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January 25, 1932

BIG JIM MINES, INCORPORATED
Merchants National Bank Building.
Los Angeles, California.

The following report covers that certain mining property known as the BIG JIM, situated in San Francisco Mining District, Mohave County, Arizona, about one mile easterly from the town of Oatman.

The area embraced in this report comprises five mining claims as follows: The Monarch, Big Jim, Little Alice, North Aztec, and Aztec claims, all forming a single compact group. These have all been accurately surveyed and mapped to which reference is hereby made. A careful study of the available maps makes further detailed description unnecessary at this time.

The Big Jim ground contains a long section or segment of the great Tom Reed-Big Jim Vein which has been and still remains the most consistent producer of profitable gold ores thus far opened in the district. The well-known United Eastern Company, the Tom Reed Company and the Big Jim Company are all located on this vein, and the aggregate production to date runs into many millions of dollars. From the Black Eagle and Aztec Center claims of the Tom Reed Company the highest grade milling ores ever opened in the district are now being taken.

For a better understanding of the situation forming the subject of this report, a brief sketch of the history of mining on this vein is essential, and here follows:

The early production came from the Ben Harrison claim of the Tom Reed Company. This was followed by the development of an extensive and rich ore body in the ground of the United Eastern Company, and this in turn by the discovery of an important ore body in the ground belonging to the Big Jim Company, all working on the same vein. Later ore in commercial quanitity was opened on the Aztec Center claim of the Tom Reed, and this was found to extend easterly into the Black Eagle claim of the same Company (See Map).

In each instance the orebody, when found, occupied what is known as the horizon of the Oatman Andesite which rock appeared to be especially favored as the locus of the ore-deposition. In working down on the orebodies, they all appeared to bottom at about the same level, or approximately 2400 feet elevation above mean tide. The single notable exception to this rule was in the Ben Harrison Claim of the Tom Reed Company where strike faulting had carried a portion of the orebody to a depth of about four hundred feet below the horizon indicated above. As a result of this it was generally

accepted by mining men interested in the district, that the orebodies when found, could not be expected to extend much if any deeper than eight hundred feet below the shaft collar, and due to differences in topographic elevation at points where shafts were sunk, in some instances a depth of six hundred feet below the shaft collar appeared to bottom the ore. At this depth the ore-shoot continued down but the values fell below the commercially profitable limit.

In general this rule is substantially sound due to the fact that the ore-making Oatman Andesite commonly rests on a much older series of volcanic flows grouped under the name of the Alcyone Trachyte makes ore. The contact between these two distinctive formations, the Oatman Andesite and the Alcyone Trachyte lies quite generally at about eight to ten hundred feet depth. Considerable drilling has been done below the horizon of the Oatman Andesite withe generally negative results.

The bearing which this accepted depth-rule has on the present situation at the Big Jim, as explaining the stoppage of work and abandonment of the property for further mining operations by the United Eastern Company which now owns the property, is important, as will be later shown. On the Big Jim, the orebody became too lean below the 600 Level, to be profitably worked. It was therefore abandoned and no effort was made to explore for orebodies at greater depth. The orebody mined above this level yielded around four millions of dollars in gold.

In the meantime, and while the ore was being taken from the vein in the Big Jim ground, the Tom Reed Company opened and mined this vein in the Aztec Center claim which end-lines on the east end of the Big Jim. Here too, the orebody became too lean to work at about the same level as in the Big Jim, and it also was abandoned. The orebody in the Aztec Center claim was found to extend into the Black Eagle claim, adjoining the Aztec Center, and a shaft known as the Black Eagle Shaft, was sunk to a depth of a thousand feet and a crosscut veinrun about two hundred feet below the 600 Level in the Aztec Center, and was rewarded by encountering the top of a second and deeper ore-shoot carrying relatively high values in gold. This second and deeper orebody is not being mined on the 1080 Level of the Black Eagle shaft, and has been opened into and nearly through the Aztec Center claim, the breast of the drift being now close to the east end line of the Big Jim Claim.

Inasmuch as the conditions governing the upper, mined-out orebodies in the three properties, the Big Jim, Aztec Center and Black Eagle, are closely analagous, the presumption is strong to the point of assurance that the deeper-lying orebody now being worked from the Black Eagle Shaft, and shown to be continuous under the Aztec Center claim, will

also be found to extend under the old workings in the Big Jim claim. The gold values in this lower orebody have been consistently higher than those in the over-lying worked out orebody.

The Big Jim Shaft has been sunk to the 730 Level, and taking the difference between the collars of the Black Eagle Shaft and the Big Jim Shaft, and the respective depths of the two shafts measured vertically, into consideration, only approximately 165 feet of sinking from the bottom of the Big Jim Shaft will be necessary to reach the hotizon of the 1080 level in the Black Eagle. Assuming the dip of the vein to remain constant at this depth in the Big Jim, a crosscut of less than twenty feet will expose the vein from the bottom of the depth proposed to be sunk in the Big Jim Shaft below its present bottom. At this depth, 1080 feet in the Black Eagle Shaft, the ore has been found to come in strong and richer than before, as previously stated. In brief, then; by sinking the Big Jim Shaft about 165 feet and crosscutting less than twenty feet, the same orebody should be encountered that is proving so rich andproductive in the Black Eagle 1080 Level, and its corresponding horizon in the Aztec Center ground.

The writer has stated that the Alcyone Trachyte, an unproductive horizon, generally forms the floor upon which rests the productive Oatman Andesite. It was presumed that this condition was true in the region of the Big Jim, Aztec Center and Black Eagle ground. However, the sinking of the Black Eagle Shaft has shown that this is not the case, but that the Oatman Andesite here lies upon a new and hitherto unsuspected formation tentatively classified as volcanic breccia. This volcanic breccia lies very flat, dipping westwardly under the Aztec Center and Big Jim claims at something like twenty degrees from the horizontal. It has been exposed well to the west of the Black Eagle Shaft, in Aztec Center ground. It is quite certain to be found underlying the Big Jim ground, gaining a little in depth as it is followed in a westerly direction. <u>It is in this volcanic breccia that The new and richer orebody lies</u>. Its thickness here is conjectural, but is proved to be sufficient to contain a very large and profitable orebody, and may go to an indefinite depth below its lowest present exposure. When this is considered, the potentialities for profitable mining these lower ores become very large.

Having considered the question of ore development at no great depth below the present Big Jim 730 Level, the question of possible ore-development in virgin ground on the strike of the vein will be now considered:

Be referring to the map of th ground and workings on the Big Jim claim it will be seen that no ground remains available for exploration in the easterly end of the Big Jim claim which endlines on the Aztec Center claim of the Tom Reed Company. Development here must be confined to sinking deeper. On the west end of the Big Jim claim, however, the situation is such that further lateral extension of the Big Jim workings into ground covered by the Monarch claim pro-

mises to yield important orebodies. (See Map).

The map showing the Big Jim workings on the 600 Level makes it plain that this level was not carried through to the west endline of the Big Jim claim, but stopped some two to three hundred feet short of it. Thisis due to the fact that at this point the vein was found to be cut by a well defined fault - the so-called Mallery Fault parallels the Big Jim vein for the greater part of its length, but turns northerly across the west end of the Big Jim where it cuts off the vein on the 600 Level, as stated. The vein has not been opened beyond the fault and remains to be located in what is now virgin ground.

The Mallery Fault dips southwestwardly while the Big Jim vein dips northeasterly. The effect of the movement on the Mallery Fault was to cut off the upper portion of the Big Jim vein and carry the broken segment bodily over into ground owned by the Tom Reed Company. This movement separated the two broken segments of the vein through a distance of some 200 feet horizontally, and formed the basis for the celebrated Apex Suit between the Tom Reed and the United Eastern Companies, which latter then owned the Big Jim properties in this locality. The result of this apex suit are too well known to require further comment.

Where the Mallery Fault turns across the strike of the Big Jim vein and dislocates it as shown on the 600 Level of the Big Jim workings, the vein was strong and clear cut. Its extension beyond the fault is certain, and a careful study of the situation makes it almost certain that this extension will be found in the ground covered by the Monarch claim of the Big Jim Company. This is supported by two important considerations. The first is that the Mallery Fault in this locality is shown to have been broken and displaced by the later, Oatman Fault,--(See Bulletin 743, U.S. Geol. Sur. 1923, by F.L. Ransome) -- with the result that the west or hanging wall of the Mallery Fault was here moved horizontally to the north through a distance of perhaps a hundred feet. This would carry the broken segment of the Big Jim vein beyond the Mallery Fault also the the north well into Monarch ground.

The second consideration is the fact that a crosscut run northerly from the east end of the Rising Star claim of the Tom Reed Company, on the 500 Level, was extended clear to the southerly sideline of the Monarch claim without dislocating the extension of the faulte Big Jim vein being here considered. Taken together, these two disclosures compel the conclusion that the Big Jim vein passes into and through the Monarch claim, and makes it of great potential value for mining. (In this connection see map of the Big Jim and adjoining claims.)

A crosscut has been extended northerly, or rather, northeasterly from a point on the 500 Level about 350 feet from the east endline of the Big Jim claim. This crosscut passes through the Little Alice and into the Aztec claim as shown on the map. In running this crosscut two veins were encountered, the first about 150 feet in from the main drift on the 500 Level, and thesecond about 650 feet in where

the crosscut terminates. The first vein encountered is called the Middle Vein, and the s-econd is known as the Hartman Vein. Both veins show small gold values, but no ore where opened. The Middle Vein was small, -- less than two feet wide, -- where the crosscut intercepts it, but widens somewhat in the short drift that has been carried out on it towards the southeast. It dips steeply to the northeast. It may possibly show some ore, but is not encouraging. It is a relatively small plane of movement parallel to the main fault which is the Big Jim vein, (which was originally a fault subsequently mineralized into a gold-bearing vein.)

The Hartman Vein at the end of the crosscut is a strong, well defined zone of movement and shearing. The vein filling is strongly stained with iron salts and it carries some small gold values. It strikes to the southeast, apparently across the strike of the Big Jim vein in the Aztec Center claim. It dips to the southwest rather steeply. As all of the prevailing dips in the producing veins in the district are to the northeast, this southwest dip of the Hartman Vein is an unfavorable feature for the finding of shoots of commercial ore in it. Many such southwestwardly dipping veins or faults are found in the district, and all of them have thus far contained no workable bodies of ore. On the other hand, there is groundfor believing that the Hartman Vein may be simply a split-off from the main Tom Reed, - Big Jim Vein, formed at the same time as the latter, and therefore subject to the same mineralizing influences. If this proves to be the case, the dip loses its evidential value, and the Hartman Vein then must be considered an important potential source of ore. The answer to this important question must await further development. West of the Ben Harrison claim of the Tom Reed, the Tom Reed-Big Jim vein splits, one leg forming the unproductive Olla Oatman vein and the other leg forming the highly productive United Eastern vein. Such a condition may exist between the Hartman and Tom Reed-Big Jim veins. One is proved to be valuable as a carrier of ore; the other may also be found to contain valuable orebodies. The Hartmen vein merits further exploration.

Conclusions based on the foregoing.

The sinking of the Big Jim vein to the horizon of the volcanic breccia from which the rich production of the Tom Reed Company is now coming, gives every promise of opening like or similar ores in Big Jim ground.

By extending the drift on the 600 Level of the Big Jim, westwardly into the Monarch ground beyond the Mallery Fault and corsscutting, the faulted extension of the Big Jim vein should be picked up. When located, it should extend for the full distance through the Monarch claim, where it may be expected to disclose orebodies comparable with those already mined and now being worked on this vein.

The Middle Vein is not believed to be of large importance for development, though it may show some small orebodies.

The Hartman Vein should be explored to determine whether or not it is a split-off from the Tom Reed-Big Jim veins, or a distinct and later movement. If the Hartman vein proves to be a branch of the main productive Tom Reed-Big Jim vein, it may disclose large and important orebodies. Otherwise, it merits little further attention.

(This report is intended to be read in connection with a study of the maps covering the locality considered.)

Physical conditions.

The Big Jim workings are entirely dry and easily accessible. No water will be encountered until a depth of 1200 feet below the shaft-collar has been reached, and this may be extended through drainage of adjoining properties now in operation.

The Shaft has been cleaned and re-timbered to the 600 Level and is in excellent condition. Being a three-compartment shaft, it is adequate for all needs on any scale of production that will be attained.

A full and complete mining equipment is already in place and ready to take care of any production up to and including 300 tons per day. All machinery is of the best quality and most approved type. Buildings and housings are well constructed and substantial.

A modern aerial tramway of the "Riblet" type connects the Big Jim with the mill on the United Eastern property and with a very little attention is ready for operation. It will easity handle and deliver whatever production may be attained.

The United Eastern Mill is now under the control of the Big Jim Mines Company, and with an expenditure estimated at not more than $10,000.00 for repairs and general overhauling, will treat u to and including 150 tons of ore per day. This mill is throughly modern in every way and was entirely successful in handling the production of the United Eastern, by cyanidation.

If, for any reason, it should be deemed advisable, the Big Jim Company can ulitize two other mills for the treatment of its ores, namely; the Tom Reed Mill, and the Telluride Mill, situated close to the Big Jim, on the property of the Telluride Company. This solves the question of ore-treatment for the Big Jim Company in a very simple, inexpensive and easy way.

All economic conditions governing operations on the Big Jim are the best possible, and will be reflected in costs ranging as low or even lower than have thus far obtained in the district. A fair statement of the average cost of mining and milling the ores of this district, taken from actual operations extending over a period of years as follows:

Cost of mining (Direct) --------$ 4.719 per ton.

Cost of milling (Direct) ------- 2.011 " "

Total mining and milling (Direct)$6.730 " "

To the above must be added the indirect costs, including interest on capital investment, administration, taxes, and miscellaneous overhead, which comes to $2.00 to $2.50 per ton, varying with local conditions. A fair average of all costs, both direct and indirect, as shown by the larger producing mines of the district, may be safely taken at $8.50 per ton ofe ore mined and milled. (The data from which the foregoing figures are drawn cover operations extending back over a period following the close of the war, and in large part reflect the inflated prices of that period.)

Under present operating conditions, as applied to the Big Jim, the costs should be materially reduced below the figures given above for the following reasons:

The Big Jim Mines Company will carry little or no capital investment, and will therefore have no interest charges to pay. This will be partially offset by the low royalties to be paid under the terms of the lease.

There will be no expense, at least for a considerable time to come, for pumping water from the mine, as thisis now being taken care of, through drainage pumped from adjacent mines operating at deeper levels.

At the present time the prices of supplies, materials, and labor have greatly receded from the levels prevailing during the time covered by the figures given above.

These combined considerations make it reasonable to conclude that the cost of mining and milling of Big Jim ores, both direct and indirect, can be brought down to between $6.00 and $7.00 per ton. This figure also includes the cost of transporting the ore from the mine to the mill -(United Eastern Mill). - which averaged only $0.0646 per ton by aerial tram. This figure is based on the actual cost of tramming 220,552 tons of Big Jim ore to the United Eastern Mill. This ore averaged about $17.24 per ton as mined.

If the richer ore not being taken from the Black Eagle Shaft continues under the Big Jim ground below its present workings as it gives every evidence of doing, it affords a potential gross profit much above that which has already come from this property.

The ores of this district are ideally suited to treatment by cyanidation, the average recovery by this method being 96% of the head-sample values in the ores that have been treated to date. This is an excellent percentage of recovery.

Ore left standing in the old workings.

On the occasion of the writer's recent visit to the property he was shown two blocks ore, one of which extends from the 500 Level up to the 400 Level, and measures approximately 6000 tons averaging about $12.00 per ton. The other block of ore is contained between the 500 Level and the 600 Level. It is about 250 feet long, but with full dimensions not fully determined. From samples taken this block promises to be wholly or in large part commercially profitable ore. Taken together these two blocks of ore should yield at least 15,000 tons, and possible more, which can be worked at a substantial profit under the present management of Mr. A.G. Keating and Mr. John Henderson, who opened and developed the original orebody in the Big Jim, and are familiar with all details of the past development in this property. They are therefore especially qualified for judgement at this time.

Assuming the average value per ton in the two blocks mentioned above, to be that shown in the block extending from the 500 Level up to the 400 Level, - $12.00 - there should be a net profit of around $90,000.00 watting to be taken out.

Final Conclusions.

The writer is familiar with the district covered in this report, having studied it in considerable detail fro more than fifteen years past. Basing his judgement on his general knowledge of the mines of the dirstrict, on the character and qualifications of the present management, and upon the facts set forth in the foregoing, the writer is in accord with the and strongly commends the program of development porposed to be carried out by the present operators. When accomplished, he believes that the Big Jim property will again become a sustained and profitable producer.

Edward W. Brooks

Consulting Mining Geologist
and Engineer.

Edward W Brooks

Copied

January 28, 1932

Mr. H.J. Moffett,
Los Angeles, Cal.

My dear Mr. Moffett:

For your information, I am setting forth herewith a brief digest of the lease as between the Big Jim and the United Eastern Mining Company.

Lease runs between the United Eastern Mining Company and Big Jim Mines, Inc. Dated 23rd day of April, 1931, for period of five years, with privilege of renewal.

Lease is based upon royalties as follows:

Upon ore of a value up to and including	$10. per ton	%5%
Upon ore of a value up to and including	$15. per ton	9%.
Upon ore of a value up to an including	$20. per ton	15%
Upon ore of a value up to and including	$25. per ton	20%
Upon ore of a value up to and including	$30. per ton	25%.

These royalties are based, not upon the assay value, but on the mill recovery; that is to say, the royalties pay only on the net mill recovery. So that, in fact, the royalties are at a much lower percent than appears from the figures, as set forth above.

Regarding the Hartman ground, being the Aztec and North Aztec mining claims, we have a lease running between the Hartman Gold Mining Company and the Big Jim Mines, Inc. This lease runs for a period of five years after the 19th day of July, 1930, with the privilege of renewal. We have with the lease, an option to purchase the claims for the sum of $10,000. and 250 shares of the common stock of Big Jim Mines, Inc. The lease is based on a royalty of 5% of the net smelter returns on all ores up to and including $10. per ton. On all ores above $10. per ton, there is to be a royalty of 10%.

With regard to the above leases, there are no stipulations, or requirements of work to be performed, other than that included in the usual form of mining lease.

Very truly yours,

Big Jim Mines, Inc.

Copied

Big Jim

Jan. 29, 1932

Copy.

Mr. H.J. Moffett,
Los Angeles, Calif.

My dear Mr. Moffett:

It might be well for you to have a brief outline of our plans for the work at Oatman. In this, we have two courses of procedure which can be followed: one, an immediate production on the basis of sixty tons per day, and the other on the basis of one hundred-fifty tons per day. If the larger tonnage basis is chosen, then there will be necessary probably three of four months preparatory work, so that when production is started, it may be assured of continuation. In any event, the program should be determined by the amount of funds we have on hand. At the present time, we have completed the rehabilitation of our plant and of our main shaft. The mill, we have not attempted to put in shape as yet, but it is estimated that this can be accomplished in less than thirty days time.

As to ore for immediate production, there is ready a block of ground ninety feet long on the five hundred foot level. This block is six to eight feet wide, and extends upward one hundred feet to the four hundred foot level. From present samplings and comparable tonnages, it is estimated to contain values of an average of Twelve Dollars per ton. There is another block of ground, which we are now preparing, extending from the six hundred foot level to the five hundred foot level, along the hanging wall side of the vein. This block is two hundred-fifty feet long, one hundredfeet high, six to eight feet wide, and should return an average grade of above Thirteen Dollars per ton.

The Big Jim main shaft is seven hundred-thirty feet deep, but the vein has not been opened below the six hundred foot level. We have a level prepared at the seven hundred foot depth, and a cross-cut can be run into the vein from this level, if deemed advisable. By sinking our main shaft from its present depth, seven hundred--thirty feet, to a nine hundred foot depth, namely one hundred-seventy feet, we reach the same depth as the Tom Reed Mining Company, our neighbors, are now mining ore.

Inasmuch as the Tom Reed Mining Company, in these lower horizons, have found far richer ore than has been mined heretofor in the district, and inasmuch as they are working on the same vein, and on the same ore shoot, it is proper to assume that we will open equally rich and equally large ore bodies by deepening our shaft.

In addition to the above, we have two areas which may be termed virgin territory. One, a new vein, which we have exposed by cross-cut at five hundred foot depth in the Hartman group of claims; Second, the location of faulted segment of the main Tom Reed-Big Jim-United Eastern vein,

vein, lying in the Monarch claim. While these two areas must be considered as speculative at this time, the evidence is conclusive, and should be considered as probable.

The physical condition of the property at the present time is excellent. We have at least One-half Million Dollars worth of equipment, which is available. This includes large compressors, hoists, tram-ways, and mills. Our working costs should be very low. The equipment has been already written off, and therefor there is not large capital investment and depreciation charges, and secondly, our nnighbor keeps our workings drained of water at no cost to us.

The records show that the Big Jim ground pfoduced $3,804,000, above the six hundred foot level. It is the opinion of engineers that with the deeper seated and richer ore bodies proven by the Tom Reed Company, that the Big Jim should produce an even greater amount than the above figures represent.

Very truly yours,

Big Jim Mines, Inc.

Copy

Gave a gmc to Ball

MAY
19
1932

Col. Louis R. Ball,
Western Precipitation Company,
1016 West Ninth Street,
Los Angeles, California.

Re: BIG JIM MINE, at Oatman

Dear Col. Ball,

Following our previous correspondence regarding this property, would state that I have recently obtained some additional information which I regret to say is not at all favorable. A recent publication of the Arizona Bureau of Mines gives a diagram of the BIG JIM vein showing that while the ore averaged $19.00 per ton ~~upon~~ the 600 ft. level the average on the 700 ft. level was only $5.40 per ton and on the 800 ft. level $4.80 per ton. This does not seem to agree with the 3rd paragraph of the letter of January 29, 1932, addressed to Mr. Moffett of which you sent me copy.

I interviewed, yesterday, a fairly reliable mining man who had recently been in the Oatman district and he told me quite positively that there was no substantial tonnage of $12.00 ore blocked out in the BIG JIM workings as per the 2nd paragraph of the letter referred to and also the report by Brooks. It really seems strange that any such block of ore which could be mined out with a net profit of $90,000 should be left long in the ground and this statement on its face is certainly open to suspicion. My friend also told me that the United Eastern ~~property~~ mill referred to on page six of Brooks report had been almost entirely dismantled and much of the equipment sold so that the expenditure required to recondition it would be a great deal more than $10,000. I also learned that the Tom Reed mill was now shut-down and that the Tom Reed had recently discontinued operations, but I could get no reliable information

concerning the condition of the Telluride Mill, also mentioned on the same page of Brooks report.

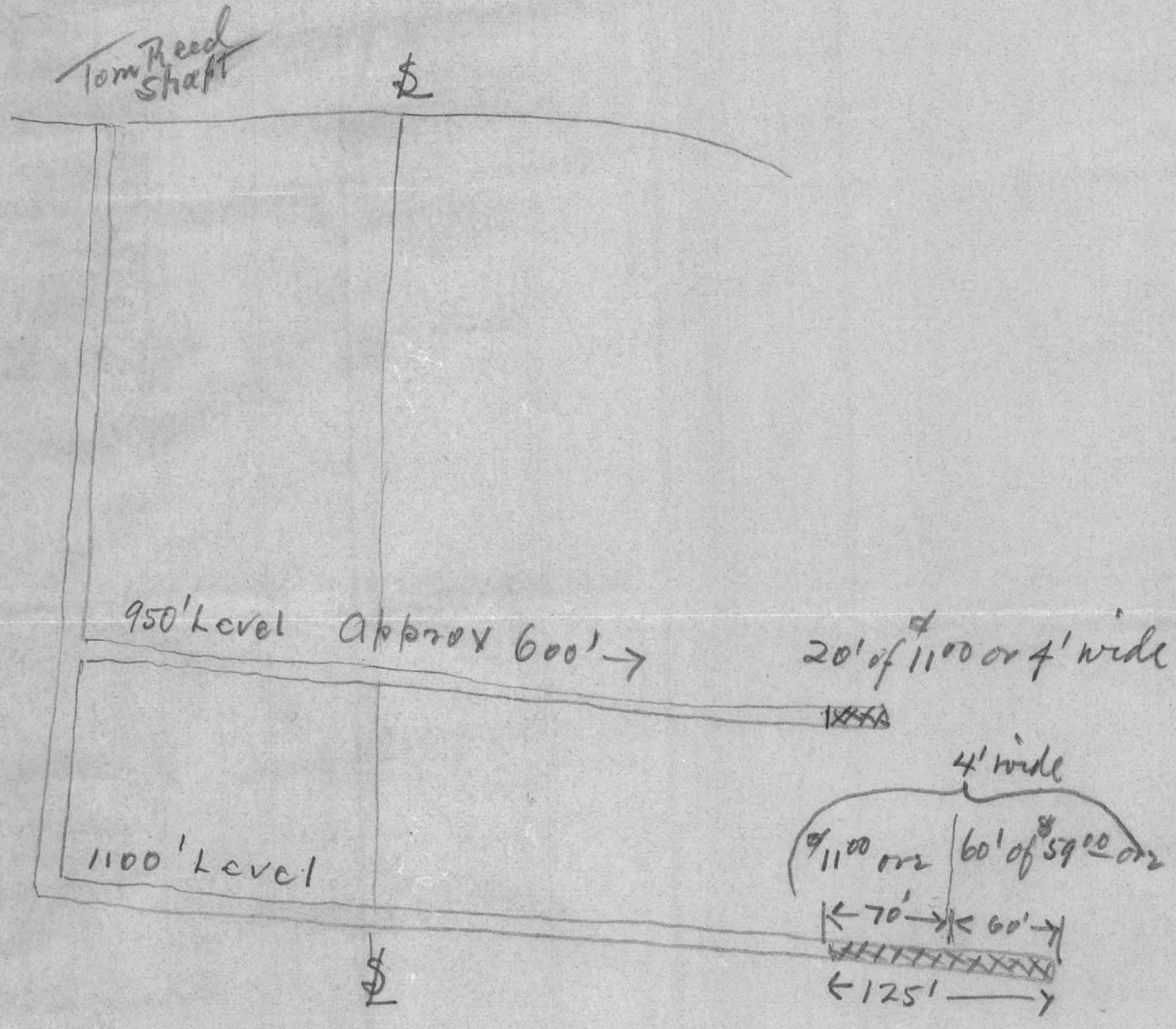
I hope you will be able to obtain some additional and reliable reports concerning the BIG JIM in Los Angeles for up to the present my feeling has not been favorable toward this proposition and I much doubt the accuracy of several of the other statements made by Brooks. The success of the venture would seem to depend upon the discovery of the faulted portion of the Tom Reed vein beyond the Mallory fault and evidently the chances of success have not appealed to the local operating companies who should be the best posted in matters of this kind.

Personal regards,

Sincerely,

G. Mc

GMC:HC


Tom Reed Shaft
℄
950' Level
Approx 600' →
20' of ☆1100 or 4' wide
4' wide
☆1100 or
60' of ☆59 00 or
1100' Level
← 70' →
← 60' →
℄
← 125' →

I. C. 6824

FEBRUARY 1935

DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES
JOHN W. FINCH, DIRECTOR

INFORMATION CIRCULAR

MINING AND MILLING METHODS AT THE BIG JIM MINE, OATMAN, ARIZ.

BY

C. H. JOHNSON

I.C. 6824
February 1935

INFORMATION CIRCULAR

DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

MINING AND MILLING METHODS AT THE BIG JIM MINE, OATMAN, ARIZ.[1]

By C. H. Johnson[2]

INTRODUCTION

The Big Jim mine of the United Eastern Mining Co. is at Oatman, Mohave County, Ariz. Oatman is in the foothills on the western side of the Black Mountains, at an elevation of about 3,000 feet. It is on a paved highway about 30 miles west of Kingman, the principal distributing center for mining supplies in the district, and 25 miles from Topock, on the Colorado River. Both latter towns are stations on the Santa Fe Railroad; Oatman has no rail connection.

Mining conditions are typical of western Arizona; water is scarce, no mine timber is available locally, and the winters are mild and the summers hot. The supply of skilled labor is usually adequate, but in 1933-34 it was not more than sufficient for the restricted operations. Wages have been $4.00 to $4.50 for miners. Electric power was supplied from Kingman and cost about 2.6 cents per kilowatt-hour.

The Big Jim claim was located in 1908, but no serious work was done until about 1915 when a crosscut on the 400 level entered the Big Jim vein.[3] In 1917 the ground was purchased by the United Eastern Mining Co. In 1922 an aerial tramway was completed from the Big Jim shaft to the United Eastern mill, a distance of about 5,000 feet. From 1921 to 1924 when the United Eastern Mining Co. ceased operations, the Big Jim produced about 220,000 tons of ore with an average value per ton of about $17.25.[4]

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6824."

2/ Assistant mining engineer, U. S. Bureau of Mines Southwest Experiment Station, Tucson, Ariz.

3/ Ransome, F. L., Geology of the Oatman Gold District, Arizona: U. S. Geol. Survey Bull. 743, 1923, 58 pp.
Lausen, Carl, Geology and Ore Deposits of the Oatman and Katherine Districts, Arizona: Ariz. Bureau of Mines Bull. 131, 1931.

4/ Moore, R. W., Mining Methods and Records at the United Eastern Mine: Trans. Am. Inst. Min. and Met. Eng., vol. 76, 1928, p. 71

In 1932 Rae L. Johnston and Ray S. Witcher leased the Big Jim ground, having decided that certain blocks of ore, too low in grade to extract under the conditions and costs prevailing in former years, could now be mined profitably.

Johnston kindly gave permission for publication of this paper and supplied most of the data. The writer is likewise indebted to B. M. Reynolds, mill superintendent, for information regarding operations at the mill.

MINING

General

The Big Jim orebody was described by Moore[5/] as a fissure vein in andesite, ranging from a solid quartz-calcite filling to a series of parallel stringers separated by andesite and of the following maximum dimensions: Height, 450 feet; length, 850 feet; thickness, 35 feet. The vein dipped 70° to 75°.

A three-compartment vertical shaft on the hanging-wall side of the vein was about 730 feet deep; the orebody was developed by five levels, the first level being above the top of the ore (which did not outcrop) and the seventh and lowest level being below the bottom of the commercial ore.

Shaft Repair

The main shaft had two cage compartments 5 feet long and 4 1/2 feet wide and a manway 4 feet long and 4 1/2 feet wide. The end and wall plates were 8- by 8-inch and the dividers 6- by 8-inch timber. The present operators found the shaft badly crushed by a cave extending from about 65 to 200 feet below the collar. At the latter point two faults converged, one dipping steeply toward the end and the other toward the side of the shaft. Some of the timbers had yielded, and subsidence had taken place along some fault planes which were well-lubricated by gouge and surface waters. The whole block had dropped about 16 feet; an opening of this height that extended 25 or 30 feet from the shaft, with a more or less flat back, was formed at the top of the block. At first an attempt was made to straighten and repair the shaft through the caved mass by using jacket sets and supporting the back of the open space by stulls resting on the broken material. It was impossible, however, to support the pressure that developed; hanger rods pulled large washers through the wall plates, and auxiliary supporting cables extending from the collar to the caved section were snapped. It was then decided to remove the caved material and to support the open ground by careful timbering. First, long stringers placed like bearer sets across the shaft were hung by cables from the surface and blocked down under the brow of the cave to support it and prevent any new falls of rock. Then it became necessary to timber with short stulls one of the fault zones whose crushed filling and gouge had slipped down into the cave; this open space was 30 or 40 feet high and 5

5/ Work cited: pp. 56-57.

to 20 feet wide. This done and the back well-trimmed and at least partly supported by timber, mucking was started. Crews of 4 men underground and 2 men on top, working for the most part 2, but at the last 3, shifts per day, mucked and hoisted 4,500 to 5,000 tons of broken, crushed, and caved rock in a 1-ton sinking bucket and installed 21 new shaft sets and 8 jacket sets. The latter were at the bottom of the cave, where they could be blocked to solid ground. There has been no further caving; the whole former danger zone is open, though closely and intricately stulled and blocked, and can be inspected and watched. In future surface water cannot accumulate and lead to weakening or slipping of the fractured block of ground. This is an instance of the unforeseen and unpredictable expenses that may attend the simplest mining undertakings.

The work was begun September 1 and finished December 15. Shaft-men were paid $5 and $6 per shift; about $1,000 worth of timber, in the form of shaft sets and stulls, was used; and the cost of distillate for the hoist was $400 to $500 monthly. The entire job cost between $9,000 and $10,000.

Surface Plant

After the shaft was repaired preparations were made to mine. The surface plant of the Big Jim was in fair order, and little work or expenses was incurred in putting it in condition for operation. A small, wooden ore bin was purchased and moved intact from a neighboring mine to load the ore into trucks. The compressor equipment comprised two Imperial type 10 (Ingersoll-Rand) machines, one 19 by 12 by 16 and the other 17 by 10 by 14, or 1,100 and 600 cubic feet in capacity, respectively. The smaller one, more suitable for the work contemplated, lacked a motor, and a 75-hp. Allis-Chalmers motor was brought from the United Eastern mill and installed. In place of the large double-drum hoist used in former production a Fairbanks-Morse, single-drum, 60-hp., distillate-burning hoist was used, capable of raising a 1-ton car on the cage 250 feet per minute. It consumed about 25 gallons of distillate per shift, costing 14 cents per gallon.

The blacksmith shop contained a coal-burning forge, a Sullivan drill sharpener, and the usual grinding wheel, drill press, anvil, and tools.

Underground Development

The chief underground preparation for mining was to extend a track on the 500 level through an old, empty shrinkage stope by setting stulls from wall to wall until a block of low-grade ore next to the boundary line of the property was reached. The vein here was 3 1/2 to 6 feet wide and had strong walls. The block of ore was mined from the 500 to the 300 level by the open-stope method; stulls were used to hold working platforms. This form of stoping made possible a prompt and economical supply of ore to the mill without preliminary development and without tying up any of the ore as broken reserve in shrinkage.

Later an extension of the orebody on the 600 level was developed and mined by underhand stoping. A raise was first put up to the level above and benching begun. As stoping progressed downward, a second and then a third raise are started at intervals of about 50 feet, so that by the time benching reached the 600 level at one raise the next raise had made connection to the level above.

Raises were driven 3 1/2 to 5 feet wide, according to the thickness of the ore, and 12 feet long in the vein. The length of the raise (12 feet) not only produced a fair tonnage of mill ore but also made possible the most effective pointing of the cut holes. The mixture of quartz and calcite in the vein made a "tough" but readily drilled ground which was exceedingly hard to break; the average length of a raise round was only 3 1/2 feet. The round comprised 28 to 30 holes with a center V-cut; it was drilled with stopers by two miners. The cut holes were loaded with 5 sticks each of 40-percent-strength gelatin dynamite and the other holes with 4 sticks; they were detonated with white, cotton-countered fuse and no. 8 caps. The joints between fuse and caps were painted with Celocap. Stemming was used in all holes, but only after a determined effort on the part of the mine superintendent to establish the practice; it was made of mill tailings rolled in thin paper and packed in powder boxes. The cartridges were dampened slightly before using.

When two raises were running, the miners drilled and blasted 1 day in one, and the timberman set stulls and placed staging in the other. Because of the delay involved and the need to continue a regular mill supply, chutes were not installed as promptly as usual; instead, the ore was allowed to fall into the drift and was shoveled off shoveling sheets into mine cars.

Wire-rope ladders were found convenient in the raises. They were made by the mine blacksmith of 1/2-inch wire rope and old 1/2-inch round iron; the latter was cut to proper lengths, the ends were heated and bent into the shape of a hook, then they were placed over the rope at the proper intervals and hammered fast. These ladders could readily be hung over two short pieces of steel set in holes drilled in the footwall; they withstood the wear and tear of blasting with little damage. The stulls used were salvaged from old stopes; the only expense was the labor cost of getting them out.

Approximately 1.4 man-shifts (underground), 21 pounds of powder, 75 feet of fuse and 10 caps were expended per foot of raise. The total of these items was about $10; to this must be added compressed air, steel, supervision, and a proportion of hoisting and general underground and surface expense. Segregated costs of three such raises, based on a total advance of 85 feet in April 1933, are shown in table 1.

Underhand Stoping

The conditions in the 600-level orebody were satisfactory for underhand stoping. No timbering was necessary, and relatively high tonnage was broken per man-shift. Stopes were started at the top of a raise by drilling down holes with jackhammers. A series of benches was then carried down to the 600

level. An essential precaution was to maintain a rill steep enough so that most of the ore would fall into the raise without shoveling; the natural tendency of the miners was to drill and blast the higher, more accessible benches first, thus burying the lower steps and flattening the slope so that the muck would not run by gravity. One miner in an underhand stope, drilling 15 to 20 holes per round each shift, broke 20 to 25 tons of ore.

Mine Costs

The following table gives the mine crew in April 1933.

Number	Classification	Wages per day
1	Foreman miner	$6.00
5	Miners	4.50
1	Timberman	4.50
3	Carmen	4.00
1	Hoist engineer	5.00
1	Blacksmith	5.00
1	Cage tender, topman	4.00

Only one shift (day) was worked. Thus 50 tons per day was mined by 10 men underground and 3 on the surface, excluding superintendence; that is, 5 tons was produced per man-shift underground, or about 3.7 tons for the entire force. Compensation insurance cost $7.25 per $100 of mine pay roll.

Some of the principal items of operating cost other than labor were as follows:

	Cost	
	Per day	Per ton
Electric power, 300 kw.-hr. per shift at $0.0267	$8.00	$0.16
Distillate for hoist, 25 gal. per shift at $0.14	3.50	.07
Explosives:		
Dynamite, 2 1/2 boxes (50 pounds) 40-percent Hercules gelatin per shift at $7.25 per box	18.15	.36
Caps, 50 per shift at $0.025 for no. 8 or $0.016 for no. 6	1.00	.02
Fuse, about 300 feet per shift at $0.008 per foot	2.40	.05

To this must be added numerous items of supplies, such as track, pipe, oil, grease, steel, tools, coke, drill repairs, and water (which was purchased from a company pumping in a nearby shaft). Timber was not yet an item in mining costs, although it would be shortly. That purchased for shaft repair cost $40 per 1,000 board-feet, including an $8 to $9 trucking charge from Kingman.

The above cost items were determined readily from an unusually good set of records that was kept at this mine compared to ones usually kept at properties of its size. Labor, explosives, and cars trammed were entered on three daily sheets which listed all the working places. A large monthly distribution sheet was carried for each working place and for each account, such as "Hoisting", "Sharpening", etc. The data from the daily sheets were transferred to the monthly sheets, and from the latter a monthly resume was prepared, such as that shown in table 1. No warehouse account was carried; supplies consumed were entered directly from the invoices to the monthly distribution sheets.

To the costs in the following statement for April 1933 (table 1), trucking to the mill must be added. The ore was hauled by a contractor who used a single 7-ton, dump-body truck. The distance to the mill was about 1 mile, over a good, but winding, dirt road with only one short, steep grade. The ore was loaded from a chute into the truck and dumped directly into the coarse-ore bin at the mill. The contract price, including truck, labor (one driver), and all supplies, was 30 cents per ton.

MILLING

General

The mill which was rented from a neighboring company, was an all-slime cyanide plant built in 1923 by the Telluride Mining, Milling, & Development Co. at a cost said to be approximately $108,000. Its rated capacity was 50 tons per 24 hours. It was operated in 1924 and 1925, since when it had been idle. However, little expense was required to put it in operating condition. No changes or additions were made in the flow sheet or in the equipment.

The flow sheet (fig. 1) comprised coarse crushing, fine grinding (one stage of each), a stage of thickening from which the pregnant solution was derived, three stages of agitation, then five stages of thickening which produced a finished tailing. The pregnant solution was clarified, then treated by the Merrill-Crowe precipitation process. The capacity of the plant as then operated was 45 to 50 tons per day; the maximum in any day had been about 60 tons.

The ore treated contained no sulphides. Except for silver, which occurred in a ratio of 1 part to 2 parts of gold, no valuable metal other than gold was present. The ore was hard and "tough"; it consisted of roughly equal proportions of quartz and calcite, with small amounts of andesite wall rock. The gold was in the quartz and was so finely disseminated that an unusually fine degree of grinding was necessary to liberate it sufficiently for cyanidation. The presence of considerable clayey material in some of the ore, added to the tendency of the calcite to form slimes, made the pulp difficult to settle; settling area was the limiting factor in the capacity of this mill.

TABLE 1. - Mining costs, Johnston and Witcher lease on Big Jim mine, April 1933
(1,457 tons mined)

Working place	Tons	Breaking		Tramming		Hoisting		Timbering		General underground	
		Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton
Breaking ore:											
501 R (overhand stope)	196	$393.91	$2.009	$32.00	$0.163	$54.31	$0.277	$16.14	$0.082	$72.52	$0.370
503 R (overhand stope)	192	102.16	.532	38.00	.198	53.13	.277	8.46	.044	37.98	.198
435 U (underhand stope)	138	125.08	.906	38.00	.275	38.28	.277	6.16	.045	27.65	.200
6 A (underhand stope)	270	324.14	1.200	50.00	.185	71.83	.266	31.01	.115	48.35	.179
506 U (underhand stope)	406	281.98	.694	62.00	.153	112.19	.276	17.46	.043	37.98	.093
Ore dump[1/]	96	106.16	1.106	.....	.....	.....	.....	.....	.....	.....	.....
Total	1,298	1,333.42	1.027	220.00	.169	329.74	.255	79.23	.061	224.48	.173
Development:											
607 R	65	207.73	3.196	6.00	.092	17.80	.274	14.38	.221	24.17	.372
601 R	105	462.86	4.408	40.00	.381	29.08	.276	16.14	.154	72.52	.691
606 R	85	213.77	2.515	20.00	.235	23.44	.275	5.38	.063	24.17	.284
Total	255	884.36	3.468	66.00	.259	70.32	.275	35.90	.141	120.86	.473
Total	1,457	2,217.79	1.522	286.00	.196	400.06	.275	115.13	.079	345.34	.237
Development costs above shown separately and computed by cost per foot	Feet	Total	Per foot	Total	Per foot	Total	Per foot	Total	Per foot	Total	Per foot
607 R	20	207.73	10.386	6.00	.300	17.80	.892	14.38	.719	24.17	1.208
601 R	45	462.86	10.285	40.00	.888	29.08	.646	16.14	.360	72.52	1.611
	20	213.77	10.688	20.00	1.000	23.44	1.173	5.38	.269	24.17	1.208
Total	85	884.36	10.404	66.00	.776	70.32	.827	35.90	.422	120.86	1.423

1/ Payment to lessees working shaft dump on "split-check" basis.

TABLE 1.- Mining costs, Johnston and Witcher lease on Big Jim mine, April 1933--Continued
(1,457 tons mined)

Working place	Tons	Steel sharpening		Compressed air		Drill steel, hose, oil		Total cost of mining	
		Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton
Breaking ore:									
501 R (overhand stope)	196	$44.64	$0.228	$43.40	$0.221	$14.18	$0.072	$671.10	$3.424
503 R (overhand stope)	192	23.38	.122	21.70	.113	7.43	.039	292.24	1.522
435 U (underhand stope)	138	17.00	.123	14.46	.105	5.40	.039	272.03	1.971
6 A (underhand stope)	270	29.76	.110	28.93	.107	9.47	.035	593.49	2.198
506 U (underhand stope)	406	23.38	.057	21.70	.053	7.43	.018	564.12	1.389
Ore dump 1/	96	.....	.....	.....	.....	.....	.....	106.16	1.106
Total	1,298	138.16	.106	130.19	.100	43.91	.034	2,499.14	1.925
Development:									
607 R	65	14.89	.229	14.46	.222	4.73	.073	304.16	4.679
601 R	105	44.64	.425	43.40	.413	14.18	.135	722.82	6.884
606 R	85	14.89	.175	14.46	.170	4.73	.056	320.84	3.757
Total	255	74.42	.292	72.32	.284	23.64	.093	1,347.82	5.285
Total	1,457	212.58	.146	202.51	.138	67.55	.047	3,846.96	2.640
Development costs above shown separately and computed by cost per foot	Feet	Total	Per foot	Total	Per foot	Total	Per foot	Total	Per foot
607 R	20	14.89	.744	14.46	.723	4.73	.236	304.16	15.208
601 R	45	44.64	.992	43.40	.964	14.18	.315	722.82	16.061
606 R	20	14.89	.745	14.46	.723	4.73	.236	320.84	16.042
Total	85	74.42	.876	72.32	.851	23.64	.278	1,347.82	15.857

1/ Payment to lessees working shaft dump on "split-check" basis.

Crushing and Grinding

The ore was dumped from the trucks over a steeply slanting grizzly formed of flat steel bars set on edge with 1-inch spacing. The fine material fell into a separate section of the coarse-ore bin. The oversize ran into a coarse-ore bin which had a capacity of 30 to 35 tons; it was built of wood and had a sloping bottom. From this bin the ore was drawn by gravity through a feed gate to the coarse crusher. The crusher product passed directly onto an inclined conveyor belt, 12 inches wide and about 200 feet long, which discharged into the fine-ore bin. The grizzly undersize was fed through a separate gate onto the lower end of the same belt and conveyed to the fine-ore bin when the crusher was not running. The crusher was belt driven by a 50-hp. electric motor. It was operated 4 to 6 hours each day shift, crushing at a rate of 11 to 12 tons per hour. The conveyor belt passed through a Merrick weightometer; the tonnage recorded by this machine was found to check very closely the tonnage estimated according to number of 1-ton mine cars trammed to the mine surface bin; the monthly discrepancy was usually less than 1 percent.

The conveyor discharged into the center of the square, wooden, flat-bottomed, fine-ore bin, which had a maximum capacity of 80 tons. A hand-operated sample cutter was installed at the head of the conveyor belt. From a center discharge gate in the bottom of the fine-ore bin an apron feeder delivered the ore to the ball mill.

The ball mill was a 6- by 4 1/2-foot Marcy mill with Williamson "mechanite" liners that were changed to standard Marcy liners about 1933. It was driven at 18 r.p.m. by a 75-hp. motor and operated in closed circuit with a Dorr duplex classifier. The classifier discharge was 82 to 85 percent minus 200-mesh; it was later changed to 80 to 82 percent. Ball consumption ranged from 2.5 to 4.5 pounds of chrome-steel balls per ton or ore; the mill run had been too short to determine liner consumption. The ball mill operated from 78 to 80 percent of the total time; grinding capacity was 2.5 tons per hour of operating time.

Grinding was done in cyanide solution, which was drawn from the main-mill storage tank at the rate of about 330 tons per 24 hours. A portion of this was added in the feed launder at the head of the mill; the balance was added at the lower end of the classifier. About 50 percent of the value recovered from the ore was dissolved in the mill.

Cyanide Section

The classifier overflow, having a dilution of 6 to 1 (or carrying 15 percent solids), flowed by gravity to the no. 1 thickener in the cyanide plant. This was a wood-stave tank 24 feet in diameter and 8 feet deep. It was equipped, as were all the thickeners and agitators, with a Dorr mechanism which was belt-driven through a long countershaft by a single 25-hp. motor. The thickener overflow passed by gravity to the precipitation section of the plant. The thickened discharge, containing about 40 percent solids, was raised by a diaphragm pump to the first of a series of three agitating tanks.

The tank of no. 1 agitator was 19 feet in diameter and 14 feet deep; nos. 2 and 3 agitators were 13 feet in diameter and 14 feet deep. The agitators were set at such relative elevations that the pulp flowed from one tank to the next by gravity. Air for the agitator air lifts, as well as for periodical drying of precipitate in the filter press, was furnished by a 7 1/2- by 6-inch compressor at a pressure of 30 pounds per square inch. The compressor was driven by a 10-hp. motor.

About 95 percent of the gold recovered was taken into solution by the time the pulp left no. 3 agitator. From there it went to no. 2 thickener, whence it was pumped in turn to thickeners 3, 4, 5, and 6. These thickeners were all 15 feet in diameter and 10 feet deep. They were set at such heights that the clear overflow from each ran by gravity to the next lower numbered tank. The thickened-pulp discharges contained about 50 percent solids. Fresh water was added to no. 6 thickener in the amount of 50 tons daily; the barren solution from the precipitation section, 180 tons daily, was added to the feed launder of no. 4 thickener. This solution contained about 2.2 pounds of sodium cyanide and 2.0 pounds of lime per ton, also a trace of gold. The overflow from no. 2 thickener, 330 tons per day, was pumped to the mill storage tanks. The thickened slime from no. 6 thickener flowed to the tailings dump. No solution was reclaimed from the tailings; they were allowed to run down the draw below the mill; within a short distance the water sank into the ground.

The overflow from no. 1 thickener ran by gravity into a Butters clarifying filter having a tank 11 feet in diameter and 5 1/2 feet deep; thence it was pumped into the clear gold-solution tank 11 feet in diameter and 6 feet deep. From this tank it passed through the standard Merrill-Crowe, vacuum-treatment, zinc-dust precipitation process. Zinc dust and lead acetate were added to an emulsifier ahead of the triplex circulating pump by an automatic feeder. The Merrill precipitate press was installed in a room adjacent to the grinding section of the mill about 200 feet from the pump.

Melting Precipitate

Usually the precipitate press was cleaned about twice monthly, after first blowing air through it for 3 to 4 hours to dry the precipitate. The precipitate was fluxed about as follows: Precipitate, 100 pounds; borax, 20 pounds; soda, 10 to 12 pounds; silica (broken glass), 6 pounds. This charge, together with some slag from the previous melt, was melted in an oil-fired tilting furnace. The fusion usually required 8 to 9 hours, including the time needed to put in and melt down the charge; the furnace consumed 25 or 30 gallons of fuel oil in this time. Compressed air for the oil burner was obtained from the compressor at the Telluride mine, where development work was in progress. The no. 150 Dixon graphite crucibles used had a life of about 40 hours, or 4 or 5 fusions. The entire charge was poured off into a cone-shaped mold; after a few minutes the slag was tapped off through a hole 2 or 3 inches above the top of the gold button and granulated by being run into water. At first this material was accumulated, periodically ground in a small mill, and concentrated on a table, the concentrates being added to a later precipitate melt. Afterward the low-grade slag was returned to the ball mill, as it was found to contain practically no shot gold. The richer slag from just above the top of the button contained most of the shot gold; it was melted with the succeeding charge.

The gold-silver button was cleaned and shipped to the mint without remelting; a sample was taken first by boring several small holes in it. The average fineness was 640 parts per 1,000 of gold, and 300 parts of silver, and 60 parts of base metal and impurities.

Metallurgical Results and Costs

The recovery was 97 to 98 percent. Cyanide consumption was 0.75 to 1.00 pound of sodium cyanide per ton of ore, and lime consumption was 3 3/4 to 4 pounds per ton. Zinc dust was added at the rate of 8 pounds per 24 hours, or 0.7 ounce per ton of solution, and lead acetate at the rate of 1 ounce per ton of ore.

The mill pay roll included 9 men: 1 superintendent whose time was charged to assaying and refining; 1 crusher man on day shift only; 1 man whose time was divided between assaying, refining, and general service; and 2 shift men, or operators, on each of three 8-hour shifts. Experienced men were paid $4.50 and ordinary labor $4.00.

Power cost $0.0267 per kilowatt-hour (May 1933). The total installed electric power in the mill was 200 hp., divided as follows:

Motor	Hp.
Crusher	50
Ball mill	75
Main conveyor	10
Apron feeder	5
Compressor	10
Cyanide plant	25
Pumps	25

However, the crusher operated only about 5 hours and only on day shift; the ball-mill motor was said to be operating at only about 70 percent full load. Consequently, the average total mill load was about 90 hp., and power consumption was about 30 kw.-hr. per ton.

Cyanide (Aero Brand sodium cyanide) cost $160 per ton (April 1933); lime cost $19 per ton, of which $5.50 was trucking cost from Kingman to Oatman; zinc cost $8 per 100 pounds; and the monthly water bill, for a daily consumption of about 50 tons, was about $100, or about 30 cents per 1,000 gallons.

The costs shown in the following regular monthly statement (table 2) are representative.

TABLE 2. – Milling cost, Johnston and Witcher lease on Big Jim mine, July 1933

(1,635 tons milled)

	Labor		Electric power		Water		Lime		Miscellaneous chemicals		Cyanide		Zinc	
	Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton
Assaying 1/ ..	$283.00	$0.173	$10.15	$0.006	.....	.....	.....	.....	$20.11	$0.012	.....	.....	.....	.....
Crushing	140.13	.086	30.43	.018	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Grinding	393.88	.241	507.26	.310	.....	.....	.....	.....	29.10	.018	.....	.....	.....	.....
Cyaniding	425.19	.260	456.54	.279	$78.61	$0.048	$116.51	$0.071	4.91	.003	$172.62	$0.106	$32.00	$0.020
Repair and replacement..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Refining and marketing ...	31.50	.019	10.14	.006	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rental of mill	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	1,273.70	.779	1,014.52	.620	78.61	.048	116.51	.071	54.12	.033	172.62	.106	32.00	.020

	Replacement and repair parts		Balls		Fuel oil and lubricants		Insurance and shipping		Mill rental and miscellaneous		Total cost of milling	
	Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton	Total	Per ton
Assaying 1/ ..	.....	.....	.....	.....	$9.99	$0.006	.....	.....	.....	.....	$323.25	$0.197
Crushing	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	170.56	.104
Grinding	$58.25	$0.036	$130.77	$0.080	2.02	.001	.....	.....	.....	.....	1,121.28	.686
Cyaniding	19.92	.012	.....	.....	4.50	.003	.....	.....	.....	.....	1,310.80	.802
Repair and replacement..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Refining and marketing ...	.....	.....	.....	.....	10.05	.006	$8.64	$0.005	.....	.....	60.33	.036
Rental of mill	.....	.....	.....	.....	.....	.....	.....	.....	$1,000.00	$0.612	1,000.00	.612
Total	78.17	.048	130.77	.080	26.56	.016	8.64	.005	1,000.00	.612	3,986.22	2.437

1/ Cost of assaying includes cost of superintendence.

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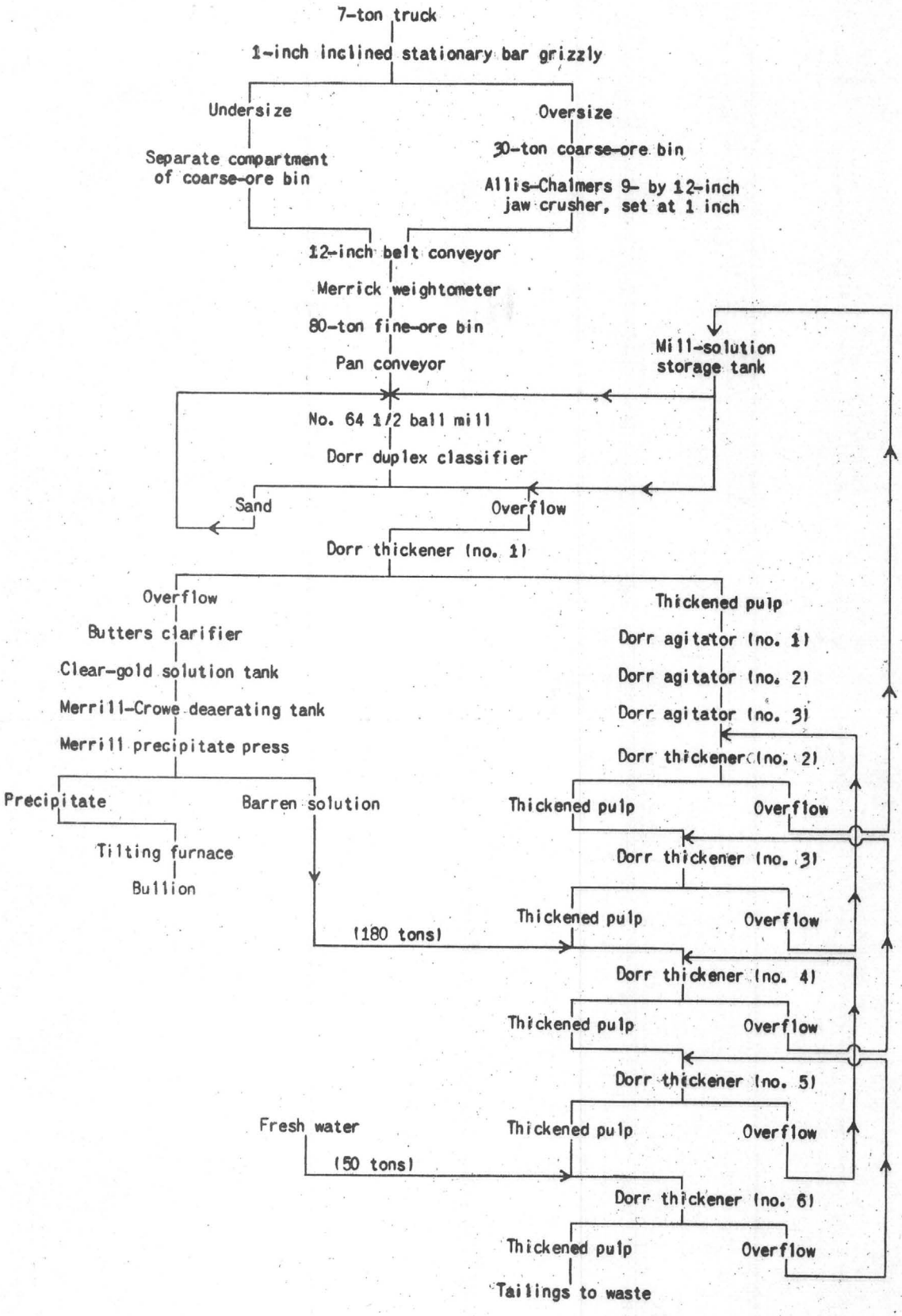
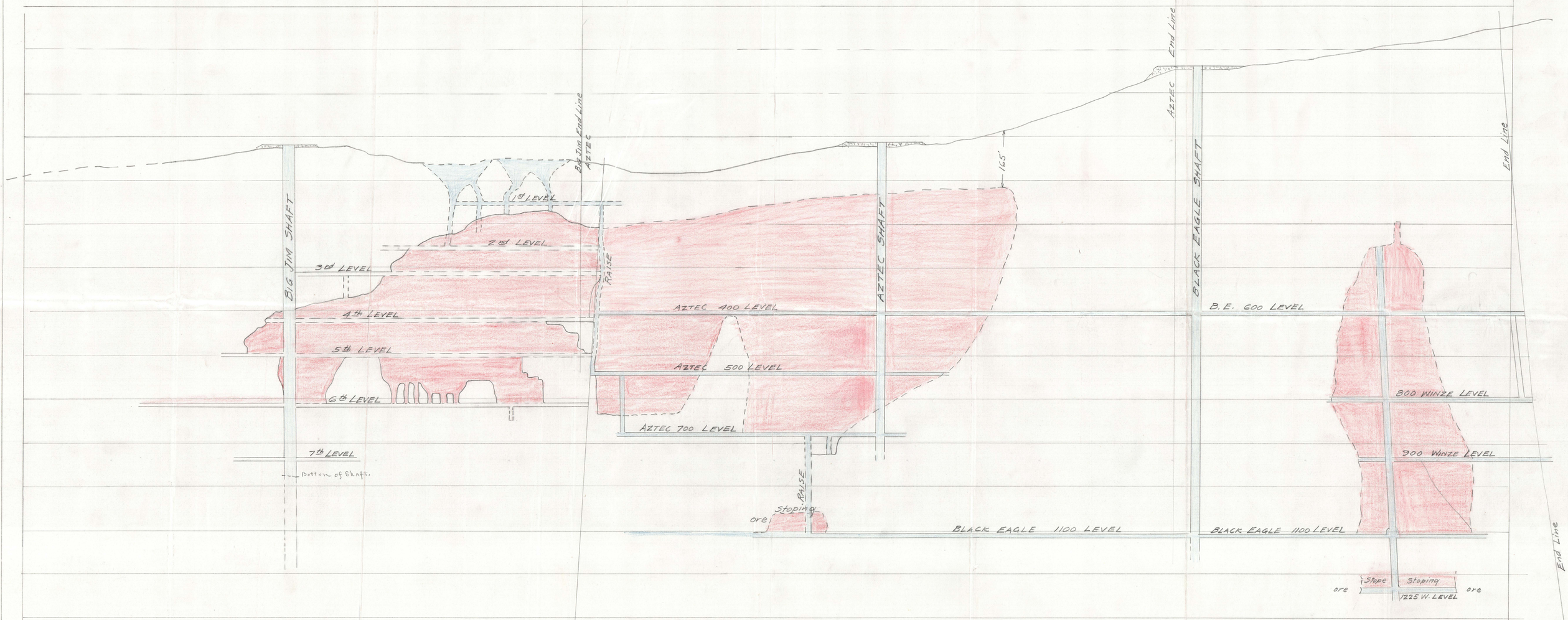
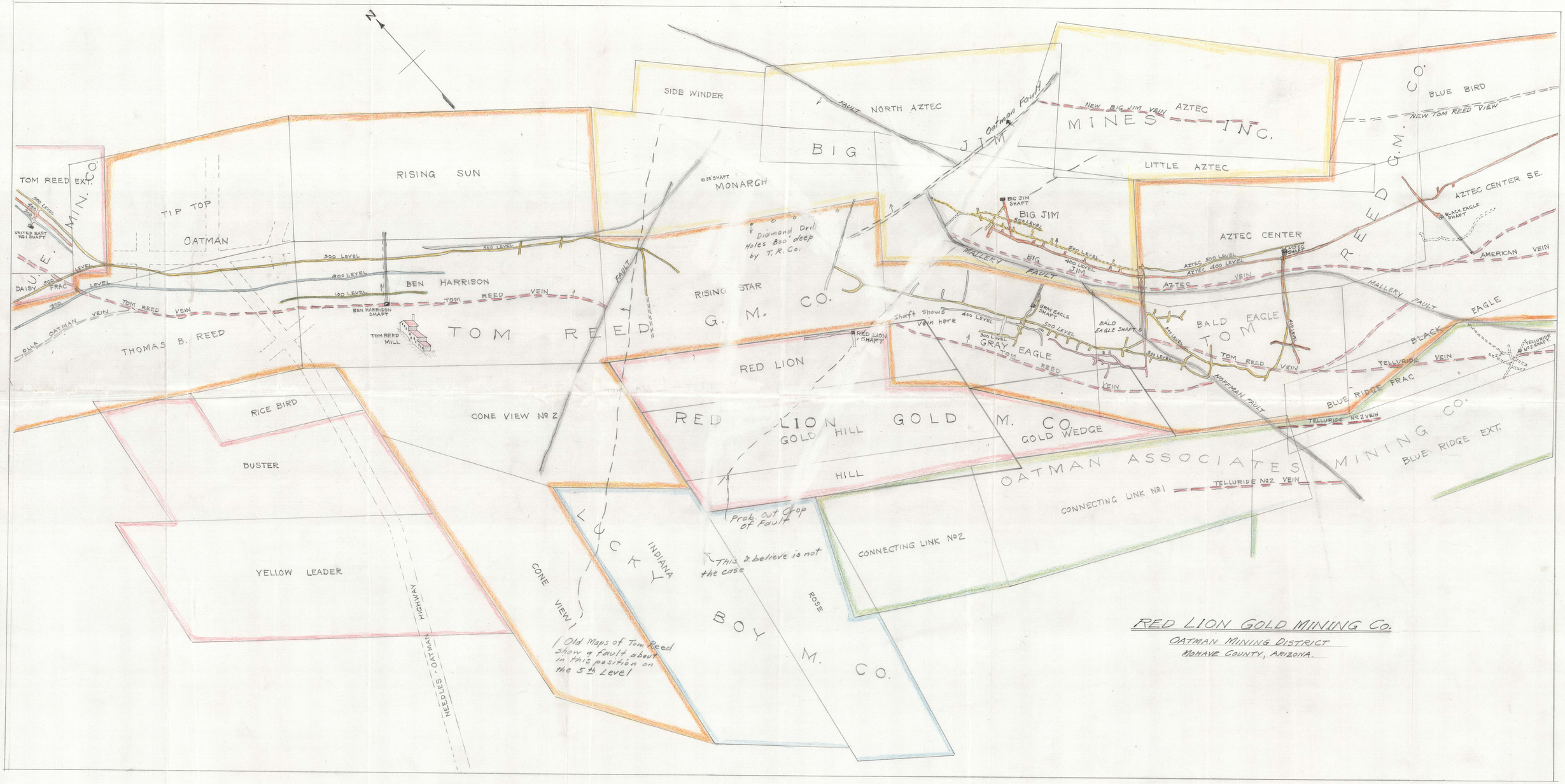


Figure 1.- Flow sheet of Big Jim (Telluride) mill.


BIG JIM SHAFT
Big Jim End Line
AZTEC
RAISE
1st LEVEL
2nd LEVEL
3rd LEVEL
4th LEVEL
5th LEVEL
6th LEVEL
7th LEVEL
Bottom of Shafts.
AZTEC SHAFT
AZTEC 400 LEVEL
AZTEC 500 LEVEL
AZTEC 700 LEVEL
RAISE
ore
Stoping
BLACK EAGLE 1100 LEVEL
165'
AZTEC
End Line
BLACK EAGLE SHAFT
B. E. 600 LEVEL
800 WINZE LEVEL
300 WINZE LEVEL
BLACK EAGLE 1100 LEVEL
Stope
Stoping
ore
ore
1225 W. LEVEL
End Line



RED LION GOLD MINING Co.

OATMAN MINING DISTRICT

MOHAVE COUNTY, ARIZONA.