dick				0	0 0	0				<5
	Bingle (Bingo)	14	31	63							
	Bingo	1,4	31	63		•					
5	Black Forest (see Monarch)	13	31	63	0	0	•				2-100
	Bronco Tunnel	1,4	31	63							
	Bullshead (Index)				0	0	•	0			>100
4	Copper Queen	1,4	31	63		•	0				
	Errington & Thiel (Holiday) (see Ruby Range)	Ruby Range									
	Fourth of July	14(2)	31	63		•					5-100
	Hartley				0	0					<b>^</b> 2
	Humbug (Parker)				0	0	•				2-100
	Index (Bullshead)	13,14	31	63	0	0	•				- 22
	Juniper (Latham & Juniper	13,14	31	63							
	Keystone (Banner Hill claim)	14	31	63	0	0	•	0			<b>~</b> 5

Table 46.--Spruce Mountain mining district, mines through 1969--Continued

	To		Lead Zinc Tungste Molybde Barite			5-100	>100	0 2-100	>100	5-100		<5		< 5·		< 5	<5	0	>100
	Commodity		Copper			0	0	0	0		•	•	0	0		0	0		0
	CO		Silver			0	0	•	0	0		0	0	0		•	0		0
			COTA				0	0	0	0		0	0	0		0			0
	DBM)	Б.		63	63	63	63	63	63		63		63	<del>1</del> 9	63			63	
	Location (MDBM)	H.N.		31	31	31	31	31	31		31		31	31	31			31	
135: Mg D)	Locat	Sec.		14	14	14	14,23		14		13		16,17	7,18	13			13	
A TRAIN THOU	Mine or prospect	(A mine may have several names; production is cumulative)		Killie (Latham, Nevada Lead)	Latham (Killie)	Latham & Juniper (Killie)	Monarch	Monarch-Black Forest	Nevada Lead (Killie)	0.D. No. 1 (Humbug?)	Never Sweat	Pals	Paramount	Parker (Humbug)	Porphyry Tunnel	Rainbow	Silver Lady	Spence	Spruce-Monarch
	Index no.	on Plate 2					2		က										

Table 46.--Spruce Mountain mining district, mines through 1969--Continued

	Total value	when sold (in thousands of dollars)	>100			<5	<5				×	×
	y	Wolybdenum Tungsten						×	×	×		
	Commodity	Sinc	0				0					
	ommo	Lead				•	•					
DATE AND DESCRIPTION OF THE PERSON OF THE PE	0	Copper	0		•	0 0	0 0					
000	i i	Gold	0			U						
HC.C.	( W	전 다	63		63			63				
Timered - 1	n (MDB	H.	31		31			31				The same
odnicely on the	Location (MDBM)	Sec.	21		22(?)			13,14			ont)	prucemont)
	Mine or prospect	(A mine may have several names; production is cumulative)	Spruce Standard	Standard	Tramp	Valley claim	Miscellaneous	Atlantic claim prospect	Lead-silver mines	Monarch	White Boy prospect (near Sprucemont)	Devaney, Howard prospect (near Sprucemont)
	Index no.	on Plate 2	1									

The average grade of all the ore mined was about 11 percent lead,

12 oz silver, and 0.01 oz gold per ton, but some shipments of lead-silver

ore contained 22 percent lead and 24 oz silver per ton, and others about

40 percent lead and 15 oz silver. Residual nodules of galena a few inches

in diameter in the oxidized ore contain about 65 percent lead and a

little silver. Copper ores averaged as much as 45 percent copper and 20 oz

silver per ton (Fourth of July mine). Zinc was recovered from ores con
taining 22 percent lead, 13 percent zinc, 5 percent manganese, 5 percent

iron, 4 oz silver, and 0.005 oz gold per ton (Granger and others, 1957,

p. 143).

Scheelite occurs on the Atlantic claim disseminated in tactite and as pods or stringers in a granitic dike 80 feet wide near its contact with the tactite for a distance of 160 feet. Samples assayed 0.5-2.0 percent WO<sub>3</sub> (A. C. Johnson and W. T. Benson, written commun., 1963).

Swales Mountain <u>District</u>

# Location and History

Sections (Approx.)	Twp.	Rge.	Quadrangle name Other district names, Remarks (7½ or 15 minute)	
S1/2	36	52	Swales Mountain, S. Mtn. NW	
SW <sup>1</sup> / <sub>4</sub>	36	53	Swales Mountain	
N <sup>1</sup> / <sub>2</sub>	35	52	Swales Mountain NW, Swales Mountain	
NE4	35	53	Swales Mountain	

The Swales Mountain district includes Fish Creek Mountain and Swales Mountain at the south end of the Independence Mountains about 15 miles north of Carlin.

Numerous gold and barite deposits have been explored but no production was recorded through 1969.

## Geologic Setting and Ore Deposits

Chert and shale strata about 4,700 feet thick of the Vinini Formation (western assemblage) of Ordovician age in the upper plate of three thrust faults of Mississippian or younger age overlie younger limestones (eastern assemblage) of Silurian (Roberts Mountains Formation), Devonian, and Mississippian ages which total more than 3,400 feet thick. The lower plate limestones are exposed only on the east slope of Swales Mountain in a fault window 2 miles long from north to south and about a mile wide. Both plates are intruded by irregular stocks, dikes, and sills of quartz porphyry, all of which are intruded by a stock and dikes of monzonite porphyry of Eocene to Oligocene age exposed within and outside the window. Large areas around Swales Mountain are covered by latite flows of Eocene-Oligocene age or by sandstones of Miocene-Pliocene age. Pleistocene fanglomerates and one Holocene landslide nearly a mile long are exposed along the east flank of the mountain (Evans and Ketner, 1971).

Numerous prospects, presumably of gold, in and near the window are nearly all in limestones of the lower plate near their contacts with the monzonite porphyry, but a few are in the upper plate near thrust faults and at least one is in the intrusive. Numerous pits and several shafts and adits were driven on narrow seams of iron oxides and residual pyrite. Three vertical holes core drilled in 1967 by the U.S. Geological Survey (Heavy Meta).

found only weakly anomalous zones of silver, lead, gold, molybdenum, mercury, and barite. Two of the holes were in limestones of the lower plate, the other was collared in the upper plate, cut the Roberts Mountains(?) thrust, and bottomed in the lower plate (Ketner and others, 1968, p. 5).

Both plates, and the thrust fault that separates them, have been folded into a north-trending anticline which may have been caused by forcible emplacement of the intrusive rocks. Mineralized rock is exposed mainly along contacts of porphyry with upper plate chert and monzonite with lower plate limestone. This geologic setting is similar to those of the gold deposits at the Carlin, Cortez, and Gold Acres mines (Ketner and others, 1968, p. 13).

Barite deposits of two genetic types, vein and replacement, on the west side of Swales Mountain in T. 35 N., R. 52 E., have been explored (Horton, 1963, p. 7, 8). At the Big Three (Chaliebois or Big Four?) prospect in sec. 2, veins of barite a few inches wide along a network of faults in shale and chert of the Vinini Formation were explored by numerous bulldozer cuts. At the Heavy Spar prospect in sec. 10, dark-gray sugary barite replacing silicified shale and chert of the Vinini Formation in an area 10 feet wide and 330 feet long was explored by four shallow bulldozer cuts.

-					
T.	P	0	0	m	a

#### District

## Location and History

Sections (Approx.)	Twp.		Quadrangle name (7½ or 15 minute)	Other district names	, Rema
1, 12, 13	41	69	Jackson Spring		
N-2/3	41	70	Jackson Spring		**

The Tecoma district includes an area about 4 miles square on the southern edge of the Goose Creek Hills at an altitude of about 5,600 feet. Tecoma siding on the Southern Pacific Railroad is 9 miles south in Tecoma Valley.

The Jackson mine was discovered in 1906 (Hill, 1916, p. 104) and was a small, fairly steady producer during the years 1907-22 and 1948-55). Small shipments were made from the Star mine in 1932, the Desert Rat in 1937, and the Big Joe in 1941 (table 47).

TABLE 47 NEAR HERE

Table 47.--Tecoma mining district, mines through 1969
[•, main product; o, by-product]

Index no.	Mine or prospect	Location (MDBM)	MD]	BM)	Con	Commodity	Y	Total value
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	H.	ж :	Gold	Copper	Lead Zinc	when sold (in thousands of dollars)
	Big Joe					0	0	<5
	Black Warrior (see Lucin dist.)							
	Cunepah (see Lucin dist.)							
	Davenport (see Charleston dist.)			1000年の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の				
	Desert Rat					•	0	<b>&lt;</b> 2
	Durham claims	SE% 18 41	41	70				
1	Jackson (Bullock)	NE% 18	111	70	0	0	•	>100
1	Jackson group				0	0	0	2-100
	Lucky Boy							
	Queen of the West	17	41	70			0 0	
	Star					0	•	<b>\$</b>
	Tecoma (see Lucin dist.)							

# Geologic Setting and Ore Deposits

In the Tecoma district, limestones, dolomites, shales, and quartzites ranging in age from Devonian to Permian are tilted 20°-40° NE., complexly faulted, and intruded by small bodies of a porphyritic igneous rock of Early Pliocene(?) age exposed in surface pits and mine workings. Most of the faults strike north and dip either east or west; a few strike east and dip south. In the area of the Jackson mine, blue and gray limestone of Devonian age is silicified to jasperoid along two north-striking faults about 1,000 feet apart. The eastern jasperoid zone is about 200 feet wide and several thousand feet long, the western zone is about 40 feet wide, 500 feet long, and dips 45° W. The ore bodies of the Jackson mine are in the western zone of silicified limestone, and do not extend into fresh limestone, dolomite, or shale.

The ore bodies are veins along fractures that strike north and dip either east or west; most of the ore mined was from west-dipping fractures. The ore shoots range from 20 to 50 feet in length, 1 to 10 feet in width, and have been mined to depths of 250 feet. Exploration at a depth of 365 feet in 1953 was unsuccessful.

The ore minerals are mainly argentiferous cerussite and a few small pods of residual galena. Museum specimens of wulfenite on calcite were found in the upper workings of the Jackson(?) mine (Schilling, 1962a, p. 13). Gangue minerals include calcite, clay, iron oxides, quartz, and locally barite and halloysite. Oxidation is estimated to extend to a depth of about 500 feet. Average grade of shipments of screened ore during the 1950's was about 17 percent lead, 4.2 oz mes silver and 0.01 oz me gold per ton, and 0.14 percent copper; some shipments also contained 0.85 percent zinc. Some shipments of sorted, oxidized ore from the Queen of the West mine, which may be partly in Utah, contained 80 oz mes of silver per ton and as much as 18 percent zinc (Hill, 1916, p. 105).

## Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute	e) Other district names, Remarks
SE <sup>1</sup> / <sub>4</sub>	40	50	Mount Blitzen	Prospects
S <sup>1</sup> <sub>2</sub>	40	51	Mount Blitzen,	Tuscarora Principal silver mines
3	39	50	Mount Blitzen	Berry Creek mercury mine
N 1/3	39	51	Mount Blitzen,	Tuscarora Original placer discoveries

The Tuscarora district was first organized to include only placer and lode gold deposits along and near McCann Creek, then enlarged to include the silvergold mines in and north of the present town of Tuscarora, and now is considered to include also the mercury mine and prospects in the drainage areas of Berry and McCann Creeks.

placer gold along McCann Creek and gold-bearing ledges nearby were discovered in 1867 (Browne, 1868, p. 429), but only the placers were worked until 1871 when the Young America claim was staked on a silver prospect in what is now the center of Tuscarora. The first shipments of silver ore were made in 1875, and although they averaged less than \$30 a ton, they stimulated prospecting which led to the discovery of bonanza silver ore at the Grand Prize mine in 1876 and to the Tuscarora Silver Rush of 1877. Production from the 15 largest mines and several smaller ones exceeded \$1 million in only 12 years, 1878 and 1879, and declined to less than \$152,000 in 1881 (Nolan, 1936, p. 12). The Navajo mine accounted for a revival of production in 1884, the Commonwealth in 1890, and the Dexter from 1897 to 1904, but most of the declining production since 1905 was from the Dexter dumps and tailings. No production of silver has been reported since 1963.

Placer production in the early days probably did not exceed 36,000 oz (Johnson, 1973, p. 97) and total production of all metals--silver, gold, lead, copper, and mercury--through 1969 was \$10,715,651.

Production figures for the district (table 5 ) include 12 tons of mercury ore which yielded two flasks of mercury valued at \$519 from the Berry Creek and Silverado mines during the 1950's. No production of metals was reported from the district from 1964 through 1969.

#### Geologic setting

The oldest rock unit exposed in the district is quartzite and black chert of the Valmy Formation of Ordovician age. It is poorly exposed about 200 feet north of the northwest corner of the Found Treasure No. 2 claim (Nolan, 1936, p. 17), and well exposed north of the district (pl. 1). The quartzite-chert unit is overlain by bedded andesite breccias and tuffs with interbedded andesite lava flows which are all light colored and total about 5,000 feet thick. These light-colored rocks are intruded by a large stock northwest of the district. By a plan of andesite

irregular bodies of dark-greenish andesite of Oligocene(?) age. The intrusive andesite bodies are as much as half a mile wide and a mile long. They trend generally northward and are of indeterminate dip, although one chilled border dips 65° W. (Nolan, 1936, p. 20). Overlying the igneous rocks along the lower southeast slopes of Mount Blitzen, alluvial gravels of Quaternary age as much as 30 feet thick cap erosion surfaces of the andesites.

The bedded andesites are regionally tilted 15°-50° E. or SE., are steeply domed around the intrusive plug, and are cut by shear zones which trend east or northeast and dip steeply. They are also locally fractured or jointed along zones that trend eastward and dip northward at low angles. Both the shear zones and the fracture zones are locally mineralized.

The intrusive andesites are cut by three sets of faults; one set strikes a few degrees west of north and dips west, another set strikes nearly east and dips northward, and the third set strikes northeast and dips northwest. Faults of the first two sets are locally mineralized and those of the third are postmineral normal faults of small displacement.

#### Ore deposits

Ore deposits of four different kinds have been mined in the district: gold-bearing stockworks in the bedded andesites, silver-rich lodes mostly in the intrusive andesites, mercury deposits in the bedded andesites, and gold placers in the gravel capping. Rutile and other titanium minerals are primary constituents universally present in the bedded andesites in non-commercial amounts. One specimen contained 0.4 percent TiO<sub>2</sub>.

Most of the silver ore contains gold, and in some of the silver lodes there are separate gold ore shoots. Similarly, the gold deposits contain by weight more silver than gold. These relationships suggest that the composition of the mineralizing solutions changed progressively with time, and that during the mineralizing process different channelways were open at different times.

Alteration is a notable feature of the district. Both the bedded and the intrusive andesites exhibit two types of alteration, an earlier chloritization (propylitization) and later adularization (Nolan, 1936, p. 24). Chloritization is peripheral to the adularia alteration. In the chloritized areas the original minerals of the andesite are replaced by chlorite, albite, calcite, pyrite, and sericite. Adularization is most intense near the centers of mineralization; silicification and bleaching of the bedded andesites is so widespread by the addition of quartz, adularia, and clay minerals that the rock has been classed as rhyolite (Emmons, 1910, p. 59). Smaller amounts of apatite and sericite are common. In the bedded andesites, which are more permeable, both kinds of alteration are intense and widespread, whereas in the more dense intrusive andesites alteration is restricted to sporadic adularization of the wallrocks in the immediate vicinity of the lodes.

Adularization has been dated at 38 m.y. (M. L. Silberman and E. H. McKee, written commun., 1974).

### Gold deposits

The gold deposits are stockworks along fracture zones that trend eastward and dip northward at low angles in adularized bedded andesite extending from the southern edge of Tuscarora southwestward to Beard Hill.

The largest gold deposit was at the Dexter mine just south of Tuscarora where a highly fractured or jointed zone 1,400 feet long and 200 feet wide was mined to a depth of 300 feet. The fractures strike in all directions and contain many closely spaced veinlets of quartz and adularia. Free gold is deposited in drusy cavities in the veinlets and also replaces altered andesite. Small pockets of rich ore containing as much as \$300 a ton in gold occur in a few places, but the average grade was about \$3.50 a ton in gold and silver. The weight-ratio of gold to silver in the products recovered was about 1 to 1 for bullion and 1 to 12 for cyanide precipitates (Nolan, 1936, p. 33). The silver content of the gold deposits evidently was so dispersed that very little secondary enrichment occurred.

### Silver-rich deposits

The silver-rich ore bodies are veins along the northwest- and eaststriking faults in the intrusive andesites. Veins along the northweststriking faults comprise a westerly belt that was mined in the Navajo,
Belle Isle, North Belle Isle, Commonwealth, and North Commonwealth mines.
These veins were the most productive in the district. An easterly belt of
mines along the east-striking faults includes the Independence, DeFrees,
Grand Prize, and Argenta. In these mines the best ore shoots pitched
northward along intersections of fissures. In both belts the ore shoots
were a few inches to a few feet wide and had a relatively small vertical
range. No figures are available for stope lengths. The deepest shaft,
the Grand Prize, was 750 feet deep, but most of the ore came from above
the 320-foot level. Except on the Navajo claim the ore shoots did not
crop out, and the Grand Prize bonanza was first exposed at a depth of
40 feet.

Ore minerals in the upper portions of the shoots below the leached zone and above the water table, which was about 100 feet below the surface, consisted largely of secondary cerargyrite and native silver. Emmons (1910, p. 60) reported: "A single block of horn silver from the Commonwealth mine is said to have sold for \$30,000. Much of the ore mined, however, contained primary argentite, stephanite, proustite, pyrargyrite, enargite, bornite, chalcopyrite, sphalerite, galena, and gold in a gangue of quartz, calcite pyrite, arsenopyrite, and altered wallrock.

Grade of the silver-rich ore mined in the early years commonly ranged from \$50 to \$350 a ton, but in later years ore was milled that averaged as little as \$6.30 for an entire year. Average value per ton throughout the life of 10 of the principal mines ranged from \$29 for the Commonwealth to \$107 for the Navajo. The silver-gold ratio of the silver-rich deposits was about 150 to 1, although recorded production from many of the mines indicates that the greater value of the ore was in gold (table 48).

TABLE 48NEAR HERE

Table 48.--Tuscarora mining district, mines through 1969.
[•, main product; o, by-product]

			1 6			
Index no.	Mine or prospect	Locati	Location (MDBM)	M)	Commodity	Total value
on Plate 2	(A mine may have several names; production is cumulative)	Sec.	T. N.	R.	Gold Silver Copper Lead Mercury	when sold = (in thousands of dollars)
m	Argenta				•	
	Aura Queen (see Aura dist.)					
2	Belle Isle				•	641
	Comet				0	<b>~</b> 22
2	Commonwealth				• •	678
	Coptis				0	46
n	DeFrees				• •	27
	Delmonte				0	56
4	Dexter				0	>1,265
	Dexter placer				0	<5
	Eira				0	>100
	Ennor				0	7
	First Chance				0	<5
	Frank and Marguerite				0	14
	Gold Nugget	က	39	51	0	<5
	Gold Nugget placer				0	<5
	Gold Fleece placer				0	<5
е	Grand Prize	34	04	51	• •	2,546

Table 48.--- Tuscarora mining district, mines through 1969--Continued

Index no. on Plate 2	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM) T. R Sec. N. E	T. R. N. E.	Gold Silver Copper Copper	Wercury	Total value when sold 1/(in thousands of dollars)
	Grey Eagle placer			•		<5
	Ham placer			0		<5
	Holden			0		<5
	Hostetter			•		
ю	Independence			•	0	909
	Ischibible			•		<5
	King (Wakefield)			•		<5
	Krug (Wakefield)			0		0
	Lancaster 1880			•		17
	Maggie (see Auma dist.)					
	May Queen			•		15
	McKenzie			0		2-100
	Modoc	#	39 51	•		
	Mystery			•		<5
2	Navajo	3,34	39,40 51	•		>1,733
	Nevada			•		<5
	Nevada Hydraulic Mining Co. placer	i.		0		\$
2	Nevada Queen				•	391

Table 48.--Tuscarora mining district, mines through 1969--Continued

Total value when sold 1/(in thousands of dollars)	<5	639	262	<5	9		\$	<5		<5	<5	<5	86	<5	<5	<5	\$
Gold Silver Copper Lead Lead ity	0	• 0	• •	• 0	• •		0	0	•	•	0	0		0	0	0	•
Location (MDBM)  T. R.  Sec. N. E.								3,4 39 51						3,4 39 51			
Mine or prospect (A mine may have several names; production is cumulative)	Nogi Extension	North Belle Isle	North Commonwealth	Original Nevada	Poorman	Queen (see Nevada Queen)	Raven	Ring	Ruby Queen group	Silver Queen group (tailings)	Surprise Fraction	Timber placer	Union Mill Company	Wakefield group (King)	White Palace	Windsor placer	Young (W. P. Young)
Index no. on Plate 2		2	2														

Table 48.--Tuscarora mining district, mines through 1969--Continued

Index no.	Mine or prospect	Location (MDBM)	(MDB	M)	Commodity	Total value
on Dlate 0	(A mine may have several names;		T.	R.	ae	w (in
	production is cumulative)	Sec.	N.	Э	Gold Silv Copp	of dollars)
	Young America	34	0#	51	•	110
	Zero	3#	04	51	0	. <2
2	Placer deposits SW of Tuscarora				•	>100
9	Berry Creek group	3,7	39	51		<5
	Liquid Metals (Berry Creek)					•
	Lope & Hewitt (Silverado)	26,35	04	51		0
	Red Bird group (Silverado)	26,35	04	51		0
1	Silverado	34	04	51		• <5

1/Includes figures from Couch and Carpenter (1943, p. 46).

# Mercury deposits

The two mercury deposits in the district consist of veinlets and disseminated crystals of cinnabar along steep fracture zones in altered andesite (Bailey and Phoenix, 1944, p. 64, 65). At the Berry Creek mine a shear zone that strikes northeast and dips 70° SE. contains cinnabar in veinlets up to an inch thick along the zone, and disseminated crystals and smaller veinlets in the walls. Gangue minerals are chalcedony, quartz, pyrite, and marcasite.

At the Red Bird (Silverado) mine a shear zone along a contact of footwall andesite with hanging wall tuff strikes N. 78° W. and dips steeply southward. The andesite for a width of about 5 feet contains disseminated cinnabar, native mercury, and pyrite, and also cinnabar and quartz in small veinlets at right angles to the shear.

Grade of the ores is not known, but they were worked only briefly in 1955 and 1958 when the price of mercury was \$290 and \$230 a flask.

# Gold placers

Placer gold was found only in the area of the primary gold deposits, from Tuscarora to Beard Hill, about 3 miles west, in the alluvial gravels that cover an area of two square miles or more to a depth of a few inches to 30 feet. Gold was recovered from dry stream beds that cross the area as well as from gravel and soil between the stream beds. The gold particles range in size from dust to nuggets weighing more than an ounce. Emmons (1910, p. 62) reported that a large number of samples from potential dredging ground in this area averaged about 14 cents per cubic yard (gold at \$20.67 per troy oz).

# Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
31,32,33	27	53	Mineral Hill, Railroad Pass	Eureka and Elko Counties
NW <sup>1</sup> ₄	26	53	Mineral Hill, Railroad Pass	Eureka and Elko Counties

Although part of the workings of the Bell lead-silver mine are in Elko County, Land Office and production records are listed under Eureka County.

A geologic map and description of the district are in Roberts and others (1967).

## Location and History

Sections (Approx.)	The second secon	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
W½	29	58	Franklin Lake NW	Ruby Range district, Dawley Canyon area, Hankins Canyon area
			Franklin Lake SW	

The Valley View district includes Mica, Dawley, Hankins Creek, and Road Canyons north of Harrison Pass on the east slopes of Green Mountain, the southernmost of two peaks by that name along the crest of the Ruby Mountains.

Native bismuth and scheelite were discovered in Road Canyon in 1913 (Hill, 1916, p. 62), and later an unsuccessful attempt was made to develop the tungsten deposits (Hess and Larsen, 1921, p. 246).

In 1928 the first of about 55 mining claims were staked in secs. 16, 17, 20, 21, 28, and 29 covering numerous pegmatite dikes containing mica and beryl. Two dikes in Dawley Canyon were explored for mica by a pit 12 feet deep and an adit 30 feet long. Other dikes were explored primarily for beryl by a few cuts and a short adit. A little beryl was produced, mainly for specimens and metal-lurgical tests. About 250 pounds of trimmed sheet mica was shipped in 1944. The tungsten deposits were restaked in 1943, and 20 tons of sorted ore containing 150 units of WO<sub>3</sub> was shipped from the Owl claim of the Valley View property. No further production has been reported through 1969.

## Geologic Setting

The Valley View district covers the east-central part of an intrusive complex in the Harrison Pass area of the Ruby Mountains. Other parts are covered by the Ruby Valley, Gilbert Canyon, Corral Creek, and Harrison Pass districts.

The intrusive complex extends westward 10 miles across the full width of the range, and northward 18 miles from Rattlesnake Mountain to Rattlesnake Creek. Its margins include Precambrian schists, Cambrian Prospect Mountain Quartzite, Cambrian limestones, and Ordovician Pogonip limestones and shales, all of which are intruded by a series of four granitic stocks, by many pegmatite dikes of three different ages, and by aplite dikes related to the youngest stock which is named the Harrison Pass stock.

Oldest of the three unnamed intrusives is an irregular stock about 3 miles wide and 10 miles long of biotite-muscovite granite of Jurassic age that forms the summit and much of the east slope of the range opposite Franklin Lake. A second stock about 5 miles wide and 7 miles long of pegmatitic granite also of Jurassic age forms the west slope. The third stock about a mile wide of muscovite-biotite granite of Cretaceous age crops out discontinuously for 6 miles along the lower east slope opposite Franklin Lake. The fourth, youngest, and largest pluton is the Harrison Pass stock about 7 miles wide and 10 miles long of granodiorite-quartz monzonite of Tertiary age that extends almost completely across the range south of the older stocks.

Pegmatite dikes as much as 55 feet wide and 2,200 feet long occupy north-trending fractures that dip steeply east in the granites or along the schistosity or bedding in the metamorphic rocks. The oldest dikes are genetically related to the Jurassic granites, others to the Cretaceous granite, and the youngest—some of which cut the Harrison Pass stock—to the Tertiary intrusive.

Aplite dikes are neither as large nor as abundant as the pegmatites.

They are related to the Tertiary (Harrison Pass) stock, and occupy northtrending fractures in the schists, the older granites, and in the pegmatites.

Within about 1,500 feet of the stocks, and along the pegmatite dikes, the
sedimentary rocks are locally metamorphosed to quartz mica schist, marble,
or lime silicate zones.

### Ore deposits

In the Dawley Canyon area of the Valley View district, mica was mined from two pegmatite dikes 6-10 feet wide and 300 feet long. The best showing was in a pit 12 feet deep where sheets and books 3-6 inches square comparatively free of blemishes constitute 10-20 percent of the rock, but other dikes contain only about 3 percent muscovite, most of which would be classed as scrap mica (Olson and Hinrichs, 1960, p. 158).

Beryl was found in nearly a third of the 350 or more pegmatite dikes in the Dawley Canyon area. It occurs as sparse white, green, and azure crystals up to 3 inches in diameter. The dikes are commonly zoned from the walls inward. Coarse-grained pegmatitic zones may contain 0.5 percent beryl; aplitic zones are lower grade. Analyses of 12 samples ranged from 0.001 to 0.10 percent BeO (Olson and Hinrichs, 1960, p. 160). Beryl also occurs in schistose layers of the Cambrian and Precambrian rocks, where gray to white crystals up to 1½ inches long have been found (R. W. Kistler, oral commun., 1973).

In Road Canyon, layers an inch to a foot wide of tactite more or less altered to chlorite are found along the margins of lenticular sills of quartz monzonite as much as 15 feet wide and 75 feet long in white crystalline limestone. At the Valley View property, scheelite in crystals up to half an inch across occur in the tactite. On the Owl claim scheelite ore was mined from a tactite layer 1 - 6 inches wide for 48 feet along the strike in an open cut and an adit. The ore was estimated to range in grade from 1 to 5 percent WO<sub>3</sub> (M. R. Klepper, written commun., 1943). Bismuthinite and native bismuth occur with small crystals of pyrite in a gangue of quartz, rutile, phlogopite, and pyroxene near the centers of some of the sills (Hill, 1916, p. 63).

TABLE 49 NEAR HERE

Table 49.--Valley View mining district, mines through 1969.

	Total value	when sold (in thousands of dollars)	<5			<5	0
	Commodity	Bismuth Tungsten Tungsten Mica	• ×	• ×		• ×	•
57	OBM)	E. R.	58	58	58	58	58
urrence	Location (MDBM)	T. N	29	29	29	29	29
ct; x, occ	Locat	Sec.	16,17	3\$	16	31	31
Lo, main product; x, occurrence	Mine or prospect	(A mine may have several names; production is cumulative)	Errington and Thiel	Hankins (Valley View)	Mick (Mica?)	Owl (Valley View)	Valley View
	Index no.	on Plate 2	1				2

Warm Creek

District

# Location and History

Sections (Approx.)		Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
14,15, 22,23, 26,27	33	61	Elko 2°	Polar Star, Clover Valley district

The Warm Creek district includes the southeast slopes of Warm Creek ridge at the south end of the East Humboldt Range, south of Warm Spring Creek and west of Clover Valley. The Polar Star group of claims was staked in 1912 (Hill, 1916, p. 60), and all of the zinc production from the district (table 5) came from the Polar Star mine during the years 1912-1943, half of it in 1916. For ger at the ore, More than 2½ tons of waste for each ton of ore was also mined. The Silver Cliff mine yielded 43 tons of lead-silver ore during the period 1927-42.2. There is no record of production for the years 1944-69.24

U.S. Bureau of Mines records are listed under Spruce Mountain district for the year 1912, under Warm Creek district thereafter. Land office records are listed under "Unknown-unnamed-unorganized mining districts."

The unnamed district in T. 34 N., R. 61 E., listed by Lotz (1934, p. 18) should probably be included in the Warm Creek district, although the type and location of the implied prospects is not known.

Geologic Setting and Ore Deposits

Eureka quartzite and overlying dolomites and limestones of Ordovician and Devonian ages exposed on the east flank of the range are in thrust-fault contact with and overlain by limestones, shales, and conglomerates(?) of Permian and Triassic ages exposed on the summit and west side of the range.

The zinc ore bodies at the Polar Star mine are irregular replacement deposits in brecciated limestones of Paleozoic age. The limestones are shattered, bleached, and recemented for 350 feet or more along three persistent faults that strike east and dip 50°-60° S. in an area 120 feet wide. Wide Pods and stringers of carbonate ore were mined from stopes as large as 20 by 50 by 8 feet to depths of about 60 feet where the water table was encountered. Both lead and zinc were recovered from the early shipments, but from most of the ore only zinc (23-26 percent) was recovered. Ores from the Silver Cliff mine contained about 18 percent lead, 11 oznces silver per ton, 0.9 percent copper, and a trace of gold.

TABLE 50 NEAR HERE

Table 50.--Warm Creek mining district, mines through 1969.
[•, main product; o, by-product]

Location (MDBM)  Location (MDBM)  Sec.  N. E. de & de
N. R. N. S.
33 61 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
33 61 0 0 0 0 • • • • • • • • • • • • • • •
33 61 000
33 61 000

# Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
A11	38	62	Metropolis, Oxley Peak	Humboldt Wells district
A11	37	62	Welcome, Wells	

The Wells district includes the low hills surrounding Oxley Peak 7 miles north of Wells and others on both sides of Clover Valley about 5 miles south of Wells.

Production of gold was reported for 1916 and 1925 (Couch and Carpenter, 1943, p. 41, 46), of sandstone (Nevada Picture Rock) for later years, and 50 tons of tungsten ore in 1956 (Southern Pacific Co., 1964, p. 128, 114). The tungsten deposits were further explored in 1970 (U.S. Bur. Mines, 1970, p. 1126). Marble, in beds 300 and 200 feet thick, and deposits of limestone, chert, and quartzite conglomerate (decorative) are also reported by Southern Pacific Co. (1964, p. 127-131).

# Geologic Setting and Ore Deposits

The tungsten deposits in sec. 31, T. 37 N., R. 62 E., are in Cambrian-Ordovician limestones with thin quartzite and biotite schist interbeds in the upper plate of a thrust fault that emplaced them on Prospect Mountain Quartzite. The limestone sequence is tilted variously southwest to northwest, and is cut by a few quartz veinlets along and across the bedding and by bedding-plane faults. At the largest of several tungsten deposits, scheelite occurs in fractures along and across the bedding in limestone and also in quartz veinlets in a zone 15 feet or more thick below a bedding-plane fault marked by a few inches of sheared biotite schist and a little quartz. The deposit is explored by a 9 by 15-foot adit about 100 feet long, and by six or more vertical drill holes from the surface above and beyond the face of the adit. Some areas in the adit appear by ultraviolet light to contain about 1 percent WO3. A lower adit leading to 20- and 50-foot drifts exposes scheelite and beryllium minerals in a tactite zone 6 feet thick that dips 30°-45° SW. in calcite mylonite. Production of 50 tons reported by the Southern Pacific Co. (1964, p. 114) averaged 2.11 WO3.

Nevada Picture Rock, used locally for facing stone and for carving into bowls and other decorative objects, was mined from numerous pits, quarries, and cuts as much as 50 feet long, 10 feet wide, and 20 feet deep. The rock consists of friable sandstone and porous siltstone of Tertiary age in beds one-fourth of an inch to a foot or more thick that strike northeast and dip 30°-40° SE. They are jointed in all directions; unbroken slabs measuring by 8 feet are about the largest obtainable. The rock contains limonite rings or is uniformly stained rust red, yellow, or purple.

Table 51.--Wells mining district, mines through 1969
[6, main product; x, occurrence]

STATE OF THE PARTY	Total value 1/	3 °		0#	18				0			2-100
	Commodity	na (eviti	Gold Berylli Tungste Marble Stone Stone Stone (Becore	•		×	×	•	×	×		• ×
-	BM)	ы ы ы				62	62	62	62	62		62
-	on (MD	H N				37.	37	38	37	37		37
מתכני שי	Location (MDBM)	Sec.				13	25	16,21	27	29		29,31
Formation broader, as commissioners	Mine or prospect	(A mine may have several names; production is cumulative)		Black Forest (1925)	Nevada Zinc Mining Co. (1916)	Limestone, chert	Quartzite conglomerate	Nevada Picture Rock	Wells, south (see SPRR)	Wells, southwest (SPRR)	Wildcat (Jensen and Steele) (see Jarbidge dist.)	Unknown (1956)
	Index no.	on Plate 2						1				2

1/ Includes figures from Couch and Carpenter (1943, p. 46).

## Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names, Remarks
A11	33	70	Shafter 1 SE	Prospects
$N_{\frac{1}{2}}$	32	70		Stone quarry

The Wendover district includes the south slopes of Leppy Peak north of Wendover, and hill 5275 6 miles south of Wendover.

Four lode mining claims on the slopes of Leppy Peak were patented on several prospects in secs. 10 and 15, T. 33 N., R. 70 E., but no production has been recorded.

Decorative stone was quarried on hill 5275 in sec. 18, T. 32 N., R. 70 E. The rock was evidently crushed and screened. Production may have been a few hundred tons.

Tungsten ore was mined during 1953 at the Great Western mine (location unknown) and about 7 units of WO<sub>3</sub> was recovered from 10 tons of sorted ore.

The adit shown on the quadrangle map in sec. 3, T. 33 N., R. 70 E., is a natural limestone cave about 100 feet below the Lake Bonneville level.

Geologic Setting and Ore Deposits

Leppy Peak consists mainly of limestone and dolomites ranging in age from Devonian to Permian. The sedimentary rocks are tilted westward and cut by a network of faults, most of which strike N. 10° to 30° W. Around the foothills of Leppy Peak the sedimentary rocks are overlain by patches of Jarbidge(?) rhyolite of Tertiary age, and by sediments of somewhat younger Tertiary age. In the southern part of the district, hill 5275 is composed of typical coarse-grained Jarbidge rhyolite overlain by a flow of medium-grained rhyolite.

Much of the coarse-grained rhyolite throughout an area of several acres on the lower west side of the hill is attractively stained bright green by ferric iron. The stone quarry is within this area.

TABLE 52 NEAR HERE

Table 52. -- Wendover mining district, mines through 1969

	Total value	when solu (in thousands of dollars)			<b>\</b>
oduct]	Commodity	Tungsten			
	BM)	ъ.	70	70	70
	Location (MDBM)	H N	33	33	32
	Locat	Sec.	10,15	15	18
[•, main product]	Mine or prospect	(A mine may have several names; production is cumulative)	Safety Last group	Salt Spring No. 2	Great Western Unknown
	Index no.	on Plate 2			1

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Surface areas of the Wendover district below an altitude of about 5,200 feet were covered by the waters of Lake Bonneville 18,000 years ago and again 13,000 years ago (Morrison, 1966, p. 88). At those times the lake extended from the Toano Range west of Wendover eastward 130 miles to the Wasatch Range, and from the Escalante Desert (Lund, Utah) northward 320 miles to Red Rock Pass between Swan Lake and Downey, Idaho. The lake then overflowed at Red Rock Pass, rapidly cutting a channel from an altitude of 5,085 feet down to 4,785 feet, through which the discharge rate into the Snake River may have reached 15 million cfm--a little more than the present flow over Niagara Falls. The lake further receded by evaporation so that by 11,300 years ago (Jennings, 1953, p. 186) the lake surface was a little lower than 4,310 feet and a little above the altitude of the Salt Flats (4,233-4,242). In recent years the altitude of the Great Salt Lake, which is a remnant of Lake Bonneville 50 miles wide and 80 miles long, was 4,200 feet at five different times from 1860 to 1960; at those times the maximum depth was 35 feet, and the average depth about 13 feet. The lake has fluctuated from 11 feet above that level in 1873 to 8 feet below it in 1963.

When Lake Bonneville was full, the weight of water, about 10<sup>13</sup> tons, caused the floor of the lake to sink; removal of the water allowed it to rise—more in the center of the basin where the lake had been 1,100 feet deep than at the edges. This isostatic rebound explains why the Bonneville shoreline is now found at altitudes ranging from 5,085 feet at Red Rock Pass to 5,300 feet in the Cedar Mountains near the center of the basin (Crittenden, 1963, p. E9). On Leppy Peak the altitude of the Bonneville shoreline is 5,200 feet.

# Location and History

Sections (Approx.)	Twp.	Rge. E.	Quadrangle name (7½ or 15 minute)	Other district names,	Remarks
A11	28	68	Elko 2° Ferguson Springs 1 SW		
W 1/3	28	69			
N 1/3	27	68			

The White Horse district covers White Horse Mountain and Sugar Loaf Peak in the Goshute Mountains—a southward continuation of the Toano Range—south of (U.S. Highway 50) White Horse Pass, formerly known as Don Don Pass.

A little copper and lead may have been produced sometime before 1913

(Hill, 1916, p. 98) and 12 tons of tungsten ore containing 28 short ton units of WO<sub>3</sub> was shipped during 1942-43.3. Lead-silver-zinc production is recorded for the years 1948-494(table15).

Geologic Setting and Ore Deposits

Limestones of the Guilmette and Devils Gate Formations of Devonian age are intruded by a stock of quartz monzonite about 3 miles across. Near the stock the limestones are metamorphosed to tactite. The stock is cut by two sets of nearly vertical joints—a north—striking set and an eastward—striking set—and by sheeted zones of fractures that dip gently eastward.

Two types of ore bodies were mined, vein deposits and contact-metamorphic deposits. Narrow quartz veins along some of the east-dipping fractures in the quartz monzonite contain copper and lead carbonates, chrysocolla, limonite, and a little residual pyrite and chalcopyrite. The veins were explored to depths of 50 feet (Hill, 1916, p. 98). Lead-silver-zinc ore presumably occurs in similar veins. In the contact-metamorphic deposits, scheelite occurs disseminated erratically in extensive bodies of tactite composed of garnet, epidote, and quartz along a contact between limestone and granitic rock. Sorted ore from the only body of commercial grade found contained about 2.3 percent WO<sub>3</sub> (D. M. Lemmon, written commun., 1948).

TABLES 53 and 54 NEAR HERE

Table 53. -- White Horse mining district, mines through 1969

# [., main product; o, by-product]

Total value	(in thousands of dollars)	<5 5	<5
Commodity	Silver Copper Lead Zinc Tungsten	0 •	
Location (MDBM)	Sec. I. R.	26 68	11(?) 28 68
Mine or prospect	(A mine may have several names; production is cumulative)	No name No name	Epidote claim
Index no.	on Plate 2		

Table 54. -- Unknown mining district, mines through 1969

	Total value	(in thousands of dollars)	<5	ľ	ç			2-100	00T-s	ς ,	ر د ۲	66	001		4	, u	, i	\$
occurrence	.y	Antimony Manganese Molybdenum Tungsten Tungsten Stone																
CCUE	Commodity	Sinc	0					0	0	0						0	•	0
	Com	Lead			0		0	•	•	0			•			•	0	•
t;		Copper	0					0	0	•	•	•	0			0	0	0
oque		Silver	0		0		•	0	0	0		0	0				0	0
., main product; o, by-product; x,	2	Sec. N. E. K.	(Ruby Range) o	See Nye County				(Ruby Range)	(Ruby Range)	(Ruby Range)	(Ruby Range)		(Ruby Range)			Spruce Mountain(?)		
•]	Mine or prospect	(A mine may have several names; production is cumulative)	Betty	Bristle Cone	Clawson & Wilson	Cunapah	Deitloff (Gates)	Galena King	Good Luck	Hogie	Holiday (Errington & Thiel)	Kristine	L. and C.	Lonesome	Little John	Nevada Monarch	Polish	Selby property

Table 54.--Unknown mining district, mines through 1969--Continued

	Total value when sold (in thousands of dollars)	\$>	\$	<b>&lt;</b> 5	<5(?)	, R	?			ų,	, v	(2)00(3)	1. VOT-6	7	•
	Barite														
	Tungsten						•			Tre-T	•	•			
	Molybdenum								×	9					
1	Mercury	-	•										•		
	Manganese	District of the second			•	•		•							
	Antimony Antima	1		•											
	Commo Lead Sinc Sinc Sinc Antimony														
	Copper														
	Silver	0													
J.	1.	"	17												
									21						
	(MDBM)				of	~									
	T. N.				NE.	nge			45			nge			
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	Mine or prospect mine may have several nam production is cumulative)	White Rock G.M. Co. placer	Young (W. P. Young)	Atlas Black Marion group	Bidee-Etcheverry (Hoalst)	Manganese Mountain No. 2	M&S (Elko County?)	Missouri	Owyhee	Rosella	Rowland (W. J. Rowland)	Stormy Night	Section 8 Ranch (1968-1969)	Tungsten Annex	Celedonite claims (misc. stone)
	Mine or prospect (A mine may have several names; production is cumulative)	Whi	You	Atlas	Bic	Mar	MES	Mis	O	Ro	Ro	St	Se	Tu	Ce

Table 54. -- Unknown mining district, mines through 1969--Continued

Total value  when sold  (in thousands  of dollars)  de to	< \$	\$	
Gold Silver Copper Lead Zinc Antimony Manganese Mercury Molybdenum Tungsten			
Location (MDBM)  T. R. Sec. N. E.	Near Jiggs	Near Wilkins	7,8, 42 62 17,18
Mine or prospect (A mine may have several names; production is cumulative)	Goliath quarry (1963) (quartz aggregate) Mayflower (sandstone, quartzite)	Yellow Jacket and Consolation (1962)	Unnamed Jungle 1-4 claims (patented)

# Guide to exploration

Prospectors risk their time and money against long odds. Their chance for success, according to a time-honored approximation, is--if they find anything at all--that 1 out of 10 mineral showings will be worth a little work, 1 out of 10 workings will result in a prospect, and 1 out of 10 prospects will make a mine.— The production records of Elko County confirm

\_/"Mining has been defined as 'the art or practice of operating mines profitably.' Until a mineral deposit may be worked with profit it is merely a prospect." (Hoover, 1933, p. 1).

the last part of that approximation. Of the 531 "mines" from which production is recorded, 53, or almost exactly 10 percent, produced more than \$100,000. While there are no records of the number of workings that failed, 358 of the remaining producers yielded less than \$5,000. No figures are available on the costs of these small producers, but settlement sheets from custom smelters commonly indicate a gross revenue of a few percent more than direct mining cost; the preliminary costs of prospecting, exploring, and developing are lost. For these small producers, it is probable that more money went into the ground than came out. Elko County is not unique in this respect; it applies the world over. Even at the Comstock lode which produced \$400 million, during its first 6 years and \$50 million of production,

the "mines as a whole had failed to show a profit—in fact had entailed a loss" (Smith, 1943, p. 58). The miner's loss, however, is the world's gain, for mankind's material standard of living is proportional to his use of minerals. Elko County has contributed 19 different mineral commodities worth over \$90,563,000.

The foregoing statistics resulted from prospecting methods of the past, when the old Cornish saying "Every fruit has its blossom" referred to gossans or even to outcrops of ore. Newer and better equipment has now largely replaced the old fultraviolet lamps, Geiger counters, seismometers, gravity meters, electrical and electromagnetic sensors, mercury "sniffers," satellite or airborne cameras, and satellites, and scintillation counters can now detect "blossoms" that were invisible to the old timers. Some of these devices even "see" thintoh the ground and detect subsurface anomalies. By "seeing" to greater depths, modern equipment appears to have kept the prospector's risk to about the same level as it was in the days of "grass-roots" discoveries—one chance in a thousand.

The most used, and possibly still the most useful guide to exploration is "Look for elephants in elephant country." While this while this guideline does not preclude the search of new areas, its applicability is confirmed by the mere fact of mining districts and metallogenic provinces. The reasons for districts and provinces are not fully known, but the following observations and speculations may serve as additional guides.

Metallic ore deposits in most districts in Elko County are in or near granitic stocks; in other districts concealed stocks can logically be inferred. The proximity of most ore deposits to intrusive rocks is assumed to connote a genetic relationship, either direct or indirect. Recent work by Coats, Marvin, and Stern (1965) and by Coats and McKee (1972) led them to imply that the relationship is indirect. They found that 15 of the plutons in Elko County are of three age groups, Jurassic, Cretaceous, and Tertiary, and that most of them are elongate either east-west or north-south in conformity with the deep-seated grain of the region. They observed that a northern belt of stocks is sparsely mineralized whereas in other east-west belts gold, silver, copper, lead, zinc, tungsten, or antimony is the dominant metal at stocks of all three ages, although not all of these metals are found in the vicinity of any one pluton. On a county-wide basis, ore bodies mined primarily for gold have been found only north of the latitude of Elko, and antimony only north of Tuscarora. They concluded that the factor that determines the dominant metal in the ore seems to be not the age or composition of the pluton but its geographic location.

An apparent exception to this conclusion is the common relationship of disseminated chalcopyrite to quartz monzonite porphyry. Even here, however, the relationship may be one of mutual dependency, the controlling factor not age or composition but location. The quartz monzonite composition, the porphyritic texture, and the copper content may all result from the same fortuitous combination of source area and a depth of emplacement so shallow that copper sulfide crystallizes while most other metals escape to the surrounding wallrock. Nevertheless, in Elko County, stocks composed of quartz monzonite or quartz monzonite porphyry are of Cretaceous or Tertiary age; none is Jurassic.

The foregoing conclusion suggests that within metallogenic provinces there are metallogenic zones, within which metalliferous deposits are localized wherever a heat source such as a pluton, and a conduit such as a fault system, coincide in time. The metals deposited in each zone may depend on a zoned metal content of oceanic sediments or oceanic crust subducted beneath the margins of the continental plate and distilled out only in the locality of a heat source that generates a hydrothermal system (Bailey and others, 1973, p. 411).

In the following localities in Elko County, deposits of various types appear to have unexplored potential.

All valleys. Because the plutons and the ore deposits associated with them were emplaced before the present valleys were formed by Basin-Range faulting, the bedrock under the valley fill may contain about the same proportion of plutons and ore bodies as the ranges. If so, then more than half the ore bodies in the county are yet to be found, since more than half the area--about 56 percent--is covered by alluvium, two-thirds of which is less than 1,000 ft thick (Archbold, 1972).

Burner district. The Mint vein in an andesite flow probably continues downward into sedimentary rocks and may intersect a replaceable limestone stratum.

Cornucopia district. Geologic mapping by Coats (1967, p. 2) revealed that the ridge south of the mine shafts (W2 sec. 19) is postmineral rhyolite on the downdropped side of a fault that separates it from the older mineralized andesite exposed in the mine area. The thickness of the rhyolite is not known, but under it the buried upper surface of the andesite may be only a few scores of feet below the ground surface. The concealed andesite may contain other veins or faulted continuations of the known veins (Coats, 1967, p. 4).

<u>Delker district</u>. The West Buttes and Delker quartz monzonite stocks are porphyritic in many places. Copper was mined from contact metamorphic deposits in limestone at West Buttes. The east-west alinement with the porphyry copper deposit in the Dolly Varden district suggests a deep-seated zoned relationship.

Elko district. In the southern Adobe Range (secs. 3, 5, 8, and 10, T. 34 N., R. 54 E.), parts of the Diamond Peak Formation are somewhat altered and slightly enriched in copper and silver. Although aeromagnetic lines give no indication of a concealed intrusive, further geochemical prospecting is advisable (Ketner, 1970, p. Bl08).

In the Peko Hills some samples of float contained about 20 percent P2O5. (Low-grade ore contains 24 percent or more.) The phosphatic beds appear from the float to be thin, but their actual thickness and extent could be determined by trenching (Ketner, 1970, p. Blo8).

Lime Mountain district. Copper-zinc-silver deposits along steep faults are in Cambrian limestone that overlies slates and phyllites equivalent to the Pioche Shale. If the phyllites contain interbedded limestone equivalent to the Combined Metals Member in the Pioche district, the intersections of the faults with that limestone may contain replacement deposits.

Mountain City district. Decker (1962, p. 56) observed that placer gold deposits along Trail Creek (T. 44 N., R. 53 E.) in the Aura district and along Van Duzer Creek (T. 45 N., R. 53 E.) in the Mountain City district appear to be spatially related to an exposed surface of the Roberts Mountains thrust fault.

Owyhee Desert area. In the northwest corner of the county, the Cenozoic formations "may yet yield significant commercial quantities of petroleum" (Decker, 1962, p. 57). The Elko Formation and equivalents throughout the county have numerous porous clastic beds and abundant oil shales in its lower member. In Bull Run Basin (Aura district) a well drilled in 1957 found continuous shows of oil between 1,522 and 2,150 feet. Pre-Cenozoic rocks in Elko County are less favorable; Mississippian, Permian, and Triassic formations contain relatively thin petroleum source beds.

Swales Mountain district. The following suggestions are quoted from Ketner and others (1968, p. 13):

"The presence of small gold deposits in the upper plate rocks at
Swales Mountain suggests the possibility of more extensive deposits
in the Roberts Mountains Formation where it lies concealed by upper
plate rocks or in the broken rock along subsurface parts of the
Roberts Mountains thrust. Exploratory efforts therefore should include
drilling through the upper plate in areas immediately surrounding
Swales Mountain. Unfortunately there is no way of knowing how deep
the thrust zone lies or how far below the thrust the Roberts Mountains
Formation lies. Both could be very close to the surface without
revealing their presence in any way.

"Lower plate rocks intruded by igneous rocks are concealed beneath alluvium on the east flank of the mountain (secs. 4, 9). Exploration of these rocks would require drilling through the alluvium east of the area where lower plate rocks are exposed."

Twin Buttes area. At the Twin Buttes, 10 miles north of Deeth (Twin Buttes quadrangle), two stocks, one on each butte and each about a quarter of a mile long, are intrusive into an exposure half a mile wide of sedimentary rocks of the Western facies. These are the only stocks that large in the county where mines or prospects have not been found, but the surrounding area is covered by Tertiary sediments and Quaternary alluvium that may conceal unknown mineral concentrations.

Valley View district. Beryl crystals up to 1½ inches long are common in some of the schistose layers of the Cambrian and Precambrian rocks in the igneous-metamorphic complex (R. W. Kistler, oral commun., 1973).

Elko County forecast. Forecasts of mineral production in Nevada through the year 2020 A.D., estimates of the amounts of water needed by the mineral industry, and maps showing areas where each commodity is abundant, sparse, rare, or absent, have been published by the Nevada Bureau of Mines and Geology (Baker, Archbold, and Stoll, 1972). The summary table for Elko County is reproduced herein as table 55.

TABLE 55 NEAR HERE

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