1902

Description of El Paso Consolidated Gold Mine

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Thesis

For the

Degree

Engineer of Mines.

Edwin T. Perkins,--1902.
This mine is located in the Cripple Creek District of Colorado, and although in the outer edge at present, new ground is continually being opened, and the ore bearing portion enlarged.

The property belonging to this company comprises some sixty (60) acres: all not being shown on the map, the main idea of the maps being to show the relation of the underground workings with respect to the surface, and the shafts connecting them. The main shaft is the only one being used by the company at present. Some of the old stopes are being worked by leasees through a number of the other shafts. The main shaft is composed of two compartments, each three and one half feet by three and one half feet in the clear: one is the pipe man-way, and the other the cage-way, a cage three feet square being as large as can be used.

The surface plant consists of three tubular boilers, and feed pumps; two feed water heaters; one air compressor and hoisting engine. Two of the boilers are eighty horse-power, carrying ninety pounds of steam, and the third one hundred twenty horse-power, carrying one hundred pounds of steam. These are made by Hendrie & Bolthoff Manufacturing Company of Denver, and are all of the horizontal tubular type. The water used comes from the mine and is quite impure. The following impurities represent an average of several analyses of the water:
<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Chloride</td>
<td>0.93</td>
</tr>
<tr>
<td>Sodium Carbonate</td>
<td>9.01</td>
</tr>
<tr>
<td>Calcium Sulphate</td>
<td>75.75</td>
</tr>
<tr>
<td>Calcium Carbonate</td>
<td>13.04</td>
</tr>
<tr>
<td>Magnesium Carbonate</td>
<td>5.07</td>
</tr>
<tr>
<td>Silica</td>
<td>5.85</td>
</tr>
<tr>
<td>Iron Oxide &amp; Alumina</td>
<td>1.15</td>
</tr>
<tr>
<td><strong>Total Solids</strong></td>
<td><strong>110.80</strong></td>
</tr>
</tbody>
</table>

As is readily seen the bulk of this sediment formed in the boilers is Calcium Sulphate. I say sediment for this is how the most of it is precipitated, and not entirely as scale on the tubes. Blow off pipes leading from the bottom of the boilers are opened several times during the day, and quite an amount of sediment is thus gotten rid of. Every four days one boiler at a time is shut down and thoroughly cleaned. This loose powder-like sediment generally accumulates to the depth of five or six inches directly over the fire box, and considerably more heat is thereby required than if pure water were used. Too, the cooling down and reheating of the boilers is not only hard on them and the brick settings, but it requires more coal than if they were run continuously.

The first heater is a "Stillwell Combined Heater and Filter". This is a cylinder, set upright, with horizontal shelves in it, which are partly packed with straw to help separate the sediment. The amount of feed water required is let into the cylinder and the exhaust from the engine and compressor (after the oil has been removed by a separator included in the heater) is led into it, and mingling together
the water is heated, some exhaust condensed and some of the sediment precipitated. This heater extracts about twenty-five per cent (25%) of the impurities in the water, and raises the temperature to about one hundred degrees Fahrenheit (100 F.). The water is then pumped into the second heater, which is a horizontal "boiler" with live steam pipes in it forming a sort of radiator, and an outside jacket into which the exhaust from the first heater is introduced, and which then passes out in the open air. The live steam circulating in the inside pipes thus raises the temperature of the feed water to that of the water in the boiler. In this heater there is about another twenty-five per cent (25%) of the sediment extracted, making in all about fifty per cent (50%).

While recognizing the fact that fuel is saved by heating feed water, the main idea in this heating is to remove all the impurities in the water possible. The sediment deposited in this second heater is very similar to that in a boiler. There is quite a scale formed on the steam pipes, and in the bottom the loose fine stuff settles. After using this second heater awhile, they found out one mistake that had been made. As shown by the plan and elevations of the buildings, this second heater is above the boilers and the check valve in the pipe from the heater to the boiler is of no use, as the water is at the same temperature and pressure on both sides, and when they open the blow-off valves, this check valve, being open creates a free circulation, and the sediment in the heater runs into the boiler. This could be obviated by having the heater below the boilers, but in the present arrangement of the whole surface plant this would be conducting the exhaust
HIGH PRESSURE CYLINDER
CRANK END  HEAD END

LOW PRESSURE CYLINDER
CRANK END  HEAD END

INDICATOR DIAGRAMS

Fig. 1:  Fig. 2:
Boiler Pressure: 90 lbs. - 95 lbs.
Revolutions: 54 - 40
Piston Diameter: 14 in. - 22 in.
Stroke: 24 in. - 24 in.
Piston Rod Diam: 2 3/4 in. - 2 1/4 in.

SCALE: 1 in. = 40 lbs.
down and create more back-pressure in the engine and compressor. These heaters are thoroughly cleaned about once a week.

The compressor is a Norwalk-compound, two stage compressor, with a pressure of one hundred pounds, and a capacity for operating twelve air drills. However the altitude being nearly ten thousand feet above the sea level, only eight air drills can be operated, thus making its efficiency about thirty-five per cent (35%). On the opposite page are some indicator diagrams of the steam end of the compressor which explain themselves.

The hoist is made by Hendrie & Bolthoff and is called their lightning, quadruple friction hoist. The cylinders are ten inches in diameter with a twelve inch stroke. The drum is forty-two inches in diameter and twenty-two inches long. It is a sixty horse-power engine. As the name implies, there are four friction bearings, two on each end of the drum, with a depression of three inches between them, where the brake is located. The brakes, thus being on both ends of the drum, make the strain more nearly balanced than in most hoists, where it is only in one end of the drum. This hoisting engine is good for a six hundred foot lift, with a load of three thousand pounds, and at present is working at its full capacity.

The blacksmith and carpenter shops are shown in the plan, and here the repairs on tools etc. and the framing of timbers is done.

Map number four shows the main part of the claims owned by the company. If I had tried to show them all, with those conflicting with them, the scale would need to have been much smaller, and even then the details of the underground
workings, that can now be seen, would have been lost. This
same map shows the shafts and underground workings, from
which the direction of the vein can readily be seen. The
distances between the levels show that the vein has some dip
but it is very irregular, and is more nearly straight up and
down in some places than in others. Of course if the vein
were vertical the different levels would appear one under the
other. As this property is located in the Cripple Creek
District, the size of the claims could be three hundred feet
wide by fifteen hundred feet long, but as can readily be seen
by the scale, none of the claims are of full size and several
are almost at right angles with the course of the vein. This
shows how little the locaters knew of the direction of the
vein, and how intelligent location of the mining claims is
of the most value.

This property, as already said, is located in the Cripple
Creek District of Colorado. However it is just within the
southern limit, and the geology of this part is somewhat
different from the rest of the district. The ground shown
in the plan is located on the west slope of a hill which has
a slant of about thirty degrees from the horizontal. The
line "AA" indicates the contact between the original granite
and a phonolite dyke. The rock below, or to the west is
granite, and the upper part of the hill phonolite. The hill
is more or less cone-shaped and this phonolite forms the cap,
or rather seems to make up the core of the hill. This phon-
olite is undoubtedly of igneous origin, as are all the rocks
of this district.
Since the disturbance causing the uplift of the Rocky Mountain range, there were local eruptions here of andesite and phonolite. These came at different periods and in the order mentioned, and are supposed to have occurred in Tertiary times. We may assume that preceding the eruption, the area was troubled with earthquakes. Various kinds of acids and hot springs appeared at the surface, indicating the fissuring of the ground that followed.

At the bottom of the fractures, which were likely numerous, molten rocks appeared, giving off vapor from bursting blisters of lava. These shoots of steam formed into clouds taking quantities of scoria and fragments with them, and which later fell back to the ground with larger fragments of the same material. These thus became imbedded in the molten lava, and formed the rocks we now call tuffs and breccias. As this was andesite we have andesitic tuffs and breccias, and these constitute the main mineralized rock of the mining area.

After the first eruption ceased, there was likely a rest for a time: the lavas cooled and consolidated, and hot springs were numerous. Then the District was again disturbed, this time by an eruption of phonolite ascending through numerous rents and fissures, not only in the overlying andesite, but down through the granite below, and also in the granitic region outside of the first volcanic area, probably finding the other too choked up by eruptive matter.

This second eruption added many new fissures to the already shattered rocks, and gave many opportunities for the
deposition of metallic and vein material deposited through the medium of gaseous and hot springs, and self-laric action, which followed upon the cessation of phonolite eruptions.

The vein of this mine under discussion occurs as has been said outside of andesitic region. Possibly the andesite may have been here once, but has now been eroded away as is shown by other mines which have gone through this andesite into the granite. Too, this hill may have been, and likely was capped with phonolite, but it being harder, the phonolite core remained and the granite has been eroded away.

This vein is in the granite from the surface down, and although there seems to be shoots of phonolite coming off from this core and cutting the vein, they do not seem to have any visible effect on the vein as to continuity or value. The vein appears to be a shattered fissure in the granite making a series of more or less parallel seams, which at present are filled with crystallized quartz. These shoots of phonolite may have been formed by the eruptive phonolite being forced up through the granite causing radiating cracks which were immediately filled with phonolite. The cooling and contracting likely caused more fissuring of the granite and phonolite.

The seams of the vein occur some three to eighteen inches apart, and vary from six to twelve in number. They converge and diverge, and join and separate. The material between the seams is an altered granite, which alteration consists in a thorough mineralization and recrystallization.

The vein, while extending the length of the property, as indicated by the drifts, does not carry values all the way, but there are shoots or pockets which carry the values, and which
which have more or less of a dip to the north, that is, a part of the vein seems to be in a sort of chimney, which dips towards the north in the vein. The ore is very pockety and has no regularity. As shown by the stoping map, there seems to be a bunch of ore here and there, and they seem to follow no special order and have no special arrangement, except as I said, they occur farther to the north as the vein is followed down.

The minerals which have altered the granite of the vein are iron pyrites, galena, zinc blende and stibnite. The main mineral, and the one most widely diffused is the iron pyrites which generally occurs in fine crystals as large as one eighth of an inch, have been found.

The seams in this vein are more or less open cracks, on both sides of which is a deposit of silica, or "water crystals" as the miners call it. These crystals of quartz sometimes fill irregular cavities in the granite and are quite different from the ordinary "bull quartz" generally found in granite and quartz veins. This latter is massive and apparently without any crystalline structure. Covering and sometimes mixed all through this quartz deposit are crystals of fluorite, which have evidently been deposited since these quartz crystals.

With these crystals of quartz the values occur. The deposit of fine quartz crystals varies from one sixteenth to one fourth inch thick, and although they may sometimes show no value to the eye they are generally overlaid, underlaid or even thoroughly mixed with a telluride of gold, and in rare cases, free gold itself, which shows up very brilliantly in its yellow color. The free gold sometimes occurs in
segregated masses as large as a pin-head, and at other times as small as a pin-point, and can hardly be distinguished from the fine pyrites, without the aid of a magnifying glass. This gold is not the oxidized kind that was so often found near the surface in mines of this district. This oxidized or "musty" gold is indeed musty, and one would, at first glance, call it a sort of clay. The free gold found here is rare, and quite an unusual thing for it occurs far below the water level and sometimes is intimately mixed with sylvanite, stibnite or both. It is possible that a part of the sylvanite has been acted upon, by some acid or gas, and the telluride changed to free gold.

The distance apart of these seams varies owing to the width of the vein; when the vein narrows these seams crowd closer together, and in places join, but again branch out and increase in numbers. Although the shattering and alteration of the granite exists along the full extent of the vein it is only where the old water course was, and the crystals deposited that the values are found.

Although the rock between the seams is of no value, the whole vein is broken down and sent to the ore-house. As shown in the plans of the buildings, the ore is first dumped over screens of three fourths inch mesh. The screenings pass down into the shipping bins, and the coarse rock runs into a hopper which leads to the washer. These are troughs having a perforated bottom. These perforations are round holes, one half inch in diameter, punched in one fourth inch sheet iron. While the rock is passing through the washer, a spray of water is thrown onto it, and all the dust and fine
wet stuff runs into the troughs and thence into the settling
 tanks. There is more or less coarse stuff in these slimes
 which has failed to go through the screens. The water is
 drained off and the slimes are shoveled into the dryer,
 which is merely a long box with steam pipes in the bottom.
 After the bulk of the water is driven off, this stuff, which
 will carry about twice the value that the screenings do, is
 thrown into the shipping bins.

 The coarse rock from the washer runs right down onto a
 sort of extension table which rests on the ore-car. The rock
 is all picked over by hand, and any rock showing the crystals
 of quartz is thrown on to a cobbing table, where the crystals
 are moiled off and thrown into the shipping bin. The re-
 mainder is thrown onto the mill dump. The washing of the
 coarse rock greatly facilitates the sorting, as any values
 can readily be seen.

 There are washers fixed up for three screens. For the
 other two screens there is only a sorting table for the
 coarse rock. Over these screens ore of doubtful value is put
 and the screenings sampled. If these screenings will average
 Ten Dollars ($10.00) in gold it is put into the shipping bin,
 and if less is drawn out into the cars and dumped with the
 mill ore. Sampling charges, including freight, are about
 Seven Dollars ($7.00) or Nine Dollars ($9.00) for ore running
 less than one ounce, so they figure that if the ore run over
 these two screens, runs any more than enough to pay for
 handling it through the ore house, that is enough. It has to
 be hoisted out of the mine anyway, and if they can make anything
 over what it costs to handle it on top, they are only that much
 ahead. The ore is necessary.
ahead. The ore is necessarily very variable in value due to the sylvanite it contains.

In the mineralized granite between the seams there will occur quite a bunch of galena; sometimes it occurs in quite a pocket, showing large cubes, but there is no large quantity. More or less mixed with this through the rock we find the zinc blende. These occur in bunches of crystals, sometimes as large as a pea, but if you were to assay the ore ready for shipping, for either the quantity would be very small. In fact where it is possible, they are separated from the ore for they carry no gold, and the quantity is too small to make it profitable to save it for the lead or zinc. Of course by picking out a sample we could get as large a per cent of either as it is possible to obtain.

The galena carries about one and one half ounces of silver, and about six hundredths ounces gold. The blende carries about one half ounce of silver, and about twenty-four hundredths ounces of gold. These are an average of several samples taken, and represent about all the values contained in these minerals.

On the other hand, the stibnite occurs very much like the sylvanite, generally between the granite and the coarse deposit. It looks very much like sylvanite, and one not accustomed to it will call it that, but as a rule it hasn't so brilliant a luster, and either occurs in long needle like crystals more or less radiating from a center or in blotches. Frequently one will see some stibnite on the vein matter, which looks as though it had been thrown there while molten and allowed to cool. It is coarser grained than sylvanite
crystals and looks more of a dull color such as galena, except one does not see the cubical crystals of the latter. Several samples of stibnite showed an average of seventy-five ounces silver and nineteen hundredths ounces gold. As in the cases of galena and blende, samples of pure antimony sulphide could be picked out and any possible per cent of antimony obtained.

The sylvinite occurs in monoclinc crystals, more or less blade like which cross each other and resemble Hebrew letters. The telluride of gold occurring here is not all sylvinite, for the ratio of gold and silver varies in different samples. Specimens of crystals have been found where there was about twenty-five per cent (25%) of each; again, twenty-five per cent (25%) gold and twelve per cent (12%) silver, which is more the composition of sylvinite. Other crystals which are not so silver like in their luster, but which seems to look more like gold, will sometimes show iridescence which is very beautiful and which seems to show all the colors of the rainbow, contain less silver. Again it has a steel blue color which looks very much like a newly tempered steel tool. In the latter the amounts of gold varies from twenty-eight per cent (28%) to thirty-five per cent (35%) and silver down to a mere trace.

The bulk of the ore is screenings, for the sylvinite crystals are very brittle and break up very fine. About one fifth of the ore put into the ore house goes through the three fourths inch screen. Of course this varies with the way the rock is broken.

One can readily see that with streaks so small that are of any value, that the largest part of the coarse rock is thrown onto the dump so that the amount of the ore that
can be handled depends entirely on the capacity of the hoisting appliance. Each mine car holds about three fourths of a ton of broken rock, and about one hundred cars of ore are put into the ore house during the twenty-four hours. This makes something over fifteen tons of shipping ore per day.