6/26

Union-Companion-Red Jacket See Cornucopia

NAME | OLD NAMES | PRINCIPAL ORE | MINOR MINERALS

6 S T | 45 E R | 27-28-29 S

PUBLISHED REFERENCES

...Baker..... COUNTY

...Cornucopia..... AREA

..... ELEVATION

MISCELLANEOUS RECORDS

..... ROAD OR HIGHWAY

..... DISTANCE TO SHIPPING POINT

PRESENT LEGAL OWNER (S) ..... Address .....

..... .....

..... .....

..... .....

OPERATOR ..... .....

| Name of claims | Area | Pat. | Unpat. |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

| Name of claims | Area | Pat. | Unpat. |
|---|---|---|---|
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| | | | |

EQUIPMENT ON PROPERTY

MI-21

6/26

Union-Companion-Red Jacket See Cornucopia

NAME | OLD NAMES | PRINCIPAL ORE | MINOR MINERALS

6 S T | 45 E R | 27-28-29 S

PUBLISHED REFERENCES

...Baker..... COUNTY

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..... .....

OPERATOR ..... .....

| Name of claims | Area | Pat. | Unpat. |
|---|---|---|---|
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| Name of claims | Area | Pat. | Unpat. |
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EQUIPMENT ON PROPERTY

MI-21

*Geology.*—The outcrop of the Union-Companion vein is at an altitude of 6,100 feet, or 1,400 feet above the town of Cornucopia, one and one-half miles away down Fall creek. The outcrop of this vein is traceable, according to Bernard McDonald, for 6,800 feet throughout the lengths of the Union, Companion, Red Jacket, and Robert Emmett claims. Its strike is about N. 20° E. and dip 45° W. into the mountain; its maximum width is 20 feet.

The chief country rock is granodiorite, but the vein is near the extremely irregular borders of the intrusion, so that in the plane of the vein the wall rocks alternate continually between the intrusion and the intruded. This older rock in some places on the walls is greenish schist, originally probably a basic sandstone; in other parts of the mine the walls were found to be a part of an old intrusion or flow now altered to greenstone.

One characteristic specimen shows what appears to be a rather irregular contact with the granodiorite, so vague that one might almost say that the assimilation, or melting of it by the intrusion had been arrested when its work had been but partially completed. On the surface granodiorite is in evidence on the Union and Companion claims, while on the Red Jacket and Robert Emmett the older rocks chiefly prevail.

Numerous dikes of granodiorite porphyry are found varying from a few inches to a few feet in width and cutting both the older and the

newer rocks. Aplite dikes are less conspicuous here than at points farther up on the mountain.

Another rock type is the Tertiary Columbia river basalt in the form of dikes. These dikes are shown on the surface with outcrops in all directions. These reddish-brown weathered outcrops contrast strongly in color with the whitish granodiorite in which they are placed.

*The Vein.*—The width ordinarily is 2 to 5 feet but it swells in places to a maximum of 20 feet.

"On the whole the vein is remarkably persistent. Hanging and footwalls are sharply marked, inclosing a massive vein of white normal quartz. A ribbon structure by shearing is usually developed in the lower parts of the vein, or at least for a few inches from the footwall."*

"The Union-Companion-Red Jacket vein has been developed, at one place in the Union claim, to a maximum depth of 800 feet, while in its northerly extension through the Union, Companion and Red Jacket claims, it has been developed to variable depths averaging 300 feet. This development has revealed the existence of four ore shoots having an average width of three feet and an aggregate length of 1,200 feet along the vein."†

"The ore is a hard quartz, containing 3 to 5 per cent pyrite carrying the gold. Silver is present partly as a sulphide, and the proportions of gold to silver by weight are approximately 1-5. There are also present in the ore appreciable quantities of chalcopyrite, arsenopyrite and blende. The ores are variable in value, ranging from $10 to $20 for mill-run grade."‡

*Waldemar Lindgren. The Gold Belt of the Blue Mountains of Oregon. 22d Annual Report U. S. G. S. Part II, p. 74.

†Bernard MacDonald's report upon the property, April 10, 1903.

‡Paul W. Gaebelein in the Engineering and Mining Journal of Feb. 28, 1914.

The principal shoot on the Union claim is now down to the 500 level, 100 feet lower than in 1903. The drifting on this level revealed a shoot of ore whose length, width, and grade compare favorably with those above. Of course a vein in which the gold is locked up in sulphides not usually disseminated, but rather in bunches within the massive quartz, must of necessity vary from place to place. Nevertheless when considered in a larger way the precious metal content is quite regular in the stopes from the different levels. Sinking on the vein has been started from the 500-foot level since the camp was visited.

This vein probably represents the final activity of the granodiorite. It would appear from the excess of sulphides on the borders of "greenstone" fragments in the vein that these ferro-magnesian silicate rocks assisted, at least locally, the other agencies in the precipitation or deposition of the metals in the vein. How much of practical value this might prove to be in determining the advisability of developing veins where they cut granodiorite only, would require considerable field examination, geologic mine mapping and assay maps to determine even if it is determinable.

The Union-Companion operators need be but little concerned on this point because they have on each level a sufficient amount of granodiorite and greenstone to secure whatever favorable influences either one of these wallrocks might provide. The lowest developed level, the 500, has perhaps a greater proportion of greenstone wallrocks than the others, although "granite" is abundant; so that the ore developed for the next lift or two at least should be unaffected by this suggested influence.

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In the case of the "Cross dike," no question would arise in the minds of prospectors or operators as to which came first, the vein or the dike. The vein was plainly completed before this crosscutting dike came to cut the vein in two.

Although the "Parallel" dike undoubtedly came since the entire filling of the quartz vein was completed, and at the same time as the "Cross dike," it is less easy to believe that it did succeed the quartz vein. This confusion arises quite naturally:

1. Because this dike is found in the plane of the vein over a large area of its walls.

2. Because the vein is found on both sides of the dike, although ore is but rarely found locally on both sides except at the outer limits of some of the stopes.

3. Because in the Last Chance vein ore is found on both sides of an aplite dike undoubtedly older than the vein.

The plane of the vein has a dip into the hill of approximately 45°. The forces which fractured the earth at this point to let in the basalt were applied in such a way that it broke at a steeper angle than the vein fissure previously formed. Approaching the plane of the vein at a rather acute angle, it then had every reason to take advantage of the plane of weakness of the quartz vein to break into and remain in it over a large area.

The dike fracture broke into the vein through the latter's hanging-wall above the Clark level and remained in the vein to a point between the third and fourth levels where it broke through the foot-wall to

continue its natural and steeper dip, so that on the 500-foot level it is some 80 feet away from the vein.

It should cause no surprise that in the fissuring anew in the plane of the quartz vein the break should follow in places the hanging-wall, in others the foot-wall of the vein, breaking diagonally across from one wall to another, and occasionally splitting the quartz vein for considerable areas. The intrusion of the basalt into this fracture left large lenses of ore on both sides of the basalt dike in such forms that the most natural conclusion to be arrived at is that the vein was formed since the dike was formed, that the dike had considerable to do with the vein and its values, and that exploration should follow closely the walls of the dike. Because of this conclusion previous managements followed the dike rather than the vein on its downward course, and for a long time crosscutting in the hanging-wall of the dike was not prosecuted. In various parts of the mine evidence is seen of much wasted money spent in the search for ore because of this erroneous theory.

Because of the habit in this camp of following dikes in the search for ore, rather than making the search independently of dikes and on the general course of the vein, it seemed advisable to make the foregoing lengthy statement and to prove its correctness by field study in the following manner:

Intrusions of molten rock naturally solidify quickly next to their cool walls. This chilling comes so quickly that close to the walls it is almost like glass, very dense and fine-grained. Here it remains fluid for so little time that crystals have little time to form. As one

2. Contacts of the dike with the vein were investigated at various points and it was found that these contacts are invariably chilled contacts and do not show the alteration due to the action of hot circulating waters, evident in all the other wall-rocks of the vein. This new or fresh condition of the basalt adjoining the vein is sufficient proof in itself that the vein was formed first.

3. On the Clark level of the Union-Companion mine, it was noted that the "Cross dike," plainly and admittedly of later age than the vein merged into the "Parallel" dike at their junction in such a way as to prove that they were intruded into these fractures and solidified at the same time. Besides the evidence of the eye at this junction of the two dikes, the microscope revealed in thin sections taken from each dike that they had identically the same mineral composition. This is in itself a sufficient proof that the "Parallel" dike came since the vein was formed.

It is quite evident that both prospector and mine superintendent can make practical use of the conclusion that the basalt or "iron" dikes came since the veins were formed. They should look upon the "iron" dike as a mechanical interruption of the continuance of the vein which must be broken through or passed over to find the vein beyond. If a dike follows a vein for some distance, when it does leave the vein rather than worry for fear the values will cease in its absence they should give thanks.

*Cyanide Plant of the Cornucopia Mines Company.*—The following excellent description of the crushing and cyaniding methods practiced at the Union-Companion mill is from the pen of their mill superin-

tendent, Paul W. Gaebelein, in an article in the Engineering and Mining Journal of Feb. 28, 1913.

"*Methods of Crushing and Grinding.*—The ore is received directly from the mine cars on three grizzlies set to 1½ in. The undersize falls directly into the ore bin, which has a capacity of 150 tons, and the oversize passes to a 9x15-in., Blake crusher, reducing the ore to 1½-in. size and delivering to the ore bin. The rock is then fed by challenge feeders to 20 950-lb. stamps which make 98 drops per minute through 7-in. Approximately 6 tons of a 0.125% solution of sodium cyanide per ton of ore are fed to the mortars, and the ore is crushed through through No. 930 ton-cap screens, which correspond to about 8 mesh. Lime is added at the feeders in sufficient quantity to give the solution a protective alkalinity of 0.7 to 0.8 lb. CaO per ton. The stamp duty is 5.15 tons per stamp. Chrome-steel shoes and cast dies are used, which combination is giving excellent results. The shoes last from 80 to 90 days, while the dies usually last from 40 to 50 days.

"At the beginning of operations amalgamation was given a thorough trial extending over a period of several weeks. With finer screens, the results obtained did not justify its continuation, due to the fact that there is but a small amount of free gold in the ore, and that the coarse crushing in cyanide solution made conditions unfavorable to good work. It was therefore discontinued.

"The battery product is equally divided between two 4-ft. Callow cones, which remove the coarse sand and feed it direct to the tube mills. Fine grinding is accomplished in two 5x22-ft. tube mills mounted on tires. The advantage of this type of mill over the trunnion type is its lower power consumption. Each mill is driven by a 50-hp., back-geared, General Electric induction motor, which is connected to the tube-mill drive by a spring coupling. The mills make 26 r.p.m.

(13)

and are lined with 4-in. silex blocks. This lining lasts seven months. Local quartzite is used for pebbles.

"Each tube-mill works in closed circuit with a simplex Dorr classifier, the overflow from the Callow cones being joined with the tube-mill discharge and fed to the classifiers. The sand discharge, joined with the underflow of the Callow cones, runs by gravity to the tube-mills, which are equipped with scoops 6 feet in diameter. The only product leaving the crushing and grinding department is the slime overflow of the classifiers.

"Each tube-mill is fed with 50 tons per day of material, which has the following screen analysis:

| | per cent | | per cent |
|---|---|---|---|
| -10 mesh | 95.9 | - 60 mesh | 36.5 |
| -20 mesh | 74.2 | -100 mesh | 26.7 |
| -30 mesh | 60.8 | -150 mesh | 22.9 |
| -40 mesh | 50.4 | -200 mesh | 20.9 |

"This material is first fed to the classifier, which removes the product finer than 200 mesh, returning the remainder to the tube-mill for regrinding. The finished product has the following average analysis:

-100 mesh, 98% -150 mesh, 94% -200 mesh, 86%

"As mentioned above, the ore is hard quartz and difficult to grind, and even when ground so that 86% passes 200 mesh, it is still fine sand, and contains practically no colloidal matter or true slime.

"*Continuous Cyanide Treatment.*—The entire product from the crushing and grinding department flows by gravity to a 30x10-ft. Dorr thickener, where it is thickened from a ratio of 6:1 to 2:1 for agitation. The solution overflowing this thickener is used for dilution, as will be described later. The thickened underflow is transferred by a 3-in. air-lift to the agitation tanks.

"The three agitators are of the standard Pachuca type, 12 feet in diameter and 36 feet deep. They are operated in series, the pulp receiving about 36 hr. agitation in passing through the three tanks. The solution is brought up to the standard strength of 3 lbs. per ton as it enters the agitation series. Continuous agitation has proven to be efficient and economical in operation, and the Pachuca tank gives satisfaction. Notwithstanding the sandy nature of the pulp and its quick-settling properties, the agitators keep the pulp of a uniform grade throughout the series, and after a year's continuous operation have disclosed no objectionable features. Compressed air at 30 pounds pressure is used, and when necessary, as after a shut-down, high-pressure air from the mine compressors can be furnished for starting.

"Tests and experiments on the mill solutions have shown that approximately 35% of the total dissolution of the gold and silver takes place in the mill, while the remaining 65% is dissolved in the agitators. The solution carrying the pulp from the last agitator of the series is consequently relatively high in value. The solution overflowing the 30-ft. thickener is also the lowest grade of the mill solutions. Owing to the fact that the filter plant consists of continuous, revolving drum filters, which are not adapted to the filtration of pulp which is carried in a high-grade solution, it is necessary to reduce, by dilution, the value of the solution which leaves the last agitator with the pulp.

This dilution is accomplished in two 20x10-ft. Dorr thickeners, and the diluting solution is the solution overflowing the 30-ft. thickener. The two 20-ft. thickeners are run in series, and the solution overflowing the 30-ft. thickener, runs into a collecting box from which it is pumped by a 2-in. centrifugal pump and equally divided

between the two thickeners. The pulp leaving the last agitator overflows into a 3-in. air-lift which transfers it to the first of the two thickeners. On entering, it is mixed with the diluting solution, which brings the dilution up to approximately 4:1. It is thickened in this tank to 1½:1, and the thickened underflow is transferred by a 3-in. air-lift to the second thickener. The solution overflowing the first thickener is collected in a box, and flows by gravity to the precipitation plant. The pulp entering the second thickener is mixed with diluting solution and thickened to 1 to 1 for filtration, while the solution overflowing is returned to the battery for use in crushing. This dilution reduces the value of the solution, leaving the second thickener to one-third of its original value, which is low enough for filtration. The pulp from the second thickener is carried by a 3-in. air-lift to the filter plant.

"The filter plant is composed of two continuous, revolving drum filters. The drums are 14 feet in diameter and 9 feet face. In common with most vacuum filters, their capacity varies with the character of the pulp filtered, and on this sandy material the capacity is great. The entire product of 20 stamps can be handled easily on one machine, and as much as 115 tons have been filtered in 24 hours. The cake is ½ inch thick, and is washed by a series of sprays, which are intended to keep the cake moist on its way to the scraper. The level of the pulp in the tank is kept as low as possible, and the cake receives a thorough air-drying before emerging from the tank. By the combined air-drying and spray-washing, the dissolved loss is kept to a reasonable figure.

"A 12x14-in. Buffalo wet vacuum pump furnishes the vacuum for the filters, and discharges the filtered solution into a small collecting tank. The tailings from the filter are removed by the scraper and deposited on a belt conveyor which stacks it on the dump. The great advantage of these filters is in their low maintenance and repair cost, and in the fact that they do not require the services of a special filterman.

"*Clarifying and Precipitation.*—The solution to be precipitated comes from two sources; the solution overflowing the first of the 20-ft. thickeners, and the filtered solution. These solutions flow into a small collecting tank, from which they are pumped by a 3-in. centrifugal pump through a 36-in., 18-frame Merrill clarifying filter. The effluent from the press flows by gravity to four pregnant-solution sumps, each 14 feet in diameter and 6 feet in height. The Merrill system of zinc-dust precipitation is used. The zinc-dust is fed by a screw feeder into an emulsifier, and the resulting emulsion of zinc-dust is fed to the suction line of a 4½x6-in. Buffalo triplex pump. There are in use two 36-in., 18-frame Merrill zinc-dust presses. The triplex pump works against a head of approximately 85 feet when filling the presses. The barren or precipitated solution leaving the presses flows by gravity to the main storage tank, 26 feet in diameter and 6 feet in depth, which is situated in a separate building, and which supplies the small battery feed tanks.

"Precipitation results have been satisfactory in spite of the fact that there is considerable copper dissolved from the ore, the precipitate often running 35% copper. The clean-up is made from 3 to 4 times a month. The precipitate is dried in a muffle furnace and melted direct in a No. 125 Donaldson tilting furnace using fuel oil. The resulting bullion varies considerably in grade, depending on the amount of copper in the precipitate, but it usually averages 750 fine in gold and silver.

"The extraction obtained is 90% of the gold and from 70% to 80% of the silver, making a total of 87.5% to 89% of the value contained in the ore. Each ton of ore treated consumes 1.40 lbs. cyanide, 3 lbs. of lime, 0.90 lb. of zinc-dust. These vary considerably with the different grades of ore, and the figures given above are an average of the consumption over a period of several months' operation, during which period the value of the ore varied from $10 to $16 per ton.

"In designing the plant, it was endeavored to make as many of

the operations as possible, continuous. The object has been attained in that, since the beginning of operations, the plant has been run by two men on a shift, exclusive of the crusherman. Crushing is done on two shifts only. The batteryman has charge of the stamps and the tube-mills. He attends to all the work incident to the operation of this portion of the plant, and is assisted only in the larger battery repairs. The solution man operates the remainder of the plant. There is no steady attendant in the precipitation room. Melting is done by the assayer, with his assistant. On the day shift there is a repair man with one helper, who keeps up all the necessary repairs.

"The plant requires 230 hp. when operating at full capacity. Power is furnished by the company's hydro-electric plant, situated about two miles from the mine. Current is transmitted at 6,600 volts and transformed to 2,200 volts at the mines for use in the motors.

The cost of treatment averages $2 per ton, and is subdivided as follows:

| | per ton |
|---|---|
| Labor | $0.65 |
| Supplies | 1.03 |
| Power | 0.12 |
| Marketing product | 0.20 |
| Total | $2.00 |

"Owing to the distance from the railroad, a 25-mile haul, most of which is a rather heavy grade, the freight charges on all supplies are high. The property has been under the management of Robert M. Betts, since the present owners acquired possession, and the mill was designed by Walter L. Reid, of Telluride, Colorado."