Hilden 6th June 1873

To the Faculty and Board of Trustees
of the Colorado State School of Mines:

As a candidate for the
degree of Engineer of Mines (E.M.), I
herewith beg leave to present the
following as my thesis on the subject
of mining.

Respectfully submitted,
W. B. McKee
The property I have taken under consideration is known as the "Medora Group" of Mining Interests situated upon Sherman Mountain in the Skiffchis Mining District Silver Creek County, Colorado, about 1/2 mile from Silver Plume & 11/2 miles from Georgetown City. It comprises the following property:

<table>
<thead>
<tr>
<th>Name of District</th>
<th>Area in Square Miles</th>
<th>Total Mines at</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheeler</td>
<td>1041</td>
<td>4.92</td>
<td></td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>171</td>
<td>1.56</td>
<td>Except westly 230' of milling</td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>190</td>
<td>1.83</td>
<td></td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>60</td>
<td>1.61</td>
<td></td>
</tr>
<tr>
<td>Mathey</td>
<td>2092</td>
<td>2.37</td>
<td></td>
</tr>
<tr>
<td>East</td>
<td>Blue Range</td>
<td>894</td>
<td>3.94</td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>Everett</td>
<td>2304</td>
<td>4.94</td>
</tr>
<tr>
<td>Wheeler</td>
<td>Fulton</td>
<td>834</td>
<td>4.7</td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>Farthing</td>
<td>111</td>
<td>1.27</td>
</tr>
<tr>
<td>Mathey</td>
<td>Genie</td>
<td>929</td>
<td>4.07</td>
</tr>
<tr>
<td>Wheeler</td>
<td>Medora</td>
<td>70</td>
<td>1.14</td>
</tr>
<tr>
<td>East</td>
<td>Montagne</td>
<td>916</td>
<td>2.11</td>
</tr>
<tr>
<td>Wheeler</td>
<td>Paynes</td>
<td>925</td>
<td>4.30</td>
</tr>
<tr>
<td>Roy Old</td>
<td>301</td>
<td></td>
<td>Included 1/3 of water power &amp; dam with right to use all water except above for use by power of other 1/2</td>
</tr>
<tr>
<td>Akron</td>
<td>311</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Victoria Tunnel 8 x 8 feet total length from face 1070 feet, Atlantic Tunnel 11 x 7 feet length nearly 500 feet. The Salmon Mountain Tunnel 8 x 7 feet length to quote 700 feet.

Geology

There is but very little to be said about the geology of this section.

The country rock is diorite granite and granite traversed by porphyry dykes. The fissure veins are also attunements of the country rock along a jointing or faulting plane and frequently six direct commissure with porphyry dykes which form either one or the other wall of the vein. Sometimes constitutes the vein material itself. In other cases the mineral vein is an impregnation of a pre-existing pegmatite vein in the granite. The ores are silver bearing or derived from argentiferous galena and copper. Where porphyry abounds the ore grades both silver and lead. The rich ores are located at a large proportion in lineating ore which impregnates the country rock at a greater or
less distance from the main vein, usually on the foot wall side. In the Mendota main tunnel we have a true_ fissure vein, i.e.,
in the granite, the vein material is called Potassium or Corn-rock and carries little or no value. The vein itself is comparatively regular and from the vicinity of Gangue. As usual we are justified in calling it a true fissure vein, it is from 2 to 4 feet in width and is all more or less mineralized. At times the whole width of the vein is mineral, which again dwindles down to a very thin streak, only to again widen out upon further development. The mineral consists of two different ones, Galena and Sphalerite, which occur in two separate distinct layers lying side by side. The Sphalerite however is in the minority, being about one inch in thickness, while the Galena is from one to three feet thick. A very curious fact to be noted however is that while the Sphalerite and Galena are so close.
proximity, yet the former carries comparatively little of the value and its most usual the galena is stripped away from the topholite, which is left sticking to the granite walls. Occasionally the veins carry considerable value though this occurs it is mixed with chipped separately from the galena, and it has been generally noticed that when a quantity of guio occurs in the veins it is a rare indication of the proximity to large bodies of lead. The greatest portion of the shipping ore appears to occur in three (3), distinct "hutes" or "chimneys" which dip slightly towards the west. The general trend of the veins being East x West and it is a peculiar fact that when the veins dips to the North the ore bodies are larger, better defined & very much richer. The Mincotta code states sometimes twice six fifty feet & it is always noticed that this rule holds true.

These hutes can be x have been
traced clear up to the surface, the main shaft having been sunk in one of these, the roof of the mine being very hard to define as they vary from practically nothing to 200' or more feet in length occupying the full width of the vein.

It may be well to mention that in this report I have dealt mainly on the Mendota & Sutton mines, they being the only fully developed properties under immediate consideration. These properties are operated through the Victoria Tunnel. These first developments known from the surface and consisted of the sinking at different periods of five (5) shafts, four upon the Mendota vein & one upon the Sutton. This tunnel as before mentioned is 87' x 8' in the clean and 108' in length, double tracked for three cars, with water drains in both sides, and is a perfect piece of workmanship, having sufficient inclination outward to allow of
For drainage & lowering fast water through however to intitue earth
passing the empty case six, or
allow of two great speed out
The great value of this tunnel lies in the fact that the one
is carrying through ghats or Pike holes from the crossing above
the line of the tunnel & as it is
down grade out, we have the assistance
of gravity in bringing the ore from
the vein to the surface & from this
in mineral this is by no means
its greatest value, it has many
other interests there the Unde
in extending from the lower portion
of the mountain side at 30 feet it
into the Medina vein to a vertical
depth of 421 feet the other interests
reached beyond the crossing of
this vein is a lode that for
convenience has been called tunnel
lode No. 4. If these also consists two
lode, or vein of lode material
as known as Tunnel carbon or 1 & 2
The improvements at the mouth
of the Victoria Tunnel are such
as to add to the convenience of
mining, for instance of having to
until to the surface everything comes through this workings particularly at the time Contessa (built over the wagon road & creek) a convenience as all the ore & out put from the Mendota & Fulton is tremed at & dressed from the ore house to Cora furnished by the Chicago Pacific Rail Road Company on the track of the siding connecting with it which referred to there. The ore is loaded onto the cars shipped for rail within to Georgetown or to the labors Smelting & Refining Co. at Denver. Here at the mouth of this key to mining on Thomson Mountain everything is found to be convenient & showing system all of which shows economy & the saving of labor money & time.

The aggregate depth of all the workings up to date including the main shaft runs 16 feet below the Victoria Tunnel on the west border is 1217 feet

The other development of the Mendota & Fulton interests interest
6790 feet of levels & intermediate levels. 2010 feet of stopes including rock & ore chutes. 265 feet of double rosses & 360 feet of Davies. The amount of aggregate amount of development work has been sufficient to test the working value of the two intervals under consideration. The total amount of ground opened by all of the enumerated workings of the Mendota & Fulton Mines, aggregate in the neighborhood of 13500 foot tons. The lake & fallon have 62 6X6 foot by the length of the vein), of which about 6180 have beenboned & stopped.

The intermediate spaces between the ore chutes are occupied by ore that can be ported & shipped directly and partly by the vein motor, which is a sort of a compressed quartz unfractured with free particles of galena. This latter route will save from the porting ore, while it would not pay to ship direct in good Concentrating or Coarse Mill.
that y is run out on the dump. Comparatively little of this quantity was removed in so poor a state it was not be perfectly mixed and put on the dump for further treatment. In the Mendota lode they stop the ore body, then short the ore down very early to prevent it from running down among the waste.

In one of these bodies the ore included 66 per cent of pyrite high and at 25 ft up they struck an ore body 2 ft quicks rich running from 200-1000 oz to the ton and in this body some 7. Mean turn out 52 tons of ore in 10 days or 2.9 tons per day, or 41 of a ton to the man per day. The total ore put on in from the Mendota & Fulton under up to May 13-1878 has been 12,969 tons 1977 lbs (the one percent for moisture). Of smelting Ore. Assay value for Gold, Silver & Lead at the market value $2 963.730.32

This gives an average of $2 44.31.
for the due entry of ore shipped and according to careful calculation there are approximately 1,000 tons of concentrating ore on the dump this together with the 12,970 tons of smelting ore shipped would give a total of about 13,970 tons of material taken from the mine. All mining in the Blodget and Fulton in Carissa under a system of leasing known as the "Tribute" system consists in letting or leasing a certain block of ground or slope in the mine to different parties, for which they have a regular legal form to go by from the conditions of which they are governed accordingly the lease is bound by the lease to strictly adhere to all the conditions set forth therein, namely the amount of ground he may work the duration to pursue, distance he may advance up or down or laterally as the case may be. The amount of royalty he must pay and last but not least the manner in which he must
extract the ore. It must not resort to any means that would endanger the mine or partial working there, but in times when necessary and keeping the territory in repair.

The lessor assumes all risks and liability and should be of all work or rushing or lifting and feel to find any one to work not expect any recompense from the company. This rule was strictly observed for a few years ago, since which time the owners have offered a bonus to parties doing work in search of ore. This has had an admirable effect by encouraging lessors to proceed with work which would otherwise have been abandoned for so often been the means of opening up large bodies of ore.

In mining with our ore, when they get $3.50 per hundred feet but should they follow the ore vein no matter how thin they get nothing
This system ensures a continuous profit with the lessee, when they are restricted, reduced to a minimum. The lessee furnish their own powder, face caps, tools etc. and put in steep in repair all timbers on their ground. All ground that is worked out and kept open for passage is kept in order by the lessee who furnish all rails, for tracks, timbers, cars for transportation of ore etc.

The royalties imposed on the lessee have ranged from 32 to 35½%, but are now 1/3 to 40%, for all mining carried on through the Victoria tunnel. The average for the past year being nearly 34% at the present, however, it exceeds this.

Considering that lessee R&B have done the principal part of the development in both the Victoria and Sultana, it is quite a fair showing for including the value of the development to their interest that are made by the lessee, the royalties and work are worth to the mines.
and owner about 60% of the net sales of the net profit.

There are at present 12 sets of men
living in the Mendota mines and
five sets in the Fulton and one
set each in the paintings tunnel
and the No. 1.

There has been but very little
work done in the latter adit
only having been sunk 112 feet
directly from the point of
intersection with a little exploratory
shooting. Some mineral has
been carried in the drift that
shows more or less for all
the distance sunk.

But more extended development
now in progress is required
to determine its comparative
value with the Mendota, which
when made the promise will
doubtless be that of a valuable
mine.

Next to the Mendota and Fulton
if not surpassing those interests
in proportion output and value is
the Frostburg Comba interests
which give every evidence (whether
development from the surface
or

...
or through the Sherman mountain or Victoria tunnel) of proving a very valuable property as on a line & situated vertically upon the same apparatus & immense vein or fissure with the famous Dundee, Terrible, & Silver, Ore. mine located near the Maric and Boton-Neos mine lastly. It must it would seem equal in value any of these interests that with but one exception have returned from one to four million dollars out past year. Nearly the same mineral vein that running down upon has returned to well for the Dundee, Terrible, and others, (with out any evidence of exhaustion), has met such a yield with active mining a like large amount for the Frostburg Combine.

With respect to the Pymatuius, Louisa, Ellen Kaye and Benton interests, these all out crop on the surface giving unmistakable evidence of strength & mineral Chances.
The Sherman mountain tunnel, designed to more or less benefit the Blue Haven, and Frostberg-Combo interests, commencing from the surface of the London survey, reached the Frostberg last month at 1,300 feet lower develops at three different points through the tunnel and could soon be opened into a large producing mine. Should the tunnel be extended beyond the crossing of the Frostberg it would reach further other properties. Similarly to what the Victoria tunnel is designed to do, if extended to its original purpose, to the London, the seven-thirty & its group of mines.

The Atlanta hole is situated on a range mountain and about 1/2 mile west of the Reuton.

The tunnel belonging to this interest is called the Atlanta tunnel and intersects the hole at about 600 feet. This tunnel is well tunneled with square sets, also by shafts and levels, and at 18 feet from the entrance it was cut by a porphyry slate. It is a slight pitch from the bottom of
the tunnel 200 ft deep, the ore being hoisted by a special whim. But at present it worked out to the extent of its development, but when in operation was a steady producer of high grade ore. Its greatest disadvantage, however, is in being isolated from transportation facilities, everything had to be taken in or out of camp via shafts.

Regarding the Arbitrator, Condor Circuit by Montaguwa interests it can not be exactly said what these interests are or are likely to prove. The value to a great extent will consist in being productive of other interests. As for instance, The Montaguwa produces Overview for a considerable distance the last portion of the Newton shaft are at the lower time adding an extension of 100 feet.

The Condor Smiley or the Graywater on the east bank. While the Arbitrator & Newton already what ever they develop to be, cover & protect two lodes or veins of said material. So near is by the Victoria tunnel is known as tunnel lode.
May 1st, 21.

All holders' names listed on page one of this report are patented except the Eureka vide, but for this reason the Bingham duplicate receipt has been received by above entry of some in the government land office of the district where writing the issue. This of course the patent title will be received. Title to all interests either whole or part will be by warranty deed, except as to Eureka and Bingham and Atlantic Tunnel which will be quit claimed.

Having stated the principal facts concerning the properties and devoted as much to describing them we will now consider & compare the different modes of working and the consequent profit & loss since the mine has been in active operation, improvements.

By the present method the owner runs no risk the ore being delivered by contract parties or access to the mouth of the Victoria Tunnel while commodeous ore houses.
is divided into "five" class lots of men having a place to keep their ore separate from that owned by another. Here the ore is sorted at the access expense and after being weighed is run over a time-wire or tower and some 100 ft long. "Bo" high connecting with a branch of the Cuba Central Rail Road any there dumped into cars I shipped to Georgetown, or the State Smelting and Refining Co. at Denver City.

the gage of or other material of second grade is thrown over the dump as before stated we have about 3000 tons of this low grade ore, the average assay of which is; Lead 10%, Zinc 12%, and Silver 6%2. This will be direct on subsequently.

The water right gives a flow of 150 feet per second the by going up the creek to the dam 6.5 miles of 20 ft in we get a fall of 420 ft which will give us considerable water power, which will be sufficient to later on.

In getting the amount of money
Expenditures in the mine we will have to approximate the cost of development work, supplies, machinery, buildings and other improvements. For convenience, so I will call the cost of driving a linear foot of drift working face, $4.75 per foot. If there are 6790 feet of 1800 per foot our total cost is $40740 as the total cost of levels.

But cutting the figures well average $20 per foot and there are 1210 feet cut in a result of $24300; as the cost of levels, 2010 feet of roadway and rock cut in chute estimated at $10 per foot will amount to $20100 as the cost, 2050 feet of double roadway at $13.50 per foot. Cutting $4375, and 360 feet of crinage at $2.00 per foot which amounted to $44320.

Of the 13500 feet of rock and gravel opened in the mine 6180 have been removed by stepping assuming that a foot contains approximacy one cubic yard. We have 63340 tons removed by stepping, the average cost of stepping is $24.82 per ton, making $167320 as the cost of all rock removed in this manner making $415720 as the cost of all rock.
The cost of driving the Victoria tunnel was $28,024. The contract price being $23,000 per running foot.

There were two driving points located at the shafts before mentioned which cost in the neighborhood of $2,000, each or $4,000, for both. The present buildings at the tunnel mouth, including ore house, stock house, B&O chemical & helix tower for the tramway, probably cost about $4,000, dollars.

The mine requires but very little timber, principally stulls, the method of placing these is by cutting stulls in the wall, 4" to 6" deep, pins are only used where the span is too great.

Piles are from 4' to 5' apart, logging used 3' to 6' piles & 3" lumber. A 85 day rest soon destroys the timber, although the ventilation is very good being natural.

$1,000 would be a safe estimate on timber, $3,000 & over. Allowing $1,000 a year for sinking fund or repairs, making in the twelve years the mine has been in operation $12,000. & if for management $13,000—Summing up
Have as the total amount expended on the mine have been inspected the following:

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drifting</td>
<td>$20,740</td>
</tr>
<tr>
<td>Tailing</td>
<td>$2,130</td>
</tr>
<tr>
<td>Revenue shoots</td>
<td>$20,100</td>
</tr>
<tr>
<td>Double raises</td>
<td>$4,275</td>
</tr>
<tr>
<td>Wages</td>
<td>$4,320</td>
</tr>
<tr>
<td>Electric current</td>
<td>$2,500</td>
</tr>
<tr>
<td>Machining</td>
<td>$4,000</td>
</tr>
<tr>
<td>Draping</td>
<td>$1,675</td>
</tr>
<tr>
<td>Buildings</td>
<td>$4,000</td>
</tr>
<tr>
<td>Undersized</td>
<td>$4,000</td>
</tr>
<tr>
<td>richtig fund</td>
<td>$12,000</td>
</tr>
<tr>
<td>Management</td>
<td>$1,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$32,439</strong></td>
</tr>
</tbody>
</table>

Subtracting this amount from the $46,373.32, money actually received, we get as a profit $4,639.39.

Cash and of the 300,000 tons in the dump came 10% lead & 60% silver. We have the value of the dump at $1,300,000. Of course, we could not realize this much from it as the cost of extraction & shipment to smelter would cost considerably. This was not profit as the character of the ore was such that no smelting charge
I have been informed that at some
the miner paid a bonus for it
and this would be sufficient
to offset any charge made
for removing the dirty part, and
the will now investigate the
possibility of the future. The first
thing to be considered is the
amount of galena in the neighborhood
of 1000 tons of material consisting
of a quartz gneiss, mica schist
galena & a small amount of
claysulfide. From 1/5 of the duct
is galena & seven (7) tons can be
concentrated into one.
A mill for treating this ore would
be one of the common limestone
mills in use in the various
mining districts of Colorado.
A mill of 160 ton capacity per day
would consist of the following:
5 - 4 compartment grams
1 - 15x9' crusader
2 - pair Crust rolls
6 - Driers or burner
2 - Tree - Formers or Rittinger trees
2 - Blowers,
Shafting, Belting, pulleys etc.
The total cost of such a mill, including buildings & accessories, not including power would be $12,000. The power required would be 3½ H.P.

There is suitable site for the erection of such a mill at 100' from the mouth of the tunnel. The ore could be run directly to the upper floor of the mill where it would be run into the Crusher & thence through the roils, from here it is carried to large agers, from there part of the ore would pass through the other four agers & thence to the jigs. The balance which is too coarse to pass through the two large agers would drop down through a chute to the other elevator which would carry it to the rolls to be crushed.

That part of the ore too fine to be handled by the jigs would be passed over the fine-vanns. Labor necessary to run this mill would be three men per shift of 12 hours, namely one man to feed the Crusher.
But last after the upper part of
the mill, two men on the lower
floor to look after the prize varnished

The power & the application will be
considered subsequently.

The capacity of the mill is 15
tons per day all drilling is
done by hand, lighted by candles,
hauling by man power, with one
man up in the stope & the other
the larger lamps being fixed &
lowered in buckets to the level of the
tunnel by means of a drum
revolving on a stilt which is
placed across the mow; the
the is held in place by staples or
staples on the periphery of
the drum, and from the
head the ore is laundered out
the Victoria tunnel to the surface.

The mine pays the driller $1.
per ton, some lodes dipping very
the tunnel from their own ore.
25' cars is considered a good
day's work. For one mine, all refuse
rock is thrown into the rock chute
each man keeping account of
the 25 of cars dumped. The
then pays 15 cents for car to stationary
who is kept in constant employ-
ment by this method.
The axe rock from the shaft
and 96 feet below the bottom of the
Victoria tunnel is raised by
a horse with the aid of a block
and tackle. This work could be done
nicely with a small electric or
compressed air hoist, as we will
use electricity for other purposes
and as it is more efficient than
compressed air, we will only
consider an electric hoist.
The total output of Raeburn Value
(at market quotations) of all ore of
from the past working of the Minotaur
& Pilot Mina has been 62,000...
<table>
<thead>
<tr>
<th>Year</th>
<th>Mass WT</th>
<th>Barrel Value Per Ton</th>
<th>Total for Year</th>
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</thead>
<tbody>
<tr>
<td>1871</td>
<td>887 lbs</td>
<td>44.91</td>
<td>$33623.29</td>
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<tr>
<td>72</td>
<td>2.91</td>
<td>364</td>
<td>16356.77</td>
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<tr>
<td>73</td>
<td>4.72</td>
<td>704</td>
<td>3766.05</td>
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<tr>
<td>74</td>
<td>7.93</td>
<td>1850</td>
<td>7359.61</td>
</tr>
<tr>
<td>75</td>
<td>7.25</td>
<td>1415</td>
<td>10359.14</td>
</tr>
<tr>
<td>76</td>
<td>14.23</td>
<td>73</td>
<td>9902.67</td>
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<tr>
<td>77</td>
<td>5.92</td>
<td>1411</td>
<td>42112.86</td>
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<tr>
<td>78</td>
<td>14.05</td>
<td>1870</td>
<td>21970.73</td>
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<tr>
<td>79</td>
<td>7.20</td>
<td>320</td>
<td>48034.76</td>
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<tr>
<td>80</td>
<td>10.75</td>
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<td>90193.36</td>
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<tr>
<td>81</td>
<td>14.95</td>
<td>1900</td>
<td>23433.01</td>
</tr>
<tr>
<td>82</td>
<td>3.00</td>
<td>19.25</td>
<td>58392.70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1761</strong></td>
<td><strong>121</strong></td>
<td><strong>76139</strong></td>
</tr>
</tbody>
</table>

From January 73 to May 15, 73, the output was 1000 tons 766 lbs, averaging $64.26 per ton, making a total of $64777.52. The total grass cut during 1872 was 3007 tons 1925 lbs, averaging $7.95 per ton. Total cutting was sold to the Able & other works during 1872 to 2977 tons 1775 lbs, averaging $9.70 per ton.

Clothes for the past year of work done are as follows: "
- 716 suits, gross, cut 324 feet, Reines
- 410 suits, " 440 feet, anducket.
Stamping amounting to 872 feet made
the total cost of the year 800 times the average value
of lead, silver, &c. per ton was
$77.91 making a total amount received for the one sold $234,350.
Because of the low price of silver the average value per ton was
$102.5 less per ton than in 1891.
The total metal production of the above mines was for 1892 was:
Salt 1,221,022 cubic feet over previous year 106,871
Silver 1,310,361.50 " " " 4.9722
Lead 2,976,699.42 " " " 18,4836.94.
The increased cost of the one 1892 was 91
in 1412 tons or 75.7% the increased cost
put one sale in 1892 over 1891 is 59.1%. 33-
or over 63%.