Methods employed for exploration and development of a gold, silver, lead property in the Idaho Springs district, Colorado

James Hopkins

METHODS EMPLOYED FOR EXPLORATION AND DEVELOPMENT OF A GOLD, SILVER, LEAD PROPERTY IN THE IDAHO SPRINGS DISTRICT, COLORADO.

BY

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INTRODUCTION.

The Tonopah Colorado Leasing Company, a subsidary of the Tonopah Mining Company of Nevada, was organized in July 1922, for the sole purpose of carrying on the development and exploration of the Lombard Mine, situated in the N.E. corner of Clear Creek County, Colorado.

The former owners of the Mine were: The Continental Mines, Power and Reduction Company. This Company was held by the Seeman Investment and Finance Company. The property comprised 128 Mining Claims - most of which were Patented. Other appurtenances of the Company comprised Mill Sites, Power Plant Site, Tunnel Sites and Ditch.

The Tonopah Colorado Leasing Company, secured a Lease on the property with an Option to purchase within 20 years. It was under this Lease that the property was explored and developed.

This property had been brought to the attention of the Tonopah Mining Company, through the President of the Seeman Investment & Finance Co., which Company was at that time in control of the property.

The history of the Lombard Mine was rather obscure, but sufficient information was obtained from various sources that substantiated various stories of the richness of the ore body that had been exploited in the upper portions of the Lombard vein. Independent reports were consulted as also the Smelter returns from the ore shipped in the early days of the Mine.

The mine is situated on what is known as "Yankee Hill", a very important mineralized section of Clear Creek County. The Lombard vein outcropping in the upper part of Cumberland Gulch is the most important mineralized fissure in the vicinity of the Yankee Hill area. Except for certain limited stretches the Lombard vein can be traced on the surface out through the upper reaches of Cumberland Gulch across a hog back between Cumberland and Yankee Hills.

In the early days of the District, the vein was opened up and exploited through two tunnels driven on the vein - No. 1, tunnel being on a level approximately 200 ft. below the apex of the hill, and No. 2, tunnel driven on the vein about 200 ft. below No. 1 tunnel.

The ore body encountered and exploited was found to extend from the No. 2, tunnel level continuously through No. 1, tunnel and to the surface.

After the ore that would warrant shipment to Idaho Springs or that could be treated in a small Mill had been extracted through these two tunnels, work was begun lower down the slope to open up the two other tunnels known as: No. 3, and No. 4. These two tunnels were respectively 175 ft. and 365 ft. below the floor of No. 2, tunnel. No. 3, tunnel had been driven 1100 ft. on the vein in an effort to reach the ore body at depth under No. 2, tunnel, but had been abandoned for lack of funds before reaching its objective. No. 4, tunnel had also been driven 3135 ft. but had failed to reach the ore shoot - owing to lack of funds.

Both tunnels were in excellent condition and were connected with the raise that provided for ventilation and as a timber and ore chute between the two tunnels.

The particular problem then consisted in driving the two tunnels with extension of the ore body that had been encountered in the upper tunnels as an objective.

Owing to the pitch of the ore shoot on the plane of the vein, it was possible only to make a very rough estimate of the distance these tunnels must be driven to encounter this ore shoot.

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GEOLOGY OF MINE & DISTRICT.

The historical Geology of this District is interwoven with the Geological history of the Western Cordillera - or Rocky Mountain System.

Briefly, the events of this history began with the deposition of sediments in Pre-Cambrian times, possibly in Marine waters. Subsequent deposition on these deposits buried them at great depth where they were subjected to great compressive stresses with result that these Pre-Cambrian sediments were changed to Biotite schists, Quartzites, Conglomerates and Crystalline Limestones that now make up what is called - the Idaho Springs Formation.

Following closely upon this metamorphism, immense intrusions of Monzonite Porphyry took place - these intrusions were accompanied by great Tectonic or mountain building movements.

Later erosion removed a great part of these formations and reduced the area to an immense Peneplain on which were laid down the sediments of the Mesozoic period and also probably deposits of Paleozoic periods. Post-Cretaceous folding and faulting was accompanied by igneous intrusive activity which resulted in the formation of the present Rocky Mountains.

An enormous period of erosion since Pre-Tertiary times has produced the present Topographical expressions.

The mineral deposits therefore, are for the most part found in the rocks of the Idaho Springs formation - which is essentially a highly metamorphosed rock, composed almost entirely of Biotite schist. The age of this formation is undoubtedly Pre-Cambrian. Along with this formation and underlying a large part of the area, are great masses of igneous rocks that are undoubtedly Pre-Cambrian and have been intruded into the Idaho Springs formation. These intrusions vary greatly in lithological characteristics in different areas, but undoubtedly they are the various phases of the same magma and have a great range in character and texture from an ultrabasic to the more acid varities.

The veins are the true fissure type and are found traversing both the Idaho Springs formations and the Pre-Cambrian igneous intrusive rocks. The veins are the result of filling of minor fault zones. The range in width is from a fraction of an inch to several feet - most veins are from 1 to 5 ft. wide. They are not persistent for greater distances than about 3,000 ft. laterally, while their vertical extent is for even less distances. They usually terminate both horizontally and vertically by branching or splitting into branches too small to be worked.

With one or two exceptions the ores in this district are believed to be directly related to the "Porphyrys" - that is, to those Monzonite porphyry intrusions of Post-Cretaceous age. They are believed to have been the result of the emanation of thermal solutions from these rocks at the time of their invasion. Very recent studies tend to show that the major portion of the ore bearing zone of Colorado conforms to a Northeasterly - Southwesterly trend on a belt of intrusive porphyrys.

Most of the veins of this district have been worked primarily for their precious metals content. The minerals associated with these two precious metals were originally only taken as to indicate to the Miner the preponderance of either of these two metals in the ore. For instance, when a Chalcopyrite ore was seen, it was taken to indicate a Gold ore; and when an ore showing much Galena was seen, it was taken to indicate an ore rich in Silver. These two precious metals in the early days were recovered principally by amalgamation, while the sulphides were allowed to run away as "Tails". Consequently, it has been only recent years that the sulphide ores of Copper, Lead and Zinc have received attention and Mills have been designed with the object of concentrating these ores, making these metals as a by-product.

The mineralogical character of the ores enables them to be classed as 4 different types:

Pyritic Ores,
Galena - sphalerite Ores,
Composite Ores, &
Telluride Ores.

The Pyrite Ores consist predominantly of Pyrite and Gangue minerals with only subordinate amounts of Chalcopyrite, Tennanite and other metalic minerals. These are as a rule irregularly massive in texture. The structure of the vein deposits depends mainly upon the relative importance of fissure filling and replacement in the vein formation. The Gold content is highest in those ores relatively high in Copper pyrite.

In the Galena sphalerite ores, the predominant primary sulphides are Galena, Sphalerite and Pyrite. The common Gangue minerals are Quartz and Calcite where the deposits are the result of vein fillings; a conspicuous alteration of wall rock adjacent to these veins is the development of Sericite and Pyrite.

The principal metalic minerals of these ores are Galena and Sphalerite: Pyrite is next in abundance and then Chalcopyrite. Bornite, Enargite, Quartz, Siderite, Barite, Free Gold and Rhodocrosite are seen in some of the veins. The texture and structure of these ores are very similar to that of the Pyritic ores. Some banding of the minerals is quite apparent. The metal content shows great variation. As a rule the primary ores of the Galena Sphalerite type are poor in Gold and Copper and richer in Silver than those of the Pyritic type.

The ores of the Lombard Mine are mainly of the Galena Sphalerite and consist in order of abundance, white quartz, sphalerite, galena, chalcopyrite and pyrite with some siderite.

The vein is of the true fissure type, principally in schist of the Idaho Springs formation, although at frequent intervals there is some Pegmatite. It is cut in numerous places with dykes of Bostonite porphyry and frequently follows one of these dykes. It ranges in width from a mere fracture up to a width of 5 feet. The vein has a general N.E. trend as is common to all main fractures of the District, while the ore shoot that had already been exploited in the upper tunnels had a distinct pitch to the East on the plane of the vein.

This feature is characteristic of the majority of the ore shoots in the District, that is, rather than being in a vertical position they are inclined more or less along the plane of the vein.

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GENERAL ITEMS THAT INFLUENCE METHODS EMPLOYED.

TOPOGRAPHY.

In general the District lies within a highly dissected Plateau. This Plateau is a direct result of Peneplanation during Post-Cretaceous times and a subsequent mountain building movement that has elevated this Plateau to a much greater height, than is now apparent. A Glaciation and swift running streams are the principal causes of the rough outline now presented. It is very rough with bold outcrops of the more resistant rocks. The difference in elevation is from 11,000 feet at the portal of No. 3, tunnel to 7,500 feet at Idaho Springs - a distance of 10 miles.

The main drainage is Clear Creek, that has cut its deep Gorge through this Plateau and whose drainages are:

Fall River,
Soda Creek, &
North Clear Creek.

Cumberland Gulch a very short drainage has its confluence with Fall River at a distance of $1\frac{1}{2}$ miles from the Lombard Mine.

CLIMATE.

At this elevation of 10,550 ft. above sea level and a comparatively high latitude (39° 50'), we find the Summer months of very short duration with a consequent lengthening of the rigorous Winter months with their attending low temperatures and deep snow falls. During the Summer months it is very rare that nights are not accompanied by frost. The rain fall is very slight. Electric storms during the Summer months are very frequent, but are not accompanied with any great amount of rain fall.

WATER and FUEL.

The demands for fuel are rather small. The only purposes for which fuel was required was for heating of the dwellings, bunk houses and boarding house. These needs were supplied by an abundant supply of dry and down timber, mostly white pine and pinion.

Water for domestic purposes for the camp was provided by a small stream that flowed continually in Cumberland Gulch. A small flow of water was encountered in driving No. 4, tunnel. This was conducted to a settling box after flowing through the tunnel and was an adequate supply for milling purposes and for water jackets of the Compressor.

Electric Power was generated at the Hydro-electric plant situated on Fall River 2 miles from the mine. Water for this plant was obatined from Fall River from which an adequate supply was obtainable only for a few months in the year. The source of the water in Fall River was the famous St. Mary's Lake and Glacier.

TIMBER and OTHER MATERIAL.

Besides being an adequate supply for fuel, the dry and down timber was used for timbering in the drifts and raises, the requirements were very small for these purposes. All camp supplies including mine supplies were purchased either in Idaho Springs or in Denver 47 miles away.

ACCESSIBILITY.

The Lombard Mine is accessible only by very good wagon road from Idaho Springs. This road follows the main travelled highway from Idaho Springs for 2 miles and then turns off into Fall River Gulch, through which it winds to the Seeman Tunnel 8 miles from Idaho Springs. From the portal of the Seeman tunnel to the Lombard Mine one had to follow a steep precipitous road with a tremenduous grade - reaching as high as 27% in some places, but for only short distances.

The Seeman tunnel can be reached by auto, but the remaining 2 miles to the Lombard Mine could only be travelled with great difficulty with teams. Mine supplies and all boarding house supplies were hauled from Idaho Springs with teams. Teams could be used the year around, while auto's could not be used after the first snow fall.

POWER.

The Company owned a very up-to-date Hydro-electric plant, that is situated at the portal of the Seeman tunnel, this plant was operated by a Pelton water wheel. Water to operate the wheel was obtained from Fall River. It was conducted through a ditch along the mountain side for a distance of 2 miles into a penstock immediately above the plant, thus affording a head of 300 feet. From the penstock to the water wheel, water was conducted through a 24" steel riveted pipe.

The output of the Power plant was 720 h.p. The current was delivered to the buss bars at a potential of 600 volts. Immediately outside of the plant were 3 Transformers that stepped the current up to a potential of 11,000 volts and transmitted over the Company's power line a distance of 2 miles to the Lombard Mine. At the mine were 3 step down transformers, which stepped the current down to 440 volts for motor driving the Air Compressor.

During the months the water was not available in Fall River the Hydro-electric plant was closed down and power was obtained from the Colorado Power Company, who delivered power to the Mine with excellent service at a cost much below what we were able to manufacture it.

A minimum guarantee was required by the Power Company amounting to $1.00 per h.p. of maximum demand. The rates for Power was as follows:

4¢ per kw. hr. for the 1st 100 kw. hrs. per h.p. of maximum demand.

13 mills per kw. hr. for additional energy up to equivalent of 250 kw. hrs. per h.p. of maximum demand.

2 mills per kw. hr. for all additional energy in excess of said 250 kw. hrs. per h.p. of maximum demand.

MINE EQUIPMENT. - MACHINES.

The Compressor in use was one that had been changed from a direct steam driven type to a belt driven type. The model was classed W.J. 2 stage, straight line, manufactured by Sullivan Machinery Co., size of low pressure cylinder 14", high pressure cylinder 9" with 10" stroke. Compressor was driven by belt with a 75 h.p. Westinghouse Motor. By reducing size of pulley on Motor from 18" to 14" a minimum amount of power was consumed but with an adequate output of air to supply drills in the mine.

The drills used in tunnel work were two No. 248 Ingersol-Leyner Drills.

The tunnels were equipped with 16# rails and 2" air line, carrying air through No. 4, tunnel to the breast and up a raise into No. 3, tunnel.

Blacksmith shop was equipped with all modern equipment.

EQUIPMENT MILL.

A mill of 100 tons capacity was located near the portal of No. 4, tunnel and had been designed after the customary methods of the District for treating typical ores.

Coarse crushing was accomplished by a Blake Jaw Crusher. This was followed by fine grinding with a battery of 20 stamps. As a lot of the Gold - probably as much as 60% - occured free, it was the custom to have amalgam plates follow the stamps. Following the Plates, concentration was effected by means of Wilfley and Card tables. Classification was effected with the fines going to a Western Engineering Co., K & K flotation machine; and the oversize product being returned to the circuit.

The produce of the Mill therefore, was an amalgam that was shipped direct to the Mint at Denver, and a concentrate that was shipped to a local Sampling Works, later to be sent to the A. S. & R plant at Leadville.

A flow sheet of the mill follows:

FLOW SHEET OF LOMBARD MILL.

Mine

Mill Bin (75 Tons)

Blake Crusher (7" x 10")

Elevator

Mill Bin (150 Tons)

Challenge Feeders (2)

20 Stamps (1050 lb. each)

Elevator

Bartlett Tables (2)

Sands	Concentrates
Aikins Classifier	Smelter
Ball Mill (4' x 5')	
Amalgamating Plates	
Card tables (3)	
Sands	Concentrates
Wilfley tables (3)	Smelter
Slimes	Concentrates
K & K Flotation machine	
Tails	Concentrates
Rejected	Smelter

MINE CAMP.

There was located near the Mine a number of log cabins and dwelling houses. These were used to house Supt. and employees and also a larger one was used as a boarding house. The Company ran the boarding house and charged only a nominal amount for board.

TUNNELS.

The two upper tunnels - No. 1 and 2 - had no further use so no work was contemplated in them. Work was concentrated in the two lower tunnels - Nos. 3 and 4. As explained in the first part of this paper, these two tunnels had been driven to a point where, with but a very short distance of tunnel work would, in all probability, cut the ore shoot at depth that had been exploited in the two upper tunnels. These two tunnels were connected with a raise and were in excellent condition at the time this work was started.

No. 4, tunnel had been driven a distance of 3135 ft. and No. 3, had been driven 1100 ft. Both were the customary size of the District - that is, 5' x 7' in the clear.

The track - 18" guage - had been laid close to the one wall thus allowing of a wide space on the opposite wall for a foot path and also for a drainage ditch, which was, of course, kept covered.

The tunnels were driven with a gentle grade of about ½" per 10 ft. which allowed water to flow freely from the breast and the loaded cars to run away from the breast with very little effort on the part of the workmen.

A small Tugger Hoist operating by compressed air was installed at the top of the raise in No. 3, tunnel and was used to hoist and lower drill steel and other materials.

CHARACTER & EFFICIENCY OF LABOR.

The character of labor that is usually available at a metal mine undoubtedly depends upon the size of operation and the mining methods employed.

Since the very early days of the Idaho Springs District, there has never been any operations on any immense scale, such as now exist in the mines of the Couer d, Alenes, or the Porphyry Copper camps of the Southwest. The narrow fissure veins have not been amenable to any such scale of operations.

It has been the custom of the District to work the mine by Leases on certain blocks of ground within the Mine. This had been found to be the most economical method and it had this effect of giving to the Lessees a certain prestige which they could never have obtained had they been owrking for a days wage. They then were in the position of small individual operators. The Leasing system, therefore, demanded of the Miners that they be above the ordinary intelligence of the present Southern European Miner and as a result the types attracted to this District were mainly from the English and Scandanavian races. The Leasing system also had the effect of abolishing the Miners Union, and, therefore, labor troubles have never been heard of.

The Southern European Miner has never obtained a foothold in the District, so that now the District is known only as a "white man's camp". The "tramp" or "10 day" miner has never been welcome in the District; so most of the miners now own their own homes and as a result are of the highest types and most efficient of any that the writer has come in contact with.

METHODS EMPLOYED.

DRILLING & BLASTING.

The drifting machine used was the No. 248 Ingersoll-Leyner using $1\frac{1}{4}$" round hollow steel with ordinary American cross bit. The "down cut system" of placing holes was adopted. The usual depth of a round of holes was 4 feet. Eleven holes were drilled to "pull" a round of $3\frac{1}{2}$ feet. This depth of round after many experiments was found to be the most economical, as two shifts were employed with 3 men at each breast - a Driller, helper and mucker.

At the begining of a shift Driller and mucker shoveled back to set up - a set up being made with a light $3\frac{1}{2}$" column and arm. The amount of rock broken in a 5' x 7' drift and $3\frac{1}{2}$' deep, was as much as the mucker could handle each shift and at the same time keep track laid to the breast.

Holes were drilled and loaded with 60% gelatine dynamite, #8 X cap being used. Tamping for holes was ordinary soil obtained outside.

Immediately after the holes had been "spit", air was turned on and allowed to blow for one hour. This kept the heavy gases moving outward before they were allowed to settle and as a result there were no bad effects such as "Gassing of men" on following shift.

TRAMMING.

At frequent intervals along the tunnels one or two rounds were taken out to permit the side-tracking of 1 or 2 cars. This was done to facilitate the work of the mucker.

Tramming was done by hand from the breast of No. 4, tunnel to a side-track where the cars were taken care of by a driver and horse, that did the tramming from the side-track to the dump outside.

Tramming in No. 3, tunnel was performed from the breast to the raise that connected the two tunnels. The ore chute in the raise on No. 4, tunnel level was just above the side-track, so that cars could be loaded from the raise and run on to the side-track where they were taken care of by the driver. The driver attended to collecting of all cars and drawing of waste and ore from the chute.

The train pulled by horse was of 4 cars of One Ton capacity each. No tramming was done to the outside at night, as sufficient cars were available to avoid this.

VENTILATION.

Ventilation of the two tunnels up to where they were connected with a raise was natural. A draft was created so that during the Winter months air tight double doors were built at the portal of the tunnels to prevent freezing of tunnels and the air lines.

From the raise in No. 4, tunnel a ventilating pipe extended to within a safe distance of the breast. This pipe was 8" in diameter of galvanized tin in lengths of 10 feet and was suspended along the back of the drift nearest the foot wall. The joints were made air tight by wrapping them securely with cheesecloth that had been dipped in tar.

Suction was effected through this pipe line by means of a small blower driven by a 4 h.p. upright Steam Engine. The engine was operated with compressed air.

In No. 3, tunnel, no blower was available, but the suction in the pipe line was effected by tapping the main air line with a 3/4" pipe leading air into the ventilating pipe and through a jet. The force of air flowing through the jet produced the suction necessary for ventilation.

100 feet from the breast was considered a safe distance to which the ventilating pipe could be carried. As the main air line was allowed to blow for 1 hour after blasting, all gasses were carried back by this force to the ventilating pipe and there picked up and carried out to the raise.

TIMBER.

No great amount of timbering was required as most of the tunnel was in hard rock which stood quite well. At one place in the No. 3, tunnel some very soft schist ground was encountered that slacked very freely. Here for a distance of 50' it was necessary to timber the tunnel by means of ordinary tunnel square sets.

Timbering in the raise consisted only of short stulls and the man ways were lagged off by heavy spruce lagging 10' long and from 4 to 6" in diameter.

UNDERGROUND SAMPLING.

Sampling of the breasts of the drifts was carried on each day after each round. These samples were only taken from the vein and used only as a guide for detailed sampling of the backs that followed later. The results of these samples were not used for calculating the values in the ore bodies.

Sampling of the back of the drift was performed by using a stiff brush to clean off a place where the sample was to be cut and then a canvass spread to catch all of the cuttings. Cutting was done almost entirely with a light single jack and moils. Only vein material was sampled. Usually the vein was much narrower than the regular stoping width, so it was necessary to allow a safe factor for dilution when calculating the value of an ore body. Samples were taken at 10 ft. intervals. The width of vein was measured;

the character of vein material physical and geological character of wall rock was carefully noted. Along the intervals between the samples the vein characteristics and wall rock was closely studied. To the average person this would seem very superfulous, but in the narrow fissure veins it was absolutely necessary, if any degree of accuracy were to be attained.

The samples were carefully sacked in new or washed sacks and sent to the Assayer.

ECONOMIC FEATURES.

The main objective of this exploration and development work as explained under a foregoing heading, was to drive the two tunnels Nos. 3 and 4, to cut the downward extension of the ore body that had been encountered and successfully exploited in No. 1 and 2 tunnels.

An appropriation was made by the holding Company to undertake and prosecute this work. If the ore shoot extended in depth and continued with reasonable richness, it would have been a very highly commercial proposition.

The tunnels after reaching their objectives were allowed to proceed only very slowly until a careful sampling and estimating of the ore bodies had been made.

The results obtained and the manner in which calculations were made is as follows:

No. 3. TUNNEL.

Sample	Gold	Silver	Lead	Copper	Width	Value	Dollars	Cents
# 1.	0.10	0.20	0.90	0.12	50	2.20	110.	00
2.	0.48	1.10	1.10	0.40	31	10.70	331.	70
3.	0.20	0.40	1.30	0.10	37	4.40	162.	80
4.	0.72	1.10	0.90	0.40	42	15.50	651.	00
5.	0.44	1.24	1.30	0.50	26	10.04	260.	34
6.	0.26	1.00	1.20	0.20	26	6.20	161.	20
7.	0.40	1.00	0.50	0.30	30	9.00	270.	00
8.	0.03	0.20	0.30	No.	40	0.80	32.	00
9.	0.12	0.40	0.30	No.	10	2.80	28.	00
10.	0.12	0.70	0.26	0.16	16	3.10	49.	60
11.	0.34	1.30	0.44	0.26	30	8.10	240.	30
12.	0.16	0.40	0.80	0.16	36	3.60	118.	80
13.	0.04	0.30	0.20	No.	20	1.10	22.	00
14.	0.24	0.80	1.00	0.20	42	5.60	235.	20
15.	0.04	0.20	0.16	No.	48	1.00	48.	00
16.	0.02	0.20	0.10	No.	49	0.60	29.	40
17.	0.52	1.96	0.40	2.70	12	11.36	136.	32
18.	0.08	0.80	0.35	Tr.	36	2.40	86.	40
19.	0.20	0.30	0.15	Tr.	32	4.30	137.	60
20.	0.03	0.90	0.20	Tr.	50	1.50	75.	00
21.	0.68	2.00	0.46	0.16	29	15.60	452.	40
22.	0.52	0.70	0.50	0.16	26	11.10	288.	60
23.	0.62	1.00	1.36	0.36	29	13.40	388.	60
24.	0.42	0.80	1.10	0.20	36	9.20	331.	20
25.	0.06	0.40	0.55	Tr.	63	1.60	100.	80
				Total -	866		$ 4,747.	26
					Average		$ 5.	47

No. 4. TUNNEL.

Sample	Gold	Silver	Lead	Copper	Width	Value	Dollars Cents
# 1.	0.36	0.70	0.40	0.20	12	7.90	94. 80
2.	0.96	0.64	0.23	0.12	18	19.84	357. 12
3.	3.04	4.20	1.00	0.96	28	65.00	1820. 00
4.	0.56	1.00	0.36	0.24	48	12.20	585. 60
5.	0.24	2.50	0.40	0.46	48	7.30	350. 40
6.	1.12	3.00	1.03	0.36	38	25.20	857. 60
7.	0.30	0.50	0.20	0.30	20	6.50	130. 00
8.	0.08	0.20	Tr.	0.10	18	1.80	32. 40
9.	0.16	0.70	0.20	0.08	18	3.90	70. 20
10.	0.32	0.40	Tr.	Tr.	18	6.80	122. 40
11.	0.06	0.20	No.	No.	15	1.40	21. 00
12.	1.38	1.00	0.46	0.10	24	28.60	686. 40
13.	0.10	0.30	No.	No.	15	2.30	34. 50
14.	0.38	0.60	1.26	0.60	20	8.20	164. 00
15.	0.04	0.40	No.	No.	8	1.20	9. 60
16.	1.16	0.50	0.20	0.06	18	23.70	426. 60
17.	0.06	0.90	Tr.	0.16	18	2.10	37. 80
18.	1.16	5.00	0.90	1.06	12	28.20	338. 40
19.	0.88	4.40	0.32	0.50	24	22.00	528. 00
20.	0.06	0.80	-	-	38	2.00	76. 00
21.	0.76	1.90	-	-	24	17.10	410. 40
22.	0.60	1.28	1.00	0.80	28	13.28	371. 84
23.	0.46	1.40	0.55	0.60	36	10.60	381. 60
24.	1.42	1.00	0.30	0.20	14	29.40	411. 60
25.	0.44	1.50	0.45	0.20	12	10.30	123. 60
26.	0.20	0.16	0.25	Tr.	20	4.16	83. 20
27.	0.18	1.80	0.30	-	14	5.40	75. 60
28.	1.16	0.70	0.30	0.26	15	23.90	358. 50
29.	0.39	1.60	0.50	0.94	21	9.40	197. 40
30.	0.10	0.62	0.20	0.24	12	2.62	31. 44
31.	0.36	3.40	1.30	0.12	26	10.60	275. 60
32.	0.24	0.40	0.80	0.12	35	5.20	182. 00
33.	0.22	1.80	2.13	0.30	24	6.20	148. 80
34.	0.30	1.30	0.20	Tr.	24	7.30	175. 20
35.	0.38	0.90	1.53	0.16	20	8.50	170. 00
36.	0.14	0.46	0.26	0.10	40	3.26	130. 40
37.	0.22	2.40	0.30	Tr.	33	6.80	224. 40
			Total	-	856	$	10,494. 40

Average Width - 25. 8"

Average $ 12. 25

Assaying of the ore body in No. 4, tunnel showed that it was 338 feet in length and 25.8 inches in width. It was assumed as extending with this average value and with same width and length one-half of the distance between levels, or 145 feet.

Thus a rectangular block of ground having these dimensions gave 103,221.50 cu. ft. of Ore.

Assuming 11 cu ft. of ore per ton, we had "in sight" 9380 tons of Ore at $12.25 per ton.

The shoot encountered in No. 3, tunnel had an average value of $5.47 per ton. This could not enter into calculations as it did not come within the category of "possible ore".

SUMMARY & REMARKS.

This development work that had been carried on at a cost of apprirximately $30,000.00, had found the downward extension of the ore shoots that were found in No. 1 and 2 tunnels. The shoot appeared to be as large in every respect as it was in the upper levels, but it failed to carry the values that would have made it a commercial proposition.

One or two important facts were brought to light regarding the ore deposit; one of them is, that the richness of the shoot in the upper levels could only be attributed to secondary enrichment.

Another fact brought out will tend to prove the theory of the so called ZONAL ARRANGEMENT of MINERALS. The character of the vein material remained the same, both physically and chemically. There was an appreciable difference in the value of the sulphide ores. The greatest difference was the decrease of Gold values in depth. Lead values decreased in depth, while Zinc values increased and the Iron value - that is - the amount of Iron that existed as sulphide remained almost constant.

The proximity of porphyry dikes to the veins as effecting the ore values could not be said to be a factor influencing ore deposition, for the vein in the upper tunnels followed a 4 ft. dyke of Bostonite porphyry for a considerable distance, while in the lower tunnels the vein had cut a 12 ft. dyke of porphyry. The vein filling in each instance being decidedly younger than the porphyry. This does not prove, however, that ores do not owe their genesis to the porphyry intrusions, for subsequent study of all ore bodies of Colorado has proven, beyond a doubt that the Monzonite Porphyry intrusions have been the ultimate source of the ore.

The ore bodies that have been encountered and developed with this work could therefore not be recommended as a commercial proposition to a large Company operating on a large scale. The dilution of the ore through stoping would necessarily bring the values of the ore far below what could be commercially treated.

The ore bodies could however, be recommended to a group of miners who working on their own time and with hand methods could extract the rich part of the vein and leave the waste in the stopes. This would require very close sorting in the stopes.

Subsequent working of this property by another Company who have attempted to work it on a large scale has borne out the writers views.

Respectfully submitted,

Jas. Hopkins.

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