WONDER MINING DISTRICT
Historical data and Reports

5420 0071

FIGURE 2

Figure 2 : PRODUCTION OF NEVADA WONDER MINE

"Schedule A"

*Tons Produced	**Price Gold	**Price Silver	**Year Produced	*Yearly Production Gold oz.	Silver oz.	Cu lbs.	Per Ton Gold oz.	Silver oz.	Cu%
88 smelted	$20	$ .65	1907	111.48	8,346		1.266	94.80	
59 smelted		.52	1908	112.63	3,783		1.900	64.11	
		.51	1909						
		.53	1910						
9,797 milled		.53	1911	2,476.00	171,900		.253	17.55	
28,376 milled		.60	1912	7,523.87	472,958		.265	16.83	
1 smelted		.60	1912	66.00	1,358		66.000	1358.00	
41,870 milled		.59	1913	9,534.00	699,163		.228	16.85	
50,115 milled		.54	1914	9,704.00	914,511		.194	18.24	
58,394 milled		.49	1915	9,779.00	1,175,839		.167	20.33	
58,131 milled		.65	1916	8,955.31	1,023.046		.154	17.60	
55,800 milled		.81	1917	7,512.74	816,852		.135	14.63	
49,710 milled		.96	1918	4,618.00)	557,924)		.098	12.34	
smelted		.96	1918	259.00)	43,741)				
40,570 milled		1.11	1919	5,612.00	462,294		.138	11.39	
8 smelted		1.00	1920	2.88	284		.360	35.50	
		.62	1921						
3 smelted		.67	1922	2.89	394		.963	131.33	
		.64	1923						
		.66	1924						
		.69	1925						
100 smelted		.62	1926	102.67	902		1.030	9.20	
		.56	1927						
		.58	1928						
		.52	1929						
		.38	1930						
83 milled		.28	1931	31.59	2,484		.380	29.93	
329 smelted		.28	1931	206.44	10,270		.627	31.52	
		.27	1932						
		.34	1933						
	35	.47	1934						
35 smelted		.64	1935	6.32	509		.181	14.54	
292 smelted		.45	1936	119.57	8,787		.409	30.10	
588 smelted		.44	1937	271.00	19,901		.461	33.84	
1,419 smelted		.43	1938	573.00	39,242		.404	27.66	
2,227 milled		.39	1939	388.00	29,852		.174	13.40	
3,378 smelted		.39	1939	1,237.00	84,678		.366	25.06	
4,871 milled		.34	1940	1,192.00	85,373		.245	17.52	
756 smelted		.34	1940	220.00	21,227	1284	.298	28.07	8½
4,388 milled		.34	1941	781.00	56,535		.178	12.88	
1,671 milled		.38	1942	199.00	14,793		.119	8.85	
413.059		Total Produced		71,597.39	6,726.946		Average 0.174	16.70	
							2.952	78.22	
							.423	29.60	not big one

Total Production in Dollars:

Gold	@ $35.00	$ 2,505,908.65
Silver	@ $ 1.293	8,697,941.18
Total Values		$11,203,849.83

Mine closed
June 30, 1942.

*United States Department of Interior
Bureau of Mines
450 Golden Gate Avenue
Box 36012
San Francisco, California

**Historical Statistics of the United States
Prepared by Bureau of the Census

WONDER CLAIMS

Scorpion Lode
B & S Lode
Nevada Wonder
Ruby No. 1
Great Eastern
Great Eastern Fraction
Great Eastern No. 1
Great Eastern No. 3
Great Eastern No. 4 (poor Title)
Last Chance No. 1
Nevada Wonder No. 2
SE½ Last Change No. 2
Ruby No. 2
Nevadan
Little Witch
Silver Tip
Valley View
Pan Handle
Yellow Jacket
Golden Dawn No. 1
" " No. 2
" " No. 3
" " No. 6
Queen No. 5
Queen No. 8
Nevada Wonder No. 3
Hidden Treasure
North Star Lode

T-1 Placer

WONDER DISTRICT

The Wonder district is on the west slope of a southern spur of the Alpine range, sometimes called the Augusta Mountains, in west Churchill County. It is 55 miles by road east of the town of Fallon, the nearest railroad point; 40 of the 55 miles are over the paved Lincoln Highway and the remaining distance is over fair desert road with an easy grade from the highway to the camp, the rise being approximately 2,000 feet in 15 miles. The elevation of Wonder is 5,500 feet.

The first location in the Wonder District was made in April 1906 by T. J. Stroud on the Jackpot group of claims, and the Nevada Wonder mine was located shortly afterward by Murray Scott, William Mays, and others. The discovery of rich silver-gold ore started a stampede from Fairview that began in May in the same year, and in a few weeks over 1,000 locations were made. The discovery attracted considerable attention, and it was not long before a camp of several thousand people was established. In the first few years of the camp's history, a number of companies were organized, but the bulk of the metal yield was derived from the Nevada Wonder mine, incorporated in Delaware on September 19, 1906. Later this mine was taken over by a group of eastern capitalists, who began a systematic development campaign and in 1913 constructed a 200-ton cyanide mill at the mine. Electric power was brought in from Bishop, Calif., and at the time this transmission line had the distinction of being the longest in the world. The Nevada Wonder Mining Co. controlled, by stock ownership, the claims of the Wonder Extension, reorganized North Star, and Hidden Treasure mining companies, totaling 401 acres, 328 of which were patented. In 1910 water was brought to the camp by a gravity pipe line from Horse Creek, a distance of 10 miles. The company ceased operations in December 1919, after a very profitable history. The total amount of dividends paid was $1,549,002. In 1924 the mine equipment was dismantled and most of it sold. In 1935 the mine and the equipment remaining was purchased by L. F. Curtis of Reno, Nev. In recent years, mining in the district has been by lessees, largely at the Nevada Wonder mine.

The production of the district from 1907 to 1937, inclusive, was $5,952,764, as shown in table 4.

Nevada Wonder Mine

The Nevada Wonder mine comprises five patented mining claims owned by L. F. Curtis, of Reno, Nev. Development consists of a main three-compartment vertical shaft 1,342 feet deep and an auxiliary shaft 2,000 feet distant sunk to a depth of 800 feet, from which various subshafts and winzes attain a maximum depth of 2,000 feet from the surface. Total underground workings comprise about 8 miles. The lower workings are caved and inaccessible.

Equipment on the property includes a 25-horsepower single-drum gasoline hoist, Rix portable compressor, ore bins, wood head frame, blacksmith shop, and mining tools. In the early part of 1939 several sets of lessees were employed in the upper levels of the mine, and the ore was trucked to the custom milling plant at Westgate for treatment. In the first 6 months of 1938 lessees produced 1,347 tons of ore having a gross smelter value of $43,040.39 or an average of $31.95 per ton.

The country rocks are a complex series of Tertiary eruptives - rhyolite, ...cite, andesite, and basalt. The Wonder rhyolite is the principal ore-bearing ...rmation. A number of veins occur, most of which contain small deposits of ...ilver-gold ore, but the principal vein from which the major part of the pro-...ction has been mined is the Nevada Wonder, whose outcrop extends 1-1/4 miles ...ong the strike.

According to Burgess[19] the Nevada Wonder vein lies partly on the contact ...etween rhyolite and the intrusive body of dacite, but toward the north the ...ein leaves the contact and lies entirely within the rhyolite. The strike is .... 25° W. and the dip is 75° NE. The widths of the oreshoots range from a few ...eet to a maximum of 30 feet, averaging between 5 and 6 feet. The values are ...ilver and gold in a gangue of quartz, feldspar, and occasional small quantities ...f fluorite. The gangue is generally stained yellowish-brown with limonite; ...me of the ore is white. No water is present in the workings, and oxidization ...xtends to the 1,300-foot elevation in the mine. The silver is in the form of ...rgentite and halogen salts, and the gold is both native and combined with ...rgentite. The silver haloids found are embolite, iodobromite, and iodyrite. ...he ratio of gold to silver by weight, according to production statistics, has ...een 1 to 94. Oxide of manganese occurs in small dendritic forms, while copper ...d lead occur only in traces.

Near the surface, where the walls of the vein were firm and stood well, the ...re was mined by the shrinkage method. Below the 400 level the walls were less ...irm, and mining was done by the cut-and-fill system, waste for filling having ...een obtained from raises driven either into the hanging or foot wall.

19/ Burgess, J. A., the Halogen Salts at Wonder, Nev.: Econ. Geol., Vol. 12, 1917, pp. 589-593.

TABLE 4.- Gold, silver, copper, and lead production from Wonder district, Churchill County, Nevada, 1907-37, in terms of recovered metal
(Compiled by Charles White Merrill, Mineral Production and Economics Division, Bureau of Mines)

Year	Lode					
	No. of mines	Ore, Short tons	Gold		Silver	
			Fine ounces	Value	Fine ounces	Value
1907.....	3	133	356.38	$7,367	10,993	$7,255
1908.....	6	408	362.13	7,486	79,187	41,969
1909-10..	-	-	-	-	-	-
1911.....	1	9,797	2,476.00	51,183	171,900	91,107
1912.....	1	28,376	7,589.87	156,897	474,316	291,704
1913.....	1	41,870	9,534.00	197,085	699,163	422,294
1914.....	4	50,121	9,715.58	200,839	914,547	505,744
1915.....	2	58,399	9,790.88	202,395	1,175,953	596,208
1916.....	3	58,142	8,955.89	185,135	1,023,288	673,323
1917.....	2	55,804	7,512.74	155,302	816,905	673,130
1918.....	5	49,741	4,883.41	100,949	603,528	603,528
1919.....	5	40,604	5,622.71	116,232	467,283	523,357
1920.....	4	1,218	517.57	10,699	14,505	15,810
1921.....	1	2	1.63	34	2	2
1922.....	2	24	14.89	308	1,755	1,755
1923.....	-	-	-	-	-	-
1924.....	1	1	.38	8	86	58
1925.....	-	-	-	-	-	-
1926.....	1	100	102.67	2,122	902	563
1927-30..	-	-	-	-	-	-
1931.....	3	416	245.20	5,069	13,377	3,879
1932.....	1	200	13.80	285	214	60
1933.....	-	-	-	-	-	-
1934.....	4	1,697	1,173.76	41,023	2,619	1,693
1935.....	2	233	42.76	1,497	14,648	10,528
1936.....	3	364	133.86	4,685	14,009	10,850
1937.....	3	705	294.00	10,290	24,970	19,315
Total.	-	398,355	69,340.11	1,456,890	6,524,150	4,494,132

REPORT ON

THE NEVADA WONDER MINE

HOLDINGS:

The property embraced in this mine consists of five patented mining claims, known as the Nevada Wonder, Nevada Wonder No. 2, Ruby No. 1, Blue Jay, and Last Chance No. 1, having a total acreage of between 90 and 100 acres. Title is vested in the undersigned, of Reno, Nevada. All taxes have been paid, and there are no liens nor encumbrances against the property.

LOCATION:

The mine is located in the Wonder Mining District, Churchill County, Nevada. Wonder is 55 miles east of the town of Fallon, the county seat of Churchill County and the nearest railroad point. Forty of the fifty-five miles are over the paved Lincoln Highway, and for the remaining distance there is a good dirt auto road. There is a gentle grade from the highway to the camp of Wonder, the rise being approximately two thousand feet in fifteen miles.

HISTORY:

The history of the Wonder Mine is well known in this part of Nevada. Discovered in 1905 by Murray Scott, William Mays and others, the rich gold and silver ores caused a stampede to the camp. Prospectors, miners, promoters, merchants, saloon men and the usual array of camp followers flocked to the new strike, and it was not long before a camp of several thousand people was established. Values were found over a wide area, but no permanent ore bodies were opened up except in the ground that afterward became the Wonder Mine.

The property was taken over by a group of eastern capitalists and they began a thorough, systematic development campaign. An immense tonnage of ore was blocked out and in 1913 a 200-ton cyanide plant was installed. Electric power was brought in from Bishop, California, and at the time of its installation this hydro-electric power plant held the distinction of being the longest transmission line in the world. The mine and mill were completely equipped with the most modern, up-to-date electrically driven machinery obtainable, and production commenced which eventually yielded over six million dollars.

In 1919 the mine and mill were suddenly closed down and the property remained idle until 1924, when the machinery was placed on the market. In 1925 the mine and what machinery remained were purchased by the present owner, who continued to sell off the equipment. In the meantime, with the losing of all operating mines in Rawhide, Nevada Hills and Wonder, the principal points of power consumption, the transmission line was removed and all mining operations ceased. But the Wonder Mine holds the distinction of being the only mine in the west where company operations were not followed by lessees or tributers.

Early in the year 1931 a lease on the property was granted to

a well known Tonopah lessee and operator. He found a man's size job confronting him, for during the long period of idleness the three-compartment main working shaft that had been sunk to the 1300 ft. level was found to be in bad repair and required considerable re-timbering. Having full faith in the property, the lessee set about the task of timbering the shaft and old workings, which work was completed only to the 200 ft. level, when lack of funds prevented further activities along those lines.

TOPOGRAPHY-ELEVATION-CLIMATE:

The surrounding country is mountainous but only moderately rugged. The hills form a part of the Clan Alpine range, an off-shoot of the Sierra Nevadas. All working places at the mine are accessible by wagon road.

The elevation at the main shaft is 6020 feet. Wonder Peak, just back of the main working shaft, attains a height of 6200 feet.

The climate is the same as prevails over all of western Nevada, there being no excessive heat in summer nor severe cold in winter. Operations were going on 365 days in the year, so far as weather was concerned, when the mine was running.

TIMBER:

There is no timber on the ground, but a plentiful supply of mine timbers and lumber is obtainable at current market prices and within easy reach from the many saw mills and lumber companies on the eastern slope of the Sierra Nevada mountains.

WATER:

The old company's requirements were supplied by a ten mile pipe line from Horse Creek, north of the camp, but this pipe line was taken up and sold several years ago. There is still a pipe line with water which formerly supplied the town of Wonder now owned by a ranch some five or six miles distant to the east, but there is some question whether it could be acquired on favorable terms. However, water can be developed in the West Gate Wash some ten miles to the south and near the Lincoln Highway, and this would seem under the circumstances the logical point to build the mill, and take the ore to the water, which in this case would be cheaper than taking the water to the ore. The cost of hauling should not exceed $.75 per ton, and could probably be done for $.50.

VEINS AND DEVELOPMENT:

There are two strong, well defined veins on the property from which former production came. These veins vary in width from four feet to forty feet.

The development consists of a main three-compartment working shaft from surface to the 1300 ft. level, and an auxiliary shaft 2000 feet distant from the main shaft which was sunk to the 800 ft. level, from

which various sub-shafts and winzes continued on down to the 1900 ft. horizon. Numerous levels connect the two shafts and extend far beyond them on either end of the veins. Altogether there are in excess of eight miles of underground workings.

PRODUCTION:

The old records of the company show that over six million dollars was produced, and in excess of one and one-half million paid in dividends prior to December 1913. No work was performed thereafter until 1931, when lessees made shipments as per schedule following:

Date	Dry Tons	Dry Tons	Assays Gold	Assays Silver	Silver Price	Value Ton	Gross Value
May 23	34.35	34.006	.36	31.76	.29	$ 16.00	$ 547.17
June 2	.186	.183	26.076	190.40	.26⅜	572.42	104.18
June 4	50.20	49.443	.38	27.71	.25	14.80	731.97
June 15	49.76	40.765	.41	32.08	.26½	16.70	814.37
July 19	51.45	50.318	.37	25.85	.29¼	15.00	754.61
July 22	53.89	52.651	.49	26.15	.28	17.08	899.14
Aug. 31	52.31	51.63	.58	33.50	.27½	20.88	1077.80
Oct. 3	41.00	39.565	.295	34.20	.28	15.48	612.59
Oct. 20	38.11	34.045	.34½	36.75	.29½	17.78	657.71
Dec. 18	27.60	25.944	.26½	32.25	.297	14.95	387.37
	Average		.40	32.00	.27 7/8	17.00	

It will be noted that the ore shipped contains .40 oz. gold and 32 oz. silver, which at the prices prevailing in 1931 of $20 per ounce for gold and $.27 7/8 per ounce for silver, yielded an average of $17.00 per ton. The prices prevailing in 1936 would have made this ore worth $38.80 per ton, as follows:

.40 oz. gold	@ $35.00	$14.00
32 oz. silver	@ .77½	24.80
Total value		$38.80

ORE RESERVES:

During the lessees' later prospecting and development work there was opened on the surface what appeared to be either a new vein or a faulted segment of the Badger vein, and this ore yielded good values. The ore has been cut on the 70 and 200 ft. level and a considerable quantity shipped, but most of it remains.

In the summer of 1932, when gold was selling at $20 per ounce and silver below $.30, Mr. W. E. Edwards, a well known and able mining engineer who had been working the property for many months and was therefore thoroughly acquainted with it, made the statement to the owner that there were between 25,000 and 30,000 tons of $7.00 ore above the 70 ft. level. On July 6, 1932, Mr. Edwards wrote as follows:

"Re Wonder Mine: The writer wishes to advise you that, in his opinion, there is blocked out above the 70 ft. level approximately 25,000 tons of ore available for immediate operations without undue expense to rehabilitate that portion of the mine. While this ore is not of a shipping grade at present prices, it is quite evident from pilot sampling that the values would range at or near $7.00 per ton at the present prices of gold and silver."

This ore at 1936 prices would be worth in excess of $15.00 per ton, and the 25,000 tons above the 70 ft. level would have a gross value of over $375,000.

As heretofor stated, no late work has been done below the 200 ft. level, due to the conditions of the shaft timbers. From the 200 ft. level to the surface there is an estimated tonnage of 40,000 tons of medium and low grade ore which will probably run from $8.00 to $16.00 per ton, with occasional bodies of ore of a much higher grade. This ore is contained in supporting pillars, stope fills and unstoped portions of the ore bodies. The same relative conditions are found on the 200 ft. level as on the 70, and there is no reason to doubt that these conditions prevail on the lower levels. If so, the tonnage of ore would be greatly augmented with the reclamation of the lower levels, and the quantity should reach 300,000 tons having a gross value of between three and four million dollars, perhaps more.

The stope maps of the old company show large areas of unexplored territory in the ore bearing zone, some of which would undoubtedly prove productive with further development, which many places show ore, both developed and undeveloped, which has never been extracted. The maps also show in many places blocks of unstoped ground where ore has actually been taken out on three sides. Such ground should be thoroughly explored; and with the known conditions existing on the 70 ft. and 200 ft. levels there seems no room to doubt whatever that further ore bodies of magnitude will be developed on the lower levels.

From general indications and the maps of the old company, there is every reason to believe that the same or greater ore reserves will be found on each and every level as on the 70 and 200 ft. Should this prove to be the case, it would mean, as stated before, that the mine contains not less than 300,000 tons of good commercial grade of ore, all of which would be found to be fairly well developed. What the known ore-bearing but undeveloped territory would produce is a matter of conjecture, but it provides a strong incentive for thorough prospecting. We already know there is ore above and below this zone, and it seems incredible that the intermediate territory should prove unproductive.

MILLING:

During the period of production of the Nevada Wonder Mine, a 150-200 ton cyanide plant was kept in operation, employing the continuous current decantation process. The results were most gratifying, even during the period when the cyanide process had not been developed to the fine point it is today, for the 1919 report of the company showed an extraction of 93.99% for the year. It has thus been clearly proven through big scale demonstration that cyanide is an ideal process and that the ore is amenable to treatment by that method.

In the year 1931 some preliminary tests were made by flotation and an extraction around 90% was obtained. Late in 1934 a 50-lb. sample of ore was taken from near the surface and sent to the International Smelting Co., who ran a series of tests, the best of which showed a recovery of 91% of the silver and 85% of the gold. The ore was not thoroughly representative as it came from near the surface and was pretty well oxidized and was rather high grade, running $33.35, to start with. The tests, however, showed the minimum recovery that could be expected by flotation, and results would be better as the lower level ores were reached.

Before erection of a new mill further tests should be made, and if it is found that the ore can be satisfactorily handled by flotation that method should be adopted, as any slight loss in recovery would be offset by the lower cost of mill installation. On the other hand, we know that the ore is perfectly adapted to cyanidation, and probably a simpler process than continuous decantation and an all-sliming plant could be worked out.

The ore extracted by lessees during the year 1931 was sent to custom mills and smelters. On $17.00 ore the cost closely approximated $12.00 per ton for trucking, freight, metal losses, smelting and smelting deductions. The ore can be handled, hauled and milled on the ground or at a point not far remote from the mine at a cost not to exceed $4.00 per ton and a saving of $8.00 per ton can therefore be effected. This saving alone would pay the cost of a 50-ton mill in three months.

RECOMMENDATIONS:

The tonnage in sight, together with the probable and possible ore recoverable, fully justifies the rehabilitation of the shaft and mine workings, and the erection of a 40-50 ton mill. For the purpose of ascertaining the best method of treatment, extraction and installation costs considered, further tests should be made by two or three independent ore testing plants and the results checked. With this information in hand, a small mill can be erected at a reasonable cost, using good used machinery where obtainable. Diesel engines should be installed, and probably an electric generator.

It would also be necessary to find a water supply, and it is known that this can be done by sinking a well in the West Gate Wash where an abundance of water has been found in two wells already sunk but which are too far away to be utilized. These wells do not exceed 50 feet in depth and the cost of a new well would be nominal.

One good five-ton truck of late design will handle the ore from mine to mill.

The program, then, would be as follows:

1. Provide necessary mine equipment.
2. Re-timber shaft.
3. Make tests on ore to determine best method of treatment.
4. Sink well for water.
5. Build 40-50 ton mill and provide Diesel power plant.

This program can be carried out, if the proper economy is exercised at an expenditure not exceeding $50,000 and possibly for considerably less.

CONCLUSION:

The ore estimates do not take into account anything except known tonnage from the 200 ft. level to surface. There is every reason to expect that the same conditions will prevail on every level between the 200 and the 1300 ft. Neither do the estimates take into consideration the possibility of virgin ore bodies which there is every likelihood of discovering. And they do not take into account those blocks of ground shown on the company's own maps as ORE and POSSIBLE ORE; nor those blocks of ground not so designated but which have been stoped on three, and in some cases four sides.

We know of no other mining property in the west that offers the same inducements for successful and profitable operation as does the Wonder Mine, nor one that can be purchased today and ore extracted tomorrow. It has already produced six million dollars from a comparatively limited area and affords excellent possibilities for another heavy production from undeveloped territory; while the ore already in sight, with a mill available, puts the property more in the manufacturing class than a mining venture.

Respectfully submitted,

Reno, Nevada, January 2, 1936.

REPORT ON

THE NEVADA WONDER MINE

HOLDINGS:

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HISTORY:

The history of the Wonder Mine is well known in this part of Nevada. Discovered in 1905 by Murray Scott, William Mays and others, the rich gold and silver ores caused a stampede to the camp. Prospectors, miners, promoters, merchants, saloon men and the usual array of camp followers flocked to the new strike, and it was not long before a camp of several thousand people was established. Values were found over a wide area, but no permanent ore bodies were opened up except in the ground that afterward became the Wonder Mine.

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a well known Tonopah lessee and operator. He found a man's size job confronting him, for during the long period of idleness the three-compartment main working shaft that had been sunk to the 1300 ft. level was found to be in bad repair and required considerable re-timbering. Having full faith in the property, the lessee set about the task of timbering the shaft and old workings, which work was completed only to the 200 ft. level, when lack of funds prevented further activities along those lines.

TOPOGRAPHY-ELEVATION-CLIMATE:

The surrounding country is mountainous but only moderately rugged. The hills form a part of the Clan Alpine range, an off-shoot of the Sierra Nevadas. All working places at the mine are accessible by wagon road.

The elevation at the main shaft is 6080 feet. Wonder Peak, just back of the main working shaft, attains a height of 6200 feet.

The climate is the same as prevails over all of western Nevada, there being no excessive heat in summer nor severe cold in winter. Operations were going on 365 days in the year, so far as weather was concerned, when the mine was running.

TIMBER:

There is no timber on the ground, but a plentiful supply of mine timbers and lumber is obtainable at current market prices and within easy reach from the many saw mills and lumber companies on the eastern slope of the Sierra Nevada mountains.

WATER:

The old company's requirements were supplied by a ten mile pipe line from Horse Creek, north of the camp, but this pipe line was taken up and sold several years ago. There is still a pipe line with water which formerly supplied the town of Wonder now owned by a ranch some five or six miles distant to the east, but there is some question whether it could be acquired on favorable terms. However, water can be developed in the West Gate Wash some ten miles to the south and near the Lincoln Highway, and this would seem under the circumstances the logical point to build the mill, and take the ore to the water, which in this case would be cheaper than taking the water to the ore. The cost of hauling should not exceed $.75 per ton, and could probably be done for $.50.

VEINS AND DEVELOPMENT:

There are two strong, well defined veins on the property from which former production came. These veins vary in width from four feet to forty feet.

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PRODUCTION:

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Date	~~Dry~~ Wet ? Tons	Dry Tons	Assays Gold	Assays Silver	Silver Price	Value Ton	Gross Value
May 23	34.35	34.006	.36	31.76	.29	$ 16.00	$ 547.17
June 2	.186	.183	26.076	190.40	.26⅜	572.42	104.18
June 4	50.20	49.443	.38	27.71	.25	14.80	731.97
June 15	49.76	40.765	.41	32.08	.26½	16.70	814.37
July 19	51.45	50.318	.37	25.85	.29¼	15.00	754.61
July 22	53.89	52.651	.49	26.15	.28	17.08	899.14
Aug. 31	52.31	51.63	.58	33.50	.27½	20.88	1077.80
Oct. 3	41.00	39.565	.295	34.20	.28	15.48	612.59
Oct. 20	38.11	34.045	.34½	36.75	.29½	17.78	657.71
Dec. 18	27.60	25.944	.26½	32.25	.29?	14.95	387.37
	397.856						
	Average		.40	32.00	.27 7/8	17.00	

It will be noted that the ore shipped contains .40 oz. gold and 32 oz. silver, which at the prices prevailing in 1931 of $20 per ounce for gold and $.27 7/8 per ounce for silver, yielded an average of $17.00 per ton. The prices prevailing in 1936 would have made this ore worth $38.80 per ton, as follows:

.40 oz. gold	@ $35.00	$14.00
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Total value		$38.80

ORE RESERVES:

During the lessees' later prospecting and development work there was opened on the surface what appeared to be either a new vein or a faulted segment of the Badger vein, and this ore yielded good values. The ore has been cut on the 70 and 200 ft. level and a considerable quantity shipped, but most of it remains.

In the summer of 1932, when gold was selling at $20 per ounce and silver below $.30, Mr. W. E. Edwards, a well known and able mining engineer who had been working the property for many months and was therefore thoroughly acquainted with it, made the statement to the owner that there were between 25,000 and 30,000 tons of $7.00 ore above the 70 ft. level. On July 6, 1932, Mr. Edwards wrote as follows:

"Re Wonder Mine: The writer wishes to advise you that, in his opinion, there is blocked out above the 70 ft. level approximately 25,000 tons of ore available for immediate operations without undue expense to rehabilitate that portion of the mine. While this ore is not of a shipping grade at present prices, it is quite evident from pilot sampling that the values would range at or near $7.00 per ton at the present prices of gold and silver."

This ore at 1936 prices would be worth in excess of $15.00 per ton, and the 25,000 tons above the 70 ft. level would have a gross value of over $375,000.

As heretofor stated, no late work has been done below the 200 ft. level, due to the conditions of the shaft timbers. From the 200 ft. level to the surface there is an estimated tonnage of 40,000 tons of medium and low grade ore which will probably run from $8.00 to $16.00 per ton, with occasional bodies of ore of a much higher grade. This ore is contained in supporting pillars, stope fills and unstoped portions of the ore bodies. The same relative conditions are found on the 200 ft. level as on the 70, and there is no reason to doubt that these conditions prevail on the lower levels. If so, the tonnage of ore would be greatly augmented with the reclamation of the lower levels, and the quantity should reach 300,000 tons having a gross value of between three and four million dollars, perhaps more.

The stope maps of the old company show large areas of unexplored territory in the ore bearing zone, some of which would undoubtedly prove productive with further development, which many places show ore, both developed and undeveloped, which has never been extracted. The maps also show in many places blocks of unstoped ground where ore has actually been taken out on three sides. Such ground should be thoroughly explored; and with the known conditions existing on the 70 ft. and 200 ft. levels there seems no room to doubt whatever that further ore bodies of magnitude will be developed on the lower levels.

From general indications and the maps of the old company, there is every reason to believe that the same or greater ore reserves will be found on each and every level as on the 70 and 200 ft. Should this prove to be the case, it would mean, as stated before, that the mine contains not less than 300,000 tons of good commercial grade of ore, all of which would be found to be fairly well developed. What the known ore-bearing but undeveloped territory would produce is a matter of conjecture, but it provides a strong incentive for thorough prospecting. We already know there is ore above and below this zone, and it seems incredible that the intermediate territory should prove unproductive.

MILLING:

During the period of production of the Nevada Wonder Mine, a 150-200 ton cyanide plant was kept in operation, employing the continuous current decantation process. The results were most gratifying, even during the period when the cyanide process had not been developed to the fine point it is today, for the 1919 report of the company showed an extraction of 93.99% for the year. It has thus been clearly proven through big scale demonstration that cyanide is an ideal process and that the ore is amenable to treatment by that method.

In the year 1931 some preliminary tests were made by flotation and an extraction around 90% was obtained. Late in 1934 a 50-lb. sample of ore was taken from near the surface and sent to the International Smelting Co., who ran a series of tests, the best of which showed a recovery of 91% of the silver and 85% of the gold. The ore was not thoroughly representative as it came from near the surface and was pretty well oxidized and was rather high grade, running $33.35, to start with. The tests, however, showed the minimum recovery that could be expected by flotation, and results would be better as the lower level ores were reached.

Before erection of a new mill further tests should be made, and if it is found that the ore can be satisfactorily handled by flotation that method should be adopted, as any slight loss in recovery would be offset by the lower cost of mill installation. On the other hand, we know that the ore is perfectly adapted to cyanidation, and probably a simpler process than continuous decantation and an all-sliming plant could be worked out.

The ore extracted by lessees during the year 1931 was sent to custom mills and smelters. On $17.00 ore the cost closely approximated $12.00 per ton for trucking, freight, metal losses, smelting and smelting deductions. The ore can be handled, hauled and milled on the ground or at a point not far remote from the mine at a cost not to exceed $4.00 per ton and a saving of $8.00 per ton can therefore be effected. This saving alone would pay the cost of a 50-ton mill in three months.

RECOMMENDATIONS:

The tonnage in sight, together with the probable and possible ore recoverable, fully justifies the rehabilitation of the shaft and mine workings, and the erection of a 40-50 ton mill. For the purpose of ascertaining the best method of treatment, extraction and installation costs considered, further tests should be made by two or three independent ore testing plants and the results checked. With this information in hand, a small mill can be erected at a reasonable cost, using good used machinery where obtainable. Diesel engines should be installed, and probably an electric generator.

It would also be necessary to find a water supply, and it is known that this can be done by sinking a well in the West Gate Wash where an abundance of water has been found in two wells already sunk but which are too far away to be utilized. These wells do not exceed 50 feet in depth and the cost of a new well would be nominal.

One good five-ton truck of late design will handle the ore from mine to mill.

The program, then, would be as follows:

1. Provide necessary mine equipment.
2. Re-timber shaft.
3. Make tests on ore to determine best method of treatment.
4. Sink well for water.
5. Build 40-50 ton mill and provide Diesel power plant.

This program can be carried out, if the proper economy is exercised at an expenditure not exceeding $50,000 and possibly for considerably less.

CONCLUSION:

The ore estimates do not take into account anything except known tonnage from the 200 ft. level to surface. There is every reason to expect that the same conditions will prevail on every level between the 200 and the 1300 ft. Neither do the estimates take into consideration the possibility of virgin ore bodies which there is every likelihood of discovering. And they do not take into account those blocks of ground shown on the company's own maps as ORE and POSSIBLE ORE; nor those blocks of ground not so designated but which have been stoped on three, and in some cases four sides.

We know of no other mining property in the west that offers the same inducements for successful and profitable operation as does the Wonder Mine, nor one that can be purchased today and ore extracted tomorrow. It has already produced six million dollars from a comparatively limited area and affords excellent possibilities for another heavy production from undeveloped territory; while the ore already in sight, with a mill available, puts the property more in the manufacturing class than a mining venture.

Respectfully submitted,

Reno, Nevada, January 2, 1936.

REPORT ON

THE NEVADA WONDER MINE

HOLDINGS:

The property embraced in this mine consists of five patented mining claims, known as the Nevada Wonder, Nevada Wonder No. 2, Ruby No. 1, Blue Jay, and Last Chance No. 1, having a total acreage of between 90 and 100 acres. Title is vested in the undersigned, of Reno, Nevada. All taxes have been paid, and there are no liens nor encumbrances against the property.

LOCATION:

The mine is located in the Wonder Mining District, Churchill County, Nevada. Wonder is 55 miles east of the town of Fallon, the county seat of Churchill County and the nearest railroad point. Forty of the fifty-five miles are over the paved Lincoln Highway, and for the remaining distance there is a good dirt auto road. There is a gentle grade from the highway to the camp of Wonder, the rise being approximately two thousand feet in fifteen miles.

HISTORY:

The history of the Wonder Mine is well known in this part of Nevada. Discovered in 1905 by Murray Scott, William Mays and others, the rich gold and silver ores caused a stampede to the camp. Prospectors, miners, promoters, merchants, saloon men and the usual array of camp followers flocked to the new strike, and it was not long before a camp of several thousand people was established. Values were found over a wide area, but no permanent ore bodies were opened up except in the ground that afterward became the Wonder Mine.

The property was taken over by a group of eastern capitalists and they began a thorough, systematic development campaign. An immense tonnage of ore was blocked out and in 1913 a 200-ton cyanide plant was installed. Electric power was brought in from Bishop, California, and at the time of its installation this hydro-electric power plant held the distinction of being the longest transmission line in the world. The mine and mill were completely equipped with the most modern, up-to-date electrically driven machinery obtainable, and production commenced which eventually yielded over six million dollars.

In 1919 the mine and mill were suddenly closed down and the property remained idle until 1924, when the machinery was placed on the market. In 1925 the mine and what machinery remained were purchased by the present owner, who continued to sell off the equipment. In the meantime, with the losing of all operating mines in Rawhide, Nevada Hills and Wonder, the principal points of power consumption, the transmission line was removed and all mining operations ceased. But the Wonder Mine holds the distinction of being the only mine in the west where company operations were not followed by lessees or tributers.

Early in the year 1931 a lease on the property was granted to

a well known Tonopah lessee and operator. He found a man's size job confronting him, for during the long period of idleness the three-compartment main working shaft that had been sunk to the 1300 ft. level was found to be in bad repair and required considerable re-timbering. Having full faith in the property, the lessee set about the task of timbering the shaft and old workings, which work was completed only to the 200 ft. level, when lack of funds prevented further activities along those lines.

TOPOGRAPHY-ELEVATION-CLIMATE:

The surrounding country is mountainous but only moderately rugged. The hills form a part of the Clan Alpine range, an off-shoot of the Sierra Nevadas. All working places at the mine are accessible by wagon road.

The elevation at the main shaft is 6080 feet. Wonder Peak, just back of the main working shaft, attains a height of 6200 feet.

The climate is the same as prevails over all of western Nevada, there being no excessive heat in summer nor severe cold in winter. Operations were going on 365 days in the year, so far as weather was concerned, when the mine was running.

TIMBER:

There is no timber on the ground, but a plentiful supply of mine timbers and lumber is obtainable at current market prices and within easy reach from the many saw mills and lumber companies on the eastern slope of the Sierra Nevada mountains.

WATER:

The old company's requirements were supplied by a ten mile pipe line from Horse Creek, north of the camp, but this pipe line was taken up and sold several years ago. There is still a pipe line with water which formerly supplied the town of Wonder now owned by a ranch some five or six miles distant to the east, but there is some question whether it could be acquired on favorable terms. However, water can be developed in the West Gate Wash some ten miles to the south and near the Lincoln Highway, and this would seem under the circumstances the logical point to build the mill, and take the ore to the water, which in this case would be cheaper than taking the water to the ore. The cost of hauling should not exceed $.75 per ton, and could probably be done for $.50.

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Respectfully submitted,

Reno, Nevada, January 2, 1936.

120155

OFFICIAL RECORDS
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RECORDED BY
Frankie Lewis
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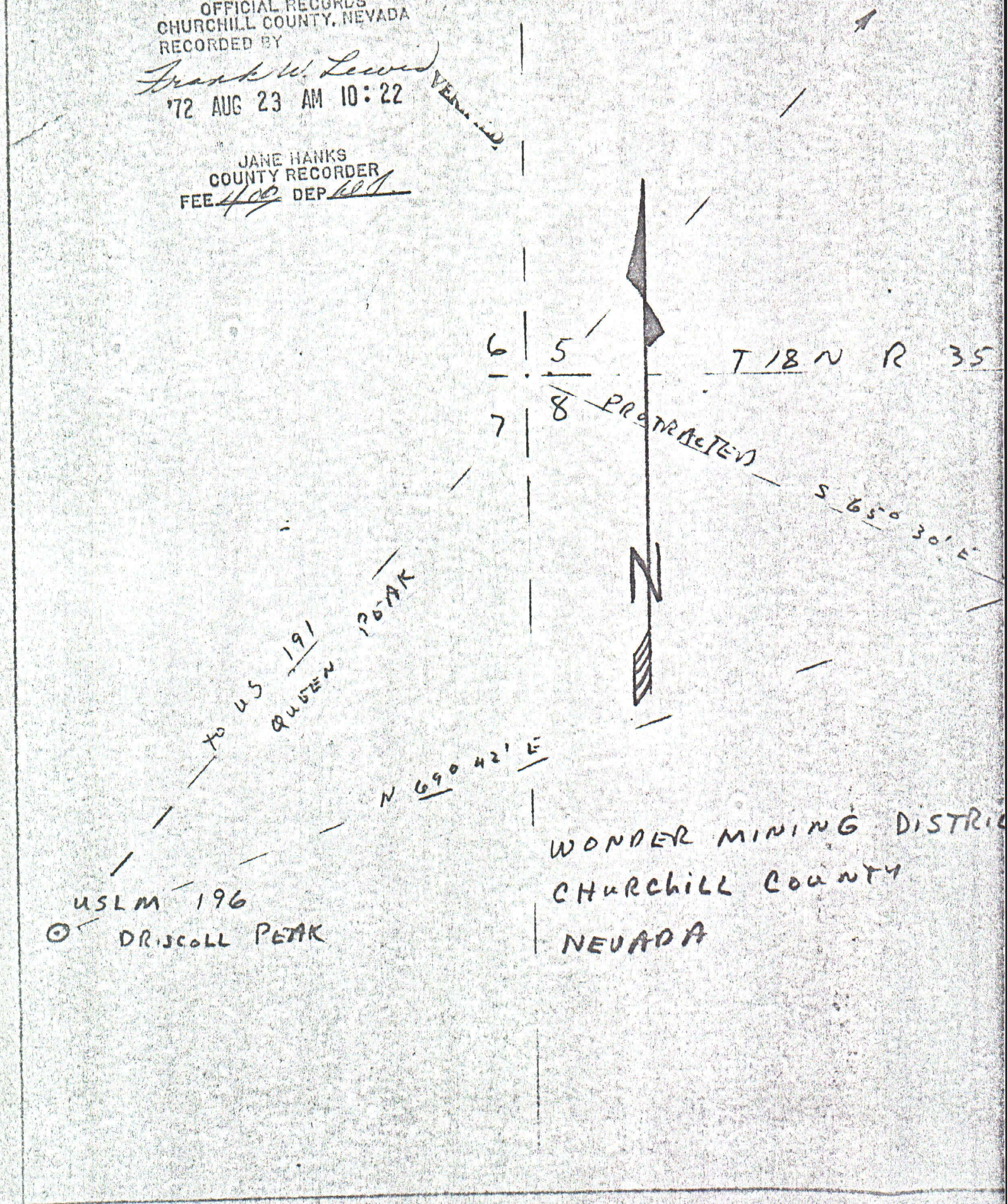
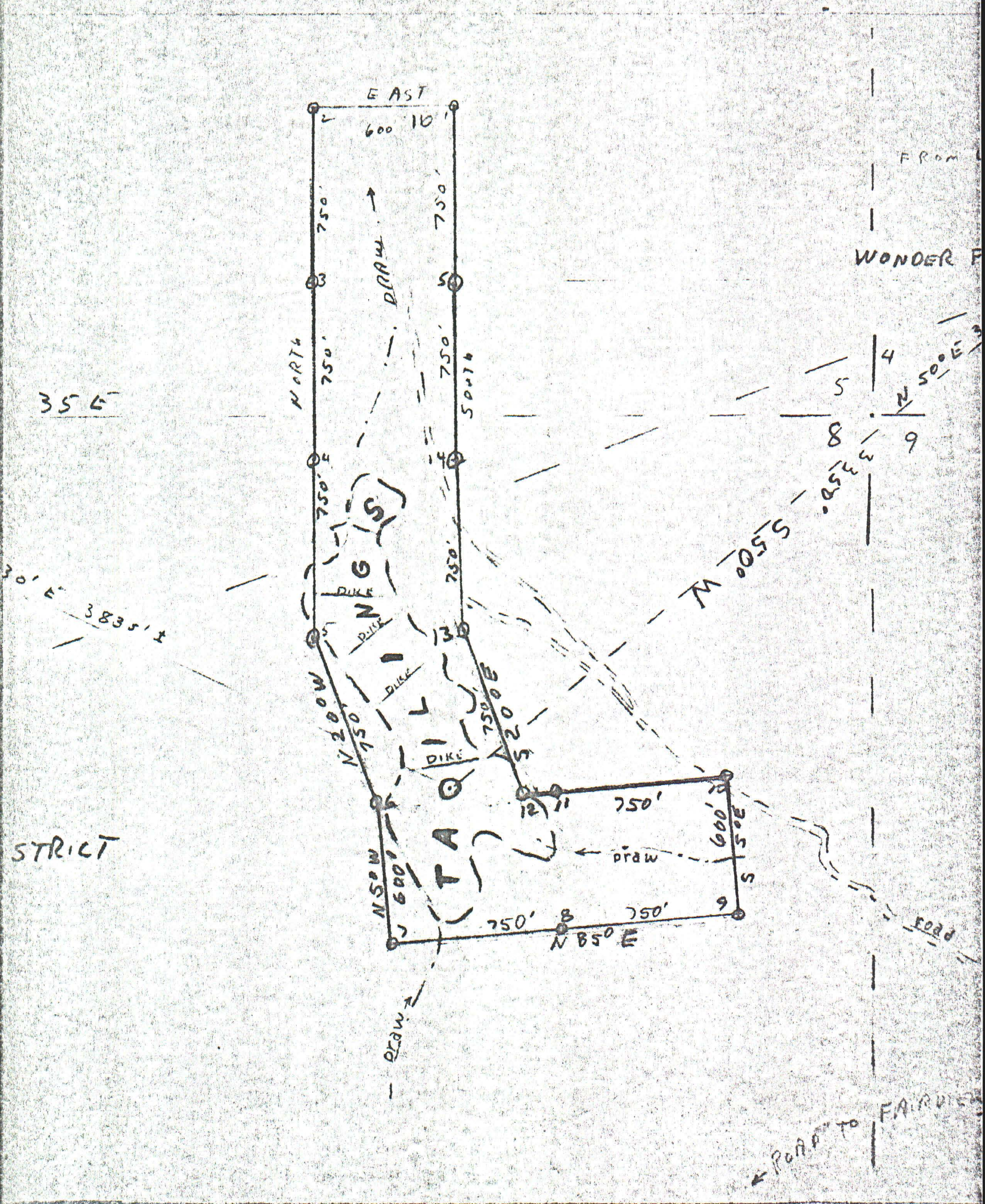
JANE HANKS
COUNTY RECORDER
FEE 4.00 DEP

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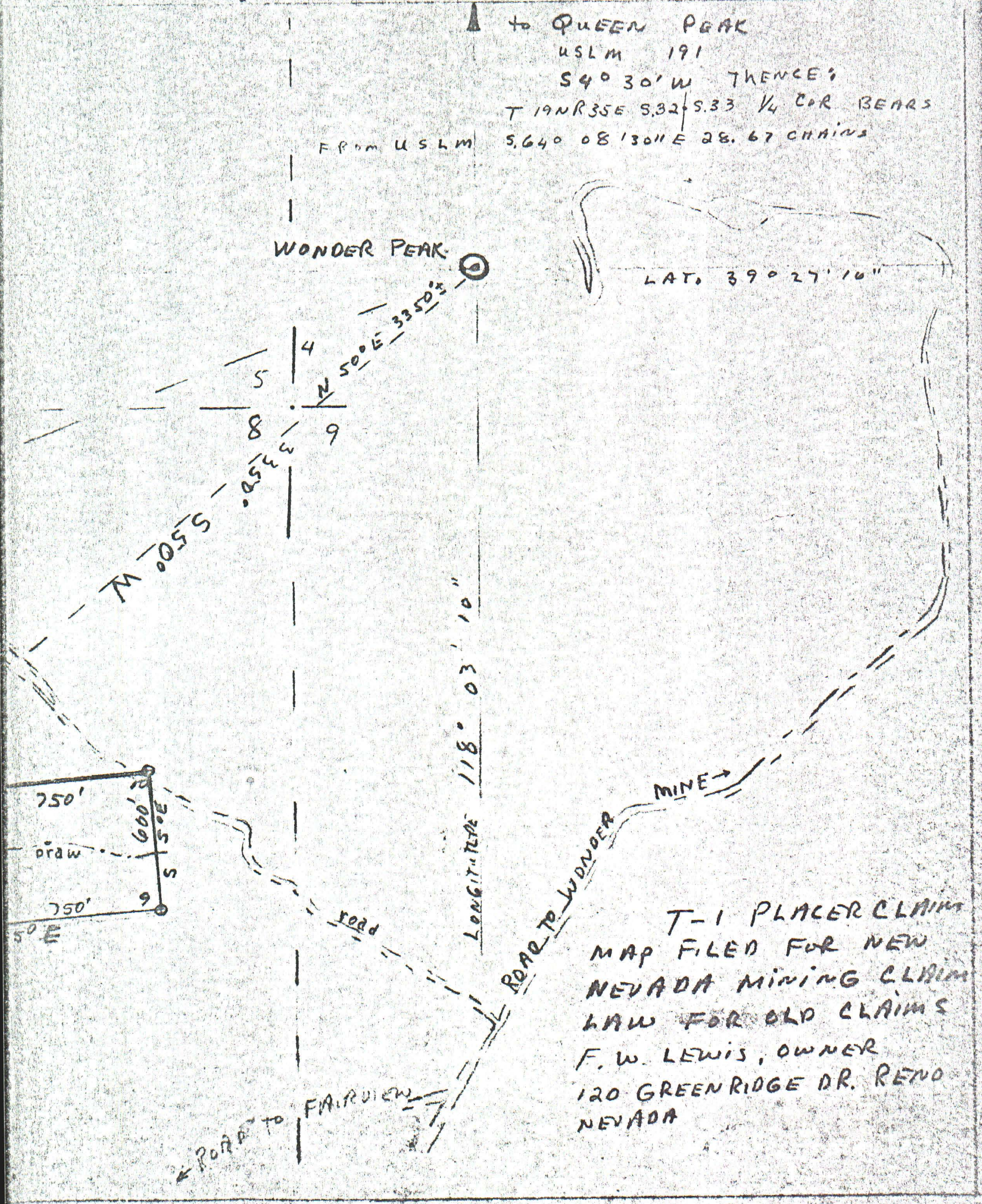

T-1 PLACER CLAIM
MAP FILED FOR NEW
NEVADA MINING CLAIM
LAW FOR OLD CLAIMS
F. W. LEWIS, OWNER
120 GREENRIDGE DR. RENO
NEVADA

CARSON SINK AREA, NEVADA

By

F. C. Schrader

Wonder District (1)

Wonder District

Location

The Wonder district is about 10 miles northeast of the center of the area and about the same distance southeast of the center of Churchill County at the south end of Dixie Valley and in the lower west slope of the Augusta Range at an elevation of about 5,700 feet. It is about 40 miles direct and 57 miles by road, via Sand Springs, a little south of east from Fallon, the nearest supply point, on the Hazen-Fallon branch of the Southern Pacific Railroad, and it is about 12 miles north of the Lincoln Highway at Westgate, fig. 3.

History

Wonder has been the most active and steadily productive district in the Carson Sink area. The first discovery of mineral in the district was made in 1906 by Tom L. Stroud, a lone prospector who came hither from Fairview 18 miles distant with only a blanket and what little food and water he could pack on his back. He was attracted by the light color of some of the exposed rocks that are conspicuous from a long distance, fig. 5. On March 18 he made the first location which he called the "Lost" claim and is now embraced in the "Stray Horse" group. A few weeks later on April 7 he located the Dickey V or famous Jack Pot group of claims, and subsequently in company with R. L. B'Arcy he made still other locations. Others who soon visited the district were Frank Schulty, R. S. Smith, Charles Lamb, and William Mayo.

Samples of the ledges discovered assayed at Fairview are reported to have run as high as $1200 to the ton in gold and silver.[1] News of the

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1/ Parker, T. C., The new Eldorado of the West, The Salt Lake Mining Review, Vol. 9, No. 3, p. 20, May 15, 1907.

strike soon became public, and the Wonder stampede began. The rush from Fairview started May 28. Many who could not procure even a burro came on foot. Soon ground was staked in all directions, and the Wonder townsite 9 blocks long by 4 blocks wide was located and surveyed. With only surface discoveries but little idea of the nature and value of the ore was gained until in June. Nevertheless, many original locators, more it is said than in any other district in Nevada, sold their claim interests for handsome fortunes.

In September, claims which had been located by Mays and associates on a rich strike on Wonder Mountain were optioned by J. B. Daniel, mining engineer, who interested with him certain Philadelphia capitalists, amongwhom were several directors of the Tonopah Mining Co. These parties formed the Nevada Wonder Mining Co. which became the nucleus, life and longevity of the district. The Company took the property over at a consideration of $300,000 and 400,000 shares of the stock having a capital of 1,500,000 shares of $1 each. The issue of the first block of treasury stock at 50 cents per share and its rapid rise to $3.50 on the Philadelphia market aroused public interest in Wonder, and many of the properties were soon capitalized for a million dollars or more.

The town of Wonder, fig. 6, was built and the principal boom occurred in 1907 and ended with the financial panic of July to August of that year. Among the many buildings which soon sprang up were a half dozen stores, a large hotel, two banks, and a $14,000 club house. The promise of the district was so great that many of the most successful mining men of the west soon acquired interest in it, and by April 1907, it is estimated that more than $2,000,000 had been expended in the district. In may the district had a

population of 1,200 people, of whom 300 men were at work in the mines and prospects. Supplies were freighted in from Hazen and Fallon for 2 1/2 cents and 2 cents a pound respectively. Lumber in Wonder sold for $72 a thousand. Water, which was hauled from Horse Creek, the nearest source of supply 7 miles to the north, cost $6 a barrell, fig. 4A.

Other thriving townsites were Hercules, 2 miles north, and Victor, 4 miles northwest of Wonder, fig. 7.

Toward the close of August the population had decreased to 800. Subsequently ground was taken up on the more promising prospects and developed in a more rational manner. Many of the more promising properties were soon taken over by mining companies or mining men of experience and means, with the result that by 1908 the Nevada Wonder, Jack Pot, Spider and Wasp, Vulture, June Wonder, and Capitol Wonder companies were working in good ore. Of these, the Nevada Wonder had 5,000 sacks of ore ready for shipment, the Jack Pot 1,000, the Spider and Wasp 1,600, and the Vulture had shipped 16 tons. Fully 30 other properties were working on ore bodies or prospects assaying from $2 to $50 to the ton.

By 1913 the district, especially the town of Wonder and the larger mines, were supplied by the Wonder Water Co. with water brought by pipe line from Bench Creek, 6 1/2 miles to the northeast, at 75 cents per barrel or $1.50 per 1,000 gallons, in large quantity for mill use etc.

Also in 1911 the Nevada Wonder Mining Co. constructed a private 10-mile water pipe line from Horse Creek Ranch, 6 1/2 miles to the north, which amply supplied its needs for mining, milling, and domestic use. Also under a

contract with the Pacific Power Co. the district was being furnished with electric power and light for mining, milling, and domestic purposes, the electricity being brought 130 miles from Jordan near Bodie, Mono County, Calif.

Crude oil cost 16 cents, distillate 26 cents, and gasoline 42 cents a gallon. The principal producer of ore was the Nevada Wonder Mine, which operated steadily with a force of 54 men.

From 1911 to 1919 the history of the district is essentially that of the Nevada Wonder mine. This mine holds a remarkable record for 8 years or more of steady production during that period, in which it was almost the sole support of the district.

Topography

The topography of the district is hilly to mountainous and in part rugged. It is essentially the type produced by trenchant erosion in an arid region of deformed Tertiary volcanic rocks that were deposited mostly in flows. It is well expressed in compact form in fig. 3, and more in detail in fig. 7, and in figs. 5 and 8, photos. It trends nearly north and south and is drained northward into Dixie Valley principally by Hercules Canyon which forms a natural thoroughfare through the eastern part of the district on either side of which the surface is more or less rugged. The surface in general declines northwest into Dixie Valley while on east it rises into the Augusta Range, which, 8 miles to the northeast, culminates in Mount Grant at an elevation of 9,000 feet. The relief is about 2,750 feet with the surface ranging in elevation from 4,250 feet on the northwest to 7,000 feet at Twin Peaks on the southeast. Beginning on the north, important land marks on the east are Queen Peak, Wonder Mountain, and Twin Peaks, and on the west Dickey, Porphyry, Camelback, Driscoll, and Crown Peaks.

In the southwestern part of fig. 7 on the slope descending from the Camel Back Peak--Crown Peak ridge westward toward Dixie Valley the topography is systemless and intricate. It is composed of rhyolitic to andesitic lavas difficult to distinguish and map.

The accompanying topographic map, fig. 7, was made in anticipation of its use for detailed geologic mapping with the attempt throughout this part of the work to distinguish areas of different phases of formational units in the volcanic rocks of which the district is composed. As will be explained in the following description of these rocks, however, the rocks are practically all rhyolites and the local ~~xxxxxxxx~~ variations of color and texture which it was at first attempted to trace and map are probably of no value or important significance.

The topography shown by the map serves a very useful purpose for the interpretation of some of the major faults of the district. The map serves as a base upon which to locate the more important mines and show their situation and accessibility, also for the location of the rock specimens which were collected including those which have been examined microscopically, and upon which determinations are here given.[2/]

2/ The map was made with a 15-inch traverse planetable, 6-inch open sight alidade and aneroid barometer. The U. S. Mineral Land monuments on Queen Peak (No. 191) and on Driscoll Peak (No. 196) were taken as ends of a base line, the length of which has been determined by several mineral land surveys. The field work of the present map was plotted on a scale of 2 inches equals 1 mile, and the relief sketched in contours of 50-feet vertical interval.

Geology

Excepting a few patches of alluvium deposits or wash the district is underlain essentially by a complex aggregate of volcanic rocks. The distribution of the rocks is indicated on the accompanying map, fig. 7.

Sedimentary rocks

Pliocene lake beds

Humboldt formation.---Just beyond the north limits of the district map, fig. 7, the alluvium deposits rest on eroded sedimentary lake beds of tuffaceous sandstone described under the Humboldt formation p. (G)-15.

Quaternary alluvium deposits

The alluvium deposits of the district consist of Quaternary gravels, talus, and silts accumulated in low places and at the foot of slopes. On the west and northwest they merge with and form a part of the Dixie Valley fill. Within the district and the limits of the map they rest essentially on the eroded Tertiary volcanic rocks.

Igneous rocks

Tertiary volcanic rocks

General statement.---The Wonder district is underlain almost entirely by a rhyolitic complex of Tertiary volcanic rocks, which is the southwestward continuation of the formation which the Fortieth Parallel Survey mapped as rhyolite to the south limits of its map,[1] which coincides with the north

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1/ Fortieth Parallel Survey, Map 5, east half.

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edge of the Wonder District map, fig. 7, on Par. 39° 30'.

The rhyolites are the volcanic equivalents of the granite, having been produced by the consolidation of the granite magma under volcanic conditions. They are highly acidic containing in most cases free silica in the form of quarts.

In the district the rocks have a known thickness of more than 2,000 feet and probably a very much greater thickness. They, in general, are similar to the Tertiary volcanic rocks found elsewhere in Nevada, but they are so inherently structureless, deformed and altered that, in most instances, their relationship and manner of deposition can not be definitely determined. Besides being much faulted, as is shown by scarps and other topographic features and by slickensiding, brecciation and gouge associated with nearly all of the veins, they are also extensively altered, mineralized and discolored hydrothermally and otherwise. For instance, in the western part of the district, about 4 miles west of Wonder Mountain, occur four north-south belts of altered kaolinized rock, chiefly Wonder rhyolite. They follow lines of lower gaps in the topography and have been extensively prospected. They probably represent a fault zone part of which is shown in fig. 7, map.

Also approximately the middle part of the district is crossed by several east-west lines of light-colored spots or areas constituting zones near which at first were thought to be light-colored rhyolite but which examination showed to be areas or zones of hydrothermal alteration. They seem to mark lines or belts of fracture or disturbance along which interruptedly hydrothermal alteration took place. Similar appearing zones were seen to be present in the Stillwater Range directly across the Dixie Valley but were not examined.

Of the several fault systems, the most important trends with variations in a northwesterly direction with its fissures containing nearly all of the veins in the district the most of which are indicated in fig. 11. These faults mostly dip to the northeast. Other faults are shown on the map, fig. 11.

The valley of Hercules Canyon for the most part seems to follow a fault, as does also the South Fork of Stray Horse gulch and the foot of the steep mountain slope at the eastern edge of the town of Wonder, with both of which features the scarp forming the ~~Sxxxx~~ west face of Twin Peaks to the south is in aligxment, suggesting that these three features are probably all on the same fault.

On the uppermost slope of the Camel Back Peak-Driscoll Peak ridge a nearly north-south demarcation line of the topography extending a mile or more along the foot of the steeper mountain slope and passing just above the Ruby shaft seems to represent a fault with upthrow on the east. Just west of the line streams of moderate grade and low divide steepen abruptly and are entrenched in narrow gorges which are difficultly passable for a horse. Just Northwest of Driscoll Peak the line is one of contact between a darker rhyolite on the east and a lighter one on the west, and many prospects have been dug along it north of Driscoll Peak and along the west flank of ~~Sxxxxx~~ Camel Back Peak.

There seems to be more or less faulting all along the west front of the Augusta Range. One fault system trends a little west of north. Just east of the Nevada Wonder vein it includes the so-called Wonder fault which 30- to 50-foot wide in places contains tabular sheets of sliced or crushed rock kaolinized gouge and rhyolitic breccia up to 5 feet ~~xx~~ or more in width.

The rocks and veins are also cut by a post-mineral cross jointing which trends N. 70° W. and dips steeply to the north as shown in the Nevada Wonder mine.

Faulting or crustal disturbance has continued intermittently up to the present time, some having taken place in the mining life of the district, as follows: One night in December 1906, prospectors and mining engineers in the district, particularly at Hercules, and sheep herders in the surrounding region were startled by pronounced earthquake disturbance which produced among other fractures a north-southerly rift or fissure 3 miles or more in extent, (which for convenience of reference may be referred to as the Gold King-Ruby fault). The fissure lies just west of the middle of the district and as indicated on the map, fig. 7, and fig. 11, is known to extend from a point beyond the Gold King ground which it crosses on the north, southward across the Quartzite and Ruby ground to a point 1/4 mile southwest of Driscoll Peak. As seen by the writer in 1911 at several points the course of the fissure is marked by an open cleft or crack 3 to 5 feet wide, particularly in alluvium, which in places was still open to depths of about 5 feet at which points it had become infilled with earth and slide rock debris (on the hill sides) and alluvium (in low places).

In places the rift is compound, as shown in the lower loop of the Quartzite road, where it consists of a detached longitudinal fault block 3 to 4 feet wide contained between two open fractures.

The fault in the Gold King tunnel is thought to be a part of the fissure, from its alignment and that of a line of overlying excavations made by burrowing animals and other features extending to the south.

An interesting feature of the fault is the curvature of its course. The Camelback Peak mountain mass lies in direct alignment with the northern part of the fault, which, however, as it approaches the mass curves gently westward thence southward along the west base of the mountain mass following apparently the line of least resistance.

As there seems to be no report of this disturbance having been felt at Fallon or other surrounding settlements, it is inferred to have been comparatively local to the Wonder district and vicinity and with its epicentrum probably within the district. It was probably caused by a minor slipping and adjustment along an earlier fault.

At the time of the Pleasant Valley earthquake of October 2, 1915, which extended over all Nevada and westward to the Pacific Coast, campers sleeping on the ground at Wonder and at Westgate 10 miles to the south report that they experienced the feeling of having the ground "jerked" from under them by degrees, but so far as learned no rifts were opened in the Wonder district. In Pleasant Valley and vicinity, however, near the center of disturbance the quake was so severe that it toppled over chimneys and railway water tanks, opened up fissures 12 feet wide and produced fault scarps having a vertical displacement of 15 feet. It is described by Professor Jones [1] of the University of Nevada.

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[1] Jones, J. Claude, The Pleasant Valley, Nevada, earthquake of October 2, 1915: Seismological Society of America, Bull. 5, pp. 190-205.

The most of the rocks, though they include tuffs, breccias, etc., are believed to have been deposited as flows, but only in the few following localities were indications to this effect found.

In the northeast part of the district, as seen from the west in bright afternoon light, the uppermost slope of Queen Peak presents the appearance of being composed of alternately hard and soft flows dipping gently eastward. The more prominent or outstanding part of the flows form low ridges or elongated parallel knobs known as the black rock knobs of Jack Pot ridge extending up to Queen Peak.

Also in the southwestern part of the map on the western slope of the Crown Peak—Driscoll Peak Mountains the harder layers of successive lava flows outcrop as ledges like sedimentary beds, with a distinct tilt to the east and northeast. The lower slope is made up of a pale-blue-weathering rhyolite. About two-thirds of the way up the slope is a massive outcropping ridge of volcanic breccia showing the same tilt. Overlying this rock is a pink porphyritic rhyolite. Two nearly vertical dikes of white rhyolite cut all of these beds, with approximately east-west trend.

Likewise in the southern part of the Driscoll range the part extending beyond the limits of the map, fig. 7. The rocks as their exposed edges of thin beds viewed from Chalk Mountain indicate are seen to dip gently northeastward toward the Fallon-Wonder road. The upper portion of the flows several hundred feet in thickness are dark brown while the underlying ones constituting the major part of the section are light brown. Also, 3 miles to the east in the main part of the Augusta range the rocks have the same dip as noted later on p. at the Wolverton prospect.

Thirdly: In the southeast part of the district from a westerly view with bright afternoon light, west Twin Peak presents an escarpment cliff shattered by nearly vertical jointing the upper 500 feet of which appears to be of a distinctly lighter yellow weathered color than the lower, which shows a darker reddish brown. The line of division is nearly horizontal on the west face of the cliff, and may represent flows of which the mountain is made up. Near the base of the steep slope prospects are opened in the bluish-white beds supposed to be the fresher rhyolite, possibly consisting of dikes or even an underlying flow, which appears to be younger than the Twin Peak rock.

From the foregoing observations and mine data the following provisional age succession of the rocks arranged in their natural columnar order has been made out. They were deposited chiefly as flows and were subsequently sliced into several or more longitudinal zones or segments by north-south faults, and tilted toward the east.

Basalt ?

Andesite

Rhyolite (Extension rhyolite)

Rhyolite (Dickey Peak)

Dacite (Alpine dacite)

Rhyolite (Wonder rhyolite)

Wonder rhyolite.---The oldest rock in the district and by far the most abundant (of the Tertiary volcanic rocks) is the Wonder rhyolite, so named from its rhyolitic character and the fact that is essentially composes Wonder Mountain and contains the Wonder vein and the Nevada

Wonder mine. It extends nearly all the way across the middle of the map, fig. 7, from east to west and from Crown Peak on the south to beyond the limits of the map on the north. In the east base of Wonder Mountain, and east of Wonder, its continuity is interrupted by a dacite dike half a mile wide, beyond which, however, it extends eastward nearly to the top of the Augusta Range where intrusive andesite forms the crest. It has a maximum known thickness of more than 2,000 feet, to which depth it has been penetrated in the Nevada Wonder mine without any indication that the deepest workings may be nearing its lower limits. This thickness is not surprising in the light of the fact that to the north in the Augusta range in the rhyolite formation of which the Wonder rhyolite is a southward continuation the 40th Parallel Survey 5/ reports a thickness of 7,000 feet.

5/ 40th Parallel Survey, vol. I, p. 632.

It is the principal ore-bearing, and therefore the most important, formation in the district. It shows veins throught its extent, and the veins that carry values show the same general mineralogical characteristics, namely they contain gold and silver, but a little less gold than the Nevada Wonder vein whose production has been remarkable and constitutes almost the entire production of the district.

Microscopically the Wonder rhyolite is brownish drab or dull ash-gray, massive, medium grained or porphyritic with small whitish feldspars, vitreous quartzes, and dark biotite disseminated through the finer groundmass.

It commonly presents a tuffaceous or brecciated appearance due to angular fragments of black calcareous slate or shale, basalt, or granite, and lighter plutonic rocks it contains. These included fragments are mostly sharply angular, and they are as plentiful near the surface as in the bottom of the Nevada Wonder mine, more than 2,000 feet in depth. Throughout this depth the rock shows little or no change in formation or character. It has no definite structure or attitude that can be made out. The nearest granitic rock exposed is that at Chalk Mountain, 9 miles to the south.

Davis[1/] determined the Wonder rhyolite to contain, on the average,

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1/ Davis, Robert G., Company engineer, Manuscript on geological data on the Nevada Wonder mine, July 10, 1916.

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about 5% by volume of foreign volcanic, metamorphic, and plutonic rocks, slate being by far the most abundant inclusion. The included fragments in general may range up to an inch in diameter, and the black slate inclusions range up to 2 inches in diameter. They were doubtless derived from some underlying slate formation through which the rhyolite was erupted. The nearest known outcrop of any such rock is 4 miles south of Wonder in the axis of the Augusta Range, and the rock is of Jurassic age. As it is known to have a wide occurrence in the Carson Sink region, it is probably deeply buried by the volcanics in the Wonder district and vicinity.

The rock here called Wonder rhyolite is a basic type of rhyolite and has been determined petrographically by Prof. E. S. Larsen, Jr., formerly the Survey's specialist in petrography, to be quartz latite, which stands near rhyolite but differs from rhyolite chiefly in containing more plagioclase, less silica, and with augite, hornblende, and biotite varying in

relative amounts. However, as rhyolite is a good field name and with which its rock the mining public is familiar, and as the Wonder rhyolite is a part of a complex of typical rhyolitic flows, and has been quite generally known by this name almost since the discovery of the Wonder district, the term Wonder rhyolite is here retained, with the accompanying explanation of the latite character of the rock as determined mineralogically by Larsen.

The rock was probably deposited as flows, but it is too devoid of structure to afford any conclusive evidence on this point. The only indications of flows are those of a topographic nature which were detected in a few localities only under very favorable light, as described on page (1)-12. In the extensive workings of the Nevada Wonder mine which penetrated the rock to a depth of more than 2,000 feet no suggestion of flows could be detected.

The microscope shows the Wonder rhyolite to consist normally of a microcrystalline to cryptocrystalline devitrified groundmass in which rest phenocrysts and fragments of phenocrysts of quartz, orthoclase, plagioclase (andesine-oligoclase) and biotite, and accessory magnetite, apatite and zircon. With decrease in quartz and increase of orthoclase, as occurs in places, the rock approaches trachyte.

The rock, however, is nearly everywhere considerably altered, the most common or secondary minerals being sericite, calcite and kaolin derived from the feldspars, limonite and ~~xxx~~ chlorite from the biotite, quartz, and epidote.

In a thin section from a specimen of the rock collected from the Nevada Wonder mine, main shaft, at a depth of 1,000 feet Davie 1/ by

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1/ Op. cit.

Rosinwal's method determined the volume of minerals and groundmass to be as follows:

	Percent
Quartz	4.6
Orthoclase	10.9
Plagioclase	5.0
Biotite	2.0
Groundmass	77.5
	100.0

In some sections the volume of plagioclase is relatively higher.

The following chemical analyses have been kindly supplied by the Nevada Wonder Mining Co.

Chemical analyses of the Wonder rhyolite

By

Booth, Garrett, and Blair, Philadelphia, Pa.

	M-14	M-91	M-92
SiO_2	70.10	71.79	70.70
Al_2O_3	14.98	15.11	14.47
Fe_2O_3	1.68	1.06	1.14
FeO	0.83	1.71	1.51
MgO	0.70	0.67	0.45
CaO	1.46	0.43	1.65
Na_2O	2.64	1.66	2.80
K_2O	4.78	3.44	4.38
SO_3		0.65	

"M-14 is the same rock as described above, i.e. from the main shaft at 1,000 feet below the collar; "M-91" is taken from EC 13-29, which is about 40 feet from the vein in the hanging-wall just south of the sunshaft, and consequently considerably altered; "M-92" is taken from EC 13-1 near station 13-18, that is, in the cross-cut from the main shaft and distant about 200 feet from the vein in the hanging-wall."

The norm of the rock computed by Larsen from analysis M-14, and which is very near the actual mineral composition, is as follows:

Norm of Wonder rhyolite.

Quartz	32.10	
Orthoclase	28.36	
Albite	22.53	ab 76 an 24 or oligoclase
Anorthite	7.23	
Corundum	2.75	not in mode. Probably partly due to TiO_2 included in Al_2O_3 of analyses P_2O_5 etc.
Magnetite	2.55	
Hypersthene	1.70	
	97.22	

The Wonder rhyolite is intruded by 4 or 5 lavas which, beginning with the oldest are as follows:

Alpine dacite	Pre-vein or pre-mineralisation
Extension rhyolite	
Hidden Treasure rhyolite ?	
Andesite	
Basalt	

These intrusives are described in order in the following pages. All of them except the basalt are pre-vein or earlier than the mineralisation of the district and some seem to be associated with its origin. The most important, both quantitatively and mineralogically, are the Alpine dacite and the Extension rhyolite.

Examples of the intrusives shown on the map, fig. 7, are the Alpine dacite, just east of Wonder Mountain and Wonder, the Extension rhyolite at Queen Peak and andesite and basalt dikes south of Wonder Mountain.

Alpine dacite.--The rock next younger than the Wonder rhyolite is a dacite, a rock standing very near to quartz latite or quartz-bearing andesite, which by the Nevada Wonder Mining Co. has been called Alpine dacite. It is in fresh specimens an iron-gray medium-grained porphyritic rock. It is darker and cleaner than the Wonder rhyolite, but like it contains fragments of black slate and other rocks, is more or less calcareous, and in places, corresponds gmx to a flow breccia. It contains phenocrysts of quartz, orthoclase (sanadine), oligoclase, (andesine), biotite, hornblende, hypersthene, and the accessories magnetite and apatite in a slightly greenish to brownish microcrystalline to glassy partly devitrified groundmass. The biotite and hornblende crystals mostly long are frequently bent or bowed to angles of 30 degrees or more.

In general, however, the rock has been considerably altered, the feldspar and hornblende being changed mostly to sericite which occurs in segregated bunches and in veinlets traversing both groundmass and phenocrysts, and the biotite to chlorite. There is also considerable calcite replacing feldspar. The rock is intrusive into the Wonder rhyolite, but it probably occurs also as a flow or flows. It contains no veins or ore deposits and is not genetically connected with the mineralization.

The following analyses of the dacite were kindly furnished by the Nevada Wonder Mining Co.

Partial chemical analyses of the Alpine dacite in the Nevada Wonder mine, Wonder district, Nevada.

By

Booth, Garrett, and Blair.

	M-76	S-75
SiO_2	62.050	61.03
Al_2O_3	17.905	18.00
Fe_2O_3	1.085	3.32
FeO	2.734	1.71
CaO	3.160	3.30
MgO	0.911	1.09
Na_2O	2.390	3.39
K_2O	4.380	4.33

"M-76 is from the 700 station of the Extension shaft and is somewhat altered; S-75 is from the surface about 300 west of the vein and is fresh."

The best known exposure of the Alpine dacite is just east of Wonder Mountain and the Nevada Wonder mine, where it occurs in a belt about 1/2 mile wide in the Wonder rhyolite and underlies the Nevada Wonder camp whence with increasing width of the belt it extends southward about 2 miles to the edge of the map, beyond which it continues on southeastward up into the mountains.

It occurs in the Nevada Wonder mine extending approximately from the 300-foot to below the 800-foot level. It is present in the lower part of the middle excavation and at the fault zone at the portal of the Last Chance tunnel. On the surface it is exposed as far north as the Hidden Treasure shaft and as far south as the Extension shaft. West of Hercules Canyon it occupies an area about 3/4 of a mile in diameter, including Porphyry peak and Camelback peak which culminate in this rock. Northeast of Hercules it forms the middle part of the west ridge of Queen Peak.

Dickey Peak rhyolite.--What seems to be the next younger rock in the District than the Alpine dacite is rhyolite. It is mostly gray or dark gray but ranges to reddish brown and includes various phases, as flows, tuffs, and breccias. It is mostly medium- to fine-grained and is profusely porphyritic with many small phenocrysts of glassy quartz and whitish orthoclase in a felsitic to glassy base often with flow structure. A little magnesite and biotite are generally present and, in places, secondary sericite and leucoxene. In places, the quartz phenocrysts are pale-reddish or wine-colored.

The rock occurs chiefly in the northwest part of the district where in the Dickey Peak field it occupies an area of nearly 3 square miles

which contains the Spider and Wasp, Dickey, Wonder and many other so-called mines. It is thought to be older than the Extension rhyolite next described because it is cut by whitish dikes referred to that rock. Its areas shown on the map probably include exposures of that rock.

Extension rhyolite.—The next younger rock in the district is a rhyolite which has been called the Extension rhyolite by the Nevada Wonder Mining Co. It is a whitish siliceous porphyritic rock apparently more siliceous than the Wonder rhyolite. It consists mainly of many small phenocrysts of quarts and sanadine in a felsitic groundmass. In places it is porous or pumiceous,and it contains fragmentary inclusions of granitic, volcanic and sedimentary rocks. It outcrops southeast of Wonder Mountain near the office building of the Nevada Wonder mines; the Extension shaft is sunk in what seems to be an intrusive volcanic neck of it, and it occurs in the hanging wall in the workings near the shaft. It is thought to be genetically connected with the mineralization of the district. It occurs chiefly as a flow,but it is also intrusive. It intrudes both the Wonder rhyolite and the Alpine dacite, and in the western part of the district it is conspicuous as a dike rock. It occurs also with a more siliceous phase in the Hidden Treasure mine, where the Company at one time regarded it as a different rock and called it the Hidden Treasure rhyolite. It is also present at Queen Peak and vicinity and in the western part of the district is occupies a couple areas each a half mile or more in extent south of the Dickey Peak area.

In the Nevada Wonder mine, on the 450-foot level at about 100 feet north of the sub-shaft and near the vein, the Wonder rhyolite is cut by a 2-foot dike of dense drab felsitic rock which may be a phase of this rhyolite.

Andesite.--The rock next younger than the Extension rhyolite is andesite. It is medium-grained porphyritic bluish ash-gray when fresh and weathers reddish or ~~pink~~ pale lavender. It is a quartz-bearing biotite hornblende andesite standing near dacite. The conspicuous phenocrysts are black biotite, generally in elongated foils less than 1/10 of an inch in length, and andesine.

Microscopically the rock is seen to consist mainly of a pale greenish microcrystalline felsophyric and vitrophyric flow structure groundmass of feldspar and ferro-magnesian minerals in which rest scatteringly small phenocrysts of andesine, biotite and sparingly sanadine, hornblende and quartz. There is also present a little magnetite. The hornblende occurs in short prismatic forms. Much of the quartz is spherulitic. Some of the feldspar is altered to sericite, and some is replaced by secondary quartz, and some of the biotite is changed to chlorite. In places, particularly in some dikes as at Victor and to the northwest of there, the rock is fine grained, nearly aphanitic with the biotite and hornblende phenocrysts restricted to slender needle-like almost microscopic forms.

The principal exposures of the rock are in the northwest part of the district where it underlies the townsite of Victor whence forming a belt 1/3 of a mile wide it extends southeastward for more than a mile on either

side of the Victor Gulch and road. Northwest of Victor a dike of it intrudes the country rock rhyolite. A 6-foot dike of it cuts the Wonder rhyolite on the southwest slope of Wonder Mountain. The rock is present at the June Wonder mine, 1 mile northwest of Wonder. Also on the Little Giant ground and vicinity a mile south of Victor it, as a dike, cuts both the Wonder rhyolite and the White or Extension rhyolite, which latter it seems also to underlie as an intrusive sheet or sill. The andesite is not known to be genetically connected with mineralization.

Basalt.--The youngest of the volcanic rocks is basalt, a massive blackish dense rock resembling trap. It is composed mainly of a mass of basic plagioclase principally forming a micro-crystalline trachytic partially devitrified groundmass containing considerable interstitial augite, olivine, and magnetite. The olivine is mostly altered to greenish calcium carbonate, serpentine and iron oxide. There is also present considerable secondary feldspar, principally orthoclase; and chlorite and green hornblende or uralite derived from the augite.

The rock occurs mainly in the northwest corner of the district about 3/4 of a mile northwest of Victor where it outcrops in two areas each a half mile or more in diameter and similarly in two much smaller areas in the southwest corner of the district. It forms relatively conspicuous hills, and its weathered croppings culminate in knob-like forms.

In the outcrops afore cited its relations to any other rock in the district are not exposed excepting with the alluvium deposits through which it protrudes nor was it seen to be in any way associated with the mineralization of the district. In these western occurrences the rock may represent

remnants of a flow or flows. In the south base of Wonder Mountain, however, it occurs as a dike cutting the Wonder rhyolite and also in the Nevada Wonder mine, from the surface down to the 1300-foot level, it occurs as a 3- to 10-foot dike branching in part and cuts directly the vein as well as the wall rocks, showing it to be intrusive and post-mineralization in age.

Summary of geologic history

The geologic history of the principal events recorded in the district may be regarded as beginning with the eruption of the Wonder rhyolite and its deposition in a series of heavy flows more than 2,000 feet in thickness on an eroded surface of Jurassic ? sedimentary rocks consisting principally of dark slate, shale, and limestone. This event was followed by the eruption and intrusion of the Alpine dacite, which, in turn, after a period of erosion during which probably much of the dacite was removed, was followed by eruption of the Dickey Peak rhyolite. This in turn was succeeded by the eruption and intrusion of the Extension rhyolite. The next event was eruption and intrusion of the Victor andesite and its deposition unconformably on the older rocks which, in turn, was followed by that of the basalt. Thus the general trend in composition of the eruptive products of volcanism from first to last has been toward more and more basic.

During eruption of the volcanic rocks, their finer ejecta, for a time suspended in the atmosphere, were deposited as Tertiary lake beds in the vicinity on the northwest.

Faulting and fracturing due in part to contraction of the lavas in cooling attended or followed the principal eruptions, as did also mineralization, the latter especially following the eruption of the Wonder rhyolite and the Extension rhyolite.

Though faulting has continued intermittently down to the present time, tilting of the volcanic rocks toward the east probably took place for the most part following the maximum eruptions and was aided by local sinking or settling down of the superincumbent mountain mass on the east into the huge hollow reservoir or cavern from which the lavas had been erupted. Relatively recent faulting or uplift is evidenced by abundant gouge and slickensiding associated with the veins and tilting of the Lake beds at high angles. The northwestward dip of the Lake beds in opposite direction from that of the volcanic rocks suggests, on the one hand, the possibility of a northeast-southwest anticline trending approximately through the northwest margin of the district which also may have shared in tilting the volcanics on its east limb toward ~~the~~ the east; and, on the other hand, that tilt of the Lake beds may represent the drag of a fault marking a general uplift of the range along its western front, as in the case of the Sonoma Range at the time of the Pleasant Valley earthquake. §/

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§/ Op. cit.

The Gold King fault passing just west of Geiger Gap, fig. 7, is traceable for more than 3 miles and was apparently caused by the ~~mid~~winter earthquake of 1906-07.

Mineral deposits

General characteristics

The mineral deposits of the Wonder district consist mainly of 50 or more siliceous silver-gold ore-bearing tabular veins and lodes contained in fissures and shear zones in the crushed Tertiary volcanic rocks mostly in the Wonder rhyolite. They are largely replacement deposits after an earlier mineralization. The general distribution of the veins is shown in fig. 11. Some of them, with slight interruptions, have an extent of 2 or 3 miles. The most of them outcrop at the surface and some are locally marked by prominent croppings, as shown in figs. 12 and 13. The prominence of some of the croppings associated with the veins, however, is due more to silicification of the inclosing wall rock than the vein itself.

The veins range from less than a foot up to 40 feet or more in width, and they are usually separated from the wall rock by a tabular sheet of gouge from less than an inch to several feet in width. Locally the gouge is well banded and mineralized and constitutes good ore some of which, in the Nevada Wonder mine, ran up to $60 to the ton.

Some of the veins probably extend to considerable depth, judging from the Nevada Wonder vein which has been worked to the depth of more than 2,000 feet, the Jack Pot vein to 1,000 feet, and others to depths of more than several hundred feet.

However, as practically all the veins have been truncated by long periods of erosion, and some of them occupy shallow fissures or shrinkage cracks formed by contraction of the heated lavas in cooling, many of them probably have only moderate depth and represent only the roots of their

former selves that once extended far above the present surface. This, however, is not so great a drawback as would at first appear in the light of the fact that although considerable deep mining has been done, nearly all the production of the district has come from depths of less than 700 feet.

Unfortunately, the Nevada Wonder vein is the only one of the deposits that has produced sufficient ore to be profitably mined.

The deposits are genetically connected with the volcanic rocks and are accordingly referred to the Tertiary age. They, in general, are similar to deposits of this class and age found elsewhere in Nevada and neighboring states in the Tertiary volcanics, as in the Jarbridge district, Nevada, and the Oatman district, Arizona.

The vein filling in general is soft and is crushed by faulting and pressure, with the result that it is easily mined and milled.

The principal gangue mineral is quartz, with which there is frequently associated considerable adularia or vein orthoclase, white potash feldspar, and more or less brecciated and crushed wall-rock material. Occasionally there is also present minor quantities of reddish fluorite, and in the oxidized zone there is also present the ~~xxxxx~~ usual feldspar and rock alteration products, including much soft clay-like material, kaolin, serifite, limonite, and in places, a little psilomelane or manganese. In places the veins are ~~xxxx~~ fairly well banded. Locally the quartz adularia gangue is pseudomorphic after an earlier spar mineral, calcite or barite, and presents especially in the weathered state the/re-pitted or entrant angle laminated and bladed structures so characteristic in many of the western Tertiary gold veins. This pseudomorphic feature, however, is not so common as in many other districts.

Some of these minerals and ore structures are well shown in figs. 14, 15, 16, 17, and 18 (specs. 21, 112A, 50, 40, and 88, respectively).

The deposits are deeply oxidized. In the Nevada Wonder mine oxidation extends quite uniformly to the depth of 1300 feet, which level seems to mark a somewhat persistent ancient groundwater table at that depth.

The oxidized deposits ordinarily white are, in part, stained yellowish brown with limonite. The deposits constitute a clean silver-gold ore very favorable for mining and milling. The valuable metals of the deposits, silver and gold, occur chiefly in the quartz-adularia gangue of the veins including their contained rock material and as replacements in the wall rock and gouge. The values occur mostly in the hanging-wall side of the vein. The silver occurs chiefly as argentite, cerargyrite, and as halogen salts. 2/

2/ Burgess, J. A., Halogen salts of silver at Wonder, Nevada: Econ. Geol., Vol. 12, No. 7, pp. 589-593, Oct.-Nov., 1917.

The gold occurs both free or native and in combination with the argentite. From the standpoint of value the two metals occur in about equal amount with the gold being slightly in the lead, and from the standpoint of volume in the ratio of about 1:5 to 8.

The following minerals have been found in the district, mostly in the Nevada Wonder mine as described under that heading.

Minerals

Adularia

Apatite

Argentite

Azurite

Bromides (very common in Nevada Wonder mine)

Bromyrite

Cacoxenite

Calcite

Cerargyrite

Chalcedony ?

Chalcopyrite (especially in June Wonder mine)

Chlorides

Embolite

Fluorite (In ore part of vein)

Galena

Gold

Gypsum (As incrustations in water courses in Nevada Wonder mine)

Hematite

Hyalite

Iodides

Iodo-bromite ?

Iodyrite

Jarosite

Jasper

Kaolinite

Limonite

Manganese oxides

Malachite

Manganite

Molybdenite

Polybasite ?

Psilomelane

Pyrargyrite

Pyrite

Pyrolusite

Quartz

Siderite

Silver

Sphalerite (Nevada Wonder mine)

Stephanite

Wavellite (In Nevada Wonder mine)

Wulfenite (Nevada Wonder mine)

Zircon

Fluorite is plentiful in the ~~xxxxxx~~ quartz veins on the Chelona group of claims in the northern part of the district.

Source of the mineral deposits

The source of the mineral deposits is complicated. It is referred to the volcanic rocks, and to heated mineral-bearing solutions that emanated from the rock magmas and circulated through the fissures, shear zones and fractures in the rocks following their eruptions. The deposits are therefore regarded as of Tertiary age, late Miocene, or Pliocene.

There were at least two periods of hypogene mineralization, one probably following the eruption of the Wonder rhyolite and the other that of the Extension rhyolite. Judging from the great quantity of the Wonder rhyolite and its eruption apparently all at one time or nearly so it seems reasonable to infer that its magma supplied large quantities of hot mineral-bearing solutions and conditions favorable for their circulation in the aftermath of eruption through the fractures, shear zones, and fissures in the slowly cooling or but recently cooled rock mass, as in the old rhyolite at Jarbidge[10] and other camps, and that considerable

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10/ U.S.G.S. Bull. 741, p. 34.

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mineralization took place which later was changed or replaced by solutions that followed the eruption of later rocks and ushered in a new period of mineralization. Thus the structure of the present siliceous gangue pseudomorphic after calcite or other spar points to an earlier period of mineralization than that which produced the present ores, a mineralization in which the principal gangue minerals were probably calcite and quartz.

The solutions of the second or later mineralization, following chiefly the eruption of the Extension rhyolite, were much more siliceous than those of the first period and inherently more suitable for the transportation and deposition of metallic constituents both by precipitation and replacement.

Burgess, 11/ who also believes that there were several periods of

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11/ Burgess, J. A., Unpublished manuscript and oral communication.

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mineralization, thinks that the earliest vein filling was a barren quartz and that the second filling which succeeded and partially replaced it was a light-gray chalcedonic quartz which may have brought with it a small quantity of silver.

The principal primary constituents of this later mineralization are:

Gangue minerals

Quartz

Adularia

Ore minerals

Argentite

Gold

Associated metallic minerals

Pyrite

Chalcopyrite

Galena

Sphalerite

Secondary minerals

Ore minerals

Cerargyrite

Iodobromite

Iodyrite

Embolite

Bromyrite

Gold

Silver

Argentite

Polybasite ?

Stephanite ?

Pyrargyrite

Associated metallic minerals

Siderite

Hematite

Limonite

Cacoxene

Jarosite

Malachite

Azurite

Manganese oxides

Molybdenite

Wulfenite

Gangue or associated nonmetallic minerals

Calcite

Quartz

Adularia

Hyalite

Gypsum

Kaolinite

As the minerals have been studied chiefly in the Nevada Wonder mine, some are described more fully under that head.

From the character of the deposits which are herein described and have been worked in the Nevada Wonder mine, it is concluded that the ores now mined in the district in the oxidized zone, though primarily of hypogene origin, owe their present economic value to secondary supergene or downward enrichment.

Before oxidation the present productive zone extending from the surface down to the 1,300-foot level in all probability contained only lean sulphide ore similar to that found in the deep part of the mine which is much too low grade to be profitably mined. However, during long periods of oxidation and weathering as the overlying rocks and veins rising hundreds of feet above the present surface were truncated by disintegration and erosion their sulphide mineral contents also became oxidized and broken down, and through the agency of gravity and descending percolating atmospheric waters were leached, filtered and carried downward to successively lower and lower levels where they were redeposited and formed the deposits now mined.

In this process of enrichment the oxidation or breaking down of argentite, the principal primary ore mineral, yielded the important secondary minerals cerargyrite, free gold, silver, electrum, and pyrargyrite, and the silver constituents for the silver halloid salts. The alkaline salts of chlorine, bromine and iodine contained in the percolating waters and regarded as of extraneous origin are believed by Burgess [12] to have been supplied by the

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12/ Burgess, J. A., Op. cit.

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agency of wind from neighboring salt marshes or playas where such salts have been found.

Gouge-clay

Tests made of several specimens of the whitish gouge or selvage which is more or less prevalent in tabular or sheet form between the veins and wall rock, and which is frequently erroneously called kaolin and talc by the miners, show it to consist largely of a white micaceous hydrous silicate of aluminum, corresponding in large part to what has been described as beidellite,[13] "leverrierite", and in part to montmarillonite. It is closely related to kaolin in the ratio and combination of its constituents, but it contains more silica, less aluminum and less water than kaolin and retains only 7 per cent of its water at 110°, whereas kaolin retains nearly all of its 14 per cent of water up to 400°.

13/ Larsen, E. S. and Wherry, Edgar T., Beidellite, a new mineral: Jour. Wash. Academy of Sciences, Vol. 15, No. 21, pp. 465-466, Dec. 19, 1925.

Pending more definite investigation being made by the chemists of the relations of these minerals, and because the material varies in composition in different fissures and from place to place in the same fissure the material in this paper is called gouge-clay. In places it apparently contains also considerable halloysite, and locally it is pink or reddish and resembles alunite.

Mines and prospects

Under this heading belong more than 200 so-called mines and prospects, of which only a few as types can here by described. Their distribution is indicated on the claim map, fig. 10, on the vein map, fig. 11, and the location of the more important ones is shown on the geologic map, fig. 7.

Though a scofe or more of the properties present good showings and have been opened to depths of several hundred feet or have had this equivalent of development work done on them and several have produced some ore, the Nevada Wonder mine is the only one that could be profitably worked.

Nevada Wonder mine

Location and topography.—The Nevada Wonder mine is in the eastern part of the district, 1/2 mile north of the Wonder townsite and about the same distance west of the foot of the steep mountain slope on the east, fig. 19. It is mainly in the upper east slope of Wonder Mountain, a prominent round hill standing about 400 feet above the surrounding surface. It is ~~xxyx~~ easy of access from the east, while in the remaining directions the topography is rough, especially on the west where the surface rapidly declines 800 feet into Hercules Canyon.

History and production.—The deposits were discovered in the pioneer days of the district in 1906 by William Mays and associates, and in September of that year the ground consisting originally of 7 and a fraction claims, fig. 20, was acquired by J. B. Daniels and others who jointly formed the Nevada Wonder Mining Co. with headquarters in Philadelphia, which became the nucleus, life, and longevity of the district.

Development was begun immediately on acquisition of the property but was arrested by the financial stringency in 1907 and not resumed until April 1911. The mill was completed by July 1 of that year since whence, excepting slight interruptions due to inclement winter weather, both mine and mill were operated continuously until the property became worked out and was closed down for good December 1, 1919. About $2,000,000 worth of ore was blocked out before the mill was built.

The total production of the mine during this period was approximately 392,763 tons of ore distributed chronologically as follows:

Production of the Nevada Wonder mine

Year	Tons of dry ore	Value	Percent of value recovered
		$	
1911	3,444	64,183	92.60
1912	25,186	412,458	94.50
1913	39,118	572,359	93.20
1914	48,570	753,993	93.20
1915	58,124	812,118	94.11
1916	72,241 1/	1,112,835	92.67
1917	55,800	923,606	89.10
1918	49,710	742,306	91.82
1919	40,570	629,131	93.99
Total	392,763	6,022,989	
Average		15.60	92.80

1/ Oct. 1, 1915, to Dec. 31, 1916.

The average tenor of the ore was $15.60 to the ton, and the percent of value recovered 92.8. Some of the ore was very rich. During most of the first half of the period of operation the mill run of the ore assayed about 18 oz. silver and 0.25 oz. gold to the ton.

During the six years May 1913 to May 1919, the company paid $1,549,005.45 dividends. 14/

14/ Thirteenth Ann. Rept. Nevada Wonder Mining Co.

The first dividend paid May 20, 1913, being 10% on the outstanding capital stock of $1,500,000.

In 1914 the company completed acquisition of properties formerly belonging to the Wonder Extension Mining Co., the Hidden Treasure Mining Corporation, and the Reorganized North Star Mining Co. of Wonder, in all about 15 claims, the first-named adjoining the Nevada Wonder property and lying on the southerly extension of its vein system, and the last two lying similarly on the northerly extension of its vein system, fig. 20.

By further purchase the property in 1915 was enlarged to 401 acres of ground of which 328 acres were patented. Still later considerable additional ground was acquired.

Development.—During its period of operation the mine was developed to the depth of more than 2,000 feet and horizontally to the extent of 3,400 feet as shown in the level map, fig. 21 and the longitudinal stope plan, fig. 22. It was also developed laterally for a distance of 1,555 feet. The development work totals more than 66,000 feet or nearly 12.3 miles. The amount of development work done is large compared to the production of the mine. This, however, is due in part to thorough search made for ore in depth, and more especially to the sound policy pursued by the management of maintaining sufficient blocked out ore in reserve to enable both mine and mill to be operated at a profit to the date on which the property was closed down for good.

The development done in search of ore preceding the final closing of the mine includes besides what is shown on the lower part os fig. 22, drifts on the ends of the ore bearing zone and short cross cuts run in many places; also 400 feet of raising and two long prospect cross cuts on the 700-foot level. One of these cross cuts extended westward under Wonder Mountain into the footwall country for the distance of 1,000 feet, and the other passing through the Extension shaft was run 555 feet in the hanging wall. The two crosscuts together therefore cut the formation for 1,555 feet at right angles to the strike of the veins.

The largest yearly development was 11,416 feet in 1917 and the next largest nearly 11,000 feet in 1914. The development was nearly all done through the Nevada Wonder or main shaft which stands at an elevation of about 6,[illegible]00 feet, fig. 22-A. Extension shaft stands at an altitude of about 5,850 ft.

Equipment.---The principal equipment of the company at the mine during its period of operation, all of which was up-to-date, was the mill, machine shops, warehouses, offices, officials' dwellings, electric power and light transformers, distributing lines and other equipment, water supply and water rights including a 10-mile 4-inch pipe line from Horse Creek and a 125 horse-power double drum electric hoist, and ice plant, storage tanks for oil and water, a 3-size compartment mine shaft down to the 1,342-foot level, double deck hoisting cages, air compressor having a capacity of 1,200 cubic feet per minute, ore [illegible] bins, and an Ingersoll-Rand No. 5 drill sharpener, refining and melting furnaces, most of which are shown in (the photographs) figs. 19 and 5. The power used in both mine and mill was electric, the electricity being supplied by the Pacific Power Co. as noted on page , at the rate of $7.50 per horse power per month which was

very cheap compared with the cost of $20 per h.p. per month when derived from gasoline distillate for hoisting and other purposes.

During cold weather the mill was heated by oil-burning furnaces. No difficulty was experienced in cold weather with the water pipe line until the temperature fell below 10° F., when it had to be watched to prevent freezing and insure the maintenance of adequate service.15/

15/ Burgess, J. A., The Nevada Wonder pipeline: Mining and Scientific Press, March 25, 1916, pp. 435-438.

During the greater part of its period of operation the Company employed a force of 150 men, most of whom worked underground. The wage for miners and machine men was $4.50 a day, hoist men and timber men $5 a day, and muckers and surface labor $4. The miners regarded the camp as the best-moneyed camp in the State. The employees were all Americans, or of the white races. There was always a good payroll and liberal circulation of money, and the labor was on the cash-bonus basis, whereby any employee who had been continuously working for the Company for a year received, in addition to his regular pay, such proportion of the total bonus as his yearly wage was of the whole bonus wage, the total bonus being 5% of the Company's dividends.

Ore deposits.—The ore deposits were contained chiefly in the veins of a vein system which has been called the Nevada Wonder vein system by the Company. The system, consisting locally of 1 to 4 parallel veins, has a lineal extent of more than 1-1/4 miles through the property. On the north it extends down Hercules Valley to the lower end of Hercules townsite, where it probably crosses the canyon and ascends the hill on the west side of it on the Missouri ground where heavy vein croppings occur. On the

north the veins are separate, but on the southern part of the property they unite and form a single vein. The veins are usually much crushed or broken by minor faulting.

The vein system lies almost entirely in the Wonder rhyolite, which, as described on page is the dominant and most widely distributed rock formation in the district. It strikes N. 25° W. approximately and dips 75° toward the east, the hade being quite uniformly 35 feet per level or each 100 feet in vertical descent. It lies about 40 feet to the west or foot-wall side of a pronounced mineralized fault or shear zone, the Wonder fault with which it is more or less closely associated, in consequence of which the individual veins or branches are in general closely spaced, as indicated in fig. 20. The fault is usually marked by a tabular sheet of gouge-clay and kaolinized rhyolitic breccia from 4 to 5 feet in thickness.

The veins are known as the Nevada Wonder, Badger, Extension, Hidden Treasure, and North Star veins, the Extension vein being merely the southerly underground continuation of the principal deposits to the south of the original Nevada Wonder property and the HiddenTreasure and North Star veins respectively to the north of the same.

The veins vary from less than a foot to 40 feet in width. They consist principally of quartz with more or less adularia, broken, crushed, and altered wall-rock material and clay-like products resulting from the kaolinization and other alteration of feldspar. The most of the vein material is dimly and imperfectly but fairly persistently banded or streaked

which, in places, is seen to be due to thinly sliced rhyolite having been partially replaced and silicified by quartz solutions that filtered through and finally filled the interjoint and cleavage planes with quartz. Locally the quartz-adularia gangue is pseudomorphic after an earlier spar mineral found to be calcite, figs. 14-16.

The deposits are deeply oxidized. In the Nevada Wonder mine oxidation extends uniformly to the depth of 1,300 feet and seems to mark a somewhat persistent ancient ground-water table at that depth.

The mine for the most part is dry. Its deepest workings did not reach the present ground-water table of the region whose depth is unknown. On the 800-foot level north there was dampness, but no water. On the 100-foot level south in the hanging-wall of the Extension ore shoot a small quantity of water was found impounded in a local reservoir, yielding for a while about a bucket of water daily. On the 1300-foot level north only there was slight seepage. The first water that required bailing was found on the 1750-foot level, from which point on down a little bailing was necessary. The water was distinctly alkaline and was not injurious to the iron piping. No excessive heat was found in the mine, the highest temperature reported in the deep workings being 86°.

A few of the veins were mined to depths exceeding 2,000 feet, but the principal ore production came from depths of less than 1,300 feet which is approximately the lower limit of oxidation, see stope map, fig. 1, though considerable good ore was found in the sulphide zone. In the sulphide zone the veins became leaner with depth, carried less quartz and more barren or nearly barren pyrite. The principal producers were the Nevada Wonder, the Badger, and the White veins.

Nevada Wonder vein.—The Nevada Wonder, or main vein, is the most easterly or hanging-wall member of the vein systems. It is accordingly the nearest to the Wonder fault, from which it is about 40 feet distant, which fact probably accounts for its containing larger and richer ore deposits than any of the other veins.

It has an extent of 5,000 feet or more, but the principal productive part had an extent of only about 1,800 feet, the extent being about 900 feet each to the north and to the south of the Nevada Wonder or main shaft through which most of the vein was worked, fig. 22. Accordingly, it is to this part of the vein that the following description is mostly directed. With this latter extent the croppings of the vein which led to the discovery of the mine, interruptedly approximately coincided. They occurred chiefly at three points, namely on the top of the hill, under the engine house, and at an intermediate point. They were from 14 to 60 feet wide in places over the top of the hill, but were not bold or prominent compared with some of the other big veins or ledges in the district. They consist of a more or less continuous reef of brownish iron-stained quarts and silicified rhyolite in part brecciated and contained good ore interruptedly through the distance of 1,500 feet.

The vein dips steeply 75° to 80° to the east and lies in the Wonder rhyolite except that toward the south in the vicinity of the Extension ore shoot the hanging-wall was Alpine dacite which in depth extends from the vicinity of the 400-foot level to below the 800-foot level. On the

surface the dacite is exposed as far north as the Hidden Treasure shaft and as far south as the Extension shaft. The vein is commonly spearated from the wall rock by a sheet of gouge from less than an inch to several feet in width.

Locally the hangingwall for considerable distances is fairly uniform, smooth and well defined, and shows well-marked joint planes and slickenslides, but generally these conditions soon give way to mineralized ore-bearing material or merge into crushed rock material in the country rock wall.

The fore part of the tunnel in the upper northeast slope of the hill exposes a width of 90 feet of kaolinized wall rock, rhyolite, and fault gouge containing considerable slickensiding. The rock alteration is due probably very largely to hydrothermal action.

On the Extension part of the vein where dacite forms the hanging wall, in proximity to the vein the dacite was much decomposed and formed a very heavy gouge, so that in mining it was necessary to keep the stopes filled with waste up to the working positions.

Break or rupture in the rocks along the location of the veins is also indicated by the southeast slope of Wonder Hill or its spur a short distance east of the fissure, the rock being relatively little oxidized at the surface, showing that it cannot have been eroded and exposed for a long period.

The principal or northern part of the vein, the part worked through the main shaft, may be referred to as the Wonder or main ore shoot. The southern part, the part worked through the Extension shaft, is well known as the Extension ore shoot. It does not outcrop at the surface but was

first found on the 500-foot level in 1914. It extended from the 250-foot level to below the 1400-foot level and horizontally about 700 feet, and through most of this extent it was about 14 feet in width, nearly all of which was good grade milling ore. The ore is of the same general character as that of the main ore shoot.

Besides the Nevada Wonder vein the mine contains three other small veins or spurs known as the Badger vein, White vein No. 1 and White vein No. 2, the two latter being named from their containing a much larger quantity of white quartz than the other veins, the better values being in or associated with the whiter part of the quartz.

The Badger vein for the most part parallels the Nevada Wonder vein from which in the latitude of the main shaft it lies about 40 feet to the west or footwall side, fig. 20. At about 500 feet to the south of the shaft it joins the main vein in depth. Its junction with the main vein, however, is indefinite, there being much quartz and siliceous material at this point in both the vein and the wall rock.

The White vein No. 1 and White vein No. 2 are blind spurs of the Extension ore shoot which they join from the east or hanging wall side north of the latitude of the Extension shaft mostly between the 1000- and 1400-foot levels. They were first found on the 1300-foot level. Their known extent horizontally is shown on fig. 22.

The White vein No. 1 joins the main vein or Extension ore shoot on the south on the 100-foot level and vicinity by rool on top and also by dip in depth, the dip being slightly steeper than that of the main vein. Nothing further is known of its upper edge. It probably wedges out perhaps along a fault.

On the 1300-foot level it joins the main vein with a more or less pronounced interfingering, and at the junction occurred a marked increase in the amount of ore in the main vein, but there was not much increase on the 1450-foot level or the lower levels. Though the vein is regarded as all primary sulphide below the 1250-foot level there are two oxidized streaks traversing it diagonally.

The following notes on the various levels will help to convey an idea of the distribution and character of the ore. In general, the ore was mostly in the hanging wall side of the veins,and the best ore was found between the 500- and 700-foot levels, which probably indicates an ancient water table at this horizon.

Beginning with the main ore shoot, that was worked through the main shaft, the grade of the ore was fairly well maintained in the oxidized zone from the surface down nearly to the 1300-foot level where the oxidized ore was succeeded by primary sulphide ore, some of which was mined to below the 2000-foot level.

From the surface down to the depth of 600 feet the workable or milling portion of the vein ranged from 4 to 10 feet in width and averaged about 5 feet, and much of the ore ran about $27 to the ton.16/

16/ Mining and Engineering World, No. 9, Vol. XL, Feb. 28, 1914, p.432.

The ore in the Badger vein did not carry quite as good values as that of the Wonder vein. It occurred mostly to the south of the main shaft. Here on the 70-foot level and just below it in the reentrant angle formed by the junction of the Badger with the main vein, a large body of ore

30 or more feet wide and high by 80 or more feet along was found. Much of the ore body was in or favored the Badger vein, but it and the Badger vein probably were formed by solutions that in course of ascension crossed diagonally over from the Wonder vein fissure. The Badger vein, however, extends also more than 100 feet to the north of the shaft where, though of less importance, on the 200-foot level, it contained ore part of the way.

On the 500-foot level the main ore shoot was productive for the distance of 700 feet north of the shaft, and at one place it was 15 feet wide. On the same level to the south, however, the vein was not solid but was composed of various stringers.

On the 600-foot level south the vein was 6 feet or more wide, was brecciated, banded and well spotted with mineral and gouge on the hanging wall. On the north it continued good for about 800 feet, beyond which point or limit of the old workings and the Hidden Treasure shaft through a distance of about 900 feet but little commercial ore was found.

On the 700-foot level the vein was 12 feet wide and contained good ore, but this width included in places 2-1/2 feet of gouge-clay which to the north merged into the hanging wall. Some of the gouge carried ore that ran as high as $60 to the ton, notably in stope 7-5.

In the 1000-foot drift south on the 7th level, driven in part for a work passage to the Extension ore shoot and mostly in the hanging wall side of the vein, stope-ore was found at two places, and the post-vein basalt dike was intersected. Opposite the shaft and to the south occurs fresh looking rhyolite which is thought to be intrusive.

Samples of the 4-foot ore shoot on the 800-foot level south assayed about $56 to the ton.

On the 900-foot level the portion of the vein stoped was about 6 feet wide. The best ore seen by the writer in the drift to the north was 2 feet of brownish-grayish siliceous ore in the foot-wall side of the vein. It was too crushed and friable to yield a good hand specimen.

On the 1000-foot level the development was mainly to the south of the main shaft. The ore continued on down here from the 700 level. A considerable portion of the ore shoot averaged nearly $100 to the ton, and much of the ore ran about $12 to the tom. The workings when seen by the writer in 1916 showed several feet of relatively high-grade ore.

The oxidized ore on the 1200-foot level and down nearly to the 1300-foot level continued good and of about the same grade as on the upper levels.

At a short distance above the 1300-foot level the oxidized ore gave way to primary sulphide ore, of which a 4-foot wide shoot extending to 45 feet below this level averaged about $35 to the ton in the winze stope 14-2. A polished section of a rich specimen of this ore (632) was found to contain pyrite, chalcopyrite, sphalerite, galena, argentite, and much wire silver. Argentite is closely associated with galena, usually forming intergrowths with it. There is no evidence that it is supergene. Northward, ore was found on this (1300) level at three points at about 400,600, and 1000 feet from the winze, as indicated respectively by stopes and raises. The ore included some banded quartz. The occurrence at the 1000-foot point was oxidized ore and ran high in gold. The oxidation here is due to decrease in depth by reason of the northward decline of the overlying surface. Here on the 1300-foot level and on the 1450- and 1600-foot levels seepage water followed the ore-bearing quartz, especially in the sulphide zone.

Between the 1300- and 1600-foot levels but little ore was found. It was mostly sulphide and mostly contained galena and chalcopyrite.

Other than very sporadic assays, but little ore was found on the 1600-foot level. Between the latitudes of the main and Extension ore shoots, the vein consisted largely or varying deposits of brecciated quarts and rock locally crudely banded with the quarts the more abundant in the foot-wall side. It contained several streaks of oxidized ore, one of which was mined for the distance of about 200 feet, but it yielded only from $2 to $5 to the ton.

From the sub-shaft and winze considerable development was done on the 1900- and 2000-foot levels. But none of this work gave encouragement as to the possibilities of finding commercial ore deposits at this depth.

The Extension ore shoot as noted extends from the 250-foot level to the 1400-foot level and was productive throughout its extent. Its ore was of the same general character as that of the main ore shoot. On the 500-foot level south, in vicinity of raise 19, bot the vein and hanging wall rock are corasely agglomeratic with material resembling weathered boulders mostly stained dark brown with iron and manganese oxides. On the north, through much of the 1200 feet distance between the Extension and main ore shoots, not only is the value character of the ore incapable of discrimination by observation, but the vein itself in large part shows no line of demarcation but grades impereceptibly into the country rock, especially on the footwall side.

Between the 500-foot and 700-foot levels the ore shoot was brownish mottled. It had a horizontal extent of nearly 700 feet. Portions of it worked were 35 feet wide, especially in stopes 7-3 and 7-5. It was worked by the bench and fill method, the ore being stoped down on platforms laid

on the waste. In places, as in a few other parts of the mine, assays were necessary to discriminate between pay ore and waste.

In stope 7-5 the vein was split by a rhyolite horse 10 feet wide by 40 feet long. Toward the north, 1 to 5 feet of the hanging wall side of the vein consisted mostly of brown or ochre-colored mineralized gouge-clay or "yellow talc;" which carried values ranging from $2 to $30 to the ton.

In stope S. 8-5 on the 800-foot level south from Extension shaft was found some of the richest gold ore in the mine, a considerable body of which ran more than $80 to the ton, and a 3-foot wide shoot of $20 ore had an extent of 35 feet.

On the 1000-foot level the ore shoot carried ore of gmmkx good milling grade.

On the 1150-foot level north in stope 13-5 which was 25 to 30 feet in width the ore was siliceous and consisted mostly of iron-stained blocky quartz and rock. The White vein No. 1 is shown here coming in to join the main vein toward the south. It is more yellowish here than on the lower levels.

On the 1300-foot level the ore shoot in stope 13-3 was 12 feet wide and mostly good ore. The White vein is situated 30 feet to the east or hanging wall side. Lower down on the floor of this level and vicinity the White vein is about 9 feet wide, consists mainly of light-colored siliceous altered and replaced rhyolite and quarts with 1 foot wide of $10 ore and tapers out to the north.

The 1401 winze, sunk from the 1400 level to the 1450 level, was all in ore.

On the 1450-foot level just north of the long crosscut the wall rock is Alpine dacite. The face of the drift on this level 1300 feet south of the sub-shaft was mostly low-grade primary ore banded with stringers of quartz and dark rock, the quartz containing many angular inclusions of the rock. To the south of the productive ground shown on the stope map is a large quartz lens extending from a little below the 1000-foot level nearly to the 1900-foot level with its north edge plunging steeply to the north.

On the 1600-foot level good oxidized ore, with some primary sulphide ore, was found both to the north and to the south of the sub-shaft. The White vein No. 1 occurs on this level in cross-cut 16-5, but it is not strong.

As to the deposits in the deeper part of the mine, the primary sulphide ore which came in on the 1300-foot level was found to be continuous on down beyond the deepest workings below the 2000-foot level, but in depth it became too low grade to be profitably mined. The condition here experienced is in keeping with that of similar deposits in other districts, where the deepest developments in the mines have shown that the degree of mineralization in general gradually decreases with increase in depth; the veins carrying more quartz and pyrite and less of the ore minerals than on higher levels.

In the Hidden Treasure and North Star ground, opened by shaft and tunnel respectively at about 1900 and 3500 feet to the north of the Nevada Wonder shaft, the geological and mineralogical conditions are, in general, similar

to those just described in the Nevada Wonder mine in the oxidized zone. The rock formations, the Wonder rhyolite and the Alpine dacite, are both present in about the same manner, and the deposits are thought to be on the northward continuation of the Nevada Wonder vein, but they have not been productive.

On the Hidden Treasure ground the deposits consisted of a 60-foot wide lode of srushed altered oxidized and, in part, silicified Wonder rhyolite with quarts stringers and veins from 2 inches up to 2 feet in width, that form lenses, bunches, or pockets, and are sometimes abruptly cut off by slips and faults. Nearly all the quarts has moderate values. The dip of the lode is ~~NEX~~ 85° to the east.

In the deepest workings which are on the 300-foot level,[17] or 300 feet

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17/ The 300-foot level of the Hidden Treasure shaft accords with the 700-foot level of the main shaft.

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bulow the surface, fig. 22, the quartz veins or stringers are strong and look well, but they average only about $1 to the ton in values. On the North Star ground where the relief is higher the principal opening is a 400-foot adit tunnel, but the results were not encouraging.

Mineralogy.---As nearly all the minerals listed for the district, on page , were found in the Nevada Wonder mine the following notes on the more ~~important~~ important occurrences are here included.

Bromides were very common in the ore.

Stephanite was an important ore mineral in some parts of the mine and caused difficulty in cyanidation of the ore.

Chalcedonic quartz occurs sparingly in the veins. Some was found on the 1600-foot level.

A little ruby silver (pyrargyrite) was found on the 1500-foot level.

The ore contains much free gold, which is liberated during the milling process. It is of a very light or pale brass color and is worth $15 to $16 to the ounce. It probably stands close to electrum, some of which alloy was found in the mine. Occasional small flakes of free gold are visible in the ore.

Native silver was found at various places and depths in the mine. It occurred in the forms of wire, tapering fangs, flakes, and other irregular small bodies, and was frequently associated with argentite from which it seems to have been derived by oxidation and in part replaced.

Some iodyrite occurred on the 1500-foot level.

The oxidized ore is in general almost entirely free from base metals. About the only evidence of their presence is in places a yellowish brown limonite or red hematite stain of iron derived from altered pyrite, and similarly a little greenish-copper carbonate or malachite stain derived from altered chalcopyrite.

Black manganese oxide, psilomelane, is locally present as dendritic forms and black stain in the ore and in joint planes in the wall rock.

Jaspery quartz is common. Hyalite, partly in globular forms and associated with adularia is present in places.

The glistening surfaces common in the ore are laminae or cleavage faces of sanadine feldspar.

Fluorite was frequently present in the ore-bearing part of the veins especially in the xxxx rich ore with adularia, but it can scarcely be regarded as an important gangue mineral.

Wavellite, white hydrous aluminum phosphate, in spherical forms composed of radiating fibers beautifully encrusts joint planes of the wall rock, notably on the 500-foot level north.

Embolite occurs as an alteration product in cracks and porous quartz.

Gypsum occurred as incrustations in former water courses in the oxidized part of the vein, especially on the 500-foot level.

Wulfenite, lead molybdate, occurred in the oxidized part of the vein in the Extension ore shoot from the 800-foot to the 1300-foot levels.

In the sulphide zone, beginning at about the 1300-foot level, the principal ore mineral is argentite and with it are associated most of the gold xxxxxx values. In this zone the base metals besides pyrite and chalcopyrite include also a small quantity of galena and sphalerite. No zinc was found, however, above the 1300-foot level.

The silver haloids were found in the following descending order principally in the Extension ore shoot.

Embolite or bromochloride.

Iodobromite or iodo-bromo-chloride.

Iodyrite or iodide [18]

18/ Burgess, J. A., op. cit.

The minerals associated with them besides the quarts and feldspar of the vein and their usual decomposition products were pyrolusite, manganese dioxide in small amount, and wulfenite.

Embolite was found down to the 950-foot level and iodobromite from that depth to the 1300-foot level.

Iodyrite was found in limited quantity only on the 1000-foot level, with some partially oxidized rich ore, and with the decomposition products was associated flaky jarosite, and well-known hydrous iron sulphate.

The embolite occurred as grayish green waxy translucent coatings of deformed crystals on the ore, the iodobromite as light to dark olive-green crystal coatings. Both minerals were associated with wulfenite and had a pronounced bromine or drugstore-like odor which first disclosed their presence in some of the stopes.

The iodyrite was found chiefly as loose sulphur-yellow crystals in pockets and cracks in the ore. Its bromine-odor was not quite so strong as that of the embolite and iodobromite.

Mining methods.--From the surface down to the 400-foot level where the walls were firm the shrinkage system of mining was employed to good advantage. In the lower levels, however, where the walls were inclined to cave away in large masses, a waste filling system was employed in which waste material for filling was mined from the walls of the stopes by inclined raises, and the cribbing of chutes and manways required a minimum amount of timber. The method is described by Smither.[19]

19/ Smither, Thomas M., Stoping methods of the Nevada Wonder Mine, Mining and Scientific Press, May 15, 1915, pp. 757-759.

Milling.--The method of ore treatment was by the Slimes process throughout. The mill was built as a 100-ton mill and cyanide plant on a 30° slope, fig. 19. The principal parts of the equipment named in order of use are as follows:

Blake crusher

Challenge feeders

Ten 1400-pound stamps

Trent Chilean mill

Dorr duplex classifier

Tube mill

Callow tanks

Deister tables

Dorr thickener

Pachuca-Type agitators

Dorr thickener

Callow tank with stirrer

Oliver filters

Zinc boxes

Faber Dufaur melting furnaces

Through improvements, however, by successive addition of essential parts, the plant was made so efficient that it easily treated 200 tons of ore a day and established a record of 240 tons a day, the average being 6,000 tons monthly. This, however, is in part due to the softness, incoherent character and other favorable qualities of much of the ore as absence of base

ore minerals, etc., which enabled it to be easily crushed, rendered it amenable to cyanide treatment, and yielded a high extraction.

The added equipment included chiefly Dorr thickeners, Callow tanks, Cone classifiers, Oliver filters, Larger air compressor, Centrifugal pumps, 4 52-ton filters (in 1916), and 4 Senn concentrators (in 1917) to remove the less soluble silver sulphides found in depth in the mine where the ore became harder to treat and yielded a lower extraction.

Details of the mill equipment and ore treatment together with flow sheets appear in the following papers given in chronological order. 20/

20/ Van Saun, P. E., New mill at Nevada Wonder mine: Eng. and Min. Jour., Vol. XCI, No. 10, pp. 520-522, March 11, 1911.

Negraw, Herbert A., Cyaniding at the Nevada Wonder Mills: Eng. and Min. Jour., Vol. XCV, No. 14, pp. 693-695, April 5, 1913.

Carpenter, E. E., Cyaniding practice of Churchill Milling Co., Wonder, Nev.: Trans. Am. Inst. Min. Eng., Vol. LII, pp. 123-137.

The mill is credited with having turned out more bullion per ton of ore than any other mill in Nevada. During the first few years of its operation $7 ore could be mined and milled with profit. As the mine deepened, however, and the ore became leaner and less docile for treatment this was no longer possible, as shown by the following paragraph.

The average cost per ton of ore of producing and marketing the bullion during the entire period of operation was about $8.92, the costs being distributed as follows:

Mining (including transportation to mill)	$5.00
Milling	3.68
Marketing the bullion	.24
Total	8.92

Jack Pot Mine

Location and topography.—The Jack Pot mine is in the northeastern part of the district about a mile and a quarter north-northwest of the Nevada Wonder mine and Wonder Mountain. It is in Jack Pot Gulch, a prominent east side tributary of Hercules Canyon through which it is easy of access, though the surrounding topography is hilly and comparatively rough, figs. 7 and 12. The main opening, the Jack Pot shaft, is at an altitude of 5,250 feet, which is 850 feet lower than the Nevada Wonder shaft. Therefore, the 50-foot level of the Jack Pot mine accords in altitude with the 900-foot level of the Nevada Wonder mine.

History and production.—The Jack Pot mine is prominently identified with the early history of the Wonder district. The property was located in April 1906, by Tom Stroud and associates and was one of the first properties in the district to produce shipping ore of which $40,000 worth was taken from a 50-foot shaft, the first opening made. The property consisting of 12 patented claims and several others was soon acquired by the Jack Pot Mining Co. of San Francisco, for $750,000 it is said, who soon took out considerable ore. In August 1910, this Company was succeeded by the Atlas Wonder Mining Co. who greatly improved the property by retimbering and adding new and heavier machinery for deep sinking, and developed it in a broad workmanlike manner with the view of blocking out sufficient ore to warrant building a milling plant as the long freight haulage to the smelter enabled only high-grade ore to be profitably shipped, the freight and treatment charges on $60 ore being $48.50 per ton. However, as the development was not sufficiently encouraging the Company ceased operations

in 1914. The production, made mostly in 1906 to 1908, was more than 4,000 tons of ore which averaged about $115 to the ton. It was shipped mostly to the Western Ore Purchasing Co., at Hazen, some to Bingham, Utah, and some to Goldfield.

The values in the ore are gold and silver in the ratio of about 1 to 5 with increase in gold with depth. Following discovery, good grade shipping ore was soon mined at five or six points on the property.

Development.—The mine is opened to the depth of 960 feet mainly through the Jack Pot shaft and comprises more than 6,000 feet of development work, more than half of which is drifts. It includes the Grand View and Hercules tunnels each 375 feet long. The Jack Pot shaft is a double compartment shaft and was equipped with a 50-horse power gasoline hoist. As the ground on the 900-foot level was wet, a sump was sunk to drain it.

Geology.—The country rock is chiefly the Wonder rhyolite, but the mine and property in part are on or near the contact of this rock with the Alpine dacite and the Extension rhyolite, fig. 7. On the southeast the dark dacite crops in a series of "black knobs" on the ridge rising to Queen Peak. In the mine it occurs on the 200-foot level west, and on the 300-foot level it seems to cut or crowd out the vein. In the face of the crosscut on the 700-foot level it is also present and is pressed and in part laminated. There is also present in the mine in dike form intrusive andesite which in places parallels the vein, it being locally in the gix fissure, and elsewhere from 2 to 50 feet distant from it.

The deposits are of the same general class as those of the Nevada Wonder mine and other deposits in the district, the ore being in part replaced brecciated quartz and rock. They are contained chiefly in a vein system which is thought to continue as the Doctor vein system west of Hercules Canyon, fig. 11. They are contained chiefly in 4 veins known as the A, B, C, and Grand View veins, which, in general, strike about N. 80° W. (or nearly east and west) and for the most part dip steeply to the north, fig. 25. The veins though composed mostly of crushed material are firmer than those of the Nevada Wonder mine. The ore is oxidized and stained brownish and blackish with iron and manganese, and is in part drusy.

The deposits differ from most of the veins of the district in their manganese content. Much of the crushed or brecciated quartz and rock is firmly recemented and partially replaced by seams, veinlets and stringers of black shiny metallic mineral which chemical tests show to consist chiefly of psilomelane, with a little associated manganite and hematite or ferric iron but no ferous iron. This manganous ore is always auriferous and occurs mostly in the hanging wall side of the veins. A thin section of this ore from the A vein on the 200-foot level shows the gangue to be about 75 percent vein quartz and 25 percent adularia.

The veins in general are narrow, and where they are ore-bearing they usually contain but little gangue other than that contained in the ore. The 400-foot level contains some reddish or pink stringers of talc-like gouge resembling alunite.

The most important of the veins is the A vein on which the main or Jack Pot shaft is sunk, and it has yielded nearly all the production.

The vein strikes northwest and stands about vertical or dips about 88° gmx to the south down to the depth of 500 feet, excepting that between the 100- and 300-foot levels. It is convex to the northwest, its position being 20 feet to the north of the shaft on the 200-foot level. The ore continued good down to the 450-foot level, but in the lower part of the mine development was not encouraging though the vein is represented there by seams and stringers of good-looking quarts.

The B, C, and Grand View veins crop respectively about 400 feet, 500 feet, and 600 feet to the south of the A vein, fig. 12 and 25, and the B and C veins dip convergingly about 80° toward the A vein and join it on the 500-foot level and vicinity, but apparently they make no material increase in the ore at the junction.

From the surface down to the 100-foot level, vein A consisted almost wholly of an ore shoot from 1/2 feet to 6 feet wide that extended nearly 200 feet on each side of the shaft and ran $30 to $60 to the ton from which the ore was cobbed to about $115 to the ton and shipped. In places a width of 18 inches of the ore is said to have been "thickly plastered with horn silver." Below the 100-foot level and on the 200-foot level the vein contained mostly $30 to $40 ore.

In 1911, 7,500 tons of $15 ore is said to have been blocked out between the surface and the 300-foot level. On the 300-foot level and just below it, a 3-foot shoot of $20 ore extended about 100 feet on either side of the shaft, beyond which limits the values decreased to $3 to $7 to the ton due to the broken character of the vein as it neared the junction with vein B.

Vein B is about 4 feet wide of which width slightly more than half is ore-bearing, and near the surface much of it will average about $20 to the ton. On the 200-foot level, however, where it is opened for 200 feet both to the east and to the west of the shaft it is much broken and crushed and carries scattered values of only $2 to $10 to the ton.

Where crosscut on the 200- and 300-foot levels the C vein is about 18 feet wide, is more or less impregnated with sulphides, and about half of its width carries values of $1 to $7 to the ton, the ore being mostly of the replacement type.

Grand View vein.—The Grand View vein dips 40 degrees toward the south and contains some replacement ore. Where cross cut on the 300-foot level, however, it consists mainly of 1 to 2 feet of crushed or brecciated and seamy rock and sugary quartz contained in a 12-foot wide shattered zone of the dacite wall rock, and does not look promising.

Source of the ore.—The source of the ore, like that of the Nevada Wonder mine, is referred to heated solutions that followed the eruption of certain of the volcanic rocks, probably that of the Extension rhyolite lastly. Of the two most important periods of mineralization the first deposited a dark gray slate colored flinty or jaspery mineralised quartz, with which much of the gold and manganese is associated. Fragments of this dark hard ore as nodules or nuclei are often found inclosed in the lighter ore-bearing quarts of the last mineralization. This feature was early recognized by Mr. E. S. Cunningham, Superintendent of the mine.

Outlook.—From what has been described concerning the mine, from the fact that the Company, though having done extensive development, did not feel warranted to install electric power when it was cheaply available in the district, and the fact that in mining below the 1000-foot level or present deep workings water will have to be contended with, the mine, though it probably contains considerable ore, is not regarded as workable under present transportation and labor conditions.

Vulture mine

The Vulture group, consisting of four claims, is in Hercules Canyon opposite the Victor road forks and joins the Jack Pot mine on the northwest. It is owned by the Vulture Mining Co., formerly of Wonder and Goldfield, and is credited with having made, in March 1907, the first shipment of ore from the district. Its principal production and shipment was 40 tons of ore that ranged from $60 to $200 and averaged about $100 to the ton. At the time of visit the tunnel dump also contained about 100 tons of $23 ore.

The mine is in the east side of the canyon, the main tunnel opening being 60 feet above the floor, fig. 9.

The principal vein, the Vulture vein, strikes N. 10° W. and stands about vertical in Wonder rhyolite, with the croppings in part prominent near the middle part of the property. It is opened chiefly by a 600-feet nearly parallel adit tunnel, cross cuts and shaft at the face of the tunnel to the depth of about 200 feet. The vein is about 2 feet wide. At the shaft from the surface down nearly to the depth of 50 feet it yielded good ore, nearly all that the mine produced. The values occur in the north

or so-called hanging wall side of the vein in a 1½ foot to 2-feet wide ore shoot consisting in places of crushed quartz and silicified rock and elsewhere of a group of parallel quartz stringers. Much of the ore is of the crushed type and contains many angular fragments of altered rhyolite firmly cemented in quartz which is more or less drusy.

Some of the ore contained much yellowish-brown silver chloride including horn silver which was so brittle and fragile that it was easily screened and yielded screenings having a high silver value. There is also present in the ore some argentite, and with it are associated better gold values than with the silver chloride.

In the deeper workings, however, the results were not encouraging. Though mineralized bunches, streaks, and stringers of crushed, silicified rhyolite and quartz are present, they, so far as learned, do not carry workable values.

The Vulture gound is much broken and faulted. The tunnel shows beds of fault breccia and gouge 5 to 6 feet in thickness which seem to be very persistent. The faulting shows two main sets of fault or joint planes one of which dips northerly and the other southerly. The tunnel exposes also a whitish dike of the Extension rhyolite which probably is genetically connected with the ore. At about 250 feet south of the tunnel the country rock is traversed by a 10-foot wide dike of andesite described on page .

Other properties

Among the many other properties or claim groups having showings of ore, some of which have made small productions, are ~~them~~ these

Dickey

Doctor

Colorado

June Wonder

Pearl Wonder

Pirouette

Queen

Rubey

Spider and Wasp

Stray Horse

Gold King

However, operators of many properties who had splendid surface showings, with bold croppings, good veins 6 or more feet wide, and found good ore near the surface, reported that they abandoned their property because the veins pinched out or became barren at shallow depths, depths of 90 to 150 feet. From these reports and their corroboration by examination made of many of the properties, it is inferred by the writer that this pinching out at shallow depths is in general characteristic of the veins of the district. To this rule, however, there are doubtless exceptions. Some well experienced mining men, who are familiar with the district, have expressed their confidence in the possibilities of the Colorado group, and each of several other properties in the western part of the district, making a mine.

Outlying deposits.—Between the Wonder district and Westgate, 8 miles to the south, the country is said to be more or less mineralized, and it contains several prospects which in 1911 to 1913 were receiving attention.

The country rock through this part of the range seems to be mainly volcanic rocks ranging from quartz latite to trachyte and is probably related to the Wonder rhyolite. It is intruded by large dikes and masses of light-colored rhyolite and aplite which locally occupy small areas. The core of the range contains also exposures of Mesozoic limestone and shale described on page on which formation the volcanic rocks seem to rest.

Among the more important of the prospects are the Cirac, Lansing and Wolverton prospects, on some of which ground is said to have held since 18$6.

Cirac prospect.—The Cirac prospect, formerly known as the "New Strike," is about 2 miles nearly south of Twin Peaks and the neighboring summit of the Fallon-Wonder road, at an elevation of about 5,$00 feet in the west front of the range, fig. 3. It comprises a compact group of 6 or more claims known as the Yellow Jacket group, owned by Cirac Brothers and C. G. Witbeck of Fallon. The strike that drew attention to this part of the region was made here in August 1911. The deposits occur mainly in a lode on the contact of a 90-foot wide rhyolitic dike with the country rock quartz latite. The latite forms the hanging wall, and the deposits occur mostly in the foot wall rhyolite, the gangue being largely dark jasperoid replacement quartz similar to that in the Jack Pot mine. Much of it is stained reddish with hematite. The lode dips about 60° toward the northeast, and the croppings extend through a vertical range of several hundred feet. Sheeting in the

latite dips 70° to the west. The lode and rocks are cut by a nearly vertical E.NE. fault. The openings are a short tunnel, cuts and trenches, on the Yellow Jacket claim, and drill tests at other points. Pannings of the deposit from the croppings down are said to nearly all show considerable gold, and some assays are said to have yielded about 30 oz. in silver and $170 in gold to the ton. Adjoining ground had been taken up on the southeasterly extension of the lode and to the northwest on a shear zone in the lower front of the range. Another prospect, known as the Lansing prospect, had been opened near by, principally by a shaft about 90 feet deep, which contained water in the bottom. This water is probably storm water, but as a spring is said to occur a short distance to the east on a large dike, it may be sub-surface water. Here the ore carries considerable pyrite, and the rhyolite which is flow banded is sprinkled with pyrite and contains also a little chalcopyrite.

Wolverton prospect.—The Wolverton prospect is about a mile nearly south of the Lansing prospect and just back of the front of the range. It too is associated with a large rhyolitic dike cutting the country rock trachyte. The trachyte is disposed in heavy flows which dip gently northeasterly. It is freely intruded by dikes and sheets of rhyolite and by dikes of aplite, which latter rock, in places, forms very sharp contacts with the trachyte.

Placer deposits

So far as learned, no placers have been found, nor has any exploration or prospecting been done for them in or near the district.

If the veins of the district formerly extended much above the present surface, carried considerable gold, and have been greatly truncated, as supposed, to their present croppings, one would expect to find concentrations of placer gold in the bordering lowlands on the northwest where the detritus eroded from the veins has been deposited. However, these concentrations, if present, probably do not constitute workable placers as most of their gold content is probably in too finely divided a form to be successfully recovered.

WONDER MINING DISTRICT

CHURCHILL COUNTY, NEVADA

PATENTED CLAIMS

Survey No. 3071	Scorpion Lode
Survey No. 3072	B & S Lode
Survey No. 3078	Nevada Wonder
Survey No. 3079	Ruby No. 1
Survey No. 3122	Great Eastern
Survey No. 3122	Great Eastern Fraction
Survey No. 3122	Great Eastern No. 1
Survey No. 3122	Great Eastern No. 3
Survey No. 3122	Great Eastern No. 4 (poor title)
Survey No. 3124	Last Chance No. 1
Survey No. 3325	Nevada Wonder No. 2
Survey No. 3326	SE-1/2 Last Chance No. 2
Survey No. 3327	Ruby No. 2
Survey No. 3398	Nevadan
Survey No. 3398	Little Witch
Survey No. 3398	Silver Tip
Survey No. 3398	Valley View
Survey No. 3398	Pan Handle
Survey No. 3398	Yellow Jacket
Survey No. 3671	Golden Dawn No. 1
Survey No. 3671	Golden Dawn No. 2
Survey No. 3671	Golden Dawn No. 3
Survey No. 3671	Golden Dawn No. 6
Survey No. 3786	Queen No. 5
Survey No. 3786	Queen No. 8
Survey No. 4225	Nevada Wonder No. 3
Survey No. 4226	Hidden Treasure
Survey No. 4227	North Star Lode