

452

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COLORADO SCHOOL OF MINES  
GOLDEN, COLORADOPerigo mine  
Gilpin Co., Colo.

Central City, Colo.,

March 12th, 1897.

Mr. Irving T. Bush,

New York, N.Y.

Dear Sir:

In accordance with your instructions, I have examined the property of the Rollins Mining Company, in Gilpin County, comparing the same with the reports of Messrs. Gribble, Teal, Foster and Tyler, and with the maps accompanying the latter report.-which correctly show the position of the workings up to October, 1896.

This extensive property, rather a mining camp than a single mine, has been so long neglected that the workings on the smaller veins are now mostly inaccessible. The tunnels have caved, shafts are without timbering or ladders, and the surface diggings are largely filled in. Even the Gold Dirt mine, said to be securely timbered, was at the time of my visit so solidly blocked with ice at the tunnel entrance, that it would take a week's work to open it for inspection. After making such examination of the surface workings as the deep show permitted, I therefore turned to the Perigo mine itself, giving special attention to the operations of the present lessees. While all records show that other parts of the property have been almost equal important producers in the past, it is on the result of these workings that its immediate future depends.

#### THE PERIGO MINE:

The Perigo mine is apparently formed by the junction and crossing of several nearly parallel veins--forming a belt

of altered and mineralized country forty or fifty feet in width, in which there are often at least two distinct pay channels, one on each wall. The underground explorations show this great vein or belt to have a horizontal length of at least eight hundred feet; and although at no level is the whole of this length pay ground, yet it is full of valuable masses and shoots of ore; while it includes no large area of entirely barren material. Beyond this pay belt, the vein to the east is unknown-and therefore probably valueless - at surface; while the eastern workings of the bottom tunnel do not encourage the expectation of finding much in depth. West of the pay belt, the great vein splits into several smaller ones, which have been but little explored; although one, at least, of them, the Sprue, is of very promising appearance. Developments in this direction are of the greater importance, because of the notable depth gained by the tunnels going west; and the surface pockets in this part of the property have been so valuable that good ore bodies are almost certain to be found by proper exploration.

#### UPPER TUNNEL WORKINGS:

These workings are in very bad condition above the tunnel level, the large ore bodies met with being extracted so unskillfully that much ore was lost from caving in of the walls. The veins on the north and south walls of the ore belt, known respectively as the Baker and the Perigo, form a great letter Y., of which the limbs join about sixty feet under the tunnel level. The mass of mineralized rock between the two is still largely intact, and represents many thous-

-ands of cords of ore ground. Some five hundred tons extracted and milled by Mr. Lawrence, in the end of 1894, yielded, according to the mill records, 3 oz. 8 pwts. per cord, or with the concentrates, about \$3.50 per ton - a payable grade of ore with anything like cheap handling. But owing to the waded condition of the workings, it would be very costly work to reclaim much of this "keyrock"; the higher grade ore has already been worked out, so that nothing could be expected to raise the general average; and from my examination I am convinced that as the center of the key is reached, the grade will fall off. It is in fact most mineralized near the limbs of the Y., and increasingly poor toward the center. I believe that these old workings can be made to produce a large tonnage to keep a mill going in slack times; but that little clear profit can be expected from them.

The extension of this tunnel west apparently leaves the Perigo, and follows the "Sprue" vein; although the last fifty feet or so are off the vein altogether. Some 200 feet of ground opened by this level is marked on Tyler's profile map as "ore six inches to three feet wide"; but by my measurements, it will average less than a foot, and is very irregular. This level was driven in Mr. Lawrence's time; and from October to December, 1894, produced eight cords of ore, which yielded in the mill 14 ounces of retorted gold. This is fairly satisfactory as to grade, and fully confirms a large sample taken by myself; but the small quantity shows that the ore streak must have been quite narrow. The great block of

ground over this level is untouched almost to surface; and while it cannot be considered as proved ore "in sight", it should certainly be further tested by one or more upraises.

The west extension of the level eighty feet beneath the tunnel is also in poor, though not in entirely barren ground; and there can be no doubt that the western or "reservation" ore body is generally poor at this horizon. The middle or "pontoon" ore chute is untested below the eighty foot level, down to which it was rich and valuable; the 200 foot level should certainly be extended west to test this ore body. The eastern ore chute is probably the same as that first cut in the bottom tunnel, on which the raise has been carried up, as described further on. To the east of this again, the vein is but little tested, but so far as is known is barren.

The only block of proved ore ground technically "in sight" in these old workings is on the south vein, from the tunnel level to the "reserve level" about forty-five feet above (See Tyler's profile map). This block is about 200 ft. long by 45 ft. high, and should produce some 2000 tons of fair mill ore. There is also some good looking ore exposed on the north or Baker vein, along the back of a little level 30 feet under the tunnel, in the east end of the mine (See Tyler's section A. A.).

#### LOWER TUNNEL WORKINGS).

As Messrs. Brooks and Lightbourn have clearly perceived, it is on the developments at the lower tunnel level, 450 ft. below the upper tunnel, that the future of the mine depends;

and here things look much more cheerful. Workings under Mr. Lawrence's lease must have been very disappointing to the lessees. After first striking the presumable eastern extension of the Perigo vein, and drifting on the barren vein matter some fifty feet, the tunnel was swung south through country; and only turned back again to the vein at a point almost vertically under the best part of the old shallow stopes. Here the vein was still barren - though nearly ten feet in width, and full of decomposed and shattered country. A cross-cut put out to the vein some 150 feet further back -- and which cuts the vein considerably south of the point shown on Tyler's map - found it also entirely barren; and this was the position when the present lessees took hold last year.

They at once commenced to drift west on the vein; which after thirty-five feet gets narrower and more vertical, and begins to show pyrites in spots. At 70 feet they struck pay ore, and this has continued more or less regularly for over ~~50~~<sup>450</sup> feet; the tunnel now being 540 feet from the point where they started, and the last 20 feet showing better than any place in the entire drift. A fair sample from the breast over four feet in width, yielded on assay \$8.50 per ton in gold. Later developments point to the conclusion that the ore chutes in this part of the mine have a strong westerly pitch, which accounts for nothing being found in the workings of the former lessees.

The attached sketch profile shows in detail the width and character of the vein (or rather of that part of the vein which is payable stoping ground) along this tunnel, and in

the raise and stope which have been carried up to communi-  
cate with the workings above. It must be understood that  
the parts marked "poor" are never entirely barren or without  
spots and strings of ore; but simply that this ground was  
thrown over the dump instead of being milled during the pro-  
gress of the drift, and that it will not, in my opinion, pay  
for stoping.

At 245 feet from the beginning of their workings, the  
lessees have cross-cut about 60 feet north, on a narrow cross  
vein which is not without gold values. Near the end of this  
cross-cut a strong vein is struck which seems to run back  
towards the Perigo, and join it near the present end. From  
this vein, 10 inches in width, a fair sample I took assayed  
\$39.20 per ton in gold--showing it to be well worth careful  
attention.

Except in these parts marked "poor" the whole of the  
stuff broken from the drift has been taken out for milling;  
nearly one-third however, being wall-rock which was picked  
out and thrown over the dump. This leaves about three and a  
half feet as the average width of the milling ore - a safe estimate of what would pay for stoping. This ore from the  
drift has unfortunately not been milled by itself, so its  
value can only be ascertained by samples and by judging the  
character of the whole of the ore milled.

The ore obtained from the raise and stope is obviously  
not quite a fair criterion of the value of the ore shoot  
through which it passes, as it was not kept at one regular  
size or angle, but enlarged wherever the ore streak was good,

and narrowed whenever it was smaller. It thus yielded more ore per square fathom of vein than would otherwise have been the case. On the other hand, it was carried up with machine drills, which broke more of the barren wall rock than would have been the case with hand labor--a condition only partly remedied by the picking out of a good deal of waste rock. I therefore judge that while this raise and stope has yielded considerably more ore than an average equal area of ore chute, the value of this ore per ton is a little less than normal.

During the present lease, nearly 6000 tons of ore have been milled; yielding in gold \$8.56 per ton, and in concentrates 0.90 per ton gross, or .44% per ton, after deducting costs of freight and treatment; a total net mill return of \$4.00 per ton of ore milled. But for the last month or two, this value has been much exceeded; the saving in gold rising to \$3.75 per ton, and in concentrates to \$1.60 per ton net; the amount of concentrates remaining the same, at about nine per cent. of the weight of the ore; but their assay increasing from 12 pwts. gold to 1 oz.4 pwts. per ton. This notable improvement from \$4.00 net to \$5.35 net, is mainly due to the change in the west end of the tunnel level.

By ~~measuring~~ measuring the area of ground broken, and comparing it with the amount of ore milled, it appears that each square fathom of vein area removed has yielded eighteen tons of mill ore. For reasons already explained, I should expect that in future the workable parts of the vein would yield only twelve tons of ore per fathom, but that it is safe

to reckon upon a net yield of five dollars per ton,

#### ORE RESERVES.:

The ore at this tunnel level has mainly been only opened on one side--by the drift itself; except on the outer ore chute there is no upraise on the vein; and the nearest level being 370 ft. above, with a very irregular ore body, it is idle to take the cubical contents of so large a block of ground, and call it all ore. The outer or eastern ore chute has already yielded 5000 tons of ore, and may fairly be expected to give 7500 tons more, above this tunnel level. And while I do not doubt for a moment that the western ground now opened in the tunnel will yield far more than this, any closer estimate at the present time would be but guess work.

#### COST OF MINING:

Except where the abnormal width of the vein would yield correspondingly more ore per fathom, the ore ground in this vein could be stoped at an inclusive price of about \$12.00 per ~~ton~~ <sup>fathom</sup>, or say \$1.00 per ton of milling ore. Trimming is at present done through the tunnel to surface, a man and horse taking out four cars, each holding 1 1/3 tons, at a trip. By widening the last 550 feet of tunnel, so that the cars could be hauled into the shoots under the stopes, and by relaying the track on a regular grade instead of the present slip-shod style, the cost of trimming need not exceed ten cents per ton on the large scale. Much of the ore from the upper part of the mine would have to be handled twice, to get it from the stopes to the passes; and these latter would also require constant attention. It is safe to say that the to-

tal cost of handling and tramping should not, on the average, exceed 25¢ per ton. The costs would thus be as under:

	Per ton of mill ore.
Stoping,	1.00
Handling and tramping,	.25
Drifts and raises,	.50
Cross-cuts and dead-work,	.10
Timbering and Foremen,	<u>.15</u>
Total; . . . . .	\$2.00 per T.

It is needless to say, these figures would only apply when working on a large scale, and while still above tunnel level.

#### TREATMENT OF ORE:

The Perigo ore differs from the regular Gilpin County type, in that the only notable sulphide present is iron pyrites; the "faces" of specular iron on the joint-planes are also unknown around Central City. The values are almost entirely in gold--the crude mill bullion being worth nearly eighteen dollars per ounce, and the concentrates rarely assaying over one ounce of silver per ton.

Ore massive enough to ship as smelting ore is rare, only amounting to a quarter of one per cent. of the total output, under the present lessees. The great mass of the product has always been of a milling grade, and there is no reason to expect any great alteration.

The ore is now treated in an old 25-stamp slow drop mill very ill situated, and with a winter water supply sufficient only for fifteen stamps. Being without crusher or automatic feeders, and having a very wasteful steam plant, the present cost of crushing must be extravagant; but I see no reason why it should not do as good work on this ore, as other mills of

its class.

A sample of the mill waste taken by the mill-man yielded \$3.30 per ton in gold and a careful sample taken by myself, assayed \$3.90 per ton. As the mill was only making a total gross saving of \$6.00 per ton at the time, a very heavy loss of nearly forty per cent. is indicated. It is, however, but fair to say that this loss was probably much less some months ago, when the value of the concentrates per ton was far lower.

To investigate the cause of this heavy loss, the waste was separated into three different sizes, each being assayed separately. The finest size was further separated by careful panning into "waste" and "slime sulphides". Results were as under:

	% of Weight.	Assay, Gold p.T.	% Gold Val.
Stayed on 60 Mesh,	9.4	\$0.50	1.275
Stayed on 100 Mesh,	24.1	2.40	15.7
Through 100 Mesh:			
Slime Sulphides,	3.83	29.20	30.355
Waste,	<u>62.67</u>	3.10	<u>52.67</u>
	100.		100.

From this, it appears that the coarse waste is almost free from gold; and that the slimes account for practically all the gold values. The slime sulphides recovered by panning, assay higher even than the coarser concentrates now saved on bump-tables; and although these could probably be recovered by second bumping, as practised at certain Black Hawk mills, there is much still finer slime pyrites which cannot be saved by any known appliance.

The remedy is obviously coarser crushing--which also fortunately means cheaper crushing. Careful panning tests show that by ordinary coarse concentration nearly 85% of the

gold can be saved; while as good results would probably follow the use of a much quicker drop mill, with amalgamation followed by careful ~~examination~~ <sup>concentration</sup> of the pulp. I should recommend that tests, under the most accurate supervision, be made at a Black Hawk quick-drop mill, and a concentration mill, before finally deciding on any alteration. But I am distinctly of the opinion that either of the processes indicated would result in an extra saving of \$1.00 per ton. - ~~the~~ most important matter with such low grade ore.

#### FUTURE MILLING:

Three sites have been proposed for a new mill to treat the ores of this property; at Rollinsville, at a point in Gamble Gulch below the Gold Dirt tunnel, and at the mouth of the present Perigo tunnel. The main points affecting a decision are water supply for milling, water for power, and cost of haulage. The present flow of water from the lower tunnel is by actual measurement, 14 cubic feet per minute; or reckoning  $1\frac{1}{2}$  cubic feet per minute for five quick-drop stamps, sufficient to mill 90 tons of ore per day. The water is pure and soft, very good for milling purposes; and the season being exceptionally dry, and at the depth of winter, this will increase rather than fall lower. With the water from the existing upper mill, this should suffice for the boiler and battery water of 100-ton mill, although this would be the utmost limit of size, unless the water were repeated.

With wood at \$3.00 per cord, delivered at the mill, the cost of fuel per ton of ore crushed would not exceed 18¢ per ton with a good engine. The distance from the tunnel to

Rollinsville is three miles in a straight line--with very rough country and a total fall of 1200 feet between the two points; so that ore could hardly be transported by any small tramway system for less than the extra cost of steam milling at the mine. The site below the Gold Dirt tunnel has very much more to be said in its favor. The distance here from the Perigo lower tunnel is about a mile by road, or 4000 feet in a direct line, with nearly five hundred feet of extra fall. A mill here would take ore from every important property of the Perigo group; it would gain quite a little extra water from the tunnels on these lower veins; and about 10 Horse-power, --or enough to drive all the concentrating machinery in the stamp mill--could be gained by fluming and piping the Perigo water to this point. But it would entail the extra cost of hauling all the Perigo ore down the valley; which would be 25¢ per ton by road, or about 15¢ by tramway and inclined plane.

The site at the Perigo tunnel would be the cheapest in every way, and probably the best, unless extensive operations on the other veins of the group were contemplated.

Milling by steam on the large scale, with good modern automatic machinery, would cost from 55¢ to 65¢ per ton, according to the perfection of the concentration of the ~~new~~ mill pulp.

#### WATER POWER:

The property includes a fine water right, two miles in length, on South Boulder creek, with a ditch designed for 3000 miner's inches, which gains about 100 feet vertical of fall, at a point half a mile below Rollinsville. But it

would not in my opinion ever convey this amount of water, even when thoroughly repaired; nor is there any such volume of water in the creek, except during five or six summer months. Like most Colorado streams, its volume of water is subject to the greatest fluctuations; and it is very low indeed from December to April, especially on cold mornings, after a hard frost. I think that a flow of 1500 cubic feet per minute--or with 100 feet of fall, say 240 H.-P.--could be relied on for say eight months in the year. But only storage on a large scale could give a power of much value during the four winter months. For this, the Rollins Company does not at present own any suitable site; although there are several further up the valley.

For these reasons, any mill now installed at the Perigo mine should be provided with a good steam-power plant; which could be used as an emergency plant, should it be deemed desirable to erect an electric generating station, or a large water driven air-compressor, on the South Boulder later on.

#### CAPITAL REQUIRED:

The main outlay immediately necessary is for a mill, as above. A 50-stamp quick-drop mill, to treat 100 tons of ore per day, with good Corliss engine and boilers, crushers and automatic feeders, and suitable concentrating plant, complete with bins, etc., would cost inside of \$35,000.. If placed below the Gold Dirt tunnel, this mill would at present suffice for the whole property; and if it were decided to erect the mill at the Perigo tunnel, a smaller capacity, say 30 stamps, or 60 tons per day, is all that the present actual

developments warrant. This could be erected for about \$20,000..

To keep development ~~well~~ ahead of ore production, it would be wise to allow \$10,000. for drifts and raises on the Perigo vein, and to make the various improvements at tunnel level, which the greater output will necessitate. There are also a few necessary surface improvements--such as rebuilding the compressor foundation, roofing the various houses on the property, building an assay office, etc., which could be done with part of this same money. About double this sum, or \$20,000., should be provided for the reopening and extending of the workings on the other veins of the group, and particularly of those on the Gold Dirt vein.

#### CONCLUSION:

It will appear that the Perigo mine, as at present opened, shows a large body of milling ore, which will yield a good profit if economically worked on a large scale. But like all other fissure veins, the pay ore only occurs in certain channels or chutes in the vein; and development work will have to be kept well ahead of extraction to make it a lasting and steady producer. This is all the more necessary as there is now no large reserve of ore blocked out and awaiting stoping.

The other mines of the group, and especially the Gold Dirt mine, are of the greatest promise. But they will require both time and money to open them out into valuable mines. The other advantages of the property--its extensive timber and farming lands--water power, and other advantages--

I need not enlarge upon. Suffice it to say, that it has the makings of one of the greatest mining properties in this part of Colorado; and if properly worked, can hardly fail to be highly profitable.

I am, dear Sir,

Your Obedient Servant,

Arthur L. Collins