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## A report on the Shattuck and Arizona Mine at Bisbee, Arizona

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T H E S I S

for

D E G R E E

of

BACHELOR OF SCIENCE IN MINE ENGINEERING

-SUBJECT-

A REPORT ON THE SHATTUCK AND ARIZONA MINE  
AT BISBEE, ARIZONA.

J. J. Sandford.

1908.

8300



A REPORT ON THE SHATTUCK AND ARIZONA MINE

AT BISBEE, ARIZONA.

LOCATION.

The Shattuck and Arizona Mine is about one-half mile southwest of the town of Bisbee and five-sixteenths of a mile west of the Holbrook shaft of the Copper Queen property. The mine is on the east slope of Escabrosa Ridge and a quarter of a mile up Uncle Sam Gulch. It adjoins the Uncle Sam Mine on the north and the Cuprite, a Copper Queen property, on the east.

TOPOGRAPHY.

The gulch in which the shaft is located is rough and broken. The material excavated from the shaft was used as filling to secure a level area on which to locate the necessary surface buildings. The elevation of the collar of the shaft is 5900 feet and is 600 feet above the B. M. at the depot.

HISTORY.

The claims were located by "Old Man" Shattuck. A company was organized under the Laws of Arizona and the shaft put down. No prospect holes were drilled. The title to the property is clear. There has never been any litigation whatever in connection with any of the claims.

GEOLOGY.

The fundamental rocks of the district are pre-cambrian schists unconformably overlain by beds of Paleozoic rocks.

The Paleozoic rocks consist of a basal quartzite, followed by limestones of Cambrian, Devonian, and carboniferous ages. These rocks were later folded, faulted, and cut by intrusions



of granitic magma. Rocks of later (Mesozoic) time are also found but have no apparent relation to the ore bodies.

The igneous rocks of the district are intrusions of magma, ranging from granite to rhyolite and varying in size from small dykes to stocks of considerable size. The most notable of these is the large irregular mass known as Sacramento Hill, one-half mile south of town.

The faulting in the district is abundant but often requires a careful investigation to render it apparent.

The Shattuck property lies on both sides of the Czar fault which has a throw of about 500 feet. This fault is about 3000 feet from the intrusion mass of Sacramento Hill. A little way farther up the gulch is a granite porphyry dyke. There are also numerous small dykes and blow cuts which are within the boundaries of the property.

The general dip of the limestones is to the southeast and at an angle of about 20 degrees. The ore is found in the lower carboniferous or Escabrosa limestone chiefly, though some deposits have been found in the upper carboniferous or Maco limestone.

The ore bodies are irregular in shape and in general are parallel to the bedding planes of the limestones.

All the ore bodies that have been found so far are along the Czar fault. It is evident that there is a close relation between the faulting and the ore deposition. The exact connection between the igneous intrusions and the ore bodies



cannot well be determined. No ore has been found at or near the contact and there is very little evidence of metamorphism in the limestone at the contact. It is highly probable, however, that mineral bearing solutions which rose through the fault and followed along the bedding planes of the limestone were of volcanic origin and the intrusions supplied the necessary heat for the replacement which took place.

The ore bodies as they are now found do not represent the original deposition but are the result of oxidation and secondary enrichment. The extent and depth to which oxidation has taken place is very irregular. Some sulphide has been found less than 500 feet below the surface. The sulphide bodies on the lowest levels usually have an envelope of several feet in thickness of oxidized ore and decomposed limestone. The processes of oxidation and enrichment are still in progress.

The ores mined are oxide in which considerable native copper is found and sulphide is also found. Small values in gold and silver are found in nearly all the ores. The principle gangue mineral is limestone.

#### MINING.

The shaft is down 930 feet, has three compartments and an enlargement on one end for the air and water pipes. It is well timbered and is in firstclass condition, and is one of the safest and best shafts in the district.

Double decked cages are used in two of the compartments for hoisting ore and hoisting and lowering the shift. In the third compartment is the "dinkey" cage to hoist or lower men from level to level or to the surface during the shift. The



head frame is of steel and is modern in every particular.

Five levels have been opened up. On the 500-ft. level but little work has been done. A drift has been driven in about 300 feet to the southwest and in this drift a small body of oxide was encountered about 200 feet from the shaft. It has not been opened up.

On the 600-ft. level right at the station is a 50-ft. body of oxide which runs 9% copper. The extent of this body has not as yet been ascertained. A cross-cut has been started, however, and at the present time is in 40 feet. One thousand feet of drifting has been done on this level and seven small oxide bodies have been encountered; these are in addition to the one mentioned at the station. None of these bodies have been opened up as yet. There is strong indication of a considerable body of oxide between the 500-ft. and the 600-ft. levels. The writer would suggest that the drift on the 500-ft. level be extended and a raise put through <sup>from</sup> the 600-ft. level to ascertain the extent of the ore bodies in that vicinity.

The 700-ft. level has received the most attention. Development work has been done to the extent of 8200 feet. Large bodies of oxide and considerable sulphide have been found. Some of the ore bodies on this level have been opened up and stopes started. Stope No. 1 has an ore body 300 feet by 100 feet which average 6% oxide. No. 2 cross-cut opens up a body of sulphide 80 feet long. This is 8% copper and runs \$7 per ton in gold and silver. No. 5 opens up a small body 15 feet by 20 feet which runs 18% copper. In No. 6 a stope has been started on an ore body 100 feet by



50 feet and runs between 6% and 7% sulphide. No. 7 cuts 60 feet of sulphide, averaging 12% copper. No. 8 cuts 70 feet of 15% sulphide. Picked samples running as high as 42% copper have been taken from some of the workings on this level.

The 800-ft. level has about 7500 feet of workings opened up. At this depth the oxide ores are less abundant and more sulphide is encountered. Stope No. 1 is on one of the largest sulphide ore bodies in the district, 130 feet by 120 feet, running 5% copper and \$5 per ton gold and silver.

No. 2 stope is in oxide 300 feet by 100 feet and averages 5%. The intermediate stope, 140 feet by 40 feet, is also in oxide but runs a little higher, 6% to 7%. No. 3 stope, 60 feet by 30 feet, also oxide, runs 6%. No. 1 cross-cut opens up 75 feet of 3% sulphide, and the main drift cuts 65 feet of 12%-15% oxide. Several small chutes of sulphide were also encountered along the main drift. The 900-ft. level has just been opened up and work is being pushed forward as rapidly as possible. The main drift is in 220 feet and two cross-cuts have been started, one southeast and the other northwest. They are in 100 feet and 110<sup>feet</sup>, respectively. Considerable sulphide, which averages 5%, has been encountered on this level. A considerable ore body is expected, reaching from the 900-ft. level to the 700-ft. level. Stope No. 1 on the 800-ft. level is a part of this body.

The accompanying maps of these show the location and extent of the workings and the ore bodies encountered.

The system of stoping is the overhand method. All stopes are square setted and the ore is shot down onto the floor and



either shoveled directly into the chute or, when necessary, moved in wheel-barrows and dumped into the chute. In the sulphide stopes machines are necessary for the work, but in oxide most of the work is done by hand. Most of the ore now being mined comes from between the 800-ft. level and the 700-ft. level, and is hoisted from the 800-ft. level.

The air over the whole mine is good except in the face of development drifts and here the machine exhaust soon clears out any smoke or gas. The ventilation is natural. The 800-ft. level being connected by a 6-ft. by 4-ft. drift with the cuprite and Czar shafts of the Copper Queen Mines.

The posts and caps in the square sets are 12 in. by 12 in. or 10 in. by 10 in., and the ties are 10 in. by 12 in. for the 12-in. by 12-in. set, or 8 in. by 10 in. for the 10-in. by 10-in. set. Each post rests on the caps of the set below. In the opinion of the writer, the timbering would be improved if the caps were cut with a shorter horn and the bottom of each post rested on the top of the post below.

The square sets are 5 feet each way, center to center, or 4 feet in the clear, are 7 feet high center to center, or 6 feet in the clear. In the drifts where timbering is necessary the regular drift set is used. The accompanying drawings show the drift set, the square set in use, and the suggested improvement.

There is more than 1,000,000 tons of ore now blocked out and at least twice that amount in the ground which is only partly developed, while the tonnage of possible ore is almost unlimited.



The ore is hoisted to the surface, dumped into bins, and sent to the railroad by an aerial gravity tram. Four-percent ores or better go to the Copper Queen Smelter at Douglas. Sulphide between 4% and 1 1/2% goes to the Globe Smelters. The Globe Smelters allow full value for gold, silver, and copper. The ore is an excellent flux and is so used by the Globe Smelters.

The low-grade oxide ore is run on the dump until such time as the Shattuck Smelter, at Douglas, now under construction, shall be completed. Much of the native copper is also being stored until it can be heated at the Shattuck Smelter.

The surface equipment consists of five 150-h.p. boilers, an electric lighting plant, air compressors, hoist, blacksmith and machine shops, tram and tram houses, bins, and a sawmill for facing up timber. Also assaying and engineering offices.

The air compressor is a product of the Sullivan Machinery Co., and has a capacity of 2950 cu. ft. of fan air per minute. Air is compressed to 90 pounds. The compressor is driven by a cross compound engine.

The hoist is an Allis-Chalmers' product and is the only one of that make in this district, 150 H.P., first motion, drum 8 ft. in diameter, and can be used to a depth of 2500 ft. There are two drums, one for each compartment. They can be used together, one hoisting as the other lowers, or can be run independantly. The "dinkey" of course has its own hoist.

The blacksmith shop is equipped with a compressed air drill sharpener.

The ore bins have a capacity of 1000 tons, and are well housed.



The tram is the Bicker gravity system. The tram house at the mine has an elevation of 5880 ft. and at the railroad track, 5400 ft., giving a drop of 480 ft. in a length of 1600 ft. At the lower tram house, the buckets dump directly into the cars. The tram was designed to handle 1000 tons in 24 hours. Its actual capacity is greater than this. As high as 450 tons have been handled in a shift of 8 hours.

The engineering and assay offices are fully equipped.

#### LABOR.

When working to full capacity, about 100 men are employed on each shift: 10 timbermen, 2 to each stope; 24 machine men, six of whom are on development work; 10 trammers; 20 miners; 27 muckers; 1 powder-man; 3 cagers; 3 topmen; 1 pumpman; 2 hoistmen. In addition to the above, there are 4 men on the tram, 2 blacksmiths, 2 machinists, 2 pipe-fitters, 2 track men, and 2 sawmill men, who work only on the day shift. The rough work on the surface is done by Mexicans. No Mexicans are allowed underground.

The engineering corps consists of a chief engineer, one rodman, one stopeman, one draughtsman, one assayer, and one sampler.

The management consists of a General Manager, Superintendent, Forman, and two Shift bosses.

The mine has been producing for such a short time, and so much development work has been done at the same time, that it has been difficult to obtain any exact data as to costs, etc. The approximate cost of sinking the shaft was \$87.00 per foot, the



total cost being about \$81000. The cost of mining is estimated at \$3.00 per ton. Timbering costs \$4.00 per set in place, including the cost of timber. A lead set costs double this amount, \$8.00. Miners and muckers receive \$3.50 per day, machine-men, \$4.00. The powder man, cagers, and topmen get the same as the machine-men. The pump and hoist men receive \$5.00. The day shift men, machinists, blacksmiths, etc., receive from \$4.50 to \$5.00. The Mexicans on the surface work, are paid \$2.00 per day.

The chief engineer receives a salary of \$150.00 per month, the stope man, \$120.00, instrument man, \$110.00, draughtsman and assayer each \$100.00, and the sampler and rodman \$90.00 each. The shift bosses are paid \$6.00 per day, and the foreman \$7.00 per day. The salaries of the Superintendent and General Manager are respectively \$3,000.00 and \$5,000.00 per year.

During the eleven months that the Shattuck has been producing through the smelters at Globe and at Douglass, the gross receipts have been \$1,500,000.00, and a monthly average of 360 tons of copper has been produced. When the smelter now in process of construction at Douglass is completed, the Shattuck will have one of the most complete properties in the district, and should be able to produce copper for about 8 cts. per pound.

It is quite probable that in time the Shattuck will be mining clear to the surface, and in event of such a condition, developing a haulage tunnel would be of great advantage. This



would necessitate going through some of the Copper Queen property. If satisfactory arrangements could be made, a 1500-ft. tunnel connecting with the present 500-ft. level would allow a considerable saving of time and expense in getting the ore from the mine to the Railroad.

The Shattuck is only in its infancy, and the high average percentage of its ores and their self-fluxing qualities, allowing the cost of production to be kept low, make it one of the safest and best investments in the territory.