

In addition to the Hill and Estes vein there is another vein in the lower adit near the portal. This vein is composed of crushed material occupying a position between a limestone footwall and overlying surface detritus. Over a width of 9 feet the crushed material averages \$2.50 in gold at the old price of \$20.67 per ounce.

Tests made in the small cyanide leaching plant erected about 1925 showed that a recovery of 85 percent of the gold and silver can be obtained by crushing to minus 10-mesh and a 4-day leaching cycle. Reagent consumption was 1/4 pound sodium cyanide and 2 pounds lime per ton of ore.

BULLION DISTRICT

The Bullion district, also known as the Lander district, is on the east slope of the Shoshone Range about 23 miles southwest of Beowawe, the nearest shipping point. It adjoins the Hilltop district on the southeast. The first locations were made here sometime in the seventies, when the town of Lander (now abandoned) was established. In the early days a number of small silver properties were operated, including the Silver Side, Grey Eagle, and Lovie mines. The latter was the principal producer and was equipped with a five-stamp pan amalgamation mill. In the spring of 1905 Charles Montgomery discovered gold ore about 2 miles southeast of Lander, and the camp of Tenabo was established more conveniently situated to the mines. A rush to Tenabo took place in 1907, and although it attained a population of nearly 1,000, the following year all but a few had left.

The placer deposits in the vicinity of Tenabo were discovered by A. J. Raleigh in 1916. No accurate statistics on the metal production in the district prior to 1902 are available. The Lovie mine is credited with a production of at least \$200,000 in silver, and a number of other properties are known to have produced smaller amounts. From 1902 to 1936 the metal production (table 4) was \$947,612, chiefly in silver and gold with some copper and lead.

Goldacres Mine

The Goldacres mine, owned by a Denver group, comprises 50 unpatented claims on the east side of the Shoshone Range about 5 miles south of Tenabo and 30 miles south of Beowawe, the nearest shipping point. Although the property was prospected many years ago, there was no production until 1936, when the present company began operations under the management of E. J. Bumstead. The mine is unique, in that it has been operated profitably from the beginning on ore carrying a little over \$4 per ton in gold. In April 1938, 11 men were employed at the mine, and daily production was about 25 tons of ore.

The mine is developed by an adit 400 feet long and subsidiary workings totaling about 2,500 feet. Equipment includes a compressor, blacksmith shop, machine drills, assay office, cyanide leaching plant, and camp accommodations for a crew of 15 men.

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TABLE 4. - Gold, silver, copper, and lead production from Bullion district, Lander County, Nevada,
1902-1936, in terms of recovered metal

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

Year	No. of mines	Placer				Total value	No. of mines	Lode		Gold	
		Gold		Silver				Short tons	Fine ounces	Fine ounces	Value
		Fine ounces	Value	Fine ounces	Value						
1902-04	-	-	-	-	-	-	-	-	-	-	\$1,812
1905	-	-	-	-	-	1	35	87.66	483.56	9,996	85,027
1906	-	-	-	-	-	4	510	483.56	4,113.19	3,123	676
1907	-	-	-	-	-	6	2,425	151.07	32.70	881	40
1908	-	-	-	-	-	8	227	42.63	1.95	321	293
1909	-	-	-	-	-	2	53	15.55	14.18	3,621	330
1910-11	-	-	-	-	-	5	214	175.17	514.50	10,636	376
1912	-	-	-	-	-	1	46	18.20	13.00	269	526
1913	-	-	-	-	-	2	498	25.43	69.68	2	1,440
1914	-	-	-	-	-	4	128	10.02	120.99	2,501	29,866
1915	-	-	-	-	-	4	609	1,444.79	534.70	11,053	7,117
1916	-	-	-	-	-	2	587	344.30	39.58	3,283	2,285
1917	-	-	-	-	-	2	1,222	157.86	110.54	2,469	5,720
1918	-	-	-	-	-	5	183	119.44	119.44	248.81	8,696
1919	-	-	-	-	-	4	157	223.77	248.81	697.42	24,410
1920	-	-	-	-	-	5	199	697.42	2,881.75	100,861	318,428
1921	-	-	-	-	-	4	29	120.99	1,444.79	2,501	29,866
1922	-	-	-	-	-	1	49	1,444.79	534.70	11,053	7,117
1923	-	-	-	-	-	3	10	344.30	39.58	3,283	2,285
1924	-	-	-	-	-	1	672	157.86	110.54	2,469	5,720
1925	-	-	-	-	-	4	2,070	119.44	119.44	248.81	8,696
1926	-	-	-	-	-	4	640	223.77	248.81	697.42	24,410
1927	-	-	-	-	-	6	105	697.42	2,881.75	100,861	318,428
1928	-	-	-	-	-	4	72	120.99	1,444.79	2,501	29,866
1929	-	-	-	-	-	3	47	1,444.79	534.70	11,053	7,117
1930	-	-	-	-	-	1	10	344.30	39.58	3,283	2,285
1931	-	-	-	-	-	1	672	157.86	110.54	2,469	5,720
1932	-	-	-	-	-	4	2,070	119.44	119.44	248.81	8,696
1933	-	-	-	-	-	2	26	223.77	248.81	697.42	24,410
1934	-	-	-	-	-	2	26	697.42	2,881.75	100,861	318,428
1935	-	-	-	-	-	7	963	120.99	1,444.79	2,501	29,866
1936	-	-	-	-	-	9	5,304	1,444.79	534.70	11,053	7,117
Total	-	1,111.10	37,372	119	80	37,452	23,736	12,698.49	318,428	318,428	318,428

See footnote on page 41

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TABLE 4. - Gold, silver, copper, and lead production from Bullion district, Lander County, Nevada,
1902-1936, in terms of recovered metal (Continued)

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

Year	Silver		Copper		Lode		Lead		Total value	Average recoverable value of ore per ton ^{1/}	Total value (lode and placer)
	Fine ounces	Value	Pounds	Value	Value	Pounds	Value	Value			
1902-04	-	-	-	-	-	-	-	-	\$1,812	\$51.77	\$1,812
1905	-	-	-	-	-	-	-	-	\$4,360	70.21	35,806
1906	31,930	\$21,393	295	\$57	-	76,506	-	-	35,992	105.91	256,827
1907	107,102	70,687	325,604	65,121	417	679,102	-	-	2,424	40.58	9,211
1908	6,127	3,247	3,159	263	-	57,714	-	-	668	44.60	2,364
1909	1,456	3,757	2,023	-	-	15,535	-	-	-	-	-
1910-11	-	-	-	-	-	-	-	-	-	-	-
1912	17,574	10,808	7,819	1,290	-	85,041	-	3,827	16,806	78.53	16,806
1913	12,521	7,563	922	143	-	-	-	10	7,746	168.39	7,746
1914	117,879	65,187	4,451	592	-	258	-	-	66,110	132.75	66,110
1915	31,876	16,161	-	-	-	-	-	-	16,454	128.55	16,454
1916	68,776	45,255	712	175	-	5,131	-	354	49,405	81.12	49,405
1917	43,457	35,809	3,817	1,042	-	926	-	80	37,261	63.48	37,261
1918	58,786	38,786	203	50	-	-	-	-	69,472	56.85	69,472
1919	13,897	15,565	122	23	-	5,785	-	307	16,271	88.91	16,271
1920	13,493	14,707	326	60	-	2,351	-	138	15,224	96.97	15,224
1921	5,996	5,996	13,060	1,685	-	18,188	-	818	9,025	45.35	9,025
1922	2,572	2,572	239	33	-	18,176	-	1,000	3,607	124.38	3,607
1923	1,887	1,547	422	62	-	11,565	-	810	3,859	78.76	3,859
1924	804	539	186	24	-	7,536	-	603	1,166	116.60	1,166
1925	19,395	13,460	44,475	6,315	-	99,970	-	8,697	30,973	46.09	30,973
1926	5,986	3,735	27,796	3,892	-	15,300	-	1,224	38,717	18.70	38,717
1927	7,127	4,041	1,153	151	-	37,166	-	2,341	17,586	27.48	17,586
1928	1,225	717	-	-	-	8,024	-	465	8,299	79.04	8,299
1929	1,298	692	2,601	458	-	11,283	-	711	2,679	37.21	2,679
1930	18	7	-	-	-	-	-	-	3,270	69.57	3,270
1931	29	8	-	-	-	-	-	-	2,293	104.23	2,293
1932	42	12	-	-	-	-	-	21	2,502	96.23	2,502
1933	1,685	590	3,310	212	-	715	-	8	6,530	29.28	7,923
1934	9,067	5,862	44,357	3,549	-	200	-	185	18,292	18.99	25,600
1935	13,433	9,652	44,742	3,714	-	5,050	-	202	37,981	7.16	51,522
1936	17,709	13,716	70,994	6,531	-	32,698	-	1,504	122,612	19.13	136,389
Total	613,147	429,074	602,791	95,859	-	1,199,222	-	66,799	910,160	38.35	947,612

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

The gold occurs in a shear zone in iron-stained, silicified limestone intruded by porphyry. The principal ore body lies between a porphyry hanging wall and a blue limestone foot wall and strikes N. 40° W., with a flat dip to the southwest. At the surface the ore body is covered to a depth of from 5 to 10 feet with material averaging 0.02 in gold. It is impossible to distinguish between ore and waste except by assay, and gold is present in such a state that it is impossible to obtain a single color by panning. Up to April 1938, 225,000 tons of positive ore and about the same amount of probable ore averaging \$2.85 per ton had been developed.

About 1,000 feet from the main ore body a large open-cut shows ore of the same character. Not enough prospecting has been done to determine whether or not the two ore bodies are connected.

The pilot cyanide-leaching plant at the mine has a maximum capacity of 30 tons per day and is characterized by its simplicity. The ore is hand-trammed from the mine and dumped into a coarse-ore bin. From the bin, the ore is crushed to 2-inch size by an Austin gyratory crusher, whence it passes into a second ore bin. The crushed ore, containing about 25 percent slimes, is transferred to the leaching tanks by hand-trammed cars. There are four steel leaching tanks, each 9 feet in height and 15 feet in diameter. The leaching cycle requires about 7 days, and the cost and consumption of reagents are as follows:

	Amount per ton of ore, pounds	Cost per ton of ore
Sodium cyanide..	1.27	\$0.266
Lime	6.20	.155
Zinc shavings...	.88	.162
Total cost of reagents per ton583

Water for milling is pumped from a well 80 feet deep on the flat 3 miles east of the mine, and it is trucked uphill to the mine at cost of \$1 per ton. The water consumption is 1/4 ton per ton of ore, and the cost is 25 cents per ton of ore. The tailings are discharged from the leaching tanks by gravity and are hand-shoveled into mine cars, which are trammed a short distance to waste piles. In addition to the leaching tanks, there are two pregnant-solution tanks (14 by 6 feet), two sump tanks (10 by 12 feet), and two stock-solution tanks (10 by 8 feet. Precipitation is effected with zinc shavings in zinc boxes consisting of four rows with five cells in each box. By crushing to 2-inch size, the extraction of the gold is between 87 and 90 percent. On one occasion the crusher broke down and the mine-run material up to 4 inches in size was treated, and the extraction was 80 percent.

Little Gem Mine

The Little Gem mine comprises one patented and three unpatented claims on the east slope of the Shoshone Range 21 miles south of Beowawe, Nev., the nearest shipping point. In recent years the property has been operated by George L. McCracken and associates, chiefly for shipping ore. In 1937 a 50-ton flotation mill was built on the west side of Crescent Valley 3 miles from the mine, but it was closed after operating a short time because of metallurgical difficulties.

Development consists of a shaft 435 feet deep inclined about 35°, with levels at 30-, 130-, 200-, 300-, and 400-foot stations, measured on the incline. Total underground workings aggregate about 1,500 feet. Equipment includes a 10-horsepower Fairbanks-Morse geared hoist, a Sullivan Unitair portable compressor, blacksmith shop, and various mining tools. The mill is equipped with crusher, Eimco ball mill (4 by 5 feet), Simplex classifier, and 10 Booth-Thompson flotation cells.

The country rock is a fine-grained andesite. The ore occurs in a fault fissure vein 1 to 6 feet in width, averaging 4 feet, with a general east and west strike and a flat dip southward. The oxidized ore is composed of copper carbonates, silver chloride, and some free gold. The sulphide ore minerals, found at a depth of about 100 feet below the surface, are chalcopryite, bornite, arsonopyrite, pyrite, galena, and sphalerite; a little gold is associated with the sulphides. The vein is composed largely of quartz and crushed country rock. Most of the production, amounting to several thousand tons, has been shipping ore taken from the oxidized zone. According to McCracken, an appreciable tonnage of sulphide ore is available, but it is too low grade to ship. A trial shipment made on June 16, 1934, to the American Smelting & Refining Co. had the following analysis:

	Ounces
Gold	0.10
Silver	9.2
	Percent
Copper	2.95
Insoluble	56.2
Sulphur	12.1
Arsenic	4.6
Iron	13.9
Lime9

Mill Gulch Placer Mining Co.

The Mill Gulch Placer Mining Co., Keith Scott of Los Angeles, Calif., manager and principal owner, controls a large acreage of placer ground at Tenabo, 24 miles south of Beowawe, Nev. The company purchased the Mill Gulch group of placer claims from A. E. Raleigh in 1936, and subsequently a large number of claims in the Tenabo area were acquired by location. A floating washing plant and a dragline were installed, and placer operations started on March 15, 1937. Since then operations have been successfully carried on continuously on a 24-hour day basis. In April 1938 the company employed a crew of about 16 men. Prior to the acquisition of the Mill Gulch placer, the only activity was some small-scale mining with rockers and dry washers by A. E. Raleigh and lessees.

Equipment includes a washing plant on a floating barge 30 feet wide and 40 feet long, a Link-Belt Speedomatic dragline unit having a boom 60 feet long and a 1-3/4-cubic-yard-capacity, heavy-duty Page bucket and R. D. 7

caterpillar tractor with a Le Tourneau bulldozer attachment, drilling and sampling equipment, pumping plant, and camp accommodations for a crew of 20 men. The barge is built of 3-inch plank on the sides and bottom, with 4-inch plank at the ends. The boat is trussbraced, with two cross bracings and two that run lengthwise. After the barge was built, heavier equipment was installed, and to provide for extra carrying capacity, three auxiliary steel pontoons were added, one on each side and the third at the stern. The barge has 40 inches draft, with 6 inches freeboard.

No yardage measurements are made, but it is estimated that the plant has a capacity of about 1,500 cubic yards per day. The trommel is 24 feet in length and 54 inches in diameter, and divided into two sections; the upper portion is of unpunched steel plate with three spiral flights for disintegrating the gravel, and the lower half is a steel screen with 3/8-inch holes. It is chain-driven, and the slope is 1-1/2 inches per foot.

The cross-riffle sluices are 30 inches wide and 12 feet long, and there are 6 cross sluices on each side of the screen. These discharge into side sluices, one on each side of the barge. The side sluices terminate in steel flumes that project about 6 feet beyond the rear of the barge. The total riffle area is 460 square feet. The riffles are of the conventional type, 1-1/4 inches square and spaced on 3-inch centers, and lined on the top with strap iron. They are built in sections so that they are readily removable when clean-ups are made. Water for washing and sluicing is pumped from the pond by a 6-inch Fairbanks-Morse centrifugal sewage and trash pump. The trommel oversize is discharged on a stacker belt 24 inches wide and 70 feet long. Power for the washing plant is furnished by a D-17000, caterpillar, 160-horsepower, V-type, 8-cylinder, Diesel engine mounted on the barge. For night work the barge is equipped with 5- k.v.-a. Kohler lighting plant. The barge is also equipped with Bodinson electric winch for holding the boat in position. Clean-ups are made daily; the concentrate is washed in a Denver pan.

Water is obtained from a well in the valley to the east and is pumped to the pond by a multistage turbine pump connected to a D-13000, caterpillar, Diesel engine. The pipe line is 15,000 feet in length and made of 12-gage iron pipe 8 inches in diameter. The pumping lift averages about 500 feet.

The caterpillar tractor with bulldozer attachment is used for leveling the ground in advance of digging operations, for road building, and for heavy hauling.

A Keystone drill and a G. B. portable placer machine are used for sampling the ground ahead of mining.

Mill Gulch is a shallow ravine several miles long and 200 to 300 feet in width. The alluvium is composed largely of sand and medium-size boulders. The depth to bedrock ranges from 10 to 45 feet, averaging about 30 feet. Most of the gold is found near bedrock. The gold is both fine and coarse, with a fineness of about 920. A little scheelite is associated with the gold.

Triplett Gulch Placer

The Triplett Gulch placer is at Tenabo about 1/2 mile south of Mill Gulch. The main part of the Gulch is covered by 9 unpatented claims owned by Mrs. G. W. Triplett and E. O. Swackhammer of Battle Mountain; for the past three years this ground has been worked under lease by Herman Rieck and associates. In April 1938 about 40 individuals were working the ground under sublease agreements with various types of dry-washing equipment ranging in capacity from a few yards to 50 cubic yards per 8-hour day.

The placer material is chiefly sand and soil containing a small proportion of angular rock fragments, none exceeding 5 inches in diameter. The depth of the alluvium ranges from 1 to 12 feet, averaging about 6 feet. The average value of the placer material treated by dry washing is about \$2 per cubic yard.

The largest operation at the time of the writer's visit was that of Reick and partners, who used power equipment. In working the placer, the ground is first broken to a depth of about 1 foot with a scarifier drawn by a 15-horsepower caterpillar tractor. It is then worked over with a spring-tooth harrow; the loosely cemented lumps of sand are broken by a flat-bottomed stone boat made of 2-inch plank weighted with stone and dragged behind the harrow. After the material is harrowed, it is allowed to dry thoroughly and is then hauled by tractor and scraper to a grizzly ramp near the dry-washing plant. The grizzly is made of 20-pound rails spaced with 3-inch openings. The undersize falls onto a Jeffrey portable conveyer, which elevates it to an inclined, 1/2-inch-mesh, woven-wire screen above a hopper. The undersize drops into the hopper, which discharges into a battery of two power-driven dry-washing machines. The screen oversize falls to the ground in front of the dry washer and is hauled away with the dry-wash tailing by tractor and scraper.

The dry-washing machines are the conventional bellows-type air jigs commonly used throughout the arid regions of the southwest. They are belt-driven by a 2-horsepower Fairbanks-Morse gasoline engine mounted 50 feet in the rear of the dry-washing equipment to avoid the dust. With the foregoing equipment, three men can handle about 50 cubic yards per day. Operations are slowed, however, by weather conditions; a light rain stops the work until the ground dries.

Mud Springs Placer Deposits

Placer-gold deposits occur in the vicinity of Mud Springs on the east slope of the Shoshone Range 8 miles northwest of Tenabo. The first placer discovery was made here in 1907 by Gus Fowler of Beowawe. The deposits have been worked intermittently by hand methods, and production has been only about \$2,000.

Placer gold has been found in Mud Springs, Rose Bud, and Tub Springs Gulches, but most of the activity has been confined to Mud Springs Gulch, which is about 4 miles in length and averages 300 feet in width. About 30 shafts 60 to 90 feet deep have been sunk to and into bedrock along the course of

the gulch. The upper portion of the alluvium consists of sand and soil and the lower part of a heterogenous mass of small and large boulders, in places cemented. Most of the gold is concentrated near bedrock. At the head of the gulch the gold is coarse and angular, but it becomes finer in proportion to the distance it has traveled down stream. The gold was probably derived from the erosion of quartz veins in the vicinity of Granite Mountain.

Other Mines

The Gold Quartz mine, owned by Thomas S. Wilson and associates, comprises a group of five unpatented claims at Tenabo. The mine has been operated with some success in recent years by the Cuba Consolidated Mining Co.

The mine is developed by two shafts, the deepest about 300 feet, and other workings totaling several thousand feet. Equipment includes a Fairbanks-Morse 6-horsepower geared hoist, a compressor (7-3/4 by 12 inches), blacksmith shop, a 20-ton flotation mill, and camp buildings.

The prevailing formation is quartzite cut by a quartz-bearing porphyry intrusive and by basalt, according to Emmons¹⁰. Free gold occurs in a shattered, altered quartzite cut by stringers of iron oxide. The ore is oxidized to a depth of 75 feet. In the sulphide zone arsenopyrite and pyrite are the principal sulphides.

A. E. Raleigh of Tenabo owns 19 claims in three groups in the Tenabo area - the Gylding group of seven claims, the Blue Rock group of five claims, and the Gold Pen group of seven claims, all unpatented. Lessees have made intermittent shipments from the various groups. There is very little equipment on the property. Development comprises a number of shafts, the deepest of which is about 300 feet. Last production was made from the Gold Pen mine several years ago, when 20 cars of ore averaging \$42 per ton (chiefly in gold) were shipped by lessees.

The Grey Eagle mine, about 4 miles southwest of the Hilltop mine, has been rehabilitated by Detroit interests in recent years. This mine has been worked intermittently since the seventies and is reported to have produced several hundred thousand dollars in silver, gold, and lead. The deposit is a quartz fissure vein in granodiorite, striking N. 70° E. and dips 70° N. The ore minerals include sphalerite, galena, pyrite, and gray copper, which have been altered near the surface to oxides, carbonate, and chloride¹¹.

The Lovie, Silver Prize, and Silver Side mines in the vicinity of the old camp of Lander, operated in the early days for silver ores, have been inactive in recent years.

¹⁰/Emmons, William H., A Reconnaissance of Some Mining Camps in Elko, Lander, and Eureka Counties, Nev.: Geol. Survey Bull. 408, 1910, pp. 117-118.

¹¹/Emmons, William H., Work cited, p. 120.