PRELIMINARY REPORT
POLAR STAR GOLD MINES.
EAGLE COUNTY, COLO.
C. T. Kennan, M. E.
The Polar Star Group of gold mines is situated in Eagle County, Colorado, in Fulford Mining District, and consists of six patented claims, to-wit:

The Polar Star No. 1; Polar Star No. 2; Polar Star No. 3; Polar Star No. 4; North Star and Aster; and four unpatented claims, to-wit: The Polar Star No. 5; Polar Star No. 6; Polar Star No. 7 and Polar Star No. 8; in all ten claims constituting a compact body of about 100 acres, or a little more. The title to the latter four unpatented claims is also good and unquestioned, and the same could be patented at any time in the regular course of business.

The distance from Fulford Mining District to the town of Eagle on the Denver and Rio Grande Railroad is about 16 miles by a good wagon road and the distance to the station on the D. & R. G. is about 10 miles with one mile of wagon road to construct to make connection with the mines.

The altitude of the mining district is from about 10,000 ft. to 12,000 ft. and the town of Eagle on the Railroad is about 6,500 ft.; and it is consequently all down grade on wagon road from mines to Eagle, also from mines to Edwards, which is about 7,000 ft.

There is ample good timber on the property and on lands adjacent to the property to last permanently for all mining purposes and as cheap fuel for milling purposes, if desired.

Ample power for all mining and milling purposes can be had from Nolan Creek, or West Lake Creek, which run through the district, the latter within a few rods of the Polar Star Group, affording the best of water for milling and culinary purposes.
The geological formations in which these mines occur are very simple, granite, basement overlaid by a blanket about 350 ft. thick of Cambrian quartzite, the upper half of which are more or less dolomitic; and further down the mountain side on the Western half of their property, the Silurian dolomite and carboniferous "Blue Lime" (Leadville formation) lap into and overlie the Cambrian quartzites, but this lower or Western portion of the property has not been prospected, and is covered with a layer of soil and has fine timber upon it.

In as far as the property has been developed on the higher and eastern side in the quartzites, it shows to be a gold property, silver seldom more than 3 oz., and lead and copper negligible. My samples 18 in number taken from the various workings and outcrops on the property averaged $15.01 in gold, besides small amounts of silver. About 3,000 tons of ores from the properties have been mined and sent to mill or smelter with assay values ranging from $10 to $60 per ton in gold, average values reckoned to have been better than $25 per ton.

These gold ores were exploited and mined on the Eastern or higher half of the property in the quartzites (as at Leadville) from veins cutting up through the granite and quartzite and in lateral replacement deposits from the veins in the quartzites. But upon exploration of the lower or Western side of the property in the Leadville "Blue Lime" and dolomite, deposits of silver ores and lead carbonates are almost sure to be encountered, as the geological and mineralogical conditions are there identical with those of Leadville and Aspen, and this property is on an outcrop of the same belt of sediments, and has the proper fissure vein "feeders" and porphyry sheets all complete.
The property is crossed by at least 7 separate, nearly parallel fissure veins, which cut up from out of the granite below through the overlying sedimentary rocks to the surface, and are there visible where the rock surface is not covered by soil or glacial drift. The blanket of quartzites immediately overlying the granite and granitic gneiss basement is about 350 ft. thick. These fissure veins have a strike approximately east-west with a dip substantially vertical, shading a trifle to the south.

Besides the ores contained in these true fissure veins, there are five series of "replacement" or "lateral" deposits in 5 separate layers or strata of the quartzites. These lateral or replacement deposits off from the main fissures are connected with and extend out from the vertical fissures at right angles to the latter, or in other words, project out from the sides of the fissures as wings in flat shaped deposits, often extending from a few feet to 100 ft. or more, on each side of the fissures, such deposits occupying space formerly occupied by a layer or layers of dolomite quartzite.

These main vertical fissures are usually more or less faulted, are persistent, and exhibit great continuity, no end of any of them longitudinally or in depth having, as yet, been found. In these fissure veins the richer ore matter lies in lenticular or tabular shoots between the walls with their longer axes probably approximating the vertical. The respective widths of these vertical veins vary at different points along their courses from a few inches, or a foot to 7 or 8 ft. with an average of perhaps 3 ft. Where the fissures have been originally open the resulting vein exhibits in many places a roughly parallel alignment of minerals, and little replacement of the wall-rock is noticeable; where on the other hand
the fissures have been narrow the maximum replacement is to be observed along the soluble sedimentaries. Narrow subsidiary fissures, or shear zones are apt to be developed in considerable numbers, and the large flatshaped ore masses or replacement deposits, are formed off from them also, as well as from the main fissures. The fissure veins, especially when faulted as is generally the case will extend in depth further than mining operations can follow them, and, for all practical purposes, are bottomless in the granite.

The "lateral" deposits above mentioned probably constitute the larger bulk of the ore located in the quartzite above the granite, and such deposits are very extensive and numerous, their extent and frequency depending chiefly on the solubility of the rock adjacent and near to the main vertical fissures. These lateral deposits are geologically similar to those of the Aspen and Leadville districts, and the great American Nettie Mine near Ouray; The so-called silicious deposits near Lead and Homestake in the Black Hills are similar, and geologically and minerallogically practically identical.

There is a steep cliff, or escarpment, running along the northeastern side of the property for the whole length of the property and beyond each way, being a perpendicular "break-off" so-called through the quartzites, of about 400 to 500 ft. down to a deep gulch, the floor of the gulch being in the granite, and on this great wall the rock formations, fissure veins, lateral deposits, and ores are plainly exposed, as on a "Blackboard"; thus naturally developing the property as it were, by an open cut through the quartzite 400 ft. deep and a half mile long. This wall is so steep, however, as to be inaccessible for prospecting except at a very few scattered places.
near the top of the quartzites, and the lateral deposits are all in the upper half of the quartzites.

From the top of this high escarpment the quartzite beds dip at an angle of about 35 degrees westwardly down the western side of New York Mountain at a somewhat steeper dip than the slope of the surface of the mountain side.

The property therefore contains these two distinct classes of ore deposits; (1) Fissure veins; (2) Replacement deposits in the dolomitic quartz; These two classes of ore bodies owe their existence to the presence of the fissures through which the mineralizing waters have ascended and circulated; the minerals having been deposited from thermoaqueous mineral-laden solutions. The form of the ore-body deposited was dependent on two factors; the amount of open space in the fissures and the kind of rock through which the fissures pass. The mineralizing waters by which these ore-bodies were produced have been both the solvents of the country rock and the agents which have effected the ore deposition, as well in the fissures and in the lateral or replacement deposits, called, "replacement" deposits because they have been formed not by the filling of open spaces existing previous to their deposition, but by a chemical interchange of ore material for original country rock.

The lowest layers of these Cambrian quartzites are made up chiefly of coarse grains of granitic quartz and feldspar, microcline feldspar, as found in the adjacent granite the cementing material being both feldspathic and siliceous. Further up in the beds the quartz grains become finer, the feldspathic constituent diminishes, the cement becomes secondary quartz grown to the grains, and the rock is very compact, but the upper half of these quartzite strata is not so
compact or pure as the rest. The tendency to oxidation increases toward the top of the series, so that in planes the whole rock is altered.

The conditions suitable for the subsequent deposition of the calcareous sediments to form the great bodies of superposed Silurian dolomites are here foreshadowed. In the interstices between the quartz-grains, besides the quartz-cement, are found frequent scattered crystals of carbonate of simple rhombic form, and of grayish color, shown by analysis to be dolomite. This very profusely scattered dolomite in some strata in the upper quartzites seems to have crystallized at the same time as the secondary quartz and it is obvious that the dissolution, and easy solubility, of these dolomitic crystals is the cause of the rapid alteration of the rock. By their removal cavities are produced which are afterwards enlarged by solution of the quartz. The quartz cement seems more easily dissolved than the original detrital grains, so that the grains become partially isolated, are carried or weathered out of the rock mechanically, and the cavities are continuously enlarged until the rock becomes so cellular as to be hardly able to hold together, and finally crumbles into soil—uncompacted sone. It was in such easily soluble rock-beds that the heated mineral laden solutions carved out a home for, and deposited their burden—the gold ores of the "lateral" deposits in the quartzites.

These lateral or replacement deposits consist of a series of broad, flat-shaped bodies of ore occupying the spaces formerly filled by quartzite beds, generally from 3 to 5 feet thick, and rest on a floor conformable to the regular slope of the strata, and are mined like coal, except that the roof and the floor are stronger and need less timbering, the ores are usually soft and friable and cheap to mine. Work to a lesser amount has been done on the fissure veins, as
as these lateral deposits are easier worked, and at least equally good
ore both kinds of deposits having been formed by the same mineralizing
solutions ascending through the fissures, and the lateral chambers be-
ing possibly the more favorable for ore deposition than the fissures
themselves. Besides it is recently held by some of our ablest geo-
logists, which opinion is finally shared by the writer that such chamber
deposits are frequently enriched by lateral and overhead secretions or
solutions circulating through the joint planes and bedding planes of
the sedimentaries, a conclusion, in this instance the more readily con-
ceived in view of the fact that these Cambrian quartzites at this place
have probably been denuded of not less than 15,000 ft. in thickness of
overlying sediments.

The ores are simple, clean, and easy of treatment. The gangue is
quartz, feldspar, and iron ores, oxide and carbonate of iron with
little pyrite and very minor amounts of calcite and fluorite. The
iron content carries much of the gold values and is very easily con-
centrated, of course. The gold in the ore exists in three positions.

(1); Coarse free gold;
(2); Gold entangled in the iron, much of it in a very fine state of
division "flour gold"
Flour gold in the balance of the gangue.

Three processes are open and feasible for saving the values;
(1) Amalgamation of the coarse gold followed by cyanidation.
(2) Amalgamation of the coarse gold, followed by concentration
and shipment of concentrates to smelter, and cyanidation of tailings.
(3) Fine crushing and Pierce Gold Savers are thought by actual
test to save better than 85 percent of the values.

On a regular tonnage of iron concentrate the smelters will fre-
quently do the smelting free of charge, needing the iron as a flux in
smelting other ores.
The ores at different positions in the mines would concentrate variously, from 3 or 4 into 1. And the concentrates would run variously from $25 to $300 per ton, sometimes much higher. If they were run over the plates the values left in them would depend largely on the fineness to which they were crushed.

The geological and mineralogical conditions surrounding the property, and evident processes of ore deposition would surely lead a sagacious miner to believe that on the lower or western half the property "Leadville" deposits of silver-lead ores should be disclosed by proper developments in the Silurian dolomites and Carboniferous "Blue Lime" which there overlie the quartzites—this portion of the property being now veiled by soil and surface material, has not been exploited, but that it has the "Leadville formation there; the Cambrian quartzite, the Silurian dolomite, and the Carboniferous "Blue Lime" the "White porphyry" and the "fault fissure feeder", all complete and identical with Leadville is certain. While I believe the existence there of "Leadville" silver lead ore-bodies to be extremely probable, it is a matter not up for consideration at this time, and the mines are amply good enough as gold mines on the lines of development already made.

Upon examination of the property two things are self-evident to the experienced engineer(1) That the ores are very abundant; (2) That the great bulk are good pay ores which on the whole, might be classed as moderately high grade. By reason of the mines distinctive geological and mineralogical characteristics and artificial development, it has passed the stage of a prospect in the ordinarily accepted meaning of that term and is a mine. From the present showings and workings made artificially and by nature on the property, and the peculiar geological and mineralogical conditions (heretofore tested and operated hundreds of times in some of the principal mining districts of this
State and elsewhere, it is manifest to any experienced miner that there is ore enough in these properties above the granite to last a mill of 100 tons per day capacity for 8 or 10 years at least. I suggest a mill of 100 tons per day capacity, as there is a 25 stamp mill in the district which has been little used, and is in good condition, could be cheaply obtained, and with the addition of other machinery above outlined it would be suitable for treating about that amount per diem.

Of the 3,000 tons sent to mill or smelter all except three carload were treated at the simple stamp mill, above mentioned, located by wagon road about 2 miles from the mines. Of course this mill saved only the coarse free gold, and not all of that; the balance of the values went off in tailings down the creek. It is estimated that only 20 or 30 percent of the values in the ore were saved in the stamp mill, and 70 to 80 percent were lost. At this, money was being made, but the enormous wastage compelled them to desist from attempting to treat the ores by stamp mill alone, and the mines have not been operated for several years past for lack of proper machinery.

The mining of the 3,000 tons was done by "lessees", whose business of course, is always to extract the ore and utilize it as fast as they come to it, and not to block out large quantities in advance, and leave it standing in the mines, with which to make a favorable showing upon which to sell the mines. Unfortunately for the owner, but fortunately for the purchaser, the property is in a poor state for examination and sale, and the owner is therefore compelled to ask a very low price in comparison to the real worth of the property. I apprehend that the judicious expenditure of $10,000 in development would give the mines a sale value of $250,000 at least.

On the great wall or "break off" on the northeasterly side of the
property are exposed the vertical fissures and five nearly horizontal lateral planes of ore deposition, with five series of the flat-shaped ore deposits, one horizon at intervals above the other, the top-most nearly at the surface; and a half dozen or more workings of greater and less extent have been made in the ores at near the top of the cliff from which opening many hundred tons of ore have been taken to mill.

A 35 ft. shaft on the vein of the North Star claim is in ore from near the top and two ten foot pits on the Aster claim are also in ore from near the top, the bottom of one of them exposing the vein over 6 ft. wide - wall not found on north side. Another 10 ft. pit west of the shaft house exposes the vein in the bottom at least 4 ft. wide. There are a half dozen, or so, other small adits, pits, and workings on the upper side of the property opened in ores which outcropped, or came near to the surface, and there is abundant float ore scattered over the surface of the property. The principal workings, however, are in and adjacent to the 400 ft. tunnel on Polar Star No. 3 with an incline upraise to surface at cliff edge which was made in stoping ore; and an incline stope 100 ft. downward from this tunnel and back westward from near the point where tunnel strikes lateral deposit. The lateral deposits in here are from 20 to 75 ft. in width, and there are some exposures of ore standing in place yet, both of fissure vein ores and replacement deposits in these workings from these workings alone over 2,000 tons of ore were taken to mill. The ore taken to mill was largely from two shoots which outcropped near top of "breakoff" one known as the $40 shoot, the other as the $60 shoot", so called from the grades of ore they usually produced and sent to mill from them. These workings were made principally on the incline of the strata from near the top of the "break-off" in stoping lateral deposits.
Three carloads of ore were sent to outside reduction works which averaged about $40 per ton. The owners of the property and all others conversant with the facts, as workmen in the mill and mine, state that the 3,000 tons, or so, sent to stamp mill from the property averaged better than $25 per ton throughout. While this was certainly large sampling and would, in most cases, be taken as conclusive for all practical purposes, yet it is not at all necessary in our position and under the circumstances, considering the small price asked for the property, to reckon it as necessarily the average run of mine.

Presumably in sending it to a mill from which an extraction of only 20 to 30 percent could be expected, it would have been sorted or "cobbed" some, but as it was mined by contract, and in such cases little or no sorting is usually done, the owners insist that everything was "thrown in". My assay samples, several of which were taken at "grass roots" and of surface material, and from ores rejected and left standing in the stopes as too low grade to then send to mill, averaged $15.01 in gold; but as the ore is of such varying grades running in pieces up to $30, $40, $50, and $60 per ton, and in spots doubtless even higher, also much lower, it is manifestly impossible at present to make an accurate and exact estimate of what the daily profits would be with such a plant as above proposed in operation, but good profit there would be is certain and even reckoning the gold content of the ores, as they would go to mill in our practice, at $10 per ton, which would be very low in the face of all the known facts, and the cost of mining and treatment at $5.00 per ton, which would be very high in view of the quantities and nature of the ores, the net profits per day on 100 tons per diem would be $500.

Respectfully submitted,
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