LOCATION:

The location of the proposed tunnel of the Pewabic Gold Company is through the center of the most productive section of one of the most famous Mining Districts of the world. It is known as the Clear Creek Mining District, Gilpin County, Colorado, 33 miles by the Colorado & Southern Railway, due west from the City of Denver; 1 1/4 miles east of the City of Black Hawk.

The Portal of the Tunnel and Site for the Mill is on North Clear Creek, 150 feet from the Colorado & Southern Railway tracks, at an elevation of 7,850 feet above sea level.

The Tunnel is now in 670 feet driven on the East Williams Lode, towards the Williams Mine.

The Williams Mine is 3,800 feet from the portal, and is the first mine of major importance on the line of the Tunnel.

The Tunnel being driven on the main vein system of the district, will have the double advantage of going the shortest distance to the objective point, but also of developing hitherto unknown ore bodies, the extent and value of which can only be conjectured.

The Tunnel continued from the Williams cuts through Lower Lake District, Lower Russell District, Middle Russell District, and to Upper Russell District, a total length of 18,500 feet.

Laterals are contemplated from the Williams along the Washington, Justice, Shamrock, Bonanza vein to the southwest; along the Orion, Pittsburgh, Nottaways, Aurora veins to the northwest, with extensions on the Clay County, Caledonia veins to the north.

The Company owns a Mill Site, a Tunnel site, and water rights at the Portal of the Tunnel on Clear Creek, where there is an abundance of water for milling purposes, and it also owns considerable patented and unpatented mineral property along the line of the Tunnel.

GEOLGY:

The Geology of the districts encountered is well surveyed and described by Professional Paper No. 94 of the U. S. Geological Survey, by Mr. Edson S. Bastin and Mr. James M. Hill.

In general the country rock is Idaho Springs Schists and Pre Cambrian Granites, but cut through by intrusions of Monzonite and Bostonite Porphyries. The vein fractures have a general S. 80 degrees W. course paralleling each other and converging at acute angles to the main fracture that the Tunnel is being driven on.

The vein fillings are quartz, and sulphides of iron, copper, lead and zinc carrying gold and silver. The country rock is impregnated and altered to quite a degree on either side of the vein, and has corresponding economic value.

North of the Tunnel site one mile are the Fifty Gold Mines whose production aggregated some $34,000,000 and whose ore is of high grade at 1,400 feet vertical. The Mines of Quartz and Gannel Hills, whose values were proven from 1,400 feet vertical to 2,200 feet vertical are one mile north of the Tunnel line.

South a mile from the Tunnel line are the Gem Mines, worked profitably to their 2,200 foot level; the Sun and Moon, 2,100 feet; the Frontenac, to a depth of 1,000 feet.

The last shipment made from the Pittsburgh Mine, which is in this project, the 1,100 foot level, approximately the Tunnel level at that point, yielded in carlots 10.50 ozt. gold, 25.00 ozt. silver, and 14% copper—a gross value of $288.00 per ton.

HISTORY:

The section through which this mining, drainage and transportation Tunnel is projected, was discovered in 1859 shortly after the discovery of the first lode gold in Colorado, June, 1859, one mile to the north of the Tunnel line.
The surface oxidized ores encountered yielded their values in gold fairly by a very crude method of crushing and amalgamation with mercury. When the sulphide ores were encountered and became more or less refractory to that method of treatment, a crude mechanical device was contrived which recovered a portion of the sulphides of the ores and their metal contents. On ore which contained appreciable amounts of copper, particularly chalcocite, enargite and tetrahedrite, but a small fraction was recovered, coincidently the gold and silver which adhered closely with these minerals was also lost.

As they worked deeper these sulphides and their associated values became more prevalent, and more difficult to recover. So that the only dependable ores for the operator were the solid and almost pure ores, which were richer in gold and silver values, for shipment to the smelter.

The ores being disseminated sulphides of lower grades, having from $5.00 to $18.00 per ton value consisting of 80% of the total tonnage, were not amenable to treatment and were rejected.

As the mines became deeper, the pumping and operating expenses became more and more prohibitive, and finally the mines closed for economic reasons.

**MILLING:**

The proposed Mill, built in units of 100 tons each daily capacity, will afford means for milling separately the ores from several mines. It is designed along the latest proven practices using the best methods for handling and crushing the ores and floating the values. The loading of the railroad cars for shipment to the smelter will be done mechanically.

The cost of milling, inclusive of amortization and upkeep will not exceed $1.00 per ton.

The operators of former times were compelled to send their ores to custom mills, whose charges ranged from $1.00 to $2.50 per ton. The recovery ranging from 35% to 75%, with an average of under 50% for the entire section. No devices were then in vogue which saved the copper sulphides and their associated gold and silver values.

On any ore that runs as high as $10.00 per ton, this mill project will give a net yield of $4.75 more per ton than by former mill practices.

**MINING FACILITIES:**

The Tunnel being driven, from an elevation of 7,850 feet North Clear Creek, cuts the greatest number of productive mines at an average depth of 900 feet, and will afford the cheapest method of operation of these mines.

The development will be along the "strike" of the veins. By laterals along the intersecting veins all the mines contiguous will be easy of access.

At the depth which it cuts these mines has been proven the maximum ore bodies and it will be the simplest arrangement to lower the ore in chutes to the loading stations at the tunnel level.

The deep mines will furnish natural ventilation and means of easy egress for the miners to Central City and Black Hawk.

Overhead expenses can be cut to a minimum, compressed air for drilling made available at the right point at a minimum of expense, in short, the mining costs will be but a fraction of former operating costs.

The average mine of these districts is located three miles by wagon road from the mills and railway station at Black Hawk. The cost formerly paid for hauling ores ranged from $1.50 to $2.50, averaging $1.75 per ton. Supplies and coal cost them an average of $3.00 per ton from the railroad to the mines.

The cost to the present Company for transportation should range from 15c to 25c per ton inclusive of upkeep and amortization. On the grade carried it will be possible to haul 50 tons per trip to the mill.

**DRAINAGE:**

The average ground water level of the mines is now about 200 feet from the surface, which leaves the major mines to pump some 300 feet of water. The tunnel will cut and drain them at an average depth of 900 feet. It is estimated that 90% of the ground water is encountered from the surface to 750 feet, so that the Tunnel will practically take care of all the water and the mines can be worked below the Tunnel level without a drainage expense.

From data available from former operators it is estimated that the drainage has cost the operators from $2.50 per ton for small tonnages to as low as 35c per ton for the large tonnages, with a probable average drainage tax of 75c per ton on all the ore shipped.

**COST OF OPERATION:**

The former operators depended upon the high grade ore to pay them and mined on an average four tons of vein matter to one ton of shipping ore so that their shipping ore must have cost them an average...
of $8.00 per ton by hand mining. The cost of hoisting was about $1.00 per ton, the cost of hauling $1.75, the cost of sorting, etc., to keep it clean, about $2.00, the cost of drainage was $75, and the overhead cost $3.00, so that the average cost to the operator for his shipping ore was about $16.50 per ton. This charge varied widely from $5.00 at the large milling mines in Upper Russell District to $45.00 at the high grade smelting mines in Russell Lake District.

Now that the metallurgical features have been satisfactorily solved, the mining takes on a simpler form, so that the power air drill may be used and the lower grades of ore that will yield a profit are shot down with the higher grade ore, and concentrated to a uniform smelting product. This will make the mining, transportation, overhead and milling cost to the Company $2.00 to $3.00 per ton.

This efficiency is not only appreciable in the direct saving of $13.50 per ton on the ore, but it also multiplies greatly the available tonnage of profitable ore. In general all the ore containing $5.00 per ton will yield a profit to the project. In exceptional cases ore with a value as low as $3.00 per ton will yield a profit.

MINING DISTRICTS

Lake District:

The first district encountered along the line of the Tunnel is the Lake District. This district from the portal to 6,300 feet is probably the best adapted of any to the new metallurgical treatment.

This area for 1,400 feet on either side of the Tunnel has been the longest inoperative. It has seven mines of major development whose average depth is 400 feet, the Tunnel will cut them at an average depth of 700 feet, so that on the dip there will average 350 feet of unexplored vein.

The estimated production of these seven mines is about $2,200,000, or an average of $79,000 per each 100 feet of each mine.

There are also some 24 mines which have been proven but not operated to any extent, contiguous to and dependent on the Tunnel.

Lower Russell District:

The second district along the Tunnel extending from 6,300 feet to 10,000 feet along the line, is also dependable for metallurgical improvement to be profitable, and the ores are peculiarly amenable to the new flotation process.

This area, embracing 1,200 feet on either side of the Tunnel, has eight mines which have had major development. The average depth of these mines is 465 feet, the Tunnel will intersect them at an average depth of 750 feet vertical, or 800 feet along the dip of the veins.

These eight mines have an estimated production of $4,100,000 of value, or an average of $110,000 for each 100 feet of depth of each mine.

There is in addition some 40 mines which have had their value proven, but not operated to any extent, also contiguous to and dependent upon the Tunnel.

Middle Russell District:

This third section, extending from 10,000 feet to 16,000 feet has been noted for the large size of its veins. The ore was not of as high grade as was the first two districts, but the tonnage was much larger. There is probably here the greatest tonnage of low grade ores of a profitable character in the County.

There are six mines in this area whose aggregate production has been estimated to be $5,860,000, their average depth is 715 feet, and the Tunnel will cut them at an average of 1,100 feet, leaving about 500 feet along the vein unexplored.

The average production for each of these mines per 100 feet of depth has been $137,000.

There are additionally some 46 mines which have been proven but undeveloped, contiguous to and dependent upon the Tunnel.

Upper Dussell District:

The upper and fourth district extends from 16,000 feet to 18,500 feet. The ore of the mines of this district has been more amenable to milling than any of the others and were favored by operations. Engineers' reports of these mines are available and indicate there are several million tons of milling ore of grade $12.00 per ton, the great necessity being drainage and milling facilities.

Five mines of major development in this area have an estimated production of $5,800,000. Their average depth is 720 feet; the Tunnel will cut them at an average of 1,220 feet. The average production from each 100 feet of each mine was about $161,000.
There are also some 57 mines additionally contiguous and dependent upon the Tunnel which have been proven but not developed.

**PROBABLE TONNAGE:**

The estimation of actual and probable tonnage cannot be made satisfactorily. Engineers have examined several mines dependent upon the project and report tonnages and values. They have recommended the properties, contingent upon the solving of drainage, transportation and milling features; extracts as follows:

1. A deep mine of 700 feet, "176,000 tons of ore blocked on three sides of grade $12.00 per ton."
2. A deep mine over 1,400 feet, "1,200,000 tons of actual and probable ore of $14.00 gross value."
3. A deep mine over 1,400 feet, "950,000 tons of reserves $9.30 gross."
4. A deep mine over 1,000 feet, the examiner estimates 422,000 tons of actual ore, grade $15.00 per ton."
5. A mine 600 feet deep, "20,000 tons of actual ore, grade $12.50."

The above five are upon ore as far as developed. Their reports do not include any probable ore to the Tunnel level.

Of the 21 others, on whose value we have no definite data, a general knowledge would indicate several of them which would equal, perhaps exceed, any of the above. All would indicate as good and greater values and tonnages down to the Tunnel level than have been taken out.

The 177 mines in the districts proven but undeveloped, should make great reserves of ore, how great and how valuable can be determined only by intelligent operation.

The ore available below the Tunnel level should be profitable as deep as the proven mines on either side of the Tunnel which have paid the owners to an average of 1,400 feet vertical and are still in ore. Certainly there is every geological reason and operating condition which favors it.

**CONCLUSION:**

The Pewabic Gold Company is essentially a corporation of efficiency, wherein it combines in the best feasible manner the greatest number of separate units which had formerly been operated at a profit, but which by reason of the natural obstacles finally became unprofitable.

The whole proposition is stated in short—

1. The ore bodies are proven, the values established, the most conservative estimation of tonnages possible estimates big returns on the investment.
2. The mining can be done and the product delivered at the mill at an average saving of $13.50 per ton over former operation.
3. Permanent drainage of the mines.
4. The milling will make an average net yield of $4.75 per ton over the former milling operations.

The proposition combines the cheap and permanent drainage of the mines, the efficient and scientific mining of the ores, the economic transportation of them to a latest improved type mill for the recovery of their metal contents.

It is projected through the center of the productive section of one of the best known mining sections of the world.

The ore bodies, and continuity of the veins, and their great number are established, the market for the product—gold, silver, copper and lead—is established. It needs only capital under judicious management to open up a great field, where the pioneer work is already accomplished.

The proposition to drive a mining, drainage and transportation Tunnel from the only feasible place to any individual mine was too formidable for any unit, and it required a combination of a great number of units to be feasible, then the relative cost becomes a small factor.

The other factor to the success of the enterprise, the recovery of the values of the ores by milling so that the lower grades of ore will yield a profit, has been worked out the past ten years by the mining companies and is now standard practice throughout the mining world.

Perry R. Edwards

Engineer of Mines.