Estimates of Ore February 15, 1913.

124,500 tons @ 0.5 oz Aug. and 1.2 oz. Ag., 3.5% Cu.

Advised further development to mine to depth of 850' and drilling was in progress (See extract A. and B. ) Surface of country was much higher than at present when ore was deposited..

From Report November 19, 1913.

Blue Buck (#5) had been found underground only on the 400' level which did not extend as far north as the #6.

Ore now developed by 850' level. Estimates of ore reserves.

154,600 @ 0.05 Au., 1.2 oz. Ag and 3.50% Cu.

Note additional tonnage of low grade ore which could not be worked with profit. Note C.

April27, 1914. Note D.

Estimate April 1, 1914, 190,720 tons @ .05 oz. Au is $1.00, 1.0 oz. Ag @ $.58 is $.58 and 3.5% copper @ 14.5¢ per poung. Mine mostly opened on 9th level (850') andintend to sink 150' to the 1000' level.

Report for 1914. Estimate of ore reserves June 1st, 151,900 tons @ Same grade as above.

Shaft sinking from 850 to 1000' started in February, 1915. 500' level extended under #6 ore body but found no ore. Stoping to end of 1913 was all by shrinkage but then started to cut and fill in the wider stopes. Note E. New hoist installed.

Annual Report for 1915. Ore reserve January 1st, 1916, 235,000 tons @ 3.5% copper with 0.05 oz. Au and 1.2 oz. Ag.

Annual report for 1916 . Ropeway rebuilt during year which reduced production.

Ore reserves at end of 1916 479,500 tons @ 3.30% copper, 0.05 oz. Au. and 1.2 oz. Ag. Five main shoots of ore developed to depth of 1000' and shaft going down to 1200' level.

Annual report for 1917. Production 3.176% copper but higher on gold and silver $2.40 and 0.06 oz. gold and 2.00 oz. silver.
Estimate of ore 536,800 tons which was probably too high.
Average grade 0.05 gold, 2. oz. silver and 3.10% copper

Annual report of 1918. Proved up ore on 12th level and started long south drift on 800' to prove up Blue Thunder and advanced to within 400' of shoot.
Estimate of reserve 470,000 tons at end of year over 2.80% copper and 0.06 oz. gold and 2.00 oz. silver.
Production for year 1918 contained only 2.771% copper but 0.063 oz. gold and 2.5 oz. silver.

Annual report of 1919. Estimated reserve at end of year 390,000 tons with 2.65% copper and 0.07 oz. gold and 2.5 oz. silver. Only low grade ore found in Blue Thunder Shaft. Started sinking to 1350' level (14th).

Annual report of 1924. Sinking conducted below the 1400' level (see diary and letter) Rework #6 shoot, Shaft sunk in 1923 to 410' level. Ore developed on 300 and 400' levels with faults at the north and south end of the shoot. Oxice and carbonate ore found on 300' level but ore does not appear to extend much above that level. On 400' level there is 500' of virgin ground to #5 which should be prospected. Later ore was found on the 5th level and mined 60' below where it had a width of 3', length of 40' and over 8.00% copper.
Shaft finished to 1500' level with 40' sump by May, 1925 and 1530 ore body found in September, 1925 with average width 14' and 3% copper but gold and

silver values were low.

By December of 1925 the 1530 had been opened for length of 90' with width 10-15' and 3% copper and low gold and silver.

In 1545 found basic ore badly broken up with 0.07 oz. gold and 2.00 oz. silver and 2.5% copper. Raised up and found better ore in place but badly fractured and faulted. 750 ore body was developing well at that time and producing 3% copper ore.

In September, 1926 the winze below 1530 had a depth of 32' and averaged 3.44% copper while on the 1500' level it had developed for a length of over 100'.

SPECIAL REPORT - BLUEBELL MINE

April 27th, 1914

. . . . . .

Victor I. Cumnock, President C.A.S.Co.:

During the past few months you have been kept advised by weekly reports from Mr. Walker and myself of the general progress made at the Bluebell. The purpose of this report, however, is to summarize these developments and to show in detail the present condition of the mine, more particularly in regard to ore reserves and outlook for future operations.

RESULTS OF PAST OPERATIONS

During the year 1913 the Bluebell Mine produced 36792 tons of ore, containing 1711.42 ozs Gold, 48920.8 ozs. Silver, and 2,765,166 lbs Copper. The average content of this ore per ton was .0465 ozs. of Gold, 1.33 ozs. of Silver, and 3.76% Copper, which, on the prices of metals prevailing throughout the year, meant a gross value of $13.23 per ton, the aggregate gross value of the production being $486.838.49.

November 19th, 1913, I made a report of the Bluebell Mine to the Board of Directors, estimating the ore reserves as they existed in the mine on November 1st. Since that date the mine has produced 10,082.53 tons of ore; 489.31 ozs. Gold, 13,296.30 ozs. of Silver, and 766,123 pounds of Copper. The average content of this ore per ton has been .0486 ozs. Gold, 1.32 oz. Silver, and 3.8% copper. The market values of copper and silver have been lower since November, 1913 than during the average of the year, and the gross value contained in the ore mentioned above was only $12.80 per ton, although in point of metal contents it was actually a trifle richer than the average of all ore produced in 1913.

The Bluebell Mine was closed down almost entirely during the latter part of December, 1913, and operations were recommenced on a small scale in February, 1914, increased to over 100 tons per day

in March, and at date of writing ore is being broken, hoisted and shipped at approximately 180 tons per day.

The figures quoted above in regard to value and grade of ore are interesting, not only as showing what the mine has actually done, but as an indication of what may be expected from future out-put. To the best of my knowledge, no attempt was made in 1913, or since that time, to gouge out the richer portions of the ore bodies, and the productions represent the average run of mine material as broken in the stopes, and approximately the average material which remains in place in these same ore bodies and from which we shall largely draw our production. It is true that there are certain portions of the mine from which a similar grade of ore can be obtained only by selective stoping, or by sorting out a considerable amount of waste, but allowance for this has been made in calculations, and the poorer portions of the mine will be seen to average with the richer portions, and to show a large reserve of very good ore awaiting extraction.

I believe, moreover, that the figures quoted above go to show that both in tonnage and quality of ore, the estimate of reserves made by me to Mr. Kittle in February, 1913, and again in the estimate which I made for the Directors in November, 1913, were conservative, and have so far been justified by the results of operations; and I further believe that the estimate made in this present report, after more careful investigation than was possible on either of the other two occasions, will be found to be also conservative, and approximately accurate, in so far as accurate knowledge is available at present.

## ESTIMATE OF ORE RESERVES

Accompanying this report and forming part of it, are two blueprints of the Bluebell Mine, as prepared by Mr. White, Engineer at the Bluebell, under the direction of Mr. Walker and myself. Neither Mr. Walker nor I have had the opportunity to check up all of the samples and measurements shown in these blueprints, but from such work as we have been able to check up we feel that Mr.

White is an accurate and careful Engineer, and that the work which he has done can be accepted with full confidence.

The first of the Blueprints is a section of the mine (excepting the northern portion), showing the workings in detail as of April 1st, 1914, and the various stopes, drifts, raises, et cetera. The stopes and drifts are all designated by numbers, and you will note that since the last plans of the mine were made we have entirely altered the system of naming and numbering the various workings. Henceforth we will use the new figures which we believe to be much simpler and less confusing than the old method of designating the various portions of the mine.

The new system may be explained as follows: Beginning at the south end of the mine, we have called the main "Bluecoat Ore Body", "No. 1".

Immediately adjoining this, and for the most part just north of the Dike, lies a silicious and somewhat detached portion of the Bluecoat Ore Body which we now call "No. 2". We think well to differentiate between these two ore chutes, as "No. 2" is much lower in grade than "No. 1", the width of ore is less, and the character is more silicious and distinctly different.

The ore body formerly called "410 South", we now call "No. 3".

The ore body formerly called "410 North" we now call "No.4".

The Bluebuck Ore Body we call "No. 5".

The Bluebell Ore Body (if developed), will be called "No.6".

In designating the stopes and various workings, we use three figures. For instance, "420", "930", "350", etc. The first figure refers to the level immediately below the stope. The second figure refers to the ore body as specified above. The third figure is a zero, except in cases of raises, cross-cuts, or other special work, which we will designate as "421", "932", etc. A few moments' study of the blueprint in connection with this explanation will I believe make all these designations quite clear, and they will be

much less confusing than the old combination of names and numerals, which were frequently mixed up even by the Mine Superintendent.

The second blueprint represents a sectional assay plan of the mine, as far as this has been made up to date. I regret to state that it is far from being complete, but this work is now progressing steadily, and it is my intention to complete the assay plan as soon as possible, bring it up to date, and keep it up to date at all times in the future. Many of the assays shown have been posted from old records and partial assay plans made in the past by Mr. Carman and Mr. Trengove, under the direction of Mr. Bennetts and Mr. Walker. Some of the assays have recently been made by Mr. White who only began his work on March 15th. In many portions of the ore bodies, no assays at all have been posted , either because these have been lost, or the samples were never taken, or else because they are so incomplete as to be considered entirely untrustworthy. We are still working over the old records, and believe that we shall be able to fill in some of these blanks, particularly at points where the ore has been stopped out and additional sampling is impossible. Elsewhere we shall recommence a new sampling of the mine, and complete the assay plan from the new records. As the sampling proceeds I shall have each result noted up on the maps, and from time to time will send you revised blueprints bringing these results up to the last minute.

The system employed on the present assay plan is as follows: The points at which the assays were taken are represented by small circles, from which a line is run to the record of the sample. The first figure represents the width of the sample in feet.(Unfortunately this does not represent the width of the ore). The second figure represents the ounces of gold per ton. The third figure represents the ounces of silver per ton, and the fourth and final figure represents the percentage of copper.

As mentioned above, the width of the ore is not indicated by the width of the sample. The former Superintendents at the Bluebell only in rare instances sampled the full width of ore developed, and in fact they rarely developed the full width of ore at any one point. The drifts usually had a width of five to six feet, with no cross-cuts or drill-holes run out from the walls, and in many instances we now find by breaking into the walls that the ore has a width of ten, twelve and even seventeen feet. In future as we go along we shall endeavor to develop the full width of the ore bodies, at least at frequent intervals, and we shall sample these in sections for a composite result representing the full width of the ore.

In calculating the tonnage I have personally, in so far as possible, measured the width of the ore independent from the widths posted on the plan. In some cases, where the ore appeared to be of uniform grade, I have estimated the full width as of the grade represented by the assay. Elsewhere this grade has been reduced by means of hand samples or approximate allowance. The estimates of tonnage and values are, therefore, not absolutely fixed nor accurate, but I believe that they are as accurate as present knowledge will permit, and that they are uniformly conservative, and as the sampling and assaying proceeds, additional revisions of the estimate will be made and forwarded to you.

In the former reports which I made on the mine, I assumed from rather incomplete ~~incomplete~~ data that the average grade of the ore was 3.5% copper, and that the gold and silver had an average value of $1.50 per ton. I have now been able to improve on this method somewhat, and have estimated each block of ground as ore of a different value, based on the available assays, and figuring gold at $20.00 per oz.; silver at 58¢ per oz.; and copper at 14.5¢ per pound. In making these estimates I have made use of a good many assays which are not posted in the plan, and also of the records of ore mined and hoisted from the various stopes.

In considering the present estimate you will note that the aggregate tonnage estimated in the mine has been considerably increased, and now amounts to 190,720 tons, as against 154,600 tons estimated November 1st, 1913. The increase in Probable Ore amounts to 13,000 tons, and the increase in Positive and Highly Probable ore accounts for the difference, namely, 23,000 tons. All of these increases are due to the increased widths of various ore bodies as proved by the work done during the last four months. During that time we have not devoted any money to exploration proper, nor have we discovered any new bodies of ore, or any substantial increases in lengths of ore chutes, but we have proved, for instance, that the width of the ore body at 930 is ten feet instead of five, as previously estimated, and in many other places we have been able to develop additional width. In nearly every place where we have carried on developments along these lines, the results have been successful and encouraging. The one exception is the No. 5 (Bluebuck Ore Body) where it now appears that our ore is lower grade than expected, and the tonnage of pay ore is doubtful. However, I cannot say very much about this ore body one way or the other, until we cut same on the 250 level, as we hope to do in the course of the next two or three months. After that we shall have some accurate data upon which to base our estimates.

At the present time we are starting again to explore the No. 6 (Bluebell Ore Chute), and we have every expectation of finding a valuable ore reserve at this point, the results of which will be recorded in due course.

## O R E  R E S E R V E S

The ore reserves of the Bluebell Mine, I estimate as follows, as at April 1st, 1914:--

| ORE BODY | SECTION | BROKEN | POSITIVE | HIGHLY PROBABLE | PROBABLE |
|---|---|---|---|---|---|
| | Above 300' Level | 1000 $12 | -------- | 3000 @$15 | 3000 @ $15 |
| NO. 1 | 300' - 400' | --------- | 2000 @ $12 | 2600 @$12 | ---------- |
| (BLUE COAT) | 400' - 500' | 1000 @$12 | 4000 @ $12 | 4200 @$12 | ---------- |
| (SOUTH END) | 500' - 600' | 1000 @$12 | 3000 @ $12 | 3500 @$12 | ---------- |
| | 600' - 700' | 2000 @$12 | 1000 @ $12 | --------- | ---------- |
| | 700' - 850' | 1000 @$14 | 10000 @ $14 | 15000 @$14 | ---------- |
| | Below 850' | --------- | ---------- | --------- | 15000 @ $12 |
| | Above 200' Level | --------- | ---------- | 2000 @$11 | 3000 @ $11 |
| | 200'- 300' | --------- | ---------- | 1000 @$10 | 2500 @ $10 |
| NO. 2. | 300' - 400' | --------- | ---------- | 1000 @$10 | 1000 @ $10 |
| (BLUE COAT) | 400' - 500' | 1950 @$11 | ---------- | 7000 @$10 | ---------- |
| (NORTH OF ) | 500' - 600' | --------- | ---------- | 7500 @$ 9 | ---------- |
| (DYKE MOST | 600' - 700' | --------- | ---------- | 6000 @$ 9 | ---------- |
| LY. ) | 700' - 850' | --------- | ---------- | 5000 @$10 | 4000 @ $10 |
| | Above 600' Level | 100 @$12 | 2000 @ $10 | 3000 $ 10 | ---------- |
| NO. 3. | 600' - 700' | --------- | 5000 @ $11 | --------- | ---------- |
| (410 SOUTH) | 700' - 850' | --------- | 5000 @ $14 | 5000 @ $13 | ---------- |
| | Below 850' | --------- | ---------- | --------- | 8500 @ $12 |
| | Above 250' Level | 2500 @$14 | ---------- | --------- | ---------- |
| | 250' - 400' | 1350 @$12 | ---------- | 2000 @ $12 | ---------- |
| NO. 4. | 400' - 600' | --------- | 8000 @ $13 | 5000 @ $13 | ---------- |
| (410 NORTH) | 600' - 700' | --------- | 5500 @ $12 | ---------- | ---------- |
| | 700' - 850' | --------- | ---------- | 6000 @ $10 | ---------- |
| NO. 5 | Above 400' Level | 320 @$ 9 | ---------- | 2000 @ $ 9 | 12000 @ $ 9 |
| (BLUE BUCK.) | Below 400' | --------- | ---------- | ---------- | 3000 @ $ 9 |
| NO. 6 (BLUEBELL) | ---------- | --------- | ---------- | --------- | ---------- |
| IN BINS &c | ---------- | 200 @$12 | ---------- | --------- | ---------- |
| TOTAL | ---- | 12420 @ $12.35 | 45500 @ $12.60 | 80800 @ 11.43 | 52000 @ $10.96 |

## S U M M A R Y

| ORE BODY | BROKEN | POSITIVE | HIGHLY PROBABLE | PROBABLE | TOTAL ALL CLASSES |
|---|---|---|---|---|---|
| In Bins | 200 | | | | 200 |
| #1 (Blue Coat, South) | 6000 | 20000 | 28300 | 18000 | 72300 |
| #2 ( " " , North) | 1950 | ----- | 29500 | 10500 | 41950 |
| #3 (410 South) | 100 | 12000 | 8000 | 8500 | 28600 |
| #4 (410 North) | 3850 | 13500 | 13000 | ----- | 30350 |
| #5 (Bluebuck) | 320 | ----- | 2000 | 15000 | 17320 |
| TOTAL -- | 12420 | 45500 | 80800 | 52000 | 190720 |

Grand Total all classes ore - 190,720 tons @ $11.75 per ton.

WORKING METHODS AND FUTURE PROBLEMS

The method of operating the mine is, to my mind, greatly improved, and the results are also shown by the costs during the last two months. In places we have substituted for shrinkage stoping, the method of "cut and fill", which has many advantages where the ore bodies are wide and the walls bad. We have been to considerable expense in preparing the mine for this system, but it is now beginning to operate steadily, and give good results. Elsewhere we still continue to stope by shrinkage, which, when the ore chute will permit, is the cheapest method of breaking and extracting Bluebell ore.

Mr. Wirtz, the new Superintendent, has taken hold of the mine with an excellent spirit and plenty of push. He is essentially a practical miner, and spends a great part of his time underground, getting the most work possible out of his men, and for the most part he has employed a new crew, new Foremen and Shift Bosses. The results of this are reflected by the working costs, which I feel confident will improve steadily. In February, with only 1259 tons shipped, the cost was naturally high,-$3.34 inclusive of freight. In March, with 3528 tons shipped, the cost had fallen to $2.05 per ton, inclusive of freight. Indications are that April will show an even better result. After this month we firmly expect to handle 6,000 tons or better per month, and to keep the entire cost well below $2.00 per ton. In this connection it may be interesting to note that the average cost for 1913 was $3.38 per ton, and that the best month record was made in November, with a cost of $2.62 per ton against 3918 tons shipped. We have spent considerable money to improve the sanitation and safety of the mine, and feel gratified that this has been appreciated by both the Inspector for the Insurance Company and the State Mine Inspector, from each of whom we have received favorable reports on the property within the last few weeks.

Mr. White, as Engineer, has started in with a difficult task, and is keeping the surveys, measurements, and the samples well up to date, at the same time catching up with some of the back work, which will enable him to gradually complete the entire assay plan of the

property. The value of sampling and assaying in permitting careful stoping, is most important at the Bluebell, and if we are able to produce a high grade of ore at a reduced cost continuously, a large part of our success in this respect can be attributed to prompt and careful engineering.

The system of records and timekeeping accounts has been changed, simplified, and made partly self-checking, under the direction of Mr. Henderson;and Mr. Freeman, Timekeeper at the Bluebell is doing his work in a conscientious and acceptable manner.

The equipment of the mine is not altogether what we could wish ~~it~~, but we have spent considerable money in improving the shaft and the skips, and also on the tramway to Bluebell Siding. We have found it absolutely necessary to purchase a new Drill Sharpener, and with this in working order our main equipment will suffice for some time to come, with the usual repairs and maintenance.

In the future we shall have many problems to face; more particularly in reference to the various methods of stoping the ore to best advantage. The question of HAULAGE from the No. 5 & No. 6 ore bodies, the differentiation between the milling ore and the ore which is best suited for smelting direct, the determination of stoping width, and the low limit of pay ore. But many of these problems can best be deferred until after the mill and smelter are operating on a regular basis, and the costs of treating the ore can be accurately determined. Even on the basis of last year's high working costs, the Bluebell Mine in itself was operating on what should have been a paying basis, and we feel confident that with the decrease in concentrating and smelting costs, and the decrease also in mining costs, a very comfortable margin of profit will be assured in the future.

In general, I believe that I can say that the condition of the Bluebell is healthy and encouraging. We are mining a good grade of ore at present, and we are developing more ore of equally good grade. We feel confident of more than two years' reserve on

the basis of 6,000 tons per month, and including the "Probable Ore" and the additional reserves which we shall almost certainly develop with within the next few months, I think there is very little doubt that the Mine will continue to furnish for several years to come. Our working costs have already decreased considerably, and there is every reason to expect that this decrease will be maintained and bettered as our work progresses, and that the ore will reach Humboldt having a gross value of over $12.00 per ton, and with a cost against it of $8.00 per ton. The subsequent treatment of this ore in the Concentrator and Smelter, has been and will be the subject of separate reports.

Yours very truly,

General Manager.

# ESTIMATE OF BLUEBELL MINE ORE RESERVES

## SEPTEMBER 1ST, 1914

| | | Broken | Positive | Highly Probable | Probable | |
|---|---|---|---|---|---|---|
| NO.1 ORE CHUTE | Above 300' level | 829 @$13 | 1000 @$12 | 1000 @ $12 | 1000 @ $12 | 972 |
| | 300 - 400' " | | 2000 " | 2600 @ " | | 25 |
| | 400 - 500' " | 320 @$12 | 4000 " | 4000 @ " | 2000 @ " | 290 |
| | 500 - 600' " | 1000 " | 3000 " | 3500 @ " | | 15 |
| | 600 - 700' " | 1280 @$11 | 1000 " | | | 1380 |
| | 700 - 850' " | 100 @$13 | 10000 @$13 | 10000 @$13 | 15000 @ $12 | 6520 |
| | Below 850' " | | | | | |
| NO.2 ORE CHUTE | Above 200' Level | (Transferred to #3 Ore Chute) | | | | |
| | 200 - 300' " | | | 1000 @$10 | 2000 @ $10 | |
| | 300 - 400' " | 300 @$10 | | 1000 " | 1000 @ " | 800 |
| | 400 - 500' " | | | 7000 @$ 9 | | |
| | 500 - 600' " | | | 7000 @$ 9 | | |
| | 600 - 700' " | | | 6000 @$ 9 | | |
| NO.3 ORE CHUTE | Above 200' Level | 120 @$12 | | 5000 @$12 | 10000 @ $12 | 6925 |
| | 200 - 300' " | 10 " | | 5000 @$11 | 5000 @ $11 | 175 |
| | 300 - 400' " | | | | 1000 @ $9 | |
| | 400 - 600' " | 40 " | | | 1000 @ $9 | 451 |
| | 600 - 700' " | 100 @$11 | 1000 @$10 | 5000 @$10 | | 460 |
| | 700 - 850' " | 1494 @$12 | 8000 @$11 | 4000 @$11 | | 5650 |
| | Below | | | | 10000 @ $12 | |
| NO.4 ORE CHUTE | Above 250' Level | 1162 @$11 | | | 1000 @ $11 | 1527 |
| | 250 - 400' " | 300 @$12 | | 2000 @$12 | | 272 |
| | 400 - 600' " | 32 @$10 | 6000 @$12 | 4000 @$12 | | 2600 |
| | 600 - 700' " | 340 @$10 | 4000 @$10 | 4000 @$10 | | 980 |
| | 700 - 850' " | | | | 1000 @ $9 | 200 |
| NO.5 ORE CHUTE | Above 400' Level | | | 2000 @$9 | 10000 @ $9 | 1000 |
| | Below 400' " | | | | 3000 @ $9 | 270 |
| | In Bins & at various Points | 237 @$12 | | | | |
| | | 7664 | 40000 | 74100 | 63000 | |

### SUMMARY

| | | | | | Total |
|---|---|---|---|---|---|
| # 1 | 3529 | 21000 | 21100 | 18000 | 63629 |
| # 2 | 300 | ----- | 22000 | 3000 | 25300 |
| # 3 | 1764 | 9000 | 19000 | 27000 | 56764 |
| # 4 | 1834 | 10000 | 10000 | 2000 | 23834 |
| # 5 | ---- | ----- | 2000 | 13000 | 15000 |
| Misc. | 237 | ----- | ----- | ----- | 237 |
| | 7664 | 40000 | 74100 | 63000 | 184764 |

GRAND TOTAL ALL CLASSES: 184764 TONS @ VALUE $11.00 PER TON

file 344

# MEMO RE LOW GRADE ORE AT BLUEBELL

No complete data on this subject is available. The general occurrence of the higher grade ore may be described as a series of pods or lenses with varying dimensions and spaced along the strike of the ore zone throughout a length of 1500'. Some 1800' further to the south there lies the Blue Thunder ore body which proved too low grade to mine on the 800' level where there was also noted an intermediate body of low grade ore. Since the full length of neither the Blue Bell Shoot at the extreme north nor of the Blue Thunder at the south was developed, it may be stated that the mineralized section of the Blue Bell vein or veins is known to have a length of at least 5000'. The greatest depth to which this ore has been developed is 1570' where the 1530' ore shoot is proved by a winze and crosscut from which samples averaged a little under 3% copper and $3.00 Au. and Ag. over a width of 23'. There is every reason to believe that this ore will extend much deeper.

The greatest width mined at any point was 40' in the #4 ore shoot and an average width of all the stopes would probably be 12'. The mine has produced 1,200,000 tons of ore with average over 3% copper, 0.06 gold and 1.5 oz. silver (value of gold and silver being $3.17 per ton with gold @ $35.00 per oz. and silver @ 71¢).

Considering the tonnage of developed and probable ore now left in the mine it may be roughly stated that the deposit has represented 1000 tons of ore per foot of depth. The cut off for pay ore during the period of my management when about 1,000,000 tons of ore was mined was kept at 2.5% copper except in a few stopes when the gold and silver were exceptionally high, - sometimes, but rarely, reaching a value of $5.00 per ton at old prices.

The cut off point prior to 1914 is reputed to have been 3.50% copper and we know that a considerable quantity of 3% and 2.5% ore is left in the upper 400' of the mine.

Generally speaking nearly all of the shoots had a core or center in which the richest ore was found, surrounded by concentric

horizontal sections of ore in which the values gradually diminished. For example we might have mined in certain stopes a length of 200' of 4% ore for a width of 10' but if we extended our mining to comprise a length of 250' and a width of 15' the average grade would be 3% and as low as 2.5% if the stope had been carried to a length of 300' and a width of 20'.

The pay ore shoots lay in two separate zones, known as the foot-wall and hanging wall zone, the #1, 2, 4, and 6 shoots were in the foot-wall and #3, 45 and 5 were in the hanging wall. The width between the foot-wall of these foot-wall shoots and the hanging wall of the hanging wall shoots was sometimes as much as 100', often it was not thoroughly explored. All of this area was mineralized to a greater or less extent and frequently we drilled or crosscut but did not attempt to mine low grade veins which generally carried much iron pyrite but in which the copper content was usually not over 1.5%. The gold and silver values in the pay ore seem to have followed the iron sulphide rather than the chalcopyrite. For example the #1 and #2 shoots which were very basic contained much higher values in gold and silver than ore of equal copper content from the siliceous shoots known as #3 and #6. However, in the #4, #45 and #5 shoots, which were neither very basic nor very silicious, the gold-silver varied generally with the copper.

Gold and silver assays were not generally run on any stope samples which carried less than 2% copper nor on the samples obtained from the non-commercial veins or shoots mentioned above but I have several records of samples which carried less than 2% copper and substantially better than $2.00 value in gold and silver at present prices. From such data as I have found on this subject and which is admittedly quite incomplete, I feel justified in saying that all of the ore which would average as much as 1% in copper would average better than $1.00 in gold and silver.

The developed zone of commercial mineralized ground extend-

ing from the south end of the #1 shoot to the north end of #6 therefore may be said to have a length of about 5000 feet and a width of approximately 100 feet and I think that there is a strong possibility that a large portion of this entire area will average better than 1% Cu and $1.00 Au and Ag down to the 1500' level and for an undetermined distanee below even considering that the higher grade ore has already been mined and shipped from the workings.

## SPECIAL NOTES

At Blue Buck shaft and glory hole the surface outcrops and crosscuts on 100' level show mineralized ground for width of 120' of which 20' in three veins will carry about 4% copper and another 10' will carry 2% copper, therefore if the entire balance of 90' should be absolutely barren it would still break down at 1% average while if this 90' should carry 0.5% copper as seems highly probable the average for the entire width would be 1.375% copper, or better than 1.5% if the 90' will carry 1% copper.

Around the 40 or 50 ore bodies it is my recollection that the distance from true foot-wall to the true hanging wall was at least 100' on the average with some 40' of stoped-out-ore and 60' of low grade or waste which may or may not carry 1% Cu but chances are in favor of its doing so.

Nearer to the main shaft there is an extension of #1 and #2 ore shoots in the foot-wall of #3 and there is also an extension of #3 in the hanging wall of #1 but all these extensions were too low grade to be mined in the past. I think that the width of low grade would be at least 60' and probably 80' but doubt if there is much available evidence as to the average grade.

Between #55 and Blue Buck I recall the finding of several iron stringers in the wall rock and further information on these is contained in the log of the drill holes. However, it appears that much of this country is barren of values.

The veins developed in the Blue Buck shaft appear to be extending well to the north and a narrow vein of better than 2% ore was followed for some distance south from the #6 ore shoot on the 500' level but I am of the impression that all of this section was tight and barren on the 800' level so that it seems possible that here the lower limit of 1% ore may be found around the 600' level. It is likely that this ore will extend for some distance north of #6 workings where I think that some stringers and pockets of high grade will also be found.

Among the attractive features of the attempt to develop low grade ore is the chance of finding some shoots of high grade that had not been mined in the previous operations, also mining out a lot of small blocks of high-grade that were left in the pillars and in isolated sections between the step faults. All these would tend to sweeten up the low grade material between the veins.

As to the mine fills which would probably represent 400,000 tons or more practically all of this came from the #1 glory hole and from #5 glory hole at the Blue Buck and I think that it should average 1% or better.

A larger portion of the dump at the main shaft is barren wall rock, which would probably not pay to run although portions of it might be sorted out and it should certainly be tested.

The dump at Blue Bell siding, - probably some 200,000 tons should average well over 1% copper but it might be expensive to get this material back to the site of the new mill.

WATER:

The requirements for a 5,000 tons mill with all possible reclaiming of water would be 2500 tons of water equals 1,250,000 gals. per day equals 1000 gal. per minute. (about)

| | |
|---|---|
| The mine makes at most | 100,000 gallons per day |
| The available flow in Turkey Creek is | 200,000 gallons per day |
| The available flow in Big Bug Creek is | 300,000 gallons per day |
| | 600,000 " " " |

The flow in the Agua Fria would be sufficient to make up the deficit but the nearest distance is eight miles from the mine and there might be trouble over water rights. Therefore, it appears that the water problem must be given serious consideration in connection with any proposed installation of this magnitude.

Elevation of Blue Bell Mine shaft is 5000' and there is a steep drop down the canyon to southwest and into Turkey Creek where elevation of 3500' would be reached about 2 miles from the mine. A tunnel 10,000' long should tap the main vein under the Blue Thunder. Its cost might be around $100 per foot, equals $1,000,000, and it would cut the vein 1500' below the surface. A new shaft sunk to this depth would cost $300,000 but the expense of hoisting 30 million tons of ore at 5¢ more than the cost of hauling in the tunnel would represent $1,500,000 and it would seem that the best location for the mill might be down in Turkey Creek as the De Soto ore could then be treated in the same mill from which it would be about four miles distant.

Ratio of concentration of this low grade ore should be 10 to 1 and if mill were located near railway grade at Cordes Siding the concentrates should be freighted to Humboldt by the operating company for 20¢ or less per ton.

WORKING COSTS:

| | Minimum | Maximum |
|---|---|---|
| Mining, say | 0.50 | .60 |
| Hauling ore to mill | | .05 |
| Milling | 0.40 | .50 |
| Frt. on conc. 20¢ | 0.02 | .05 |
| Smelt. conc. @ 2.00 | 0.20 | .20 |
| Convert. & refin. etc. at 2¢ | 0.40 | .45 |
| General and taxes | .08 | .15 |
| | 1.60 | 2.00 |

Value Au and Ag, ~~1.00~~ .84
Value Cu ~~20#~~ ~~12¢~~ - ~~2.40~~ 2.16
~~3.40~~ 3.00 Profit $1.00 per ton.

Might cave as per Miami System and starting at top, allowing hanging wall to come down and make a mat.

## BLUE BELL CAPITAL INVESTMENT TO REOPEN ON LARGE SCALE

Exploration and Development: -

| | |
|---|---|
| Reopen old shaft and install equipment for development | $25,000.00 |
| Drill every 100' on 800' level for width 100', length 4500' - 4500' holes @ $2.00 per ft. plus incidentals | 15,000.00 |
| Drill on 500' level, 200' level, 1200' level and 1500' level, total say 100 holes to 100' depth - 10,000 feet @ $2.00 per foot as plus other expenses as above. | 30,000.00 |
| Engineering, assaying, etc. | 10,000.00 |
| | $80,000.00 |
| Extending 1200 and 1500' level drifts | 20,000.00 |
| | $100,000.00 |

This work might serve to develop (1) an ore body with a width of 100' and from surface to 800' depth with a length of 4500' (Block A). (2) Ore body with length 1500, width 100' and depth 700' from 800' level to 1500' level. (3) Small block in 1530 ore body below 1500' level.

Tonnage of developed area @ 12 cu. ft. per ton.

| | |
|---|---|
| Block A - | 30,000,000 |
| Block B - | 8,750,000 |
| Block C -, | 50,000 |
| | 38,800,000 |
| Less Ore mined and lost in caving, say | 8,800,000 |
| Total ore to be mined | 30,000,000 |

Total investment required to put mine on operating basis: -

| | |
|---|---|
| Cost of property and reorganization | $ 20,000.00 |
| Preliminary development ( as above ) | 100,000.00 |
| Main haulage level from Turkey Creek | 1,500,000.00 |
| Main haulage drifts | 200,000.00 |
| Main mine equipment | 200,000.00 |

| | |
|---|---|
| Pipe Lines and pumping plants, Agua Fria | 100,000.00 |
| Mill with capacity 5000 t. per day | 3,500,000.00 |
| Smelter at Humboldt for concentrates and custom ore | 1,500,000.00 |
| Railroad to mill, etc. | 100,000.00 |
| General equipment, camp buildings, etc. | 280,000.00 |
| Incidentals and working capital | 500,000.00 |
| | $8,000,000.00 |

Assuming 30,000,000 tons of ore to be mined and treated with a net profit of $1.~~50~~ per ton over a period of 20 years the profit would be $~~34~~27,000,000.00 after repayment of the invested capital (neglecting interest). There would be an excellent chance to double this tonnage by further development at Blue Bell and at De Soto (including the Whale ore body) and Arizona Binghampton, little Copper Queen, etc. For all such additional tonnage the initial capital expense per ton should be much less but the workings costs might be higher.

L. M. Colcord

SHIPMENTS BY LEASERS FROM BLUE BUCK ORE BODY

IN 1937 as per SMELTER SETTLEMENT SHEETS

| Shipment No. | Tons Dry | Au. oz. Per Ton | Ag. oz. Per Ton | Per Cent Cu. |
|---|---|---|---|---|
| 1 | 43.9415 | 0.030 | 1.90 | 7.55 |
| 2 | 50.530 | 0.030 | 1.10 | 4.95 |
| 3 | 50.440 | 0.01 | 1.90 | 5.04 |
| 4 | 50.121 | 0.03 | 1.90 | 5.92 |
| 5 | 38.006 | 0.03 | 2.50 | 6.60 |
| 6 | 52.2005 | 0.04 | 2.00 | 5.59 |
| 7 | 54.0040 | 0.03 | 1.80 | 5.16 |
| 8 | 56.323 | 0.02 | 1.90 | 6.11 |
| 9 | 57.3635 | 0.02 | 1.70 | 5.10 |
| 10 | 50.9155 | 0.03 | 1.70 | 4.60 |
| 11 | 52.6745 | 0.03 | 1.80 | 5.49 |
| TOTAL | 556.5215 | | | |

I do not have copies of the settlement sheets for shipments made by the Blue Buck leasers prior to 1937 but I have checked them over and found that in round figures they totalled 1000 tons averaging 0.05 ozs gold, 2.00 ozs. (plus) silver, and 7.00% copper, the higher values being due to the mining of one shoot of rich copper-gold ore which brought up the average grade. An approximate average analysis of other componemts of this ore was as follows:

| | | % |
|---|---|---|
| | Fe | 15.0 |
| | S | 10.0 |
| | CaO | 0.5 |
| | $Al_2O_3$ | 9.0 |
| | $SiO_2$ | 44. |
| | $H_2O$ | 2. |
| Add | Cu | 6.67 |
| | | 87.17 |

Also small quantities of Zn, Pb and MgO. Some of the iron occurs as oxide.

An approximate average analysis of metals paid for in all the shipments was as follows:

| | | | |
|---|---|---|---|
| Au | - 0.044 oz. | gross value | $1.54 |
| Ag | - 2.00 oz. | " " | 1.42 |
| Cu | - 6.67% @ 12¢ | | 16.01 |
| Total gross value per ton | | | 18.97 |

It will be noted that the grade of the shipments held up well except for lot #10 in which the miners put in a lot of rock from the dump. The ore had to be hauled to Mayer at a cost of $1.00 per ton, shipped by rail to Hayden or Magma at $2.40 - $3.30 depending on grade and pay a treatment charge of $3.50 or more for the higher grade material. Total of above charges $7.00 to $8.50 per ton. The leasers paid a royalty of 10% of net smelter returns after deducting freight and treatment and they made good money until the price of copper dropped late in 1937 to below 10¢ per pound.

The shipments represent ore of a higher grade than the average which was broken because the operators found it advantageous to sort the ore to some extent in order to bring up the grade for shipment, however, the average of all ore broken and hoisted from the veins was certainly close to 5% copper and showings of lower grade were not mined.

LIST OF DOCUMENTS RE BLUE BELL AND DE SOTO
FURNISHED TO OHIO COPPER COMPANY.

Blue Bell.

(1) U. S. G. S. Bulletin #762, by Waldemar Lindgren,1926
(Copy given Mr. Snedaker)

(2) Extracts from Berkeys Petrographic Report, 1919, Copy given Mr. Snedaker.

(3) List of Blue Bell Patented Mining Claims.

(4) Extracts from report by G. M. Colvocoresses, to Chas. A. Kittle, Feb. 15, 1913.

(5) Extracts from Report by G. M. Colvocoresses, November 19,1913.

(6) Extracts from Special Report, Blue Bell Mine, by G. M. Colvocoresses, April 27, 1914.

(7) Extracts from Special Report by G. M. Colvocoresses, September 26th, 1914.

(8) Annual Report, 1914.

(9) Consolidated Arizona Smelting Co., Annual Report, 1915.

(10) Consolidated Arizona Smelting Co., Annual Report, 1916.

(11) Consolidated Arizona Smelting Co., Annual Report, 1917.

(12) Consolidated Arizona Smelting Co., Annual Report, 1918.

(13) Consolidated Arizona Smelting Co., Annual Report, 1919

(14) Shipments by Leasers from Blue Buck Ore Body in 1937.

De Soto Mine

(1) Assessment Returns for Year 1928

(2) Extract from U. S. G. S. Bulletin, #782, by Waldemar Lindgren, 1926.

(3) Extracts from Report by G. M. Colvocoresses to Charles A. Kittle, Feb. 15, 1913.

(4) Special Report, January 26, 1915, by G. M. C.

(5) Consolidated Arizona Smelting Co. , Annual Report, 1915.

(6) C. A. S. Co. Annual Report, 19161

(7) C. A. S. Annual Report, 1917
(8) C. A. S. Annual Report, 1918
(9)C. C. A. S. Annual Report, 1919
(10) Report to G. M. C. by H. R. Banks on Special Sampling.
(11) Estimate of Ore Reserves, July 1, 1920, Revised Jan. 1, 1921.
(12) Report on Sampling at De Soto Mine, May, 1930 by G. J. Harbauer

No date. Check with Joy ore + loss
Map for reference

| | | | | | | | Copper |
|---|---|---|---|---|---|---|---|
| Blue Bell | #1 | Ore. | | | | | 3.12 % |
| | 63 | " | 403 | stope N. end hanging-wall | 4½' | wide | 4.56 % |
| | 64 | " | 403 | " " " middle " | 3½' | " | 2.08 % |
| | 65 | " | 403 | " " " foot-wall | 4 ' | " | 2.52 % |
| | 66 | " | 303 | " " " hanging-wall portion | 4' 4" | " | 1.58 % |
| | #3 | Ore | | | | | 3.60 % |
| | 1 | " | | | | | 3.72 % |
| | 3 | " | | | | | 3.72 % |
| | 67 | | 403 | " S. " foot-wall portion | 5' | " | 2.65 % |
| | 68 | | 403 | " " " hanging " " | 7' | " | 3.00 % |
| | 69 | | 403 | " N. center " " " | 9' | " | 5.50 % |
| | 70 | | 422 | drillings " " " | 3' | | .62 % |
| | 71 | | 422 | " " " " | 4' 8" | " | .96 % |
| | 72 | | 422 | hanging-wall portion | 4' | " | 1.62 % |
| | 73 | | 406 | " " " | 5' | " | 2.22 % |
| | 74 | | 410 | N. end hanging-wall | 5' | " | 2.90 % |
| | 75 | | 851 | drift at 264' 5' wide footwall | | | .40 % |
| | 76 | | 406 | " " 7' N. of crosscut | | | 3.56 % |
| | 77 | | 851 | " " 270' ( 5½' wide) | 5½' | " | .38 % |
| | 78 | | 706 | 16' South | 4½' | " | 3.72 % |
| | 79 | | 706 | 12' North | 4½' | " | 2.20 % |
| | 80 | | 406 | 18' North | 4½' | " | |
| | 81 | | 852 | 208' | 5 ' | " | 3.44 % |
| | 82 | | 406 | 25½' North | 4½' | " | 1.56 % |
| | 83 | | 852 | 212' | 5' | " | 2.51 % |
| | 84 | | 851 | 320' | 5' | " | .35 % |
| | 85 | | 421 | drift oxide 285' bunch of ore | | | |
| | 86 | | 852 | " 257' | 4½' | " | 2.16 % |
| | 87 | | 852 | " 264' | 5 ' | " | 2.44 % |
| | 88 | | 421 | " 300 level of quartz | | | .52 % |
| | 89 | | 852 | " 284 3' wide, hanging-wall | | | 3.18 % |
| | 90 | | 711 | 8' south, 3' wide, hanging-wall portion | | | 3.50 % |
| | 91 | | 711 | 8' " 6' " E. of 3' sample | | | 2.82 % |
| | 92 | | 711 | 8' " 2½' " E. of 6' " | | | 0.42 % |
| | 93 | | 711 | 8' " 1½' " E. of 2½" sample | | | 4.84 % |
| | 49 | | | | | | 3.00 % |
| | 94. | | 851 | drift at 369' 2½' hanging-wall portion | | | 1.46 % |
| | 95. | | 851 | at 383½' 5' wide foot-wall | | | .98 % |
| | 96 | | 851 | at383½ 2' " hanging-wall side | | | 1.08 % |
| | 97 | | 711 | at 22' | 6' | " | 3.76 % |
| | 98 | | 851 | drift 387½' | | | .98 % |
| | 99 | | 423 | " 48½' oxidized | | | |
| | 100 | | 711 | " 26' from shaft 2½' wide ore in foot-wall | | | 4.50 % |
| | 101 | | 851 | " 389½' | 5' | wide | 1.26 % |
| | 102 | | 851 | 398½ | 5' | " | 2.48 % |
| | 103 | | 851 | 401½ hanging-wall | 5' | " | 2.48 % |
| | 104 | | | | | | 1.96 % |
| | 105 | | 851 | 410½' from shaft | 5½' | " | 1.76 % |
| | 106 | | 602 | North | | | 2.78 % |
| | 107 | | 602 | South | | | 4.98 % |
| | 108 | | 851 | 420' under horse of waste | | | 3.42 % |
| | 109 | | 851 | 423' | 5' 5" | " | 2.10 % |
| | 110 | | | 428 | 5'5" | " | ( 4.20 or ( 4.80 |
| | 111 | | | 433 | | | 3.82 % |
| | 112 | | | 438 face | 5' 5" | " | 4.80 % |
| | 113 | | 410 | in ~~brick~~ 286' N. of C. Raise. | 5' | " | 5.36 % |
| | 114 | | 410 | on sill 10' N. " " | 5' | " | 3.94 % |
| | 115 | | 410 | in ~~brick~~ face 35' N. " " " | 4' 6" | | |

| | | | | Copper |
|---|---|---|---|---|
| 116 | 851 foot-wall portion 440½' | 5' | widw | 4.30 % |
| 117 | 851 " " side at 447½ | 5' | " | 5.28% |
| 118 | 602 South 10' S. of crosscut | 5' | " | 5.44 % |
| 119 | 200' level, near shaft, N. Side corsscut | 4½" | " | 4.56 % |
| 120 | 410 32' N. of Carmen Chute | | | 3.98 % |
| 121 | 851 face of drift 455' | 7' | " | 5.90 % |
| 122 | 851 " " " 458' | 5' | " | 5.18 % |
| 123 | 851 " " " 470' | 5½' | " | 6.44 % |
| 124 | 410 stope 145' N. of Carmen Raide | 5' | " | 2.64 % |
| 125 | 851 drift 482½' | 4½' | " | 8.46 % |
| 126 | 854 Crosscut hanging-wall | 3' | " | .52 % |
| 127 | 855 "" foot to hanging-wall 6 to 10' | 4' | " | 6.20 % |
| 128 | 423 "" 532' at face | 4' | " | 1.44 % |
| 129 | De Soto face of drift | | | tr. |
| 130 | " " bottom of drift | | | 1.52 % |
| 131 | 500 at end of main crosscut N. Side | 5' | " | 3.54 % |
| 132 | 500 " " " " " S. " | 5' | " | 2.54 % |
| 133 | 410 50' N. of Carmen Raise | 7' | " | 5.40 % |
| 134 | 886 Crosscut from 10' to 16' tunnel hanging | | | 2.34 % |
| 135 | 602 South 15' from end of crosscut | | | 4.40 % |
| 136 | 851 Face at 489' | 5' | " | 6.08 % |
| 137 | 851 Face at 498' | 5' | " | 7.38 % |
| 138 | 851 Face at 510' | 5' | " | 5.36 % |
| 139 | 851 Face at 518' | 5' | " | |
| 140 | fines from siding "L Ore. | | | 4.2 % |
| 141 | 856 Hanging-wall side from 5 to 9' | | | |
| 142 | 501 North | | | 3.4 % |
| 143 | 851 Face at 522 | 6' | " | 4.6 % |
| 144 | 851 Foot-wall side at 525 | | | 4.2 % |
| 145 | 851 Hanging-wall side at 525 | | | 2.8 % |
| 146 | 851 Drift face at 529 | | | 2.7 % |
| 147 | 851 " " " 533 | | | 3.4 % |
| 148 | 851 " " "540 | | | 1.8 % |
| 149 | 851 " " " 546 | | | 3.30 % |
| 150 | 851 " " " 550 | | | 2.90 % |
| 151 | 851 " " " 554 | | | 1.80 % |
| 152 | 851 "Vin " " 558 | | | 2.60 % |
| 153 | 851 " at 567' | | | 2.00 % |
| 154 | 851 " " 571' | | | 3.10 % |
| 155 | 851 " " 574' | | | 3.50 % |
| 156 | 851 " " 577' | | | 3.05 % |
| 157 | 851 Crosscut foot-wall N. Side | 3' | " | |
| 158 | 250 Ore in crosscut | 5' | " | 2.60 % |
| 159 | 602 North of main corsscut, N. end of stope | | | 1.46 % |
| 160 | 602 stope foot-wall portion | | | |
| 161 | 403 " " " " | | | |
| 162 | 403 South end | 4' | " | 1.90 % |
| 163 | 250 North " above fault blocks, oxidized | | | 9.08 % |
| 164 | 851 At 413'ft. Fault above drill hole in hanging wall. | | | 2.75 % |
| 165 | 851 Drill hole in hanging wall wall at 457 | | | |
| 166 | 250 Black Ox. North end | 2' | " | |
| 167 | 250 Red Ox. North end. | | | |
| 168 | 403 Face at North end. | | | |
| 169 | 602 Op. corsscut, South end. | | | |
| 170 | 602 " " Northeast center | | | |
| 171 | 851 drill hole in hanging wall at 470' | 5' | " | 1.92 % |
| 172 | 851 " " " " " " " | 5' | " | 3.76 % |
| 173 | 851 At 460'(from shaft) 2' next hanging wall | | | 1.14 % |
| 174 | 703 Grab sample from raise ar N end | | | 1.72 % |
| 175 | 851 At 470' from shaft 2' next hanging wall | | | 2.83 % |
| 176 | 403 1st level in N end 4' | | | 1.53 % |
| 177 | 403 2nd level from N/ end 5½' | | | 3.92 % |
| 178 | 403 3rd level from N. end 6' from top of manway. | | | 1.08 % |
| 179 | 300 hanging wall portion 4' | | | 0.90 % |
| 180 | 300 middle wall portion 6' | | | 1.18 % |
| 181 | 300 foot wall portion 3½' | | | 1.28 % |
| 182 | 602 S. end foot-wall 4' wide | 6' | " | 0.86 % |
| 183 | 602 center foot to hanging | | | 2.95 % |
| 184 | 851 1st 3' hanging wakk at 425' drill hole | | | 2.18 % |
| 185 | 851 last 2' " " " 425' " " | | | 0.77 % |
| 186 | 851 Footwall at 400' | | | 1.57 % |

Note F.W. (220) means foot-wall.

| | | | Copper |
|---|---|---|---|
| 187 | 851 | Hanging-wall at 400' | 1.57 % |
| 188 | 851 | Foot-wall at 405' | 4.01 % |
| 189 | 851 | Hanging-wall at 405' | 2.79 % |
| 190 | 501 | in Manway, lower edge 7' | 4.49 % |
| 191 | 501 | " " 12' higher 8' | 3.13 % |
| 192 | 501 | " " 15' " 7' | 2.50 % |
| 193 | 501 | " " 15' " 8' | 3.72 % |
| 194 | 501 | " " back of stope 9' | 4.21 % |
| 195 | 703 | on sill 32' S. of 1st turn 6½' | 2.05 % |
| 196 | 703 | " " 42' " " " " 8' | 1.85 % |
| 197 | 703 | " " 70' " " " " 8' | 1.60 % |
| 198 | 703 | " " 85' " " " " 10' | 2.05 % |
| 199 | 703 | " " 95' " " " " 15' | 2.46 % |
| 200 | 703 | " " 110' " " " " 15' | 1.81 % |
| 201 | 851 | Hanging-wall at 425' | 2.87 % |
| 202 | 602 | Center stope 1st bunch N. of manway 5' | 3.64 % |
| 203 | 851 | 420' from shaft, hanging-wall portion | 1.40 % |
| 204 | 851 | 400' 3' next footwall | 3.47 % |
| 205 | 851 | 400' 3' " toward hanging-wall | 1.08 % |
| 206 | 851 | 395' from shaft 3' on footwall side | 2.45 % |
| 207 | 851 | " " " 3' to 7' on footwall side | 1.60 % |
| 208 | 851 | at 355 3' in foot wall side | 3.39 % |
| 209 | 602 | south end foot-wall portion | 0.50 % |
| 210 | 851 | foot-wall side 6' ore, 2' in foot wall taken | 3.04 % |
| 211 | 403 | 4' South end | 0.32 % |
| 212 | 200 | stope N. face at 1st crosscut to stope 10' | 2.63 % |
| 213 | 200 | " 5' N. of crosscut | 3.80 % |
| 214 | 200 | " 10' " " " | 2.63 % |
| 215 | 200 | " 15' " " " | 3.35 % |
| 216 | 200 | " 20' " " " | 2.35 % |
| 217 | 200 | " 25' " " " | 3.04 % |
| 218 | 200 | " 30' " " " | 1.85 % |
| 219 | 200 | " opposite shaft 35' N of corsscut to big stope 4½' | 5.10 % |
| 220 | 200 | " " " 40' " " " " " " 4½' F.W. | 1.93 % |
| 221 | 200 | " N face, hanging-wall portion 6 ' | 1.81 % |
| 222 | 200 | " " " foot-wall " 5 ' | 2.79 % |
| 223 | 100 | North side strt. at pillar 4 ' | 1.89 % |
| 224 | 100 | South drift face 5½' | 1.49 % |
| 225 | 100 | station 6' N. of South dyke face 7' wide | 3.68 % |
| 226 | 100 | " N. face of south drift 4' " | 3.60 % |
| 227 | 100 | " on pillar 10' from shaft 5' " | 3.27 % |
| 228 | 100 | " stope N. of dyke, hole in hanging-wall 2' wide. | 3.24 % |
| 229 | 501 | stope N/ of dyke, hole in hanging-wall 2' " | 4.25 % |
| 230 | 200' | level, South side 1st crosscut, 1 ft. hanging-wall | 3.40 % |
| 231 | 200' | " " " " " 4 " Foot-wall | 2.42 % |
| 232 | 200' | " North " 2nd " " " " " | 2.42 % |
| 233 | 200' | " South " " " " " " " | 1.36 % |
| 234 | 200' | " " " " " 3 " hanging wall | 0.98 % |
| 235 | 200' | " " " " " 4 " foot-wall | 0.90 % |
| 236 | 200' | " " " " " 3 " " " side | 0.58 % |
| 237 | 200' | " North end of 3rd " 4 " of ore | 0.26 % |
| 238 | 200' | " South " " " " 6 " " " | 0.78 % |
| 239 | 851 | N. end 3' foot-wall | 1.28 % |
| 240 | 851 | " " 3' toward hanging-wall | 0.56 % |
| 241 | 250' | S. # from raise 140 above sill, block oxidize | 3.55 % |
| 242 | | North of dyke hanging-wall 2½' Blue Coat (5D1) | 6.16 % |
| 243 | | " " " " " " " " | 7.86 % |
| 244 | 421 | at fault | 8.78 % |
| 245 | 300' | station at pocket, hole in hanging-wall 5' deep | 0.30 % |
| 246 | 200' | North side 2nd crosscut next to footwall 4' | 0.98 % |
| 247 | 200' | 2nd corsscut 4' to 8' from foot-wall 4' | 10.26 % |
| 248 | 200' | " " 8' to 12' " " 4' | 2.10 % |
| 249 | 200' | " " 12' to 16' " " 4' | 3.55 % |
| 250 | 200' | " " 16' to 20' " " 4' | 3.35 % |
| 251 | 200' | 3rd " 4' to 8' " " 4' | 2.20 % |
| 252 | 200' | " " foot-wall to 4' 4' | 2.35 % |
| 253 | 501 | drill core, hanging wall N. of dyke | 1.10 % |
| 254 | 501 | N"of dyke, middle of ore body 3' | 1.28 % |
| 255 | 708 | S " hanging-wall portion 4' | 5.18 % |
| 256 | 501 | 49' N of dyke 4' wide | |

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# REPORT ON THE MINES & OPERATIONS OF THE CONSOLIDATED ARIZONA SMELTING COMPANY.

FEBRUARY 16th. 1913.

Office Copy.

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(ROOM 1407)
NEW YORK CITY

TELEPHONE HANOVER 6940

New York, Feb. 15, 1913.

Mr. Charles A. Kittle,
43 Exchange Place,
New York, New York.

Dear Sir:

I herewith beg to submit my report on the Mines and Operations of the Consolidated Arizona Smelting Company, which I examined in accordance with your instructions during the latter part of January and early in February, 1913. Attached to this report and forming a part of it, is a tracing of the workings of the Blue Bell Mine.

It is not intended that this report shall cover the past operations of your company nor have I gone into details in regard to equipment, plant, etc. The report is confined to a review of the present conditions at mine, mill and smelter and an estimate of the probable results of future operations.

GENERAL CONCLUSIONS.

I consider that recent developments at your Blue Bell mine have been distinctly encouraging and that there is good reason to feel hopeful as to the results of additional development now in progress. You have developed in the Blue Bell property, positive and probable ore reserves to the amount of 124,500 tons, averaging $1.50 in gold and silver and 3.5% in copper. There is every reason to expect that the ore shoots now partially developed, will extend downward and if such proves to be the case, your developments will, in the next few months, increase your ore reserves by approximately 75,000 tons, assuring your mining and mill operations for a period of somewhat over two years. I advise that development work should be continued vigorously at the Blue Bell Mine and probably at the De Soto, and I believe that there is every prospect

of proving up additional ore reserves sufficient to assure your operations for a period of several years to come.

In my opinion, your ore is logically a concentrating proposition and the trial runs of your mill have been most encouraging, leading me to expect that you will make a concentrate in the ratio of at least 5 to 1 with the recovery of 70 to 75% of the values in the form of a nearly self-fluxing concentrate. (L.S. by gravity) In the near future I believe, it will be found advisable to increase the capacity of your mill and also to adopt improved means for fine grinding your ore and additional saving of values. I believe that you will find it advantageous to operate the mine on the basis of 250 to 300 tons daily production, and further increase may be justified at a later date.

Your present smelter equipment while not altogether satisfactory, is sufficient for the moment and may be enlarged and improved after the smelting of concentrates becomes a regular operation. I do not think that there is any advantage in attempting to do custom work at your smelter, except, in so far as it may be necessary to procure a small quantity of outside ore for fluxing your concentrates, and I believe that your best policy will be to concentrate and smelt your own ore almost exclusively.

After mine and mill are operated to full capacity, I believe that you will be able to make matte for a cost of $5.00 per ton ore milled, and (excluding the New York Office expense and depreciation) your profit with copper at 15 cents should be $1.44 per ton of ore milled or approximately 2½ cts. per lb. of copper marketed. I figure that you will be able to market copper for a total cost of 12½ cts. per lb., and I believe that additional economies will, in the near future, reduce this cost to 11½ cts. or 11 cts. per lb.

Your future results will, of course, depend very largely on the results of exploration and development at your mines, and if these results are favorable, I believe that this cost can be maintained for several years to come.

DETAILED

REPORT ON THE MINES & OPERATIONS

OF THE

CONSOLIDATED ARIZONA SMELTING COMPANY.

## L O C A T I O N.

The property is located in the Bradshaw Mountain District, Yavapai County, Arizona. The Company is operating the BLUE BELL MINE near Mayer, and Concentrating Mill and Smelter at Humboldt. The Company also owns the BLUE THUNDER CLAIMS and the DE SOTO MINE which was operated prior to 1907. The Sante Fé, Prescott and Phoenix Railroad passes through Humboldt and also within three miles of the Blue Bell and Blue Thunder and within one mile of the De Soto Mine.

## GEOLOGY & ORE OCCURRENCE.

In the immediate vicinity of the mine, the country is sericite schist, known as Yavapai schist and formed during the Algonkian period. These schist are cut by dykes of eruptive rock and by travertines of limestone. In the schists, there are found zones of silicification and it is in these zones that the ore bodies occur. The ore deposits are of the replacement type and are found as lenses, varying considerably in size and apparently having a much greater length vertically than horizontally, with a width of three to fifteen feet. These lenses are frequently near the edges of the silicified zones.

On the surface the outcrops are quite prominent; the schists being stained with copper carbonates and calcocite, is occasionally noted. Below the outcrops, there extends a zone of oxidation down toward local water level and below the oxidation, there is a comparatively unimportant band of secondary enrichment denoted by bornite and calcocite and succeeded in depth by the primary sulphides, mostly chalcopyrite, which constitute the main ore body. Associated with the chalcopyrite, there is a quantity of iron pyrites varying from equality to double the amount of chalcopyrite.

There is also considerable quartz; all of these minerals having replaced the sericate and chlorite schist.

Aside from copper, the ore carries small values in gold and silver. The aggregate of these two metals varying from $1.00 to $2.00 per ton. There is also some lead and a little zinc; the zinc is not in sufficient quantity to be a hindrance in smelting the ore.

## BLUE BELL MINE.

### DESCRIPTION.

The silicified zone extends for a length of 2,500 feet and for a width of 600 feet. The strike is North 20° East and the dip approximately 70° toward the West. There are six distinct lenses or shoots of ore noted by outcrops on the surface or underground and referred to as follows:

"Blue Coat", "410 West or South", "410 East or North", "Blue Buck West", "Blue Buck East", "Blue Bell."

Of these ore shoots, the "410 East and West" have no well defined outcrops, while "Blue Buck East" is so far unproved underground, and "Blue Bell" though possessing an excellent outcrop and proved to a depth of 180 feet, has not yet been developed into the zone of primary sulphides. These lenses of ore occur in two parallel bands striking north and south and separated from each other by about 40 feet of the schist rock; the western band is close to the edge of the silicified schist. Through the entire zone of silicification, there is a certain amount of mineralization and both copper and iron pyrites are found, but not in sufficient quantity to be of commercial value outside of the ore bodies mentioned above.

Blue Bell Group has been worked, but not continuously, for the past twelve years and a large tonnage of ore has been produced; the average grade of all shipments made since 1907 appears to have been 3.5% copper with gold and silver, to the value of $1.50 per ton. Aside from surface indications, the mine has been developed in one place to a depth of 850 feet by shafts and drifts, while

Diamond Drill holes have gained an additional depth of from 50 to 100 feet. The development work to date is best shown by the tracing accompanying this report, and as will be noted, the property is only partially developed. The"Blue Coat"ore shoot is proved to a depth of 700 feet. The "410 South" to a depth of 850 feet and by drill holes to a depth of 950 feet. The "410 North" to a depth of 700 feet and the "Blue Buck" to a depth of 400 feet.

From a brief study of the general geology of this district and such information as I was able to gather regarding the behavior of similar ore bodies, I can see no reason why these deposits should not continue downward to a much greater depth than has been gained up to the present time. In your own mine the indications are encouraging, for none of the ore bodies so far developed show any tendency to become pinched or impoverished down to the lowest point at which they have been proved. It is true that the drill holes did not give encouragement regarding the continuance of the Blue Coat to a greater depth, and it may be that this particular ore deposit will not extend below 850 or 900 feet, but I do not consider the evidence conclusive on this point and it may go down much deeper. The "410" ore bodies were apparently blind on the surface and so far as developed, they show an improvement with depth and, considering the mine as a whole, each succeeding level has proved up an equal or greater quantity of ore than found on the levels above. It should be taken into consideration that the lenses or ore in which you are at present working were undoubtedly deposited at a time when the surface of the country was from one to three thousand feet higher than at present, and, therefore, that this ore was once at a very considerable depth. The upper portions of these lenses have been carried away by the erosion and it may be that other lenses have been altogether destroyed by this same influence, but conversely, new lenses of ore may well be discovered at any depth in the silicified portion of the schist, and it is my opinion that as long as this silicification continues downward, you will continue to find ore bodies similar to those in

which you are now working. The largest ore bodies of similar type in this district, are found at the United Verde Mine, which is at present developed to a depth of 1500 feet and in which I am reliably informed, that the ore in the 1000 and 1200 foot levels, also in the 1500 foot level, is of excellent quality and quantity and better than anything found below the original zone of secondary enrichment.

ORE RESERVES.

From present development, I am able to estimate the ore reserve in the Blue Bell Mine, as follows:

| | POSITIVE: | HIGHLY PROBABLE: | PROBABLE: |
|---|---|---|---|
| "Blue Coat" | 39,000 tons at 3.50% copper (14,000 tons broken in stopes) | 12,000 tons @ 2.80% copper. | 9,000 tons @ 3.50% copper. |
| "410 South" | | 7,000 tons @ 3.50% copper. | 6,000 tons @ 3.50% copper. |
| "410 North" | | 21,500 tons @ 4% copper. | 10,000 tons @ 4% copper. |
| "Blue Buck" | | | 20,000 tons @ 3.20% copper. |
| Total | 39,000 tons @ 3.50% | 40,500 tons @ 3.50% | 45,000 tons @ 3.50% |

Grand Total All Classes ..... 124,500 tons @ 3.50%.

In connection with the above estimate, the ore classed as "positive" has been blocked out on three or four sides. The ore classed as "Highly Probable" is developed by two successive levels being not yet traversed by raise or winze. The ore classed as "Probable", represents the continuance of the ore sheets for a distance of approximately 100 feet above and below the last points of development. This extension may be fairly assumed to exist, considering the nature and proved extent of the ore bodies.

The average content of all ore at present developed is put at 3.50% copper, in addition the average value in gold and silver is $1.50 per ton, representing an average of .05 ounces in gold and 1.2 ounces in silver. (Value $2.60 in 1941)

According to instructions, I did not sample the ore bodies myself; a complete sampling would have required several week's time and would, I believe, have been altogether superfluous and a partial sampling would have been of no particular value and the results might have appeared misleading. I satisfied myself that the ore bodies had been thoroughly sampled by the management at the mine and I believe that this sampling has been conducted with care and judgment and the results are fairly well checked up by the assays of shipments made to the smelter. In order to obtain data for the above estimate of the grade of your ore, I obtained assay results of several hundred samples and from these, computed the average grade; in some cases unfortunately full data concerning the samples was not obtainable, more particularly, the width and exact point at which the samples were taken; but I feel satisfied that the above estimate is a conservative one and will be fully borne out by the production from the mine.

In addition to the reserves estimated above, there is a large amount of ground containing from one to two percent of copper. Under present conditions, this cannot be mined and treated at a profit, hence is not considered as ore. It is possible that at some later date, decreased working costs combined with improved metallurgical practice may permit you to increase your tonnage by mining certain quantities of this low-grade stuff; but for the present at least, it is most essential that the grade of production should be maintained at 3.50% copper, and in order to do this, only the ore bodies estimated can be profitably mined, and further: care should be taken to maintain the grade of production by the use of selective stoping, prevention of wall rock slides in so far as possible, and hand-sorting of ore at the tramway-terminal.

## FUTURE POSSIBILITIES & DEVELOPMENT.

As stated above, your property is only partially developed and additional development should be prosecuted vigorously. The developments which I consider most important are as follows:

(1) Extension North and South of the drift on the 850 foot level through the "410 North" ore body and the "Blue Coat".

(2) The extension northward of the 400 foot level to tap and develop the "Blue Bell" ore shoot.

(3) The extension northward of the 700 foot level to develop the "Blue Buck" ore shoot.

You may quite reasonably expect to find ore in all of these drifts, and if such should prove the case, your reserves may be increased by approximately 75,000 tons positive and probable ore, which reserve will be further increased by gaining additional depth on the ore shoots named.

At the time of my visit, there were approximately 14,000 tons of ore broken in the stopes, and 124,500 tons developed. After your mill is in steady operation, I believe that it will be found expedient and possible to produce from 250 to 300 tons daily from your mine in order to supply the mill and smelters, and as soon as regular production on this basis is started, it would seem prudent to keep a minimum of 40,000 tons broken in your stopes and 200,000 tons developed in advance.

After the Blue Bell ore body has been cut on the 400 ft. level, I would recommend that crosscuts should be run eastward at intervals between the main shaft and the Blue Bell ore shoot; it is particularly important to explore under the surface outcrop known as the "Blue Buck East", and there also seems a possibility of discovering entirely blind ore bodies at any point in the silicified area. Similar crosscuts may be run out from the 700 ft. level and from deeper levels as these are driven. I would not recommend any further Diamond Drilling of your property, as I do not consider that Diamond Drills are well suited to explore this particular kind of ore body, and such work is nearly as expensive as crosscuts or drifts.

Aside from the crosscuts mentioned, I believe that your most valuable exploration will consist in deepening your shaft and developing at a greater depth the various ore shoots which you have proved in the upper levels. If the known ore bodies continue down-

wards ~~as good as at present~~, you will develop from 30,000 to 40,000 tons of new ore for every additional hundred feet gained in depth.

OPERATION OF MINE.

I consider that your mine is in the main, well operated and that care and skill are evident in the conduct of operations. In some respects, however, there is room for improvement; the ventilation of the lower levels is very bad and this will be in part remedied by the ventilation system which your management plans to install and which I should advise to have completed with all possible haste. I would suggest that in general, more care should be taken of the sanitary condition of the mine and the safety of the workmen. The fencing of abandoned and unsafe stopes and drifts is advisable and the removal of all old timber from drifts and crosscuts is an excellent precaution against fire; great care should be taken of the explosives stores underground. I would also suggest that a cage or covered skip should be used for sending men up and down the shaft at change of shift.

The walls of your ore bodies are bad and scale continuously in the stopes mixing a good deal of waste with the ore and also causing additional tramming and hoisting. I believe that judicious use of stulls as the muck is lowered in the stopes would considerably decrease the scaling of the walls and the filling of worked out stopes with waste will be found advantageous.

As soon as the Blue Bell ore shoot is reached, it would be advisable to connect at once with the surface or the old #1 shaft, assuming of course, that ore is discovered in the Blue Bell ore shoot. A raise from the 400 ft. level could be run up into the old shaft going up in ore practically all of the way, thus exploring all the upper part of the ore body, as well as serving for a new connection with the surface. It appears to me that your old shaft is located too far south to be useful for hoisting ore from the Blue Buck and Blue Bell ore bodies and rather than install a system of electrical haulage I would suggest that the new Blue Bell shaft should be used for hoisting ore from this portion of the mine and the aerial ropeway

should be tapped so as to permit ore from this shaft to be sent over it to the terminal.

Bearing in mind that your ore shoots may extend to a very considerable depth, I would advise that the equipment of this Blue Bell shaft should be made extremely substantial and capable of handling material from the depth of 1500 to 2000 feet.

TRANSPORTATION & SORTING.

The present method of handling Blue Bell ore is by Bleichert Ropeway for a distance of three miles to a railroad siding and thence by railroad to mill and smelter. The ropeway operates fairly well and if kept in good repair, should be able to handle up to 300 tons per day. This is undoubtedly the best method of transportation that could be used under the circumstances, and the terminal at the railway is well arranged and permits a certain amount of hand-sorting of the ore; this hand-sorting appears to me to be a particularly important matter since your margin of profit on ore running less than 3½% copper is extremely small, and I would suggest that a slight amount of additional time and labor devoted to sorting would be more than repaid by the increased value of the ore treated.

In so far as possible, your management should insist that the railroad company furnish you with hopper-bottom cars for the transportation of ore from the terminals to the mill, as these are unloaded much more cheaply than the standard freight cars and also when a larger tonnage is handled, it would seem as if the Railroad might be induced to give a better rate of freight than they are charging at the present moment; the actual figure of 35 cents per ton for the haul of ½ miles is extremely high.

BLUE THUNDER CLAIMS.

BLUE THUNDER:

This portion of your property is merely a prospect. It is located south of the Blue Bell Claims, approximately 2000 feet from the main shaft. The outcrop consists of a surface conglomerate found in the bed of a creek, the pebbles being cemented with iron oxide and copper carbonates.

The prospect has been developed by short adits and test-pits. So far as development has gone, the only ore found is in the form of narrow stringers scattered more or less through a mineralized zone about 40 feet wide. No commercial ore body has yet proved up and it is doubtful to my mind whether any such will exist. At the present moment, I would not recommend any additional development at this point, but at a later date, it may seem advisable to sink the test-pits to somewhat greater depth and crosscut the mineralized zone. It would not be necessary to go to any great depth, as the water level is comparatively near the surface at this point, and the primary sulphides should be encountered at rather less than 100 feet.

DE SOTO:

This mine is located ~~four~~ five miles south, - 20° east of the Blue Bell Group. The geology and ore occurrence are entirely similar to the Blue Bell. The lenses outcrop on the summit of a mountain and the property has been developed by adit levels to a depth of 600 feet and by winze and drifts for an additional depth of 200 feet.

The ore from this mine was sent by aerial ropeway to Middleton on the railroad, a distance of one mile. This ropeway is still in fair condition, although the terminals would have to be rebuilt. The rails and mine equipment have been mostly removed and before operations could be recommenced, it would be necessary to arrange for electric power equipment. I understand that the Arizona Power Co would be willing to build a line to the mine if assured of a contract covering a certain period of years; the additional cost of equipping the mine and putting same in operation should not exceed $15,000.00 at the start, and further equipment could be added as conditions render same justifiable.

The mine has not been worked since 1907 and neither Mr. Walker nor any other person in the vicinity was familiar with the old workings or with the ore bodies developed in same. The present condition of the mine renders a thorough examination impossible, as the upper workings are caved in, and the two lower levels are full of water. From visiting all the accessible portions of the property, I

gather a rather favorable impression and I believe that the mine thoroughly warrants the small expense which would be necessary in order to make a thorough examination for the purpose of determining if it is advisable to recommence mining operations.

The outcrop on the surface is large and extends for a length of nearly one-half mile. The carbonates and oxides of copper predominate over the iron gossan and the general character of the copper ore is silicious and suitable for concentration. From the underground workings, it would appear that the commercial ore occurred in small lenses, three of them very well defined and having a maximum width of 30 feet with a length of somewhat less than 200 feet. The average value of all ore extracted from the mine appears to have been 4% in copper with $2.00 of gold and silver per ton. I could find no accurate record of the total tonnage produced, but estimate that it may have been between thirty and forty thousand tons.

It is not possible to give any figures as to the ore reserves left in this mine. I have it on good authority, that approximately 3,000 tons of broken ore was left in the stopes and aside from this, a very considerable tonnage may remain in place. I would suggest that in the near future, a young Engineer should be employed by Mr. Walker to sample and estimate the reserves in this mine above the 600 foot level, and at the same time, that the main winze should be pumped out by means of a small gasoline pumping outfit, and the lower 200 feet of the mine unwatered; so that the examination might be carried down to the lowest level; at which point especial care should be taken with the samples. The results of this examination would give a basis for estimate as to whether or not it will pay to reopen the De Soto; the total cost of examination should not exceed $1,200.00.

As a prospect, I consider the De Soto promising and there is good reason to believe that the ore bodies on which you have worked may extend downwards to a considerable depth and there would also appear to be good chances of discovering other lenses of ore. It should be borne in mind that because of the development which has already been done, the ore from the upper workings could be mined very

cheaply and each additional hundred feet opened up will add to your reserves (judging from the upper levels) between twelve to fifteen thousand tons of ore.

At the time the mine was formerly worked, the high cost of transportation was a very serious handicap. The railroad charged $1.25 per ton to haul the ore from Middleton to Humboldt and before opening the mine, it would be most essential to get a new and much better freight contract; I believe that the freight should not exceed 50 cents per ton, to which would be added the cost of operating the gravity ropeway approximately 10 cents per ton so that ore from the De Soto would cost about 10 cents per ton more than ore from the Blue Bell assuming the mining costs to be the same.

CONCENTRATING MILL.

The concentrating mill had only begun operation at the time of my visit and no positive statement can be made in regard to its operation for some weeks to come. The old mill building had been utilized and the old machinery rearranged with some new material added. The mill ran smoothly from the mechanical point of view and from the metallurgical standpoint, the first runs were exceedingly encouraging. The method of concentration consists essentially in crushing the ore, sizing with trommels and grinding the over-size with rolls until all material passes three mesh; the ore is then jigged and both over-size and the hutch concentrates are produced. The tails from the jigs are classified, the coarser product reground and reclassified and the sands are treated on Wilfley Tables, the slimes on Frue Vanners. The middlings from the tables are reground and retreated on a special Wilfley Table, the tails from both Wilfleys and Vanners go directly to waste. This system of concentration appears to be logical and so far as I could tell, it is working out very well in practice. Although much of your ore contains a great deal of iron pyrites, it is none the less suitable for concentration, and I think it unfortunate that milling operations were not undertaken a long time ago. During the first few runs at the mill, there was some trouble in classification of the pulp and also some difficulties

were experienced with pumps, etc., but these matters have the attention of your management and will unquestionably be rectified in a short time; the chief difficulty will, I think, be found in the fine grinding, for which your small rolls and Huntington Mill are poorly adapted and I believe that these could be advantageously replaced by Hardinge ball and pebble mills which are doing similar work at many other concentrators in a most efficient manner.

There seems to be every reason for believing that Mr. Walker's estimate of a 70% recovery will be borne out and in my opinion, there is a good chance that you will recover up to 75% of the values. I also think that the ratio of concentration will be from five to seven into one, although it may be found advantageous not to attempt to push the ratio of concentration. It should be borne in mind that from the smelter standpoint, you are anxious to make your concentrate as nearly self-fluxing as possible, and it may be policy to make a comparatively low-grade concentrate retaining enough Silica to balance the high iron content of the concentrate and thus minimize the flux necessary for the furnace.

## S M E L T E R.

The Smelter as at present operated, consists of two White Howell revolving roasters 30 feet in length. Following these is the reverberatory furnace 40 ft. in length - capacity 60 tons of ore per day. Both the roasters and the reverberatory are fired by oil which is at present mixed with steam, although in the near future, it is planned to mix air instead of steam with the oil.

The ore is first fed into the roasting furnaces and roasted ore passes directly in the reverberatory and is mixed with silicious fettling, the resulting matte contains approximately 38% of copper. The slag loss averages a little less than 10% of the value. The matte from the reverberatory is taken to the Bessemer Converter ( a basic converter now being in use ) and is there blown up to Blister Copper in about five hours' time. Up to the present, it has been customary to blow three or four times per week; the converter slag goes back to the reverberatory furnace.

The present plant has been made over from the old smelter and unfortunately ( although the ~~present~~ outlay reflects a great deal of credit on the ingenuity and hard work of the present management ) the arrangement is bad and the handling of material very expensive. The chief drawback to economical operation consists in the two sets of bins, the first being located directly under the railway tressel. From these bins, ore is drawn by self-dumping cable cars and conveyed to a crushing and sampling plant, then after crushing it goes to the main storage bins from which the material is drawn for the smelter. This double or triple handling is expensive and a certain amount of mechanical loss results in handling the ore and in the blowing away of dust. After the mill is in continuous operation and the main portion of the smelter feed consists of concentrates, there should be an opportunity to gradually improve the system of handling the material and to reduce the cost of these operations, it will then, I think, be possible to crush all the material for the smelter at or near the mill and to handle same direct to the main storage bins by means of belt conveyor , as planned by Mr. Walker, or possibly by bringing the charge cars for the smelter directly around to the tressel bins.

## C O S T S.

The Office at Humboldt was destroyed by fire last October and this, combined with subsequent lack of office staff, has made it a very difficult matter to obtain the exact cost of operation. At the time of my visit, Mr. Jansen was just getting the books in shape for April and May of 1912. The costs of past operations which I have obtained , will serve as a rough basis for estimate of future working costs. Because of concentration, you are now entering on an entirely new system of operation and your costs in future should show a very marked improvement over what they have been in the past. Mining costs in 1911, as given me, were as follows per dry ton:

| | |
|---|---|
| Stoping & Drifting ..... | $1.5552 |
| Development ..... | .5438 |
| Hoisting ..... | .2925 |
| Water Disposal ..... | .1450 |
| ~~General Expense .....~~ | ~~.4147~~ |
| Total at Mine ..... | $2.5477 |

Total cost of 2.5477 is correct although a mistake has been made by me in extending figures of the items

| | | |
|---|---|---|
| Amount brought forward from Page 15 ..... | $ 2.5477 | |
| Aerial Ropeway to Terminal .... | $ .1576 | |
| Loading & railway freight to Humboldt ..... | .3756 | |
| Total cost of ore at Humboldt.. | $ 3.0809 | |

Smelting costs over a period in 1912 amounted to $5.8519 per ton (including Land Expense), making a total cost of $8.9328 plus the cost of converting and marketing, which was figured at $.025 per lb. of copper. During this time the working costs very nearly balanced the value of copper produced from the ore, and as far as I could gather from the books, no profit was made from materials smelted at Humboldt. On account of the custom work done at the smelter, it is hard to figure exactly what the results of operations on your own ore were, and lately the better grade of ore has been shipped to Swansea and has yielded a profit.

As to the future, I estimate that once the mill and mine are operating on a steady and continuous basis and up to their full maximum capacity, the working costs should be , as follows:

| | | |
|---|---|---|
| Total Mining & Development ..... | $2.00 | per ton. |
| Transportation to Mill ..... | .50 | " " |
| Sorting ..... | .10 | " " |
| Milling ..... | 1.15 | " " |
| Smelting ..... | 1.25 | " " |
| Total . . . . . | $5.00 | " " |

Assuming that the average grade of ore milled is 3.50% copper and containing gold and silver to the value of $1.50, the results of your operations will be as follows:

## TOTAL COST OF PRODUCTION.

( Not including New York Office Expenses or Depreciation)

| | COPPER 15¢ | COPPER 15.5¢ | COPPER 16¢ | COPPER 16.5¢ |
|---|---|---|---|---|
| Value (Gold & Silver | $1.50 | $1.50 | $1.50 | $1.50 |
| Value ( Copper 70-lbs. | 10.50 | 10.85 | 11.20 | 11.55 |
| Gross Value per dry ton Ore | 12.00 | 12.35 | 12.70 | 13.05 |
| Concentration Loss 30% | 3.60 | 3.705 | 3.81 | 3.915 |
| Value of Concentrates | 8.40 | 8.645 | 8.89 | 9.135 |
| Smelting Loss 10% | .84 | .865 | .89 | .915 |
| Value of Matte (Containing 44-lbs. Copper) | 7.56 | 7.780 | 8.00 | 8.220 |
| Converting & Marketing charge (2½¢ per lb.) | 1.12 | 1.12 | 1.12 | 1.12 |
| | 6.44 | 6.66 | 6.88 | 7.10 |
| Cost of Mining, Milling & Smelting to Matte | 5.00 | 5.00 | 5.00 | 5.00 |
| Net Profit | 1.44 | 1.66 | 1.88 | 2.10 |

Figuring the gold and silver as equivalent to an equal value in pounds of copper, the total cost of your production should be 12½ cents per lb. copper sold.

I would further say, that there is reason to hope that the above costs may be gradually reduced to a small extent and if your ore bodies hold good in depth, I believe that after the next year you should be able to produce copper for 11½ cents, possibly 11 cents per pound.

## GENERAL CONSIDERATIONS.

From an examination of your property, it would appear that past managements have considered that your best policy lay in purchasing as much ore as possible and emphasizing the custom end of your smelting business. I believe this to have been a mistake, it does not seem possible that you can compete for outside ore with the larger and better plants which are in the market; this will be more

particularly the case after the new United Verde Smelter starts operations, as it will within the course of a year. The past history of your company certainly shows that no profit has been made from custom work, and I believe that it will be your policy to neglect entirely, or almost entirely, the custom smelting and to operate your own mine and concentrate and smelt your own ore. Your ore, at least the great portion of it, is better suited to concentration than to direct smelting since the excess of Silica in the ore has always obliged you to purchase, at heavy expense, ores with high iron content to give a proper mixture in your furnaces. By concentration, you not only increase the copper content of the furnace feed, but you also decrease the Silica and increase the proportion of iron, and your concentrate should be nearly or quite self-fluxing. At a later date, I think it will be wise to make provision for handling a larger tonnage of material by opening up the De Soto Mine and possibly acquiring some outside prospects or mines which appear to give promise. Obviously, the larger the tonnage which you handle, the lower will be your working costs, and there would seem to be in your vicinity several prospects which might develop into producing mines and enable you to obtain for the mill and smelter a much larger supply of ore than is at present available.

With Mr. Walker, I visited two prospects near Humboldt, the "Copper Queen Gold Mine" and the "Binghampton"; the former appears to be of no value but the latter is a fairly promising prospect and might develop into a small producer of comparatively high-grade copper ore. Mr. Walker has already reported to the Company concerning the "Tiger Gold Mine" near Crown King, which he considers promising and I would suggest that if your own development and concentrating operations result favorably, special attention should be paid to the possibility of acquiring other prospects and mines in yout neighborhood and thereby eventually enlarging the scale of your operations.

Respectfully submitted,

G. M. Colvocoresses.

Office Copy.

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S. M. C.

Yearly Report 1915

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# ANNUAL REPORT ON BLUEBELL MINE

## COST STATEMENT

## STATISTICAL DATA

1-9-1-5...

* * * * * * * * * * * * * * * * * * * * * * *

Humboldt, Arizona.

February 1st, 1916

To The Board of Directors of the
Consolidated Arizona Smelting Co.,
No. 15 Broad Street,
New York, New York..

Gentlemen:-

I herewith beg to submit the following data on the operations of the Bluebell Mine, for the Fiscal Year, ending December 31st, 1915, and corresponding figures for 1913 and 1914:--

TONNAGES OF ORE SHIPPED - (Dry Weight)

| | 1913 | 1914 | 1915 |
|---|---|---|---|
| January | 3,387 tons | ----- tons | 7,498 tons |
| February | 3,214 tons | 1,058 tons | 6,693 tons |
| March | 2,354 tons | 3,528 tons | 7,378 tons |
| April | 3,336 tons | 3,826 tons | 6,325 tons |
| May | 3,356 tons | 3,953 tons | 7,588 tons |
| June | 2,439 tons | 5,164 tons | 7,209 tons |
| July | 2,957 tons | 5,287 tons | 7,435 tons |
| August | 3,184 tons | 6,102 tons | 7,031 tons |
| September | 3,320 tons | 5,266 tons | 6,129 tons |
| October | 3,748 tons | 6,821 tons | 6,411 tons |
| November | 3,918 tons | 7,405 tons | 6,291 tons |
| December | 1,579 tons | 7,648 tons | 6,183 tons |
| TOTALS | 36,792 tons | 56,058 tons | 82,171 tons |

## METAL CONTENTS OF ORE SHIPPED

| | 1913 | | 1914 | | 1915 | |
|---|---|---|---|---|---|---|
| Gold | 1,711.42 | ozs. | 2,064.15 | ozs. | 2,795.43 | ozs. |
| Silver | 48,920.8 | " | 71,526.48 | " | 91,118.8 | " |
| Copper | 2,765,166 | lbs. | 4,078,021 | lbs. | 4,887,469 | lbs |

## AVERAGE ASSAY OF ORE SHIPPED

| | 1913 | | 1914 | | 1915 | |
|---|---|---|---|---|---|---|
| Gold | .0465 | ozs. | .0368 | ozs. | .0340 | ozs. |
| Silver | 1.330 | " | 1.276 | " | 1.109 | " |
| Copper | 3.758 | % | 3.637 | % | 2.97 | % |

## DEVELOPMENT WORK PERFORMED IN 1915

| | | | |
|---|---|---|---|
| 343 Raise | Advanced | 548 feet | R |
| 351 Raise | Advanced | 188 feet | R |
| 941 Raise | Advanced | 113 feet | R |
| Shaft | Advanced | 164 feet | |
| 345 W. X-cut | Advanced | 94 feet | |
| 560 N. Drift | Advanced | 12 feet | |
| 560 E. X-cut | Advanced | 5 feet | |
| 1000 X-cut | Advanced | 159 feet | |
| 1000 Station | Advanced | 10 feet | |
| 500 X-cut | Advanced | 23 feet | |
| 732 Raise | Advanced | 25 feet | R |
| 1000 S. Drift | Advanced | 595 feet | |
| 568 X-cut | Advanced | 5 feet | |
| 565 X-cut | Advanced | 32 feet | |
| 500 N. Drift | Advanced | 62 feet | |
| 1000 N. Drift | Advanced | 71 feet | |
| 569 X-cut | Advanced | 67 feet | |
| 1031 Raise | Advanced | 62 feet | R |
| 570 X-cut | Advanced | 43 feet | |
| 571 X-cut | Advanced | 47 feet | |
| 532 X-cut | Advanced | 20 feet | |
| 800 N. Drift | Advanced | 303 feet | |
| 551 Stope | Advanced | 35 feet | |
| 1011 Raise | Advanced | 60 feet | R |
| TOTAL ADVANCE | | 2,743 feet | |
| Total Advance 1914 | | 1,411 feet | |
| Total Advance 1913 | | 1,299 feet | |

The total money expended for Development work during the year 1915 amounted to $22,391.74 (exclusive of overhead charges) as against $11,751.65 in 1914 and $9,361.01 in 1913.

## COST OF MINING AND TRANSPORTATION - 1915

| | Total | P. T. Ore Shipped | P. Lb. Ct. Shipped from Mine |
|---|---|---|---|
| Development | $ 22,391.74 | $ .273 | .458 ¢ |
| Extraction | 79,484.10 | .967 | 1.626 |
| Water Disposal | 2,834.38 | .034 | .058 |
| Hoisting | 12,257.80 | .149 | .251 |
| General Supplies | 6,383.34 | .078 | .131 |
| General Surface Work | 17,635.67 | .215 | .361 |
| Tramming, Sorting & Loadg. | 23,405.11 | .285 | .479 |
| Gen'l Exp. & Gen'l Suprvn. | 17,709.11 | .215 | .362 |
| TOTAL | 182,101.25 | 22216 | 3.726 |
| Credit Operating Revenues | 5,452.10 | .066 | .112 |
| TOTAL NET EXPENDITURES | 176,649.15 | 2.150 | 3.614 |
| Decrease ore brkn. Mine etc | 10,207.50 | .124 | .209 |
| TOTAL COST OF ORE SHIPPED | 186,856.65 | 2.274 | 3.823 |
| Freight to Humboldt | 29,217.89 | .355 | .598 |
| TOTAL COST OF ORE SHIPPED F.O.B. HUMBOLDT | $216,074.54 | $2.629 (82,171 tons) | 4.421¢ (4,867,469 lbs) |

## COST OF MINING AND TRANSPORTATION 1915 BY MONTHS.

| 1-9-1-5 Month | Total | P. T. |
|---|---|---|
| January | $ 18,384.07 | 2.452 |
| February | 16,610.32 | 2.482 |
| March | 18,735.47 | 2.539 |
| April | 16,823.24 | 2.660 |
| May | 18,799.41 | 2.477 |
| June | 17,955.73 | 2.491 |
| July | 18,579.11 | 2.499 |
| August | 20,169.92 | 2.869 |
| September | 17,159.05 | 2.800 |
| October | 17,006.70 | 2.653 |
| November | 18,615.28 | 2.959 |
| December | 17,236.24 | 2.788 |
| Total | 216,074.54 | 2.629 |

The average cost of ore shipped (F.O.B. Humboldt) during 1914 was $2.3759 p. ton, including 20.96¢ per ton for Development Work; and during 1913 was $3.3403 p. ton, including 25.44¢ per ton for Development Work.

I am also enclosing a diagram showing Tonnage Shipped, and the cost per ton F.O.B. Humboldt.

Very truly yours,

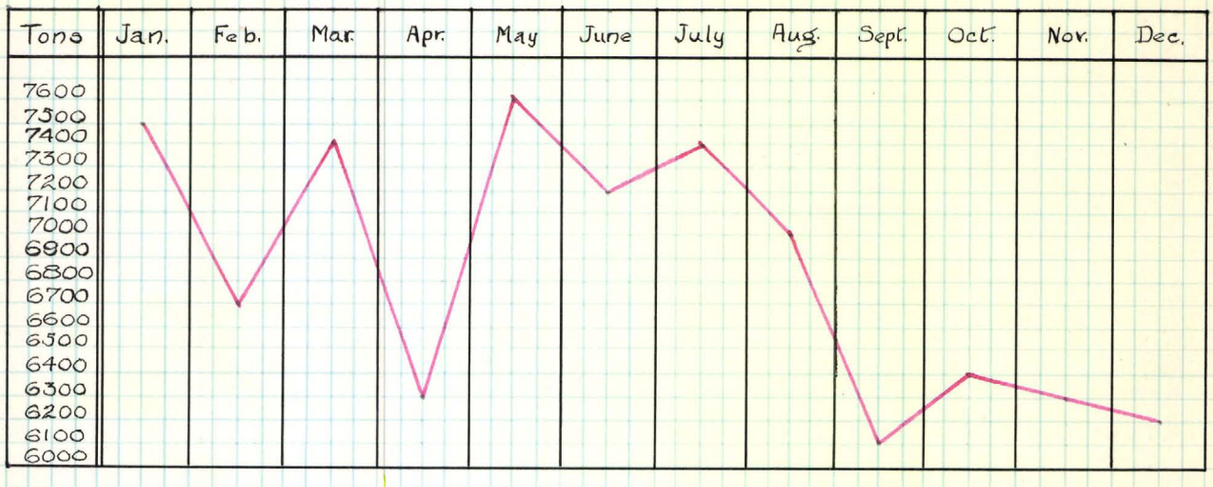
O.F.J.

Auditor.

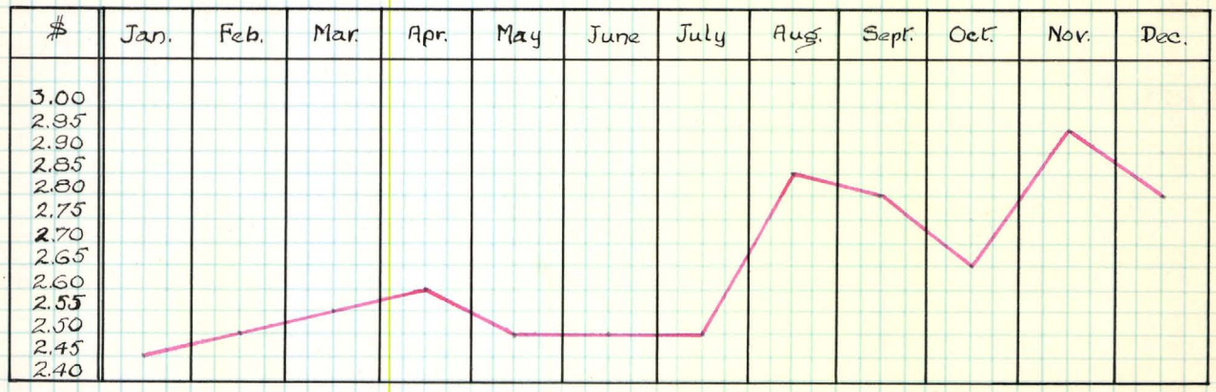
C.C. TO MR.G.M.C.

# BLUE BELL MINE
1915

## Tonnage Shipped (Dry Weight)




## Average Cost of Ore Per Ton Shipped (f.o.b. Humboldt)



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# ANNUAL REPORT ON BLUE BELL MINE

## COST STATEMENT

## STATISTICAL DATA

1-911-6

* * * * * * * * * * * * * * * * * * * * *

Humboldt, Arizona
February 1st, 1917.

To the Board of Directors of the
Consolidated Arizona Smelting Co.,
No. 15 Broad Street,
New York, New York.

Gentlemen:-

I herewith beg to submit the following data on the operations of the Blue Bell Mine, for the Fiscal Year ending December 31st, 1916, and corresponding figures for the years 1915, 1914 and 1913:-

TONNAGES OF ORE SHIPPED (Dry Weight)

| | 1913 | 1914 | 1915 | 1916 |
|---|---|---|---|---|
| Jan. | 3,387 T. | ---- | 7,498 T. | 5,138 T. |
| Feb. | 3,214 T. | 1,058 T. | 6,693 T. | 6,932 T. |
| Mar. | 2,354 T. | 3,528 T. | 7,378 T. | 6,864 T. |
| Apr. | 3,336 T. | 3,826 T. | 6,325 T. | 6,555 T. |
| May | 3,356 T. | 3,953 T. | 7,588 T. | 6,697 T. |
| Jun. | 2,439 T. | 5,164 T. | 7,209 T. | 5,523 T. |
| Jul. | 2,957 T. | 5,287 T. | 7,435 T. | 6,195 T. |
| Aug. | 3,184 T. | 6,102 T. | 7,031 T. | 5,509 T. |
| Sep. | 3,320 T. | 5,266 T. | 6,129 T. | 6,695 T. |
| Oct. | 3,748 T. | 6,821 T. | 6,411 T. | 5,871 T. |
| Nov. | 3,918 T. | 7,405 T. | 6,291 T. | 5,291 T. |
| Dec. | 1,579 T. | 7,648 T. | 6,183 T. | 7,800 T. |
| Totals | 36,792 T. | 56,058 T. | 82,171 T. | 75,070 T. |
| Average Per month | 3,066 T. | 5,096 T. | 6,848 T. | 6,256 T. |

4

(11 months only)

## METAL CONTENTS OF ORE SHIPPED.

| | G-o-l-d | S-i-l-v-e-r | C-o-p-p-e-r |
|---|---|---|---|
| 1913 | 1,711.42 ozs. | 48,920.8 ozs. | 2,765,166 lbs. |
| 1914 | 2,064.15 ozs. | 81,526.48 ozs. | 4,078,021 lbs. |
| 1915 | 2,795.43 ozs. | 91,118.8 ozs. | 4,887,469 lbs. |
| 1916 | 3,411.57 ozs. | 90,048.5 ozs. | 4,921,367 lbs. |

## AVERAGE ASSAY OF ORE SHIPPED.

| | G-o-l-d | S-i-l-v-e-r | C-o-p-p-e-r |
|---|---|---|---|
| 1913 | .0465 ozs. | 1.330 ozs. | 3.758 % |
| 1914 | .0368 ozs. | 1.276 ozs. | 3.637 % |
| 1915 | .0340 ozs. | 1.109 ozs. | 2.97 % |
| 1916 | .0454 ozs. | 1.200 ozs. | 3.278 % |

## DEVELOPMENT WORK PERFORMED IN 1916.

| | | | |
|---|---|---|---|
| Blue Thunder | Advanced | 45 | feet |
| 1055 X cut | " | 4 | " |
| 868 X cut | " | 30 | " |
| 351 Raise | " | 145 | " |
| 1000 N. Drift | " | 516 | " |
| 800 N. Drift | " | 1082 | " |
| 700 N. Drift | " | 253 | " |
| 1011 Raise | " | 30 | " |
| 845 X Cut | " | 111 | " |
| 846 X Cut | " | 21 | " |
| 845 N. Drift | " | 25 | " |
| 751 Raise | " | 106 | " |
| 1046 Raise | " | 122 | " |
| 900 N. Drift | " | 162 | " |
| 1040 Pil. X Cut | " | 12 | " |
| 343 Sub Drift | " | 35 | " |
| 1040 Sill | " | 125 | " |
| 850 Sill | " | 94 | " |
| 1010 A Sill | " | 179 | " |
| 1011 Raise | " | 68 | " |
| 851 Raise | " | 115 | " |
| 612 Raise | " | 10 | " |
| 562 Raise | " | 107 | " |
| 750 Sill | " | 223 | " |
| 1041 Raise | " | 140 | " |
| 231 Winze | " | 17 | " |
| 1046 X Cut | " | 26 | " |
| 1045 Sill | " | 158 | " |
| 845 N. Drift | " | 131 | " |
| 750 N. Drift | " | 18 | " |
| 850 Pil. Raise | " | 44 | " |
| ~~1046 Raise~~ | ~~"~~ | ~~12~~ | ~~"~~ |

| | | |
|---|---|---|
| 1046 Raise | Advanced | 12 feet |
| 1040 Pil. Raise | " | 32 " |
| 751 Raise | " | 117 " |
| 900 N. Drift | " | 193 " |
| 945 Sill | " | 53 " |
| 951 Raise | " | 128 " |
| 1055 X Cut | " | 16 " |
| 950 Sill | " | 31 " |
| 1050 Sill | " | 83 " |
| Total Advance 1916 | | 4819 feet |
| Total Advance 1915 | | 2743 feet |
| Total Advance 1914 | | 1411 feet |
| Total Advance 1913 | | 1299 feet |

The total money expended for Development Work during the year 1916, amounted to $63,197.01 (exclusive of overhead charges) as against $22,391.74 in 1915; $11,751.65 in 1914, and $9,361.01 in 1913.

COST OF MINING AND TRANSPORTATION - 1916

BY MONTHS.

| Month | 1--9--1--5 | | 1--9--1--6 | |
|---|---|---|---|---|
| | Total | P. T. | Total | P. T. |
| Jan. | $ 18,384.07 | $ 2.452 | $ 17,327.27 | $ 3.372 |
| Feb. | 16,610.32 | 2.482 | 19,567.63 | 3.823 |
| Mar. | 18,735.47 | 2.539 | 24,359.39 | 3.549 |
| Apr. | 16,823.24 | 2.660 | 22,109.15 | 3.373 |
| May | 18,799.41 | 2.477 | 23,318.11 | 3.482 |
| Jun. | 17,955.73 | 2.491 | 24,395.90 | 4.417 |
| Jul. | 18,579.11 | 2.499 | 23,901.88 | 3.858 |
| Aug. | 20,169.92 | 2.869 | 21,400.41 | 3.885 |
| Sep. | 17,159.05 | 2.800 | 22,996.44 | 3.435 |
| Oct. | 17,006.70 | 2.653 | 24,089.88 | 4.103 |
| Nov. | 18,615.28 | 2.959 | 19,765.00 | 3.736 |
| Dec. | 17,236.24 | 2.788 | 24,482.54 | 3.139 |
| Totals | $ 216,074.54 | $ 2.629 | $ 267,713.60 | $ 3.565 |

The average cost ofnore shipped (F.O.B. Humboldt) during 1915 includes $0.273 for Development Work, and costs for 1916 include a charge of $0.84174 for development. The average cost of ore shipped (F.O.B. Humboldt) during 1914 was $2.3759 per ton, including 20.96¢ per ton for Development Work; and during 1913 was $3.3403 per ton, including 25.44¢ per ton for Development Work.

COST OF MINING AND TRANSPORTATION - 1915 AND 1916

| | 1---9---1---5 | | | 1---9---1---6 | | |
|---|---|---|---|---|---|---|
| | Total Cost | P. T. Ore Shipped | P.Lb.cu. shpd.from Mine | Total Cost | P. T. Ore Shipped | P. Lb. cu. shpd. from Mine |
| Development in Waste | $(22,391.74 | $ .273 | .458 ¢ | $ 28,060.39 | $ .37374 | .57017 ¢ |
| Development in Ore Extraction | 79,484.10 | .967 | 1.626 | 35,136.62<br>80,743.54 | .46800<br>1.07545 | .71396<br>1.64067 |
| Pumping | 2,834.38 | .034 | .058 | 1,880.80 | .02505 | .03822 |
| Hoisting | 12,257.80 | .149 | .251 | 15,005.58 | .19986 | .30491 |
| General Supplies | 6,383.34 | .078 | .131 | 11,098.79 | .14783 | .22552 |
| General Surface Work | 17,635.67 | .215 | .361 | 24,599.60 | .32765 | .49985 |
| Tramming, Sortg. & Loadg. | 23,405.11 | .285 | .479 | 24,936.34 | .33213 | .50670 |
| Gen'l Expense & Gen'l Spvsn. | 17,709.11 | .215 | .362 | 27,944.60 | .37220 | .56782 |
| T o t a l | 182,101.25 | 2.216 | 3.726 | 249,406.26 | 3.32191 | 5.06782 |
| Credit Operating Revenues | 5,452.10 | .066 | .112 | 4,756.56 | .06335 | .09665 |
| Total Net Expenditures | 176,649.15 | 2.150 | 3.614 | 244,649.70 | 3.25856 | 4.97117 |
| In) De) crease Stock in Mine & Tr. | 10,207.50 | .124 | .209 | 3,545.50 | .04722 | .07204 |
| Total Cost of Ore Shipped | 186,856.65 | 2.274 | 3.823 | 241,104.20 | 3.21134 | 4.89913 |
| Freight to Humboldt | 29,217.89 | .355 | .598 | 26,609.40 | .35442 | .54069 |
| TOTAL COST OF ORE SHIPPED FOB HUMBOLDT | $ 216,074.54 | $ 2.629 * | 4.421 ¢ ** | $ 267,713.60 | $ 3.56576 *** | 5.43982 ¢ **** |

* (82,171 tons)
** (4,867,469 lbs.)
*** (75,070 tons)
**** (4,921,367 lbs.)

COMPARATIVE STATEMENT OF MINING COSTS

BLUE BELL AND DE SOTO MINES - 1916.

| | Cost Per Ton Shipped | | Cost P. L. Cu. Prod. | |
|---|---|---|---|---|
| | Blue Bell | De Soto | Blue Bell | De Soto |
| Exploration | $ | $ .26024 | ¢ .38550 | ¢ |
| Development in Waste | .37374 | .09639 | .57017 | .14280 |
| Development in Ore | .46800 | .14658 | .71396 | .21714 |
| Extraction | 1,07545 | 1.24756 | 1.64067 | 1.84809 |
| Pumping | .02505 | .00312 | .03822 | .00463 |
| Hoisting | .19986 | | .30491 | |
| Hoist. in winze & Trmg.to Upper Terminal | | .11764 | | .17428 |
| General Supplies | .14783 | .12373 | .22552 | .18328 |
| General Surface Work | .32765 | .28118 | .49985 | .41653 |
| Sorting Ore, Operating Ropeway & Loadg. Ore | .33213 | .25231 | .50670 | .37376 |
| Gen. Exp. & Gen. Spvsn. | .37220 | .476000 | .56782 | .70510 |
| T o t a l | 3.32191 | 3.00475 | 5.06782 | 4.45111 ¢ |
| Operating Revenues | .06335 | .01203 | .09665 | .01782 |
| Total Net Expenditures | 3,25856 | 2.99272 | 4.97117 | 4.43329 |
| Increase in Stock in Mine and in Transit | .04722 | .14383 | .07204 | .21306 |
| Total Cost FOB Mine | 3.21134 | 2.84889 | 4.89913 | 4.22023 |
| Freight to Humboldt | .35442 | .70912 | .54069 | 1.05046 |
| Cost FOB Humboldt | $ 3.56576 | $ 3.55801 | 5.43982 ¢ | 5.27069 ¢ |

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I am also enclosing a diagram showing Tonnage Shipped, and the cost per ton, F. O. B. Humboldt.

Very truly yours,

D.F.

Auditor.

COMPARATIVE STATEMENT OF MINING COSTS

BLUE BELL AND DE SOTO MINES - 1917

| | Cost Per Ton Shpd. | | Cost P. Lb.Cu.Prod. | |
|---|---|---|---|---|
| | Blue Bell | De Soto | Blue Bell | De Soto |
| Exploration | $ -.- | $0.03536 | -.- ¢ | 0.05825 ¢ |
| Development in Waste | 0.23561 | 0.04767 | 0.37089 | 0.07852 |
| Development in Ore | 0.34178 | 0.05091 | 0.53803 | 0.08386 |
| Extraction | 1.22684 | 1.16633 | 1.93129 | 1.92122 |
| Shaft Repair | 0.00712 | -.- | 0.01120 | -.- |
| Pumping | 0.01420 | 0.00433 | 0.02235 | 0.00714 |
| Hoisting | 0.15541 | -.- | 0.24465 | -.- |
| Hoisting in Winze and Trmg.to Upper Term. | -.- | 0.15508 | -.- | 0.25546 |
| General Supplies | 0.13662 | 0.06766 | 0.21507 | 0.11144 |
| General Surface Work | 0.33537 | 0.23163 | 0.52794 | 0.38155 |
| Sort. Ore, Opertg.Ropeway and Loading Ore | 0.27794 | 0.26827 | 0.43752 | 0.44190 |
| Genl.Exp.& Genl.Supervsn. | 0.33890 | 0.40264 | 0.53350 | 0.66324 |
| T O T A L | $ 3.06979 | $2.42988 | 4.83244 ¢ | 4.00258 ¢ |
| Operating Revenues | 0.08477 | 0.04608 | 0.13345 | 0.07591 |
| TOTAL NET EXPENDITURES | $ 2.98502 | $2.38380 | 4.69899 ¢ | 3.92667 ¢ |
| In) De) crease in Stock in Mine and in Transit | 0.01150 | 0.05733 | 0.01810 | 0.09443 |
| TOTAL COST FOB SIDING | $ 2.99652 | $2.44113 | 4.71709 ¢ | 4.02110 ¢ |
| Freight to Humboldt | $ 0.35444 | $0.70899 | 0.55796 ¢ | 1.16787 ¢ |
| TOTAL COST FOB HUMBOLDT | $ 3.35096 | $3.15012 | 5.27505 ¢ | 5.18897 ¢ |

(1) (2) (3) (4)

(1) 102,773 tons
(2) 44,483 tons
(3) 6,528,635 lbs.
(4) 2,700,478 lbs.

147,256

------ooo0ooo------

I am also enclosing a diagram showing Tonnage Shipped, and the Cost Per Ton, F.O.B. Humboldt.

Very truly yours,

O.J.,

AUDITOR.

OFJ :TMM

CONSOLIDATED ARIZONA SMELTING CO., HUMB[illegible]T, ARIZONA.

Fr. M. Solovevesses.

* * * * * * * * * * * * * * * * * * * * * * * * *

# ANNUAL REPORT ON BLUE BELL MINE

## COST STATEMENT

## STATISTICAL DATA

## 1 9 1 7

* * * * * * * * * * * * * * * * * * * * * * * * *

CONSOLIDATED ARIZONA SMELTING CO., HUMBOLDT, ARIZON

Humboldt, Arizona,

February 1, 1918.

To the Board of Directors of the
Consolidated Arizona Smelting Co.,
No. 15 Broad Street,
New York City, N. Y.

Gentlemen:-

I herewith beg to submit the following data on the operations of the Blue Bell Mine for the Fiscal Year ending December 31, 1917, and corresponding figures for the years 1913, 1914, 1915 and 1916:-

TONNAGES OF ORE SHIPPED - (Dry Weight)

| | 1913 | 1914 | 1915 | 1916 | 1917 |
|---|---|---|---|---|---|
| Jan. | 3,387 T. | ---- | 7,498 T. | 5,138 T. | 7,069 T. |
| Feb. | 3,214 T. | 1,058 T. | 6,693 T. | 6,932 T. | 9,091 T. |
| Mar. | 2,354 T. | 3,528 T. | 7,378T. | 6,864 T. | 8,820 T. |
| Apr. | 3,336 T. | 3,826 T. | 6,325 T. | 6,555 T. | 6,734 T. |
| May | 3,356 T. | 3,953 T. | 7,588 T. | 6,697 T. | 9,067 T. |
| Jun. | 2,439 T. | 5,164 T. | 7,209 T. | 5,523 T. | 8,085 T. |
| Jul. | 2,957 T. | 5,287 T. | 7,435 T. | 6,195 T. | 8,392 T. |
| Aug. | 3,184 T. | 6,102 T. | 7,031 T. | 5,509 T. | 9,217 T. |
| Sep. | 3,320 T. | 5,266 T. | 6,129 T. | 6,695 T. | 8,686 T. |
| Oct. | 3,748 T. | 6,821 T. | 6,411 T. | 5,871 T. | 9,722 T. |
| Nov. | 3,918 T. | 7,405 T. | 6,291 T. | 5,291 T. | 8,370 T. |
| Dec. | 1,579 T. | 7,648 T. | 6,183 T. | 7,800 T. | 9,520 T. |
| Totals | 36,792 T. | 56,058 T. | 82,171 T. | 75,070 T. | 102,773 T. |
| Average Per month | 3,066 T. | 5,096 T.* | 6,848 T. | 6,256 T. | 8,564 T. |

* 11 months only

## METAL CONTENTS OF ORE SHIPPED

| | Gold | Silver | Copper |
|---|---|---|---|
| 1913 | 1,711.42 ozs. | 48,920.8 ozs. | 2,765,166 lbs. |
| 1914 | 2,064.15 ozs. | 71,526.48 ozs. | 4,078,021 lbs. |
| 1915 | 2,795.43 ozs. | 91,118.8 ozs. | 4,887,469 lbs. |
| 1916 | 3,411.57 ozs. | 90,048.5 ozs. | 4,921,367 lbs. |
| 1917 | 6,062.01 ozs. | 150,115.6 ozs. | 6,528,635 lbs. |

## AVERAGE ASSAY OF ORE SHIPPED

| | GOLD | SILVER | COPPER |
|---|---|---|---|
| 1913 | .0465 ozs. | 1.330 ozs. | 3.758 % |
| 1914 | .0368 ozs. | 1.276 ozs. | 3.637 % |
| 1915 | .0340 ozs. | 1.109 ozs. | 2.97 % |
| 1916 | .0454 ozs. | 1.200 ozs. | 3.278 % |
| 1917 | .059 ozs. | 1.461 ozs. | 3.176 % |

Gain 50¢ on avg. value 2# on = 30¢ per ton

## DEVELOPMENT WORK PERFORMED

| | |
|---|---|
| Total Advance 1913 | 1,299 feet |
| Total Advance 1914 | 1,411 feet |
| Total Advance 1915 | 2,743 feet |
| Total Advance 1916 | 4,819 feet |
| Total Advance 1917 | 3,676½ feet* |

* Exploration 21 feet
Dev. in Waste 1,164½ feet
Dev. in Ore 2,491 feet

Sinking

The total money expended for Development Work in 1913 amounted to $9,361.01 (exclusive of Overhead Charges) as against $11,751.65 in 1914 - $22,391.74 in 1915 - $63,197.01 in 1916 and $59,339.99 in 1917.

## COST OF MINING AND TRANSPORTATION - BY MONTHS

| Month | 1916 | | 1917 | |
|---|---|---|---|---|
| | Total | Per Ton | Total | Per Ton |
| Jan. | $ 17,327.27 | $ 3.372 | $ 21,017.89 | $ 2.973 |
| Feb. | 19,567.63 | 2.823 | 25,379.22 | 2.7918 |
| Mar. | 24,359.39 | 3.549 | 25,593.51 | 2.9018 |
| Apr. | 22,109.15 | 3.373 | 26,344.01 | 3.9121 |
| May | 23,318.11 | 3.482 | 27,509.18 | 3.0340 |
| Jun. | 24,395.90 | 4.417 | 29,367.60 | 3.6322 |
| Jul. | 23,901.88 | 3.858 | 30,431.72 | 3.6265 |
| Aug. | 21,400.41 | 3.885 | 32,475.48 | 3.7388 |
| Sep. | 22,996.44 | 3.435 | 30,845.42 | 3.3466 |
| Oct. | 24,089.88 | 4.103 | 34,401.09 | 3.5385 |
| Nov. | 19,765.00 | 3.736 | 30,820.36 | 3.6822 |
| Dec. | 24,482.54 | 3.139 | 30,202.97 | 3.1726 |
| Totals | $ 267,713.60 | $ 3.565 | $ 344,388.45 | $ 3.3501 |

The average cost of ore shipped (FOB Humboldt) during 1916 includes a charge of $0.84174 for development work, and costs for 1917 include a charge of $0.57739 for development work.

COST OF MINING AND TRANSPORTATION - 1916 AND 1917

| | 1916 | | | 1917 | | |
|---|---|---|---|---|---|---|
| | Total Cost | P.T. Ore Shipped | P.Lb.Cu.shpd. from Mine | Total Cost | P.T. Ore Shipped | P.Lb.Cu.Shpd. from Mine |
| Development in Waste | $ 28,060.39 | $ .37374 | .57017 ¢ | $ 24,214.12 | $ .23561 | .37089 ¢ |
| Development in Ore | 35,136.62 | .46800 | .71396 | 35,125.87 | .34178 | .53803 |
| Extraction | 80,743.54 | 1.07545 | 1.64067 | 126,086.37 | 1.22684 | 1.93129 |
| Shaft Repair | --- | --- | --- | 731.60 | .00712 | .01120 |
| Pumping | 1,880.80 | .02505 | .03822 | 1,458.96 | .01420 | .02235 |
| Hoisting | 15,005.58 | .19986 | .30491 | 15,971.98 | .15541 | .24465 |
| General Supplies | 11,098.79 | .14783 | .22552 | 14,040.93 | .13662 | .21507 |
| General Surface Work | 24,599.60 | .32765 | .49985 | 34,467.16 | .33537 | .52794 |
| Tramming, Sorting and Loading -Opr.&Rep. | 24,936.34 | .33213 | .50670 | 28,564.80 | .27794 | .43752 |
| Genl. Exp. & Gen. Supvsn. | 27,944.60 | .37220 | .56782 | 34,830.02 | .33890 | .53350 |
| T o t a l | 249,406.26 | 3.32191 | 5.06782 | 315,491.81 | 3.06979 | 4.83244 |
| Credit Operating Revenues | 4,756.56 | .06335 | .09665 | 8,712.41 | .08477 | .13345 |
| Total Net Expenditures | 244,649.70 | 3.25856 | 4.97117 | 306,779.40 | 2.98502 | 4.69899 |
| In) De) creasd Stock in Mine and Transit | 3,545.50 | .04722 | .07204 | 1,182.00 | .01150 | .01810 |
| Total Cost of Ore Shipped | 241,104.20 | 3.21134 | 4.89913 | 307,961.40 | 2.99652 | 4.71709 |
| Freight to Humboldt | 26,609.40 | .35442 | .54069 | 36,427.05 | .35444 | .55796 |
| TOTAL COST OF ORE SHIPPED FOB HUMBOLDT | $ 267,713.60 | $ 3.56576 | 5.43982 ¢ | $ 344,388.45 | $ 3.35096 | 5.27505 ¢ |
| | | (75,070 T.) | (4,921,367 lbs) | | (102,773 T.) | (6,528,635 lbs.) |

## COMPARISON HUMBOLDT COSTS AND ESTIMATED COSTS

| | COSTS FOR YEAR 1913 | | COSTS ESTIMATED IN MY REPORT OF NOV., 1913, TO APPLY AFTER COMPLETION OF THE NEW PLANT | | COSTS FOR YEAR 1914 (SMELTER COSTS FOR LAST 8 MONTHS) | | COSTS FOR LAST QUARTER OF YEAR 1914 | | ESTIMATED COSTS FOR 1915 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cost P. Ton of Mat'l Treated | Cost P Lb. of Cu. Recovered in Bul. | Cost per Ton | Cost per Lb. | Cost P. Ton | Cost P Lb. | Cost P. Ton | Cost P. Lb. | Cost P. Ton | Cost P. Lb. |
| MINING, INCL. DEVELOPING, SORTING & FREIGHT | $3.350 | .0600 | 2.750 | .0500 | 2.376 | .0440 | 1.847 | .0309 | 2.350 | .0350 |
| CONCENTRATION | 2.090 | .0400 | 1.470 | .0251 | 1.816 | .0320 | 1.363 | .0200 | 1.250 | .0200 |
| RECEIVING, CRUSHING, ETC. | 0.685 | .0103 | Included with Mining & Smelt'g Costs | | 0.863 | .0100 | 0.709 | .0060 | 0.600 | .0050 |
| SMELTING, INCL. ROASTING ETC. | 4.100 | .0440 | 3.280 | .0278 | 4.687 | .0456 | 4.282 | .0357 | 3.500 | .0300 |
| CONVERTING | ----- | .0137 | ----- | .0057 | ----- | .0061 | ----- | .0047 | ----- | .0040 |
| GEN'L EXPENSE, INCL. MANAGEMENT & FIXED CHARGES | ----- | .0138 | ----- | .0057 | ----- | .0112 | ----- | .0070 | ----- | .0060 |
| TOTAL HUMBOLDT EXPENSE, INCL. CUSTOM MAT'L, ETC. | ----- | .2060 | ----- | .1143 | ------ | .1277 | ----- | .1034 | ----- | .1000 |

The comparative figures shown in the above table are really only fair as far as the total cost per lb. of copper prod is concerned, since the method of cost keeping was radically changed in 1914.

The costs for 1913 were complicated by shipments of ore to Swansea, while 1914 costs were complicated by shipments of concentrates to Hayden, and by the fact that the smelter only operated during a portion of the year and the operations of both mine and mill were intermittent and irregular during the early part of the year.

Copy for Mr. Clemmons.

"X"

CONSOLIDATED ARIZONA SMELTING COMPANY

BLUE BELL MINE

Statistical Data

1919

and previous years

Humboldt, January, 1920.

Auditor.

# B L U E  B E L L  M I N E

## METAL CONTENTS OF ORE SHIPPED

| | Gold Ozs. | Silver Ozs. | Copper Lbs. |
|---|---|---|---|
| 1913 | 1,711.42 | 48,920.8 | 2,765,166 |
| 1914 | 2,064.15 | 71,526.48 | 4,078.021 |
| 1915 | 2,795.43 | 91,118.8 | 4,887,469 |
| 1916 | 3,411.57 | 90,048.5 | 4,921.367 |
| 1917 | 6,062.01 | 150,115.6 | 6,528,635 |
| 1918 | 8,251.05 | 202,995.6 | 7,263,779 |
| 1919 | 7,360.75 | 174,098.4 | 6,303.405 |

## AVERAGE ASSAY OF ORE SHIPPED

| | Gold Ozs. | Silver Ozs. | Copper % |
|---|---|---|---|
| 1913 | .0465 | 1.330 | 3.758 |
| 1914 | .0368 | 1.276 | 3.637 |
| 1915 | .0340 | 1.109 | 2.97 |
| 1916 | .0454 | 1.200 | 3.278 |
| 1917 | .059 | 1.461 | 3.176 |
| 1918 | .0629 | 1.548 | 2.771 |
| 1919 | .0603 | 1.426 | 2.582 |
| 1920 | | # 2.30 | 2.368 |

## DEVELOPMENT WORK PERFORMED

| | | |
|---|---|---|
| 1913 | | 1,299 feet |
| 1914 | | 1,411 " |
| 1915 | | 2,743 " |
| 1916 | | 4,819 " |
| 1917 | * | 3,676½ " |
| 1918 | ** | 4,638½ " |
| 1919 | *** | 2,821 " |

* Including 215½ ft. Shaft sinking

** 2,552½ ft. in waste
2,086 ft. in ore

*** 236 ft. in waste
586 ft. in ore
405 ft. Exploration
1,594 ft. Diamond Drilling

# B L U E  B E L L  M I N E

## 1 9 1 8

### TONS OF ORE SHIPPED TO HUMBOLDT

| | Dry T. | Au. Ozs. | Ag. Ozs. | Cu. Lbs. | Cost P.T. |
|---|---|---|---|---|---|
| Smelting Ore | 70,005 | 4,998.70 | 129,957.1 | 4,137,220 | $ 3.7861 |
| Conctg. Ore | 61,085 | 3,252.35 | 73,038.5 | 3,126,559 | 3.7861 |
| T O T A L | 131,090 | 8,251.05 | 202,995.6 | 7,263,779 | $ 3.7861 |

### AVERAGE ANALYSIS OF ORE SHIPPED

| | Dry Tons | Au. Ozs. | Ag. Ozs. | Cu. % |
|---|---|---|---|---|
| Smelting Ore | 70,005 | .0714 | 1.856 | 2.955 |
| Concentrg. Ore | 61,085 | .0532 | 1.196 | 2.559 |
| T O T A L | 131,090 | .0629 | 1.548 | 2.771 |

## 1 9 1 9

### TONS OF ORE SHIPPED TO HUMBOLDT

| | Dry T. | Au. Ozs. | Ag. Ozs. | Cu. Lbs. | Cost P.T. |
|---|---|---|---|---|---|
| Smelting Ore | 48,762 | 3,828.22 | 96,505.6 | 2,912,430 | $ 4.0063 |
| Conctg. Ore | 73,307 | 3,532.53 | 77,592.8 | 3,390,975 | 4.0063 |
| T O T A L | 122,069 | 7,360.75 | 174,098.4 | 6,303,405 | $ 4.0063 |

### AVERAGE ANALYSIS OF ORE SHIPPED

| | Dry Tons | Au. Ozs. | Ag. Ozs. | Cu. % |
|---|---|---|---|---|
| Smelting Ore | 48,762 | .0785 | 1.979 | 2.986 |
| Conctg. Ore | 73,307 | .0482 | 1.058 | 2.313 |
| T O T A L | 122,069 | .0603 | 1.426 | 2.582 |

Rates on Ore & Concentrates from Blue Bell Siding (Magna) to:

| Value. | Clarkdale | Magna | Hayden | Jerome & Siding |
|---|---|---|---|---|
| $ | $ | | | |
| 10.00 | 1.00 | 2.40 | | |
| 15 00 | 1.30 | 3.30 | | |
| 20.00 | 1.70 | | | Jerome & Clarkdale. |
| 25 | | | | |
| 30 | 2.05 | | | |
| 35 | | | | |
| 40 | 2.35 | | | |
| 45 | | | | |
| 50 | 2.65 | | | |

Rates on Ore & Concentrates

Probable value Complete ~~Ore~~ Concentrate rate 5 : 1 & 93% copper & 85% on day

= 40.00. per ton.

Feb 43

? would times fine of copper be considered in figuring rate

Revised Summ for Blue Bell. Conc.

for 28. J Ryan.

Based on Hayden Summ for Summ Conc

2 + frying rate etc & Claridge

| | | |
|---|---|---|
| Sold. Summ. | | 5.47 |
| Sdr " | | 4.16 |
| Conc, 247 @ 9.4. | | 22.65 |
| Bonus. | | 12.05 |
| | | 44.33 |

| | | |
|---|---|---|
| Less Sand | 2.50 | |
| Sdr + sd. | 2.53 | |
| Summ. | 1.10 | |
| | 6.13 | 6.13 |
| | | 38.20 |
| 5% | | 7.64 |
| Less Dig. Sundry etc | | 4.37 |
| Net Profit | | 3.27 |

Blue Bell

| | Ton ore (dry) | g. gold | g silver | # Copper | Cost Expenditure & Development $ Tons | Cost Mining, Tramway, Hoisting etc |
|---|---|---|---|---|---|---|
| 1913 | 36792 | 1,711 | 48,921 | 2765166 | | |
| 1914 | 56058 | 2.064 | 71526 | 4078021 | | |
| 1915 | 82171 | 2.795 | 91119 | 4887469 | 0.2730 | 1.5670 |
| 1916 | 75076 | 3412 | 90049 | 4,921367 | 0.8417 | 1.7286 |
| 1917 | 102773 | 6062 | 150116 | 6528635 | 0.5774 | 1.8874 |
| 1918 | 131090 | 8251 | 202996 | 7263779 | 0.5875 | 2.1558 |
| 1919 | 122069 | 7360 | 174098 | 6303405 | 0.2148 | 2.6250 |
| 1920 | 111749 | 6116 | 135647 | 5291274 | 0.1938 | |
| 21 | Closed down | | | | | |
| 22 | 25052 | 1147 | 30.647 | 1589869 | | |
| 23 | 80811 | x.035 | x1.012 | x3.233 | 0.4812 | |
| 24 | | | | | | |
| 25 | | | | | | |
| 26 | @ 4000 p.a. | | | | | |

Blue Bell hunt Rush

# Extracts from Annual Report

Production of DeSoto Mine,(continued)

| YEAR | TONS | AVERAGE GOLD (OZ.)PER TON | AVERAGE SILVER (OZ.) PER TON | AVERAGE % COPPER PER TON |
|---|---|---|---|---|
| 1921) | 20,000 | .050 | 1.20 | 3.00 |
| 1930) | Worked by leasers. | | | |
| TOTAL ABOUT | 300,000 | .050 | 1.20 | 3.00 |

(Average value in gold & silver at 1936 prices $2.68.)

CONSOLIDATED ARIZONA SMELTING COMPANY

ANNUAL REPORT

1919

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## BLUEBELL MINE

Exploration and Development:

Our expenditure on this account amounted to only $26,157.40 equal to $0.2143 per ton of ore shipped, against a normal development expenditure of 50 cents per ton. We put in 1594 feet of diamond drill holes at a cost of $2.595 per foot and 1227 feet of drifts and cross-cuts at $17.947 per foot. No sinking was done during the year. We considerably extended the limits of some of the known ore bodies and at the end of the year found some ore in the Blue Thunder claim, half a mile south of the shaft. The importance of this discovery cannot yet be determined but it may eventually prove a very valuable addition to our reserves.

Ore Reserves:

At the end of the year it is estimated that there were 390,000 tons of ore developed as positive, highly probable and probable. Of this tonnage, 54,548 tons were broken in the stopes. In making up this estimate several blocks of known ore which have figured in previous estimates were thrown out since it will probably be impossible to recover them at any profit. Also there is a considerable tonnage of fairly low grade material which is not considered as ore under present market conditions although it may be so considered if the price of copper should advance to 25 cents per pound. The average grade of the estimated ore is $2.80 in gold and silver value and 2.65% copper.

The reduction of the Blue Bell Ore Reserves during the past year is due to the fact that development work did not keep pace with production and not to any actual failure of the ore bodies. There is every reason to believe that the ore will continue downward considerably deeper than it has been proved to date; also that we shall find additional ore reserves laterally, and particularly in the Blue Thunder Claim. If we are able to carry out diamond drilling and sufficient development work

during the present year and also to sink the shaft to the 1350 foot level it seems reasonable that the ore reserves will again increase by the first of 1921. Otherwise we must expect an additional decrease since we are taking out approximately 10,000 tons of ore per month and there is no way to maintain the reserves of the mine except thru exploration & development.

Production:

The Blue Bell Mine produced 122,068 tons of ore. The average grade was $2.82 in gold and silver and 2.582% copper. The grade of ore in copper was exceptionally low and represented a lower grade than the average of ore remaining developed in the mine. Certain conditions made it necessary to work out this low grade ore and we were also unfortunate in encountering several faults in the bigger stopes, and in suffering from falls of wall rock which seriously contaminated the grade of the ore drawn from the chutes. I think it reasonable to expect that the production for the present year will show at least equally good values in gold and silver and approximately ½% higher value in copper.

Working Costs:

In spite of every effort to economize, a continued increase was noted and the average cost of all Bluebell ore f.o.b. Humboldt was $4.0063 per ton. Here again, in addition to the general increases in the price of all supplies we were adversely affected by certain local and temporary conditions. I would especially point out the large increase in the reserves of broken ore which amounted to nearly 40,000 tons, it being necessary to pile up this large reserve in order to properly work out our big shrinkage stopes. The broken ore is only credited on our books at a cost of 50 cents per ton but actually costs us over $1.50 so that our working costs for 1919 have been increased by some $40,000.00 on this account.

As the operations of the Mine continually bring us to deeper workings and also, generally speaking, to ore bodies which are located further away from the shaft, our costs naturally tend to increase and moreover, we must take note of the fact that the efficiency of men underground has certainly fallen off during the past few years and particularly during 1919. Everything considered, I see very little

prospect of materially decreasing the cost of producing ore from the Bluebell, and we must hope for increased profits from these operations rather because of the higher grade of the ore which we expect to produce and the higher price which we expect to receive for our product, - than from any expected decrease in the costs of mining.

CONSOLIDATED ARIZONA SMELTING COMPANY

ANNUAL REPORT

1918

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## BLUEBELL MINE

### Exploration and Development:

During 1918 we started a campaign of exploration by means of a diamond drill and 3112 feet of drilling were accomplished at a cost of $9,142.35, equal to $2.938 per foot. The exploration planned at the outset was only half completed during the course of the year and fully justified the expenditure made since it resulted in the discovery of three new ore bodies, two of which have since been opened up and put on the producing basis. Both of these ore bodies are located in the hanging wall of the main vein and have been productive of a good grade of ore although, unfortunately they are of limited size.

Development work was carried on in the usual manner by drifts, crosscuts and raises but no sinking of shafts or winzes was undertaken during the year. The total expenditure for this work amounted to $67,874.62 for which we advanced 4,638½ feet at an average cost of $14.63 per foot of advance. The entire cost of exploration and development amounted to $77,016.97; this was charged against the mining operations for the year and amounted to $0.5875 per ton of ore shipped.

The main object of last year's development was to prove up the full extent of the ore bodies on the 12th level and also the extent of the new ore bodies found with the diamond drill. This work was only partly completed and results were fairly satisfactory except that some disappointment was experienced in the #5 ore body on the 12th level.

We also started a long drift southward from the main workings of the Mine to prove up the ore indicated by surface work on the Blue Thunder claim; this work did not advance as fast as expected and the drift lacked 400 feet of attaining its object at the end of the year, and shortly thereafter the drop in the price of copper made it necessary to temporarily discontinue this advance.

Development work was retarded throughout the year by the necessity of producing the maximum tonnage from the Bluebell Mine which

frequently made it impossible to handle the waste from the development and exploration work. We were also handicapped by shortage of labor during the greater part of the year and by the general inefficiency of much of the labor which was available. The new ore developed amounted to 69,290 tons against which the actual cost of exploration and development amounted to $1.11 per ton. This figure may seem extremely high as compared to the cost of development work in previous years, but in this connection it must be remembered that the long south drift which represented a large proportion of the charge made on this account in 1918 has so far been absolutely unproductive of results, although we have every reason to hope that the Blue Thunder ore body will be developed in 1919 and will eventually justify all the expenditure involved.

Ore Reserves:

The total reserve of ore estimated as positive, highly probable and probable on January 1st, 1919 was 470,000 tons, of which 15,593 tons was broken in the stopes. The estimated reserves show a decrease of 66,800 tons during the past year, during which period 131,090 tons of ore were produced and shipped from the mine. The fact that the reserves have decreased must not be considered as indicating any really serious condition or any material falling off in the future prospects of the mine but this condition is simply brought about by the fact that development during the past year could not proceed at a rate to keep pace with the production. If we are able to carry on more extensive or more fortunate development in 1919 it is probable that the ore reserves will have again increased on the 1st of January, 1920 although at the present time with development practically at a standstill the reserves are continuing to gradually decrease.

The average grade of all ore included in this estimate is figured at $2.50 in gold and silver and 2.80% copper.

Production:

The Bluebell Mine made a record production of 131,090 tons of ore containing an average of $1.26 value in gold, $1.50 value in silver, and 2.771% copper. By comparison with production of previous years, it will be noted that the tonnage increased 30% over 1917 output

and was more than double the output for 1914. It will also be noted that gold and silver have shown a steady increase in values since the end of 1913, while the copper values have been somewhat erratic, but have generally tended to decrease since that year, this being due to the fact that as a larger percentage of the Mine production is drawn from the lower levels we find that the average grade of ore is richer in gold and silver but correspondingly lower in copper, - the aggregate content of the three metals being practically the same.

At the present time the output of the Bluebell Mine is slightly less than 400 tons per day which is about the maximum that can be efficiently handled by the present Mine equipment and during this year it is probable that our production will fall below that of 1918 since economic conditions do not make it advantageous to push the Mine to the limit of its capacity.

Working Costs:

With labor receiving a higher compensation than ever before, supplies at top-notch prices and with the workings of the mine being carried on at greater depth the cost of producing ore at the Bluebell showed a considerable increase and amounted to $3.786 per ton of ore produced. This cost included all exploration and development, also sorting and freight transportation to Humboldt (and in passing it may be remarked that the freight was increased July 1st, 1918, from 35 to 40 cents per ton). Since the beginning of the present year, the scale of wages has been somewhat reduced, and if (as expected) a reduction is experienced in the price of certain principal supplies such as powder, steel, etc. there is every reason to expect that mining costs for 1919 will show a material decrease and work back again to the average of less than $3.50 per ton maintained during the five years preceding.

CONSOLIDATED ARIZONA SMELTING COMPANY

ANNUAL REPORT

1917

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## BLUEBELL MINE

Development:

During 1917 we expended for development $59,339.99; this was all charged against operations and represented $0.577 per ton of ore shipped. The development work consisted principally in sinking the main shaft from the 1000 to the 1200 foot level, a total of 215 feet, accomplished at a cost of $12,592.94, equal to $58.43 per foot. In addition, drifts, crosscuts, raises and winzes were run 3,461 feet at a cost of $46,747.05, equal to $13.51 per foot of advance. Aside from the sinking, our development was mainly aimed to prove up the extent of the #5 ore body on the 8th, 9th and 10th levels and to develop the ore bodies on the 12th level. This latter work was only started at the end of the year.

The new ore developed during the year is estimated at 160,073 tons, the cost of development amounting to $0.37 per ton of new ore developed, which is unduly high on account of the heavy expense of shaft sinking and because of the fact that only a portion of the ore which we anticipate developing on the 12th level can as yet be included in the above estimate.

During 1917 we found one entirely new ore body which is apparently a blind shoot, its upper termination being 50 feet above the 700 foot level. This discovery is particularly interesting because it demonstrates the existence of blind ore shoots in the Mine (i.e. ore shoots which are not represented by any outcropping) and in all probability other similar shoots may be located as we explore more thoroughly the mineralized zone.

Aside from the above discovery we developed considerable new ore in the southward extension of the #5 and this we have proved up on the 850 foot level, the 1000 foot level and in part on the 1200 foot level.

The work of sinking the shaft was delayed beyond our expectations and the development of ore on the 1200 foot level only began at the first of the present year. At date of writing this report (Feb. 20 1918) we have encountered only two of the ore bodies, the #2, which is now proved up for a length of 75 feet, and the #5, which is proved up for a length of 185 feet. We confidently expect to prove up in due course of time and within the next six months the balance of the #2 and #5 and also the #1, 3 and 4 ore bodies.

During the coming year we have laid out an extensive plan of development intended to thoroughly prove up all the known ore bodies on the 12th level, also to explore by means of diamond drilling, the hanging and foot wall sections of the main veins from the 700 foot level and to explore the southern extension of the ore bearing zone for a length of 2000 feet south of the #1 ore body and ~~the~~ particularly under the Blue Thunder out-cropping, where shallow work has proved up the existence of some ore.

In general it may be said that development work during 1917 was to a very large extent preparatory to the 1918 development, therefore, the actual increase in ore reserves is small compared to what we may expect to show if 1918 work results successfully.

Production:

The output of the Bluebell Mine was increased 37% during the past year and 102,773 tons of ore were shipped to Humboldt. The average grade of ore produced was $2.40 in gold and silver and 3.176% copper. The copper content was a little lower than in 1916 but this was more than compensated by the higher average values in precious metals and in general it may be said that although the Bluebell ore appears so far to remain constant in copper values as depth is gained the gold and silver have steadily increased and the average grade of the ore developed in the lower levels has shown improvement rather than the contrary.

Since the beginning of 1918 we have been producing at the rate of nearly 400 tons of ore per day and the outlook is that this year's production will show a very considerable increase over the production of 1917.

Working Costs:

The cost of Bluebell ore f.o.b. Humboldt, including development, mining, hoisting, rope-way transportation, sorting, freight and all general mine expense and local taxes, was $3.35 per ton or 21 cents less than 1916. The cost of mining proper (excluding development & freight) was $2.42 pr 7 cents more than 1916. The conditions under which we have been operating for the last three years have all tended to steadily increase working costs, but we hope to approximately maintain the present mining costs, compensating by a larger production the fact that our ore will come from deeper levels. The charge for development work will probably be higher in 1918, but this should be justified by the tonnage of new ore developed.

Ore Reserves:

The estimate of ore reserves presents peculiar difficulties since we are just beginning to open up the downward extensions of the ore bodies on the 1200 foot level and although each daily advance increases the reserve tonnage this work has not yet progressed sufficiently far to justify more than a partial estimate of the 1200' level ore bodies

The total estimate of positive, highly probable and probable ore as of January 1st, 1918 is 536,800 tons of which 26,967 tons was broken in the stopes. This estimate shows an increase of 57,300 tons over the estimate of 479,500 made at the end of 1916, and as we shipped during the year 102,773 tons of ore, it results that a total of 106,073 tons of new ore were developed. In addition to this estimate I think it fair to say that there is a large quantity of prospective ore representing the downward extensions of the #3 and 4 and the north end of #5 and "55" ore bodies which in all probability will be proved up by the 12th level during the next 6 mos. No definite figures can be placed on this tonnage.

It is particularly important to note that the #5 or principal ore body, including the "45" and "55" shows continuous improvement as depth is gained. This shoot represents 543 tons of ore per vertical foot between the 600 and 700' levels; 747 tons per vertical ft. between the 700 and 800' levels and 1209 tons per foot between the 850 and 1000' levels.

The average grade of all developed ore reserves is estimated at $2.00 per ton in gold and silver values and 3.10% copper.

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CONSOLIDATED ARIZONA SMELTING COMPANY

ANNUAL REPORT

1916

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## BLUEBELL MINE

### Development:

During 1916 we accomplished 4819 feet of development work at a cost of $63,197.00, representing an average cost of $13.11 per foot of advance, or $0.84 per ton of ore produced during the year. The main features of this work were the lateral extension northward of the 400, 700, and 1000 foot levels for the purpose of proving up the #5 and #6 ore bodies. The general results of this work were successful and we developed 319,570 tons of new ore, the cost of development work amounting to $0.20 per ton of such new ore developed. As the production from the mine during 1916 was 75,070 tons, it should be noted that during the year we have developed more than four tons of new ore for each ton of ore which has been mined.

During the current year (1917) it is our intention to continue actively the development work and more particularly to sink the main shaft from the 1000 foot to the 1200 foot level and to extend the 1200 foot level under all the ore bodies known to exist at the present time. In addition to this development at a greater depth we shall make special efforts to fully develop the #6 ore body on the 700 and perhaps on other levels and it is also probable that we shall explore the country lying to the south of the main Bluebell workings and in the direction of the new discoveries on the Blue Thunder claim, at which point good indications of ore are found 1600 feet south of the workings from our main Bluebell shaft.

### Production:

The output of the Bluebell mine was 75,070 tons of ore containing on the average $1.70 per ton in gold and silver values and 3.278% copper. This is a distinct improvement over the grade of the ore produced in 1915. That production was not as large as in 1915 was due

to the increased output from the DeSoto Mine, which produced approximately one-third of the domestic ore treated at Humboldt during the year and the production of both mines was limited by the capacity of the Concentrator and Smelter at Humboldt. It should also be stated that the Blue Bell ropeway, three miles in length, was in very bad shape during the early part of the year and it has been practically rebuilt and completely equipped with new cables, this work necessarily interfering, to some extent, with the tonnage handled.

The rope-way, now entirely renovated, is in excellent condition and capable of handling upwards of 500 tons of ore per day. The capacity of the Concentrator and Smelter has been increased (and will be still further increased during 1917) so that it is reasonably certain that the production of the Bluebell will show an increase from this time forward.

Working Costs:

The cost of the Bluebell ore f.o.b. Humboldt, including development, mining, hoisting, rope-way transportation, sorting, freight (35¢ per ton); general mining expense, taxes, etc. was $3.565 per ton. Tables included in this report show that the cost of producing ore at Bluebell has been steadily increasing during 1915 and 1916, but such increase has been, to a large extent, caused by the greater amount of development work carried on during these two years and particularly during 1916, and the large increase in ore reserves which has accompanied this expenditure has, I believe, been excellent justification for same. Other factors entering into the increased cost of operations have been the increased cost of labor and the advancing prices of all supplies, especially explosives; also the difficulty of operating the rope-way during the reconstruction period and the fact that the large stopes in the #5 ore body were being timbered and prepared for active production at heavy expense.

We are now working at greater depth than we were in 1913 and 1914 and in ore bodies located further away from the main hoisting shaft and in spite of the greater production and the economies which are constantly being effected it is altogether probable that the cost

of mining at the Bluebell cannot be greatly reduced in the future, except as the falling price of copper may reduce the cost of labor and as the cost of supplies may fall due to other conditions; and, also, as it may be advisable to reduce the amount of development work which is carried on in connection with the actual production. The outlook for 1917 is favorable for a slight reduction in costs because of the larger tonnage that we expect to produce and because of the better condition of our mining and tramway equipment.

Ore Reserves:

The reserves of positive and probable ore are estimated as of January 1, 1917, at 479,500 tons and the average grade $1.60 in gold and silver and 3.30% copper and of this reserve 21,248 tons were broken in the stopes ready to hoist. I desire to call particular attention to the ore reserves at Bluebell and especially in comparison with past ore reserves as shown in the accompanying table. Ore reserves are the foundation of all successful mining operations but on the other hand an excessive tonnage blocked out in advance means the investment of a large sum of money on which interest is lost until such time as the ore is actually mined and, moreover, ore that is opened up by drifts, raises etc. tends to oxidize superficially and to become less suitable for concentration. It is, therefore, a question that must be decided in each individual case as to how far it is justifiable to develop ore reserves in advance and many large companies only carry a reserve of from two to five years ahead of their production, feeling confident, nevertheless, that additional development work will serve to maintain these reserves at approximately the same level for a long period of years to come. On the other hand, the companies operating the porphyry coppers and other deposits of similar nature have frequently developed from twenty to fifty years' ore supply, but this development is done by drilling and at infinitely less expense than is necessary in the case of a deposit like our own.

After careful consideration it would seem that the mines of the Consolidated Arizona Smelting Co. should be developed to a point where approximately five years ore reserve can be counted on with

definite assurance and it is towards this point that I have been aiming during the past two years.

General:

It may be said that the condition of the Bluebell Mine has continued to steadily improve and that progress has been made from every standpoint except in the reduction of working costs. The five main ore shoots of the mine are now developed to a depth of 1000 feet and although there have been some local impoverishments these ore bodies generally appear to have held their own and there is every indication that they will continue to do so for a considerably greater depth. Should development prove as good on the 1200 foot level as on the 1000 foot level we shall add approximately 200,000 tons to our reserves of ore, and moreover, there are probabilities that additional lateral development will prove up more ore, this being particularly true of the #6 ore body and also in the case of the ore which is indicated to lie south of the main workings and in the Blue Thunder claim.

We still possess a considerable amount of unexplored territory in the Bluebell group of claims, much of which is of a promising nature, and which little by little we hope to explore and develop.

CONSOLIDATED ARIZONA SMELTING CO.

ANNUAL REPORT

1915

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Bluebell Mine: Development

During 1915 we accomplished 2,743 feet of development work at a cost of $22,391.74. This included the sinking of the shaft 150 feet and the opening of the 1000 foot level; the drifts on the 400 ft. and 700 ft. levels were also extended northward and important discoveries of ore were made by these extensions. The development work represented a cost of $0.273 per ton of ore shipped and the new ore developed amounted to 165,000 tons.

Production:

We produced 82,171 tons of ore containing an average of $1.40 per ton in gold and silver values and 2.97 per cent copper. The comparatively low grade of ore produced was mainly due to lack of sufficient development during previous years and during the last three months of 1915, the production averaged well above 3 per cent. copper as it may be expected to do during all of 1916.

The 1915 output should be compared with 56,000 tons produced in 1914, and 37,000 tons in 1913. We expect to produce over 100,000 tons during 1916.

Working Costs:

The cost of Bluebell ore f.o.b. Humboldt including development, mining, hoisting, ropeway transportation, sorting, freight and general mining expense was $2.629 per ton in 1915, against $2.38 per ton in 1914 and $3.35 in 1913. During the year just past we have been mining from greater depth than in previous years and also from ore bodies located further from the shaft, the average rate of wages has also been higher and many supplies such as dynamite, fuse, and drill steel have greatly increased in price. These factors have all tended to increase mining costs and the outlook is that ore will be produced during 1916 at approximately the same average figure as during the past year.

Ore Reserves:

The reserves of positive and probable ore January 1, 1916 are estimated at 235,000 tons, average grade $1.50 in gold and silver values and 3.5 per cent copper. Of this reserve 11,000 tons was broken in the stopes ready to hoist. This reserve compares with previous estimated reserves of 152,000 January 1, 1915, and 154,000 tons January 1, 1914. If developments are successful during the present year we should have a reserve of 400,000 tons by January 1, 1917, and it may be mentioned that the reserve at date of writing (February 21st) is estimated at 280,000 tons.

General:

The mine is in better condition from every point of view than at any time during the past three years, the ore reserves are larger and better opened up and so far no one of our six producing ore shoots has been bottomed. There are particularly strong reasons to expect material additions to our reserves in the No. 5 and No. 6 ore shoots which we have only just begun to develop in depth. The equipment of the mine, in the main, is in good condition and the excellent new hoist recently installed will enable us to work down to a depth of 2000 feet.

# ANNUAL REPORT - 1914

## BLUE BELL MINE

General Results of Operations:

During 1914 the Bluebell Mine produced 56,058 tons containing 2,064.15 ozs. of Gold, 71,526.48 ozs. of silver and 4,078,021 lbs. of copper. The average grade of the ore produced was: Gold .0368 ozs. Silver 1.276 ozs, and Copper 3.63%. In 1913 the total production was 36,792 lbs. with average grade as follows: Gold .0465 ozs., Silver 1.330 ozs., and Copper 3.758%.

The lower grade of production during 1914 may be attributed in part to the increased tonnage, but more particularly to the larger proportion of milling ore which was extracted in 1914. The smelting ore at Bluebell constituted nearly one half the production in 1913 and practically all of this was taken from the No. 1 Ore Body which is the richest ore in the mine, particularly in reppect to gold values.

An examination of the results for 1913 show that operations were conducted with fair regularity throughout the entire year while as stated above the operations at the Bluebell for the first six months of 1914 were irregular and comparatively small. During the last six months the Bluebell produced 38,529 tons, or nearly 2000 tons more than the entire production for 1913 and the average rate during this period was 6.420 tons per month, while the production during the last two months averaged 7,500 tons.

Ore Reserves:

On January 1st, 1914 no estimate was made of the ore reserves in the Bluebell but for comparison with the estimate accompanying this report I take the estimate which I made on November 1st, 1913 from which there appeared to be 34,000 tons of "Positive" ore, 71,600 tons of "Highly Probable" ore, and 39,000 tons of "Probable ore, a total of 154,600 tons, estimated to average 3.5% copper and $1.50 in gold and silver, equivalent to 80 lbs. of copper per ton of ore. The above estimate was largely based on old samples and assay maps and the data available was not nearly as complete as I could have wished but nevertheless this estimate has so far proved to have been fairly accurate.

During the past year 56,000 tons of ore included in this estimate were mined and shipped away but on the other hand development work added new ore reserves and the estimate which accompanies this report, which is based on fairly complete information, shows 74,500 tons of "positive" ore, 26,500 tons "highly probable", and 50,900 tons "probable, a total reserve of 151,900 tons, estimated to contain on the average 76 equivalent pounds of copper per ton. For purposes of general comparison it can therefore be said that the development work during the last 14 months proved up just about as much ore as was extracted, so that in effect the ore reserves held their own although this statement is not strictly accurate owing to the different conditions under which the two estimates were made. It will be understood that development work does not always serve to increase the ore reserves estimated in a mine. The ore, as noted, is divided into three classes, and after it is first indicated additional development is necessary to put the "probable" ore into the "highly probable" class, and again more development work is necessary to bring the "highly probable" into the "positive class". In these respects we have gained considerably as will be noted by comparing the figures given above and especially the relative tonnages of "positive" ore figured in the two estimates. On the other hand, it should be considered that we are now operating the mine on a basis of more than double the average production made in 1913, and therefore the reserves which at the end of that year represented approximately four years ore supply may now be considered as representing, at best, only two years ore supply and it must further be taken into consideration that at least 40% of the ore estimated will not be available for extraction for several months yet to come so that in more senses than one we are operating the mine from "hand to mouth", and it is most essential that the amount of ore reserves, and particularly the amount of available ore reserves, should be very considerably increased.

Development Work:

The development work in 1914 was composed of 63 feet of cross-cuts, 555 feet of raises and 793 feet of drifts, making a total of 1411 feet advance against 1299 feet advance in 1913. The direct expenditure

for development amounted to $11,751.65, practically $1,000 per month, and representing an average of $8.33 per foot of advance. The expenditure for development work was governed largely by outside conditions and much of the development which had been planned had to be postponed with the outbreak of the European War and was not resumed again until nearly the close of the year. It is a matter of deep regret to me that we were not able to expend more money on development of the mine during 1914, and we find ourselves with the beginning of the present year very far behindhand with this work.

The very foundation of every mining and metallurgical enterprise lies in the ore reserves and if these are allowed to fall below a certain figure a very dangerous condition immediately arises with future operations all hinging upon the uncertain results of additional discovery of ore bodies and under these conditions no great security can be felt either by the management or by those financially interested in the company. Now that we have largely increased the scale of our mining operations our ore reserves must frankly be considered as pitifully and dangerously small and it is very vital that every effort should be made to increase these ore reserves at the earliest possible moment. It is with this object in view that I have urged so strongly the sinking of the Bluebell shaft (work on which has fortunately been begun in February of 1915) and also for this purpose that I am particularly desirous of reopening the De Soto Mine, where approximately 30,000 tons of ore can be estimated.

From this time forward then it is absolutely essential to the success and security of our operations that a larger monthly expenditure should be made for mining development, and during the present year I hope to expend approximately $2000 per month on this account and I trust that the results of this work may be satisfactory and that at the end of 1915 after a yearly production of 70,000 to 80,000 tons of ore we shall be able to estimate at least 200,000 tons of reserves in the mine.

There is at the present time every indication that our Bluebell ore bodies will persist in depth but even assuming that No. 1, No. 3 and No. 4 ore bodies continued downwards as at present the amount of ore

which we may expect to develop in these three ore bodies will be approximately 40,000 per 100 feet of depth so that in order to keep up with the production of the property it will be necessary for us to sink at the rate of 200 feet per annum.

During the past year the results of our development have been good and satisfactory, with one exception, in that we have failed to prove up so far any commercial ore in the No. 6 Ore Body on the 5th level. Although this particular work has so far been rather discouraging, I do not consider that it should be discontinued and am entirely confident that we shall eventually find the ore at this point. Many of our ore bodies have been faulted and thrown both laterally and vertically for some distance and we have only recently, after several months of work, succeeded in locating the No. 4 Ore Body above the fault in the 340 stope. Undoubtedly the No. 6 Ore Chute has been displaced and we shall simply have to keep on looking for it until the location of the 5th level is definitely determined.

The main accomplishments of our development work during last year were as follows:

(1) The No. 1 Ore Body was proved to be valuable above the old stopes and on either end of the Glory Hole south of the shaft. A considerable amount of good ore was mined from both ends of the Glory Hole and run down into the 410 Stope.

(2) We proved good ore in the No. 3 Ore Chute above the 2nd Level and at this point we opened up one of the best stopes in the mine, in which over 10,000 tons of excellent ore were broken. We have also proved ore in the No. 3 Ore Chute on the 3rd and 4th levels and we are now stoping above these levels with good results.

(3) We developed some commercial ore in No. 4 Chute between the 8th and 9th levels and are now raising up to connect these two levels prior to starting a stope. This ore is only fair and unfortunately indications are that No. 4 Ore body will not extend very far below the 9th level.

(4) We proved ore to exist in No. 5 ore chute on the 3rd level and proceeded to connect up the 5th and 3rd levels by means of a raise and we are now preparing to stope the No. 5 Ore Body upwards from both the 5th and 3rd levels.

(5) In the ore reserves already partially indicated we worked upwards above the 3rd level in the No. 4 Ore Body and are getting some very excellent new ore at this point although unfortunately it is all oxidized and suitable only for converter flux. We also connected up the 8th and 9th levels in No. 1 Ore Body and in No. 3 Ore Body and we connected the 7th and 8th levels in No. 3 and No. 4 ore bodies.

A considerable amount of work, not strictly development, was also undertaken in the old stopes and workings and a great deal of valuable ore was discovered at these points, either covered with waste or left on the hanging or foot walls of the stope. The fact that this ore was left by former managements was undoubtedly due to the fact that it could not be suitably handled by the plant which was then operated at Humbodt, as most of it is too siliceous for direct smelting.

To sum up then the results of our development, we have held our own in point of tonnage during the past year but having doubled the rate of production we have reduced our ore supply to 50% of what it formerly was in point of time and in future our development work must also be doubled if we are to keep our ore reserves from passing out of existence altogether. I consider that we should make every effort to increase these ore reserves until they amount to at least a three years ore supply on the actual basis of operations and that we should from this time forward endeavor to maintain the reserves at approximately the amount of a three years supply. As stated above if we do not succeed in developing altogether new bodies we will have to sink approximately 200 feet per year in order to keep up with our extraction and it is of course to be expected that No. 1 and No. 3 Ore Chutes will grow poorer and disappear altogether at some point in depth although I am glad to say that there is no reason to believe that either of these ore bodies will not go down several hundred feet deeper than proved up to

the present time. We must also make every effort to follow down the No. 5 Ore Body which so far is only developed to the 5th level and which unfortunately appears to be decreasing in value as it goes downward, and we must make special effort to locate and develop the No. 6 Ore Body about which very little can be said except that it has an exceptionally strong and promising surface outcrop. It will also be our effort to discover and develop ore in other places where indications are favorable but where no exploration work has yet been attempted.

Method of Stoping:

Until the end of 1913 the stoping at the Bluebell had always been done by the shrinkage system but near the end of that year several stopes were started by cut-and-fill. The cut-and-fill method although possessing some advantages has not proved economical and has now been abandoned except in the case of one or two stopes where the walls of the ore body are particularly bad and we have reverted to the shrinkage method wherever possible. The ore from the shrinkage stopes is not as clean or free from waste as that which is taken by the cut-and-fill method, but the additional expense involved in sorting this shrinkage ore is more than compensated by the decreased expenditure in underground mining, it being particularly difficult to secure waste for filling the stopes. In both cases the ore is broken down with hammer drills and we now use piston drills only for drifts and cross-cuts and jack hammers are used for sinking, all of our work being done therefore by one-man drills.

Working Costs:

In 1913 the sorted ore F.O.B. Siding, cost $2.9853 per ton. The average cost for the year 1914 was $2.3759 per ton, while the average during the last six months of 1914 was $1.79 per ton and as has been stated above, the last six months during which time the mine was operating regularly formed the only fair basis of comparison. Excluding the development work in each case the cost figured at $2.72 for 1913 and $1.30 for the last half of 1914. This very large reduction in working cost has been due in part to the increased tonnage which we have handled,

and in part to new methods of stoping and tramming, but more particularly, I think, to a better organization and better discipline of the working force. To some extent the last cost figure has been influenced by the valuation which we put on the increase or decrease of broken ore in the mine and the figure given above is probably about 10¢ lower than it should be but even so it is pleasant to report that we have decreased our actual mining costs to 50% of the mining cost in 1913.

As to the cost of mining in the future there are several things that must be considered. In the first place we must double the amount of development work which we have done in the past and it is to be expected that the cost of development in 1915 will average 50¢ per ton of ore shipped. Aside from this a larger proportion of our ore will have to come from the deeper workings and from the stopes which lie at some considerable distance from the shaft and these causes will tend to increase the cost of operations. To offset this we hope to get away almost entirely from the cut-and-fill method of stoping and we also expect to open up our new stopes in a better manner than was done in the past and to maintain and if possible improve the efficiency of the working force. I believe therefore that the cost of our ore at the siding should only increase in proportion to the added amount of development work which we shall do and I would estimate that for 1915 our average cost of ore should be $2.00 per ton at the Siding, including the development work, which would make the cost of the ore at Humboldt approximately $2.35 per ton.

Exploration Work:

During the past year we have not been able to devote as much time and attention as could be desired to a study of the geological conditions at the Bluebell and to the possibilities of discovering and developing entirely new ore bodies. I hope, however, to devote considerable atudy to this question during 1915.

An examination of the surface indications at the Bluebell Mine would seem to indicate that there are two parallel ore zones, in which ore chutes of commercial ore may be expected to occur. These two zones lie approximately 125 feet apart in an east and west direction

and appear to continue nearly parallel and I believe that by cross-cutting from the ore chutes which we have at present developed there may be a good possibility of discovering the ~~xxx~~ parallel ore chutes in the other zone. For instance, we have now clearly proved that the outcropping of the No. 4 Ore Body lies in the bed of the creek, and directly west of this outcropping, 140 feet, we have another strong surface outcrop which should represent an unknown ore body lying that distance to the west of the No. 4. In the near future it is my intention to cross-cut in the hope of developing this ore underground. In the same way we have found a rather weak outcrop lying approximately 100 feet east of the No. 5 ore body, and to this also we hope to cross-cut in the near future.

As to the possibilities of discovering ore outside the limits of the present mine workings very little can yet be said. If we should have good success in developing the No. 6 Ore Chute it would seem advisable to do some prospecting and exploration further north, although work done several years ago in that direction did not meet with success. About half a mile south of the Bluebell shaft we have the outcroppings and surface work on the Blue Thunder Claim and during the past year we scraped up a few tons of surface ore from this property. The work which was done here in former times and the little assessment work which we did during the last year have not proved up anything of commercial importance but nevertheless the Blue Thunder presents rather an interesting geological problem, and I am inclined to think that here also some exploration will be well justified and that there are good possibilities of discovering commercial ore in this section of our property.

EXTRACTS FROM

SPECIAL REPORT ON BLUEBELL MINE BY G. M. COLVOCORESSES

September 26th, 1914

## RESULTS OF MINING OPERATIONS DURING 1914

During the first eight months of this year we shipped from the Bluebell 28,918 tons of ore, containing 1158.34 ozs. of gold, 37,902.18 ozs of silver and 2,192,539 lbs. of copper. This represents an average content per ton of .04 oz. gold, 1.31 ozs. silver and 3.75% copper. The value of the ore based on the low prices which have prevailed during the year has been a little better than $12.00 per ton. Since the 1st of April, at which date the last estimate of ore reserves was made, we have shipped 24,332 tons of ore of approximately the same average composition as mentioned above. From the above statement it will be noted that the grade of ore is just about the same as the average grade produced during the year 1913. The gold and silver are just a shade lower, and the copper content is precisely the same as the average in the year 1913.

## RESULTS OF DEVELOPMENT WORK IN 1914

Since reopening the mine in February and up to the 1st of August a steady program of development was pursued and an effort was made to increase our ore reserves as much as possible. We were not able to devote as much time or money to this development as I could have wished but in the main the results have been satisfactory, although, as will be seen from the estimate of ore reserves, our new developments have not really kept pace with our extraction of ore. The principal work along this line has been as follows:

No. 1 Ore Chute: Developments near the surface prove that a very considerable body of ore existed between the 210 Stope and the surface and on either side of the cave which we have referred to as the Glory Hole. A portion of this ore was considerably oxidized and was used for converter flux. Another portion was fairly basic and passed as direct smelting ore, while the greater part is suitable for milling. We have already mined the ore reserve left on the south side of the Glory Hole and we are now just beginning to mine on the north side. The total reserve on September 1st amounted to 829 tons of broken ore, and approximately 3000 tons Positive

and Probable ore in place. The gross value of this ore may be considered as a little better than $12.00, and the cost of breaking same and hoisting it is comparatively cheap.

Aside from this point there has been no attempt to develop an additional ore reserve in No. 1 Ore Chute. In several of the old stopes there remain large pillars of ore and also a good deal of broken ore mixed with waste, and as we gradually work down from above we expect to rob the pillars and sills and to sort out the broken ore from the waste, in so far as it is economical to do so. It would appear from the map that there is really a large block of ore left at the south end of the 611. This is at present inaccessible but in due course we expect to extract whatever reserve may be left at this point.

No. 2 Ore Chute. No development work was done here but a large amount of sampling has resulted in proving that much of the ore is low grade and under present conditions can hardly be mined at a profit. Aside from the 420 stope (which is now worked out) there does not appear to be any continuous body of ore averaging better than $8.00 to $9.00 per ton. I have estimated that under present conditions it would hardly be profitable to mine any of this material but I consider that in all probability we should be able to handle this with profit in 1914 and have, therefore, continued to include the ore from this chute in the estimate of commercial reserves although it will be understood that this ore is not really available at the present time. There seems to be good reason to believe that occasional pockets or chimneys of fairly high grade ore occur through this chute and by careful and accurate sampling and selective stoping, we shall undoubtedly be able to eventually extract practically the entire tonnage estimated.

No. 3 Ore Chute: The most important of our recent developments have been in connection with this portion of the mine. On the 2nd level we have opened up a length of 200 feet of excellent ore, averaging nearly 10 feet in width and have a value of better than $12.00 per ton. We are now beginning to stope at this point and although we do not know how far upwards the ore will extend it seems fair to assume that it should extend at least up to the oxidized zone, which is probably 100 feet above the back of the level.

Below the 2nd level the developments have no where been as good and while it is quite certain that we shall get some good ore between the 4th and 2nd levels the amount and value of this is rather problematical The grade of ore continues to decrease down to the 6th level and then increased again until we find most excellent ore along the 8th level, and more particularly along the 9th. We are now getting some of the best ore in the mine from the 930 stope and there is every probability that below the 9th level a very excellent reserve will be developed in this cute.

No. 4 Ore Chute: No developments of importance were made here. In the back of the 340 stope the ore is so badly faulted as to become unworkable, and we have not been able to extend our work upward to the oxidized zone although I believe that it will pay to return to this point later when we have more time to spare for exploration. We are mining good ore in both the 740 and 840 stopes and it seems quite certain that some ore must exist between the 8th and 9th levels and on the 9th the indications are that the ore has been carried over into the hanging wall, and this is a matter which we mean to investigate more thoroughly in the course of the next few months.

No. 5 Ore Chute: We are without much definite information concerning the value of this reserve since we have only cut it on the 5th level and our 3rd level still lacks about 100 feet of reaching the point where it should intersect with No. 5 Ore Chute. I had intended to push this work more speedily but a variety of causes have made it difficult to go ahead here and therefore no additional information has been gained since last April.

No. 6 Ore Chute - Bluebell: I am particularly disappointed not to have any definite information to give you in regard to this ore body. I continue to have the highest opinion of the probabilities of developing a large reserve of ore at this point and have been most anxious to push the development work but as will be noted this ore chute is a long way from all the other workings of the mine and progress is slow and expensive. It has not yet been possible to push this work as I could have wished or to actually strike in to the position where we believe the ore body must lie on the 5th level and which apparently is located some

80 or 90 feet to the east of the present heading in the drift. We are now resuming developments at this point which were interrupted in July and I shall hope to have some definite statements to make in regard to the Blue Bell Ore Body in the course of the next two or three months.

In general it is my intention to prove up the No. 5 and No. 6 ore bodies as quickly as possible and also to endeavor to locate No. 4 on the 9th level but it should be noted that aside from these points the mine is now pretty well developed down to the 9th and that we cannot hope to prove up any extensive additional ore reserves in No. 1, 2, 3 or 4 ore bodies which up to the present time have been the mainstay of the property. There is an opportunity for considerable exploration work and a possibility that parallel ore chutes may occur east or west of main line of workings. This exploration will receive due attention as time permits but it should be considered secondary to the development of additional ore reserves at points where we have every reason to believe that they actually do exist.

By examining carefully the estimate of ore reserves included in this report and by comparing it with the estimate attached to the report of April 27th, it will be noted that although we have developed approximately 18,000 tons of new ore we have extracted and shipped some 24,000 tons during the same period of time so that our reserves at date are approximately 6000 tons less than they were on April 1st. This statement is not strictly accurate because in revising the estimates in the light of the latest sampling of the mine it became necessary to materially change some of the figures given in previous estimates but nevertheless it can be taken as a statement of fact that we cannot expect to prove up any considerable bodies of new ore in the southern portion of the mine above the 9th level and that in this section of the property our ore reserves from now on will continue to decrease unless we immediately begin to deepen the mine, and start about the opening up of the 1000 ft. level. We may of course find some large reserves both in No. 5 and particularly in No. 6 Ore Chutes but these are at best uncertain quantities at the present time and I consider that the time has come to seriously consider the necessity of deepening the mine and gaining new ore with

depth on the ore bodies which we have so far followed down to the 850 foot level.

CONCERNING THE 1,000 FOOT LEVEL

It is my desire to deepen the shaft by approximately 150 feet, put in the usual station, sump, ore pocket and extend a level at a depth of 1000 feet from the collar of the shaft, this to be known as the 10th level. From all indications which we have up to the present time it seems reasonably certain that we can figure on No. 1 and No. 3 Ore Chutes extending downwards below 150 feet below their present known limits. It is also possible but not probable that we shall find commercial ore in No. 2 and No. 4 Ore Chutes and as yet I have not sufficient knowledge concerning No. 5 and No. 6 to do any figuring for or against their continuance to this depth. But assuming that No. 1 and No. 3 continue downwards with approximately the same quantity and quality as proved on the 850 level we should develop by the 10th level an additional reserve of approximately 50,000 tons of ore which on the present basis of production would keep us running for something like 8 months.

EXTRACTS FROM SPECIAL REPORT

BLUE BELL MINE

April 27, 1914

By G. M. Colvocoresses

Results of Past Operations

During the year 1913 the Bluebell Mine produced 36792 tons of ore, containing 1711.42 ozs gold, 48920.8 ozs. silver and 2,765,166 lbs. copper. The average content of this ore per ton was .0465 ozs of gold, 1.33 ozs. of silver and 3.76% copper, which on the prices of metals prevailing throughout the year meant a gross value of $13.23 per ton, the aggregate gross value of the production being $486,838.49.

November 19th, 1913, I made a report of the Bluebell Mine to the Board of Directors, estimating the ore reserves as they existed in the mine on November 1st. Since that date the mine has produced 10,082.53 tons of ore; 489.31 ozs. gold, 13,296.30 ozs of silver, and 766,123 pounds of copper. The average content of this ore per ton has been .0486 ozs. gold, 1.32 oz. silver, and 3.8% copper. The market values of copper and silver have been lower since November, 1913 than during the average of the year, and the gross value contained in the ore mentioned above was only $12.80 per ton although in point of metal contents it was actually a trifle richer than the average of all ore produced in 1913.

The Bluebell Mine was closed down almost entirely during the latter part of December, 1913, and operations were recommenced on a small scale in February, 1914, increased to over 100 tons per day in March, and at date of writing ore is being broken, hoisted and shipped at approximately 180 tons per day.

The figures quoted above in regard to value and grade of ore are interesting, not only as showing what the mine has actually done, but as an indication of what may be expected from future output. To the best of my knowledge no attempt was made in 1913 or since that time to gouge out the richer portions of the ore bodies and the productions represent the average run of mine material as broken in the stopes, and approximately the average material which remains in place

in these same ore bodies and from which we shall largely draw our production. It is true that there are certain portions of the mine from which a similar grade of ore can be obtained only by selective stoping, or by sorting out a considerable amount of waste, but allowance for this has been made in calculations and the poorer portions of the mine will be seen to average with the richer portions and to show a large reserve of very good ore awaiting extraction.

I believe, moreover, that the figures quoted above go to show that both in tonnage and quality of ore the estimate of reserves made by me to Mr. Kittle in February, 1913, and again in the estimate which I made for the Directors in November, 1913, were conservative and have so far been justified by the results of operations; and I further believe that the estimate made in this present report after more careful investigation than was possible on either of the other two occasions will be found to be also conservative and approximately accurate in so far as accurate knowledge is available at present.

In calculating the tonnage I have personally, in so far as possible, measured the width of the ore independent from the widths posted on the plan. In some cases, where the ore appeared to be of uniform grade I have estimated the full width as of the grade represented by the assay. Elsewhere this grade has been reduced by means of hand samples or approximate allowance. The estimates of tonnage and values are therefore not absolutely fixed nor accurate but I believe that they are as accurate as present knowledge will permit and that they are uniformly conservative and as the sampling and assaying proceeds, additional revisions of the estimate will be made and forwarded to you.

In the former reports which I made on the mine I assumed from rather incomplete data that the average grade of the ore was 3.5% copper and that the gold and silver had an average value of $1.50 per ton. I have now been able to improve on this method somewhat and have estimated each block of ground as ore of a different value based on the available assays, and figuring gold at $20.00 per oz; silver at 58¢ per oz; and copper at 14.5¢ per pound. In making these ~~xii~~ estimates

I have made use of a good many assays which are not posted in the plan, and also of the records of ore mined and hoisted from the various stopes.

In considering the present estimate you will note that the aggregate tonnage estimated in the mine has been considerably increased, and now amounts to 190,720 tons, as against 154,600 tons estimated November 1st, 1913. The increase in Probable Ore amounts to 13,000 tons, and the increase in Positive and Highly Probable ore accounts for the difference, namely, 23,000 tons. All of these increases are due to the increased widths of various ore bodies as proved by the work done during the last four months. During that time we have not devoted any money to exploration proper, nor have we discovered any new bodies of ore, or any substantial increases in lengths of ore chutes, but we have proved for instance that the width of the ore body at 930 is ten feet instead of five, as previously estimated, and in many other places we have been able to develop additional width. In nearly every place where we have carried on developments along these lines, the results have been successful and encouraging. The one exception is the No. 5 (Blue-buck Ore Body) where it now appears that our ore is lower grade than expected and the tonnage of pay ore is doubtful. However, I cannot say very much about this ore body one way or the other until we cut same on the 250 level, as we hope to do in the course of the next two or three months. After that we shall have some accurate data upon which to base our estimates.

At the present time we are starting again to explore the No. 6 (Bluebell Ore Chute) and we have every expectation of finding a valuable ore reserve at this point, the results of which will be recorded in due course.

## ORE RESERVES

The ore reserves of the Bluebell Mine I estimate as follows, as at April 1st, 1914:-

| Ore Body | Section | Broken | Positive | Highly Probable | Probable |
|---|---|---|---|---|---|
| No. 1 (Blue Coat) (South End) | Above 300' Level | 1000 $12 | ------- | 3000 @ $15 | 3000 @ $15 |
| | 300' - 400' | ------- | 2000 @ $12 | 2600 @ $12 | ------- |
| | 400' - 500' | 1000 @ $12 | 4000 @ $12 | 4200 @ $12 | ------- |
| | 500' - 600' | 1000 @ $12 | 3000 @ $12 | 3500 @ $12 | ------- |
| | 600' - 700' | 2000 @ $12 | 1000 @ $12 | ------- | ------- |
| | 700' - 850' | 1000 @ $14 | 10000 @ $14 | 15000 @ $14 | ------- |
| | Below 850' | ------- | ------- | ------- | 15000 @ $12 |
| No. 2 (Blue Coat) (North of Dyke Mostly) | Above 200' " | ------- | ------- | 2000 @ $11 | 3000 @ $11 |
| | 200' - 300' | ------- | ------- | 1000 @ $10 | 2500 @ $10 |
| | 300' - 400' | ------- | ------- | 1000 @ $10 | 1000 @ $10 |
| | 400' - 500' | 1950 @ $11 | ------- | 7000 @ $10 | ------- |
| | 500' - 600' | ------- | ------- | 7500 @ $9 | ------- |
| | 600' - 700' | ------- | ------- | 6000 @ $9 | ------- |
| | 700' - 850' | ------- | ------- | 5000 @ $10 | 4000 @ $10 |
| No. 3 (410 South) | Above 600' " | 100 @ $12 | 2000 @ $10 | 3000 @ $10 | ------- |
| | 600' - 700' | ------- | 5000 @ $11 | ------- | ------- |
| | 700' - 850' | ------- | 5000 @ $14 | 5000 @ $13 | ------- |
| | Below 850' | ------- | ------- | ------- | 8500 @ $12 |
| No. 4 (410 North) | Above 250' " | 2500 @ $14 | ------- | ------- | ------- |
| | 250' - 400' | 1350 @ $12 | ------- | 2000 @ $12 | ------- |
| | 400' - 600' | ------- | 8000 @ $13 | 5000 @ $13 | ------- |
| | 600' - 700' | ------- | 5500 @ $12 | ------- | ------- |
| | 700' - 850' | ------- | ------- | 6000 @ $10 | ------- |
| No. 5 (Blue Buck) | Above 400' " | 320 @ $9 | ------- | 2000 @ $9 | 12000 @ $9 |
| | Below 400' | ------- | ------- | ------- | 3000 @ $9 |
| No. 6 (Bluebell) | ------- | ------- | ------- | ------- | ------- |
| In Bins & C | | 200 @ $12 | ------- | ------- | ------- |
| TOTAL --- | | 12420 @ $12.35 | 45500 @ $12.60 | 80800 @ $11.43 | 52000 @ $10.96 |

## SUMMARY

| Ore Body | Broken | Positive | Highly Probable | Probable | Total all Classes |
|---|---|---|---|---|---|
| In Bins | 200 | | | | 200 |
| #1 (Blue Coat, South) | 6000 | 20000 | 28300 | 18000 | 72300 |
| #2 (Blue Coat, North) | 1950 | ----- | 29500 | 10500 | 41950 |
| #3 (410 South) | 100 | 12000 | 8000 | 8500 | 28600 |
| #4 (410 North) | 3850 | 13500 | 13000 | ---- | 30350 |
| #5 (Blue Buck) | 320 | ---- | 2000 | 15000 | 17320 |
| TOTAL | & 12420 | 45500 | 80800 | 52000 | 190720 |

Grand Total all classes ore - 190,720 tons @ $11.75 per ton.

Working Methods and Future Problems

The method of operating the mine is, to my mind, greatly improved, and the results are also shown by the cost during the last two months. In places we have substituted for shrinkage stoping the method of "cut and fill, which has many advantages where the ore bodies are wide and the walls bad.

In February, with only 1259 tons shipped, the cost was naturally high, - $3.34 inclusive of freight. In March, with 3528 tons shipped, the cost had fallen to $2.05 per ton, inclusive of freight. Indications are that April will show an even better result. After this months we firmly expect to handle 6000 tons or better per month, and to keep the entire cost well below $2.00 per ton. In this connection it may be interesting to note that the average cost for 1913 was $3.38 per ton, and that the best month record was made in November, with a cost of $2.62 per ton agains 3918 tons shipped.

In general, I believe that I can say that the condition of the Bluebell is healthy and encouraging. We are mining a good grade of ore at present and we are developing more ore of equally good grade. We feel confident of more than two years' reserve on the basis of 6000 tons per month and including the "Probable Ore" and with the additional reserves which we shall almost certainly develop within the next few months I think there is very little doubt that the Mine will continue to furnish for several years to come. Our working costs have already decreased considerably and there is every reason to expect that this decrease will be maintained and bettered as our work progresses, and that the ore will reach Humboldt having a gross value of over $12.00 per ton and with a cost against it of $2.00 per ton. The subsequent treatment of this ore in the Concentrator and Smelter has been and will be the subject of separate reports.

EXTRACTS FROM REPORT BY

G. M. COLVOCORESSES

November 19, 1913

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## BLUE BELL MINE

### Recent Developments

The principal development during the past ten months has been the opening up of the Blue Coat Ore Body on the 850' level rendering as positive and probable ore an additional reserve of 38000 tons averaging well over 3½% copper. The ore-shoot on the 850' level did not at first appear to be quite as long as on the 700' level and in the above calculation has been estimated at 215' length against 282' on the 700' level. However, it would appear to me that the limits of pay ore are not as yet defined on the lower level and there is evidence that good ore still exists in the hanging-wall and it may be possible by careful sampling and selection to stope as far north as the dyke. The evidence is entirely favorable to continuation of the ore body downwards and I consider it reasonably certain that you will still find a good ore body on the 1000' level when this is opened up, and very likely on still lower levels.

The 410 South Ore Body has so far increased in quantity and quality with each successive level and shows better on the 850' level than anywhere above this point. There is every probability that this ore-shoot will also persist to a considerable depth and should certainly be encountered on the 1000' level.

The 410 North Ore Body on the contrary shows a progressive decrease in value with depth and between the 700' and 850' levels it is so poor that I doubt if it will be workable. Some additional exploration should be done before it is positively considered that the ore has petered out, but in estimating reserves I am not considering anything in the 410 North Ore-Shoot below the 700' level.

No further work has been done on the Blue Buck Ore Body which so far has been cut underground only on the 400' level. It is now proposed to extend the 250' level to intersect this ore body and considering the surface indications and the general character of the

ore-shoots, I do not think there can be much doubt that good stoping ground will be opened up between the 400' level and the 250'. There should also be mined, some good ore above the 250' working up through the sulphides and the zone of secondary enrichment and into the oxides.

The Blue Bell Ore Body has not yet been definitely proved to exist on the 400' level (which at this point is about 500 ft. below surface). However, in the breast of the drift and the cross-cuts, the stringers of ore are now beginning to show carbonates, oxides and also a little sulphide. These indications make it seem altogether probable that the drift is approaching the end of the ore-shoot; just how large the ore-shoot may be at this point, is impossible to say, and this can only be determined after the drift has proceeded throughout the full length of the ore body, - presumably a matter of 100 to 300'. The extension of this drift under present conditions would be expensive and slow and it seemed best to suspend development until this can be carried out under more favorable conditions, which should be possible within the course of the next two or three months. I consider that there is every probability that a good ore body will be opened up at this point.

## ORE RESERVES

The ore reserves of the Blue Bell Mine I estimate as follows as at November 1st, 1913: -

| ORE BODY | SECTION | BROKEN | POSITIVE | HIGHLY PROBABLE | PROBABLE |
|---|---|---|---|---|---|
| Blue Coat: | 200 & 250 | | | 3700 | |
| | 405 | | 2000 | 2600 | |
| | 400 - 500 | | | 3600 | |
| | 501 | | 4000 | 4200 | |
| | 602 | 1700 | | | |
| | 605 | | 3000 | 3500 | |
| | 703 | 3100 | | | |
| | 851 | 400 | 8000 | 30000 | |
| Below | 850 | | | | 10000 |
| 410 South: | 501 up | | | 3000 | |
| | 601 | 1000 | 4000 | 1000 | |
| | 701 | | 1000 | 4000 | |
| | 801 | | 1000 | 4000 | |
| Below | 850 | | | | 3000 |

(Cont'd)

| Ore Body | Section | Broken | Positive | Highly Probable | Probable |
|---|---|---|---|---|---|
| 410 North: | 250 | 3600 | | | |
| | 410 | 3500 | 2400 | | |
| | 400 - 602 | 700 | 4600 | 12000 | |
| | 600 - 700 | | | | 6000 |
| Blue Buck: | Surface & 410 only proved as yet | | | | 20000 |
| Blue Bell: | Surface only | | | | |
| TOTAL | | 14000 | 30000 | 71600 | 39000 |

SUMMARY:

| | | | |
|---|---|---|---|
| Blue Coat | 22200 | 47600 | 10000 |
| 410 South | 7000 | 12000 | 3000 |
| 410 North | 14800 | 12000 | 6000 |
| Blue Buck | | | 20000 |

Total all Classes: 154600 tons @ 3.5% copper and $1.50 per ton in gold and silver.

In connection with the above estimates it should be noted that 14,000 tons of Positive ore is broken in the stopes, while the balance, 30,000 tons is proved by the levels above and below, and by raises cutting the ore vertically. It is therefore all exposed on three and for the most part on four sides.

The Highly Probable ore is exposed above and below and in part on the sides and considering the continuity of the ore-shoots as proved to date, this class of ore may be considered as being almost positive.

The Probable ore represents the continuation of the proved ore bodies below and above the last point where they are positively indicated.

The Blue Coat and 410 South are estimated to continue as at present for approximately 50 feet greater depth. The 410 North is estimated to continue (though considerably diminished in grade) between the 600' and 700' levels. The Blue Buck is estimated to contain a considerable quantity of ore, considering the surface indications and the

ore shown on the 400' level. The estimate of Probable ore is, of course, merely a personal opinion, but it is submitted that this estimate is conservative and there is a probability that future developments will very considerably increase the quantity of your reserves beyond the figures which are given above.

Regarding the grade of the ore estimated, it is not possible to give an exact figure owing to the incomplete sampling of a large portion of the ore-body and more particularly to the careless manner in which the record of past sampling has been kept. The estimate is based on a study of all the samples recorded and also on the grade of shipment made to date from which it would appear probable that the broken ore will average close to 4% copper after sorting and that the grade of all the reserves estimated above will average better than 3.5% copper, and $1.50 in gold and silver to the ton; these figures having been given as an average for the above estimate. In addition to these estimated reserves, it will be noted that there is a large amount of low grade ore not considered in my estimate, much of which will average 2% in copper and $1.00 in gold and silver to the ton. Such ore is not payable under present working conditions, but it is believed that at some time in the future, increased efficiency of mine operations and reduced milling and smelting costs will make it possible to mine and treat a great part of this ore with profit.

Since I estimated the reserves in February this year, very encouraging developments have been made by means of crosscuts into the foot and hanging walls, more particularly the latter, and these have proved the ore bodies to be wider in general than previously estimated by me and it seems likely that in stoping out the various blocks of ore additional width will be gained at several points.

## Working Costs

The following is a table showing what the mining costs have been from January to August of the present year, and showing also what I estimate the working costs should be after the mine is operating regularly on the basis of 200 tons or more per day extraction. These

latter costs should be attained by May of next year. The estimate given here has been shown to Mr. Walker and also to Mr. Trengove, and both agree that these figures can be attained when the new scale of operation goes into effect. Meantime, every effort should be made to reduce the present workingx costs and to prepare the mine for breaking and handling the necessary tonnage in the most economical and efficient manner:

PER TON OF ORE MINED

| | Present Costs (From Jan to Aug 1913) | Estimated Future Costs. |
|---|---|---|
| Extraction | 2.04 | 1.63 |
| Development | | .25 |
| Hoisting | .24 | .15 |
| Pumping | .12 | .05 |
| Tramming & Sorting on Surface | .28 | .16 |
| Operating Blacksmith Shop | .02 | .02 |
| Taxes & Insurance | .11 | .09 |
| Proportion Humboldt Expense | .12 | .07 |
| Superintendence at Mine | .10 | .05 |
| Mine Office | .01 | .01 |
| Stable | .02 | .01 |
| General Expense & Sampling | .25 | .15 |
| TOTAL | 3.31 | 2.65 |

EXTRACTS FROM REPORT BY G. M. COLVOCORESSES

to CHARLES A KITTLE

February 15, 1913

- - - -

## GENERAL CONCLUSIONS

I consider that recent developments at your Blue Bell Mine have been distinctly encouraging and that there is good reason to feel hopeful as to the results of additional development now in progress. You have developed in the Blue Bell property, positive and probable ore reserves to the amount of 124,500 tons, averaging $1.50 in gold and silver and 3.5% in copper. There is every reason to expect that the ore shoots now partially developed, will extend downward and if such proves to be the case, your developments will in the next few months increase your ore reserves by approximately 75,000 tons, assuring your mining and mill operations for a period of somewhat over two years. I advise that development work should be continued vigorously at the Blue Bell Mine and probably at the De Soto, and I believe that there is every prospect of proving up additional ore reserves sufficient to assure your operations for a period of several years to come.

## GEOLOGY & ORE OCCURRENCES

In the immediate vicinity of the mine, the country is sericite schist, known as Yavapai schist and formed during the Algonkian period. These schist are cut by dykes of eruptive rock and by travertines of limestone. In the schists, there are found zones of silicification and it is in these zones that the ore bodies occur. The ore deposits are of the replacement type and are found as lenses, varying considerably in size and apparently having a much greater length vertically than horizontally, with a width of three to fifteen feet. These lenses are frequently near the edges of the silicified zones.

On the surface the outcrops are quite prominent; the schists being stained with copper carbonates and chalcocite is occasionally

noted. Below the outcrops there extends a zone of oxidation down toward local water level and below the oxidation there is a comparatively unimportant band of secondary enrichment denoted by bornite and chalcocite and succeeded in depth by the primary sulphides, mostly chalcopyrite, which constitute the main ore body. Associated with the chalcopyrite there is a quantity of iron pyrites varying from equality to double the amount of chalcopyrite. There is also considerable quartz; all of these minerals having replaced the sericate and chlorite schist.

## BLUE BELL MINE

### Description

The silicified zone extends for a length of 2500 feet and for a width of 600 feet. The strike is North 20 degrees East and the dip approximately 70 degrees toward the West. There are six distinct lenses or shoots of ore noted by outcrops on the surface or underground and referred to as follows.

"Blue Coat", "410 West or South", "410 East or North", "Blue Buck West", "Blue Buck East", "Blue Bell".

Of these ore shoots the "410 East and West" have no well defined outcrops, while "Blue Buck East" is so far unproved underground and "Blue Bell" though possessing an excellent outcrop and proved to a depth of 180 feet, has not yet been developed into the zone of primary sulphides. These lenses of ore occur in two parallel bands striking north and south and separated from each other by about 40 feet of the schist rock; the western band is close to the edge of the silicified schist. Through the entire zone of silicification, there is a certain amount of mineralization and both copper and iron pyrites are found, but not in sufficient quantity to be of commercial value outside of the ore bodies mentioned above.

Blue Bell Group has been worked, but not continuously, for the past 12 years and a large tonnage of ore has been produced; the average grade of all shipments made since 1907 appears to have been 3.5% copper with gold and silver to the value of $1.50 per ton. Aside from surface indications, the mine has been developed in one place to a depth of 850 feet by shafts and drifts, while diamond drill holes have

gained an additional depth of from 50 to 100 feet. The development work to date is best shown by the tracing accompanying this report, and as will be noted, the property is only partially developed. The "Blue Coat" ore shoot is proved to a depth of 700 feet. The "410 South" to a depth of 850 feet and by drill holes to a depth of 950 feet. The "410 North" to a depth of 700 feet and the "Blue Buck" to a depth of 400 feet.

From a brief study of the general geology of this district and such information as I was able to gather regarding the behavior of similar ore bodies, I can see no reason why these deposits should not continue downward to a much greater depth than has been gained up to the present time. In your own mine the indications are encouraging, for none of the ore bodies so far developed show any tendency to become pinched or impoverished down to the lowest point at which they have been proved. It is true that the drill holes did not give encouragement regarding the continuance of the Blue Coat to a greater depth, and it may be that this particular ore deposit will not extend below 850 or 900 feet, but I do not consider the evidence conclusive on this point and it may go down much deeper. The "410" ore bodies were apparently blind on the surface and so far as developed, they show an improvement with depth and, considering the mine as a whole, each succeeding level has proved up an equal or greater quantity of ore than found on the levels above. It should be taken into consideration that the lenses or ore in which you are at present working were undoubtedly deposited at a time when the surface of the country was from one to three thousand feet higher than at present and therefore that this ore was once at a very considerable depth. The upper portions of these lenses have been carried away by the erosion and it may be that other lenses have been altogether destroyed by this same influence, but conversely, new lenses of ore may well be discovered at any depth in the silicified portion of the schist, and it is my opinion that as long as this silicification continues downward, you will continue to find ore bodies similar to those in which you are now working. The largest ore bodies of similar type in

this district, are found at the United Verde Mine, which is at present developed to a depth of 1500' and in which I am reliably informed that the ore in the 1000 and 1200' levels also in the 1500' level is of excellent quality and quantity and better than anything found below the original zone of secondary enrichment.

## ORE RESERVES

From present development I am able to estimate the ore reserve of the Blue Bell Mine as follows:

| | Positive | Highly Probable | Probable |
|---|---|---|---|
| "Blue Coat" | 39,000 tons at 3.50% Cu (14,000 tons broken in stopes) | 12,000 tons @ 2.60% Cu | 9,000 tons @ 3.50% Cu |
| "410 South" | | 7,000 tons @ 3.50% Cu | 6,000 tons @ 3.50% copper |
| "410 North" | | 21,500 tons @ 4% copper | 10,000 tons @ 4% copper |
| "Blue Buck" | | | 20,000 tons @ 3.20% copper. |
| Total | 39,000 tons @ 3.50% | 40,500 tons @ 3.50% | 45,000 tons @ 3.50% |

Grand Total all classes - - - 124,500 tons @ 3.50%

In connection with the above estimate, the ore classed as "positive" has been blocked out on three or four sides. The ore classed as "Highly probable" is developed by two successive levels being not yet traversed by raise or winze. The ore classed as "Probable", represents the continuance of the ore shoots for a distance of approximately 100 feet above and below the last points of development. This extension may be fairly assumed to exist, considering the nature and proved extent of the ore bodies.

The average content of all ore at present developed is put at 3.50% copper, in addition the average value in gold and silver is $1.50 per ton, representing an average of 05. ounces in gold and 1.2 ounces in silver (value $2.60 in 1941)

In addition to the reserves estimated above, there is a large amount of ground containing from one to two percent of copper.

Under present conditions, this cannot be mined and treated at a profit, hence it is not considered as ore. It is possible that at some later date, decreased working costs combined with improved metallurgical practice may permit you to increase your tonnage by mining certain quantities of this low grade stuff; but for the present at least, it is most essential that the grade of production should be maintained at 3.50% copper, and in order to do this only the ore bodies estimated can be profitably mined, and further; care should be taken to maintain the grade of production by the use of selective stoping, prevention of wall rock slides in so far as possible and hand-sorting of ore at the tramway terminal.

## FUTURE POSSIBILITIES & DEVELOPMENT

As stated above your property is only partially developed and additional development should be prosecuted vigorously. If the known ore bodies continue downward you will develop from 30,000 to 40,000 tons of new ore for every additional hundred feet gained in depth.

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# R E P O R T

FOR

# CONSOLIDATED ARIZONA SMELTING COMPANY

C. M. COLVOCORESSES.

Office Copy

New York, November 19, 1913.

GEORGE M. COLVOCORESSES
MINING ENGINEER
43 EXCHANGE PLACE
(ROOM 1407)
NEW YORK CITY

TELEPHONE HANOVER 6940

Office Copy.

New York, Nov. 19, 1913.

Mr. Victor I. Cumnock, President,
Consolidated Arizona Smelting Company,
15 Broad Street,
New York, N. Y.

Dear Sir:

In accordance with your instructions, I proceeded to Humboldt, Arizona, on October 8th and between the date of my arrival and November 8th, I made a thorough and careful examination of the mines, plant and equipment of the Consolidated Arizona Smelting Company, and herewith beg to submit report on same:

## CONCLUSIONS.

Since the concentrating mill was started in February of this year the results of operations have been steadily unprofitable and the main object of my examination was to go carefully into all the conditions at Humboldt and Blue Bell and in consultation with your General Superintendent, to devise if possible a plan whereby with the smallest additional capital expenditure, your property could be so equipped and operated as to yeild an operating profit instead of a loss. My examination has resulted in the following conclusions.

(1) Your mine has developed well and you now have a reserve of positive and probable ore amounting to 154600 tons averaging 3.5% copper and $1.50 in gold and silver, and there is every probability that additional development will materially add to these reserves.

(2) Your present method of treating the ore by concentration, roasting the concentrates, and reverberatory smelting is correct; but the scale on which these operations were carried on has been too small to yield a financial profit. The small output is due to the unsatisfactory condition of the concentrating and smelting equipment, both of which are faulty in several vital respects and which have limited your production to 90 tons of blister copper per

month on which basis an operating loss has necessarily been made.

(3) A total expenditure of $45,000.00 ($7,000.00 of which has already been made) will enable you to equip your plant for the efficient treatment of 6500 tons of ore and 1500 tons of tailings per month. This new equipment should be completed by May 1st, 1914. From that date you should produce a minimum of 175 tons of blister copper per month, worth , at 15 cts. a lb., $52,500.00. The total Humboldt and New York expenses on this basis of operations should not be more than $42,500.00 per month leaving you a net profit of $10,000.00. This profit with copper at 15 cts. is equal to nearly 3 cts. per lb. of copper produced, or $1.25 per ton of ore and tailings treated.

(4) The treatment of De Soto ore now in stock and of the Pennell ore belonging to Muller Schall & Company would enable you to make a good operating profit beginning with the month of December and owing to the improved equipment of the plant, from now on a steady increase in production of copper and resultant profits should be made, culmunating in May, 1914, when you begin to operate on the basis mentioned above.

All of the essential cost estimates in the report, are made after full consultation with your General Superintendent, Mr. Walker and with his confirmation. The costs are estimated after a careful comparison with the working costs of several properties similarly situated and with similar equipment and full consideration of all the local conditions governing at Blue Bell and Humboldt. It is assumed that constant attention will be given by the Management to the efficient operation of all the machinery in the plant and that a fair return will be exacted from all the laborers employed.

## RECOMMENDATIONS.

The main recommendations which I would make are as follows:

(1) That the recently ordered Hardinge Mill, Flotation

Plant, and Dorr Thickener, should be installed in your mill with all possible haste and put into operation as quickly as possible.

(2) That the reclaiming installation should be set up on the tailings dump and put into operation as soon as the plant will handle tailings in addition to the ore.

(3) That a 22' 6" Wedge Roaster should be ordered and erected at the point decided on by Mr. Walker in the vicinity of the reverebratory furnace and that this Wedge roaster should be utilized to desulphurize the concentrates from the mill.

(4) That a new reverberatory, approximately 60' x 14' should be erected West of your Sterling boilers and that this reverberatory should be used to smelt the calcines from the new roasting furnace and to make approximately a 40% matte which will afterwards be blown to blister copper in the present converter plant.

(5) That during the next few months you should treat the Pennell ore (provided permission to do so can be obtained) also the 6200 tons of De Soto ore now located at the plant and also the 1000 tons of Blue Bell ore in stock at Humboldt, and that while operating on these ores your labor and working expense at the Blue Bell should be reduced to as low a figure as possible.

(6) That as soon as the new equipment is all erected and operating smoothly, you should arrange to mine and treat 6500 tons of ore and 1500 tons of tailings monthly, resulting in the production of upwards of 175 tons of blister copper.

(7) That special attention be given to the economical and efficient operation of all portions of your plant, more particularly of the mine and the concentrating mill and that a continuous endeavor be made to immediately reduce the working costs far below the present figures and to attain and surpass the figures estimated in this report.

Respectfully submitted,

E. M. Colcrovers

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# R E P O R T  I N  D E T A I L

## B L U E  B E L L  M I N E

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### RECENT DEVELOPMENTS

A full description of this mine was contained in my report of February 15th, 1913 to Mr. Kittle, copies of which were placed at the disposal of the Directors and since that time the details of development and progress of work have been fully reported at intervals by Mr. Walker, and especially in his letter of September 13th.

In the present report it is merely my intention to summarize the most important matters in connection with the mine.

The principal development during the past ten months has been the opening up of the BLUE COAT ORE BODY on the 850' level rendering as positive and probable ore an additional reserve of 38000 tons averaging well over 3½% copper. The ore-shoot on the 850' level did not at first appear to be quite as long as on the 700' level and in the above calculation has been estimated at 215' length against 282' on the 700' level. However, it would appear to me that the limits of pay-ore are not as yet defined on the lower level and there is evidence that good ore still exists in the hanging-wall and it may be possible by careful sampling and selection to stope as far North as the dyke. The evidence is entirely favorable to continuation of the ore-body downwards and I consider it reasonably certain that you will still find a good ore-body on the 1000' level when this is opened up, and very likely on still lower levels.

The 410 SOUTH ORE BODY has so far increased in quantity and quality with each successive level and shows better on the 850' level than anywhere above this point. There is every probability that this ore-shoot will also persist to a considerable depth and should certainly be encountered on the 1000' level.