

EUREKA DISTRICT

The Eureka mining district is on the west slope of the Diamond Range in southeastern Eureka County. It extends from Secret Canyon on the north to Adams Hill on the south, an area about 8 miles long and 1-1/2 miles wide. In this area a large number of mines and prospects have been opened; the underground workings probably total about 60 miles. The most productive mines are on Ruby Hill (altitude 7,300 feet) 2 miles west of the town of Eureka. Eureka (altitude 6,500 feet) is connected with Palisade, a station on the Southern Pacific and Western Pacific Railroads about 90 miles north, by the Eureka-Nevada (narrow-gage) Railroad.

Although the first location in the district was made in 1866 in New York Canyon, on the east flank of Prospect Mountain, there was very little activity until 1869, when the Ruby Hill deposits were discovered and it was demonstrated that the ores could be reduced successfully by smelting. The first locations on Ruby Hill were the Champion and Buckeye mines, made by Alonzo Monroe, M. G. Clough, and Owen Farrell. These properties formed the nucleus of the famous Eureka Consolidated Mining Co., organized in 1870. In 1871, the Richmond Consolidated Mining Co. purchased the Richmond and other properties adjoining that of the Eureka Consolidated. These two companies, as well as others of lesser note, erected smelters, so that by 1872, 13 furnaces with a combined capacity of 600 tons of ore per day were operating.

With the completion of the Eureka and Palisade Railroad (now Eureka-Nevada Railroad) in October 1875, Eureka became the center of wagon and stage transportation for nearly all the mining camps in eastern Nevada, including Austin, Belmont, Tybo, Ward, Hamilton, and Pioche. The population at this time numbered about 7,000.

The following news item from the Ruby Hill Mining News, dated August 15, 1881, furnishes an idea of the condition of the mining industry at that time:

There are 50 producing mines in the Eureka district at the present time and thrice that number could be made productive at a very small outlay. Every share of the Eureka Consolidated (50,000 shares) purchased in 1871 has returned a profit of \$82 to the stockholders. The Richmond, only 900 feet in depth, has already returned nearly \$3,000,000 in profits.

Of the amount invested in the district by outside capitalists, \$800,000 has come from England and about \$400,000 from the Pacific Coast and other points in the United States. The value of the Eureka mines, as shown by (stock) quotations, is \$55,000,000. Ten thousand dollars per month would more than cover the amount paid in prospecting non-dividend-paying mines, and still the district has yielded in gross \$68,000,000, has paid over \$7,000,000 in dividends, and its bullion production is constantly and rapidly increasing.

The capacity of the smelting works in Eureka is at present 750 tons per day.

Protracted lawsuits between the Eureka Consolidated and Richmond Consolidated started in 1871, and it was the beginning of hard feelings that lasted for many years. It is interesting to note that the first celebrated apex suit in the United States, forerunner of the numerous similar suits, began between the Eureka and Richmond companies in 1877, and was finally adjudicated by the United States Supreme Court in 1881. The point at issue in this case hinged largely on whether or not the Ruby Hill ore deposits constituted a lode within the meaning of the mining statutes. The Richmond company had followed downward, from the Tip-Top claim, an ore shoot that terminated in a bonanza ore body, known as Pott's Chamber, and which lay in ground claimed by both companies. The Richmond company crossed over the compromise plane that had been established in a previous suit and mined ore on the Eureka ground to a reputed value of \$2,000,000. The Eureka company claimed this compromise plane as the limit of their ground, but in order to establish their claim it was necessary that they possess a lode within the meaning of the statutes. The Richmond company claimed the whole of Pott's Chamber and the right to follow their body of ore into Eureka ground beyond the limit of the compromise plane as originally established. Both companies proved the existence of a lode apexing on their respective properties and leading into Pott's Chamber.

The court decided that the belt of limestone between the quartzite and shale through Ruby Hill constituted a lode in the sense of the law of 1872, and that therefore the portion of Pott's Chamber lying within the Eureka Company's ground belonged to the Eureka company by virtue of the compromise plane previously established. This decision was upheld by Chief Justice White of the United States Supreme Court.

With the depletion of the bonanza ore bodies, the Richmond smelter closed down in 1890 and the Eureka Company abandoned their smelter the following year. Subsequently, the bulk of the ores from the district was shipped to distant smelters. Contributing factors to the cessation of local reduction of ores were the decline in the price of silver, high operating costs, and the Government edict restricting the cutting of timber for the manufacture of charcoal.

In 1906, a revival of mining activity occurred, when the Richmond and Eureka properties were consolidated and operated by the U. S. Smelting, Refining, & Mining Co. This company rehabilitated the mines and made shipments of ore to their smelter up to 1910. A cloudburst in the latter year washed out the railroad spur to the mine and company operations were suspended. Subsequently, the mines were operated by lessees. From time to time other companies have been active in the district.

The production of the district from 1869 to 1902 is estimated at \$95,000,000.^{15/} The annual production from 1902 to 1936, inclusive, is

^{15/} See section on mineral production.

shown in table 5. Although Eureka is generally known as a lead producer, more than half of the value has been in gold and silver.

For the amount of capital invested in the Eureka district, it has been one of the best camps in Nevada. The mines did not levy the large assessments that characterized early operations on the Comstock, and the speculative features that attended some other prominent mineral discoveries were not so common.

There is no doubt that there are considerable quantities of low-grade ore in a number of the old mines in the Eureka district, and it is possible that well-planned and executed exploration work may result in the discovery of rich ore bodies. The fact that most of the mines have been idle for many years does not prove their lack of prospective value. In recent years, because of the dearth of new mineral discoveries, the attention of established companies has been focused on a number of the old districts in the State, and, in comparison with other districts of equal prominence, Eureka has not received the attention it merits. The principal drawback to greater activity is the fact that the only outlet for the low-grade or base ores is distant smelters; the metallurgy of such ores by a process other than smelting still awaits a satisfactory solution.

Early Mining and Smelting

The history of the first smelting operations at Eureka is given in this paper in the section "History of Mining." Eureka is generally conceded to be the birthplace of the silver-lead smelting industry in the United States, and from 1869 to 1879 it was the source of a large part of the domestic production of pig lead. In the latter year, its importance as a lead producer was overshadowed by the deposits at Leadville, Colo. The principal reason for the rapid expansion of the smelting industry at Eureka is attributed to the character of the ores; the ores contain the slag-forming constituents iron, lime, and silica to make them largely self-fluxing.

The furnaces used in the district were of the blast type designed after the Piltz and Raschette furnaces used in Europe. The first furnaces had daily capacities of from 20 to 50 tons per day, but later the capacity of individual furnaces was increased to 90 tons. The height of the furnaces was from 10 to 20 feet from the tuyeres to the charging door. Sturtevant fans and Baker and Root blowers were used for the air blast. The number of tuyeres for each furnace varied from 3 to 10. The siphon tap, the greatest contribution Eureka made to lead smelting, was invented by Albert Arentz in 1870. This was a considerable improvement over the tap-holes previously used. Dust- and fume-collecting systems were erected at both the Eureka and Richmond smelters in 1873. Water-cooled furnace jackets were introduced in 1873. In 1878, the Eureka Consolidated company erected an experimental furnace in which air jackets were to take the place of the water jackets, but it proved to be impractical.

TABLE 5. - Gold, silver, copper, and lead production from Eureka district,
Eureka County, Nevada, 1902-1936, in terms of recovered metal
(Compiled by Charles White Merrill, Mineral Production and
Economics Division, Bureau of Mines)

Year	No. of mines	Lode				
		Ore, short tons	Gold		Silver	
			Fine ounces	Value	Fine ounces	Value
1902	7	4,508	3,742.82	\$77,371	96,287	\$51,032
1903	10	4,397	3,876.38	80,132	95,596	51,622
1904	7	2,582	1,653.22	34,175	44,772	25,968
1905	7	1,692	651.85	13,475	36,341	21,950
1906	6	11,896	2,396.01	49,530	68,760	46,069
1907	9	35,092	8,370.61	173,036	152,872	100,896
1908	19	28,000	8,337.68	172,355	109,826	58,208
1909	17	87,936	20,306.76	419,778	179,315	93,244
1910	7	11,923	3,412.25	70,537	33,349	18,009
1911	7	15,484	4,920.48	101,715	5,584	2,960
1912	16	20,810	5,642.88	116,649	18,546	11,406
1913	26	1,096	639.83	13,226	24,173	14,601
1914	24	807	892.88	18,457	28,441	15,728
1915	25	1,135	1,092.20	22,578	34,308	17,394
1916	19	3,666	1,873.59	38,731	80,657	53,072
1917	31	3,304	973.85	20,131	39,708	32,720
1918	2	3,804	1,337.23	27,643	51,980	51,980
1919	15	3,283	1,015.29	20,988	66,459	74,434
1920	19	8,825	3,017.85	62,384	78,878	85,977
1921	14	9,644	2,383.92	49,280	45,886	45,886
1922	15	4,236	1,895.02	39,174	44,925	44,925
1923	12	26,937	4,149.02	85,768	84,068	68,936
1924	9	20,006	1,477.76	30,548	48,552	32,530
1925	12	31,004	1,539.12	31,816	101,703	70,582
1926	14	34,816	3,894.40	80,504	153,979	96,083
1927	9	13,024	2,372.55	49,045	75,223	42,652
1928	6	6,006	2,249.70	46,505	30,530	17,860
1929	4	4,981	1,819.42	37,611	27,760	14,796
1930	3	1,898	693.90	14,344	17,037	6,559
1931	4	888	416.47	8,609	4,040	1,172
1932	5	819	452.96	9,364	9,380	2,645
1933	5	283	154.60	3,952	3,408	1,193
1934	6	3,868	1,448.67	50,631	18,094	11,697
1935	16	6,809	2,298.81	80,458	40,972	29,449
1936	11	14,486	3,181.04	111,336	60,830	47,113
Totals	-	429,945	104,581.02	2,261,836	2,012,239	1,361,348

TABLE 5. - Gold, silver, copper, and lead production from Eureka district, Eureka County, Nevada, 1902-1936, in terms of recovered metal -
Continued

(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Lode					
	Copper		Lead		Total value	Average recoverable value of ore per ton ^{1/}
	Pounds	Value	Pounds	Value		
1902	-	-	903,875	\$37,059	\$165,462	\$36.70
1903	-	-	577,748	15,311	147,065	33.45
1904	-	-	496,306	19,827	79,970	30.97
1905	-	-	416,308	19,566	54,991	32.50
1906	6,653	\$1,283	992,929	56,497	153,379	12.89
1907	115,557	23,111	2,936,672	155,643	452,686	12.90
1908	72,477	9,567	2,310,572	97,044	337,174	12.04
1909	90,100	11,713	4,340,768	186,653	711,388	8.09
1910	702	89	672,801	29,603	118,238	9.92
1911	-	-	27,570	1,240	105,915	6.84
1912	2,394	395	195,036	8,777	137,227	6.59
1913	3,053	473	287,959	12,670	40,970	37.38
1914	2,379	316	194,803	7,597	42,098	52.17
1915	5,653	989	393,526	18,496	59,457	52.39
1916	41,420	10,189	1,290,448	89,041	191,033	52.11
1917	31,771	8,674	693,757	59,663	121,188	36.68
1918	63,517	15,689	1,142,937	81,149	176,461	46.39
1919	40,713	7,573	1,179,723	62,525	165,520	50.42
1920	120,268	22,129	2,457,094	196,568	367,058	41.59
1921	206,948	26,696	776,943	34,962	156,824	16.26
1922	68,450	9,241	501,980	27,609	120,949	28.55
1923	645,715	94,920	1,345,409	94,179	343,803	12.76
1924	160,344	21,005	1,776,927	142,154	226,237	11.31
1925	25,955	3,686	4,326,303	376,388	482,472	15.56
1926	66,194	9,267	5,568,282	445,463	631,317	18.13
1927	38,988	5,107	2,263,168	142,580	239,384	18.38
1928	26,168	3,768	932,090	54,061	122,194	20.35
1929	20,874	3,674	755,488	47,596	103,677	20.81
1930	9,016	1,172	365,725	18,286	40,361	21.27
1931	2,565	233	124,374	4,602	14,616	16.46
1932	1,120	70	122,516	3,675	15,754	19.24
1933	622	40	31,300	1,158	6,343	22.41
1934	13,331	1,067	295,056	10,917	74,312	19.21
1935	20,644	1,713	482,033	19,281	130,901	19.22
1936	5,597	515	283,828	13,056	172,020	11.87
Totals	1,909,188	294,364	41,462,254	2,590,896	6,508,444	15.14

^{1/} Not to be confused with average assay value of ore.

The average recoveries attained by smelting in 1874 were 81 to 83 percent of the lead and 82 to 85 percent of the gold and silver, based on the assay contents of the ore. The principal losses of precious metals occurred in dust and fumes, 8 to 10 percent, in the speiss $4\frac{1}{2}$ to 5 percent, and in the slag less than 1 percent.

Charcoal was used as fuel and it was the most important related business in the district. Annual consumption reached $1\frac{1}{4}$ million bushels per year, and as many as 800 men were employed in charcoal manufacture. All the mountain ranges within a radius of 60 miles from Eureka were denuded of trees suitable for use in making charcoal, and a number of the pits and kilns can still be seen in various places in the county. Approximately 30 bushels of charcoal were obtained from each cord of nut-pine wood, and the cost ranged from 25 to 33 cents per bushel delivered at Eureka. The average consumption of charcoal per ton of ore ranged from 25 to 35 bushels.

During the first years of smelting operations a number of small companies erected their own plants, but later the operators realized that the smelting rate charged by a large plant was less than the operating cost of a small individually owned one, so that eventually the smelting business reverted to the two major companies, the Eureka Consolidated and Richmond Consolidated. The prices paid for custom ore in 1875, by at least one company, were as follows:

<u>Assay value of ore</u>	<u>Percent of assay value gold and silver paid.</u>
\$ 50	16
60	25
70	35
80	43
90	45
100	50
150	55
200	55
225	60
250	62
300	63

For higher-grade ores, rates were established by special agreement. Lead over 20 percent was paid for at the rate of 40 cents per unit.

Up to 1877, all the base bullion was shipped for refining either to Balbach Refinery in New Jersey or to the Selby Smelting & Lead Co. (established in 1866) at Selby, Calif. In 1877, the Richmond Co. constructed a refinery for desilverizing bullion by the Lucien Rozan process, a modification of the Pattinson method. The lead was refined by successive crystallization in pots, into which steam was admitted. The silver-rich lead obtained in this manner was cupeled twice in wood-fired furnaces holding about 1 ton per charge. The cost of separating lead and silver by this process was about \$20 per ton of base bullion. The Eureka company also set up a refinery in 1886 wherein the base bullion was desilverized by means of zinc (Parkes process).

The first ores were easily mined from shallow workings, and the only tools required were picks and shovels. As depth was attained, the square-set system of mining was generally adopted. Data on the cost of mining and smelting are shown in table 6. These costs were compiled from the annual reports of the Eureka Consolidated Mining Co. for 1871 to 1874, inclusive, and 1878. From the data available, the writer estimates that from 1869 to 1891, when the Eureka ores were smelted locally, the cost of mining and smelting averaged between \$25 and \$30 per ton. Although the cost of smelting decreased in the latter part of this period, this reduction was offset by the lower grade of ore mined, increased cost of mining from greater depths, and the cost of keeping the mines unwatered.

The report of the president of the Richmond Company, made to the directors in 1892,^{16/} summarizes the operations of the company from 1871 to 1891, and the cost of mining, smelting, transportation of bullion, and miscellaneous expenses averaged \$40.50 per ton of ore treated. The ore mined by the company amounted to 465,297 tons, and the company purchased 89,578 tons of custom ore, thus smelting 554,875 tons. The product consisted of 83,183 tons of lead, 362,950 ounces of gold, and 11,022,465 ounces of silver. The gross returns amounted to \$28,170,070. The value of the ore mined between 1869 and 1891 ranged between \$30 and \$300 per ton. It is estimated that the average value of the ore was between \$50 and \$60 per ton.

In 1878, T. J. Read, superintendent of the Eureka Consolidated, introduced the tribute or leasing system in the district for the purpose of recovering ore unprofitable to mine under company account. Certain portions of the mine were divided into small blocks or "pitches", and the lessees paid a royalty of 10 percent of the assay value of the gold and silver in the ore above \$40 per ton. One year later this was increased to 15 percent. In 1881, the schedule of prices paid the lessees was \$2.50 for ore assaying \$30 per ton and 50 percent of the assay value of the gold and silver above \$30 per ton. The leasing system was very successful, and it was generally adopted, so that after 1884 most of the ores were mined by lessees.

Geology

The geology of the Eureka district has been described by Hague^{17/} and by Curtis^{18/}.

^{16/} Cited by Chance, H. M., The Silver-Lead Deposits of Eureka, Nev.: Eng. and Min. Jour., vol. 85, 1908. p. 123.

^{17/} Hague, Arnold, Geology of the Eureka District: Geol. Surv. Monograph 20, 1892.

^{18/} Curtis, J. S., Silver-Lead Deposits of Eureka, Nev.: Geol. Surv. Monograph 7, 1884.

TABLE 6. - Operating costs of Eureka Consolidated Mining Co., 1871 to 1874, inclusive, and 1878

	1871	1872	1873	1874	1878
Tons ore mined and hauled to furnaces	18,847	32,172	25,692	22,831	72,352
Total cost of mining and hauling to furnace	\$104,412.19	\$252,274.96	\$287,459.44	\$312,785.81	\$477,548.99
Cost of ore at furnace, per ton.	\$5.54	\$7.84	\$11.19	\$13.70	\$6.60
Tons ore smelted	18,825	31,069	26,155	22,197	71,352
Total cost of smelting ore	\$370,053.68	\$569,601.13	\$408,527.16	\$350,897.36	\$824,066.53
Cost of smelting ore, per ton ..	\$19.60	\$18.33	\$15.62	\$15.81	\$11.55
Total cost of mining, hauling, and smelting ore, per ton	\$25.14	\$26.17	\$26.81	\$29.51	\$18.15
Tons base bullion produced	3,468	3,570	3,227	3,159	16,342
Tons of ore required to produce 1 ton base bullion	5.43	8.70	8.10	7.03	4.37
Cost of producing base bullion per ton	\$135.70	\$220.43	\$237.36	\$210.02	\$79.30
Cost of marketing base bullion per ton	--	\$78.00	\$78.00	1/\$32.10	\$75.00

1/ Prior to 1874, bullion refined at Balbach Refinery, N. J.; in 1874, bullion refined in San Francisco.

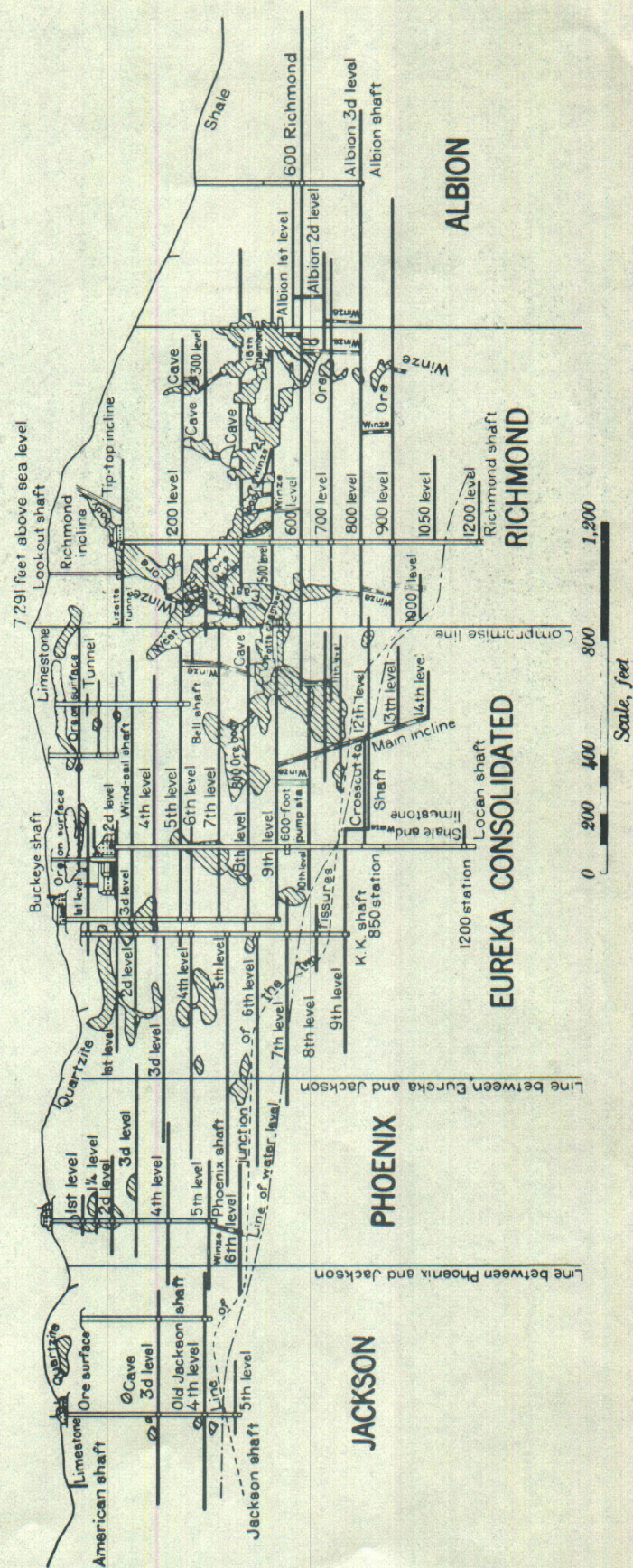


Figure 5.—Longitudinal projection through Ruby Hill mines, Eureka County, Nev. (after Curtis). (Plane of section, northwest-southeast.)

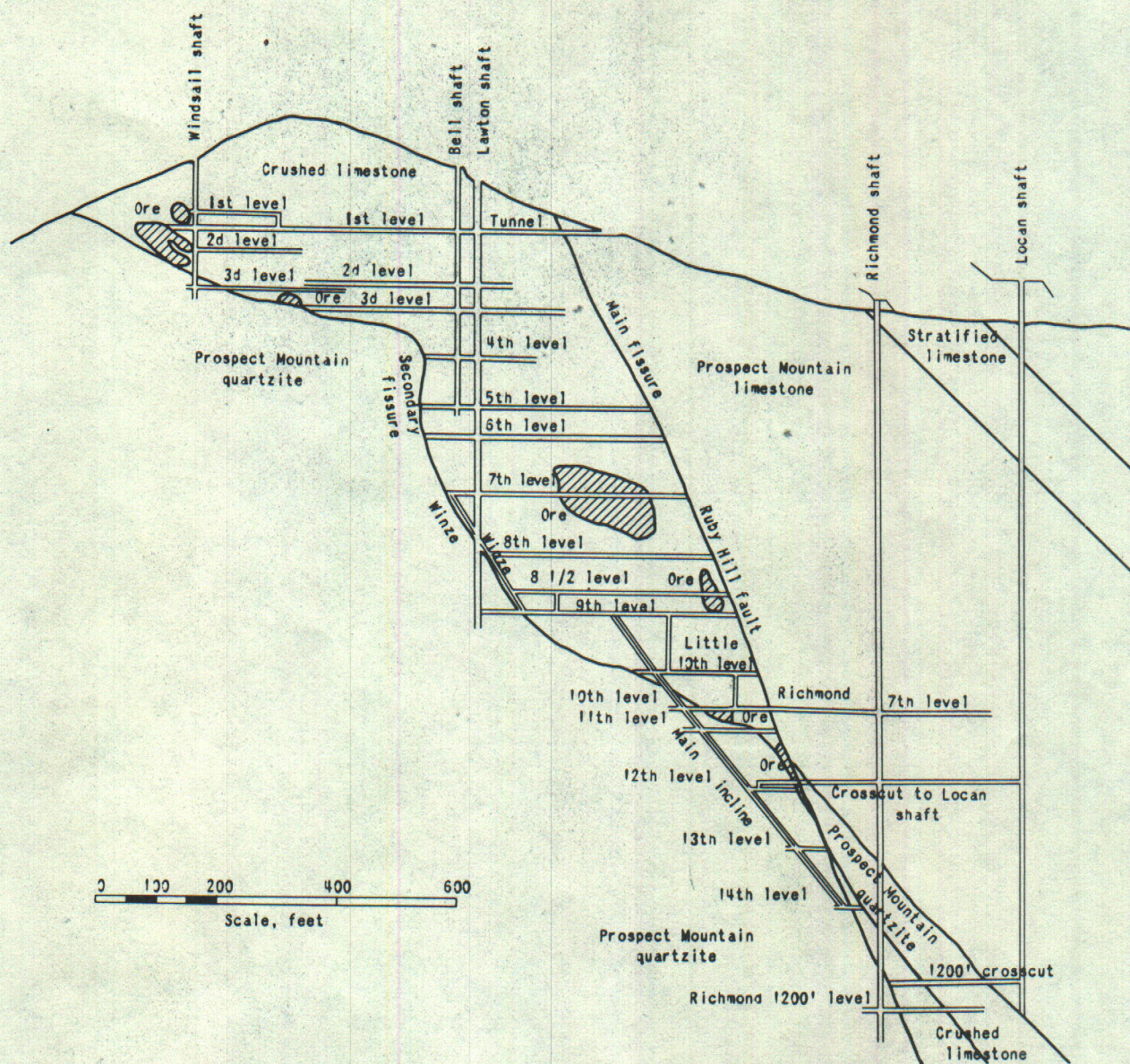


Figure 6.- Cross section through Ruby Hill, Eureka district, Eureka County, Nev. (after Curtis).
(Plane of section northeast-southwest.)

The geologic section in the Eureka region is the representative section for eastern Nevada, and, according to Hague^{19/} and Emmons^{20/}, is as follows:

<u>System</u>	<u>Formation</u>	<u>Thickness (feet)</u>
Carboniferous ..	(Upper coal measures	500
	(Weber conglomerate	2,000
	(Lower coal measures	3,800
	(Diamond Peak quartzite	3,000
	(White Pine shale	2,000
Devonian	(Nevada limestone	6,000
Ordovician	(Lone Mountain limestone unconformity	1,800
	(Eureka quartzite	500
	(Pogonip limestone	2,700
Cambrian	(Dunderberg shale	350
	(Hamburg limestone	1,200
	(Secret Canyon shale	1,600
	(Eldorado limestone	3,050
	(Prospect Mt. quartzite	1,500

Hague^{21/} states that the Eureka ore deposits extend through a vertical range of over 17,000 feet, but virtually all of those that have proved remunerative to the investor lie within restricted limits, chiefly in the Cambrian strata.

The distribution of the ore has been determined largely by the physical condition of the limestone; wherever the limestone is mineralized it is crushed, fissured, and faulted. The deposits are of the replacement type and include bedded deposits, chimneys, pipe veins, and large and small chambers associated with fissures. As a result of oxidation, caves have been formed above the principal ore bodies; these caves constitute one of the most marked characteristics of the district. Curtis believed that they were formed subsequent to the deposition of the ore, partly by the action of water carrying carbon dioxide and partly by the shrinkage of ore due to its oxidation. Longitudinal and cross sections through Ruby Hill are shown in figures 5 and 6.

The ores consist mainly of argentiferous carbonate of lead interspersed with nodules of galena and a large amount of ferruginous material carrying gold. As a rule the gold decreases and silver increases with the rise in the percentage of lead. The ores, for the most part, were deposited as sulphides and later oxidized by atmospheric agencies. The depth reached by oxidation is about 1,200 feet. The

^{19/} Hague, Arnold, work cited, p. 13.

^{20/} Emmons, William H., A Reconnaissance of Some Mining Districts in Elko, Lander, and Eureka Counties, Nev.: Geol. Surv. Bull. 408, 1910, p. 16.

^{21/} Hague, Arnold, work cited, p. 299.

I.C. 7022

following is an analysis (by Fred Claudet of London) of a composite sample of all the ores smelted for the Richmond Eureka Co. during 1878.

Lead oxide	35.65	(Lead	33.12)
Bismuth	---		
Copper oxide	.15	(Copper	.12)
Iron sesquioxide	34.39	(Iron	24.07)
Zinc oxide	2.37	(Zinc	1.89)
Manganese oxide	.13		
Arsenic acid	6.34	(Arsenic	4.15)
Sulphuric acid	4.18	(Sulphur	1.67)
Antimony	.25	(Antimony	.25)
Chlorine	---		
Silica	2.95		
Alumina	.64		
Lime	1.14		
Magnesia	.41		
Water and carbonic acid	10.90		
	99.50		
Silver	27.55 oz. per short ton.		
Gold	1.59 " " " "		

The minerals that have been observed in the Eureka ores are cerrusite, anglesite, mimetite (chloro-arsenate of lead), galena, pyrite, wulfenite, sphalerite, calamine, smithsonite, arsenopyrite, malachite, azurite, manganese, limonite, siderite, calcite, aragonite, and quartz.

Eureka Corporation, Ltd.

The Eureka Corporation, Ltd., was organized by Canadian interests in 1937 under the laws of Nova Scotia with a capitalization of 20,000 shares, no par value. The company acquired an extensive mineral acreage in the vicinity of Ruby Hill, including the Richmond-Eureka property owned by the U. S. Smelting & Refining Co., the Jackson mine, and other adjoining properties. In the latter part of 1937, diamond drilling by the E. J. Longyear Co. under contract, was in progress, and a crew of about 25 men was employed in the rehabilitation of some of the old workings on Ruby Hill. Shipments of ore from surface workings were being made to McGill and Salt Lake Valley smelters.

Eureka-Croesus Mining Co.

The Eureka-Croesus Mining Co. controls 18 patented and 16 unpatented claims on Prospect Mountain several miles from Eureka. Included in the holdings are several mines that had their greatest production in the '70s and '80s. According to the records of the county assessor, the Dunderberg and Connolly mines, now in the Eureka-Croesus group of claims, had the following net production:

<u>Mine</u>	<u>Tons ore</u>	<u>Value</u>
Dunderberg	51,268	\$1,882,933
Connolly	<u>4,657</u>	<u>166,794</u>
Totals	55,925.	2,049,727

According to the foregoing figures, the average net value of the ore was \$36 per ton.

The Eureka-Croesus Mining Co. was organized in 1917, and from 1917 to 1920 the company shipped 4,800 tons of ore having a gross value of \$64.67 per ton. Since 1931, the property has been worked under lease by the Cardinelli brothers, J. A. and G. A., and T. J. Frank, who have shipped about 3,500 tons of ore ranging in value from \$12 to \$40 per ton.

Development consists of about 6 miles of old workings, some of which are inaccessible. The main shafts are the Catlin, 425 feet deep, and the Atlas, 800 feet deep, both vertical. In addition, there are a number of other shafts ranging from 60 to several hundred feet in depth, which were sunk chiefly by lessees.

Equipment includes a double-drum air hoist, one Ingersoll-Rand, type 10, 2-stage, compressor belt connected to a 60-horsepower, Fairbanks-Morse distillate engine, two Chicago-Pneumatic single-stage air compressors, blacksmith shop, and other mining tools.

Ore bodies occur as replacement deposits in limestone along fault fractures, where they are cut by cross-fissures. The ores are largely oxidized and carry gold, silver, and lead; arsenic is present in amounts usually less than 1 percent. The smelter returns on a shipment of ore made on June 13, 1936, to the American Smelting and Refining Co. furnished the following data.

Metal quotations:	Gold	\$34.9125 per ounce
	Silver	\$.77 per ounce
	Lead	4.8 less 3.725 cents per pound

		<u>Ounce per ton</u>
Settlement assay:	Gold	0.4
	Silver	19.0

	<u>Percent</u>
Lead	7.5
Insoluble	43.5
Zinc	0.5
Sulphur	2.6
Arsenic	1.2
Iron	16.6
Antimony	None
Lime	3.5

	<u>Pounds</u>	
Wet weight	89,980	
Moisture 5.5 percent	<u>4,948</u>	
Dry weight	85,032	or 42.516 tons
Metal payment:	Gold, 100 percent at \$31.81825	
	per ounce	\$12.73
	Silver, 95 percent at \$0.77	
	per ounce	13.90
	Lead, 50 percent at \$0.215	
	per unit (20 lbs.)	.81
		<hr/>
		27.44
	Treatment charge	5.22
		<hr/>
	Net value per ton	22.22
	42.516 tons at \$22.22	\$944.71
Deductions:	Freight at \$6.20 per ton	278.94
		<hr/>
	Net proceeds	665.77

Royalty paid by the lessees is 15 percent of the value of the dump ore after freight and smelting charges are deducted.

Silver Connor Mine

The Silver Connor mine comprises 15 claims, 9 of which are patented, and 1 patented millsite, owned by J. B. McNaughton of Eureka. It is on the western slope of Prospect Mountain, 5 miles southwest of Eureka and 2 miles south of Ruby Hill. In the '80s, the property made a net production of \$158,900.98 from 4,626 tons of ore, according to the records in the office of the county assessor. About 1910, it was worked by Farmer's Mining Co., controlled by Chicago interests. This company erected a 100-ton-daily-capacity cyanide plant, which was metallurgically unsuccessful. Last activity occurred about 1919, when it was worked for a time by Bulkeley Wells and associates. In the fall of 1937, John S. Baggs of Los Angeles acquired the property under a bond and lease agreement.

Development consists of Prospect Mountain adit, 3,500 feet in length, which intersects the ore zone about 1,000 feet below the collar of the Silver Connor shaft, and subsidiary workings totaling about 4 miles. The underground workings, although largely open, are inaccessible because the ladders have either been removed or are in a decayed condition. There is no water in the workings.

Equipment includes an Ingersoll-Rand compressor, size 10 by 12 inches, belt-driven by 60-horsepower Fairbanks-Morse gasoline engine, and a blacksmith shop.

The ore occurs in a series of irregular cavities or caves in limestone connected by seams and small fissures. The ore bodies have a general northwest course with a slight dip eastward and range in length from 30 to 90 feet and from 10 to 30 feet in width. Values are in gold and silver associated with arsenical compounds. The gangue is largely iron oxides, in places hard and siliceous but generally soft and ochery in character. According to a report on the property made by W. H. Stovell, formerly superintendent of the mine, at least 25,000 tons of ore are available containing an average of 0.361 ounce in gold per ton and 4.02 ounces in silver.

Geddes and Bertrand Group

The Geddes and Bertrand group of 5 claims and 2 mill sites, all patented, owned by Leo Eager, 320 Felt Bldg., Salt Lake City, Utah, is in Secret Canyon, about 14 miles by road south of Eureka. This property was worked in the '70s and '80s by the Bertrand Mining Co., controlled by English capital. From the county assessor's records it appears that this company made a net production of \$629,468.40 from 32,081 tons of ore. The gross production was probably a little more than \$1,000,000. The ore was probably treated by the chlorination process, as the remains of an old roasting plant are still in evidence. The mine has been inactive for many years.

Development comprises an adit 1,000 feet long and a shaft reported to be 300 feet deep. The shaft is in a caved condition. There is no usable equipment on the property.

The ore bodies occur as irregular masses of ferruginous material along east and west fractures in limestone. Several ore bodies have been stoped to the surface, and a large open stope at the end of the adit is about 100 feet long, 60 feet wide, and 50 feet high. Values are said to have been chiefly in silver. The tailings pile, estimated to contain about 40,000 tons, has been sampled, but the results are not available.

Eureka Prospect

The Eureka Prospect, formerly known as the Diamond mine, comprises a group of 20 patented claims and 4 patented mill sites, owned by the John Hays Hammond estate. In recent years the property has been operated under lease by James A Hogle, of Salt Lake City, and associates.

Development consists of a main adit about 3,000 feet long, three underground shafts, and subsidiary workings totaling 8 miles. The deepest working is 710 feet below the adit level. Property is equipped with a 240-horsepower Deisel engine, two Ingersoll-Rand Deisel operating compressors, 55-horsepower each, two air-operated hoists, blacksmith shop, assay office, camp buildings, a 50-ton cyanide plant, and other equipment.

According to the records in the county assessor's office, from 1873 to 1896 the property made a net production of \$1,060,875 from 32,705 tons

of ore. In recent years the property has been a consistent producer, chiefly of shipping ore. In 1935-1936, the company did considerable testing on the ores in an effort to devise a process for treating them locally. The outgrowth of this testing was the construction of a small mill, wherein the ore was subjected to a chloridizing roast and subsequently leached with cyanide solution. After treating about 10,000 tons of ore, the mill closed down, and thereafter the ores were sent to distant smelters.

During 1937, an average of 45 men were employed by the company and the production averaged about 50 tons of ore per day. In the early part of 1938, mining on company account was suspended and the mine was turned over to lessees. The ores are shipped either to McGill smelter or to smelters in Salt Lake Valley, Utah.

The ore deposits occur in irregular masses, pipes, and caves in limestone. The caves constitute one of the marked characteristics of the ore-bearing limestone and may be of large dimension; one cave seen by the writer in the Diamond workings is roughly 401 feet high and 200 by 100 feet in plan. The lower parts of these caves are filled with rubble breccia, below which good ore is invariably found.

The ores are all oxidized and contain values in lead, silver and gold and from 1/2 to 1 percent arsenic.

Windfall Mine

The Windfall group of 10 patented claims owned by E. H. Snyder and associates of Salt Lake City, is about 5 miles southwest of Eureka on a spur of Prospect Mountain. The ground now included in this group was located and relocated by prospectors in the early days, but little more than location work had been done until 1904, when rich gold ore was discovered by Eugene Geraty. A group of claims was located by Geraty, with G. S. Greenwood and Dan Morrison as partners. From 1904 until 1908 the owners are reported to have shipped \$30,000 worth of ore, and in the latter year the property was bonded to a group from Goldfield, Nev., who organized the Eureka-Windfall Mining Co. A cyanide leaching plant with a capacity of 150 tons (later increased to 200 tons) per day was erected, which operated from 1909 to 1912, and, judging from the tailings pile, a large tonnage of ore was treated.

About 5 years ago the Snyder interests started to rehabilitate the property, but operations ceased when the mine surface plant was destroyed by fire. In recent years the property has been inactive.

Development consists of a shaft, said to be 540 feet deep, and about 7,000 feet of underground workings. There is no usable equipment on the property.

The mill, erected by George L. Kaeding for the Eureka-Windfall Mining Co., probably holds the record in Nevada for low cost of installation and operation. The plant consisted of a gyratory crusher, a set of rolls (24

by 24 inches), eight leaching tanks (each 20 feet in diameter and 6 feet deep), and a 40-horsepower gas engine. The cost of the completed plant, including some road building, was less than \$30,000. Only two men were required per shift, and the extraction by cyanide leaching was over 95 percent on ore ranging between \$4 and \$7 per ton. The operating costs were 80.4 cents per ton for the first 30,000 tons of ore milled. Later, this cost is said to have been reduced to 65 cents per ton when the plant capacity was increased. Zinc shavings were employed for precipitation. Such efficient results were due to the nature of the ore, which consisted of a soft, friable, sandy material easily crushed and leached. The ore is largely oxidized and siliceous in character. Values are chiefly in gold, with some silver and a little lead. The Windfall ore differs from the bulk of the Eureka ores in that it is amenable to cyanide treatment.

Gordon Group

The Gordon group of 1 patented and 12 unpatented claims, owned by David and Harry Morris, is on the west side of Prospect Mountain, 4-1/2 miles by road from Eureka. This property was located by Harry Morris about 30 years ago.

Development consists of 9 disconnected adits and subsidiary workings, totaling about 5,000 feet. Nearly all of this work has been done by the present owners. The only production has been a number of small lots of shipping ore having a total smelter value of about \$10,000. There is no equipment on the property other than tools for hand mining.

Formations in the vicinity are shale, quartzite, and limestone. The ore is oxidized and occurs in fissures and irregular pockets in the limestone. Values are chiefly in gold and silver, with some lead. The smelter returns on a small shipment of ore made on Sept. 19, 1935, to the American Smelting, Refining & Mining Co. supply the following data:

Metal quotations:	Gold	\$34.9125 per ounce
	Silver	\$0.77 per ounce
	Lead	4.3 less 1.525 cents per pound

		<u>Ounce per ton</u>
Settlement assay:	Gold	0.425
	Silver	24.8
		<u>Percent</u>
	Lead	13.1
	Copper	0.125
	Insoluble	15.85
	Zinc	3.25
	Sulphur	0.7
	Arsenic	1.3
	Iron	22.2
	Antimony	3.7
	Lime	2.6

	<u>Pounds</u>	
Wet weight, gross	9,812	
Sacks, (122) weight	221	
	<u>9,591</u>	
Moisture 1.8 percent	173	
	<u>9,418</u>	
Dry weight	9,418	or 4.709 tons
Metal payment:	Gold 100 percent at \$31.81825	
	per ounce	\$13.52
	Silver 95 percent at \$0.77 per	
	ounce	18.14
	Lead less 1.5 percent, 90 percent	
	at \$0.555 per unit (20 lbs.)	5.79
		<u>37.45</u>
	Treatment charge	3.96
		<u>33.49</u>
	Net value per ton	
	4.709 tons at \$33.49	157.70
Deductions:	Freight at \$5.00 per ton	\$24.53
	Sampling	10.00
		<u>34.53</u>
		123.17
	Net proceeds	

Other Mines

In addition to the aforementioned mines, at least 50 others are known to have made a net production ranging from several thousand to over \$800,000 prior to 1900. Some of the more important properties, with their productions, taken from the records of the county assessor, are as follows:

	<u>Tons ore</u>	<u>Net value</u>
Albion Consolidated Mining Co.	7,127	\$245,305
Alexander Mining Co.	1,291	54,155
Altoona	526	30,479
Bullwacker	4,118	116,069
Banner	1,277	44,905
Bowman	1,095	51,092
California and Silver King	1,780	40,264
Eureka Tunnel	4,275	192,476
El Dorado	605	59,803
Fraser and Molino	641	26,873
Grant	627	38,913
Industry	539	40,551

	<u>Tons ore</u>	<u>Net value</u>
Idaho	1,319	\$41,224
Irish Ambassador	174	29,188
Jackson Consolidated Mining Co.	24,245	834,230
King Lear	488	27,972
Lone Pine	762	26,568
Lord Byron	2,613	118,578
Marguerite	887	32,928
Metamoras	1,479	80,080
Macon City	897	73,407
Members	1,891	31,317
Mountain Boy	354	29,392
Oriental and Belmont	1,434	27,094
Prospect Mountain Tunnel	891	29,791
Paul Pry	742	29,929
Phoenix Mining Co.	4,630	134,078
Silver Lick	4,875	219,349
Williamsburg	2,936	75,112

A large proportion of the foregoing properties are controlled by absentee owners and they have been inactive for many years.

Slag and Speiss Dumps

In the vicinity of Eureka there are a number of slag and speiss dumps containing more than 1,000,000 tons of waste products from former smelting operations.

The question arises whether or not these dumps contain sufficient values to be worth re-treating under present conditions. In early-day smelting operations, the slag losses were relatively small, and this material is too low-grade to be reworked. The following analysis (by Fred Claudet of London) of slag from the Richmond furnaces for 1878 is probably representative of the slag dumps in the district:

	<u>Percent</u>
Silica	23.67
Iron protoxide	58.32
Alumina	1.64
Lead oxide	3.51
Metallic lead	3.26
Bismuth	None
Copper oxide	1.08
Zinc oxide	4.44
Manganese oxide	.23
Molybdenum	.32
Arsenic	.25
Antimony	None
Sulphur	2.19
Lime	4.78
Magnesia	1.27
Silver, 0.58 oz. to the ton of 2,000 pounds;	
gold, trace.	

However, in addition to the slag product, large quantities of speiss (chiefly FeAs_2) formed in smelting was a source of considerable trouble to the early-day smelters, as they could not completely extract the values. An analysis (by F. Claudet, London) of the speiss from the Richmond furnaces for 1878 was as follows:

	<u>Percent</u>
Arsenic	32.95
Antimony	.13
Molybdenum	2.31
Sulphur	3.34
Lead	2.18
Copper	1.06
Iron	57.02
Zinc	.07
Lime	.34
Silica	.23
Silver and gold	.029
Silver, per ton of 2,000 pounds, 8.01 ozs;	
gold, 0.43 oz.	

The speiss was formed in proportion of about 1 ton of speiss to each ton of base bullion; with a production of at least 225,000 tons of base bullion, the amount of speiss thrown on the dumps probably originally exceeded 100,000 tons. Some of the speiss was reworked, so that the metal content is less than that given in the analysis. The valuable content of the speiss probably averages 30 percent arsenic, 3 percent lead, 1 percent copper, 2 to 3 ounces in silver, and 0.15 to 0.20 ounce in gold. From 1920 to 1924, the U. S. Smelting, Refining & Mining Co. shipped to their smelter in Salt Lake Valley more than 40,000 tons of speiss. Re-treating this material depends largely on the market for arsenic, as this element constitutes the principal value.

FISH CREEK DISTRICT

The Fish Creek district is at the south end of Antelope Valley, 35 miles by automobile road southwest of Eureka. The first location was made here about 1870 by James Butler, who, 30 years later, attained fame by discovering the rich silver deposits at Tonopah. In 1881, Butler obtained patent on two claims known as the North and the South Antelope. Although considerable development work was done on these claims in the early days, the only production was a few tons of shipping ore. After the death of Butler, the two claims were held by his heirs for a number of years, but they finally reverted to the county for nonpayment of taxes and in 1933 were sold at a tax sale.

Eight miles northerly from the Antelope property, a group of claims was located in 1882 by Angelo Belli, who made several small shipments of silver ore. In 1929, the property was relocated by Stanley Fine of Eureka, who discovered scheelite on the ground. There has been no production of tungsten ore or concentrates.