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GEOLOGIST'S OFFICE

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ATLANTIC CITY GOLD MINING DISTRICT

Fremont County

BY

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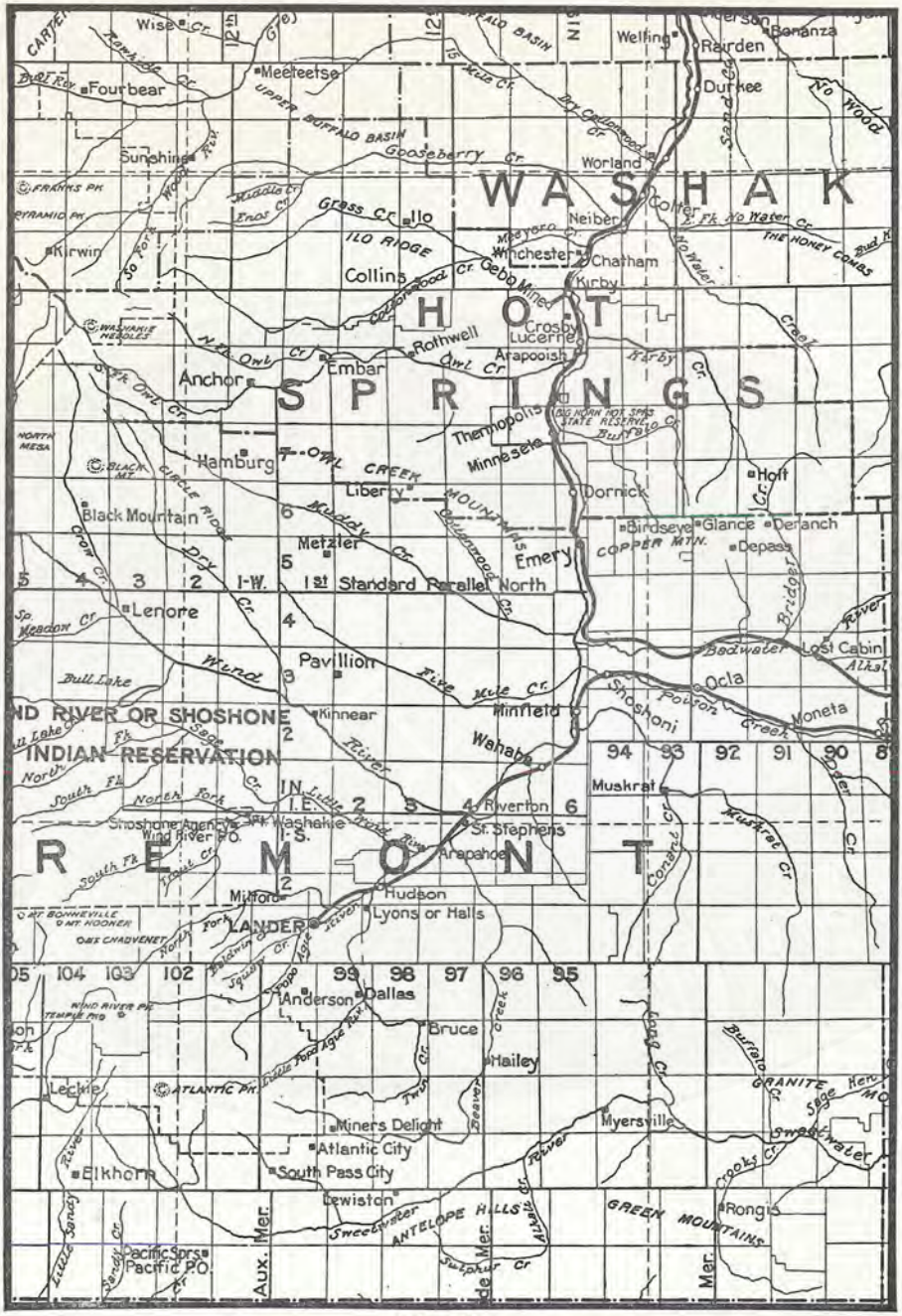

KEY MAP

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INTRODUCTION

This pamphlet upon the South Pass-Atlantic City-Miners' Delight district has been written in response to many inquiries, received from all parts of the country, for definite information regarding mining conditions and geology of the district.

Late in the fall of 1913, the writer spent ten days in the camps. The accompanying map shows the surface geology as closely as could be determined by so short a study. Outcrops were tied to nearest land or claim corners by means of pacing and compass. The base map has been worked up from U. S. land surveys, the patented properties as shown on the maps of the Surveyor General's office, and various private surveys to the records of which access could be had. For this base map, this office is under obligation to Mr. P. F. E. Gebhard, Chief Engineer of the Timba Bah Mining Company. No effort has been made to map all the mining claims of the district. All patented lode claims are shown and a few of the unpatented which had been carefully located by instrumental survey. Nor are the patented placer lands shown; for practically all the lands along creek bottoms are patented, and the map would become too complicated were all these claims shown.

Many minor details of the surface geology are certain to be found in error, but, as there is no other geologic map of the district in existence, it is thought best to publish this at this time, rather than to wait until a more detailed survey of the area can be made.

This district, during the days of the rich placer deposits and the free surface ores, was a large producer, and it is believed that now, since the problem of economic treatment of the base ores has been solved, and the introduction of relatively cheap gas engine, or even electric, power has

become possible, the district will again become a steady and probably a relatively large producer.

For the article on the Duncan Mill, the writer gladly makes acknowledgment to Mr. D. C. Kelso, Superintendent of the property, who wrote it, and to Capt. O. M. Beck for the accompanying illustration, for his suggestions, and for his hospitality while the district was being studied. The writer also wishes to thank all the other members of the community, too numerous to mention by name, who were of assistance in gathering information regarding the district.

For help in the determination of rocks by means of thin section and microscope, the writer is deeply obliged to Dr. A. C. Boyle of the State University.

L. W. TRUMBULL.

February, 1914.


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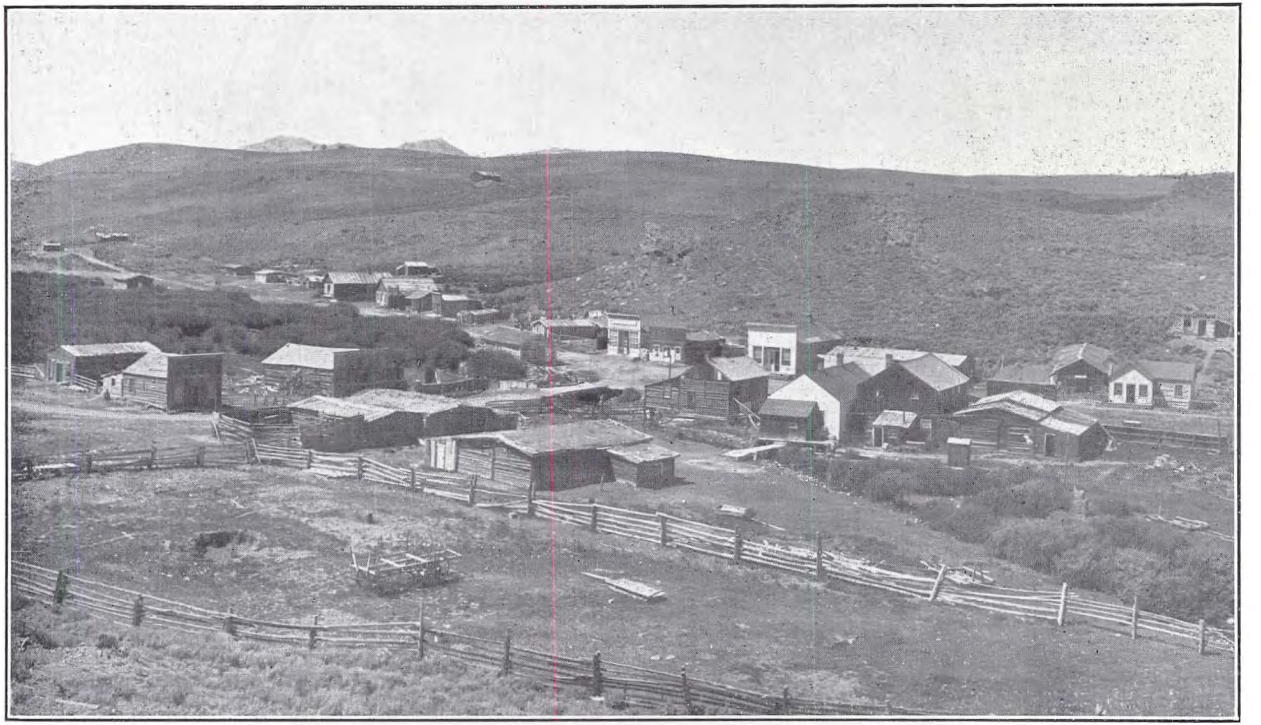

South Pass City

Atlantic City Gold Mining District

LOCATION

Atlantic City lies twenty-four miles due south of Lander. The key map (Plate 1) gives location of railroads and towns, as well as streams of that portion of the State. The district is best reached over the thirty mile stage road from Lander. This road, as well as the roads from Rock Springs or Rawlins on the Union Pacific, is passable for automobiles except when there is snow on the ground, or when the ranchers in the valley have flooded it with irrigation water. Freighting is done the year around, at prices varying from 75 cents per cwt. in the summer to $1.00 per cwt. in the snowy season. A daily stage runs between Lander and South Pass. Hotels at both Atlantic and South Pass.

TOPOGRAPHY

The district may be described as a foothill plateau on the southeasterly end of the Wind River Mountain Range. The average altitude is about 7,800 feet. The plateau sloping to the south to the Sweetwater River, into which the streams, draining the district, empty.

The geology controls the topography. At the north and west are the high, rough, fir-clad, granite ridges and peaks of the Wind River Range proper. The Algonkian schist area of the gold bearing district is smooth, rolling and grass clad; an ideal grazing range. The only trees are those upon occasional outcropping ridges of intrusive rock, or the fringe of willows along each creek bed.

who killed three and drove off the remainder. The survivors returned to the mine July 28th and remained over winter. They succeeded in extracting from the cropping of the lode, which they crushed in a hand-mortar, $1,600 in gold. Seven thousand dollars more they washed out of the detritus in the gulch below the vein. The news of the success spread rapidly and was greatly exaggerated. A great rush commenced from the neighboring territories, but the majority of the adventurers, not finding the facts to bear out the reports, left very soon. Only about 500 remained and went to work. Their labor was well rewarded and gradually more population was attracted, so that in July, 1869, 2,000 people had settled there. Although all of these people came to the district very poor, they had then three stamp-mills, with twenty-six stamps running, and several arrastras were in operation."

This story may be disregarded by some, but it contains all of the information known about the discovery and very early history. The data were secured and published by Mr. E. A. Slack, then Editor of the Sweetwater Miner, but who, for years, had been Editor of the Sun, Sun-Leader, and Leader of Cheyenne.

Mr. Reed, the Surveyor General of Wyoming in 1871-72, prepared a report for Dr. Raymond, who had charge of the mineral statistics of the United States at that time. Mr. Reed's report was published in the report of 1872 and was a rather lengthy description of the conditions of the mines and prospects at that time.

In 1870 Dr. Hayden visited the South Pass mining district, and on page 36 of his report for that year his observations read as follows:

"The portion in which the South Pass is located is about ten miles wide, and is composed mostly of metamorphic slates in a nearly vertical position. It is in these slates that the gold mines are found. The gulch diggings are quite extensive, and, although

much has been done in that way, yet there is a most extensive field for enterprising miners or laborers.

"The facilities for placer mining are very great on account of the supply of water. The gold bearing rocks are composed of gneissic slates, which occupy a somewhat restricted area about ten miles wide and twenty or thirty miles long. Some of the slates are very thin and might be made use of for building purposes, others are more silicious and fracture into columnar masses.

"Veins of white quartz run through these slates quite frequently and it is in these the gold is found. The most celebrated lodes in this district are the Carissa and Miners' Delight. The Carissa lode is four feet wide, the shaft has been sunk 140 feet, the quartz yields $50 to $75 per ton. About $75,000 has been taken out of the mine by its owners. The lode has a strike northeast and southwest and a dip of seventy degrees. It was discovered in 1867 and has been worked two years. The lode itself is mostly composed of white quartz, with some iron pyrites, while the country rock consists of gneisses. It will be seen at once that the great value of these ores lies in the ease with which the gold can be extracted. I shall describe these mines more in detail in a subsequent portion of this report, and simply allude to them now in their geographic relations."

The report that followed was simply a reference to the production and country rock of a few lodes.

Prof. T. B. Comstock's report in "Northwestern Wyoming" by Capt. W. A. Jones, 1873, p. 147:

"The gold in this region occurs in thick veins of impure quartz among schists and gneissic slates of the northeastern side of the anticlinal, the greater portion disseminated through the matrix, but not infrequently is found in cavities in the quartz in fair sized flakes or scales. Silver is frequently associated

with it, and iron pyrites in varying proportions is rarely absent."

He continues by discussing a few of the lodes, but does not enter into the geology of the subject.

Endlich, in Hayden's report of the geological survey of the territories, 1877, reports as follows:

> "Ten or twelve years ago, ore bearing bodies were discovered in these metamorphics (referring to the rocks of South Pass district), gold was washed out of the gulches and the Sweetwater mines were far-famed for their richness and reported production. Misrepresentation, bad management, and unscrupulous speculation ruined what might have been a flourishing mining district. To-day the town South Pass presents a dreary appearance. Many, if not the majority of its houses are deserted and broken window panes, swinging doors, and torn roofs tell a pitiful tale of desolation. On the surrounding hills buildings are located which are in connection with the mines. Very few of the latter are being worked, while a large number appear to be abandoned temporarily. Ascending a steep hill, we passed through a very pretty country and after a short drive, reached Atlantic City. This, too, is located in a narrow valley and was formerly the active center of mining operations."

I leave the reader to digest these various reports, but I wish to call attention to a few statements. Dr. Hayden seemed to think it an ideal place for placer mines on account of the water supply, and Mr. Reed lamented the fact that water was so scarce.

In none of these reports was the best feature of the district mentioned, viz: the occurrence of eruptive rocks with the schists and also the schists in many instances being produced from eruptive rocks.

Mr. Endlich was a mining engineer of more than ordinary attainments and his statement of the condition of the mining industry in the Sweetwater district for the


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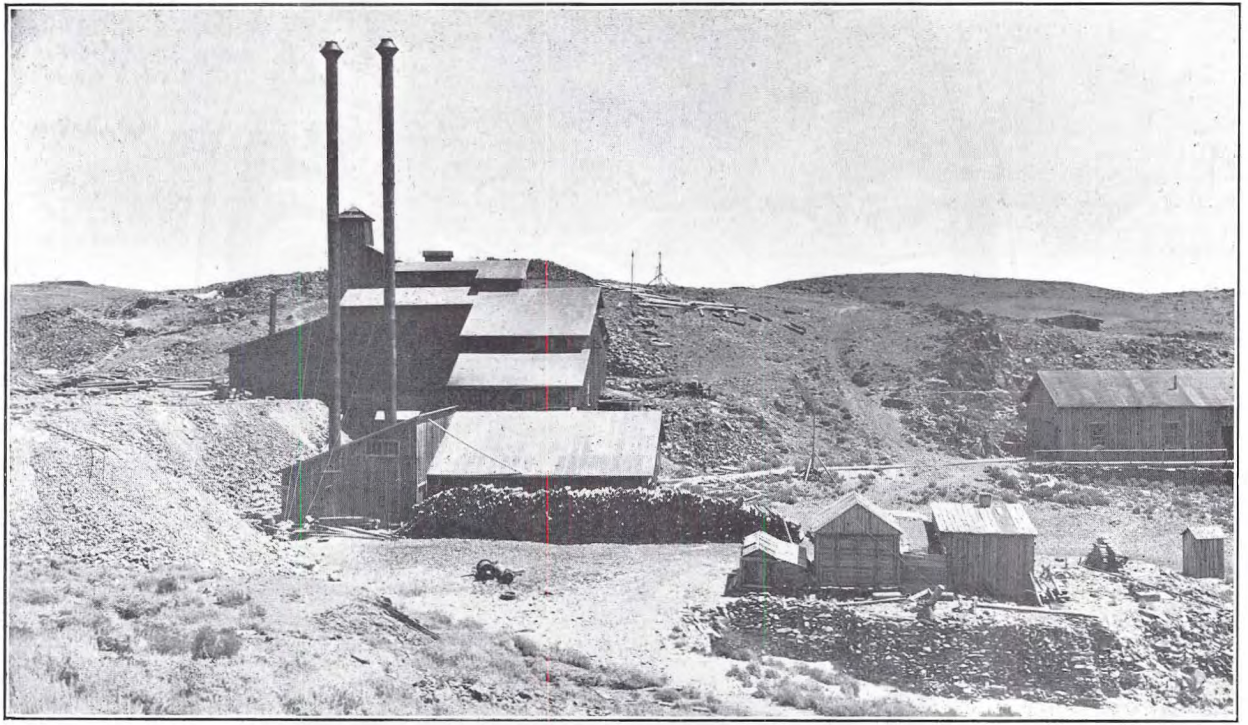


The Carissa Mill and Shaft House

year 1877 must be considered as authoritative. He also reported, in a brief way, the claims of this gold camp, which is too extended to publish. It resembles very much the report of Surveyor General Reed, only it was made seven years later.

Since 1877, until recently, this district has been anything but prosperous. Each year some of the mines would work a small force of men, but most of them have been continuously idle. Occasionally, the spell has been broken by some promoter visiting the camps and securing a bond on a mine, and, in a few cases, some money has been spent in un-watering and opening up old shafts and drifts, but all of this kind of work availed nothing until the Carissa passed into the hands of Chicago capital.

Between the years 1869 and 1875 considerable capital was attracted to the mines, but unfortunately the men who furnished the money were not mining men, and after spending a few thousands and not seeing thousands of dollars in sight, not only withdrew their support, but also decried the camp. This unfortunate experiment was repeated the following years and, in fact, has been rehearsed many times during the last decade. While undergoing these experiences the camps were also favorite places for mining and gambling sharks and, with the blighting effect of these combined influences, it is almost miraculous that such a place as Sweetwater mining district is known to-day upon our maps.

After South Pass and Atlantic City and Miners' Delight had all experienced booms and had dwindled down to small places with a few inhabitants, a fourth camp, Lewiston, was opened, which also had a similar experience. Lewiston, like the others, had rich veins of quartz and placer grounds, but, for all of that, the mills that were erected have not stamped much ore, and the camp is sorely in need of good mining men who will be willing to develop a mine before they expect it to yield a dividend.

But these are not all the drawbacks. The surface ores were quite free and rich, but with depth they rapidly became base and were associated with iron pyrites and

arsenopyrite. The ores extracted near the surface milled easily and good values were saved, but long before the water level was reached the amount of free gold had diminished so that the tailings were assaying $35 and $40.

GEOLOGY

Schists

The rocks of the district are generally Algonkian schists, slates and quartzites, the stratification coinciding with the schistose structure, striking roughly northeast-southwest, and dipping at ninety degrees and over, producing an apparent dip to the north-west approaching the vertical.

As the distance across the upturned edges of the Algonkian is about four miles, the thickness of the series is about twenty thousand feet. The pressure from the northwest and southeast closely folded the schists in between granites, and erosion later cut the whole area down to approximately the present surface. A sinking below sea level allowed the deposition of the Cambrian and later series, which were later eroded after the present Wind River Range was forced up by a northeast-southwest pressure. The Tertiary beds were then laid down along the flanks of the mountains and have since been cut away, along with vast amounts of the various older series, leaving the Algonkian schists exposed over this area, with outcrops of Cambrian and younger rocks surrounding them.

IGNEOUS METAMORPHICS

Among the schists, which are evidently of sedimentary origin, are bands, or dykes, of rocks which have undergone metamorphism with the schists; strike and dip with them, but are volcanic or igneous in origin, although their structure is now distinctly schistose. Whether these were lava flows upon the old surface, or are intrusions, is not now ap-

parent in the hand specimen. In thin section some prove to be basalts.

In addition to the old igneous rocks, there are dykes of porphyrys and holocrystaline rocks which are evidently intrusions of a later date, but which also coincide in strike and dip with the enclosing sedimentaries. Some of these are of considerable width, and extend for a great distance along the strike. In addition to the above there is, just to the southwest of the area mapped, a mountain of graphic granite, extremely coarsely crystalline, which has sent long dykes of pegmatite into the area mapped. These dykes fault certain of the mineralized veins to the west of South Pass, according to the statement of miners who worked on the veins in early days. This quartz-feldspar intrusion is of great scientific interest, both from its method of occurrence and from the fact that the crystal orientation is the same throughout the mass, so that the whole side of the mountain flashes together. What effect this intrusion has, if any, upon the mineralization of the mining area could not be determined.

The Algonkian series is very silicious, consisting largely of quartzites with but few slates, and, so far as the writer could find, not one single limestone or marble stratum. The minerals, characteristic of metamorphism, are abundant. Mica and chlorite schists are frequent, and several exposures of staurolite schist are prominent. Beeler (Report of 1908) says that he observed garnet schists. The writer did not find such. The original sedimentaries were mostly sandstones, no doubt. Among these metamorphosed sandstones, which now appear as quartzites, or where slightly argillaceous, as phyllilis and graywackes, are occasionally bands of rock which are almost entirely composed of hornblende. As these have taken on a very decided schistose structure, one can but call them hornblende schists and ignore their origin. They are conformable with the schists above and below, but may be in part intruded basic lavas, or perhaps surface flows, although specimens taken from a few places showed their sedimentary origin plainly, where cut in thin section and studied under the microscope.

Green Dykes

Among the oldest intrusives are the various, so-called "Green Dykes". These are pyroxenites of varying structure and decomposition. One of these extends for several miles, parallel with the schists, just to the north of the Carissa Lode. Another (or perhaps the same one) shows on the south contact of the Mary Ellen granite area. Others were noticed in various parts of the district. They frequently look almost exactly like the exposures of serpentine in the northern Sierras of California. The McFarlane shaft (Copper Queen Claim) is being sunk in one of these serpentine dykes. These "Green Dykes" are usually only a few feet wide and are not shown upon the maps of the district. To trace them out and correctly map them would require months of work. This is because of their usually being softer than the schists, and being worn down and covered with soil and grass.

The Later Intrusive Rocks

These are mapped under the three names of Andesites, Diorites, and Granites. But it must be understood that no two areas mapped under the same name are identical rocks. A closer classification would require a different symbol for each area shown, and it has not seemed best to attempt this upon a small scale map and upon the relatively small amount of field work done. There are certainly other areas of these rocks besides the ones mapped. In many cases, pieces of float rocks were noticed which were not traced back to their places of origin. Future development and prospecting will show many more such rocks, there is no doubt.

The importance of these rocks is apparent when one realizes that the veins and the ore-bodies are directly due to their presence in the schists. The veins occur either in, beside, or near one of these intrusive rock areas every time. Nowhere are there promising prospects at any considerable distance from one of these areas.

The underground structure has not been worked out.

In fact, it is probably impossible to work it out until deeper mine openings have been made. Roughly, the main belt of the intrusives seems to follow close to the syncline in the Algonkian schists. But what relation this may show cannot be stated.

Veins

The veins are all quartz filled, and the dip and strike of those carrying workable values show no relation to the strike or dip of the schists. The Big Atlantic and Mammoth are heavy wide bands of what seems to be vein quartz, running for miles across the district, following the schists in both dip and strike. But neither of these have shown shoots of pay ore; the gold value usually being a dollar or less per ton. These leads have been well prospected, for one can follow their course with the eye for miles by the prospect holes dug in them. Their great length and uniform width, also their parallelism with the enclosing schists, make one certain that they are of sedimentary origin.

The gold bearing veins are found in the schists, diorite, the andesite, and, in one case, in granite. There is no uniformity of strike. It has been stated that the strike of the veins was in general parallel to that of the schists. The writer has not reached this conclusion. In some cases this is true, but is apparently only a coincidence. The Miners' Delight vein, for a part of its length, runs parallel to the strike of the schists. But in other places it strikes nearly across the schists, and the portion parallel to the schists, has both foot and hanging wall of andesite. A fracture, running through andesite, surely cannot be controlled by the schists upon either side of the andesite intrusion. Again, the Mary Ellen is a fissure in granite, the strike of which is at nearly right angles to the strike of the schists, surrounding the granite intrusion. The veins of the Gold Dollar group and of the Rose strike across the formation, the first in diorite and the latter in schist. The Carissa, it is true, does strike parallel to the schists. So also do the several veins of the Garfield. But, on the whole, there is not evidence to prove that the structure of the schists has controlled the strike or dip of the veins.

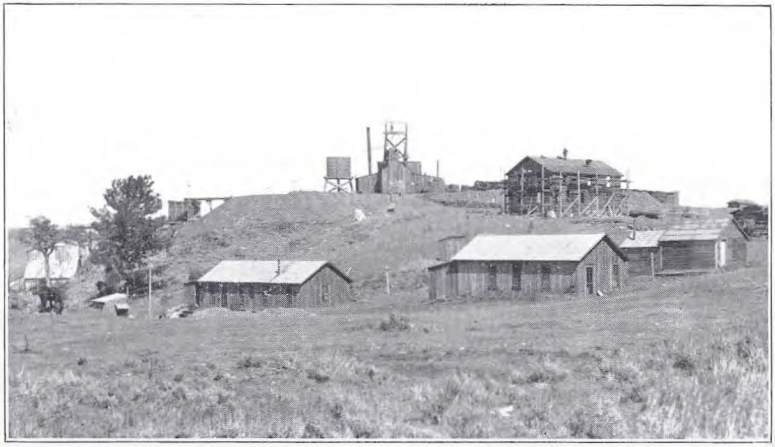
The veins are younger than most of the intrusives; the intrusives younger than the schists, of course, but intrusives and probably the veins of different ages.

THE MINES AND MILLS

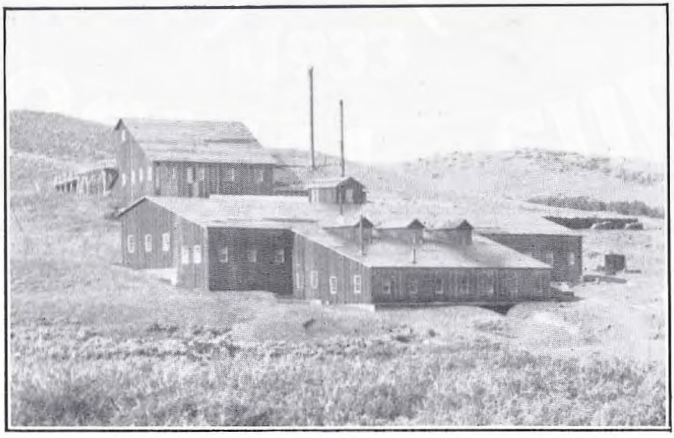
No detailed description of the various prospects will be attempted in this report. A strict interpretation of the word mine leaves the district with but one, the Duncan, for it is the only property making a gold production. At South Pass, Mono Claim, is the old Carissa property with a record of large production in years past, but now idle for several years. At the other end of the district, is the Old Miners' Delight property with a similar record, but idle for years, and now full of water, so that no examination can be made. Both of these properties are worthy of further exploration, but are owned by non-mining men who hold them at a ridiculous figure. Until time forces a change in the ownership of these two properties, little can be expected of them.

At Atlantic City is the Dexter Mill, now part of the property of the Timba Bah Mining Company. This mill is an example of the kind of mine management that furnishes the topic for so many stories and jokes among real mining men. The mill, costing several times its value, was built beside the townsite and the manager's office, although there was no mine near and the slope was too slight to allow the material to be handled by gravity. After the completion of the mill, ore was hauled in wagons from various prospects in the district. Twelve thousand tons of five to thirty dollar ore were milled, and the cleanup gave six thousand dollars off the plates and absolutely nothing from the cyanide plant. After the company had sold seven hundred thousand dollars' worth of stock, it became bankrupt. Fraud and ignorance played about equal parts in the management of the company affairs. The whole affair naturally was no help to the reputation of the district.

The Beck Milling Company operation on the Duncan Claim is the only producing concern in the district at the



The Duncan Mill and Shaft House



The Dexter Mill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present time. They are cyaniding (all slime) ore from a nearly vertical vein in schistose quartz diorite. Their shaft is down between two and three hundred feet, the bottom being level with the bottom of the nearest draw. A chapter in the later part of this report is devoted to milling operations at this mine. That the mill is handling ore at a profit by up-to-date methods seems to the writer positive proof that the other properties of the district may be expected to prove equally profitable when similarly equipped and operated.

A half mile east of the Duncan is the Mary Ellen claim. This property is very interesting for several reasons. The vein of quartz strikes northeast and southwest at a low dip to the west, in a small granite area, intruded into a larger diorite area. Near the south contact of the granite is one of the typical narrow "green dykes" of the district. Mining was done in early days from the outcrop to a depth of some two hundred feet along the dip. The openings stand without timber and the characteristic black powder mining of the early days shows as if the mining had been done yesterday. As the miners sorted and took out only the richest ore, a large tonnage of mill ore is already broken ready for treatment. This is one of the very few holes that are dry and can be entered and examined. As the mining did not extend to the granite-diorite contacts, no information regarding the behavior of the vein at those points was obtained.

Of the many properties which have in past years made a production, but few can now be examined. Shafts are caved and filled with water and tunnels have broken in and blocked entrance. But little development work is being done. Assessment work is scattered so that what is done one year does not add to the depth or length of openings made in previous years. While the criticism holds generally for the district, as well as other districts, there are a few exceptions. Notable among these are the Gold Dollar Group owned by McGrath and Burton and the J. A. Reynolds Group, owned by Cassi. Both these are kept in shape so that examination can be made.

ESTIMATED OUTPUT OF THE DISTRICT*

Lode Mines

Miners' Delight	$1,200,000
Carissa	1,000,000
Caribou	500,000
Garfield	400,000
Victoria Regia	350,000
Franklin	300,000
Mary Ellen	125,000
Lone Star	40,000
Carrie Shields	35,000
Ground Hog	30,000
Other quartz mines, total of	157,000
Total	$4,137,000

Placers

Meadow Gulch Placers	$1,000,000
Yankee Gulch Placers	500,000
Spring Gulch Placers	30,000
Promise Gulch Placers	30,000
Smith Gulch Placers	20,000
Red Canyon Placers	20,000
Atlantic Gulch Placers	15,000
Beaver Creek Placers	10,000
Other Placers	100,000
Total	$1,725,000

Cost of Mining Ore for Fifty-ton Mill

2 trammers at $3.50 per day	$7.00
2 hoistmen at $4.00 per day	8.00
1 blacksmith at $4.00 per day	4.00
1 blacksmith helper at $3.00 per day	3.00
2 miners at $3.50 per day	7.00
Wood for boiler, pumping 200 feet	9.00
Blacksmith coal	.50
Candles and oil	.30
Powder, caps and fuse	3.20
Timbering	2.00
Power compressor, distillate at $.155 per gal.	3.75
Power for hoist	1.25
Total	$52.00
Per ton	1.05

The above does not include repairs, which is a very small charge per ton. The labor costs would be cut when doing the above in conjunction with other mining. The development is not included in the above. Hoisting was done in 750 pound buckets and from a little more than 200 feet depth.

Costs of Driving a 350-foot Adit

First 130 feet by hand labor in medium hard schist. Cost per foot as follows:

*From Jamison's Mineral Resources of Fremont Co., State Geologist's Office, 1911.

Labor	$2.05
Powder	.26
Other supplies	.12
TOTAL	$2.43

This does not include supervision, nor the sharpening of steel, which was done by the hoist engineer.

The remaining 220 feet was driven by No. 8 Leyner Drill. Costs per foot as follows:

Labor	$3.14
Fuel and oil	.50
Powder	.825
Candles and carbide	.051
Fuse and caps	.072
Drill repairs	.020
TOTAL	$4.608

This does not include attention to the compressor nor tool sharpening, both being taken care of by the hoistman.

Cost of 4½ by 7 foot drift at 200 foot level varied from $2.75 to $7.00 per foot, depending upon hardness of rock and distance from shaft.

MILLING

The district still shows the relics of old time stamp mills and arastras. No record of the number of mills has been kept, but judging from the number of mines one observes, there must have been upwards of a hundred at various times. The early mills stamped to various degrees of fineness, using both inside and plate amalgamation, but never concentration, or any further treatment. The tailings were run to the creeks and have all been lost.

The Dexter mill, elsewhere written about, erected a leaching plant (cyanide) as a part of their mill, but it was not intelligently handled, or else the precipitate was stolen, for the test run gave no yield from the cyanide plant.

The operations at the Duncan Mill (see later chapter) have shown that the ore is ideal for all-sliming treatment. The sulphide and arsenosulphide, which put an end to amalgamation, cause no trouble, and the tailings' assays show a surprisingly low percentage of loss.

POWER

One of the heavy handicaps of the district has been the excessive cost of power. Wood to burn under boilers,

now costs about five dollars per cord. And as the nearby timberland is all within the National Forest, good live wood is not obtainable at all. Fortunately for the future of the district, the forest boundaries do not include much of the mineralized portion of the district.

The power problem has been solved by the Beck Milling Company by the use of gasoline engines. With the adaptation of the Deisel engine to the heavy asphaltic oil of the Dallas field, will come another reduction in cost. This can be done either by carrying the oil to engines at the mines, or by the developing of electric power at Dallas and carrying it to the mines on wires. Other possibilities are the carrying of power from the Boysen Dam Power Plant, or the erection of an hydro-electric plant on the Popo Agie, both of which plans are being considered.

Still another possible advantage to the district is the possibility of either the Northwestern or the Burlington Railways building to the westward, to a southern gateway to Yellowstone National Park. Either would of necessity, go by way of South Pass. While neither may build in the immediate future, one who knows the geography and natural resources of the State, cannot doubt that eventually one or the other will build such an extension.

PLACER MINING

The district was first worked for its placer gold, and for years made a considerable production from the smaller tributaries of the main streams. These were exceeding rich in places and have long since been worked out.

At present, the only remaining placer ground is in the beds of the main streams. These are of so slight grade that there is no room for tailings, if worked by hydraulic giants and sluices. Consequently, elevators of some description must be used. Years ago an attempt was made to bring a larger head of water from the Popo Agie drainage and handle the gravel with hydraulic elevators. The two following quotations explain this plan.

Sweetwater District*

"In the old mining districts towards the head of the Sweetwater, including South Pass City, Atlantic City, Rock Creek, the Strawberry and Miners' Delight, active work is again in progress, with gratifying promise of success.

"The Christina Lake Company, conducted by French interests, and managed by Colonel Emile Granier, has inaugurated work on a large scale. Its purpose is to work the rich placer grounds known to exist in this section. The company intends to conduct the water from the lakes at the head of the Little Popo Agie to Rock Creek. The ditch on Rock Creek, nearly seven miles long, is nearly completed. Sixty-five hundred feet have been taken out on the Christina Lake ditch. This ditch, when completed, will be five miles in length and run 8,000 miners' inches of water. Portions of it will be heavily timbered, one flume having a projected length of five hundred and a height of seventy feet. The company expects to work all the placer ground from Rock Creek to the Strawberry. It has located a great deal of ground, and reports itself well pleased with the results of the prospecting which it has done during the season. One of the results of the work was the finding of gold nuggets of unusual size along Rock Creek. The company has expended in this preparatory work over $100,000. This enterprise is a very important one to the mining interests of the Territory, and if continued cannot fail to be richly remunerative to its projectors. Heretofore, the prime obstacle to placer mining has been the scarcity of water. This difficulty this company is overcoming by their long ditches and canals. It is not, however, engaged in quartz mining.

"The placer grounds on Spring Gulch, at Miners' Delight, are still successfully worked every spring while the water lasts. Up to date these grounds have yielded over $400,000 in gold."

*From Territorial Geologist Aughey's Report for 1886.

LETTER FROM EMILE GRANIER TO L. D. RICKETTS

"In 1884 I bought from the original locators some placer claims on Willow Creek, Rock Creek, Strawberry Creek, and Sweetwater River, and the next year I commenced digging ditches for the purpose of washing those creeks. The ditch on Rock Creek is 10.5 miles long, 3 feet wide at the bottom, 6.75 feet wide at the water-line, 2.5 feet deep with 10 feet grade to the mile, and can carry about 40 feet of water per second. I expected that the ditch would be filled up with water of Rock Creek alone long enough to wash during the whole summer; but Rock Creek was not sufficient, and had to finish the big ditch that will carry the water of Christina Lake to the head of Rock Creek. The last mentioned ditch is 6 miles long, 5 feet wide at bottom, 11 feet wide at water-line, and 3 feet deep and 16 feet grade to the mile, and can carry 144 feet of water per second. It was cut through solid granite rock for more than half of the way. It has a flume, on trestles 70 feet high and 500 feet long, 6 feet wide and 4 feet high.

"Christina Lake is about one mile and a half long and one mile wide, and it is situated at the foot of Atlantic Peak at 10,000 feet above the level of the sea.

"I intended to wash the Rock Creek bottom with one of Joshua Hendy's Hydraulic Elevators because the grade of the bed of the creek is so small that it is impossible to wash off the tailings. It is not yet quite certain that this machine will work well."

The ditch was completed and a total expenditure of over $100,000 made, when the company encountered financial difficulties and the property passed into the hands of the Dexter M. & M. Co., which, after spending tremendous sums in securing land and building a mill, became bankrupt, and its holdings passed to the Timba Bah Co. which holds them at the present time. These placer lands, extending for miles along Rock Creek, have been patented and, of course, can be worked by the owners only. There

are no unworked placer grounds, subject to entry as placer claims, left in the district. That the flat-lying placers along the creeks will eventually be worked cannot be doubted. The gold obtained from the creek placers is surprisingly coarse. The writer was shown quarter-ounce nuggets last summer, and none of the placer gold examined was very fine or flakey. There is no trouble in saving the gold, and the difficulties of low grades and hard ribby bedrock will be overcome. No reliable data relative to gold content per yard were obtained.*

Laboratory Tests†

The samples were selected in quantities varying from two to seventy-five pounds, the majority being a sack of ore. These were taken to the School of Mines laboratory, crushed with a Dodge crusher, sampled with a large quantity ground fine enough to pass through a 100-mesh sieve. The samples were ground fine so that the assays would agree upon the pulp and make it possible to do good work. Crushing an ore so it will pass through a 100-mesh sieve will increase the percentage of gold to be collected by either the free-milling process or any wet method.

After the samples had been prepared they were subjected to the following tests:

1. Assayed to find their entire value.
2. Tested by free milling process.
3. Tailings from free milling process were assayed.
4. Tailings from free milling process were treated with cyanide.
5. Cyanide tailings were assayed.
6. The raw ore was treated by a chlorination process.
7. Chlorination tailings were assayed.

The tests were conducted in the following manner:

The sample was assayed by using one A. T. for a charge. The ores being very low grade in silver, no attention was paid to the silver values except in one instance. A small piece of c. p. silver foil was usually added to the assay to decrease the fineness of the button so that they could be parted as they were taken from the cupel. These ores all having a silicious gangue, there was no difficulty experienced in making any of the assays. For free milling tests, two pounds of ore that had been crushed to 100-mesh were introduced into a Case-Buck's amalgamating mortar, together with mercury and enough water to make a good pulp. The mortar was then rotated for one-half hour. The

*Table of Placer Production on page 88.

†Report of tests made in 1900 by Prof. W. C. Knight, University of Wyoming.

pulp was then transferred to a gold pan, the mercury and amalgam collected and the tailings dried for assaying.

In assaying tailings 1 A. T. was used, and in most cases a small piece of c. p. silver foil was added to facilitate parting.

In making the cyanide tests the pulp was carefully examined for detrimental compounds, and in no instance were any detected. This would be very difficult if the tailings contained sulphides of iron and arsenic and were allowed to stand for any length of time in a dump. Sulphides oxidize very rapidly and produce sulphates and sulphuric acid which seriously interfere with the cyanide process. Tests were made with solutions of various strengths to find out if possible the most economical strength to use. It was found that .30 per cent. was ample in every case and in no instance was this amount consumed. The cyanide tests were made by taking a half-pound of the dried tailings from the free milling process and placing them in a liter flask and filling flask half full of cyanide solution. These flasks were agitated occasionally through the day and at the end of twenty-four hours were emptied upon a filter. The tailings were allowed to drain, then thoroughly washed with three applications of warm water and dried.

The cyanide tailings were assayed by using 1 A. T. in the usual way.

The chlorination tests were made with one exception upon the ores without any preliminary treatment. In conducting the tests about a half-pound of ore was placed in a liter flask that was provided with a stopper. Sufficient water was added to form a pulp, then enough bleaching powder to produce more chlorine than would be necessary to dissolve the gold. This was thoroughly mixed and a small amount of sulphuric acid added and the bottle was tightly corked. The bottle was shaken occasionally, and after twenty-four hours was emptied upon a filter and washed until chlorine free. The tailings were dried and assayed in the usual way.

The results from these various tests are much more flattering than one might naturally expect, but at the same time prove conclusively that no mining man should attempt to save the gold values in the ore of Sweetwater district by the free milling process alone.

That those interested may have a better understanding of the tests made, I append here a very brief statement in connection with each sample and occasionally make a few comments on the treatment.

No. 1. Diana Mine. Atlantic. Sample taken, one sack. Assay, 1.5 ozs. of gold per ton. Tailings after free milling test assayed .27 oz. of gold per ton, making a saving by amalgamation of 82 per cent. The cyanide tailings were assayed and found to contain only a trace of gold. In practice the owners cannot expect to extract 82 per cent. by amalgamation on account of

coarse crushing. They can, however, depend upon cyanide to save the gold left behind by amalgamation and effect a saving of nearly 100 per cent.

Tailings from the chlorination process assayed .55 oz. of gold per ton, which was a saving of a little less than 65 per cent. of the gold values. This ore is of sufficient value to work by the chlorination process, but would have to be roasted before one could expect to make a good gold saving.

No. 2. King Solomon Mine. Atlantic. Sample taken, one sack. Assay, .162 oz. of gold per ton. Tailings from the free milling test assayed .061 of an ounce of gold per ton. The amount of gold saved was only 62.3 per cent., which was very low. The tailings were treated with cyanide, after which they assayed .01 of an ounce of gold per ton, which practically made a complete saving. A sample of this ore treated by a chlorination process yielded only 73.82 per cent. of the original value. On account of this being a low-grade ore, chlorination would be impossible. Amalgamation followed by cyanide process should effect a saving of upwards of 95 per cent. of the gold value.

No. 3. Garfield Mine. Atlantic. One sack of ore taken as a sample. Ore assayed. .99 of an ounce of gold per ton. Tailings from the free milling test assayed .072 oz., thus saving 92.7 per cent. of the gold. The cyanide removed the last trace of gold from the tailings. The combined methods made a perfect saving. The ore was then tested by the chlorination process, which extracted 95.1 per cent. of the gold. Amalgamation followed by cyaniding should work this ore without the least trouble. Chlorination would also work it, but the ore would have to remain for a long time under the influence of the chlorine gas.

No. 6. Cariboo Mine. Lander, Wyoming. One sack of ore taken. Assay value, .61 of an oz. of gold per ton. Tailings assayed .13 of an oz. of gold per ton. Saving effected by free milling test, 78.7 per cent. After this the tailings were treated with cyanide and they did not assay a trace of gold. The chlorination test saved 71.2 per cent. of gold. This ore contained a very small percentage of sulphides and could not be successfully treated by chlorination, unless roasted.

No. 8. Victoria Regia Mine. Atlantic. One sack ore taken. Sample assayed .65 of an oz. of gold per ton. Tailings after free milling test assayed .12 of an oz. of gold per ton. Free milling process saved 81.5 per cent. of the gold. The tailings from the cyanide test assayed .025 of an ounce of gold values. I have no doubt that the cyanide would make a complete extraction could it be given additional time, say 48 in place of 24 hours.

The chlorination test was not a success, since it extracted only 77 per cent. of the gold values. In this instance there were no sulphides and the poor extraction was not accounted for.

No. 9. Rustler Mine. Atlantic. One sack of ore taken. Sample assayed .171 of an oz. of gold per ton. Tailings from the free milling test assayed .012 of an oz. of gold per ton. The cyanide test extracted the last trace of gold from the tailings. In ores of this class when 94 per cent. of the gold value can be saved in the mill and there is nothing in the ore to concentrate, there is no chance to make additional saving on account of the low grade tailings, which would not pay the expense of the cyaniding. On account of this ore being very low grade it will be impossible to work it by any process unless found in vast quantities, easily accessible and under favorable conditions. The chlorination test was not made.

No. 17. The Carissa Mine. South Pass. Sample taken was a rich sulphide, weighing only two pounds, but was typical of the rich ore found in this mine. It assayed 171 ozs. of gold per ton and 17.08 ozs. of silver. The tailings from the free milling test assayed 21 ounces of gold per ton. These were treated with chlorination after being roasted and the combined processes made a saving of 97.8 per cent. This cannot be considered satisfactory for an ore of this grade. Cyanide was not applied to this sample on account of the high percentage of sulphides. The gold was not quite coarse in the specimen and in ordinary stamp milling practice the saving would not be as high as in the test. On account of the sulphides and especially a small percentage of arsenic, this ore slimed very badly and also had a very bad effect upon the mercury. Losses may be looked for in slimes and in flour mercury. In my opinion ores of this class should never be milled. It is a serious mistake to attempt to bring up the average value of the milling ore by including such very rich shoots. Rich ores should be sacked and shipped to a smelter. Lower grades of this class can be milled, provided the mill is provided with gold slime saving devices and concentrators. The concentrates can be successfully handled by barrel chlorination.

No. 18. The Carissa Mine. South Pass. Sample weighed five pounds and was typical ore from this property. Ore assayed 1.24 ounces of gold per ton. The free milling test extracted 79.83 per cent. of the gold values. The tailings from the free milling test after being cyanided assayed .041 of an ounce of gold per ton, making the saving by the combined processes 96.7 per cent. The same ore chloridized without roasting yielded only 56.45 per cent. of the gold it contained. This sample was from below the oxidized zone and contained pyrites of iron and arsenopyrite and for this reason could not be successfully handled with chlorination unless roasted. The success of the free milling process followed with cyaniding seems sufficient for ores of this class.

No. 19. The St. Louis Mine. Atlantic. Sample, five pounds. Ore assayed 10.44 ozs. of gold per ton and was taken

from near the surface. The gold in this sample was remarkably free. The free milling test extracted 92.04 per cent. of the gold. The tailings although rich, yielded almost perfectly to the cyanide; the combined processes making a saving of 99.99 per cent. The same pulp chloridized showed a saving of only 67.24 per cent. of the gold. This sample was very high grade ore, but demonstrates very nicely how the ore can be successfully treated.

No. 20. Bryan Timba Bah. Sample weighed ten pounds and was oxidized ore. Pulp assayed 2.16 oz. of gold per ton. Free milling test extracted 94.9 per cent. of the gold. The tailings after being treated with cyanide assayed only a trace of gold. The pulp was treated with chlorine, which also extracted all of the gold. This is an example where the ores are near the surface and are practically free milling.

No. 21. St. Louis Mine. Atlantic. Sample weighed eight pounds and assayed .36 of an oz. of gold per ton. The free milling test extracted 83.33 per cent. of the gold, and the tailings after being treated with cyanide assayed only a trace, making the saving nearly 100 per cent. This ore also chloridized exceedingly well, since only a trace of gold was left in the tailings. This sample was taken from the fines of the mine and represents the oxidized ore.

No. 22. Timba Bah. Sample weighed ten pounds and assayed .92 of an oz. of gold per ton. The free milling process extracted 94.02 per cent. of the values of this ore. The tailings after being treated with cyanide assayed only a trace of gold. The pulp was treated with chlorine after which the tailings assayed only a trace in gold. This is another sample of an oxidized ore that can be easily handled by any of the above processes.

This completes a statement of the tests made. All of the miners and prospectors had equal opportunities to take advantage of this laboratory work and in case anyone's ores have not been tested it has been their own fault.

This chapter has been included in this report for the reason that it gives data regarding ores from many properties which cannot now be examined. The assay records are reliable. The names of some of the properties have been changed and cannot be identified upon the attached map. As this report is of the district in general and not of the individual properties of the district, the exact place from which the samples were taken is of minor importance. The important thing is that ores from various places in the district, both high and low grade, gave a splendid saving under cyanide test.

THE DUNCAN MILL, ATLANTIC CITY, WYO.

DESCRIPTION—DISCUSSION

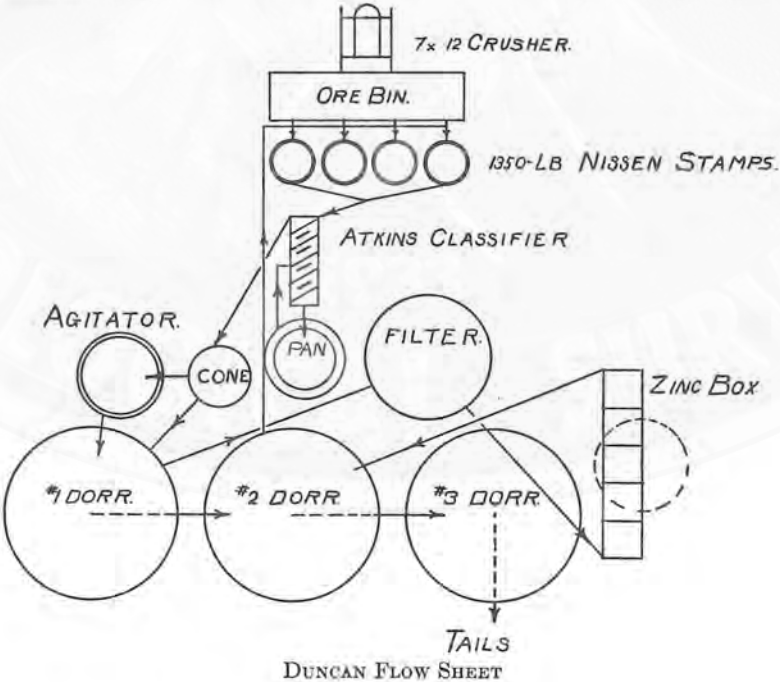
By D. C. Kelso, Supt.

The ores of this district are ideally susceptible of cyanidation, because of the rather quick and complete extraction, and the small consumption of chemicals.

The mill of the Beck Mining Company, at the Duncan Mine, was originally designed and built to crush with Nissen Stamps and amalgamate the gold, using both inside and plate amalgamation.

It was learned, after several months operation, that the best practicable extraction, from quartz of the oxidized portion of the vein, and using clean water, was never over 75 per cent. for the month. These conditions could not be maintained when using water into which a steam pump had exhausted, and ore with sulphides. It required careful operation to keep the extraction above 60 per cent. under these conditions.

A continuous decantation mill was designed after some experimentation, and the following arrangement was finally established.



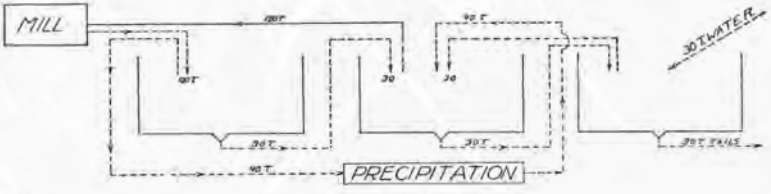
Duncan Flow Sheet

An attempt was made to crush in cyanide solution and amalgamate on plates, but the usual difficulties, by this practice, were met, and it was shown that an equal extraction could be obtained by all-sliming and cyaniding without amalgamation. It is quite likely amalgamation could be successfully carried on, in cyanide solution, in some device, as a Pierce Amalgamator, thereby catching the coarse gold, without exposing a large surface to the atmosphere or adding mercury to the crushing machines.

The mill is capable of sliming about 30 tons per day. Eight-tenths (.8) pounds of cyanide per ton of solution, with proper agitation, is of sufficient strength to dissolve the gold.

The accompanying flow sheet shows the course of the pulp, and the following table gives the itemized cost of operation for the month of February, 1913. Since that time air-lifts have been installed, thereby eliminating a considerable expense for repairs and power that is herein charged to sand pumps, which were found to be entirely impracticable, troublesome, and expensive. Other improvements have been made and could be made, which would cut the cost to a little over $2.00 per ton.

An example of the decantation problem, about as it appears, is given. From this it can be figured that the addition of another thickener would decrease the tailing loss, for dissolved values, to a very few cents.



ASSUME:

Mill treats 30 tons dry ore per day.

90 tons solution, value $1.00 per ton, precipitated to $.03.

Pulp, in thickeners, thickened to one of ore to one of solution.

Strength of solution 1 lb. per ton of solution.

Let X, Y, and Z equal the value, in gold, per ton of solution.

Equating the solution in and out of the thickeners, we have:

(1) 120 Y plus 90, equals 30 X plus 90 X.

(2) 30 X plus 90 (.03) plus 30 Z, equals 30 Y plus 120 Y.

(3) 30 Y plus 30 (0), equals 30 Z plus 30 Z.

Equating we have:

Y equals X plus .75, equals 2 Z, equals .24, hence Z equals .12 dollars, the amount of dissolved values lost for each ton of solution discharged. The cyanide loss, figured in a similar manner, is .44 lbs., at about $.20 per pound, would be $.088.

COSTS

Zinc used per ton of ore, .41 pounds at .14	$.057
Lime used per ton of ore, 7.00 pounds at .02	.140
Solium cyanide used per ton of ore, .44 pounds at .22	.096
Lead acetate used per ton of ore, .003 pounds at .15	.0004
Battery screens at .35 per foot	.023
Wear on shoes and dies (chrome), .75 pounds at .075	.056
Wear on grinding pan (soft iron), at .07	.135
Labor, time six men	.96
Fuel, gasoline at $.233 per gal., distillate $.205	1.19
Heating both mine and mill, wood at $5.00 per cord	.05
TOTAL	$2.708

Fuel is now obtained for 75 per cent. of the above price, and a slight increase in tonnage decreases the cost per ton.

The details are not shown here with the idea that the mill is a model, because it could be improved, but it does show conclusively that the ore is very amenable to this method of treatment, and in spite of high freight and power charges, it is possible to treat a comparatively low grade ore, profitably.