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GEOLOGICAL SURVEY

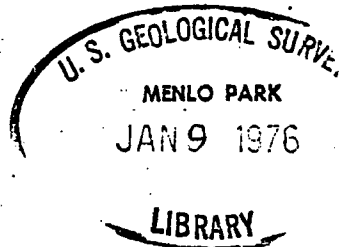
MINERAL RESOURCES OF ELKO COUNTY, NEVADA

By

Roscoe M. Smith

Prepared in cooperation with

Nevada Bureau of Mines and Geology



[REPORT OPEN FILE]

Open-file report

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MINERAL RESOURCES OF ELKO COUNTY, NEVADA

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 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 ft wide and 1,200 ft 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 thrust fault, inferred to underlie the area at a depth of about 5,000 ft.

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 that 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 other U.S. Geological Survey geologists for their frequent consultations and information on the geology of most of the mining districts and to the many authors whose names appear in the list of references for the publications from which much of this report was compiled. Members of the staff of Nevada Bureau of Mines and Geology reviewed the manuscript; their many helpful suggestions are gratefully acknowledged.

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, 1925-32), are the main sources of compilations by Lincoln (1923) and Granger and others (1957).

Since Bulletin 54 was published, many geologic reports and maps on individual districts and areas have been completed; they are referenced where appropriate in the text of this bulletin.

The names of mining districts were compiled from records of the County Recorder at Elko, from those of the Bureau of Land Management (Land Office) in Reno, and a few others from data in the references cited.

Locations of many of the mines are shown on topographic maps of the U.S. Geological Survey; others on maps of individual districts.

For the lists of productive mines in the county, I am indebted to Roy Ashizawa, formerly of the Statistical Division, U.S. Bureau of Mines.

Residents of Elko County were unfailingly generous of their time and information during the course of the fieldwork.

I especially wish to acknowledge the reviews of E. C. Stephens, former geologist of the Rio Tinto mine, of the section of this report on the Mountain City district, and by R. A. Gulbrandsen, U.S. Geological Survey, who contributed to the sections on phosphates.

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 1 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 1.

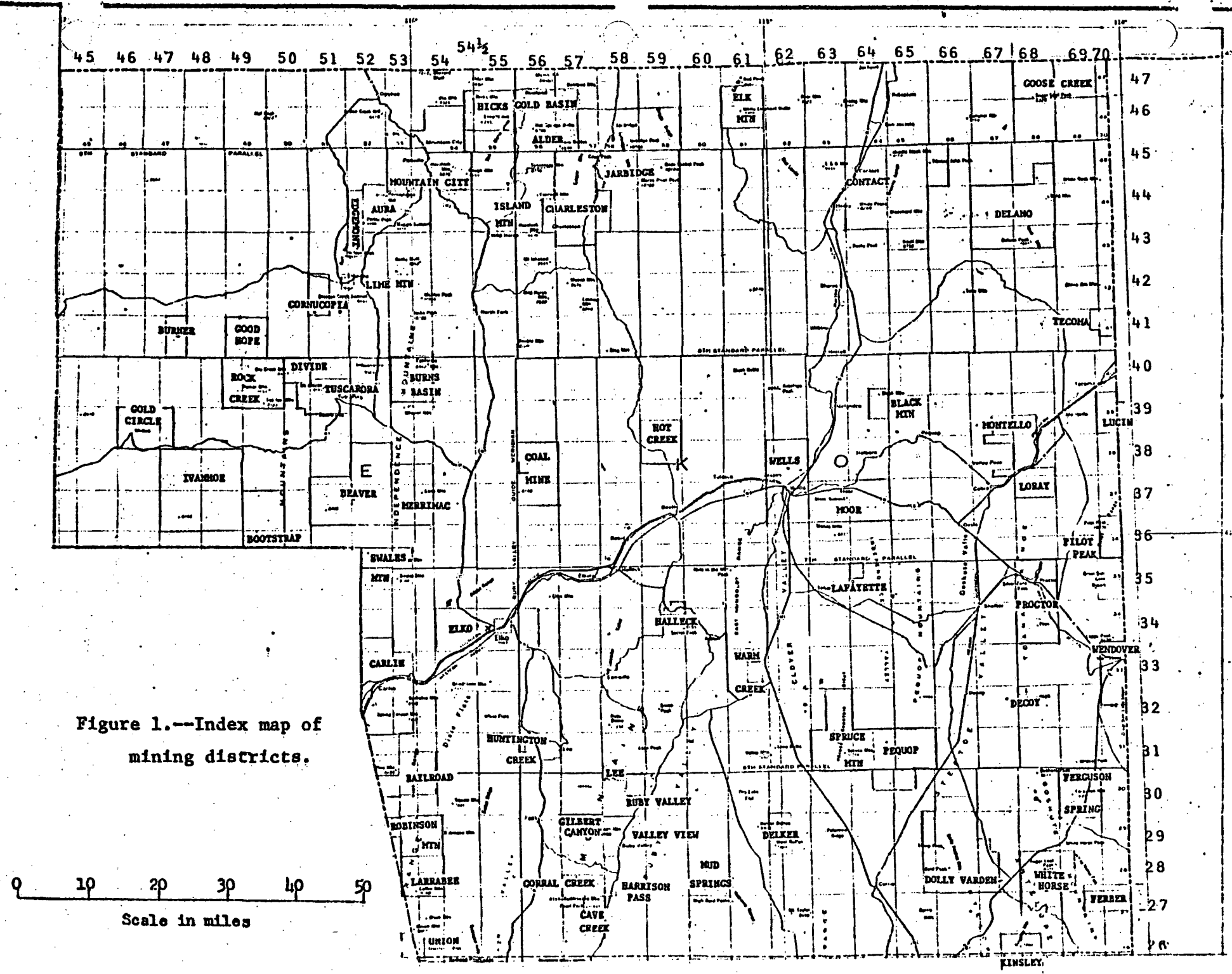


Figure 1.--Index map of mining districts.

0 10 20 30 40 50
Scale in miles

Table 1.--Index of mining districts, Elko County, Nev.

Adobe Range - see Coal Mine
Alabama - see Contact
Alder (Tennessee Mountain, Tennessee Gulch)
Allegheny (Alleghany) - see Ferguson Spring
Amazon - see Good Hope
Antelope - see Kinsley
Aura (Bull Run, Centennial, Columbia, Blue Jacket, Cope)
Aurora - see Good Hope
Battle Mountain - see Ivanhoe
Beaver
Black Forest - see Spruce Mountain
Black Mountain
Blue Jacket - see Aura
Bootstrap (Boulder Creek)
Boulder Creek - see Bootstrap
Bruneau (Wyoming, Bruno) - see Charleston
Buell - see Lucin
Bullion - see Railroad
Bull Run - see Aura
Burner (Burner Hills)
Burns Basin
Butte Valley - see Mud Springs
Carlin
Castle Park - see Loray
Cave Creek
Centennial - see Aura, Edgemont
Charleston (Copper Mountain, Cornwall Basin, Wyoming, Bruneau, Mardis)
Clover Valley - see Warm Creek
Coal Mine (Coal Canyon)
Cobre section - see Loray
Columbia - see Aura
Contact (Kit Carson, Salmon, Salmon River, Porter, Alabama)
Cope - see Mountain City, Aura
Copper Canyon - see Robinson Mountain
Copper Mountain - see Charleston
Cornucopia
Cornwall Basin - see Charleston
Corral Creek (Ruby Range)
Dawley Canyon - see Valley View
Dead Horse - see Mud Springs
Decoy
Deep Creek - see Lime Mountain
Delano (Delno, Goose Creek?)
Delker(Delkar)
Delno - see Delano
Divide (Rock Creek)
Dolly Varden (Mizpah, Granite Mountain, Granite)
Edgemont (Centennial, White Rock)
Elk Mountain

Elko
Empire City - see Railroad
Fairweather (Sooner) - see Mountain City
Falcon - see Rock Creek
Ferber
Ferguson Spring (Alleghany, Allegheny)
Gilbert Canyon area
Gold Basin (Rowland)
Gold Circle (Midas, Summit)
Gold Creek - see Island Mountain
Good Hope (Aurora, Amazon)
Goose Creek
Grand Junction - see Merrimac
Granite - see Dolly Varden
Granite Mountain - see Dolly Varden
Halleck
Harrison Pass (Ruby Range, Valley View)
Hicks
Hot Creek - see also Nye County
Humboldt Wells - see Wells
Huntington Creek (Mineral Soap mine)
Independence - see Lime Mountain
Island Mountain (Gold Creek)
Ivanhoe (Battle Mountain)
Jarbidge
Johnson - see Spruce Mountain
Kingsley - see Kinsley
Kinsley (Kingsley)
Kit Carson - see Contact
Lafayette
Latham - see Spruce Mountain
Larrabee
Lee (Ruby Range, Ruby Mountain Range)
Leroy - see Loray
Lime Mountain (Deep Creek, Independence)
Lone Mountain - see Merrimac
Loray (Leroy, Luray, Montello, Cobre, Castle Park)
Lucin (Lucine, Buell)
Lucine - see Lucin
Luray - see Loray
Maggie Creek - see Beaver
Mardis - see Charleston
Marseilles - see Mountain City
Medicine Springs - see Mud Springs
Merrimac (Lone Mountain, Grand Junction)
Midas - see Gold Circle
Mineral Hill - see Eureka County
Mineral Soap mine - see Huntington Creek
Mizpah - see Dolly Varden
Montello - see Loray
Montello phosphate area
Moor

Mountain City (Sooner, Fairweather, Murray, Marseilles, Cope,
 Van Duzer, Rio Tinto)
 Mud Springs (Dead Horse, Medicine Springs; Butte Valley)
 Murray (Murrey - see Mountain City)
 New York - see Delano
 Peko Hills - see Coal Mine
 Pequop
 Pilot Peak (Pilots Peak)
 Pine Mountain - see Railroad
 Polar Star - see Warm Creek
 Porter - see Contact
 Portis - see Contact
 Proctor (Silver Zone)
 Railroad (Bullion)
 Rio Tinto - see Mountain City
 Robinson Mountain (Copper Canyon)
 Rock Creek (Falcon, formerly included Divide)
 Rowland - see Gold Basin
 Ruby Range, Ruby Mountain Range - see Corral Creek, Harrison Pass, Lee,
 Ruby Valley, Valley View, Unknown
 Ruby Valley (Smith Creek, Ruby Range)
 Salmon - see Contact
 Salmon River - see Contact
 Silver Zone - see Proctor
 Smith Creek - see Ruby Valley
 Sooner (Fairweather) - see Mountain City
 Spruce Mountain (Latham, Johnson, Steptoe, Black Forest)
 Spruce Mountain phosphate area - see Pequop
 Steptoe - see Spruce Mountain
 Summit - see Gold Circle
 Sun Creek - see Jarbidge
 Susie Creek - see Eureka County
 Swales Mountain
 Tecoma
 Tennessee Gulch - see Alder
 Tennessee Mountain - see Alder
 Tuscarora
 Union
 Valley View (Ruby Range, Dawley Canyon, formerly included Harrison Pass)
 Van Duzer (Van Duzen, Van Duyser) - see Mountain City
 Warm Creek (Polar Star, Clover Valley)
 Wells (Humboldt Wells)
 Wendover
 White Horse
 White Rock - see Edgemont
 Wyoming (Bruneau) - see Charleston

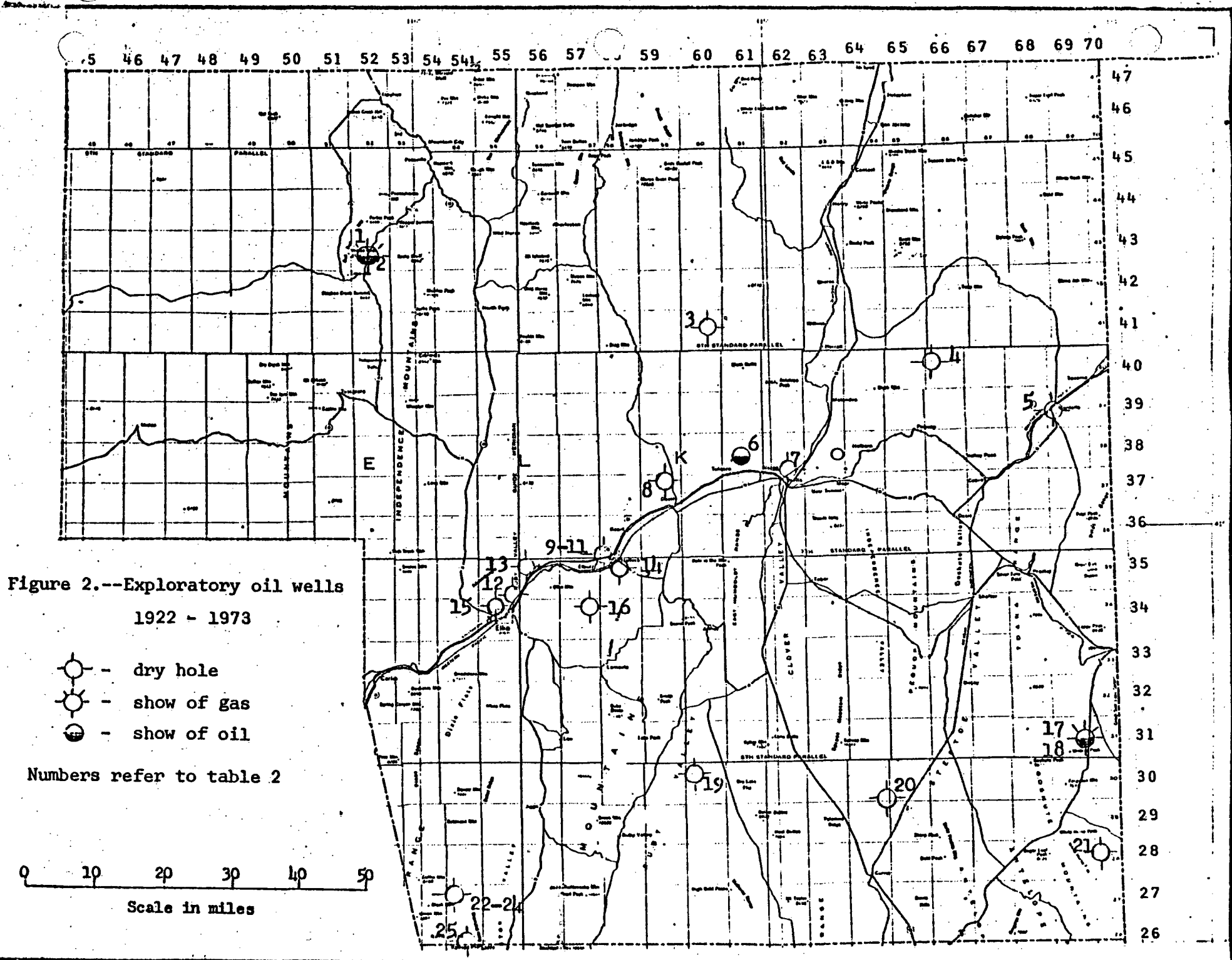


Table 2.--Exploratory drill holes, petroleum, through 1973

Listed by townships; compiled from Nevada Bureau of Mines files, Bull. 52, Report 18

Index Map No.	Company, Unit, Hole No.	Year drilled	Location (MDBM)			Collar Elevation (ft)	Total depth (ft)	Bottom Formation	Shows	Depth of shows (ft)	Age of formation, containing shows
			Sec.	T. N.	R. E.						
1	Bull Run Oil and Gas Co. No. 1	1922	SE 21	43	52		800	Tertiary	gas	625	Tertiary
2	Richfield Oil Corp. Scott-Ogilvie No. 1	1957	SE/SW/SW 22	43	52	6,101	3,386	Paleozoic	oil gas	1,522-2,150 1,712	Tertiary
3	Gulf Refining Co. Mary's River Federal No. 1	1955	CNW/NE 16	41	60	5,962	6,612	Ordovician	oil(?)		
4	Gulf Refining Co. Thousand Springs No. 1	1954	NE/SE/SW 8	40	66	5,650	8,412		oil(?)		
5	Gulf Refining Co. Wilkins Ranch No. 2	1954	CS ¹ /NE/NE 19	39	69	4,889	4,938	Paleozoic	oil(?)		
6	Gulf Refining Co. Wilkins Ranch No. 1	1954	NE/NE/NE 21	38	61	5,589	8,415	Paleozoic	oil oil	6,510-6,532 6,700-6,740	Paleozoic
7	Atlantic International Oil Corp. Dalton No. 1	1973		34	38	62				5,200(?)	
8	Gulf Refining Co. Pete Itcaina No. 1	1954	CSE/NW 3	37	59	5,505	5,465		fresh water	5,028-5,083	Paleozoic
9	Inland Oil Co. Itcaina No. 1	1954	NW/NE/SE 31	36	58	5,500	910(?)				
10	Inland Oil Co. Itcaina No. 2	1954	CSW/SE 31	36	58	5,500	890(?)				
11	Inland Oil Co. Itcaina No. 3	1954	NE/SW/SE 31	36	58		324				
12	Merritt Armstrong	pre-1953		35	55			shallow			
13	Dr. Eby's Well	pre-1953		35	56			shallow			
14	McCarthy Oil Co. Rahas No. 1	1950	NE/NE 9	35	58	5,250	4,125	Paleozoic			
15	Elko Oil Development & Improvement Co. No. 1 (John Brown Well)	1924	SE/SE/SE 4	34	55		3,337	Mississippian			
16	Richfield Oil Corp. Rabbit Creek No. 1	1956	CNW/NW 11	34	57	5,308	7,349				
17	Western Osage Oil Co. Govt. No. 1	1951	SW 14	31	69		980		gas	60	
18	Last Frontier Oil Co. Govt. No. 1	1953	NE/NW 23	31	69		1,327	Pennsylvanian	oil	805-813	Paleozoic
19	Pan American Petr. Corp. USA Franklin No. 1	1970(?)	SE/NW/SW 8	30	60	5,952	10,000(?)				
20	Gulf Refining Co. Dolly Varden No. 1	1953	E ₄ /NE/SE 36	30	64	5,850	3,158	Permian			
21	Gulf Oil Corp. of California Owl Hill Federal No. 1	1963	NE/SW/NW 18	28	70	5,600	1,546				
22	Diamond Oil Co. Diamond Valley No. 1	1953	NW ₄	27	54		904				
23	Diamond Oil Co. Diamond Valley No. 2	1953	NW ₄	27	54		165				
24	Diamond Oil Co. Diamond Valley No. 3	1953	NW ₄	27	54		565				
25	Diamond Oil Co. Conquest No. 1	1984	NW/NW/NE 18	28	84		1,072				

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.

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.

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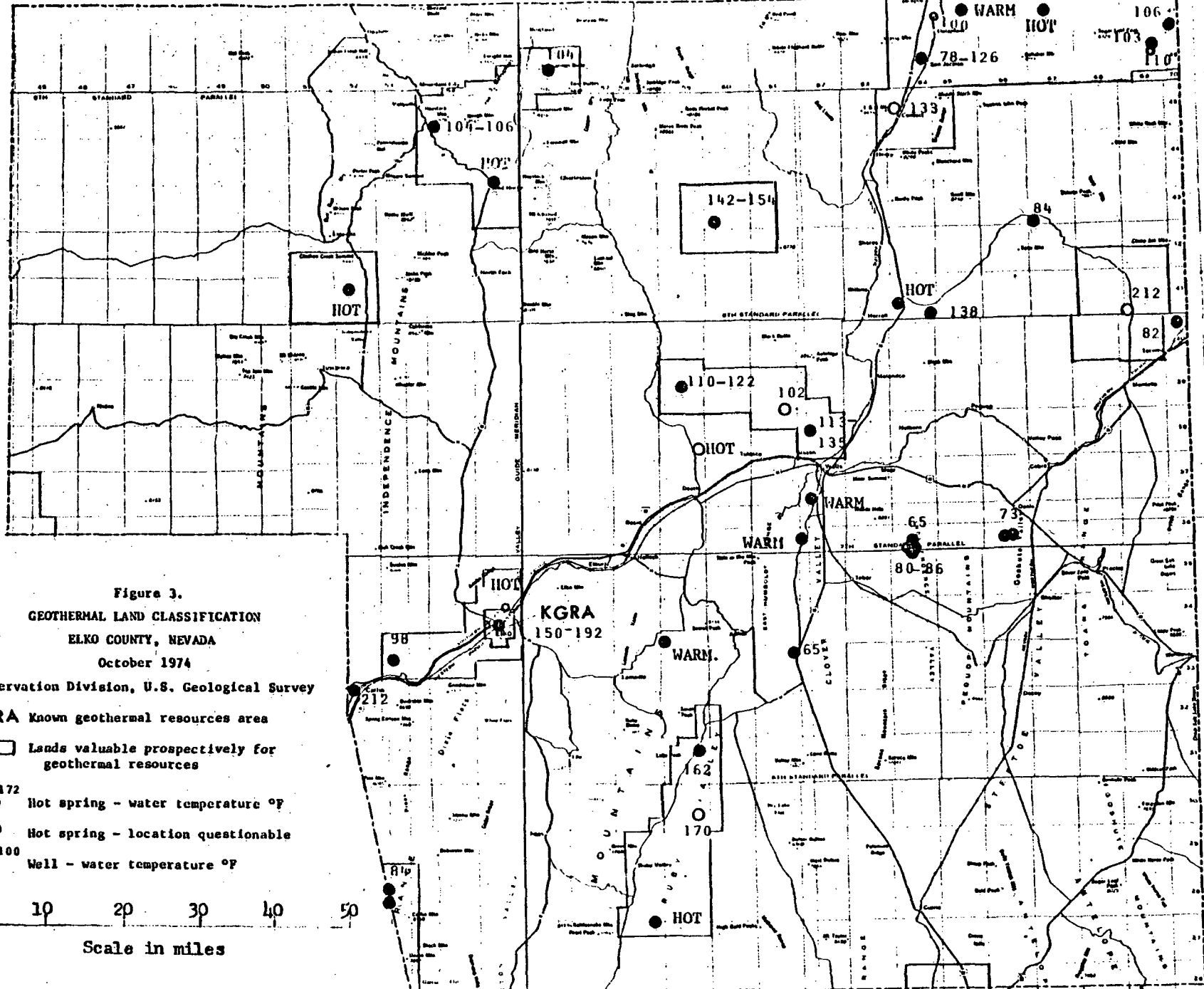


Figure 3.
 GEOTHERMAL LAND CLASSIFICATION
 ELKO COUNTY, NEVADA
 October 1974

Conservation Division, U.S. Geological Survey

KGRA Known geothermal resources area

□ Lands valuable prospectively for geothermal resources

- 172 Hot spring - water temperature °F
- Hot spring - location questionable
- 100 Well - water temperature °F

0 10 20 30 40 50

Scale in miles

47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31
30
29
28
27
26

Table 3.--Temperatures of some Elko County hot springs

[From Hose and Taylor, 1974, table 1]

Name	Location (MDBM)			Temperature °C						Type of deposit (where recorded)
	Sec.	Twp. N.	Rge. E.	Measured surface	Computed minimum subsurface (Fournier and Truesdell, 1973)					
					Silica		log (Na/K)	log (Na/K) + 1/3 log $\sqrt{\text{Ca/Na}}$	log (Na/K) + 4/3 log $\sqrt{\text{Ca/Na}}$	
					Conductive	Adiabatic				
Unnamed	9	47	67	30	-	-	-	-	-	None
Niles Warm Spring	30	47	70	43	81	84	543	220	44	Travertine
Unnamed	4	40	69	45	-	-	-	-	-	Travertine
Contact Mineral Spring	16	45	64	60	127	124	75	129	103	
Rizzi Ranch Hot Spring	29	45	54	41	69	74	153	156	86	
Unnamed	4	43	55	42-54	92	94	255	197	111	
Unnamed	18	39	50	47						Travertine
Hot Sulfur Spring	8	41	52	50	128	125	190	191	153	None
Unnamed	17	38	62	61	140	135	188	181	124	Travertine
Tuscarora	20	38	62	90	167	158	184	184	139	None
Unnamed	33	33	52	79	118	117	395	216	81	None
Elko Hot Spring	16	34	55		115	113	380	234	127	
Stonier Lake	11	31	59	45	190	176	139	178	180	Opaline silica
Hot Sulfur Spring	11	31	59	93	183	171	140	181	190	Sinter
East Ruby Marsh	2	27	58	40-65	102	103	314	202	86	Travertine

Table 4.--Distribution of mineral deposits by district, Elko County
 [o, main commodity; o, by-product; x, occurrence (no production)]

Mining districts	Major metals						Other metals														Nonmetals													
	Gold, placer	Gold, lode	Silver	Copper	Lead	Zinc	Antimony	Beryllium	Bismuth	Columbite-Tantalite	Iron	Manganese	Mercury	Molybdenum	Selenium	Thorium	Tin	Titanium	Tungsten	Uranium	Vanadium	Asphaltite	Barite	Clay	Coal	Diatomite	Gems	Mica	Oil shale	Phosphorite	Stone	Volcanic ash	Wollastonite	
Alder	o	o	o										x																					
Aura	o	o	o											x																				
Beaver	o	o	o											x																				
Black Mountain																																		
Bootstrap	o	o	o																															
Burner			o																															
Burns Basin																																		
Carlin			o										x																					
Cave Creek			x	x	x																													
Charleston	o	o	o											x																				
Coal Mine																																		
Contact		o	o											x																				
Cornucopia	o	o	o																															
Corral Creek			o	o	o	o																												
Decoy																																		
Delano	o	o	o	o	o	o								x																				
Delker			o																															
Divide	o	o	o																															
Dolly Varden	o	o	o	o	o	o								x																				
Edgemont	o	o	o	o	o	o																												
Elk Mountain	x	x	x	x	x									x																				
Elko			x																															
Ferber	o	o	o																															
Ferguson Spring	o	o	o																															
Gilbert Canyon								x	x																									
Gold Basin	o	o	o	o																														
Gold Circle	o	o	o	o	o	o																												
Good Hope	o	o	o																															
Goose Creek																																		
Halleck	x	x																																
Harrison Pass																																		
Hicks	o	o	o	o	o	o																												
Hot Creek																																		
Huntington Creek																																		
Island Mountain	o	o	o	o	o	o																												
Ivanhoe																																		
Jarbridge	x	o	o																															
Kinsley	o	o	o																															
Lafayette				x	o																													
Larrabee																																		
Lee	o	o	o	o	o	o																												
Lime Mountain	o	o	o	o	o	o																												
Loray	o	o	o	o	o	o																												
Lucin	o	o	o	o	o	o																												
Herrinac	o	o	o	o	o	o																												
Montello																																		
Moor																																		
Mountain City	o	o	o	o	o	o																												
Mud Springs	o	o	o	o	o	o																												
Pequop																																		
Pilot Peak	o	o	o																															
Proctor	x	o	o																															
Railroad	o	o	o	o	o	o																												
Robinson Mountain																																		
Rock Creek	x	o	o																															
Ruby Valley	o	o	o	o	o	o																												
Spruce Mountain	o	o	o	o	o	o																												
Swales Mountain	x	o	o	o	o	o																												
Tecoma	o	o	o	o	o	o																												
Tuscarora	o	o	o	o	o	o																												
Union			o																															
Valley View			o	o	o	o																												
Ware Creek	o	o	o	o	o	o																												
Wells			o																															
Wandover																																		
White Horse			o	o	o	o																												

Table 5.--Production of mining districts in Elko County through 1969

[0, none; blank, figures not available]

District	Ore, etc., sold or treated (sh. tons)	Gold (oz)	Silver (oz)	Copper (lb)	Lead (lb)	Zinc (lb)	Mercury (flasks)	Value when sold ^{2/} \$	Other ^{2/}
Alder	75	27	503					1,278	Tungsten
Aura	174,643	67,266	4,293,060	1,762	2,297	0	0	6,032,831	
Beaver		0	0	0	0	0	0		Barite, turquoise
Bootstrap	38,636	9,657	140	0	0	600		338,196	Placer gold, barite, antimony
Burner	2/	0	2/	0	2/	0	0	30,000	
Burns Basin									Antimony
Carlin	4	0.1	227	0	3,905	0	0	313	Diatomite
Charleston	1,322	358	446	1,772	970	0	0	10,518	Antimony
Contact	62,825	1,110	91,134	5,007,345	324,633	18,400	0	1,316,208	Tungsten, barite
Cornucopia	31,017	13,428	762,107	300	0	0	0	1,273,650	
Corral Creek	4/	0					0		
Decoy		0	0	0	0	0	0		Manganese
Delano	78,735	303	1,657,449	157,827	20,517,904	987,277	0	3,128,696	Tungsten
Delker	791	0	0	98,434	0	0	0	26,156	
Divide	26	12	7,564	0	0	0	0	4,893	
Dolly Varden	>3,928	39	15,368	452,339	227,215	0	0	>75,042	
Edgemont	171,501	43,977	38,608	10,552	552,781	500	0	987,705	Antimony, tungsten
Elk Mtn.	0	0	0	0	0	0	0	0	
Elko	0	0	0	0	0	0	0	0	Shale oil, stone
Farber	1,498	58	21,288	180,040	500,000	0	0	62,243	
Ferguson Spring	356	1	394	44,973	0	0	0	7,037	
Gold Basin	924	281	155	445	0	0	0	8,128	
Gold Circle	401,659	126,968	1,634,752	736	18,900	200	0	4,152,423	
Good Hope			90,909	0	0	0	0	100,000	Antimony
Goose Creek	0	0	0	0	0	0	0	0	Lignite, stone (Idaho)
Harrison Pass		0	0	0	0	0	0		Tungsten
Hicks	>163	>13	>2,471	>77	>2,975	>4,316	0	>1,725	
Huntington Creek	0	0	0	0	0	0	0	0	Clay
Island Mtn.	8,823	666	105,618	8,400	1,433,700	68,500	0	357,603	Placer gold, antimony, tungsten
Ivanhoe	67,900	8	21	0	0	0	2,166	220,119	
Jarbridge	892,998	433,938	1,279,823	129	0	0	0	10,112,423	
Kinsley	898	102	14,062	66,203	145,204	0	0	11,338	Tungsten
Larrabee	0	0	0	0	0	0	0	0	Barite
Lee	165	0	1,345	202	51,708	0	0	7,918	
Lime Mtn.	>18,211	8,423	25,795	635,156	0	28,319	0	340,000	
Loray	4,472	4	29,496	26,065	487,595	1,727	0	78,215	
Lucia	403	2	649	9,746	83,721	25,585	0	14,598	

[0, none; blank, figures not available]

District	Ore, etc., sold or treated (sh. tons)	Gold (oz)	Silver (oz)	Copper (lb)	Lead (lb)	Zinc (lb)	Mercury (flasks)	Value when sold ^{1/} \$	Other ^{2/}
Merrimac	67,438	552	745,151	177,060	5,753,420	3,435,093	0	1,263,139	Turquoise
Moor	0	0	0	0	0	0	0	0	Limestone
Mountain City	1,110,726	11,081	1,473,363	196,379,131	192,836	0	0	25,970,557	Uranium, manganese, tungsten
Mud Springs	3,749	22	13,913	55	325,189	1,700	0	45,946	
Pilot Peak	6	22	186		0	0	0	863	
Proctor	11	0	224	38	0	0		195	Tungsten, limestone
Railroad*	77,592	2,634	1,284,605	6,985,108	24,316,609	543,793	0	4,715,189	Barite
Robinson Mtn.	0	0	0	0	0	0	0	0	Barite
Rock Creek	58	18	15,869	0	0	0	^{2/} 23	9,894	
Ruby Valley	2,795	14	3,305	22,300	364,000	231,800	0	98,021	Tungsten
Spruce Mtn.	104,955	1,109	1,261,823	797,119	23,877,532	3,176,290	0	2,998,760	
Swales Mtn.			0	0	0	0	0		Barite
Tecoma	6,899	89	55,483	10,217	2,930,312	2,000	0	312,851	
Tuscarora	426,488	162,099	7,139,637	14,358	145,838	0	^{2/} 2	10,715,132	
Valley View	0	0	0	0	0	0	0	0	Beryl, mica, tungsten
Warm Creek	4,107	2	1,101	1,725	61,994	1,915,499	0	240,000	
Wells			0	0	0	0	0		Tungsten, stone
Wendover	0	0	0	0	0	0	0		Tungsten, stone
White Horse	24	0	85	0	3,500	600	0	704	Tungsten
UNDISTRIBUTED	<u>3,662</u>	<u>36</u>	<u>9,933</u>	<u>15,846</u>	<u>1,774,781</u>	<u>220,477</u>		<u>201,111</u>	
Totals	3,772,483	884,339	22,078,062	210,120,352	84,099,519	10,662,676	2,191	75,271,613	

^{1/} Gold, silver, copper, lead, zinc, mercury only

^{2/} Production reported—not included in total tons or value

^{3/} Includes small placer production

^{4/} Included in Undistributed

* Through 1968

Table 6.--Recorded annual production of ores, 1859-1969

[0, none; *, estimated; blank, figures not available]

Year	Number of operating mines Lode ¹ / Placer ² /	Ore and tailings sold or treated (Thousand short tons)	Total value when sold (Thousand dollars)	Remarks
Gold, silver, copper, lead, zinc				
1859				Coal discovered, Carlin district
1860				
61				
62	1	0	0	Copper discovered, Kinsley district
63				
64				
65				Kinsley district rediscovered
66				
67				Placer gold discovered, Tuscarora district
68				
69				Silver discovered, Aura, Mtn. City, Spruce Mtn., Railroad, Lone Mtn.
1870				Mtn. City silver rush; copper discovered, Contact
71		4	124	Silver discovered, Tuscarora district
72		1	58	Cornucopia silver rush; copper discovered, Dolly Varden district
73		1	50	Placer gold discovered, Island Mtn. district
74		0	0	
75		5	407	
76		5	444	Placer gold discovered, Charleston district
77		16	1,047	Tuscarora silver rush
78		16	1,281	Silver discovered, Good Hope district
79		17	1,094	
1880		8	438	Copper discovered, Ferber district
81		3	156	
82		4	334	Silver mines depleted, Cornucopia district
83		4	526	
84		7	641	
85		6	312	
86		6	226	
87		2	222	
88		5	565	
89		11	538	
1890		30	700	
91		6	484	
92		9	381	
93		6	183	Placer gold discovered, Mtn. City (Van Duzer) district
94		3	96	Copper discovered, Delker district
95		3	41	Gold discovered, Edgemont district
96		4	64	Gold Creek rush, Island Mtn. district
97		5	106	
98		26	175	
99		50	199	

Table 6.—Recorded annual production of ores, 1880-1949—Continued

Year	Number of operating mines		Ore and tailings sold or treated (Thousand short tons)	Total value when sold (Thousand dollars)	Remarks
	Lode ^{1/}	Placer ^{2/}			
Gold, silver, copper, lead, zinc					
1900			61	257	
01			58	261	
02			69	238	
03	11	2	58*	249	
04	9	4	61*	262	
05	6	3	30	202	Gold discovered, Dolly Varden district
06	7	1	34	209	Lead discovered, Tecoma district
07	11	0	43	211	Midas gold rush, Gold Circle district
08	29	3	26	247	
09	30	3	12	199	
1910	35	2	4	64	Jarbridge gold rush
11	27	3	27	115	
12	45	4	14	139	Zinc discovered, Warm Creek district
13	44	1	5	128	
14	38	7	12	266	Shale oil produced, Elko district
15	75	3	20	352	
16	76	1	41	1,099	Mercury discovered, Ivanhoe district
17	80	3	28	826	
18	44	5	51	1,019	
19	28	1	60	998	Silver rush, Divide district
1920	38	3	65	1,078	
21	32	6	54	939	Diatomite-produced, Carlin district
22	33	3	49	721	
23	28	0	44	517	
24	23	0	70	804	
25	43	0	67	950	
26	35	0	65	940	
27	39	0	56	868	
28	30	1	86	1,091	
29	37	0	78	1,127	
1930	29	0	63	667	Barite developed (produced 1931), Pine Mountain district
31	20	1	72	637	Rio Tinto copper ore body discovered, Mtn. City district
32	26	3	51	602	
33	35	2	4	85	
34	53	15	10	225	
35	61	5	29	853	
36	52	2	141	2,890	
37	62	9	210	4,623	Rio Tinto produced over 33 million lbs. copper
38	54	5	103	1,617	
39	64	4	175	3,314	
1940	58	4	198	3,621	
Subtotal			2,667	46,269	Figures above (gold, silver, copper, lead, zinc)
Subtotal			2,186	37,992	Couch and Carpenter, 1943 (incl. diatomite 1933 and mercury 1940)

Table 6.--Recorded annual production of ores, 1882-1969--Continued

Year	Number of operating mines		Ore and tailings sold or treated (Thousand short tons)	Total value when sold (Thousand dollars)	Remarks
	Lode ^{1/}	Placer ^{2/}			
Gold, silver, copper, lead, zinc					
1941	55	5	151	3,053	
42	38	3	136	2,149	
43	20	0	117	1,581	
44	19	snipers	92	1,487	
45	16	snipers	56	1,103	
46	17	0	44	1,079	
47	27	1	32	893	Rio Tinto mine closed
48	36	2	9	544	
49	26	2	5	278	
Subtotal			3,309	58,438	Gold, silver, copper, lead, zinc
Subtotal			3,453	69,124	Granger and others, 1957, table 2 (incl. mercury 1915-4
1950	34	0	6	305	
51	18	2	5	225	
52	15	snipers	4	200	
Subtotal			3,324	59,168	Gold, silver, copper, lead, zinc
All commodities except water in order of total value when sold					
53	16	0		762	S&G, barite, Cu, Pb, Ag, Zn, W, Au
54	29	1		599	W, barite, Pb, S&G, Ag, Cu, Zn, stone, Au, Hg
55	33	0		952	S&G, W, Pb, barite, Ag, Cu, Zn, stone, Hg, Au, gems
56	22	0		1,126	S&G, Cu, barite, Pb, W, Ag, Zn, Au, stone, Hg
57	15	snipers		669	S&G, barite, Pb, Cu, Ag, Zn, W, Au, Hg
58	14	1		953	S&G, Au, Pb, stone, barite, Ag, U, Zn, Cu, Hg
59	10	snipers		1,252	S&G, Au, barite, stone, Pb, Ag, Zn, gems, Cu, Hg
1960	15	collectors		647	S&G, barite, Pb, Ag, U, Au, Zn, Cu, Hg, stone, gems
61	12	collectors		753	S&G, barite, Pb, Ag, U, Zn, Au, Hg, gems, Cu, stone
62	8	collectors		1,707	S&G, barite, stone, Pb, Ag, gems, Au, Hg, Zn, Cu
63	7	collectors		1,685	S&G, barite, stone, Pb, Ag, Zn, gems, Au, Cu
64	9	0		1,273	S&G, barite, stone, Zn, Pb, Ag, Hg, Cu
65	8	0		508	S&G, stone, Pb, Ag, Zn, Cu, Au
66	12	1		1,066	S&G, Cu, barite, stone, Pb, Ag, Zn, Au, Hg
67	6	0		1,695	S&G, Cu, barite, stone, Sb, Pb, Ag, Zn, Au
68	8	0		2,270	Cu, Ba, S&G, Ag, Pb, Zn, Hg, Au
69	NR	NR		2,792	S&G, Cu, Ba, Ag, Pb, Zn, Hg, Sb, stone, Au
Subtotal 1953-1969				20,709	
Total 1871-1969				90,563	Including 1949 subtotal by Granger

^{1/}Excluding low-grade manganese ores 1953-1955; includes quarries

^{2/}Excluding sand and gravel pits (S&G) and gem collectors

NR - No report. USBM discontinued county reports on mining and now reports farm income, residential construction, etc.

DESCRIPTIONS OF MINING DISTRICTS

Alder district

Location and history

Sections (Approx).	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names, remarks
All	46	56	Rowland	Lost Gulch placers
W½	46	57	Rowland	Young American Creek lodes
N½	45	56	Rowland	Tennessee Gulch, Tennessee Mtn.

The first discoveries were gold-bearing veins located in 1869 along Young American Creek (White, 1871). When the district was organized in 1870 it included also the Tennessee Gulch and Lost Gulch placer areas. According to Vanderburg (1936, p. 71), the "Alder or Tennessee Gulch district is * * * 10 miles south of Rowland. Considerable placer mining was done in the early days, as indicated by the old placer tailings on Gold Run Creek, half a mile north of Baker Ranch."

The Garnet tungsten deposits discovered in 1949 (Granger and others, 1957, p. 26) on the upper southwest slopes of Tennessee Mountain are considered to be in the Alder district, but the Little Joe prospects (gold-scheelite) on the southeast slope are in the Island Mountain district.

Production, principally of placer gold, during the early years is not known. Gold was produced also from fissure veins, and a mill was built near the Parks cabin (Bushnell, 1967, p. 34). Lode mining from 1916 through 1939 from the Clipper Alder, Mohawk, and Pittsburg Silver mines (table 7) yielded 84 tons containing 36 oz gold and 1,190 oz of silver. No production has been recorded from 1940 through 1969.

Geologic setting and ore deposits

The oldest rock formation in the district is Prospect Mountain(?) Quartzite of Lower Cambrian age. It is overlain by phyllites, limestones, and argillites of Cambrian and younger Paleozoic(?) ages, and intruded by the quartz monzonite Coffee Pot stock of Cretaceous(?) age, which underlies most of the district. The edges of the stock and the adjacent sedimentary rocks are cut by dikes as much as 200 ft wide of aplite and alaskite, and locally are overlain successively by erosion remnants of older volcanics, Young America gravels, and younger volcanics. The older volcanics are Eocene(?) Bieroth Andesite 200-400 ft thick and Miocene Jarbidge Rhyolite 1,000-1,500(?) ft thick. Young America gravels are as much as 300 ft thick and consist of pebbles and boulders of the older rocks an inch to 3 ft in diameter. The younger volcanics are rhyolite ash, tuffs, and flows totaling about 350 ft thick, of the Pliocene Idavada Formation.

Adjacent to the quartz monzonite the limestones are metamorphosed to marble and tactite, the argillite to hornfels.

Table 7.--Alder mining district, mines through 1969

[Blank spaces, figures not available; ●, main product; ○, by-product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Molybdenum	Tungsten	Uranium	
	Clipper Alder				○	●				<5
	Lonesome	Island Mtn. dist.(?)			●	○				<5
1	Lost Gulch placer	34 3,10	46 45	56	●					
	May placer (Lost Gulch)				●					<5
3	Mohawk	7,8	45	56	●	○				<5
2	Pittsburg Silver	5,6	45	56	○	●				
4	Tennessee placer	4,5,9, 10,15	45	56	●					
	Apex	8	45	56				x		
6	Garnet (Garnet Tungsten)	8,17	45	56			x	x	x	0
	Gribble Quartz	See Island Mtn. dist.								
5	Knowles Bros - see Garnet	17	45	56						
	Little Joe	See Island Mtn. dist.								
	Mohawk - Pittsburg	5,6,7,8	45	56				x		0
	Montrose - see Garnet	8	45	56						
	Star Metal	See Island Mtn. dist.								

The pre-Tertiary rocks are folded, displaced in at least one locality (Trail Creek) along a bedding-plane thrust fault (western facies over eastern facies?), and are also displaced along steeply dipping normal or reverse faults that trend northeast or northwest. The early Tertiary volcanics are locally in fault contact with quartz monzonite, but the middle Tertiary gravels and later volcanics are relatively undisturbed (Bushnell, 1967).

The ore bodies are contact metamorphic deposits in the tactite, quartz veins along both sets of steep faults, and placer deposits in stream gravels.

Contact metamorphic deposits contain scheelite, powellite, molybdenite, bismuthinite, and pyrite disseminated in the tactite. The largest deposits are at the Garnet Tungsten mine where three tactite lenses along or near aplite dikes are parallel with the bedding and dip about 60° SW. They range in length from 100 to 500 ft, in width from 25 to 150 ft, and have been explored 400 ft down the dip. Scheelite is disseminated throughout the tactite but is concentrated in some layers more than in others. The largest ore body has been exposed 400 ft along the strike, 400 ft down the dip, averages 30 ft wide, and is estimated to contain 0.3-0.5 percent WO₃ and about 0.01 percent Mo (H. W. Jones and R. G. Reeves, written commun., 1955). No production of tungsten is recorded through 1969.

Quartz veins along faults that cut the Paleozoic rocks and the quartz monzonite contain gold. At the Garnet Tungsten mine some of the quartz veins, which are as much as 8 inches wide, contain a little scheelite. In one locality at the Garnet Tungsten mine a quartz vein about 3 inches wide along a fault gouge a foot wide cutting tactite contains as much as 3 percent U₃O₈ as pitchblende (R. E. Cohenour, written commun., 1961).

Placer deposits in Tennessee Gulch, Lost Gulch, and Slate Creek yielded unknown but evidently small amounts of gold.

Aura district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
34, 35, 36	45	52	Owyhee, 15'	Centennial, Bull Run
E½	44	52	Bull Run	Centennial, Columbia, Blue Jacket
All	44	53	Bull Run	Centennial, Columbia, Van Duzer

The Aura district covers the east slope of the Bull Run Mountains, formerly the Centennial Range, north of the site of Aura in Bull Run Basin, and south of Van Duzer Creek. Its western boundary is approximated by a north-south line through the summit of Porter Peak.

The district has been renamed several times and includes areas formerly grouped with the Edgemont and Van Duzer districts. The first discoveries in 1868 included the Blue Jacket mine, whereupon the Bull Run district was organized in 1869. The name was later changed to White Rock (see Edgemont district) and then to Centennial. During the 1870's, placer deposits along Columbia Creek, Blue Jacket Creek, and California Gulch were worked. During the boom times of 1906, an extensive system of ditches, flumes, and pipelines was built to hydraulic the gravels in Bull Run Basin, and the town of Aura was founded on Columbia Creek 1½ miles below the old town of Columbia. Only a few hundred yards of gravel was washed. In 1925 another ditch was dug to bring water for hydraulicking from Blue Jacket Canyon, but this venture also was unprofitable (Vanderburg, 1936, p. 71). The placers have not been worked since, and total production is estimated to be 30 oz of gold (Johnson, 1973, p. 97). Land Office records for other placers on Trail Creek, Hutch Creek, and Wood Gulch are listed under Van Duzer district; records for the western part of the district are listed under Centennial.

Production through 1949 was reported by Granger and others (1957, p. 23). None is recorded for the years 1950-69 except a small shipment from the Aura Queen mine in 1964.

Geologic setting and ore deposits

Sedimentary rocks of the eastern assemblage--Prospect Mountain Quartzite overlain by slates, phyllites, limestones, quartzite, and cherts 18,000-20,000 ft thick of Cambrian to post-Devonian ages--are folded, faulted, and overlain by erosion remnants of metavolcanic rocks of the western assemblage in the upper plate of the Trail Creek thrust fault of pre-Jurassic age. Both plates are intruded by two dioritic stocks; the larger Columbia stock, about a mile across, is of Jurassic age. Four smaller stocks or plugs crop out in the lower plate in areas where the upper plate has been stripped away by erosion.

Three types of ore bodies, veins, replacement deposits, and placers, have been mined. Quartz veins as much as 5 ft wide occupy faults both along and across the bedding of limestone, and contain pyrite, argentiferous galena, sphalerite, chalcopyrite, tetrahedrite, or their oxidation products, and gold. A siliceous replacement vein at the California mine (Emmons, 1910, p. 74) is also 4 or 5 ft wide and is similarly mineralized. Gold placers along Trail Creek, because of their low gold content and the large size of the boulders, were not profitable. The gold in these placers may have been derived from the fractured rocks along the Trail Creek thrust fault (Decker, 1962, p. 56).

Other types of deposits in the district have been explored. Gold-bearing quartz veins cut some of the granodiorite intrusives, manganese occurs at the Maggie Summit mine, coal was reported from an unknown locality in Bull Run Basin, and shows of oil and gas were found in the two exploratory wells in Bull Run Basin (Decker, 1962, p. 57).

Table 8.--*Aura mining district, mines through 1969*

[Blank spaces, figures not available; ●, main product; ○, by-product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Manganese		
	Arrowhead			On Bull Run Creek	●	○		○				<5
	Astor (see Edgemont dist.)											
3	Aura King				●	○		○				<5
	Aura Queen	26	44	52	●	○	○	●	○			<5
	Big Four (see Island Mtn. dist.)											
1	Blue Jacket	21,22	44	52		○	○	●	○			<5
	Burns (see Edgemont dist.)											
2	California	28	44	52	○	●	○	○				<5
	Centennial (Blue Jacket group)	15,22	44	52								
	Columbia (Columbia Queen)	25	44	52	○	●						<5
	Eagle Rock		44	52		○	○	●				5-100
	Gold Dollar (see Edgemont dist.)											
	Gold Bug and Charlotte placer	13,24, 25,18	44	52,53	●	○						<5
	Gold Bug Consolidated placer	22,23,26	44	52								
4	Golden Eagle	19	44	53	●			○				<5
	Golden Eagle placer				●	○						<5
	Humboldt											
	Infidel	25	44	52								
	Jackpot				●	○						5-100
	Little John (see Edgemont dist.)											

Table 8.--*Aura mining district, mines through 1969--Continued*

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc		Manganese
	Lucky Girl (see Edgemont dist.)										
	Maggie Combine	19,21, et al.	44	53	•	•	o	o			<5
	Montana Lucky Girl (see Edgemont dist.)										
	Nevada Lode	2	44	52							
	Paddison (see Edgemont dist.)										
	Polaris	23,24	44	52							
	Protection placer										
	Red Cloud										
	Richelieu										
	Riddle	28	44	52							
	Schley.				•	o					<5
	Tiger Lode										
	Tuscarora	28	44	52							
	White Rocks										
	White Rock G.M. Co. placer (see unknown dist.)										
	Maggie Summit										x
	Burns Tungsten (see Edgemont dist.)										

Beaver district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names, remarks
S-1/6	38	51	McDermitt 2°	
All	38	52	McDermitt 2°	Turquoise
All	37	51	McDermitt 2°	Beaver district, 1934
All	37	52	McDermitt, Blue Basin	Maggie Creek placers(?)

The Beaver district was listed by Lotz (1934, p. 18) in T. 37 N., R. 51 E., MDBM. As herein described, it includes Beaver and other creeks north of Dalton Peaks which drain into Maggie Creek along the east slope of the Tuscarora Mountains.

Turquoise was produced from gold placers in this area during the Tuscarora boom, but the amount is not known.

A few tons of silver-gold ore reportedly produced in 1906 by the Nevada Star Mining Company from the Maggie district in Elko County (U.S. Geol. Survey, 1906, p. 293) probably should be credited to the Nevada Star mine in the Maggie Creek district in Eureka County.

The Stampede turquoise mine, which operated before 1968, is an open pit about 70 ft long and 40 ft wide near the crest of a southerly trending ridge in the SE¼ sec. 9, T. 38 N., R 52. E. Total production of turquoise including the early placer production is less than \$500,000.

Barite was produced from the Jones Marvel mine in 1962.

Geologic setting and ore deposits

In the locality of the Stampede mine strata of black chert and gray quartzite that strike N. 65° E. and dip 65° NW. are cut by numerous fractures which dip 45° SE. Turquoise occurs as nodules and seams along bedding planes in the chert and the quartzite, and also as float in the gullies. The turquoise is extremely hard and of good color; solid-blue, matrix-marked, and spider-web varieties have been produced (Morrissey, 1968, p. 5).

Barite at the Jones Marvel mine is reported to be a bedded-type deposit (Horton, 1963, p. 7). It replaces limestone lenses in strata of the western facies (R. R. Coats, written commun., 1975).

Table 9.--Beaver mining district, mines through 1969

[•, main product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity		Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Barite	Turquoise	
2	Marvel (Jones Marvel)	1	37 N.	51 E.	•		>100
1	Stampede	9	38 N.	52 E.		•	>100

Black Mountain district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names; remarks
34,35,36	40	64	Wine Cup Ranch SW	No published data
NE¼	39	64	Wine Cup Ranch SW	

Black Mountain is about 18 miles airline northeast of Wells. Two prospects, one on the east slope (sec. 2, T. 39 N., R. 64 E.) and the other on the west slope (sec. 10); are shown on the topographic map of the quadrangle. No production has been reported from the area.

Geologic setting

Black Mountain, a north-trending ridge about 4 miles long, is composed of sedimentary rocks ranging in age from Devonian to Permian. No igneous rocks have been mapped in this locality. The oldest strata are dolomites of the Simonson and Sevy Formations overlain by limestones of the Guilmette or Devils Gate Formation exposed along the crest of the ridge. They are in fault contact with younger limestone (Mississippian) strata exposed along the west side of the ridge and with still younger siltstones and cherts of the Carlin Canyon sequence (Permian) exposed in the east half of the district. In a few nearby places west of the ridge these Permian rocks comprise remnants of the upper plate of a thrust fault.

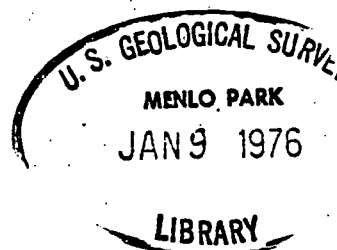
The prospect adits in sec. 2 explored a breccia zone about 10 ft wide that dips steeply west in limestone of the Nevada Formation. The breccia is cemented and partly replaced by strontium-bearing barite and calcite.

Bootstrap district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
All	37	49	Santa Renia Fields	Boulder Creek
N-1/3	36	49	Santa Renia Fields	Boulder Creek

The district includes much of the drainage areas of Boulder and Antelope Creeks on the west slopes of the Tuscarora Mountains. Another Boulder Creek on the east side of the range south of Tuscarora is not included.



The area was called the Boulder Creek district from 1953 to about 1960, but was later known as the Bootstrap district after the Bootstrap mine became the largest gold producer in the county in 1958. From 1953 through 1969 the district yielded a little more than half a million tons of barite having an average value of about \$6.65 per ton. The Rossi mine is one of the two largest barite mines in the United States, the other being the Greystone mine in Lander County.

A load of antimony ore from the Bootstrap mine was hauled to Dunphy in 1914 but was never shipped (Lawrence, 1963, p. 58).

During 1972 the Newmont Mining Co. was preparing to reopen the Bootstrap mine in Elko County and the nearby Blue Star mine in Eureka County, estimated to contain over a million tons of low-grade gold ore which could be mined profitably at the higher gold price then in effect.

In the Bootstrap mine area thick-bedded limestones of Devonian age, which closely resemble the Popovich Formation at the Carlin mine, are exposed in a window through the overlying cherts, shales, and limestones of the Vinini Formation of Ordovician age, and separated from them by the Roberts Mountains thrust fault. The Vinini strata are cut by many steep north-trending faults and intruded by quartz latite to dacite dikes as much as 15 ft wide along some of the faults. Gold occurs, mostly as microscopic particles, along fractures in the dikes and in the cherts and shales near the dikes. Where several dikes are spaced closely, ore bodies are minable by open-pit methods. A few samples, not necessarily representative of the average grade, contained 0.10-0.3 oz gold per ton (A. S. Radtke, oral commun., 1973). Gravels from the Bootstrap placer averaged 0.024 oz gold per ton.

Burner district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names, remarks
E½	41	47	McDermitt 2°	Burner Hills district Mint mine, sec. 12

The Burner district covers the Burner Hills, an isolated group of hills about 2 by 3 miles across, which rise to altitudes of 6,200 ft, but only about 700 ft above the undulating plain of the Owyhee Desert. According to Emmons (1910, p. 67), "A number of claims are located in these hills, but the Mint mine is the only one on which any considerable amount of work has been done. This mine was operated in the early eighties and shipped about \$30,000 worth of lead-silver ore to smelters. Active operations were suspended in 1893, and since that time but little work has been done." No further production has been recorded from the district through 1969, but exploration at the Silver Ace (Burner Hill or Mint) mine was reported during 1961-64.

Table 10.--Bootstrap mining district, mines through 1969

[•, main product; o, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Barite	
2	Bootstrap	2,3, 10,11	36	49	•	o	o	o	o		>100
	Bootstrap placer (Boulder Creek--1966)				•						<5
	Estabrook (see Jenkins) ^{1/}									•	(>10,000 tons)
	Jenkins Ranch (Estabrook) ^{2/}	20(?)	38	50(?)						•	5-100
	Marvel (Jones Marvel) (see Beaver district)									•	
1	Rossi	14,15,21, 22,27,28	37	49						•	>100

^{1/} May be in Beaver district.

^{2/} May be in R. 51 E.

The Mint mine is developed by a crosscut adit driven southwestward 175 ft to the lode, by a drift S. 25° W. for 300 ft along the lode, by a winze of unreported depth, and by small stopes above and below(?) the level.

Geologic setting and ore deposits

The oldest rocks exposed in the district are interbedded chert, shale, argillite, and quartzite of the Valmy Formation of Ordovician age which crops out on the east slope of the Burner Hills (SW¼ sec. 13). Younger interbedded chert, shale, argillite, and limestone of the Havallah sequence of Permian-Mississippian age also crop out on the slopes farther north (SW¼ sec. 12) and dip away from the central axis of the hills. These formations are overlain by flows of unweathered andesite and by rhyolite tuffs and pumice of Miocene-Oligocene age, which in turn are overlain by rhyolite tuffs of Miocene age. Basalt gravels of the Banbury Formation, also of Miocene age, cover the plains to the north and west.

The sedimentary rocks and the andesite are cut by faults that trend northeastward and dip steeply or are vertical. One of the vertical faults in the andesite contains the Mint lode; other faults in the sedimentary rocks south of the Mint mine contain small quartz veins that cut across the bedding and stringers parallel to the bedding.

At the Mint mine the ore bodies are veinlets parallel to the walls and irregular masses in hydrothermally altered andesite in a fault zone up to 4 ft wide. They were mined from small stopes for 300 ft along the adit level and an unreported distance above and below it. The ore consists of argentiferous galena, sphalerite, pyrite, arsenopyrite, and chalcopyrite in a gangue of quartz and calcite. Near the surface lead carbonate and iron oxide are present (Emmons, 1910, p. 67). According to Emmons "the high-grade ore is said to be irregular and buncy in the vein, but a zone up to 4 ft wide is regarded by the owners as available for concentrating, as a considerable proportion of the silver values is in the galena."

Burns Basin district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
All	40	53	Tuscarora, Mahala Creek West	Byrne Basin

The Burns Basin district covers the area of Burns Basin on the west slope of the Independence Mountains about 12 miles east of Tuscarora. The only mine in the district for which production has been recorded is the Burns Basin antimony mine, also known as the Lonesome Kid, Williams, Parker, Chaffie, Griffith, or Andrae mine, but antimony and barite prospects have been found along the range both north and south of the district from Taylor Canyon to Jacks Peak.

Table 11.--Burns Basin mining district, mines through 1969

[●, main product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity		Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Antimony	Barite	
	Birds Eye prospect	2,11	40	53	x		0
1	Burns Basin (Byrne)	22	40	53	●		5-100
	Eagle prospect	6	39	53	x		0
	Lost and Found prospect	9,10, 15,16	40	53	x		0
	Unnamed prospect	16,17	41	53		x	0

The Burns Basin mine is near the head of Burns Creek. It is developed by a 29-ft vertical shaft, 80 ft of underground workings, and an open pit. Total recorded production is 20 tons of antimony metal in 1918 and 12½ tons in 1945.

Geologic setting and ore deposits

(Lawrence, 1963, p. 47-48)

At the Burns Basin mine thin-bedded limestone of Paleozoic age strikes N. 20° E. and dips 10° E. It is cut by a fracture zone 12-18 inches wide that strikes N. 10° W. and dips 75° W. The zone is silicified and some fractures contain calcite and quartz. In the footwall of the fracture zone the limestone is brecciated. Stibnite and its oxidation products occur as single crystals, pods, and veinlets up to three-fourths of an inch wide in the brecciated limestone and along the bedding planes, mostly within 10 ft of the fracture zone. Barite crystals also occur along the fractures with the stibnite; in other deposits they are perched on the stibnite. A sample of stockpiled ore contained 17 percent stibnite and 0.5 oz silver per ton.

Carlin district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
S-1/3	34	52	Huntsman Ranch	"Prospect" on quadrangle map
E-5/6	33	52	Huntsman Ranch, Carlin	Diatomite, manganese
W½	33	53	Huntsman Ranch, Carlin	Diatomite, coal
E-5/6	32	52	Carlin	Uranium
W½	32	53	Carlin	Uranium

The Carlin district covers the mountainous areas for about 7 miles north and south of Carlin, and from Carlin (Moleen) Canyon westward to the Eureka County line. The district does not include the Carlin gold mine which is in the Lynn district in Eureka County about 18 miles northwest of Carlin.

Coal was discovered in 1859, 2½ miles east of Carlin and south of the Humboldt River. The deposit was explored by the Humboldt Coal Company with three shafts 60-80 ft deep and four parallel adits driven toward the shafts. The coal was reported to contain 46 percent carbon, and to burn freely leaving a white ash. Work was suspended in 1874 due to the large quantities of water encountered (Whitehill, 1875, p. 29). The company was still active during the years 1895-97, but no production was reported. There are no reports of subsequent work on the deposit.

Lead-silver ore from the Wagner mine is credited to the Carlin district for 1908, but the location of the mine is not known. Gold production of 15 oz from the Big Six mine in 1908, and about 10 oz of placer gold in 1934, was formerly credited to the Carlin district, but the Big Six gold mine and associated placers are in the Lynn district in Eureka County.

A diatomite deposit $1\frac{1}{2}$ miles north of Vivian siding was mined by underground methods from 1921 through 1952. Production figures were not published, but in 1922 the capacity of the grinding and air-classifying plant at Vivian was 12 tons per day (Lincoln, 1923, p. 39), and in 1926 the deposit was being mined at the rate of 2,000 tons per year (Eardley-Wilmot, 1928, p. 105). Most of the product was sold for use as insulation. Average value at the mine of 928 tons reported for 1933 was \$8.44 per ton (Couch and Carpenter, 1943, p. 41).

Uranium deposits on the Deerhead (Deerhorn) and Black Kettle claims were prospected in 1956, but no production resulted.

Barite from the Graves mine was shipped from Carlin in 1956; the location of the deposit is not known.

Manganese deposits at the Berning prospect were explored, but there has been no production.

Geologic setting and ore deposits

Oil shale occurs in the Elko Formation (Smith and Ketner, 1974) of Eocene-Oligocene age which in its type section near the line between secs. 10 and 15, T. 31 N., R. 53 E., is 2,075 ft thick. About half of the strata near the middle are composed of carbonaceous laminated papery shales that weather nearly white, but their area and thickness do not indicate a commercial tonnage under 1974 economic conditions.

In the area of the Tri-O-Lite mine a bed of diatomite 15 ft thick crops out at intervals for several miles. It is underlain and overlain by a friable limy rock interlayered with thin beds of clay, all of late Miocene(?) age. The strata are tilted 35° SE. and are cut by many small faults.

The diatomite bed tapers to a thin hard seam at its southern edge, but in most places the edges of the original basin have been eroded away. The central 10 ft of the deposit, which was the only part mined, contains a thin stratum of limy rock in the middle; the best grade of diatomite occurs below this stratum. The diatoms are well-preserved, fairly uniformly sized, cylindrical *Melosira granulata*. The diatomite contains about 15-20 percent moisture (Eardley-Wilmot, 1928, p. 105).

In the locality of the Deerhead uranium claims, thin-bedded black shale conformably overlain by water-laid(?) tuff strikes N. 40° W. and dips 23° NE. These strata are cut by a fault that strikes N. 50° W. and dips 75° NE. Shale and tuff along the fault are brecciated and silicified for a width of about 20 ft. Carnotite occurs in small flakes in the breccia and in slope wash near the breccia. Samples containing as much as 0.03 percent U_3O_8 were reported (H. W. Jones, written commun., 1957).

A 50-ft shaft on the nearby Black Kettle claim yielded samples containing up to 0.04 percent U_3O_8 (W. E. Peterson, written commun., 1960).

Table 12.--*Carlin mining district, mines through 1969*

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Lead	Uranium	Manganese	Barite	Coal		Diatomite
	Big Six (see Eureka County Gold placers (see Eureka County) Massachusetts et al. claims Wagner (1908)	7,18	33	53									0 <5
3	Black Kettle prospect	27	32	52				x					0
2	Deerhead prospect	24	32	52				x					0
	Berning	NW 32	33	52					x				0
	Carlin Canyon		33	53						x			0
	Humboldt Coal Co. (see Carlin Canyon)		33	53						x			0
	Odis Graves										●		5-100
1	Tri-O-Lite	18(?)	33	53								●	>100

Cave Creek district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
E½	27	57	Sherman Mountain

The Cave Creek district is 12 miles north of Fort Ruby, on the eastern slope of the Ruby Mountains, near the summit (White, 1871, p. 62).

"The cave was discovered in the 1850's and explored during the 1860's by a group of soldiers stationed at Fort Ruby. These men went into the cave in a rowboat; the boat capsized and one of the soldiers was drowned. The Cave Creek Mining District was discovered by General Ewing and recorded in 1869." (Patterson, 1964, p. 18).

Lead, copper, and silver minerals were discovered, and 10 or more claims were staked on three(?) veins 6-10 ft wide that strike north in an area a mile wide and 3 miles long. Very little work was done, and no production has been reported.

The exact location of the veins is not known, but Cave Creek issues from a cave in limestone of the Devils Gate Formation of Devonian age at an altitude of about 6,200 ft.

Charleston district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
All	45	57	Rowland, Jarbidge	Mardis, Copper Mountain
SW¼	45	58	Jarbidge	Copper Basin area
E-1/3	44	56	Mt. Velma	Wyoming, Cornwall Basin
All	44	57	Mt. Velma	Bruneau, Mardis
W-1/3	44	58	Marys River Basin NW	Mardis
N-1/3	43	57	Mt. Velma	Bruneau

The Charleston district includes the drainage area of the Bruneau River and its tributaries from Dry Creek 1½ miles south of Charleston to Coon Creek about 11 miles north, but excludes the Coon Creek tungsten mine which is in the Jarbidge district and the St. Elmo mine on Cornwall Mountain which is in the Island Mountain district. Land Office records are listed under Mardis (Wyoming) district. The old Wyoming district is mostly in Island Mountain district.

The earliest discovery in the area was the Bruno district "east of Bruno Creek, joining Wyoming. It was discovered in 1864, and organized in 1869, and is fifteen miles square" (White, 1871, p. 59). The principal mine was the Young America gold-bearing ledge located in 1869. Placer gold discovered along Seventy-six Creek, presumably in 1876, led to the organization of the Mardis district and the founding of the town of Charleston 4 miles south of the placers.

Later discoveries of other placers along several miles of the Bruneau River and its tributaries (Badger, Union, Pennsylvania, and Dry Creeks) and of lode deposits on Copper Mountain extended the district southward to Dry Creek and northward to about Coon Creek. Schrader (1923, p. 81) reported that the Buck Creek Mountains and Bearpaw Mountain north of Coon Creek were included in the district, but they are now included in the Alder and Gold Basin districts, respectively.

According to Vanderburg (1936, p. 71), "The bed of 76 Creek produced considerable gold in the years following the discovery of placer gold." Johnson (1973, p. 14) estimated "that about 300 oz of placer gold was probably recovered prior to 1900" from the district, and an additional 141 oz since 1901. Schrader (1923, p. 82) reported "a small production" of gold, silver, copper, and antimony from the Graham, Prunty, and other lode mines from 1905 to 1920. Production for 1936-38 is recorded under Mardis district. Part of the production from mines listed in table 13 has evidently been credited to other districts. No production was reported for the years 1946-69.

Geologic setting and ore deposits

The oldest rock formation exposed in the district is in sec. 25, T. 45 N., R. 57 E., where an outcrop half a mile across of schist, quartzite, and hornfels of Precambrian(?) age is in fault contact with Prospect Mountain(?) Quartzite of Cambrian age, which forms Copper Mountain. A few small areas of hornfels, phyllites, and limestones of younger Paleozoic age crop out at lower altitudes around Copper Mountain. These formations are gently to tightly folded or are overturned, are cut by many steep normal faults and by the Copper Mountain thrust fault of Late Mesozoic age, and they are intruded by the Coffee Pot stock, about 11 miles long from east to west, of quartz monzonite of Cretaceous age. Only the southern edge of the stock is included in the Charleston district. Near the stock the limestones are recrystallized and locally contain tremolite and other skarn minerals. Overlying parts of these formations are flows as much as 2,000 ft thick of Jarbidge Rhyolite of Tertiary age and beds nearly 800 ft thick of Young America Gravel of somewhat younger Tertiary age (Bushnell, 1967, pl. 1; Coats, 1964, pl. 1). The rhyolite but not the gravel is cut by many steep faults, but unlike those in the adjoining Jarbidge district, they are not mineralized.

Table 13.--*Charleston mining district, mines through 1969.*

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Antimony	Tungsten		Molybdenum
	Black Warrior		44	57	●	o	o	o				<5
	Carleton tunnel (700 feet)	34(?)	45	57								
	Cleaveland	14	44	57								
	Davenport				o	o	●					<5
	Graham				o		●					
	Knopf (Vanity Fair?)				●	o	o					<5
	Log Cabin placer				●							<5
	Mardis											
3	McKnights placer	22	44	57	●							
	Memphis (Slattery)	10,11(?)	43	57	●	o	o					<5
	Pennsylvania placer				●	o						<5
	Prunty				o	●	o		o			
	Rescue placer				●	o						<5
	Slattery (see Memphis)											
	Vanity Fair	13,14, 23,24	44	57	●	o	o					<5
2	Virginia	13,14,23	44	57	●	o	o	o				5-100
	Weston placer				●	o						<5
1	Batholith	13,14	45	57						●	x	

Small deposits of gold, copper, gold-silver, copper-silver, tungsten, and antimony have been mined or prospected. The largest and highest grade lode deposits were mined at the Virginia mine where about 450 tons averaged 2.8 oz gold and 2.3 oz silver per ton. The ore also contained about 0.74 percent copper and 3.7 percent lead. At the Batholith tungsten mine, scheelite occurs with molybdenite and powellite in a contact metasomatic deposit. No production of tungsten has been officially recorded.

Placer gold deposits as much as 50 feet thick contain rather fine gold in gravels composed of well-rounded pebbles of rhyolite and smaller amounts of quartzite and granite. Vanderburg (1936, p. 72) noted their similarity to Mountain City placers, and Schrader (1923, p. 83) observed, "Their occurrence and origin are of more than passing interest, as the adjoining Jarbidge district, with its numerous gold veins, has not yielded any placers."

Coal Mine district

Location and history

Sections (Approx.)	T. N.	R. E.	. Quadrangle name (7½ or 15 minute)	Remarks
All	38	56	N. Fork 4 NW	Coal Canyon mine, phosphate prospects
N½	37	56	N. Fork 4 NW	Coal Mine Canyon prospects

The Coal Mine district includes both sides of Coal Mine Canyon in the north end of the Adobe Range, about 25 miles north and a little east of Elko. The Coal Canyon mine is a prospect shaft on a stratum of oil shale of unknown thickness that is inferred (Ketner, 1970, p. B108) to underlie nearly all the major valleys in the Elko-Coal Mine Canyon area. The oil-bearing stratum is part of the Chainman Shale Formation of Mississippian age which is of regional extent.

The coal mine for which the canyon was named was probable on a bed of lignite in the Elko Formation in sec. 12, T. 37 N., R 56 E. The remains of a tipple and a waste dump were recognizable in 1959 (R. R. Coats, oral commun., 1975).

Phosphate deposits have been identified within the district. These deposits and others in the southern Adobe Range (Elko district, T. 34 N., R. 54 E.) and in the Peko Hills (T. 37 N., R. 58 E.) were described by Ketner (1970, p. B108) as follows:

"Permian rocks in the southern and northern Adobe Range and in the Peko Hills are significantly phosphatic. Outcrops of chert, siltstone, and limestone in these areas contain small percentages of phosphate, and concealed thin beds of very phosphatic rock are indicated by loose pieces scattered on the surface. Analyzed selected samples from the southern Adobe Range contained as much as 13 percent P₂O₅, and some samples from the Peko Hills

contained about 20 percent. Because the richly phosphatic beds fail to crop out, their extent and thickness can be determined only after exploratory trenching in areas where loose pieces are found."

The general geology of phosphate deposits is summarized herein under Pequop phosphate area.

Contact district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names, remarks
All	45	63	Contact	Salmon, Salmon River
All	45	64	Contact, Delaplain	Salmon, Salmon River
All	45	65	Delaplain, Texas Spring	Kit Carson, Alabama
W½	45	66	Delaplain, Texas Spring	
N½	44	63	Henry	
All	44	64	Henry, Blanchard Mtn.	Salmon River (N½) Porter (Portis) (S½)
All	44	65	Blanchard Mtn., Texas Spring	
W½	44	66	Texas Spring, Delano Mountains	(Uranium prospects)
N½	43	65	Blanchard Mtn., Texas Spring, Knoll Mtn., Knoll Mtn. SE	Alabama(?)

Although a mining claim was staked in 1870, the first mining districts to be organized were the Alabama in 1871 and the Salmon and Kit Carson in 1872. When the Salmon River district was organized in 1909 it included 35 townships (T. 41-47 N., R. 63-67 E.). By 1910 the Contact district was considered to be about 20 miles square from Knoll Creek on the south to San Jacinto on the north, and from Bad Lands on the west to Tijuana John Peak on the east (Schrader, 1912, pl. XIV). This area includes all of the granodiorite stock and all of the surrounding sedimentary rocks in contact with it in which ore deposits have been found. Land Office records for the area are listed under Kit Carson, Porter, and Salmon River districts.

Nearly half the production from the district was made during 1952-57, most of it from the Marshall (Nevada-Bellevue) mine. No production was reported during 1958-69 (table 14).

Barite of high purity and specific gravity (4.20) was shipped from the district in 1956, and the Jungo claims were explored by the American Colloid Company in 1957.

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Molybdenum	Barite	Tungsten		Uranium
	Alice.				o	o	●		x				<5
	Allen (see Marshall)				o	o	●						
	Amestoy				o	o	●	●					5-100
	Antelope				o	o	●						<5
	Arizona	22	44	64	●	o	●						<5
10	Bell	3	43	65									
	Bellview (see Marshall)												
6	Blanchard	19	44	65	o	o	●						<5
	Blue Bird				o	o	●						<5
	Blue Ridge No. 1					o	●						<5
	Blue Rock					o	o	●					<5
3	Bonanza	21	45	63	o	o	●		x				5-100
	Bonnie Copper		China Mtn.		o	o	●	o					
1	Boston	9,10	45	65	o	o	●						<5
	Brooklyn				o	o	●						5-100
	Champ Clark (see Clark)												
	Chany (see Clark)												
	Chestnut Burr					o	●	o					<5
	Clark				o	o	●						<5
	Copper Button	4,9	45	65	o	o	●						

OF

Table 14.--Contact mining district, mines through 1969--Continued

Index no. on Plate 1	Mine or prospect A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Molybdenum	Barite	Tungsten		Uranium
	Copper Queen				o	o	•						<5
6	Copper Shield	19,24	45	64,63			•		x				<5
5	Delano	22	44	64	o	o	•	o					>100
	Detweiler												
	East Contact	15 mi E. of Contact				o	•						<5
	Effie Fay and Lucie claims	24,25, 27,28, 33,34	45	63									0
	Ethiopia (Ethopia)	2 mi W. of Contact			o	o	•						<5
	Galena King (see Ruby Range district)												
	Grand View	1½ mi NW. of P.O.				o	•						<5
	Gray	3 mi SW. of Contact			o	o	o	•					5-100
	Gray Copper	4 mi W. of Contact			o	o	•		x				<5
	Green Monster (Brooklyn)				o	o	•						<5
	Hanks and Miller				o	o	•						5-100
	Hawks					o	•						<5
	High Ore					o	•						<5
	Hullinger (various dumps)				o	o	•						>100
	Ilo Tunnel (see Marshall)												
	Independence												
	Ivy Wilson (see Wilson)												

Table 14.--Contact mining district, Mines through 1969--Continued

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Molybdenum	Barite	Tungsten		Uranium
7	Vulcan	29	44	65	o	o	•						<5
	Wasconda	3 mi N. of Contact				o	•						<5
	Wilson (Guy Wilson)				o	o	•						<5
	Wilson (Ivy Wilson)	3	44	63					x				
	Zetta Blanchard	(On Little Salmon River)			o	o	•						<5
	Zetta Standard					o	•						<5
8	Hice	31	44	65							•		
	Jungo Group	On Dry Creek		44	64					•			
	Pink Horse Claims	32	44	66								x	
	Prince No. 1 prospect	16,17, 20,21	44	66								x	0
4	Tunnel	21,22	44	64						•			

The Silver Star property was explored during 1972 by Sunshine Mining Co., Kellogg, Idaho, by diamond drilling. Vein intercepts of 20-60 ft were reported, one of which assayed 22.3 oz silver per ton over a width of 25 ft (Eng. Mining Jour., July 1972, p. 134).

Calta Mines Ltd. reported over 8 million tons of blocked-out ore averaging 2.3 percent copper near Contact (Eng. Mining Jour., April 1973).

Geologic setting and ore deposits

The oldest rock in the district is Carboniferous quartzite about 200 ft thick. It is overlain by shaly quartzite, shale, black limestone, quartzite, and blue, white, and gray limestones totaling about 1,400 ft thick of Carboniferous(?) age.

The sedimentary rocks are domed and variously tilted, folded, and brecciated around an intrusive stock of Jurassic granodiorite 16 miles long from east to west and 8 miles wide. Concealed portions of the stock are doubtless much larger. Within 2,000 ft of the contact the limestones are locally altered to tactite, and some of the shale to slate and hornfels.

The granodiorite and the sedimentary rocks are cut by faults that strike northeast, northwest, or are parallel with the contact, and dip steeply. Some of the faults of the first two sets contain dikes--a few older basic dikes up to 8 ft wide, and numerous younger siliceous dikes as much as 200 ft wide and 5 miles long. Other faults, as well as some of the dikes and also parts of the contact, contain quartz veins as much as 18 ft wide.

The foregoing assemblage is unconformably overlain by rhyolite flows and tuffs about 200 ft thick of Miocene age which correspond to the younger volcanics of the general region. A few erosion remnants of these rhyolites cap small areas of the granodiorite. Parts of the volcanic rocks and all older strata are unconformably overlain by sandstone lake beds as much as 400 ft thick of the Humboldt Formation of Pliocene age. Recent stream beds and valleys contain Quaternary alluvium.

Ore deposits of two genetic types have been mined, quartz veins along faults, dikes, and the granodiorite contact, and contact metamorphic deposits in the metasedimentary rocks near the intrusive.

The largest ore bodies mined were in quartz veins along the contact (Nevada-Bellevue mine) on the north side of the granodiorite near its west end. Other smaller ore bodies were mined along the north side near L & D (Ellen D.) and Middle Stack Mountains, along the south side near China and Blanchard Mountains, in the granodiorite mostly near its west end, and in the sedimentary rocks south of the stock near Knoll Mountain.

In the quartz veins, which are as much as 10,000 ft long and pinch and swell from a few inches to about 18 ft wide, ore shoots up to 10 ft wide extending as much as 500 ft along the strike have been mined down the dip for 400 ft or less.

Ore minerals in the vein deposits are chalcopyrite, smaller amounts of bornite, and locally galena, sphalerite, molybdenite, argentite, and gold, but to depths of 150-250 ft much of the sulfide ore is oxidized to malachite, chrysocolla, azurite, cuprite, native copper, covellite, chalcocite, cerussite, anglesite, and probably cerargyrite.

Average grade of all production recorded was nearly 4 percent copper, 0.18 oz gold per ton, and 1.5 oz silver per ton, but some small vein ore shoots contained nearly 50 percent copper. Some lead-silver ores contained 18 percent lead, 3 percent zinc, and 12 oz silver per ton, although much higher grades were also reported.

Contact metamorphic deposits of copper sulfides and oxides in a gangue of garnet, axinite, chloropal, epidote, calcite, quartz, actinolite, diopside, and iron oxides are in general rather small, perhaps 10-25 ft across, and have yielded only a few hundred tons of ore. Some of the ores contained 7-8 percent copper, 8-38 oz silver per ton, and a little gold. At least one contact metamorphic deposit was mined for its tungsten content (Tunnel mine, table 14). Schrader (1912, p. 113) reported the occurrence of allanite as a minor accessory mineral in the contact zone.

Autunite and other uranium minerals occur in thin stringers along the bedding of tuffaceous lake sediments at the Pink Horse claims (table 14), and in brecciated limestone near the intersection of two faults at the Prince #1 prospect. Selected samples assayed over 1 percent U₃O₈, but the average grade is less than 0.2 percent U₃O₈.

Cornucopia district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
W½	42	51	Wilson Reservoir

According to Thompson and West (1881, p. 393), silver ores were discovered and the district was organized in 1872. "The excitement incident to the discovery of the district caused the building of the town of Cornucopia, which at one time, in 1874, was quite lively and contained about 1,000 inhabitants." The Leopard Mining Company built "first a 10-stamp mill which was consumed by fire and replaced by a twenty-stamp mill * * * which was likewise destroyed" in 1880, whereupon the population dwindled to 174. No production has been reported since 1882 except from 10,000 tons of old mill tailings during 1937-40 (table 15).

There are two principal mines in the district, the Leopard (Cornucopia) which was the larger, and the Panther. The Leopard shaft was said to be 800 ft deep, but the deep workings are caved (Emmons, 1910, p. 62). The Leopard vein was worked extensively in an area now covered by mine dumps (Coats, 1967, p. 3). The Panther vein was stoped in two areas about 700 ft apart (Emmons, 1910, fig. 5).

Table 15.--*Cornucopia mining district, mines through 1969*

[●, main product; ○, by-product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity			Total value when sold <u>1/</u> (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	
	Cornucopia	18	42	51	●	●	○	5-100
	Hussey Mining Co. (1877-78)				○	●		83
1	Leopard (1875-79)	18,19	42	51	○	●	x	1,032
	Panther Group (1877)				○	●		7
	La Plata (1937-40)				○	●		<5
	Whitney & Vesey mill (1882)							9

1/ Includes published figures.

Surface chip-sampling during 1973 indicated disseminated gold-silver mineralization over a broad area in the vicinity of the Leopard vein (Eng. Mining Jour., June 1974, p. 19). Exploration by trenching during 1974 indicated that drilling is warranted in an area east of the Leopard shaft, and that open-pit mining may be feasible (Eng. Mining Jour., March 1974, p. 230).

Geologic setting and ore deposits

The oldest rocks that crop out in the district are rhyolite tuff and andesite flows of probable Eocene age. They are overlain by, or are in fault contact with, andesite porphyry flows and rhyolite flows of Miocene age. The andesite porphyry is overlain unconformably by a series of rhyolite tuff, rhyolite welded tuff, and rhyodacite tuff layers of later Miocene age.

The andesite porphyry and older rocks are cut by four sets of faults that dip steeply or are vertical: one set strikes north, another east, a third strikes northeast, and the fourth northwest. Some faults of all sets also cut the younger rhyolitic tuffs.

The ore deposits that were mined were found only in the andesite porphyry; the postandesite rhyolite and rhyodacite tuffs are postmineral in age (Coats, 1967, p. 1). The ore bodies are quartz veins in sheeted zones of highly altered andesite along all four sets of faults, but the very productive Leopard vein strikes north, and the Panther, eastward. Post-mineral movement on silicified faults that strike northwest have displaced these two veins; the Leopard vein is cut off at the north end, and the Panther vein is cut into segments displaced 100 ft or more. The main ore body in the Panther vein was in a fault segment 60 ft long; widths are not reported. Numerous prospect pits in an area extending 1,000 ft north of the vein, 500 ft south of it, and about 700 ft from east to west, were evidently not productive.

The ore minerals are cerargyrite and pyromorphite(?) near the surface, and argentite, tetrahedrite, and ruby silver (proustite or pyrargyrite) at greater depths. The sulfides form narrow ribbons in the quartz veins. Gangue minerals are quartz, pyrite, iron oxide, and the alteration minerals, kaolin, silica, sericite, and chlorite.

Average grade of the ore reported by Couch and Carpenter (1943, p. 42) was about \$44 per ton, but some mill runs were said to have carried 400 oz of silver to the ton (Emmons, 1910, p. 64). Reworked tailings yielded 0.13 oz gold and 9 oz silver per ton.

Corral Creek district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
S½	28	57	Jiggs	Ruby Range

The Corral Creek district on the west slope of the Ruby Mountains about 3 miles southwest of Harrison Pass includes the drainage area of Corral Creek and its tributaries. The Summit View mine and nearby prospects are near a south branch of Corral Creek in sec. 21 at altitudes of 7,400-7,800 ft.

The only recorded production from the district was during the years 1948-52 when 108 tons of lead-zinc ore was shipped from the Summit View mine. In table 5 the quantities are included with undistributed production.

Geologic setting and ore deposits

The Corral Creek district covers part of the contact of upper Cambrian limestones and argillite with Tertiary granodiorite-quartz monzonite of the Harrison Pass stock along its southwest corner. The Summit View mine and the Summit King and other prospects are in the sedimentary rocks near the contact.

A pegmatite dike in the stock near the head of Corral Creek contains lepidolite. Other dikes were examined (Olson and Hinrichs, 1960, p. 171) for beryl, but none was found.

Ore shipped from the district averaged about 2.5 percent lead, 1.1 percent zinc, 0.15 percent copper, and 3.0 oz silver per ton.

Decoy district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
6	32	68	Shafter 3 NE	Manganese

The Decoy district covers a small area on the lower west slopes near the center of the Toano Range. Manganese ore, the only commodity produced from the district, was shipped during 1917 and 1918 from the Darkey mine, and during 1952 from the Black Rock mine. Total production is not known but was probably less than 2,000 tons.

Geologic setting and ore deposits

Limestone and dolomite strata of Ordovician and Silurian ages are generally flat lying and are displaced along steep faults that strike north or east. The manganese ore bodies occur along a north-striking fault and also in limestone adjacent to the fault. The largest of several ore shoots in the Darkey mine was 25 ft long, 8 ft wide, and 60 ft deep. Psilomelane, pyrolusite, and wad were accompanied by quartz, calcite, and limonite. Ore selected for shipment from the Darkey mine contained about 45 percent manganese and less than 5 percent silica (Pardee and Jones, 1920, p. 241). Shipments from the Black Rock mine averaged about 28 percent manganese.

Delano district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names, remarks
SE¼	45	68	Goose Creek, Dairy Valley	Prospects
All	44	67	Delano Mountains	Prospects
All	44	68	Delano Mountains, Dairy Valley	Delno district, Goose Creek(?) district
N½	43	67	Delano Mountains	Prospects
N½	43	68	Delano Mountains, Dairy Valley	New York district, Mitchell mine

The district covers the north and central parts of the Delano Mountains north of Delano Peak. Near the north end of the range the original Delano district includes the Delno and Cleveland lead-silver mines; in the central part near Indian Springs the former New York district (Lotz, 1934, p. 18) includes the Mitchell silver-copper mine and the Indian Springs tungsten property. In addition to the productive mines, numerous prospects west (Rock Spring Creek) and north of the range are, in this report, included in the district.

The Delano district fits the description by Thompson and West (1881, p. 393) of a Goose Creek district, which was organized in 1872 in the Goose Creek Mountains about 30 miles north of Tecoma to include veins in limestone and porphyry assaying \$160-\$350 per ton.

The Delano district was organized sometime before 1881 (Thompson and West, 1881, p. 393), and was named in honor of Alanzo Delano¹ who, in his Overland Journal of 1849, tells of the mineralized area in the Thousand Springs-Goose Creek drainage basins. In local usage, the name Delno has precedence, but Land Office records are listed under the Delano mining district.

¹/Alanzo Delano was a member of the family from which President Franklin Delano Roosevelt was descended (Patterson, 1964, p. 25).

The first recorded production was in 1908 from the Cleveland (44 tons) and Argyle (31 tons) mine. Ore was produced during every year from 1917 through 1969 except 1967; maximum annual production was about \$340,000 in 1948 (Granger and others, 1957, p. 44). Most of the production from the district came from two mines, the Cleveland with 6,700 ft of workings in 1950 and the Delno with 5,900 ft. The latter has also been called the Delano mine (table 16), but all production under the name of Delano for 1911-44--more than \$100,000--is credited to the Delano mine in the Contact district. Seven or more tin prospects were discovered during the 1950's, but no tin has been produced.

Exploration at the Indian Springs tungsten deposit on the Gamble Ranch in 1969 was reported by the Arizona Colorado Land and Cattle Co to have discovered 17.4 million tons of ore averaging 0.19 percent WO_3 (Nevada State Jour., October 5, 1969).

Geologic setting and ore deposits

In the Delano Mountains, three successively younger sedimentary formations are tentatively identified and mapped (Slack, 1972, pl. 1) as Pequop, Grandeur, and Phosphoria Formations of Permian age. Near Delano Peak they are intruded by an igneous stock of Cretaceous age, and surrounding the range they are overlain by sedimentary and volcanic rocks of Tertiary age.

The Pequop(?) Formation here consists of three members, a lowermost calcareous sandstone, a middle carbonaceous limestone, and an upper bioclastic limestone and chert which total nearly 4,000 ft in thickness. It is conformably overlain by, or locally is in fault contact with, dolomites containing a few thin beds of limestone and quartzite of the Grandeur member of the Park City Formation which total about 2,500 ft in thickness. The overlying Phosphoria is represented by siltstones, shale, and phosphorite of the Meade Peak member, which is of variable thickness due to low-angle bedding-plane thrust faults, and by massive chert beds of the Rex chert member 2,500-3,000 ft thick.

Low-angle bedding-plane thrust faults, mainly in the Meade Peak member, displaced the Phosphoria Formation eastward over the Grandeur. During the Jurassic Period the Permian strata were gently folded. On the northeast slopes of Delano Peak they were intruded and domed by the Indian Springs stock about a mile wide and nearly 2 miles long (N. 20° E.) of quartz monzonite porphyry which, in places, grades into other compositions and textures. Minimum age of the stock is about 135 m.y. or earliest Cretaceous. Permian strata surrounding the Delano Mountains are overlain unconformably by Jarbidge Rhyolite of Miocene age and by volcanic ash and sediments of the Salt Lake (Idavada?) Formation of Pliocene age. The Salt Lake Formation is overlain by a few small patches less than 1,500 ft across of welded tuff--including perlite--of Pliocene age.

Table 16.--Delano mining district, mines through 1969

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Tungsten	
	Argyle				o	o		●			<5
	Black Bird				o	o	o	●			<5
	Blue Bell	28	44	68	o	o		●			5-100
	Bonnie Ray					o		●	o		<5
2	Cleveland (Cleavland)	28,29	44	68	o	o	o	●	o		>100
	Comeback				●	o	o	o			<5
	Cranky Hank					o	o	●			<5
	Delano (see Contact district)										
1	Delno (Net, Panther)	24	43	68	o	o	o	●	o		>100
	86		44	68							
	Gold Bond	28(?)		69(?)	o	o	o	●			5-100
3	Gold Note Group	28,29	44	68	o	●	o	o	o		
	Lead Canyon				o	o	o	●			5-100
	Little Darling					●	o	●			<5
4	Mitchell	3,4, 9,10	43	68		●	o				
	Net (see Delno)										
	Panther (see Delno)										
	Rainstorm					●	o	o			<5
5	Indian Springs	S½ 10	43	68						x	

51

Around the borders of the stock calcareous sandstones and limestones are locally altered to garnet tactite which contains pyrite, chalcopyrite, magnetite, a little scheelite, powellite, and possibly sphalerite, or their oxidation products. The stock and the rocks around it are cut by a network of faults having displacements of a few inches to 1,000 ft or more. Some of the faults are occupied by granitic dikes and others by quartz veins as much as 15 ft wide, most of which strike northeast. Stockworks of quartz veins along the east edge of the stock contain pyrite, magnetite, scheelite, powellite, molybdenite, and a little fluorite, but tungsten production, if any, is not recorded. Other quartz veins contain pyrite, molybdenite, and chalcopyrite, others silver and copper minerals, and still others are barren.

Two types of ore bodies in two separate parts of the district have been mined. In the southern part of the district silver-copper-bearing quartz veins in the stock near its west edge were worked at the Mitchell mine, but production records are not available. In the northern part of the district lead-silver replacement bodies in the Grandeur limestones about 2 miles north of the stock were mined at the Delno, Cleveland, and other mines.

In the Cleveland and Delno mine areas the strata are tilted 20°-45° W. and are cut by four sets of faults. One set is along the bedding, another set dips steeply east or is vertical, and two other sets dip 45° or more northeast and northwest. The ore bodies in the Cleveland, Delno, and Gold Note mines are replacement deposits along bedding faults in two parallel limestone beds 18 inches to 6 ft thick separated by a partly silicified dolomite stratum 6-8 ft thick. The footwall of the lower bed is Loray(?) sandstone; the hanging wall of the upper bed is blue Grandeur dolomite. Most of the ore came from the upper bed.

Ore shoots in the upper bed were as much as 6 ft thick, 125 ft long, and were mined down the dip for 450 ft in the Cleveland mine and 1,700 ft in the Delno mine. They are displaced by faults which offset the beds a few feet to 65 ft, and also apparently control the lateral limits of the ore (Granger and others, 1957, p. 48, figs. 7 and 8). Ore minerals are cerussite, galena, bindheimite, unidentified silver minerals, and minor amounts of anglesite, sphalerite, argentite, tetrahedrite, and malachite. Cerussite is more abundant than galena even on the deepest levels. The gangue is amorphous silica, jasper, and iron oxides.

Average grade of all the ore mined through 1969 was gold 0.004 oz/ton, silver 21 oz/ton, copper 0.1 percent, lead 13.1 percent, and zinc (1950-69) 1.9 percent.

Tin deposits were found near the Cleveland mine in the same stratigraphic horizon, and also in lower horizons of the Grandeur member in an area extending 1,600 ft east, 800 ft north, and 2,400 ft south of the mine (Olson, 1960, pl. 4). A tin-bearing(?) mineral was also found in veins(?) in silicified sedimentary rocks north of the rhyolite porphyry 2½-8 miles east of the mine, and possibly in the porphyry itself (Olson, 1960, p. 80, 44). The tin occurs with unidentified silver minerals as fine-grained cassiterite(?) in yellow earthy stringers in brecciated veins of quartz and jasper healed

with chalcedony and opal along bedding faults in shaly limestone. At the deposit 1,800 ft southeast of the Cleveland shaft, the tin-bearing vein is 2 ft thick between layers of iron oxide 6-18 inches thick. Selected specimens contained as much as 2 percent tin. A channel sample across the vein and another across the iron oxide layer on the footwall each assayed 0.66 percent tin; the hanging wall layer of iron oxide contained 0.33 percent tin.

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.)	T. N.	R. E.	Quadrangle name	Other district names
W $\frac{1}{2}$	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 ft 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.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
N½	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 silver per ton.

Dolly Varden district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name	Other district names
S-1/3	30	66	Elko 2°	
E-1/3	29	65	Elko 2°	
All	29	66	Elko 2°	Mizpah
29,30, 31,32	29	67	Elko 2°	Dolly Varden
E-1/3	28	65	Elko 2°	
All	28	66	Elko 2°	Granite, Granite Mountain
W½	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, Mont., where a hydrometallurgical plant will treat the high-bismuth ores by the Arbiter process.

Geologic setting and ore deposits

Limestone 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).

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 ft 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_3O_8 , 1.5; cU_3O_8 , 0.128; rare earth oxides, 0.35 (Davis, 1954, p. 17).

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

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Molybdenum	Thorium		Bismuth
	Anchor						x						
	Atlas						x						
	Belleview					o	●						<5
	Bi-Metallic						x						
	Butte group						x						
3	Dolly Varden (D. V. Queen)	14	28	66	o	o	o	●	o				<5
	Eugenia (Eugene)	4	28	66			x						Small
	First Chance						x						
	Franklin (Iron Duke)						x						
	Garnet group				o	o		●					<5
	Hidden Treasure							●					Small
	Iron Duke (Franklin)						x						
	Keystone	12,13	28	66		o		●					Small
	Lewis						x						
1	Mizpah Consolidated	18,19	29	66	x		x						
	Mud Springs (see Mud Springs dist.)												
	Red Hill prospect						x						
	Tenderfoot	18	29	66			x						
2	Victoria	5	28	66	o	o	●	o			x		5-100
	White Horse						x						
	Lead-silver oxidized ores		28	66						x			
	Southam group		29	66							x		

Edgemont district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
W½	44	52	Bull Run	Centennial, White Rock
NW¼	43	52	Bull Run	Bull Run, Centennial

The district covers the west slope of the Bull Run (Centennial) Mountains north of Bull Run 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 Run) 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 was reported for the years 1965-69.

Geologic setting and ore deposits

Prospect Mountain Quartzite more than 4,200 ft 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 ft thick, which crop out along the north limb of the Bull Run Basin anticline. These overlying rocks are intruded by the White Rock diorite stock about 6,000 ft 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 ft 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 in limestone 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.

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

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value when sold (in thousands of dollars)		
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Antimony		Tungsten	Uranium
	Arrowhead (see Aura dist.)												
	Astor					o		●					<5
	Big Bob	30	44	52									
	Big Four (Lucky Girl)				o	●	o	o					5-100
	Blue Jacket (see Aura dist.)												
4	Bull Run	4,5	43	52	●	o							>100
	Burns	5,20, 28,29	44	52	o	o		●	o				<5
	Eagle Rock (see Aura dist.)												
	Echo Canyon (Elko Canyon)				●	o	o	●	o				5-100
	Edgemont (Lucky Girl)	31	44	52	●	o	o	o					<5
	Gold Dollar (Aura dist.?)				●	o							<5
	Little John				●	o							<5
	Lucky Boy (see Lucky Girl)												
3	Lucky Girl group	29,30, 31,32	44	52	●	o	o	o					>100
	Montana Lucky Girl				●	o							<5
1	Nevada	20	44	52					●				
	Paddison				●	o		o					<5

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	Antimony	Tungsten		Uranium
			N.	E.									
	Red Cloud					o		•					<5
	Richelieu				•	o							<5
	White Rock					o	o	o	•				5-100
	White Rock G.M. Co. placer (Aura dist.)												
	Blue Ribbon (Ried)	2	44	52						•			<5
2	Burns (Blue Jacket)	28	44	52							•		<5
	Unnamed prospects											x	0

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 ft along the strike and 900 ft down the dip; they ranged from a few inches to about 7 ft in thickness. The veins are offset in several places as much as 60 ft by postmineral 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.

Elk Mountain district

Location and history

Sections (Approx.)	T. R. N. E.	Quadrangle name (7½ or 15 minute)	Remarks
S½	47 61	Elk Mountain	
N½	46 61	Elk Mountain	Southwest 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 been done, and no production is recorded for the district through 1969.

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 ft 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 ft long and at least 50 ft wide. Contact metamorphic mineral deposits as much as 14½ ft 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

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Antimony	Molybdenum	Tungsten	
	Austeon		46	61	x		x					0
3	Estes	3,4	46	61			x					0
2	Gold prospect	4	46	61	x	x		x	x			0
	O'Neil		46	61			x					0
1	Red Elephant	4	46	61	x	x	x					0
4	Robinette (June, Pyramid)	9,10	46	61						x	x	0

were reported (Schrader, 1912, p. 156). At the Robinette prospect (pl. 1), particles of scheelite and molybdenite are scattered throughout the tactite, but only small portions contain as much as 0.25 percent WO_3 and 0.2 percent MoS_2 (D. M. Lemmon, written commun., 1948).

Elko district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
All	34	54	Hunter, Elko West	Phosphorite, oil shale
All	34	55	Elko West, Elko East	Oil shale, stone
W½	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. 1).

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 gal was produced in an experimental plant in 1919 (Bulwulda, 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 2½ 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.

Geologic setting and ore deposits

The oldest rock formation exposed in the Elko district is the Diamond Peak Formation comprising 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 shaly Elko 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). 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 ft thick, conglomerates up to 25 ft thick, numerous limestone beds less than 8 ft, rhyolite tuffs and sills(?) generally less than 2 ft, and several lignite beds a few inches thick.

The Elko Formation south of the Humboldt River 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 ft 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 ft 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 ft. 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 ft 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 ft thick of Pennsylvanian-Permian age 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 P₂O₅ (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).

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

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold ^{1/} (in thousands of dollars)
		Sec.	T. N.	R. E.	Copper	Coal	Oil shale	Stone	Geothermal energy	
	Basalt quarry							●		
1 - 2	Catlin and Norton inclines	27 and 26	34	55			●			>2
	Coal Canyon (see Coal Mine dist.)									
3	Conglomerate quarry	34	34	55				●		
	Humboldt Coal Co. (see Carlin dist.)									
	Lignite prospect	SW. of Elko				x				0
	Ogilvie prospect					x				0
	Oil shale prospect	NW ¹ / ₄ 2	34	54			x			0
	Pilot quarry (limestone) (see Pilot Peak dist.)									
	Elko Hot Springs	21	34	55				●		

^{1/} Includes published figure

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).

Ferber district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name
34-36	28	69	Elko 2°
31-34	28	70	Elko 2°
NE½	27	69	Elko 2°
N½	27	70	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).

Geologic setting and ore deposits

Limestones of Pennsylvania-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 ft 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.

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

[Blank spaces, figures unavailable; ●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity				Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	
	Ajax								
	Big Chief	4	27	70		○	○	●	<5
	Ferber					○	●		<5
2	Martha Washington claims	5,8	27	70	○	○	●	●	5-100
	Red Cloud	3	27	70					
1	Regent	1,6	27	69,70	○	○		●	<5
	Salt Lake group	9	27	70	○	○	●	○	<5
	Siddon claims								
	Shaffer				○	○	●		<5
	Sidney						●		<5

The ore shoots in the metamorphic rocks are as much as 10 ft wide but are lenslike and rather short. They have been mined to depths of 150 ft or more. The Big Chief vein is 2-8 ft wide, and the deepest shaft is about 75 ft deep; the Regent shear zone is 20 ft 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 ft, 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 early days, but the total recorded production averaged about 16 percent lead, 6 percent copper, and 14 oz silver per ton.

Ferguson Spring district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle (7½ or 15 minute)	Other district names
All	30	69	Ferguson Spring	Alleghany
N-1/6	29	69	Ferguson Spring	Alleghany

The district covers Ferguson Mountain, altitude 7,695 ft, 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 Allegheny¹ 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.

Geologic setting and ore deposits

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 geologic maps, but Heyl and Bozion (in U.S. Geol. Survey, 1972) reported two small stocks of quartz monzonite northwest of

¹/Named for George Washington Mardis, an early Indian scout and prospector called "Old Allegheny."

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity			Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	
	Badger (see Pilot Peak dist.)							
	Bartus group				○	○	●	<5
	Bullion(?) (see Railroad dist.)							
	Copper Valley					○	●	<5
	Crazy Dutchman (see Pilot Peak dist.)							
1	Dead Cedar	32	30	69		○	●	<5
	Elevated	28,29	30	69				
	Hank	29	30	69				
	Hobo	28	30	69				
	Polly	29	30	69				
	Will	28,29	30	69				

Ferguson. Zones of hydrothermally altered limestone, shale, and sandstone surround the stocks. 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 ft long and 30 ft wide; the deepest workings are about 50 ft 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.

Gilbert Canyon area

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
N½	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 ft, and Mound Valley, altitude about 5,500 ft.

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 (SE¼ sec. 9) about 18 ft 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 Ta₂O₅ (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 west-central part of the intrusive complex described under Valley View district.

Gold Basin district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
S½	47	56	Rowland	Rowland
SW¼	47	57	Rowland	

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

Table 23.--Gold Basin mining district, mines through 1969

[Blank spaces, figures not available; ●, main product; ○, by-product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity			Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	
2	Bruneau	29	47	56	●	○	○	5-100
1	Deep Creek	24	47	56	●			
	Dream		47	56	●	○		<5
	Elko (Bruneau)				●	○		<5
	Gold Hill (Jarbidge dist.?)				●			<5
	Longwill placer (Bruneau River)				●			Small
3	Mendive	31	47	56	●	○	○	Minor
	Never Sweat (see Hicks dist.)							
	North Star group (see Hicks dist.)							
	Unknown	22	47	56				
	Unknown	17	47	57	x			
	Rowland tungsten (see Jarbidge dist.)							

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 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.

Geologic setting and ore deposits

Paleozoic limestones, schist, argillites, and phyllites about a mile thick 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.

Gold Circle district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
All	39	46	Midas, Squaw Valley Ranch	Midas, Summit
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 lb copper, and 200 lb zinc. No further production is reported through 1969.

Geologic setting and ore deposits

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 pre-mineral faults. One set that strikes eastward and dips steeply south is in places intruded by dikes of rhyolite or andesite as much as 100 ft wide and 600 ft 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 ft 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.

Postmineral faults offset the mineralized faults a few inches to several feet in a few localities, but the largest postmineral displacements are along or parallel with the veins and are marked by slickensides and gouge. Where a postmineral 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, sericite, adularia, 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 ft, breccia veins from a few inches to 25 ft. 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 2,800-5,000 ft along their strikes (Rott, 1931, pl. 1). The Elko Prince and Grant-Jackson veins terminate at their intersections with east-striking faults.

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

[●, main product; o, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	
			N.	E.						
	Banner (St. Paul)				●	o				<5
	Belvoir									
	Big Chief				●	o				<5
	Black Cloud	2 mi SE. of Midas			●	o				<5
	Blue Heaven	5			●	o				<5
	Bobcat				●	o		o		<5
	Buena (see Esmeralda)	27,34	39	46						
	Capitol				●	o				<5
	Circle Bird				●	o				<5
	Colorado Grande				●	o				<5
	Dixie Gold	½ mi SE. of Midas	39	46	●	o	o	o	o	<5
6	Eastern Star	13	39	46	●	o	o			5-100
1	Elko Prince-June Belle (Gold Circle group)	16	39	46						
7	Esmeralda (Buena)	27,34	39	46	●	o				>100
	Gabbeart				●	o				<5
	Gibson									
	Gold and Silver Circle				●	o				<5
	Gold Circle--Crown				●	o				<5
	Gold Circle group <u>1/</u>				●	o				>100

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

Index no. on Platel.	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	
	Gold Circle--Queen				•	o				5-100
	Gold Cloud				•	o				<5
	Gold Cloud placer				•					<5
	Gold Crown	16,21	39	46						
	Golden Chariot claim				•	o				<5
	Golden Chariot placer				•					<5
2	Golden Circle				•	o				<5
	Grand and Golden Sapphire				•	o				<5
	Grant Millsite (cleanup)				•	o				<5
	Hardscrabble	28	39	46	•	o				5-100
	Homestake				•	o				<5
5	Jackson	21	39	46						
	Judge				•	o				<5
	June Belle (Elko Prince)				•	o				5-100
	Kansas				•	o				5-100
	Last Chance				•	o	o	o		<5
	Link	21	39	46	•	o				5-100
	Long Chance	17,20	39	46	•	o				<5
	Lucky Boy				•	o				<5
	Marion				•	o				<5
	Midan	21	39	46	•	o				<5

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	
4	Miners Gold ½ mi N. of Midas	16	39	46	•	o	o			5-100
	Missing Link (see Gold Circle)				•	o				5-100
	Molly Lee				•	o				<5
	Nevada Gold				•	o		o	o	<5
	North Star									
	Old Judge	16	39	46	•	o				5-100
	Queen				•	o				5-100
	Queen placer				•	o				<5
	Rand and Massey				•	o				<5
	Reco				•	o				<5
3	Regalia				•	o				<5
	Rex (Gold Circle group)	21	39	46	•	o				>100
	Ripsaw	21	39	46	•	o	o			<5
	St. Paul	21	39	46	•	o				<5
	St.. Paul-Banner									
	San Juan				•	o	o	o		<5
	Sleeping Beauty	27,28	39	46	•	o				5-100
	Tod Adams group (Gold Queen, Silver Queen)		39	47	•	o				5-100
Vidette				•	o				<5	

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	
	Water Witch	20,17	39	46	●	○				<5
	Weston (Dick Weston)				●	○				<5
	Wicks and Gebhardt				●	○				<5
	Miscellaneous (cleanup)				●	○				<5

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

Ore shoots are localized along portions of the veins. The main ore shoot in the Elko Prince vein was 630-810 ft 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 ft 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 chalcopryrite 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 ft.

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 1:13. Small amounts of lead, copper, and zinc were recovered only from shipments in later years.

Good Hope district

Location and history

Sections (Approx.)	T. N.	R. 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.--Good Hope mining district, mines through 1969

[●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity			Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Antimony	
1	Amazon	(SE $\frac{1}{4}$)	2	41 49	●			
3	Buckeye and Ohio	(Cen)	16	41 49	●		>100	
	Buckeye and Ohio (Recorded under Good Hope)					●	<5	
2	Good Hope	(NE $\frac{1}{4}$)	9	41 49	●			
	Midnight				○	●	<5	
	Page and Kelley					●		
	Silver Brick		2	41 49		●		
	Snyder							

Geologic setting and ore deposits

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 ft 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 ft.

Goose Creek district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
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.

Geologic setting and ore deposits

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 ft thick, overlain by volcanic ash and welded rhyolitic tuff of the Salt Lake Formation which is at least 2,300 ft 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 ft 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 ft thick and an upper bed 14 inches to 9 ft 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 ft 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 district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name	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.)	T. N.	R. E.	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_3 .

Geologic setting and ore deposits

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 ft 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 ft wide and 300 ft long crop out at intervals for a distance of about 4,000 ft. Scheelite and a little powellite occur in the tactite. Ore shoots range in width from 1 to 20 ft, in length from a few feet to about 100 ft, and were mined to depths of a little more than 65 ft. 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 1-10 ft along many small faults.

Grade of the ore mined ranged from about 0.5 percent to 2.0 percent 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 .

Table 26.--Harrison Pass mining district, mines through 1969.

[●, main product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity		Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Beryllium	Tungsten	
	Baldwin Lease (Climax)					●	
	Campbell (New Deal)					●	
	Climax	17	28	58		●	5-100
1	Lakeview	5, 6	28	58		●	<5
	Sliper	6	28	58		x	
2	Star	18	28	58		x ●	>100
	Star Metal (see Island Mountain)					●	
	Star Tungsten (Star)	18	28	58		●	

Hicks district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
S½	47	54½	Mountain City
S½	47	55	Mountain City, Rowland
N½	46	54½	Mountain City
N½	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) 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.

Hot Creek district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
All	39	59	Hot Springs Creek, Twin Buttes

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); Gilbert included the district in a list but did not specify its location. He 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 discharge into Hot Springs Creek.

Huntington Creek district

Location and history

Sections (Approx.)	T. N.	R. E.	Quardangle name (7½ or 15 minute)	Remarks
SW½ 18	31	56	Lee	Mineral Soap mine

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

[●, main product; ○, by-product]

Index no. on Plate 1	Mines or prospects (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	
			N.	E.						
	Clipper Alder (see Alder district)									
	Hicks				○					
2	McDonald	8	46	55						
	McDonnell lode									
	Never Sweat - on McDonald Creek				○	●	○	○	○	<5
	North Star group - on McDonald Creek		47	55	●	○	○	○	●	5-100
1	Silver King group - McDonald Creek claim				○	○	○	●	○	<5

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 ft high that borders the east side of Huntington Creek and is about 20 ft 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, 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 ft apart driven southeastward about 50 ft and connected underground by a horizontal stope extending to the end of the adits. A 75-foot prospect adit 100 ft south and another short adit 300 ft north were apparently not productive.

Geologic setting and ore deposits

The clay deposit is a discontinuous bed of swelling bentonite as much as 2 ft thick interbedded with 4-8 ft of sandy clay in a conglomerate stratum 50 ft 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.

Island Mountain district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
36	45	55	Rowland	
14, 15, 16	45	56	Rowland	
S½	45	56	Rowland	Wyoming
All	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. 1). 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, now 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, but by 1880 the 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.

Geologic setting and ore deposits

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, and the Young American Gravel of Miocene age, and by the Idavada Volcanics of late Miocene age (Bushnell, 1967).

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

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

Index no. on Plate 1	Mine or prospect A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Antimony	Tungsten		Barite
	Anna												
	Bertie Lee & Gold Pan placer				●	o							
	Blackbird group placer (tails)	Gold Creek			●								5-100
7	Coleman	11(?)	44	55	●	o	o						<5
	Davenport	1, 2, 11,12	44	55									
4	Diamond Jim	34	45	56	o	o	o	●	o				>100
	Dream (see Gold Basin dist.)												
	Gold Centre				●	o	o	o					
	Gold Creek placers	5,8,32	44-45	56	●	o							5-100
	Golden Star												
	Gold Ore				●	o	o						<5
	Gold Pan placer	12	44	55	●	o							<5
	Groelm & French												
	Han Griff placer												
	Hope (Owyhee)												
	Island Mountain												
	Lonesome			Alder dist.									
	Mammoth			Mardis Mtn.									

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Antimony	Tungsten		Barite
	Mardis Elko (Diamond Jim)												
8	McGregor placer	13	44	55	•	o							
	Oro Fino				•	o	o						<5
	Oro Vista				•	o							<5
	Owyhee-Hope Consolidated												
6	Penrod (W. A. Penrod)	1,12	44	55									
6	Penrod group placer	1, 7, 12,18 etc.	44	55-56									
	Rosebud		45	56	o	o	o	•	o				5-100
5	St. Elmo (Diamond Jim)	2,3	44	56	•	o							<5
	Silver Bell	Loray dist.											
	White Gold				•	o							<5
	Garnet (see Alder dist.)												
3	Gribble Quartz	30	45	56							x		
1	Little Joe	15	45	56							x		Few tons 3% ?)
2	Star Metal (Gribble Antimony)	29	45	56						•			5-100
	Star Metal										•		<5
	Unknown (1958)												

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 foot-wall 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 ft 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- by 2- by 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.

Placer deposits are of two different ages, Miocene and Holocene. Most of the older placer deposits, including all of the largest ones, are in the Young American Gravel as much as half a mile from and 50 ft higher than the present streams. They contain well-rounded quartz boulders 3 ft 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.

Ivanhoe district

Location and history

Sections (Approx.)	T. R. N. E.	Quadrangle name (7½ or 15 minute)	Other district names
All	38 47	Squaw Valley Ranch	Battle Mountain
All	38 48	Willow Creek Reservoir	Battle Mountain
All	37 47	Rock Creek Ranch	Battle Mountain
All	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 1916-17. 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.

Geologic setting and ore deposits

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 ft. The younger group, lying unconformably on the older, is composed of quartz-rich rhyolite, tuff, and ash about 1,000 ft 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 ft. 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 ft and are as much as 800 ft wide and 1,500 ft long.

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

[●, main product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity Mercury	Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.		
	Amexco (see Homestead)	30	38	48	●	<5
	Bowers and Rand (see Butte)				●	0
5	Butte	32,33, 5,4	38,37	48	●	5-100
	Cinnabar group (see also Homestead)	30	38	48	●	<5
8	Clementine	4	38	48	●	<5
	Clippier (see Silver Cloud)	25,26	37	47	●	0
	Coleman (see Midas)	35,36	38	47	●	0
4	Fox	32,33, 5,4	38,37	48	●	0
3	Governor group	25	38	47	●	5-100
	Haltermah				●	<5
	Hatter	34,35	38	48	●	0
	Homestead	30	38	48	●	5-100
3	Ivanhoe (see Butte)				●	0
	Lark (see Homestead)	30	38	48	●	<5
	Lucky Boy (see Homestead)	30	38	48	●	<5
	Mayflower (see Butte)				●	0

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity Mercury	Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.		
	Midas	35,36	38	47	•	<5
7	Old Timers	6	37	48	•	<5
	Pangburn (see Governor)				•	
1	Rimrock and Homestake (see Homestead)	30	38	48	•	0
	Rimrock uranium (see Mountain City dist.)					
2	Sheep Corral (see Governor)	26	38	47	•	<5
9	Silver Cloud	25,26	37	47	•	>100
	Silver Fox (see Governor)	20	38	47	•	5-100
	Staggs & Quilici				•	
6	Velvet (see also Butte)	32,33, 5,4	38,37	48	•	5-100
	Wild Horse (see Butte)	32,33, 5,4	38,37	48	•	5-100

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, alunite, montmorillonite, and rarely sulfur, barite, and quartz.

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

Jarbidge district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	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	
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 (Schrader, 1912, p. 14-19), 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 * * *."

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 WO_3 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.

Geologic setting and ore deposits

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 $1\frac{1}{2}$ 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 ft 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 ft thick. The younger rhyolite is locally overlain by basalt flows 105 ft 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 1,000-6,000 ft (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.

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

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value when sold ^{1/} (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Tungsten	Molybdenum	Barite	
	Alpha (and Blizzard tailings)				●	o					>100
	Altitude	26	46	58							
	Barefoot (Bearfoot)				●						<5
	Ben Hur										
1	Blizzard	22	46	58	●	o					5-100
4	Bluster	21	46	58	●	o					>100
	Bourne (North Star)				●	o					<5
	Buckeye										
	Bullion										
	Bull Run.										
	Candy										
	Elkoro (see Starlight)										
	Flaxie	15,22	46	58	●	o					<5
	Florence				●	o					<5
	Forlorn Hope		45	58	●	o					<5
	Gold Hill										
	Gold Springs										
	Jarbidge Altitude				●	o					<5

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value when sold ^{1/} (in thousands of dollars)	
		Sec.	T.	R.	Gold	Silver	Copper	Tungsten	Molybdenum	Barite		
			N.	E.								
	Jarbidge Pavlak (May Day claim)				•	○						5-100
	Joy				•	○						<5
	July-August				•	○						<5
	July 3 & July 4 (tailings)				•	○						<5
	Jumpers				•	○						<5
	Kookaburra				•	○						5-100
	Legitimate	22	46	58	•	○						<5
	Log Cabin	16	46	58	•	○						<5
2	Long Hike (Starlight)	16	46	58	•	○						7,833
	Martin (Rex, Blizzard)				•	○						<5
	Mahogany	21,22	46	58	•	○						<5
	New Hope											
	New Star											
	Nimrod				•							<5
	North Star (Bourne)	16,21	46	58								
7	Norman	24	45	58								
	O.K. (see Starlight)	21,22	46	58								
	Parlak (Pavlak)				•	○						<5
	Payday				•	○						<5
	Pick and Shovel	28,33,34	46	58	•	○						<5

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value when sold ^{1/} (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Tungsten	Molybdenum	Barite	
	Red Dike										
6	Rex (Martin)	34	46	58							
	Starlight group	21,22	46	58	•	o	o				>100
3	Success	27,28	46	58	•	o					5-100
	Sunday (Sun Ray?)				•	o					<5
	Sunset	22	46	58	•	o					<5
	Tacoma	22	46	58							
	Wild Horse				•						<5
	Wonder Bar				•	o					<5
9	Young America (location?)	35	44	59	o	•	o				<5
	Miscellaneous				•	o					<5
	Batholith (see Charleston dist.)										
6	Coon Creek	6	45	58				•			
	Copper Queen prospect	15	46	57				•			
	Montana							•			
	New Chance							•			
	Rowland	6(?)	45	58				•	x		15 STU
8	Wildcat (Sun Creek, Hunter)	NE 1/4 20	44	59					•		5-100

^{1/} Includes published figures.

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 ft 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_3 (D. M. Lemmon, written commun., 1948).

Quartz veins along northwest-striking normal faults in the quartzite, limestone, and quartz monzonite are small and have not been extensively worked. The principal gold-silver ore bodies in the district are lodes or reefs, locally called "dikes," along all three sets of steep normal faults in the Jarbidge Rhyolite. The lodes consist of sheared and altered rhyolite in fault zones as much as 40 ft wide which contain stringers and veins generally less than 3 ft wide of calcite partly or wholly replaced by quartz and (or) adularia. The rhyolite is silicified as much as 100 ft 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 ft wide, as much as 1,000 ft long, and were mined 1,250 ft 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 (Schrader, 1912, p. 69) "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."

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 ft 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 ft wide in silicified argillite (Horton, 1963, p. 6) of Ordovician age.

Kinsley district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name	Remarks
E ₂	26	67	Elko 2°	Elko and White Pine Counties
W ₂	26	68	Elko 2°	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 1939 and a few tens of units of WO₃ was produced between 1942 and 1945. In 1966 a marble deposit high on the southwest slope of the range in Elko County was developed.

Geologic setting and ore deposits

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 ft long and 18 ft wide, and the deepest shaft, the Morning Star (table 31), was 275 ft deep, but most 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.

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 ft wide, 80 ft long and was mined to a depth of 30 ft 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).

Table 31.--Kinsley mining district, mines through 1900

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Tungsten	Molybdenum	Marble		
	Bessie Turner					o	●	o					<5
	Captain	19	26	68		o	●						<5
5	Doty Tunnel (Dotty)	19	26	68									
	Kerong				o	o	o	●					<5
	Kinsley												
	Kinsley Consol.	18	26	68			x						
4	Morning Star	24,19	26	67,68		●	o	o					
	Phalen					o	●						<5
1	Captain Jack	24,19,18	26	67,68					●				<5
2	Southam (Kerong)	18	26	68					●	x			<5
3	Western	13	26	67							●		

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_3 .

Lafayette district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
5, 6, 7, 8	35	64	Snow Water Lake NE

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.

Geologic setting and ore deposits

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 ft deep inclined 45° NE. in limestone exposed a quartz vein as much as 3 ft wide containing malachite, azurite, and limonite. In sec. 7 the 30-foot shaft inclined 60° NW. in limestone exposes a fault breccia about 4 ft wide containing mariposite, calcite, and iron oxides.

Larrabee district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
All	28	53	Pine Valley, Robinson Mountain	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.

Lee district

Location and history

Sections (Approx.)	T. N.	R. 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

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

Geologic setting and ore deposits

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 ft 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.--Lee mining district, mines through 1969

[●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	
			N.	E.						
1	American Beauty	33	31	58	○	○	○	●	○	>100
	B.B.					○	●	●		<5
	Fordham					○		●		<5
	Galena King (see Ruby Range district)									
	Giant				○	○	○	●	○	<5
3	Hargrove	5,6	30	58		○	○	●	○	5-100
	Knob Hill (Long Canyon)	32	31	58	○	○	○	●	○	5-100
2	Long Canyon (see Knob Hill)	32	31	58						0

Lime Mountain district

Location and history

Sections (Approx.)	T. N.	R. 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 1½ 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 oz of silver, 635,156 lb of copper, and 28,319 lb 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.

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 ft thick which are overlain by limestones about 3,200 ft 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 lower plate--is intruded by the 2-mile-diameter Wilson plug composed of andesite porphyry of Eocene(?) age; the plug 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 ft 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 ft (Decker, 1962, pl. 1).

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, chalcocite, bornite, a little silver and gold, and some secondary chalcocite are intergrown with white and black mica, calcite, and quartz (Emmons, 1910, p. 71).

Table 33.--*Lime Mountain mining district, mines through 1969*

[●, main product; ○, by-product]

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

Loray district

Location and history

Sections (Approx.)	T. N.	R. 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
N½	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. 1).

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) 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.

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 Cambrian through the Pennsylvanian Grandeur Formation. The strata are tilted generally about 30° W., are intruded by a stock (T. 36 N., R. 68 E., between Loray and Proctor) about 3 miles long of granodiorite of Jurassic age, 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. 1), a deposit of very light gray, friable pumicite (rhyolite vitric tuff) 100 ft or more thick strikes northwest and dips about 10° NE. A stratum about 20 ft 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 and copper pitch, malachite, azurite, 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 oz silver per ton, 0-9 percent copper, 0-9 percent lead, and 0-9 percent zinc.

Table 34.--Loray mining district, mines through 1969

[●, main product; ○, by-product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Volcanic ash	
2	Alabama					●	○	○			<5
	Castle Park	1,36	37,38	68	○	○	●				<5
	Lost Hope	14	37	68	x	○	○	●	○		<5
	May Bell (Maybelle)				○	●	●	●			5-100
	New Deal					○	●				<5
	Silver Bell				○	●	○	●			<5
	Silver Star						●	○			
	Skootumpaw (Castle Park)				○	○	●				<5
1	Cobrecite	35	38	67							

Lucin district

Location and history

Sections (Approx.)	T N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
All	39	70	Tecoma, Patterson Pass	Elko County, Nev.
All		7* 19 W.*	Tecoma, Lucin	Box Elder County, Utah
All		6* 19 W.*	Tecoma, Patterson Pass	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, Nev., 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.

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]

Index no. on Plate 1	Mine or prospect ^{1/} (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	
1	Black Warrior	21	39	70		●				5-100
	Cunapah (in Utah)				o	o		●		5-100
	Soliday				o	o		●		<5
2	Tecoma	21	39	70	o	o	o	o	●	5-100
	Uneeta				o	o		●		<5

^{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 3½ miles wide. 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 of quartz monzonite about half a mile across. Along the borders of the stocks the limestones are locally 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 north-striking fractures of the Copper Mountain fault zone about 1,000 ft wide where it cuts massive limestone strata 850-900 ft thick which form the basal member of the Guilmette Formation. The largest copper deposits occur as 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 and Emmons (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 1½ 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 ft; explorations below depths of about 200 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 district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
S½	38	53	McDermitt, Wells	Lone Mountain
All	37	53	Blue Basin, Singletree Creek	Grand Junction(?)

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 listed under Merrimac district include a South Merrimac claim.

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 and all of Tertiary age. Oldest of these intrusives is a stock $1\frac{1}{2}$ 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 dike-like body of quartz monzonite porphyry 3 miles long, one-third of a mile wide, dipping 70° W., 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 of quartz monzonite 1.7 miles long, which is itself intruded by dikes of quartz porphyry as much as a mile long and 1,000 ft 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 ft wide in places and was mined or explored for 600 ft 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.

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

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity										Total value when sold (in thousands of dollars)		
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Iron	Molybdenum	Tungsten	Titanium	Barite		Turquoise	Sulfur
	Annex				o	●	o	o	o								<5
	Antelope				o	o	●										<5
	Baltimore-Morgan	11	37	53	o	o	●	o									<5
	Coal Mine Canyon					o		●									<5
	Copper Queen				o	o	●										5-100
	Eagle (see Rip Van Winkle)	3	37	53													
	Elfreda					o		●									<5
	Gem					o		●									<5
	Ironsides					o	●										<5
	Jackpot (Tunnels)	NE 11	37	53	●	o											0
	Lone Mountain				o	o	o	●									5-100
	Malachite				o	o	●										<5
	Monarch																0
	Morgan (see Baltimore)																
	Open Pit	11	37	53			x										
	Pacific Consolidated				o	o	●	o									<5
	Pine Ridge					o	o	●									<5
2	Rip Van Winkle	3,34	37,38	53	o	o	o	●	●								>100
	Silver Tip				●	●											<5

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)		Commodity										Total value when sold -- (in thousands of dollars)				
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	Iron	Molybdenum	Tungsten	Titanium		Barite	Turquoise	Sulfur	
			N.	E.														
	Top Lead group					o	•	o										<5
	Miscellaneous					o	•	o										<5
	Black Beauty		39	54									x					
3	Iron Hood prospect (Pacific)	13	37	53					x									0
1	Lone Wolf											•						
	Open Pit (Lone Mountain)	11	37	53								•						
	Fox Creek Ranch		37	54							x							
	Black Beauty		39	54												x		
	Carlin Black Matrix														•			<500
	Unknown													x				

1/ Includes published figures.

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A few miles north of the Merrimac district, sulfur has been reported to occur with minor amounts of pyrite and ilmenite (1-1½ percent TiO₂) 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.

Montello phosphate area

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
SE¼	39	67	Valley Pass, Loray
SW¼	39	68	Loray
1, 2, 3, 4	38	67	Valley Pass, Loray
W½	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 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 ft that assayed 15.77 percent P₂O₅. The highest grade found was 20.5 percent P₂O₅ across 5.5 ft. 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.

Moor district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
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 ft thick in the SW¼ sec. 7, T. 37 N., R. 64 E. The limestone analyzed 97.18 percent CaCO₃, 1.2 percent MgCO₃, 1.35 percent SiO₂, 0.13 percent Fe₂O₃, and 0.02 percent Al₂O₃ (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 S $\frac{1}{2}$ 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, predominantly 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 ft 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 ft and a depth of 30 ft. Galena occurs in stringers and pods in an oxidized zone $\frac{1}{2}$ - $3\frac{1}{2}$ ft 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 ft wide strike northeast for several hundred feet and dip steeply in calcareous mylonite (Southern Pacific Co., 1964, p. 93).

Mountain City district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7 $\frac{1}{2}$ or 15 minute)	Other district names, remarks
25, 26, 35, 36	46	53	Mountain City	Murray(?), Cope, Duck Valley Indian Reservation
All	46	54	Mountain City	Fairweather, Sooner
All	45	53	Owyhee, Mountain City	Cope, Marseilles (sec. 21), Van Duzer (S. 1/3), Rio Tinto
All	45	54	Mountain City	Cope, Van Duzer (secs. 30, 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.^{1/} The mine produced \$21 million,

^{1/} "In 1919 he (S. F. Hunt) was attracted to the area by an extensive gossan outcrop. He located the ground and a short time after succeeded in interesting V. P. Strange, local contractor, in the prospect. In 1922 Mr. Hunt started development of the property on a small scale and the work continued until 1930 when his backers were forced to give up the project. At this time a shaft was down 73 feet.

"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.)

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.

Uranium was discovered in 1954, and by 1959 eleven or more prospects had been found, three of which resulted in commercial production (table 37). As of 1963, the largest uranium producer in the county was the Racetrack mine which yielded nearly 10,000 lb of U_3O_8 (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 mining plan was to partly remove the Footwall ore body to permit block caving and to leach the broken ore in place through drill holes from the surface. Production was 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 ft 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 ft 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 ft thick; the second is thin alternating layers of gray and black well-bedded phyllite (Footwall shale) 450-710 ft thick; and the middle unit, which is the host rock of the Rio Tinto lode, is a black carbonaceous shale 130-250 ft thick. The fourth unit is a well-bedded black phyllite (Hanging wall black shale) 110-250 ft thick; and the uppermost unit is a limy, gray, well-bedded phyllitic shale more than 370 ft 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" of predominantly carbonate strata.

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

[●, main product; ○, by-product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity								Total value when sold ^{1/} (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Manganese	Molybdenum	Tungsten		Uranium
	Argenta (1869)													200
	Arrowhead (see Aura dist.)													
	Aspen				○	●								<5
	Aura Queen (see Aura dist.)													
	Coffee Pot	36	46	53	○	●	○	○						<5
	Columbia				○	●								<5
	Copper Mountain	25	47	54			x							
	Excelsior				○	●								5-100
6	Golden Ensign (Silver Banner)	1,6	45	53,54	○	●	○	○						5-100
	Gold Star placer				●	○								<5
	Harris claim placer				●	○								<5
	Hall & Greenback				○	●								>100
	Hidden Treasure				○	●								<5
	Hope					●	○							<5
2	Independence (Independent)	36	46	53										75
	King of Nevada				●	○								<5
	Lime Creek					●	○							<5
	Maggie Combine (see Aura dist.)													

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold ^{1/} (in thousands of dollars)		
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Manganese	Molybdenum		Tungsten	Uranium
	Mariposa	6	45	54	o	•	o	o						<5
	Mercury (see Mountain City Mercur)													
	Mill Creek(?)						•							0
9	Morrison-Knudsen placer	34	45	53	•									5-100
8	Mountain City Copper (see Rio Tinto)	SE 1/4 2	45	53										
	Mountain City placer	1	45	53	•									
7	Mountain City Mercur	1	45	53	•	o	o	o						<5
	Mountain Laurel	21	45	53	o	•	o	o						5-100
	Nelson	1,12,6	45	53,54	o	•	o	o						1,000
	Nevada placer				•	o								<5
	North Star group (Rio Tinto)	2,10,11	45	53										
	Pardner				o	•								<5
	Pioneer				o	•	o	o						<5
1	Protection group	35,36	46	53	•	•	o	o	o					>100
	Protection placer - Maggie Gulch				•	o								<5
3	Resurrection (1888-1892)	35,36	46	53										45
	Rio Tinto (Mountain City Copper)	2,10,1	45	53	o	o	•							21,000

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity								Total value when sold ¹ / (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Manganese	Molybdenum	Tungsten		Uranium
	Silver Banner (see Golden Ensign)	1,6	45	53,54										
	Silver Cougar placer				•									<5
	Small Fry				o	•	o							<5
4	Soft Snap (Soap)	36	46	53										
	Tea Kettle				o	•								<5
	Walker Boy	36	46	53	o	•	o	o						<5
	Woodward				•									<5
	Wyoming placer	26	46	53	•	o								<5
	Miscellaneous				•	o	o							<5
	Miscellaneous					o	o	•						<5
	Miscellaneous placer				•									<5
	East Fork											•		<5
	Garnet (see Alder dist.)													
	Golden Ensign (Banner)	1,6	45	53,54							x	o		
	Hawk	33	46	54								•		
	Hot Spot	2	45	53								•		

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

Index no. on Plate 1	Map or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity								Total value when sold ^{1/} (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Manganese	Molybdenum	Tungsten	
5	Racetrack No. 1	31	46	54								•	5-100
	Rimrock	26	46	54								•	
	South Fork (Pixley)	36	46	54								•	<5
	Tag	5	45	54								•	
	Wicker (W. side Merritt Mtn.)	?								•			<5
	No name (1959) Gems (Petrified wood)												

^{1/} Includes published figures.

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

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 ft thick.

In parts of the Owyhee River valley the Paleozoic rocks are overlain by gold-bearing quartzite gravels of Quaternary age that occupy terraces at three different altitudes. These gravels are noteworthy for their coarseness--boulders as large as 17 ft--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 displacement are older than the quartz monzonite. They may be contemporaneous with the Roberts Mountains thrust fault of early Mississippian(?) age which is inferred to underlie the area at a depth of about 5,000 ft. 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 faults that strike in various directions and have vertical displacements of not more than a few hundred feet. Some of these faults contain silver-gold-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 ft horizontally and the Tertiary volcanics 400 ft 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 ft 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 volcanism, later than the Roberts Mountains thrust fault. Secondary enrichment, however, is of early Tertiary and Holocene 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 ft) and to a depth of about 200 ft, the Rio Tinto lode is represented only by a leached gossan. The surface exposure is about 400 ft long and 100 ft wide, but at the 200 level (altitude 5,880 ft), the gossan is more than 1,000 ft long and 40-80 ft wide. Below the gossan and above the water table at about 230 ft 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 ft 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 ft, 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 ft 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, comprise 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 mentioned above.

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

The primary minerals in the ore are predominantly 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 blanket layer 6 inches to 20 ft 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. Much of the ore was bluish black in color, without metallic luster, and contained about 35 percent chalcocite, 35 percent chalcopyrite, 5 percent covellite, 1-5 percent oxide copper minerals, and 20-24 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 ft long, 75 ft wide, and extended 150 ft 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 25-55 percent copper.

The 600 ore body was stoped 300 ft along the strike between the 450 and 650 levels. It was explored down the dip to the 1000 level (altitude 5,077 ft) 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 ft 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 ft attaining a width of 300 ft and a thickness of about 230 ft between depths below the surface of 220 and 450 ft. 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.

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 silver-gold 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: "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 as much as 5 ft wide, 100 ft long, and subsequently have been mined as deep as about 600 ft. 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, pyromorphite, 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 of silver and 0.75 oz of gold per ton (Roberts and others, 1971, p. 29).

Uranium deposits

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 ft 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 ft thick and as much as 100 ft wide and 200 ft long. Lenses of ore grade (0.3 percent U_3O_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 metatyuyamunite, uranophane, or torbernite may predominate. Grade of the deposits is commonly less than 0.25 percent U_3O_8 (chemical assay), but a few exceeded 0.3 percent. One mineralized log assayed 0.5 percent U_3O_8 .

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 $1\frac{1}{2}$ miles starting a mile above Van Duzer Creek.

Largest of the placer deposits was along Van Duzer Creek where the gold-bearing gravel channel was 50-200 ft wide and as much as 15 ft 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).

Mud Springs district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name	Other district names
ALL	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 ft 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 ft 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 ft 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 part of the range are interbedded sandstones, chert conglomerates, limestones, and calcareous siltstones of the Thaynes Formation of Triassic age. Thin lake beds of siltstone, sandstone, and limestone, flows of rhyolite ash, and remnants of basalt crop out locally in the Tertiary 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 ft 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.

Table 38.--*Mud Springs mining district, mines through 1969*

[●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	
			N.	E.						
	Al Smith					●	○	●		<5
	Black Metals				○	●	○	○		<5
	Dead Horse (Silver Butte)									
	Evening Star					○	○	●		<5
	Fasano					○		●		<5
	Johnnie 1 and 2	4	27(?)	60	○	○	○	●		<5
	Monitor					○		●		<5
	Mud Springs					●		●		<5
	Rainbow group				○	○		●		<5
1	Silver Butte	24	28	60	○	○	○	●	○	5-100
	Silver Crown				○	●		○		<5

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 ft wide and 2,000 ft long made up of many individual interlacing fault strands. The ore shoots are discontinuous overlapping lenses of vein material as much as 3 ft wide, 60 ft long, and were mined to depths of 400 ft 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.

Pequop phosphate area

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
E½	31	64	Spruce Mountain 4	Boone Spring, southern Pequop Mountains
All	31	65	Spruce Mountain 4	Boone Spring, southern Pequop Mountains
NE¼	30	64	Spruce Mountain 4, Elko 2°	Boone Spring, southern Pequop Mountains
NW¼	30	65	Spruce Mountain 4, Elko 2°	Boone Spring, southern Pequop Mountains

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.

Prospecting permits 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 nine 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^{1/} during the Permian period. Phosphorite occurs in all these strata but is more abundant in the shales. Phosphorite^{2/} is not a very distinctive rock. Most phosphorites consist of dark-colored sand-sized phosphatic pellets and nodules up to about 1½ 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).

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 (0.005-0.05 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 Permian 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 ft thick; the formation thickens to about 1,300 ft in south-central Idaho. It consists of four members

^{1/}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.

^{2/}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.

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 ft; it is overlain successively by Rex Chert (156 ft), Cherty Shale (67 ft), and the Retort Phosphatic Shale Member (30 ft).

The Park City Formation near its type locality in Big Cottonwood Canyon near Salt Lake City, Utah, is about 800 ft 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 ft thick; it is overlain successively by Meade Peak Phosphatic Shale (300 ft) and Franson dolomite-sandstone-chert 235 ft 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 ft thick of nearly pure phosphatic material containing as much as 39 percent P_2O_5 . High-grade phosphorite contains over 31 percent P_2O_5 and is commonly mined from beds 2-7 ft thick. Low- or furnace-grade rock averaging 24 percent P_2O_5 or more is mined from beds as much as 40 ft thick. Most phosphorite is mined from open pits, and production of a million tons or ore a year is common.^{1/}

In Nevada, the Phosphoria extends as far west as the Adobe Range in Elko County and reaches a maximum thickness of about 4,000 ft in northeastern Elko County, but the thickness of the Meade Peak Member is only 25-100 ft. 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 inter-tongues 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 ft 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 ft thick. It contains thin beds of phosphorite in the lower 200 ft, which is predominantly cherty, and also in the middle 300 ft and upper 200 ft,

^{1/} 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 ($\%P_2O_5 \times 2.184 = \%BPL$). "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. Bur. Mines, 1925-73).

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 ft that assayed 10.5 percent P₂O₅; the highest grade was 20.2 percent P₂O₅ across 6 ft.

Pilot Peak district

Location and history

Sections (Approx.)	T. R. N. E.	Quadrangle name (7½ or 15 minute)	Remarks
All	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 ft. Gold and silver mines and prospects are at altitudes of 6,000-6,200 ft 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 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 occur along the east side of the range, and fragments of diorite and granodiorite were found on the limestone dump of the crosscut adit in sec. 20.

Proctor district

Location and history

Sections (Approx.)	T. R. N. E.	Quadrangle name (7½ or 15 minute)	Remarks
All	35 68	Shafter(?)	Silver Zone district
All	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; the railroad crosses a productive tungsten deposit about a quarter of a mile northeast of Silver Zone Pass.

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

[●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity			Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	
	American Flag	20	36	70				
1	Badger	20	36	70	●	○		<5
2	Crazy Dutchman	20	36	70	○	●	○	<5
	Dead Cedar (see Ferguson Spring dist.)							
	Pilot limestone quarry (see Proctor dist.)							

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.

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 Toano 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 ft 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 ft wide exposed for 650 ft north of the railroad and again for 50 ft about 150 ft south of the tracks. The vein is displaced as much as 40 ft by four transverse faults.

The ore shoot that was mined was about 300 ft north of the railroad. It contained scheelite crystals one-fourth of an inch across in a mineralized layer as much as 18 inches thick along the east wall of the vein for a length of 40 ft and a depth of 35 ft. 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).

Railroad district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names, remarks
SE¼	31	52	Carlin	Barite mines
S½	31	53	Carlin, Dixie Flats	Bullion
NE¼	30	52	Carlin, Pine Valley	
N½	30	53	Carlin, Dixie Flats, Pine Valley, Robinson Mountain	Bullion

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

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

Index no. on Platel	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity				Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Silver	Copper	Tungsten	Stone	
	Keystone (Nickel Duke, Del Duke)	15(?)	35	68	●				<5
	Klondike King 1 & 2 placer		34	69					
	Mary Lou placer		34	69					
	Silver Hoard	15(?)	35	68	●	o			<5
	Hice prospect	8,9,16 (?)	35	68			x		
	Pilot quarry	14,23	34	68				●	<5
	Rare metals	16(?)	35	68				●	5-100

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 north-trending spur of Ravens Nest which is the highest peak (altitude 8,710 ft) 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 ft below the 600 level and 6,040 ft 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 ft 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 Pinon 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 predominantly dolomite and limestone about 2,300 ft 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 ft 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 ft 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 ft long and 100-400 ft wide, and at distances up to about 1,000 beyond the limestone is marbleized. The stock has a core 2,500 ft 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 ft long and as much as 700 ft wide, trends northward about 4,500 ft 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 contact-metamorphic 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, scheelite-bearing 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 ft in diameter, extended through a vertical range of about 400 ft, and yielded more than 50,000 tons of oxidized ore containing 18.2 percent lead, 5.4 percent copper, and 19 oz of silver per ton. Oxidation is nearly complete to depths of about 500 ft. 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 ft along the stike, is 2-4 ft 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 ft wide and a few feet to 200 ft 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).

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_2 (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 Piñon Range (Ketner, 1970, p. B108).

Scheelite-bearing tactite 2-3 ft wide is exposed for 30 ft in the Davis Tunnel about 3,000 ft from the portal. Assays ranged from 0.3 to 4.3 percent WO_3 . Tactite is also exposed in the Tripoli mine and on the surface 1,000 ft 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.

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

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)		
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Iron	Tungsten		Barite	Wollastonite
3	Aladdin (Nevada-Bunker Hill)	4	30	53	o	o	●	●	●					>100
	Bald Mountain Chief (see Hecla)	33	31	53										
	Blue Wing					o	o	●						<5
	Brodine													
	Bullion	4	30	53		o	o	●						<5
	Burke													
	Como (see Sweepstake)													
2	Copper Bell	33,34	31	53	o	o	●	o						5-100
	Copper Creek	15	28	53		o	●							<5
	Copper Queen					o	●							<5
	Davis Tunnel													
3	Delmas (see Sweepstake)													
	Elk				o	o	o	●						5-100
	Emmov				o	o	●							5-100
4	Gray Eagle													
	Grey Eagle	4,9	30	53	o	o	●	o	o					5-100
	Hale and Peterson					o	●							5-100
	Hecla and Bald Mountain Chief	4	30	53	o	o	●							5-100
	Helen M				o	o	●							5-100

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)		
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	Iron	Tungsten		Barite	Wollastonite
			N.	E.										
	Hula						•							5-100
	Independence				o	o	o	•						<5
	Kentucky				o	o	•	o						5-100
	Key				o	o	•	o						5-100
	King Alfred						•	o						<5
	Lee (William S. Lee)	4	30	53	o	o	•	o						5-100
	Mahogany.													
	Mayflower					o	•							<5
	Mendota													
3	Nevada-Bunker Hill (Aladdin)				o	o	o	•	o					>100
	Nevada Pine				o	•		o						<5
	Palisade													
	Phillipine no. 2						•							<5
	Red Bird													
	San Hone					o	•	•						<5
	Silver King	4,33	30,31	53		o	o	•						<5
	Siri				o	•	o	•						<5
	Sky Blue	3,4	30	53										
	Stafford					•	o							<5

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

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

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Robinson Mountain district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names, remarks
NE¼	29	52	Pine Valley	Asphaltite
N½	29	53	Robinson Mountain, Pine Valley	Barite
S½(?)	29	53	Robinson Mountain, Pine Valley	Copper Canyon(?)

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 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 district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name	Other district names
E¼	40	48	McDermitt 2°	Falcon
All	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.

Table 42.--Rock Creek mining district, mines through 1969

[●, main product; ○, by-product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity				Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Antimony	Mercury	
1	April Fool group (Ruby Silver)	13	40	49	○	●			5-100
	Divide (see Divide dist.)								
	Falcon (April Fool)	13	40	49					
	Rock Creek (April Fool)								
	Ruby King				○	●			<5
	Ruby Silver (April Fool)								
	Silver Globe					●			<5
	Boston (see Teapot)						●		
	Horse Mountain (see Staggs)		40	49			●		0
	Horse Mountain 1 and 2 (see Staggs)						●		<5
2	Rock Creek prospect	23	40	48			x	●	0
	Staggs and Quilici		40	49				●	<5
	Stampede turquoise (see Beaver dist.)								
	Teapot group (Salet)	12	40	49				●	<5

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

Geologic setting and ore deposits

Sedimentary rocks of the Valmy Formation (Ordovician) and the Havallah sequence (Mississippian-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 remnants 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 ft 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 mine 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 lb of mercury per ton of ore treated.

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.

Table 43.--Ruby Mountain Range mining district, mines through 1969

[●, main product; ○, by-product]

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

Table 44.--*Ruby Range mining district, mines through 1969*

[●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Assigned district
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Manganese	Tungsten	
	American Beauty	33	31	58	○	○	○	●	○			Lee
	Betty				○	○	○	●	○			unknown
	Errington & Thiel (Holiday)						●					unknown
	Friday (Battle Creek)	6	30	59	○	○	○	●				Ruby Valley
	Galena King				○	○	○	●	○			unknown
	Galente #2 (Battle Creek)	1	30	58	○	○	○	●	○			Ruby Valley
	Giant				○	○	○	●	○			Lee
	Good Luck				○	○	○	●	○			unknown
	Hairgrove (Hargrove)	5	30	58	○	○	○	●	○			Lee
	Hogle				○	○	●	○	○			unknown
	Knob Hill (Long Canyon)	32	31	58	○	○	○	●	○			Lee
	Phill (Errington & Thiel)											unknown
	Summit King	17	28	57								Corral Creek
	Summit View	21	28	57			○	●				Corral Creek
	Thiel (Errington & Thiel)											unknown
	Manganese Mountain #2									●		unknown
	Stormy Night										●	unknown

Ruby Valley district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names
NE¼	30	58	Lamoille, Franklin Lake NW	Smith Creek, Ruby Range
6.7, 18	30	59	Lamoille, Franklin 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.

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°-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 oz 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 ft and is 100 ft long. About 900 units of WO₃ was produced from ore that averaged 1.5 percent WO₃. A similar deposit, the Fawn Creek prospect south of Meyers Creek, was estimated to contain 0.5 percent WO₃ but has not been productive (D. M. Lemmon, written commun., 1948).

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

[●, main product; ○, by-product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Tungsten	Mica	
2	Battle Creek group (Friday)	1,12, 6,7	30	58,59	○	○	○	●	○			5-100
	Betty open pit				○	○	○	●	○			
	Challenge											
	Copper King				○	○	●					<5
	Crescent (Friday)											
	Francis, Mariana, Rodges				○	○		●				<5
	Friday (Noonday)				○	○	○	●				5-100
	Galente no. 2 (see Friday)				○	○	○	●	○			
	Lead King					○		●				<5
	Long Canyon (see Lee dist.)											
1	Michigan (Short group)	1,2	30	58	○	○	○	●	●			5-100
	Noonday (Friday) group				○	○	○	●	○			5-100
	Ruby Valley (see Battle Creek)					○		●				<5
	Short group											
	Baldwin Lease (Climax) (see Harrison Pass dist.)											
Climax (see Harrison Pass dist.)												

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Tungsten	Mica	
	Lakeview (see Harrison Pass dist.)											
	Star (see Harrison Pass dist.)											
	Anna D									x		
	Battle Creek	1	30	58						•		5-100
	Noonday (see Railroad dist.)											
	Stormy Night									x		
	Ruby Valley (C. W. Kennedy, 1939-41)										x	

Spruce Mountain district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
E-2/3	32	63	Spruce Mountain	Many prospects
All	31	63	Spruce Mountain	Main part of district
W½	31	64	Spruce Mountain	Mines and prospects

The Spruce Mountain district includes Spruce Mountain (altitude 10,262 ft), 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 Sprucemont, 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 1970.

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 ft) and the Monarch (600 ft), which are on opposite sides of the mountain. The tunnel has a maximum depth of 800 ft. An aerial tram 6,800 ft 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 Sprucemont 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 ft thick. It is overlain or is in fault contact with limestones, dolomites, shales, and quartzites of Silurian through Permian ages (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 ft 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 ft of the intrusives, but generally less than 30 ft, 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 ft 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 ft 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(?) ft long, and extend 100 ft 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 ft wide and 360 ft long, but one fissure zone in the Spruce Standard mine is 20 ft 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 ft or more in diameter, and at the Ada H mine a stockwork at intersecting fissures is 1,800 ft 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 ft down a 28° dip, a width of 100 ft, and a thickness of 40 ft or more, and was estimated to contain 50,000 tons containing about 10 percent lead, 10 percent zinc, 3 oz 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).

Oxidation extends irregularly to depths of 200 ft 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.

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 containing 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 ft wide near its contact with the tactite for a distance of 160 ft. Samples assayed 0.5-2.0 percent WO_3 (A. C. Johnson and W. T. Benson, written commun., 1963).

Swales Mountain district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
S½	36	52	Swales Mountain, Swales Mountain NW
SW¼	36	53	Swales Mountain
N½	35	52	Swales Mountain NW, Swales Mountain
NE¼	35	53	Swales Mountain

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

[●, main product; ○, by-product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Tungsten	Molybdenum		Barite
	Ada H	21	31	63	○	○	○	●					5-100
	Badger	14	31	63		○	●	○					
	Banner Hill	11	31	63			●						
	Big and Little Dick				○	○	○	○	●				<5
	Bingle (Bingo)	14	31	63			●						
	Bingo	14	31	63			●						
5	Black Forest (see Monarch)	13	31	63	○	○	○	●					5-100
	Bronco Tunnel	14	31	63									
	Bullshead (Index)				○	○	○	●	○				>100
4	Copper Queen	14	31	63			●	○					
	Errington & Thiel (Holiday) (see Ruby Range)												
	Fourth of July	14(?)	31	63		○	●						5-100
	Hartley				○	○	○	●					<5
	Humbug (Parker)				○	○	○	●					5-100
	Index (Bullshead)	13,14	31	63	○	○	○	●					<5
	Juniper (Latham & Juniper)	13,14	31	63									
	Keystone (Banner Hill claim)	14	31	63	○	○	○	●	○				<5

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	Tungsten	Molybdenum		Barite
	Killie (Latham, Nevada Lead)	14	31	63									
	Latham (Killie)	14	31	63									
	Latham & Juniper (Killie)	14	31	63		o	o	•					5-100
2	Monarch	14,23	31	63	o	o	o	•	o				>100
	Monarch-Black Forest		31	63	o	•	o	•	o				5-100
3	Nevada Lead (Killie)	14	31	63	o	o	o	•	•				>100
	O.D. No. 1 (Humbug?)				o	o	•	•					5-100
	Never Sweat	13	31	63			•						
	Pals				o	o	•						<5
	Paramount	16,17	31	63	o	o	o	•					
	Parker (Humbug)	7,18	31	64	o	o	o	•					<5
	Porphyry Tunnel	13	31	63									
	Rainbow				o	•	o	o					<5
	Silver Lady					o	o	•					<5
	Spence	13	31	63			•						0
	Spruce-Monarch				o	o	o	•					>100

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity							Total value when sold (in thousands of dollars)	
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	Tungsten	Molybdenum		Barite
			N.	E.									
1	Spruce Standard	21	31	63	o	o	•	•	o				>100
	Standard												
	Tramp	22(?)	31	63			•						
	Valley claim					o	o	•					<5
	Miscellaneous					o	o	•	o				<5
	Atlantic claim prospect	13,14	31	63						x			
	Lead-silver mines										x		
	Monarch									x			
	White Boy prospect (near Sprucemont)											x	
	Devaney, Howard prospect (near Sprucemont)											x	

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 ft 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 ft 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 conglomerates 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 contact 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 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 of 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 ft wide and 330 ft long was explored by four shallow bulldozer cuts.

Tecoma district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)
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 ft. 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).

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 ft apart. The eastern jasperoid zone is about 200 ft wide and several thousand feet long, the western zone is about 40 ft wide, 500 ft 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 ft in width, and have been mined to depths of 250 ft. Exploration at a depth of 365 ft 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 ft. Average grade of shipments of screened ore during the 1950's was about 17 percent lead, 4.2 oz silver, and 0.01 oz 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 of silver per ton and as much as 18 percent zinc (Hill, 1916, p. 105).

Table 47.--*Tecoma mining district, mines through 1969.*

[●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)	
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc		
	Big Joe					●	○	○		<5	
	Black Warrior (see Lucin dist.)										
	Cunepah (see Lucin dist.)										
	Davenport (see Charleston dist.)										
	Desert Rat					○	●	○		<5	
	Durham claims	SE $\frac{1}{4}$	18	41	70						
1	Jackson (Bullock)	NE $\frac{1}{4}$	18	41	70	○	○	○	●	>100	
1	Jackson group					○	○	○	●	○	5-100
	Lucky Boy										
	Queen of the West	17		41	70		●		○	○	
	Star						○		●		<5
	Tecoma (see Lucin dist.)										

Tuscarora district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
SE¼	40	50	Mount Blitzen	Prospects
S½	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 silver-gold 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 2 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 ft north of the northwest corner of the Found Treasure No. 2 claim (Nolan, 1936, p. 17), and well exposed north of the district. 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 ft thick. These light-colored rocks are intruded by a large stock northwest of the district and by many 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 ft 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 noncommercial amounts. One specimen contained 0.4 percent TiO₂.

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; 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 ft long and 200 ft wide was mined to a depth of 300 ft. 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 1:1 for bullion and 1:12 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 east-striking faults in the intrusive andesites. Veins along the northwest-striking 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 ft 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 ft.

Ore minerals in the upper portions of the shoots below the leached zone and above the water table, which was about 100 ft 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 150:1, although recorded production from many of the mines indicates that the greater value of the ore was in gold (table 48).

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

[●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold ^{1/} (in thousands of dollars)
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Mercury	
			N.	E.						
3	Argenta				○	●				
	Aura Queen (see Aura dist.)									
2	Belle Isle				○	●				641
	Comet				●	○				<5
2	Commonwealth				○	●				678
	Coptis				●	○				94
3	DeFrees				○	●				27
	Delmonte				●	○				26
4	Dexter				●	○				>1,265
	Dexter placer				●	○				<5
	Eira				●	○				>100
	Ennor				●	○				7
	First Chance				●	○				<5
	Frank and Marguerite				●	○				14
	Gold Nugget	3	39	51	●	○				<5
	Gold Nugget placer				●	○				<5
	Gold Fleece placer				●	○				<5
3	Grand Prize	34	40	51	○	●				2,546

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold 1/ (in thousands of dollars)
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Mercury	
			N.	E.						
	Grey Eagle placer				●	○				<5
	Ham placer				●	○				<5
	Holden				●	○				<5
	Hostetter				○	●				11
3	Independence				○	●	○	○		606
	Ischibible				●	○				<5
	King (Wakefield)				●	○				<5
	Krug (Wakefield)				●	○				0
	Lancaster 1880				○	●				17
	Maggie (see Aura dist.)									
	May Queen				○	●				15
	McKenzie				●	○				5-100
	Modoc	4	39	51	●	○				
	Mystery				●					<5
2	Navajo	3,34	39,40	51	○	●				>1,733
	Nevada				○	●				<5
	Nevada Hydraulic Mining Co. placer				●	○				<5
2	Nevada Queen				●	●	●			391

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold 1/ (in thousands of dollars)
		Sec.	T.	R.	Gold	Silver	Copper	Lead	Mercury	
			N.	E.						
	Nogi Extension				•	o				<5
2	North Belle Isle				o	•				639
2	North Commonwealth				o	•				262
	Original Nevada				o	•				<5
	Poorman				o	•				6
	Queen (see Nevada Queen)									
	Raven				•	o				<5
	Ring	3,4	39	51	•	o				<5
	Ruby Queen group				o	•		o		
	Silver Queen group (tailings)				o	•				<5
	Surprise Fraction				•	•		o		<5
	Timber placer				•	o				<5
	Union Mill Company									98
	Wakefield group (King)	3,4	39	51	•	o				<5
	White Palace				•	o				<5
	Windsor placer				•	o				<5
	Young (W. P. Young)				o	•		o		<5

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

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold ^{1/} (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Mercury	
	Young America	34	40	51	o	•				110
	Zerq .	34	40	51	•	o				<5
5	Placer deposits SW of Tuscarora				•					>100
6	Berry Creek group	3,7	39	51					•	<5
	Liquid Metals (Berry Creek)								•	0
	Lope & Hewitt (Silverado)	26,35	40	51					•	0
	Red Bird group (Silverado)	26,35	40	51					•	0
1	Silverado	34	40	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 ft 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 2 square miles or more to a depth of a few inches to 30 ft. 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¢ per cubic yard (gold at \$20.67 per troy oz).

Union district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
31, 32, 33	27	53	Mineral Hill, Railroad Pass	Eureka and Elko Counties
NW¼	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).

Valley View district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Other district names, remarks
W½	29	58	Franklin Lake NW Franklin Lake SW	Ruby Range district, Dawley Canyon and Hankins Canyon areas

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 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 ft deep and an adit 30 ft 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 metallurgical tests. About 250 lb 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_3 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

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 ft wide and 2,200 ft 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 north-trending fractures in the schists, the older granites, and in the pegmatites. Within about 1,500 ft 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 ft wide and 300 ft long. The best showing was in a pit 12 ft 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 ft wide and 75 ft 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 ft along the strike in an open cut and an adit. The ore was estimated to range in grade from 1 to 5 percent WO₃ (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.--Valley View mining district, mines through 1969.

[●, main product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity				Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Bismuth	Tungsten	Beryl	Mica	
1	Errington and Thiel	16,17	29	58			x	●	<5
	Hankins (Valley View)	35	29	58	x	●			
	Mick (Mica?)	16	29	58					
	Owl (Valley View)	31	29	58	x	●			<5
2	Valley View	31	29	58		●			0

Warm Creek district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name	Other district names
14, 15, 22, 23, 26, 27	33	61	Elko 2°	Polar Star, Clover Valley

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 1912-43, half of it in 1916. 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. There is no record of production for the years 1944-69.

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 ft or more along three persistent faults that strike east and dip 50°-60° S. in an area 120 ft wide. Pods and stringers of carbonate ore were mined from stopes as large as 20 by 50 by 8 ft to depths of about 60 ft 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 oz silver per ton, 0.9 percent copper, and a trace of gold.

Table 50.--Warm Creek mining district, mines through 1969.

[●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Silver	Copper	Lead	Zinc	
	Morning Star	22,23, 26,27	33	61						
2	Polar Star	23	33	61	○	○	○	○	●	>100
	Parker (Silver Cliff?)				○	○	○	●		<5
1	Silver Cliff	14	33	61	○	○	○	●		<5

Wells district

Location and history

Sections (Approx.)	T. N.	R.. E.	Quadrangle name (7½ or 15 minute)	Other district names
All	38	62	Metropolis, Oxley Peak	Humboldt Wells
All	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 300-200 ft 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 ft 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 ft 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 per cent WO_3 . A lower adit leading to 20-50-foot drifts exposes scheelite and beryllium minerals in a tactite zone 6 ft 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 percent WO_3 .

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 ft long, 10 ft wide, and 20 ft 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 3 by 8 ft 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

[●, main product; x, occurrence]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity						Total value ^{1/} when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Gold	Beryllium	Tungsten	Marble	Stone (Decorative)	Stone (Broken)	
	Black Forest (1925)				●						40
	Nevada Zinc Mining Co. (1916)				●						18
1	Limestone, chert	13	37	62						x	
	Quartzite conglomerate	25	37	62					x		
	Nevada Picture Rock	16,21	38	62					●		
	Wells, south (see SPRR)	27	37	62				x			0
	Wells, southwest (SPRR)	29	37	62				x			
	Wildcat (Jensen and Steele) (see Jarbidge dist.)										
2	Unknown (1956)	29,31	37	62	x	●					5-100

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

Wendover district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
All	33	70	Shafter 1 SE	Prospects
N½	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_3 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 ft 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°-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.

White Horse district

Location and history

Sections (Approx.)	T. N.	R. E.	Quadrangle name (7½ or 15 minute)	Remarks
All	28	68	Elko 2°, Ferguson Springs 1 SW	
W-1/3	28	69		
N-1/3	27	68		

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

[●, main product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity		Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Tungsten	Stone	
	Safety Last group	10,15	33	70			
	Salt Spring No. 2	15	33	70			
	Great Western				●		<5
1	Unknown	18	32	70		●	

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 White Horse Pass (U.S. Highway 50), 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_3 was shipped during 1942-43. Lead-silver-zinc production is recorded for the years 1948-49 (table 5).

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 ft (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_3 (D. M. Lemmon, written commun., 1948).

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^{1/}. The production records of Elko County confirm 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

^{1/}"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).

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

[●, main product; ○, by-product]

Index no. on Plate 1	Mine or prospect (A mine may have several names; production is cumulative).	Location (MDBM)			Commodity					Total value when sold (in thousands of dollars)
		Sec.	T. N.	R. E.	Silver	Copper	Lead	Zinc	Tungsten	
	No name					●	○			
	No name		26	68	○		●	○		<5
	Epidote claim	11(?)	28	68					●	<5

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

[●, main product; ○, by-product; x, occurrence]

Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity										Total value when sold (in thousands of dollars)		
	Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	Antimony	Manganese	Mercury	Molybdenum	Tungsten		Barite	Stone
		N.	E.													
Betty	(Ruby Range)			○	○	○	●	○								<5
Bristle Cone	See Nye County															
Clawson & Wilson				●	○		○									<5
Cunapah																
Deitloff (Gates)				○	●		○									<5
Galena King	(Ruby Range)			○	○	○	●	○								5-100
Good Luck	(Ruby Range)			○	○	○	●	○								5-100
Hogie	(Ruby Range)			○	○	●	○	○								<5
Holiday (Errington & Thiel)	(Ruby Range)					●										<5
Kristine					○	●										<5
L. and C.	(Ruby Range)				○		●									5-100
Lonesome																
Little John																
Nevada Monarch	Spruce Mountain(?)				○	○	●	○								<5
Polish				○	○	○	○	●								<5
Selby property				○	○	○	●	○								<5

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

Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity										Total value when sold (in thousands of dollars)		
	Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	Antimony	Manganese	Mercury	Molybdenum	Tungsten		Barite	Stone
		N.	E.													
White Rock G.M. Co. placer Young (W. P. Young)				o												<5
Atlas											•					<5
Black Marion group										•						<5
Bidee-Etcheverry (Hoalst)	25 mi NE. of Midas									•						<5(?)
Manganese Mountain No. 2 M&S (Elko County?)	(Ruby Range)									•			•			<5
Missouri										•						
Owyhee	16	45	51										x			
Rosella													•			
Rowland (W. J. Rowland)													•			<5
Stormy Night	(Ruby Range)												•			<5
Section 8 Ranch (1968-1969)											•					5-100(?)
Tungsten Annex													•			<5
Celedonite claims (misc. stone)																

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

Mine or prospect (A mine may have several names; production is cumulative)	Location (MDBM)			Commodity										Total value when sold (in thousands of dollars)			
	Sec.	T.	R.	Gold	Silver	Copper	Lead	Zinc	Antimony	Manganese	Mercury	Molybdenum	Tungsten		Barite	Stone	
		N.	E.														
Goliath quarry (1963) (quartz aggregate)																•	
Mayflower (sandstone, quartzite)																•	
Roy Manne, Jr.																•	<5
Yellow Jacket and Consolation (1962)																•	<5
Unnamed																	43 54
Jungle 1-4 claims (patented)																	7,8, 17,18 42 62

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.

4 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--ultraviolet lamps, Geiger counters, seismometers, gravity meters, electrical and electromagnetic sensors, mercury "sniffers," and satellite or airborne cameras, magnetometers, and scintillation counters can now detect "blossoms" that were invisible to the old-timers. Some of these devices even "see" into 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 guideline does not preclude the search of new areas, its applicability is confirmed by the mere face 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 countywide 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 deposits 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:

1. 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).

2. Burner district

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

3. Cornucopia district

Geologic mapping by Coats (1967, p. 2) revealed that the ridge south of the mine shafts (W $\frac{1}{2}$ 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).

4. Delker district

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.

5. 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. B108).

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. B108).

6. 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.

7. 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.

8. 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 ft. Pre-Cenozoic rocks in Elko County are less favorable; Mississippian, Permian, and Triassic formations contain relatively thin petroleum source beds.

9. 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."

10. 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.

11. Valley View district

Beryl crystals up to $1\frac{1}{2}$ 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).

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APPENDIX

Explanation to Plate 1

Map symbols-----	194a
Principal mines by district-----	194b-e
Mines, alphabetical-----	194f
Exploratory holes drilled for oil---	194g

EXPLANATION - PLATE 1

	Production		
	Over \$100,000	\$5,000 to \$100,000	Small mine or prospect
METALS			
Gold, placer		▽ _p	▽ _p
Gold, lode	▽	▽	▽
Silver	▲	▲	▲
Copper	●	●	●
Lead	■	■	■
Zinc	▢	▢	▢
Groups of mines	⊕		
Antimony		*	*
Iron			○
Manganese		○	
Mercury	✱	✱	x
Tungsten	◆	◆	◆
Uranium		★	★
NONMETALS			
Asphaltite			x _a
Barite	X _{Ba}	X _{Ba}	x _{Ba}
Beryl			x _{Be}
Clay			x _c
Coal			x _C
Diatomite	X _d		
Gem stones	X _g		
Gravel pits	X		
Mica			x _m
Oil shale			x _o
Phosphorite			x _p
Stone		X _s	x _s
Volcanic ash		X _v	
Exploratory hole drilled for oil	⊙		
Show of gas	⊙		
Show of oil	●		
Show of gas and oil	⊙		
Commodity unknown	x		

PRINCIPAL MINES BY DISTRICT

(Numbers correspond to those on map)

Districts indexed by Township-Range

Alder (46-56)

1. Lost Gulch placer
2. Pittsburg Silver
3. Mohawk
4. Tennessee placer
5. Knowles Bros.
6. Garnet Tungsten

Aura (44-53)

1. Blue Jacket
2. California
3. Aura King
4. Golden Eagle

Beaver (37-52)

1. Stampede
2. Marvel (Jones Marvel)

Black Mountain (39-64)

Unnamed prospects

Bootstrap (37-49)

1. Rossi
2. Bootstrap

Burner (41-47)

Mint

Burns Basin (40-53)

1. Burns Basin

Carlin (33-52)

1. Tri-O-Lite
2. Deerhead
3. Black Kettle

Cave Creek (27-57)

Locations unknown

Charleston (44-57)

1. Batholith
2. Virginia
3. McKnights placer

Coal Mine (38-56)

1. Coal Canyon

Contact (45-64)

1. Boston
2. Marshall group
3. Bonanza
4. Tunnel
5. Delano
6. Copper Shield, Blanchard
7. Vulcan
8. Hice
9. Silver Star
10. Bell

Cornucopia (42-51)

Cornucopia (Leopard)

Corral Creek (28-57)

1. Summit View

Decoy (32-69)

Darkey, Black Rock

Delano (44-68)

1. Delno
2. Cleveland
3. Gold Note
4. Mitchell
5. Indian Springs

Delker (29-62)

Delker

Divide (40-50)

Divide

Dolly Varden (28-66)

1. Mizpah
2. Victoria
3. Dolly Varden

Edgemont (44-52)

1. Nevada
2. Burns
3. Lucky Girl
4. Bull Run

Principal mines by district--Continued

Elk Mountain (46-61)

1. Red Elephant prospect
2. Gold prospect
3. Estes prospect
4. Robinette prospect

Elko (34-55)

1. Catlin
2. Norton
3. Conglomerate quarry
Phosphate prospects

Ferber (27-70)

1. Regent
2. Martha Washington

Ferguson Spring (30-69)

1. Dead Cedar

Gilbert Canyon (29-57)

1. Pegmatite
2. Pegmatite

Gold Basin (47-56)

1. Deep Creek
2. Bruneau
3. Mendive

Gold Circle (39-46)

1. Elko Prince
2. Gold Circle
3. Rex
4. Missing Link
5. Jackson
6. Eastern Star
7. Esmeralda

Good Hope (41-49)

1. Amazon
2. Good Hope
3. Buckeye and Ohio

Goose Creek (47-69)

Lignite, stone—Twin Falls County,
Idaho

Halleck (35-59)

Gold—location unknown

Harrison Pass (28-58)

1. Lakeview
2. Star

Hicks (46-55)

1. Silver King
2. McDonald

Hot Creek (39-59)

Unknown

Huntington Creek (31-56)

1. Mineral Soap

Island Mountain (44-55)

1. Little Joe
2. Star Metal
3. Gribble
4. Diamond Jim
5. St. Elmo
6. Penrod
7. Coleman
8. McGregor

Ivanhoe (38-47)

1. Rimrock
2. Sheep Corral
3. Governor—Ivanhoe
4. Fox
5. Butte
6. Velvet
7. Old Timers
8. Clementine
9. Silver Cloud

Jarbidge (46-58)

1. Blizzard
2. Long Hike
3. Success
4. Bluster
5. Rex
6. Coon Creek
7. Norman
8. Wildcat

Principal mines by district--Continued

Kinsley (26-67)

1. Captain Jack
2. Southam
3. Western
4. Morning Star
5. Doty Tunnel

Lafayette (35-64)

Copper prospects

Larrabee (28-53)

1. Unnamed barite

Lee (30-58)

1. American Beauty
2. Long Canyon
3. Hargrove

Lime Mountain (42-51)

1. Lime Mountain

Loray (37-68)

1. Cobrecite
2. Castle Park

Lucin (39-70)

1. Black Warrior
2. Tecoma

Merrimac (37-53)

1. Lone Wolf
2. Rip Van Winkle
3. Iron Hood

Montello (39-68)

Phosphate prospects

Moor (37-68)

1. Limestone
2. Iron prospect

Mountain City (46-54)

1. Protection
2. Independence
3. Resurrection
4. Soft Snap
5. Racetrack
6. Golden Ensign
7. Mountain City Mercur
8. Rio Tinto
9. Morrison-Knudsen

Mud Springs (28-60)

1. Silver Butte

Pequop (31-65)

Phosphate prospects

Pilot Peak (36-70)

1. Badger
2. Crazy Dutchman

Proctor (35-68)

1. Hice prospect
2. Rare Metals
3. Pilot quarry

Railroad (30-53)

1. Pine Mountain
2. Copper Bell
3. Aladdin, Delmas, Nevada-Bunker Hill, Standing Elk, Sylvania, Tripoli, Webfoot
4. Grey Eagle

Robinson Mountain (29-53)

1. Asphaltite
2. Unnamed barite

Rock Creek (30-49)

1. Falcon
2. Rock Creek

Ruby Valley (30-59)

1. Michigan
2. Battle Creek group

Spruce Mountain (31-63)

1. Spruce Standard
2. Monarch
3. Nevada Lead
4. Copper Queen
5. Black Forest

Swales Mountain (35-53)

1. Barite prospects
2. Gold prospects

Tecoma (41-70)

1. Jackson

Principal mines by district--Continued

Tuscarora (40-51)

1. Silverado
2. Belle Isle, Commonwealth,
Navajo, Nevada Queen,
N. Belle Isle, N. Commonwealth
3. Argenta, DeFrees, Grand Prize,
Independence
4. Dexter
5. Placer deposits
6. Berry Creek

Union (26-53)

1. Bell

Valley View (29-58)

1. Errington and Thiel
2. Valley View

Warm Creek (33-61)

1. Silver Cliff
2. Polar Star

Wells (37-62)

1. Nevada Picture Rock
2. Unknown tungsten

Wendover (33-70)

1. Unnamed stone quarry

White Horse (28-68)

1. Epidote claim

ALPHABETICAL

Plat

Mine	District
Aladdin	Railroad
Amazon	Good Hope
American Beauty	Lee
Argenta	Tuscarora
Asphaltite	Robinson Mountain
Aura King	Aura
Badger	Pilot Peak
Barite prospects	Swales Mountain
Batholith	Charleston
Battle Creek group	Ruby Valley
Bell	Contact
Bell	Union
Belle Isle	Tuscarora
Berry Creek	Tuscarora
Beryl prospects	Gilbert Canyon
Black Forest	Spruce Mountain
Black Kettle	Carlin
Black Rock	Decoy
Black Warrior	Lucin
Blanchard	Contact
Blizzard	Jarbidge
Blue Jacket	Aura
Bluster	Jarbidge
Bonanza	Contact
Bootstrap	Bootstrap
Boston	Contact
Bruneau	Gold Basin
Buckeye and Ohio	Good Hope
Bull Run	Edgemont
Burns	Edgement
Burns Basin	Burns Basin
Butte	Ivanhoe
California	Aura
Captain Jack	Kinsley
Castle Park	Loray
Catlin	Elko
Clementine	Ivanhoe
Cleveland	Delano
Coal Canyon	Coal Mine
Cobrecite	Loray
Coleman	Island Mountain
Commonwealth	Tuscarora
Conglomerate quarry	Elko
Coon Creek	Jarbidge
Copper Bell	Railroad
Copper prospects	Lafayette
Copper Queen	Spruce Mountain
Copper Shield	Contact
Cornucopia (Leopard)	Cornucopia
Crazy Dutchman	Pilot Peak
Darkey	Decoy
Dead Cedar	Ferguson Spring
Deep Creek	Gold Basin
Deerhead	Carlin
DeFrees	Tuscarora
Delano	Contact
Delker	Delker
Delmas	Railroad
Delno	Delano
Dexter	Tuscarora
Diamond Jim	Island Mountain
Divide	Divide
Dolly Varden	Dolly Varden
Doty Tunnel	Kinsley

Mine	District
Eastern Star	Gold Circle
Elko Prince	Gold Circle
Epidote claim	White Horse
Errington and Thiel	Valley View
Esmeralda	Gold Circle
Estes prospect	Elk Mountain
Falcon	Rock Creek
Fox	Ivanhoe
Garnet Tungsten	Alder
Gold - location unknown	Halleck
Gold Circle	Gold Circle
Golden Eagle	Aura
Golden Ensign	Mountain City
Gold Note	Delano
Gold prospect	Elk Mountain
Gold prospects	Swales Mountain
Good Hope	Good Hope
Governor-Ivanhoe	Ivanhoe
Grand Prize	Tuscarora
Grey Eagle	Railroad
Gribble	Island Mountain
Hice	Contact
Hice prospect	Proctor
Hargrove	Lee
Independence	Mountain City
Independence	Tuscarora
Indian Springs	Delano
Iron Hood	Merrimac
Iron prospect	Moor
Jackson	Gold Circle
Jackson	Tecoma
Knowles Bros.	Alder
Lakeview	Harrison Pass
Lime Mountain	Lime Mountain
Limestone	Moor
Little Joe	Island Mountain
Lone Wolf	Merrimac
Long Canyon	Lee
Long Hike	Jarbidge
Lost Gulch placer	Alder
Lucky Girl	Edgemont
Marshall Group	Contact
Martha Washington	Ferber
Marvel (Jones Marvel)	Beaver
McDonald	Hicks
McGregor	Island Mountain
McKnights placer	Charleston
Mendive	Gold Basin
Michigan	Ruby Valley
Mineral Soap	Huntington Creek
Mint	Burner
Missing Link	Gold Circle
Mitchell	Delano
Mizpah	Dolly Varden
Mohawk	Alder
Monarch	Spruce Mountain
Morning Star	Kinsley
Morrison-Knudsen	Mountain City
Mountain City Marcour	Mountain City
Navajo	Tuscarora
Nevada	Edgemont
Nevada Bunker Hill	Railroad
Nevada Lend	Spruce Mountain
Nevada Picture Rock	Wells
Nevada Queen	Tuscarora

Mine	District
Norman	Jarbidge
N. Belle Isle	Tuscarora
N. Commonwealth	Tuscarora
Norton	Elko
Old Timers	Ivanhoe
Pegmatite (beryl)	Gilbert Canyon
Penrod	Island Mountain
Phosphate prospects	Elko
Phosphate prospects	Montello
Phosphate prospects	Pequop
Pilot quarry	Proctor
Pine Mountain	Railroad
Pittsburg Silver	Alder
Placer deposits	Tuscarora
Polar Star	Warm Creek
Protection	Mountain City
Racetrack	Mountain City
Rare Metals	Proctor
Red Elephant prospect	Elk Mountain
Regent	Ferber
Resurrection	Mountain City
Rex	Gold Circle
Rex	Jarbidge
Rimrock	Ivanhoe
Rio Tinto	Mountain City
Rip Van Winkle	Merrimac
Robinette prospect	Elk Mountain
Rock Creek	Rock Creek
Rossi	Bootstrap
St. Elmo	Island Mountain
Sheep Corral	Ivanhoe
Silverado	Tuscarora
Silver Butte	Mud Springs
Silver Cliff	Warm Creek
Silver Cloud	Ivanhoe
Silver King	Hicks
Silver Star	Contact
Soft Snap	Mountain City
Southam	Kinsley
Spruce Standard	Spruce Mountain
Stampede	Beaver
Standing Elk	Railroad
Star	Harrison Pass
Star Metal	Island Mountain
Success	Jarbidge
Summit View	Corral Creek
Sylvania	Railroad
Tecoma	Lucin
Tennessee placer	Alder
Tri-O-Lite	Carlin
Tripoli	Railroad
Tungsten mine	Wells
Tunnel	Contact
Unnamed barite	Robinson Mountain
Unnamed barite	Larrabee
Unnamed prospects	Black Mountain
Unnamed stone quarry	Wendover
Valley View	Valley View
Velvet	Ivanhoe
Victoria	Dolly Varden
Virginia	Charleston
Vulcan	Contact
Webfoot	Railroad
Weutera	Kinsley
Wildcat	Jarbidge

EXPLORATORY HOLES DRILLED FOR OIL

Listed by Township-Range, MDBM

Index No.	Company, Unit, Hole No.	T. N.	R. E.
1	Bull Run Oil and Gas Co. No. 1	43	52
2	Richfield Oil Corp. Scott-Ogilvie No. 1	43	52
3	Gulf Refining Co. Mary's River Federal No. 1	41	60
4	Gulf Refining Co. Thousand Springs No. 1	40	66
5	Gulf Refining Co. Wilkins Ranch No. 2	39	69
6	Gulf Refining Co. Wilkins Ranch No. 1	38	61
7	Atlantic International Oil Corp. Dalton No. 1	38	62
8	Gulf Refining Co. Pete Itcaina No. 1	37	59
9	Inland Oil Co. Itcaina No. 1	36	58
10	Inland Oil Co. Itcaina No. 2	36	58
11	Inland Oil Co. Itcaina No. 3	36	58
12	Merritt Armstrong	35	55
13	Dr. Eby's Well	35	56
14	McCarthy Oil Co. Rahas No. 1	35	58
15	Elko Oil Development & Improvement Co. No. 1 (John Brown Well)	34	55
16	Richfield Oil Corp. Rabbit Creek No. 1	34	57
17	Western Osage Oil Co. Govt. No. 1	31	69
18	Last Frontier Oil Co. Govt. No. 1	31	69
19	Pan American Petr. Corp. USA Franklin No. 1	30	60
20	Gulf Refining Co. Dolly Varden No. 1	30	64
21	Gulf Oil Corp. of California Owl Hill Federal No. 1	28	70
22	Diamond Oil Co. Diamond Valley No. 1	27	54
23	Diamond Oil Co. Diamond Valley No. 2	27	54
24	Diamond Oil Co. Diamond Valley No. 3	27	54
25	Diamond Oil Co. Conquest No. 1	26	54