

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 out ^{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 feet 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 feet. 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.

OR E R E S E R V E S

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
<u>BLUE COST:</u>					
	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
<u>410 SOUTH:</u>					
	501 up			3000	
	601	1000	4000	1000	
	701		1000	4000	
	801		1000	4000	
	Below 850				3000
<u>410 NORTH:</u>					
	250	3600			
	410	3500	2400		
	400-602	700	4600	12000	
	600-700				6000
<u>BLUE BUCK:</u>					
	Surface & 410 only proved as yet.				20000
<u>BLUE BELL:</u>					
	Surface only.				
T O T A L:		14000	30000	71600	39000
.....					
<u>SUMMARY:</u>					
Blue Cost			22200	47600	10000
410 South			7000	12000	3000
410 North			14800	12000	6000
Blue Buck					20000
T O T A L			44000	71600	39000

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 cross-cuts 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.

FUTURE DEVELOPMENTS.

I would recommend that the following development work should be undertaken in the near future:

- (1) Extension North of the 250' level to the Blue Buck ore-shoot and the subsequent raise from 400' to 250' level in the ore-body.
- (2) Extension of the 400' level to tap and develop the Blue Bell ore-shoot throughout its entire length and subsequent raise to connect this level with the old shaft.
- (3) Extension North of the 700' level to tap the Blue Buck ore-body and subsequent raise from 700' to 400' level.
- (4) Deepening the shaft to 1000' and subsequent cross-cuts and drifts to develop the various ore-shoots on this level.
- (5) Cross-cuts at various intervals throughout the length of the mineralized zone from the 400' level and other levels, more particularly to explore the ground lying directly under ore-bodies indicated on the surface.

The first of these developments should be carried on at once as it is absolutely necessary to permit the extraction from the

Blue Buck ore-shoot where a large reserve will probably be found. The other developments, although very important may be deferred for five or six months, until such time as the mill and smelter are operating on a regular and, as we anticipate, a profitable basis. After that time I would recommend that a fixed sum of money, say \$1500.00 should be allotted each month for development and exploration work and that a most vigorous and progressive policy of development should be continuously pursued.

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 working 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

In addition to the figures given above, the cost of freight on ore from the siding to Humboldt has been heretofore 35 cts. per ton.

If this freight rate should be continued, the total cost of ore laid down at Humboldt will be \$3.00 per ton; but we are hopeful that the Railroad Company will decrease the rate to 25 cts. per ton in consideration of the larger quantity of ore which we expect to handle and this will reduce the cost to \$2.90 per ton laid down at Humboldt.

M I N E O P E R A T I O N

Certain matters in connection with the operation of the Blue Bell Mine appear to me to require attention and alteration both in order to operate the property efficiently on an increased scale, and more particularly in order to reduce the operating costs to the figures estimated above. With this in view, I call your particular attention to the following points.

(1) SAMPLING & ASSAYING

In working a mine such as the Blue Bell, it is of great importance to stop out all of the pay-ore and at the same time to break and handle as little waste as possible. My experience has been that the recognition of copper-ore underground by the eye is a very difficult matter and the importance of careful and accurate sampling is generally recognized at all the large mines of this character. The system of sampling the Blue Bell in the past and at the present time is not sufficiently thorough and results of samples have never been properly tabulated, so it is very difficult to estimate the exact limits and average grade of ore developed in the mine. I recommend, that as each new block of ore is opened up, it should be proved at intervals to its full width and the whole block sampled in five-foot or ten-foot sections, as may be advisable. This sampling should be carried on under the immediate direction of the Superintendent and the actual work should be done by one or more thoroughly competent men, one of whom should also do the assaying at the mine, and immediately after the samples are taken. The assay results of these samples, together with all data as to width and character of ore should be carefully kept and these should be promptly plotted out on the assay-plan from which tracings may be made at intervals for Humboldt and New York.

Such an assay-plan will serve not only as a basis for estimation of ore reserves, but also as a guide for stoping ore and in both respects will be of great practical value, more particularly in cases where the slicing and filling method of stoping is adopted. By following closely along the limits indicated by such a plan, much less waste than at present will be broken with the ore and the hoisting sorting and ^{trimming} costs will be reduced. Also there will be no possibility of leaving valuable blocks of ore in the mine to be subsequently covered up with the filling and rendered inaccessible.

(2)

SAFETY

The mine is not at present operated with due regard to the Mining Laws of Arizona nor the recognized precautions governing safety in mining operations. The dynamite is not kept as it should be underground, and is often carelessly handled by the miners, boxes are sometimes left open at the stations and the sticks of dynamite are dumped out on the floor and become mixed with the muck. It should be constantly borne in mind that any explosion, aside from possible loss of life and injury to the mine, is likely to wreck the shaft and render operations difficult for several weeks. There is absolutely no excuse for ^{permitted} careless handling of the dynamite; strict rules should be laid down in this respect and immediate discharge meted out to men who are guilty of breaking these regulations.

The open skips used for taking men in and out of the mine are an additional menace to life and limb and the Management plan to substitute covered skips which should be in operation in the very near future. The ladder-way in the shaft is in very bad condition and practically useless. Proper ladders should be installed here at once and kept in good condition and ladder-ways should also be provided at one or more additional means of exit through raises and stopes on either side of the shaft.

(3)

LIVING CONDITIONS AND UNDERGROUND SANITATION.

Since I last visited the property in February, the air in the underground workings has been materially improved by the introduction of pipe lines blowing fresh air into various drifts and

stopes. These pipes should be kept in good condition and fresh air supplied to the men in all parts of the mine.

Sanitary conditions in the mine are otherwise very bad and this matter can be remedied at small expense and should receive attention without delay. The bunk house is not kept in very good condition and it should be provided with a proper system of change rooms, lockers, heating apparatus and shower baths. I would also suggest that a few small houses should be erected on the property for the married men and rented for a small sum monthly, sufficient to pay the cost of construction inside of three or four years. The food furnished to the men appears to me excellent and I feel certain that attention to the matters mentioned above will materially assist you in keeping a good class of miners in the camp and lowering working costs through more efficient labor.

(4) BLACKENING.

The drill steel furnished the ^{miners} at the present time is very bad and breakage is excessive. The drill-sharpening machine is not in good condition and in the near future it will be well to purchase a new sharpener, but meantime I would suggest that means be taken to materially improve the sharpening and tempering of the drill steel.

(5) WIRE TRACKS

The cost of tramming has been excessive and one cause for this may be easily found in the very poor condition of the tracks underground. It should be the duty of the Foreman to build the tracks in the first place with proper ties and fish plates and with a uniform grade and afterwards to keep them in good shape whenever tramming is going on. The Foreman should also inspect and keep in repair the skipways, manways and ore chutes and the various means of access to the stopes.

(6) CONTRACT WORK

At present some of the underground work is done by contract and this system appears to work well at the Blue Bell and has generally found favor at most of the mines of the Southwest. I

would suggest that this system should be extended as much as possible.

All of the matters mentioned above have been subjects of verbal conversations between Mr. Walker, Mr. Trengove and myself, and I believe that these gentlemen fully appreciate the advantage of conforming to the recommendations mentioned and I trust that these changes will be put into effect without delay.

M I N E E Q U I P M E N T

The hoisting equipment is sufficient for present purposes and will raise 200 tons or more of ore per day without difficulty. The hoist has reached its limit at the 850' level and when it becomes advisable to sink to the 1000' level it will be necessary to purchase a new and stronger hoist, otherwise the skips cannot be filled to full capacity and the expense of hoisting will be heavy. This matter is one that will come up for attention in due course of time and need not be considered at the present moment.

The head frame and landing arrangements are satisfactory at present and the aerial ropeway to Blue Bell siding continues to work fairly well. Some repairs are necessary on the towers on this ropeway and these repairs should be made during the next few months before the plant starts operating on the increased tonnage basis. At Blue Bell siding the equipment for sorting ore is ample and with slightly increased labor, the loading facilities will be sufficient to enable you to handle economically 200 or even 250 tons of ore per day.

C O N C E N T R A T I N G M I L L

The operation of the mill has on the whole been disappointing. This is true more particularly, of the mechanical rather than the metallurgical operations and in a large part this fact is due to the poor arrangement of the mill, the faulty character of the old equipment and the large amount of repairs and renewals which have been necessary. The Management has tried to better the operations by making a number of changes in equipment and additions to same and these have been a heavy charge against operating expenses. In looking over the operating costs during the past few months, it would appear that rather more than 50% of the total expense has been chargeable to maintenance and repairs.

On the whole the metallurgical operation has been good although the saving of values in the slime, as anticipated, has not been very satisfactory. The recovery during the months of April to September (inclusive) has been 75% copper; 58.5% gold; 60.5% silver, and considering the equipment of the mill, this work appears to me to be very creditable. It must of course be considered that a very low ratio of concentration averaging 2.6% to one, has been made.

The cost of concentration during this period has been about \$2.11 per ton (September cost not yet complete) and so far no substantial gain has been made in this respect; in fact, the expense per ton has been higher during the last few months than in April or May. The only explanation for this that I can find is the poor mechanical condition of the mill and the large amount of repairs which have been necessary, also the rather poor class of millmen employed and the poor work which they have done due in part to dust and water and the general sloppy condition of the mill and much of its equipment.

In planning a new equipment for the mill, we have carefully gone over all the machinery at present operating and as far as can be told, the worst mechanical defects should be eliminated

at the same time as the metallurgical equipment is improved by the addition of new machinery. Such being the case, there is every reason to believe that operating on the new basis of increased tonnage and with the flotation plant making a better saving in values, the working costs will fall from \$2.11 per ton to approximately \$1.35 not including the flotation royalty, and with this royalty added, the cost should not in any case exceed \$1.47^{1.47} per ton of ~~material~~^{ore} treated or 2.42^{2.42} cts. per lb. of copper recovered in the concentrates and 2.51 cts. per lb. of ^{copper} produced. Working costs similar to these quoted above are being attained by several other mills operating under similar conditions and with similar capacity and I am confident that with the new machinery and efficient operations, these figures should easily be reached.

The total cost of the new mill equipment on which we have decided amounts to \$11,000.00 and the details of this have been covered by Mr. Walker in his various reports. The flow-sheet of the mill will remain unchanged until after the material has all passed the jigs and the subsequent classification will make two products; a coarse material which will be treated as at present on Wilfley Tables and a fine product which will go to the Separation plant after having been all ground to pass 40-mesh. The tailings from the Wilfley Tables will be returned for reclassification and all material coarser than 40-mesh will be reground in the Hardinge Mill and then sent to the Mineral Separation Plant combined with the fine material mentioned above. The tailings from the Separation plant will be allowed to go entirely to waste.

It is proposed also to treat daily about 50-tons of the old tailings in the Separation plant and special equipment will be provided for reclaiming these tailings, the coarser portion of which will be also ground in the Hardinge Mill. The Huntington Mill which has caused so much trouble in the past, has gone to pieces and it is expected that the Hardinge Mill will operate by the 15th or 16th of the present month and soon after it should be possible to slightly in-

crease the tonnage of the mill feed and by treating a more silicious ore to increase also the percentage of copper in the concentrates thereby enabling a slight increase in production of copper monthly.

The flotation plant with accessories has been ordered and it is expected that this will arrive about the end of November and that same will be in operation early in December. A full month should be allowed for the proper tuning up of this plant; no great production from same can be anticipated before the month of January, although during all of December a steady improvement should be noted in results of daily operations.

Early in January the mill should be in all respects capable of treating 300 to 250 tons of ore and old tailings per day. Conditions at the smelter may make it appear inadvisable to put through so large a tonnage for some little time, but it is my expectation that it will be found wise to treat as large a tonnage as possible and to store the excess of concentrates until the new reverberatory is in operation. After the flotation plant is operating steadily according to the plans mentioned, it will be in order to experiment and determine whether ultimate economy will be gained (considering the cost of operation and the royalty) by eliminating altogether the table treatment and by crushing all of the jig tailings for direct treatment by flotation. The Wilfley Tables are rather old and are not doing particularly good work, and it is my opinion that after the operators become skillful in handling the flotation plant at Humboldt, these tables can be eliminated from the treatment of the ore. The jigs are at present working nicely and making a good product and while it may be well to experiment also with the treatment of the mill-feed direct by flotation and without jigging, I do not expect that you will be ready to do away with the jigs for some little time to come. If it should seem advantageous to continue jigging the ore, it may later be expedient to substitute Woodbury Jigs for the present Hartz Jigs; as the former will require less power and less water and will treat an unclassified product more advan-

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tageously than the Hartz. The Woodbury Jigs were seen at Globe and Morenci and are giving most excellent satisfaction at these mills.

In dewatering the concentrates from the flotation plant, considerable trouble can be expected as these concentrates will consist of very fine particles and will contain 20% moisture besides froth from the separation process. Mr. Walker has decided to attempt the dewatering by means of tanks fitted with porous false bottoms under which a suction will be created; if this does not sufficiently dry the concentrates to make them suitable for placing on the upper or drying hearth of the Wedge Furnace, it may be necessary to use some form of filter press or as a last resort to fall back on the White Howell cylinders which might be used as dryers. I am quite sure that after a little experimenting, some comparatively cheap and satisfactory method of drying these concentrates will be discovered.

In the operation of the mill I would suggest that means be taken to at once save the dust which is now sucked out by the fan and to eliminate further the floating dust from the mill itself and, by dampening the mill feed, to reduce the production of such dust as much as possible. Further; the mill should be cleaned up and kept clean and good repair men employed continuously to prevent leaks, overflows, etc. A little later it may be possible to simplify the mechanical arrangements and do away with some of the elevators which at present are a great source of trouble and expense.

In general; although the operation of the mill has not been satisfactory to date, I consider that it conclusively proved that concentration is the logical method of treating a great portion of your ore and when the improvements which we have planned are completed I feel absolutely confident that the mill can be so operated as to give complete satisfaction and make a total recovery of 85% of the values, in a concentrate that will be nearly self-fluxing (after proper roasting) and for a total operating cost of \$1.47 per ton or say 2.5/cts. per lb. of copper recovered.

S M E L T E R .

The smelter equipment operating at present consists of two White Howell Cylindrical Roasters, one 40' x 14' reverberatory furnace followed by Bessemer Converters fitted with basic lining. Mr. Walker has fully explained the difficulties with these roasters and I confirm everything that he has said on the subject and am positive that no satisfaction could be obtained from their operation. This type of roaster is essentially expensive and unsatisfactory for the class of work which you are doing at Humboldt, and the expense for fuel in roasting is estimated at \$1.50 per ton of concentrates roasted, equal to \$1800.00 per month. Under present conditions, these roasters are badly overloaded, with the result that they fail to remove more than 50% of the sulphur contained in the concentrate, leaving the sulphur content in the clacines so high that a very low-grade matte is of necessity produced in the reverberatory furnace, to the great detriment of the reverberatory itself and subsequent operations.

To relieve the roasting situation, we plan to eliminate the White Howell Roasters altogether and to substitute a 22' x 6' Wedge Cylindrical Roasting Furnace having 7 hearths besides a top hearth which may be used as a dryer. With this Wedge Furnace we expect to make an 80% or better desulphurization of the concentrate, reducing the sulphur from 30% to 5% or 6%. I am confident that 80 to 90 tons of concentrate can be roasted per day absolutely without the use of fuel and should it be necessary to roast 100 tons or even 120 tons daily, this furnace will do the work with the addition of a small amount of fuel oil costing in any case not more than 15 cts. to 20 cts. per ton of material roasted. By reducing the sulphur to the percentage mentioned, you should be able to make a much better concentration in the reverberatory furnace than at present and the resultant matte should contain approximately 40% of copper. This matte will be made with much less damage to the lining of the furnace and with a smaller proportion of flux than can be used at the present time, and the sub-

sequent conversion of the high-grade matte into Blister Copper will be more quickly and economically done.

The capital expenditure involved in the purchase and erection of the Wedge Furnace with accessories is estimated at \$15,000.00, and I am thoroughly satisfied that this is the most essential portion of the new plant and that taken in connection with the other improvements it will repay its own cost in a very short time aside from treating a much larger tonnage than at present which is absolutely essential to profitable operation.

The reverberatory when skillfully handled has operated well and this type of furnace is quite satisfactory. The size of the present furnace, is however, too small to permit smelting the much larger quantity of calcines which we expect to make in the near future. Its capacity is approximately 60 tons of marginal material per day while we anticipate producing from 80 tons to 100 tons of calcines and may also be in position where a certain amount of ore could be smelted in addition to the calcines.

In order to alter the present furnace and give it the necessary capacity, it would have to be lengthened some 15 or 20 ft. and this would involve rebuilding the roof and floor, as well as the ends of the furnace; also the erection of a new flue. To make these changes, the roasters would have to be taken out as soon as alterations were commenced and it is safe to say, that the entire plant would be shut down for at least one month with the incidental loss of revenue.

From all points of view it is better to go to a somewhat greater expense in order to have a new and larger furnace built along improved lines, better placed and operating more economically. Therefore, we have planned to erect a new reverberatory furnace about 65' x 16', placing same in the position formerly occupied by the Northern one of the two original reverberatory furnaces, and almost directly back of the Sterling Boilers. This will amply take care of all calcined concentrates which the mill and roaster will be able to

produce, and it will also have capacity for some crude ore should it be found possible to smelt the additional tonnage without affecting the smelting mixture. Because of greater width, the consumption of fuel oil per ton should be reduced while the waste heat going into the boilers will effect an additional economy in power which I have estimated will amount to \$1500.00 per month.

The capital expenditure involved in erecting the new reverberatory is estimated at \$16,000.00 and this can be built at the same time that the Wedge Furnace is being set up, so that both furnaces should be finished about the end of March, permitting the new plant to begin operations in April and to reach its full capacity by May 1st or slightly before that date.

By this plan you will be equipped with two complete smelting plants, a new roaster and reverberatory capable of handling up to 120 tons of concentrate per day, and the present plant which can always be utilized in case of accident and which, if circumstances permit, might be temporarily run in conjunction with the new plant materially increasing your production of copper without additional capital expense.

In the meantime the operation of the old roaster and the reverberatory will have to be continued as at present, although some slight changes may possibly be made with advantage. It seems feasible to cease roasting a large part of the converter slag skulls and change these in the side doors for fettling the reverberatory furnace. I am personally of the opinion that same might be done with the lime rock which is used as flux and I have suggested to Mr. Walker that experiments should be made in that direction with a view to relieving the present roasters of their heavy tonnage burden.

I am also of the opinion that when the new roasting equipment is installed, it should be possible and advantageous to charge all of the converter skulls and limestone flux into the reverberatory independently of the roaster, always provided you find the Wedge roaster is charged with concentrates up to its maximum capacity.

From now on it is anticipated that with the Hardinge Mill and subsequently the flotation plant in operation, a somewhat higher grade of concentrate can be made through utilizing some of the more silicious ores from the Blue Bell and the De Soto Mines; such being the case, we should anticipate a slightly higher grade of matte and a subsequent increase of copper production per month. This increase will be slow at first but should be continuous until maximum production is reached in May.

The converter plant appears to be altogether satisfactory and considering the conditions under which they have been operated, these converters have been handled well and economically during the past few months. With the ordinary repairs and renewals, the converter plant should answer all your requirements for months to come and no difficulty need be anticipated even if the production of 250 tons to 300 tons of blister copper is desired monthly.

When the reverberatory and roaster are in operation, the converters will receive a much higher grade of matte than they are now getting. The present matte carries from 12% to 18% copper and it is often necessary to blow to white metal only and resmelt same in the reverberatory. With the 40% matte, the converters can blow blister direct in very much less time and at very much less expense and with much less detriment to their lining than at present.

The total operating expense for roasting and reverberatory smelting and converting was \$4.90 per ton of marginal material smelted from April to August inclusive, and we confidently expect that the new plant will reduce this to around \$4.00 per ton. This reduction will correspond to a decrease in the present cost of roasting and smelting from 3.7 cts. per lb. of copper finally recovered to 2.35 cts., and the cost of converting should be also reduced from 1.1 ct. per lb. to 0.57 cts. per lb. of copper, making a total smelting and converting cost under the new plan, 2.92 cts. per lb. of copper produced, which I consider will be very reasonable.

O P E R A T I N G C O S T S

NOTE: (In this section of the report, the value of gold and silver in the ore and in the resultant bullion is neglected, because when treating Blue Bell ore, the bullion contains from \$30.00 to \$40.00 per ton, value in gold and silver, averaging say \$35.00 per ton. The charge for freight and refining is 1.4 cts. per lb. or say \$30.00 per ton. The bullion runs from 98.70% to 99% fine so that there are contained from 1974 to 1980 lbs. of copper plus the \$35.00 in gold and silver, from which must be deducted the \$30.00 for freight and refining. These various factors on an average balance almost exactly, so that to simplify calculation, I have figured that operating on Blue Bell ore, your bullion at Humboldt is worth the New York market price of copper - with 2000 lbs. of copper to the ton; I am then able to neglect the credit which you would receive for precious metal contained, and also the debit which should be charged against the bullion for freight, refining and impurities in the copper.

Your bullion at Humboldt with copper at
14 cts. is worth \$280.00 per ton, at
15 " " " 300.00 " " "
16 " " " 320.00 " " "
17 " " " 340.00 " " "

Wherever I have figured on profits of operations or resultant returns from production, I have assumed copper at 15 cts. per lb. in this report. These figures may be adjusted at any time to meet the actual market conditions.)

In estimating the cost of present operations at the Consolidated Arizona Smelting Company, I take as a basis the accounts for April, May, June, July and August and I have computed the cost of each particular operation over these five months. The working costs for January, February and March are neglected, because at that time the mill was not in regular operation and hence conditions were altogether different from those which prevail at present. The accounts for September and October are not yet made up.

During the five months mentioned, your production of copper in the form of bullion amounted to 749582 lbs.

Appended are two statements showing in detail, (A) what the costs have been during the period mentioned and (B), what we estimate the costs will be after the new schedule goes into effect.

S T A T E M E N T " A "

COSTS FOR FIVE MONTHS (APRIL TO AUGUST INCLUSIVE)

Ore mined, 15274 tons, containing 1,112,014 lbs. copper (73 lbs. copper per ton = 3.65% copper).

Ore milled 13511 tons containing 1,024,930 lbs. copper, recovered 5090 tons concentrates containing 772066 lbs. copper.

% of recovery = 75% of copper
 ratio of concentrate = 2.66
 Mill loss = 25%

Marginal material smelted = 7233 tons containing 865247 lbs. copper. (X)
 Copper recovered as bullion = 749582 lbs. = 85% recovery (smelter loss 15%)
 Final recovery 63.75% of copper values in ore mined.

Expense	Cost per ton of ore mined.	Cost per ton of material treated.	Cost per lb. of copper treated.	Cost per lb. of copper recovered in process.	Cost per lb. of copper recovered in bullion. (749582 lbs.)
Mining	245123	2.95	.0406	.0406	.0601
Development					
Freight & Receiving	11122	0.73	.0100	.0100	.0150
Killing	28491	1.87	.0278	.0370	.0380
Ore purchased	16041	1.05			.0213
Smelting	35303	2.31	4.90	.0400	.0471
Converting		2.80 1.10			
General Expense	9513	0.62			.0127
N. Y. Expense	10563	0.69			.0141
TOTAL:	156156	10.22			.2083

(X) Note.

The loss is in reality somewhat less than this, due to absorption of copper in furnace bottom from which it will eventually be recovered.

STATEMENT "B" (2)

ESTIMATE OF COSTS AFTER MAY 1st, 1914 PER MONTH.

Ore mined, 6500 tons containing 415000 lbs. Average 3.2% copper = 64 lbs. of copper per ton.

Tailings reclaimed, 1500 tons containing 45000 lbs. copper.

Mill Treating 7500 tons ore & tails contain 440000 lbs. copper recovery 85% = 374000 lbs. copper, in 2500 tons concentrate. Ratio of concentration = 3 to 1.

Smelter treating 2500 tons concentrate & 500 tons silicious ore, contain 394000 lbs. copper, recovery almost 90%. (Final recovery 70% of copper mined in ore and tailings treated)

Reverberatory production 438 tons 40% copper matte contain 347000 lbs. copper

Converters treating 438 tons of matte and about 200 tons of silicious ore for flux and making 175 tons of blister copper containing equivalent to 100% copper at full market value, i.e. 380000 lbs. copper; value at 15 cts. = \$52500.00.

	Expense	Cost per ton of ore mined 6500 tons.	Cost per ton of material treated.	Cost per lb. of copper treated.	Cost per lb. of copper recovered in process.	Cost per lb. of copper recovered in bullion.
Mining, tramming & sorting	\$14000	\$2.16	\$2.16	\$.0336	\$.0336	\$.0400
Developpent	1500	0.23	.23	.0036	.0036	.0043
Freight & Receiving	3500	0.54	.54	.0084	.0084	.0100
Milling & tailing recovery	8800	1.35	1.47 (per ton ore)	.0225	.0242	.0251
Smelting	8200	1.26	3.28 (per ton concentrate)	.0207	.0234	.0235
Converting	2000	0.31	.31	.0055	.0057	.0057
General Expense	2000	0.31				.0057
N. Y. Expense	2500	0.36				.0071
TOTAL:	42500	6.54				.1214

NOTE: The figures of tonnage, losses and recovery in process are of course approximate and will vary especially according to the exact grade of the silicious ore and the respective amounts of such ore which will be used for fettling and for converter flux. It is believed that these estimates are close enough for all practical purposes.

S T A T E M E N T " B " (2)

COST & PROFIT PER TON ORE (AND TAILS)

(Considering copper only. Copper at 15 cts. per lb.)
(see NOTE)

Value per ton ore ----- \$9.60 (64 lbs. copper per ton)
" " " tails --- 4.50

Ore 6500 @ \$9.60	-----	\$62400
Tails 1500 @ 4.50	-----	6750
		\$69150

Value in concentrates - \$58777, 85% recovery
" " bullion - \$52500 nearly 90% "

Average value all heads 8000 tons @ 8.64
Recovery " 8000 " 6.56

Cost of ore: Mine, freight, mill & Smelter,

General & New York \$5.88 per ton

Cost of Tails, Mill & Smelter, \$2.95 per ton.

6500 tons @ \$5.88	---	\$38220
1500 " " 2.95	---	4425
7500		42645

Deduct 145 credit for ore
smelted without
milling.

42500 = total cost all
operations.

Average cost per ton -- \$5.31

Average recovery value -- \$6.56 per ton

" cost ----- 5.31 " "

Average profit ----- \$1.25 " "

8000 @ \$1.25 -- \$10,000. total monthly profit.

The results of these figures show a total working cost of 20.85 cts. per lb. of copper produced; in other words, you have lost approximately nearly 6 cts. per lb. on every pound of your production during the time mentioned. Nor has there been any decrease in this loss during the last few months of operation; in fact, September will show up very badly and October will make only a slight improvement. It is evident from these figures that something has been radically wrong and that the continued operation of your property under similar conditions could only lead in the end to financial disaster. It has been my effort to discover just what the trouble has been and to devise means whereby these difficulties might be remedied and the loss converted into a working profit.

A careful examination of various departments of your property and of the costs chargeable to each of these departments, leads me to place the blame at several different points. Summing up, I consider that first of all your policy has been correct in method but wrong in scale. With a mining, concentrating and smelting plant such as you have at Humboldt, I do not think that it would be possible for you to operate profitably on a basis of 150,000 lbs. of copper production per month, nor for that matter, on a basis of 200,000 lbs. It seems absolutely necessary to increase the output of your plant, which can certainly be done without anything like a proportionate increase in the cost of operations, since at the present time a large part of this cost is chargeable to overhead expenses, up-keep of plant, insurance, taxes and other items, which will be little or not at all increased by doubling your capacity for producing copper.

The second cause of high operating costs has been inefficient machinery. This does not apply to the mine except to a small extent, but it does apply very forcibly to the mill and even more so to the roasting department of the smelter. At the time that the mill was started, no person at Humboldt appreciated just how bad the condition of much of the machinery was. From a personal in-

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inspection of the mill in February, I realize that nearly all of this machinery appeared to be in good condition and no one could well anticipate the great amount of trouble which has been experienced in the concentrator.

As to the roasters, these machines had never been tried out under conditions similar to those under which they have worked during the last few months and while the results of operating them on concentrates rich in sulphur should have been to some extent foreseen, it could probably have been accurately foretold only by some person extremely familiar with the operation of White Howell Roasters. As stated elsewhere in this report, the cost of repairs and up-keep at both the mill and the smelter has been disproportionately high, and it is fair to estimate that fully 4 cts. per lb. of copper produced is chargeable directly or indirectly to this cause.

In planning with Mr. Walker for operating on a new and larger scale, we have carefully considered each separate piece of machinery and when your new plant is in operation I believe that all of the machines with which we will work will be in very fairly good condition and the cost of maintenance and up-keep should be greatly reduced.

The third cause of high cost has been the lack of efficient operation. Faulty machinery is a standard excuse for poor operators since the breaking or bucking of a machine is always made responsible for poor results and it is often very difficult to know where the deficiency of the machine ends and the deficiency of the operator begins. Hence, both at the mill and smelter a great deal of poor work has been done and this has been allowed to pass partly because it was difficult to tell just where the blame should be placed. In future, this will be changed, because all new machinery is of standard make and of a high grade and except for the flotation plant, the cost of operating same is closely known. After this machinery is properly erected and operating, there should be no possible excuse for its giving an undue amount of trouble and the cost of operating at

both the mill and smelter should compare favorably with the cost at other similar plants treating approximately the same tonnage.

I am obliged to say that I consider it highly important that the general efficiency of both the staff and the general labor should be considerably increased in order that the working cost may be reduced. It is necessary that every member of the staff should not only be conscientious, but capable and resourceful and he should maintain strict discipline among the men working under him. A certain standard of operations should be set and insisted upon and a close watch of both the metallurgical results and costs should be kept daily and monthly. The standards which are set forth in this report are not any higher than those which are maintained at ^{many} other plants ~~existing~~ and barring unforeseen accidents, I can see no reason why they cannot be reached and maintained continuously at Humboldt.

In reducing operating costs the element of efficiency of labor is of the utmost importance and this has been considered at length by Mr. Walker, and myself. I frankly admit that the estimated costs cannot be attained unless there is a great improvement in this respect. This statement is particularly true of the operations at the mine and it is also true at the mill, and until very recently at the smelter also. Just how much of the past working loss has been due to faulty equipment and small tonnage and how much to faulty operation, I am not prepared to definitely state, but with the new equipment and the larger tonnage ^{the} operating costs will depend within certain limits on the economy and efficient operations of your new plant.

The labor situation at Humboldt has not been the best, but I believe that it will be quite possible to steadily improve matters in this respect by attracting to the camp a good class of men and retaining the best of them at the same time weeding out promptly the inferior element. Living conditions and climate are excellent. The wages are high; such being the case there is no reason why you

should not obtain as good men as any camp in the Southwest; in fact it appears to me that you have a distinct advantage over almost every other camp in Arizona. It should, therefore, be possible to set a high standard of work and to steadfastly insist that this standard be maintained.

The exact method of obtaining the best labor results is a matter on which opinions may differ very radically, but under the present circumstances this should be left entirely in the hands of your General Manager, whose methods, provided they accomplish the desired results, should receive the unqualified support of the Directors.

All of the estimates in this report in regard to tonnage and costs have been made after full consultation and discussion with Mr. Walker, and as stated in his letter to you of October 31st, these estimates meet with his approval and confirmation. The working costs which we hope to obtain are figured after a careful review of costs in other camps in so far as these are obtainable, and with particular reference to our local conditions and equipment. I am confident that there is nothing impossible or difficult in the attainment of these figures, although in many departments it may be necessary to make radical changes in the personnel in order to bring about the desired results.

P O W E R

Under present conditions, the electric power for operating the mill, the water supply, lights, converter plant, etc., is purchased from the Arizona Power Company at 1.5 cents per K. W. hour. With the construction of the new plant, we hope to make a radical reduction in the cost of power. The amount required is approximately 150 K. W. for the present scale of operations and when 250 tons of material are treated daily, this requirements would vary

from 200 to 250 K. W. It seems, however, wise to radically alter the power arrangements in connection with the equipment of the plant.

The blowing engine runs only while the Converters are in operation (an average of say 8 hours per day) and the power for this engine is furnished by boilers using waste heat from the reverberatory and also burning a considerable quantity of oil additional. The waste heat from the present reverberatory, because of the long and badly insulated flue amounts only to about 40 h. p.; the flue is 60 feet long and the gases entering same are reduced in temperature from 1300° C. at the end of the furnace to approximately 700° C. at the intake for the boilers.

In erecting the new reverberatory, it is planned that this should be placed almost immediately behind the boilers and with a good tight flue connection; the waste heat should serve to generate approximately 250 h.p. In order to utilize the resultant h.p., it is planned to run one of the old generators in the power plant, each one of which is capable of generating 300 K. W. and this should be ample to operate the plant at all times. The blowing engine will run by steam as at present, and if running non-condensing as it does now it would require 250 h.p. but it is planned to hook up the old condenser and connect same with both the blowing engine and the generator. The total power required to run both of these machines condensing, should not exceed 500 h. p. which will be easily supplied by the two 350 h.p. boilers, which during the great part of the time will operate only with the waste heat from the reverberatory furnace and when the blowing engine is running with a certain amount of fuel oil additional; it is not believed that more fuel oil will be needed than at present, and this cost I estimate will be approximately the same as now; say, \$700.00 per month.

Under the new system, the force will have to be increased by two Engineers and one Fireman daily amounting to an additional expense of \$20.00 per day including all the extra labor, oil, waste and repairs. The daily saving in electric power as purchased from the

Arizona Power Company is estimated at \$70.00 per day which will make a net saving in Power of \$50.00 per day or \$1500.00 per month. This is an economy which should be sought for just as quickly as possible after the new plant goes into operation and the new reverberatory is blown in. The total expense for fixing up the generator and the condenser with necessary pumps, etc. is estimated not to exceed \$500.00 and I recommend that this matter should have the earnest attention of your Management.

(In this connection it should be noted that the Company must use at least \$900.00 worth of electric power per month in order to keep the present rate with the Arizona Power Company, but no difficulty need be anticipated on this account as the power used at the Blue Bell Mine now amounts to from \$900.00 to \$1,000.00 per month and working in a larger scale it will run \$1,200.00 or over per month)

F R E I G H T

The present freight rate from the Blue Bell siding to Humboldt - a distance of eleven miles - is 35 cts. per ton. Mr. Walker and I had a conference with Mr. Drake, the Vice President of the Santa Fé, Prescott & Phoenix Railroad and proposed that in consideration of our agreeing to ship a larger tonnage of ore we should be granted a reduction in rate to 25 cts. per ton for this distance. Mr. Drake appeared favorably impressed with our argument and the result has been that the local Officials of the Santa Fé have recommended to their General Management that our rate be reduced to the above figure provided we ship 6000 tons of ore monthly from Blue Bell to Humboldt. This reduction if finally obtained will amount to \$600.00 per month, that is, \$7200.00 per annum; a very important item on considering the cost of operation on the new basis.

In view of the possibility of developing and opening up the De Soto Mine, we also requested from Mr. Drake that the rate from De Soto siding should be reduced from \$1.25 to 50 cts. per ton. I understand that this reduction was also recommended. We can, there-

fore, probably consider that the freight rate will be 50 cts. We mentioned to Mr. Drake that in case we decided to open up this property, it would probably be on the basis of 100 tons per day. The question of the De Soto is one which need not occupy your attention at the present moment, but in June 1914 after the new equipment is operating at Blue Bell and Humboldt, I trust that you will give this matter due consideration.

OFFICE & ACCOUNTING DEPARTMENT.

In the past this department has been badly handicapped and ever since the fire, which destroyed the old accounts, it has been very far behind in its work. The attempt to operate short-handed has resulted in no direct benefit nor economy, and much of the detail work has been forced upon the Chief Clerk and the General Manager and has served to keep their attention away from other more important matters. To remedy this, I have already recommended that the Office should be provided with a proper staff and at the same time have tried to make the routine work as easy as possible. Such work as remains should be promptly brought up to date and not allowed, under any circumstances, to fall behind again at any time in the future.

In consultation with Mr. Walker and Mr. Henderson, several changes of a labor saving character were suggested and these will be brought to the attention of the President and Directors. The effect of these changes is merely to simplify and reduce the amount of clerical work at Humboldt in making up returns for the New York Office.

The most important recommendation in regard to the Accounting Department is that accounts should be kept strictly up to date and sent forward from Humboldt to New York about the 20th of each succeeding month or before that day. This matter is not only important for the New York Office, but it appears impossible for the General Manager at Humboldt to operate efficiently if he is not informed of the cost of each department very soon after the first of

every month and is thereby able to know exactly what the results of his work have been and the comparative efficiency of each department of the plant.

PLAN OF OPERATIONS DURING THE NEXT FEW MONTHS

&

TREATMENT OF ORE IN STOCK.

It is somewhat difficult to forecast the exact results of your operations during the next few months on account of the alterations which will be in progress at the plant, the uncertainty of dates of delivery and the time required for erecting and properly adjusting the new machinery. I have, however, made the following estimates which I believe to be conservative.

During September and October your operations were not profitable due to the small tonnage treated and the high cost of making copper. In November an excellent start was made and during the first five days, 35,000 lbs. of blister copper was produced. Unfortunately a break in the furnace roof caused suspension of operations and the production for this month will undoubtedly be small.

The Concentrating Mill at present is well ahead of the Smelter, and it is to be hoped that every effort will be made to rush the smelting end of the plant to catch up with the concentrator if possible during the latter part of November and early December; but in any case there is likely to be a deficit of approximately \$5,000.00 to \$10,000.00 as result of November operations.

The mill equipment continues to be gradually improved. The Huntington Mill broke down on the first of this month but this was rather fortunate than otherwise, and the Hardinge Mill should be installed and operating by the middle of this month. I can see no reason why the mill should not treat 3500 tons of ore during the pres-

ent month and quite a lot of concentrates should be accumulated in the bins. In December you may expect to have the flotation plant on hand and this should begin to operate during the early part of the month, although for some weeks the operations will be of an experimental character and no large tonnage can be treated properly until January 1st., by which time the Dorr Thickener should also be installed. Meantime we hope to be able to treat the Pennell Ore which will very sensibly increase the financial returns from operations.

In January it is expected that the flotation plant will be working properly and the De Soto ore at present stocked at Humboldt can be run through the mill in connection with the Blue Bell ore and during January, February and perhaps a part of March. The estimated results of operations, ^{are} shown more particularly on a statement attached to this report, in which it is assumed that permission is given to treat the Pennell Ore and to defer payments for same to Muller Schall & Company for a matter of six months. In April the new equipment at the smelter should be in operation and your ore stocked at Humboldt will be practically exhausted, aside from the old tailings which will last for a year or more. You will then begin to operate entirely on the new basis of treating 250 tons of ore per day in the mill and produce 175 tons of blister copper per month. The details of this plan of operation are treated in another section of this report.

Below is tabulated the stock of ore and material which is at present on hand at Humboldt and which, with the exception of tailings should all be treated within the next few months of operation.

The estimate as to tonnage and values is given me by Mr. Walker, and the estimated cost of treating the various ores and the losses incident thereto are also his figures in a large part:

Name:	Tons:	Value Gold & Silver Per ton:	Value Copper Per ton:	Gross Value Per ton:	Total Gross Value:	Estima- ted ex- pense of treatment & loss in treatment:	Estima- ted prof- it to Consolida- ted Arizo- na:
Fennell Ore <i>(Mc Cabe Mine)</i>	1500	\$20.00	\$3.00	\$23.00	\$34500.	\$34500.	\$
De Soto Ore	6220	1.86	9.10	10.96	68171.	36885.	31286.
Blue Bell Ore	1000	1.80	6.50	8.00	8000.	6000.	2000.
Mill Tailings	15000	0.75	4.50	5.25	78750.	62750.	16000.
Total:	23720						\$49286.

In connection with the above estimates it should be understood that there will be approximately \$24,000.00 payable to Muller Schall on account of the Fennell Ore and \$2,500.00 payable to the same firm on account of the De Soto Ore.

From the treatment of the Fennell Ore a very small profit only will be realized by the Consolidated Arizona and in fact there may be no profit at all after paying the cost of milling and smelting. From the De Soto Ore a very substantial profit will be realized provided the values are as given in this estimate.

In regard to the tailings, the profit has been made very low on account of past difficulties in treating this material and also the uncertainty of the average assay. I believe, however, that the net profit can be made somewhat greater than estimated in the table above.

For various reasons it will not be practical to treat old tailings until after the flotation plant is operating in a thoroughly efficient manner nor until after the De Soto Ore and probably also the silicious Blue Bell Ore in stock has all been used up and hence it will probably not be wise to begin treating tailings until February or March and possibly not before April.

The Fennell Ore on the contrary should be utilized just as quickly as possible, both on account of the money which will

be received for same and because this ore will undoubtedly be handled better by gravity concentration and smelting than by any attempt to treat by flotation. We have planned to crush this ore and concentrate by gravity, making a rather foul concentrate and at the same time impounding all of the tailings. The concentrate will be rather silicious for smelting but we should be able to handle it without any great difficulty in the furnace. The tailings will be very silicious indeed and can be used for fettling and converter flux and these tailings should be put through the plant just as fast as possible, but even so, some months will pass before they are entirely used up. On account of the character of this ore the concentrating alone will be unsatisfactory and probably not more than 60% of values will be recovered in the concentrates. However, by smelting all of the tailings as well, the values should be recovered except for smelting losses and it is estimated that eventually 90% of all values will be recovered in the bullion.

In regard to the De Soto ore, this should be treated just as soon as the flotation process is installed and working in proper order. I have assumed that you will begin to treat this in January and will put through a little more than 2000 tons per month for three months. Mr. Walker has estimated that the net profit after paying treatment costs and Muller Schall, will be \$5.03 per ton of ore amounting to \$31286.00 for the entire stock now on hand and said profit should be realized during the next four or five months.

Statements "C" and "D" follow, showing the estimated date of payments for new equipment and the estimated financial results of operating and smelting from November 1913 to June 1914, assuming that we handle the Pennell and Blue Bell Ores as outlined above; the arrangement of the finances has been outlined by Mr. Cumnock and Mr. Jansen.

S T A T E M E N T " C "

ESTIMATED DATE OF PAYMENTS ON NEW EQUIPMENT

(\$38,000.00)

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Hardinge Mill	500.							
Flotation Plant	500.	500.						
Dorr Thickener		1000.	500.					
Tails Equipment		1000.		1000				
Reverberatory		2000 4000.	2000 6000.	2000 6000.	2000	2000		
Wedge Furnace pay- ments			2500. 1000	4000. 6500	2000. 2000	2000. 2000		
Wedge Furnace la- bor, etc.			1000.	4000. 1000	2500. 5500			
TOTAL EXPENSES	\$1000.	\$6500.	\$10000.	\$14000. 10500	\$4500. 15500	\$2000. 4000	0	0

S T A T E M E N T " D "

ESTIMATED FINANCIAL RESULT OF OPERATIONS DURING NEXT FIVE MONTHS.

	1913	1	2	3	4	5	6	
	Nov. 20-30th.	Dec?	Jan.	Feb.	Mch.	Apr.	May	June
Gross Value								
Bullion shp'ts.	11.000	<i>25000</i> 45.000	<i>50000</i> 40.000	<i>45000</i> 40.000	<i>45000</i> 40.000	45.000	52.000	52.000
Available 85%	9.000	38.000	34.000	34.000	34.000	38.000	44.000	44.000
Total Expense, including construction	19.000	<i>45000</i> 40.000	<i>30000</i> 35.000	<i>35000</i> 39.000	<i>30000</i> 32.500	37.000	40.000	42.000
Balance	-10.000	-2.000	-1.000	-5.000	+1.500	+1.000	+4.000	+2.000,9500
Equities of Bullion	8.000	7.000	6.000	6.000	6.000	7.000	8.000	8.000 56000

PLAN OF OPERATIONS AFTER MAY, 1914.

With your new plant entirely completed and operating in April, you should on May 1st, be able to enter upon an entirely new scale of operation. At this time you should be mining at the Blue Bell upwards of 200 tons of ore per day and shipping same to the concentrator which will handle in addition 50 tons of old tailings daily. The copper content in all the material treated will amount to upwards of 460,000 lbs. per month. All of this material should be handled without difficulty in the newly equipped mill making a gravity concentrate and also a concentrate by the flotation process and the resultant concentrates will be roasted in the Wedge Furnace, smelted in the new reverberatory and converted, resulting in a production of at least 350,000 lbs. of copper per month. As a fundamental basis for your operations, I make the following statement:

The necessary ore is already developed in your mine and your mine equipment is such that you can produce and ship 6500 tons of ore monthly, of which, 500 tons will be used for fettling and converter flux. The ore which you have shipped during the past few months has averaged 3.65% copper to the ton. The average grade of the ore reserves as determined by sampling is 3.5% copper. The average of the production is estimated at 3.20% copper to provide for intermixture of waste which may result in handling a larger tonnage. You will have on your dump 15,000 tons of old tailings which can be sent to your mill at the rate of 1500 tons per month and treated there for a good recovery of values, the average content of these tailings is estimated to be 1.5% copper, through sampling shows an average of nearly 1.75%.

The plans which we have laid down for the new equipment of the mill and the smelter will enable you to handle all of this material regularly and efficiently. The mill should recover 85% of the values and the smelter should make a better than 88% recovery; the final recovery being under the circumstances 76% of values in ore and old tailings. In connection with this estimate it should be said, that the

recovery in the mill is still somewhat uncertain since we cannot tell what the flotation process will do, but we do know what percentage we can recover by gravity with the jigs and tables and considering the experiments which have been made with flotation I think that the estimate is a safe one and I am hopeful that eventually a 90% recovery will be attained.

As to the losses in smelting, there is good reason to believe that at present when running steadily you do not reach 12% although the average for the past months has been 15% and I feel very confident that with the small dust loss which may be expected from the Wedge Furnace and with the operation of the new reverberatory, you will eventually be able to make from 92% to 94% in the smelter recovery. I therefore consider that the new plant ought to in every respect handle the tonnage mentioned and that the metal losses should be no greater than those which are given in the above estimate, leaving a production of upwards of 350,000 lbs. of copper per month.

There remains the question of the cost of production and this matter has been fully treated in other parts of my report. The proportion of working cost which will be made up of power, supplies and other known items have been carefully considered and there will not be any great deviation from the figures assumed in this report. The last and most important item is labor and it is in this connection that the Management will have to exercise their very best effort to improve conditions, arrive at and maintain a high standard of efficiency.

It will be noted that in this report no account is taken of expansion beyond the scheme laid out for operating after May. The main object of my present examination has been to devise a means of operating profitably with the least possible outlay for the new equipment and I have attempted to plan for one thoroughly efficient unit with capacity of 250 tons of material per day. Future plans of operation will depend very largely on results of developments at the Blue Bell Mine and at the De Soto, and also on the success which may attend the operation of the flotation process and the new equipment. If the mining

developments are satisfactory during the next two years, I anticipate that you will be in a position to increase the size of your plant by adding another unit similar to the one which we are installing at present.

Attached is statement "B" giving the flow sheet of the plant as it will be after May, together with the amount of material treated in each operation and the cost of each step in the process per pound of copper eventually recovered as bullion.

G. M. C.

S T A T E M E N T " B "

MONTHLY SCHEDULE OF METALLURGICAL OPERATIONS.

Cost per lb.
of copper re-
covered as
Bullion.

\$.0443

.0100

.0251

.0235

.0057

General &
New York
Expense
.0128

M I N E

Produce 6500 tons of sorted ore containing
415000 lbs. of copper.

OLD TAILINGS
1500 tons contain-
ing 45000 lbs.
copper.

Trammed & sorted & shipped to Humboldt,
6500 tons ore, containing 415000 lbs. copper.

CONCENTRATING MILL.

Receive 6000 tons ore containing 385000 lbs.
copper, and
1500 tons tailings, containing 45000
lbs. Copper. Total feed
7500 tons containing 440000 lbs. copper.

Silicious ore for
fettling, etc. 500
tons containing
20000 lbs. copper.

Concentrates, approximately 2500 tons con-
taining 374000 lbs. copper.

TAILS TO WASTE
containing 66000
lbs. copper.

ROASTER TREATING ALL CONCENTRATES.

Calcines, approximately 2250 tons containing
365000 lbs. copper.

FUMES & DUST loss
9000 lbs. copper

REVERBERATORY

Treating 2250 tons calcines containing
365000 lbs. copper. Fettling 300 tons con-
taining -----

FUMES & DUST loss
3000 lbs.

12000 " " " " " "
377000 " " " " " " 2700 tons.

SLAG to waste
containing 27000
lbs. copper.

MATTE (40%)

about 438 tons containing 347000 lbs. copper.

Converter, treating 438 tons matte containing
347000 lbs. copper and 200 tons silicious ore
containing -----

FUMES & DUST loss
5000 lbs. copper

8000 " " " " " "
355000 " " " " " "

BLISTER COPPER

175 TONS CONTAINING 350000 lbs. copper.

L. M. C.
Office Copy.

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EXTRACTS FROM REPORT BY

G. M. COLVOCORESSES

November 19, 1913

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			

(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				
<hr/>					
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 working 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
	<hr/>	<hr/>
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 sericite 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:

	<u>Positive</u>	<u>Highly Probable</u>	<u>Probable</u>
"Blue Coat"	39,000 tons at 3.50% Cu (14,000 tons broken in stopes)	12,000 tons @ 2.50% 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.
<hr/>			
Total	39,000 tons @ 3.50%	40,500 tons @ 3.50%	45,000 tons @ 3.50%
<hr/>			
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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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 respect 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 interest^{ed} 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 Humboldt, 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

at 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 Stopping:

Until the end of 1913 the stopping 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 study 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 ~~pxx~~ 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.

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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 ~~estimates~~ 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 Most- ly)	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

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 (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 259 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 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 against 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.

CONSOLIDATED ARIZONA SMELTING CO.

ANNUAL REPORT

1915

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.

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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 5th 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 cutover.

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.

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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.

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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 ^rtermination 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 or 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.

(12)

CONSOLIDATED ARIZONA SMELTING COMPANY

ANNUAL REPORT

1918
- - - -

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 131,990 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

1919

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-outs 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 $\frac{1}{2}\%$ 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.

Verly J. Ford

BLUE BELL MINE

(Taken from U.S.G.S. Bulletin 782) by Waldemar Lindgren (1926)

History:

The Blue Bell mine has for many years been the property of the Consolidated Arizona Smelting Company and has yielded a large quantity of low-grade pyritic copper ore. It is now held by the successor of this company, the Southwest Metals Co., which also operates the Humboldt Smelter. Jaggard and Palache in 1901 mentioned the property briefly, but it was not until 1906, when the mine was transferred to the Consolidated Arizona Smelting Co., that it began to acquire importance. Since then it has developed into the largest producer in the Bradshaw Mountains. The total production of ore to 1921, inclusive, was 800,000 tons of copper ore, with an average gross value of \$10 a ton. In common with many other mines the property was idle in 1921, but it reopened in 1922 at the same time as the Humboldt smelter.

Development:

The Blue Bell mine is 4 miles south of Mayer, at an altitude of ⁵⁰⁰⁰4500 feet. (see Pl. 18, A.) It has modern, electrically driven equipment and is connected with the railroad siding by an aerial tram ³1 mile^s long. There is a concentrating plant of 350 tons capacity at the Humboldt smelter. The developments consist of a vertical shaft 1400 feet deep in 1922 with almost 30,000 feet of workings north and south. There are five smaller shafts.

Geology:

The deposit is contained in the Yavapai schist, which here is a complex character, including ledges of quartzite, biotite schist, small lenses of crystalline limestone, chloritic schist, clay slate, and schistose quartz porphyry. The strike is N. 27 degrees 30' ^EW. and the dip 70 degrees W.

The reef of brownish quartzite crops out prominently at the village below the mine, and close by is some light-gray fissile

Verly J. Ford

clay slate. Quartzite also occurs on the 1400 foot level. Another specimen collected from the same level is a dark green dense schist which looks like hornfels and contains dirty green biotite, magnetite, zoisite, chlorite and quartz mosaic. Still another specimen from the same level is a greatly crushed quartz porphyry with microcrystalline groundmass of quartz and orthoclase, with some microcline, albite, and sericite. The quartz phenocrysts are also greatly crushed.

Veinlets of calcite and quartz are abundant in the mine. A persistent dike is exposed on all levels and is not affected by schistosity. A thin section of this dike shows partly idiomorphic augite, brown hornblende, some of it with kernals of augite, lathlike labradorite, magnetite, and apatite. Secondary chlorite and sericite are present. The grains average 1 to 2 millimeters in size. This is a granular dike rock related to camptonite. This dike is generally vertical and intersects ore about 200 feet south of the shaft. It shows no mineralization.

The ore body:

The ore body is essentially a silicified and mineralized zone that conforms to the schist. The width is about 100 feet. The ores form a series of six flat lenses within the zone; in part they overlap and they pitch about 75 degrees S. in the zone. These lenses are as much as 40 feet wide and occur on both foot and hanging walls.

The stopes stand well; some of them are 80 feet high and 20 feet wide. Relatively to the walls of the zone, each shoot keeps its position well. Most of them continue from points near the surface down. The surface is generally barren, probably as a result of leaching. The fourteenth level was just opened in 1922. The developed length of the deposit is 1600 feet. (see pl. 16).

Structure:

The ore bodies are intersected by several faults that dip 30 degrees - 40 degrees NW., thus intersecting the lenses at an oblique angle. The faults are of the reverse type and show a slip of 50 to 100 feet. One fault observed on the 500 foot level strikes east and dips 60 degrees S., and the fault plane shows striations

parallel both to strike and dip. The faults cut the ore cleanly and show no mineralization.

The walls of the ore shoots are mostly well defined, but in some places they show transitions to silicified country rock. Locally on such walls a groove structure is noted which conforms with the southward pitch of the shoot.

The Ore:

The most common country rock is a chlorite-biotite schist. Within the silicified zone it may, however, be difficult to recognize the original character of the rock. The silicified material may contain sparse sulphides, but as a rule the ore is well defined. The ore is classified as heavy smelting ore and siliceous concentrating ore and averages 3 per cent in copper. The smelting ore contains also 1.5 ounces of silver and 0.05 ounces of gold to the ton. As a rule the siliceous ore contains a little less gold and silver than the smelting ore.

The smelting ore is usually massive and rather fine-grained; it consists of pyrite intergrown with more or less chalcopyrite and containing spots of quartz and imperfectly replaced schist. A little calcite is universally present, but a fine-grained quartz mosaic replacing the schist is the principal gangue. The siliceous ore usually shows the schistose structure of the original rock and contains streaks of replacing sulphides. The minerals are pyrite and chalcopyrite, with very small amounts of arsenopyrite, sphalerite, and galena. No tetrahedrite was observed.

Polished sections show rude crystals and rounded grains of pyrite, fractured, cemented, and replaced by chalcopyrite and the other scant sulphides, among which dark sphalerite is the most abundant. (See pls. 9, B; 17, B)

The ore shows less ankerite and more quartz than usual in the schist replacement deposits, but the succession of minerals is the same; quartz and carbonates are the oldest, followed by pyrite and later by chalcopyrite. The same dark green iron rich chlorite that was observed at Jerome appears here again in places.

Oxidation and Water:

At the surface the ore is leached and rusty brown; there is no chalcocite zone proper, but a little chalcocite may be found in places down to the 1200 foot level. On the 400 foot level a little oxidation is observed, and 1800 feet farther north on the 500 foot level the drift encountered a 2 foot vein of chrysocolla and cuprite fully oxidized and containing no silver. The workings are rather warm, and the mine water is acidic and contains much copper. The original water level was probably at the 400 foot level; the mine makes little water, say 150,000 gallons in 24 hours.

GEORGE M. COLVOCORESSES
MINING AND METALLURGICAL ENGINEER
1102 LUHRS TOWER
PHOENIX, ARIZONA

file 344
Revised March, 1941
September 1940

STATEMENT REGARDING BLUEBELL AND DE SOTO MINES

These properties are located in Yavapai County, Arizona and were worked for many years by the Consolidated Arizona Smelting Company and its successor, the Southwest Metals Company which is still their owner of record.

The reasons for considering their acquisition and re-opening are set forth in the following statement which can be amplified by further details, maps etc.

Bluebell Mine: The Bluebell Mine, located on a group of nine patented claims, is a replacement deposit in Yavapai schist. The ore is a mixture of chalcopyrite and iron pyrites with a siliceous gangue and occurs in lenses of varying length and width but uniformly with long vertical axes and the shoots are continuous from the surface to the greatest developed depth.

The mine was operated intermittently from 1895 to 1938 and has produced altogether about one million two hundred thousand tons of ore with a recorded value of over \$14,000,000. One million tons of this ore were taken out from 1913 to 1930 under my management. The maximum annual production of 131,000 tons was made in 1918. The mine has been developed for a length of over one mile along the vein and to a maximum depth

of 1570' and it was equipped for operating on any basis up to 400 tons per day. Subsequent to 1932 the equipment was removed and the water has been allowed to rise to its normal level, which is about 800' below the collar of the shaft.

The average value of the ore produced to date has been \$2.35 per ton in gold and silver (at present prices) and over 3% copper. The positive and probable ore reserves including the more recent developments in the Blue Buck Claim are approximately 100,000 tons of similar grade and an equal additional tonnage is partially developed. Future developments should materially add to these reserves since it was never the policy of the management to open up the workings very far in advance of actual production and only one of the six ore shoots has actually been bottomed.

The profits earned from the operation of this mine fluctuated widely in accordance with the market price of copper but in the aggregate they were very substantial. The cost of producing copper after crediting gold and silver values varied from a fraction over 9¢ per pound to a considerably higher figure when wages and commodities had risen during the world war period. The ore is very suitable for concentration and if a flotation mill were built at the mine (where a sufficient water supply is obtainable) and modern equipment provided, I think that copper might again be produced for from

8¢ to 19¢ per pound considering the ^{greater} credits for gold and silver at present prices.

The cost of reopening the main shaft and deeper workings and providing equipment for large scale operations would be considerable, and I do not advise any such procedure at the moment but since I believe that a higher copper price will some day maintain, I consider that this situation offers an exceptional opportunity to secure at a very low price the ownership of a property with great potential value.

DeSoto Mine: The DeSoto Mine, comprising a group of 18 patented claims, is also a replacement in Yavapai schist and the geology is similar to the Bluebell. The lenses are smaller and located very irregularly in the mineralized zone which has been developed for a length of about 1000' and to a depth of 900'. The width of the mineralized zone is considerably greater than the Bluebell and extends on both east and west sides of a steep ridge. The lenses on the east slope of the hill, which have been principally worked to date, do not appear to carry much value below a depth of 800' where barren quartz replaces the sulphide minerals, but there is good prospect of finding lateral extensions of these ore-shoots in the upper levels of the mine and also chances of opening up additional ore bodies, some of which are indicated by outcrops or shallow workings. Very

little work has ever been done under the large outcropping on the western side of the hill which would appear to have great promise with depth.

This mine was operated on a small scale from 1890 to 1905 when quite extensive work was undertaken, interrupted by the panic of 1907 and renewed again from 1915 to 1921. Lessees subsequently operated with success until the drop in the price of copper, coupled with the burning of the lower tramway terminal, forced them to discontinue in September, 1930.

Total production of ore appears to have been 300,000 tons with value of about \$4,000,000 but at no one time have the developed ore reserves been large. Exploration was naturally neglected by the lessees and the quantity of ore which can now be measured is relatively small but indications point to the discovery of additional ore, particularly under the WHALE CLAIM and a small expenditure for development work might greatly increase the present reserve.

The average grade of ore produced to date has been \$2.68 value in gold and silver (at present prices) and 3% copper. Some ore of similar grade remains and in addition there is a very substantial tonnage of lower grade material which cannot be considered commercial under present conditions. This ore should all be concentrated and the recovery by flotation is excellent but little or no profit could be expected except when the price of copper exceeds 11¢ per pound.

In 1921 the Bluebell and DeSoto Mines were assessed by the State Tax Commission at \$1,751,558 and the developed ore reserves are now only about 25% less than they were at that date.

Proposed Program of Operation:

After clearing the title and acquiring complete ownership of these two mines, I should propose to concentrate attention upon the Blue Buck ore body. The workings of the Bluebell passed through this shoot and a considerable tonnage of ore was mined below the 300' level but above that point the veins branched into the foot-wall of the ore-bearing-zone and only one of them had been located before the large scale operations of the Bluebell were discontinued. However, a raise had been put up to the surface through which waste, broken in a glory hole, was dropped down for filling in the deeper stopes.

Just prior to the depression of 1930, lessees took over the Blue Buck and using this raise as a shaft, carried forward an exploration in the course of which they discovered the foot-wall ore shoots on the 100' level and mined a small tonnage of excellent ore. This work was resumed in 1936 and the developments opened up similar ore in two parallel veins in the foot-wall of the raise and additional ore in the hanging wall vein previously discovered.

The 1500 tons which were mined and shipped from these upper Blue Buck workings had an average assay of 0.044 oz. gold, 2.00 oz. silver and 6.6% copper equivalent to a gross value of over \$16.00 per ton with gold at \$35.00 per oz., silver at \$0.71 per oz. and copper at 10¢ per pound.

The tonnage of positively developed ore in the Blue Buck workings is small but indications very definitely point to its extensions and it seems certain that at least 50,000 tons from this and other neighboring sections of the mine would have a gross value of about \$13.00 per ton (with copper @ 12¢ per lb.). Mining and Milling this grade of ore at the rate of 100 tons per day should yield a net profit of over \$4.00 per ton.

The recovery of copper in Blue Bell ore by flotation was in excess of 92% and there is an excellent site for a mill close to the collar of the main shaft from which ample water can be secured and right over which runs the electric power line of the Arizona Power Company.

In view of the present and probable future demand for copper the resumption of operations at Blue Bell should obviously be attractive to any company which can afford to make the initial investment and two such concerns have already made inquiries regarding the opportunity to take over this mine under bond and lease with usual 10% royalty payment to the owners.

The future of the DeSoto is obviously more uncertain for either a sufficient tonnage must be developed to justify a local mill or one can only anticipate small scale operations by lessees from which, however, with a copper price of 11¢ or better, the royalties should normally be more than sufficient to cover the carrying charges and net a small annual income to the owner.

Legal and Financial: Except for the work of lessees at the mines, the Southwest Metals Company became inactive in 1930 and during the next five years sold all of its real and personal property except the 27 patented mining claims in the Blue Bell and DeSoto Groups. The Delaware Charter of the Company and its license to do business in Arizona have been rendered subject to forfeiture for lack of payment of taxes and fees and the company has long since ceased to function as a corporation.

Meantime, - and after having failed in all my efforts to revive and refinance the company itself, which would have required a very substantial outlay, - I have so arranged matters that I can acquire clear title and ownership to all of these mining claims for an additional cash expenditure of about \$3000.00. After title is secured it will only be necessary to make the upper workings of the Blue Bell accessible in order to be in a position to make a favorable presentation of this property to interested parties.

I hardly need to add that there is always a risk involved in any and every mining investment but since the purchase price of these 27 patented claims will represent so small a figure, I sincerely believe that either through lease or sale there is far more than a substantial probability that the owners will get back their principal plus a very tangible but quite unpredictable profit.

L. H. Colman

SPECIAL REPORT - BLUEBELL MINE

Humboldt, Ariz., Sept. 26th, 1914.

Attention Mr. Victor L. Cunnock, President:

The last Special Report on the Bluebell Mine was written on April 27th of this year, and after five months additional work and a considerable amount of development, as well as a pretty thorough sampling of the entire mine (in so far as it is now accessible), it seems well to go over this ground again and report on the condition of the property at the present date.

The fundamental basis of all our operations at Humboldt must (at least for some time) continue to be the production of ore from the Bluebell Mine, and hence this subject becomes one of paramount importance. It is very particularly my desire in this report to outline and to recommend a certain program of development which must be carried on in the near future, in order that the production of the mine may be increased, or even continued, on the present scale. Accompanying this report and forming part of it, are blueprints showing the outline of the workings on September 1st, and also the latest assay plan of the mine. I have embodied in the report also a revised estimate of the ore reserves as of September 1st, and this should be considered in conjunction with the estimate found on page 7 of my report of April 27th.

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 ozs. gold, 1.31 ozs. silver, and 3.76% 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 3,000 tons Positive and Probable are 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 1915, 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 chute.

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 Bluebell 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 6,000 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 can^{not} 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 foot 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 350 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.

Necessary Equipment: In order to operate on the 1000 foot level, it is absolutely necessary that another and larger hoist be installed at the main shaft. We have looked into the question of this hoist with care and obtained specifications and quotations from several of the best manufacturers. I feel that it is necessary that this hoist should be a very high grade machine, as the entire operation of the mine will be dependent upon it, and also that it should be sufficiently strong to raise ore from a depth of 1500 feet or 1600 feet. I have found that not only will it be necessary to purchase a new hoist, but also we shall have to purchase another motor, as the ones which we have on hand, and which I had previously figured on, are not of sufficiently great strength to handle the hoist properly.

The cost of a high grade hoist and proper sized motor and all necessary attachments and completely installed at the Bluebell Mine, will amount to \$10,000.00, and we cannot hope to have this hoist in operation in less than four months time when we place the order, as hoists of this kind are not carried in stock and will have to be built after the order is received by the manufacturers. Assuming, therefore, that we ordered the hoist during the latter part of October, same would not be actually working until about the 1st of March.

Development Work Necessary: Our first operation incident to opening up the 10th level will be to sink our shaft to a distance of 150 feet, to timber same, cut out the station, and put in the necessary ore pocket. This work will require in all probably ninety days, and will cost approximately \$6,000.00. The sinking can all be done with a small auxiliary hoist placed on the 9th level, and the material from this point can be raised to the surface with our present hoist. Therefore, we can carry on this work and complete same before the new hoist arrived, and it would not be well to attempt any cross-cutting or drifting before the new hoist is in operation, or say the 1st of March.

It will be necessary to cross-cut from the shaft to the No. 3 Ore Chute, a distance of 150 feet, and this cross-cut will require about one month to complete, and will cost about \$1500.00. After that it will be necessary to drift southward a distance of nearly 400 feet to the north end of the No. 1 Ore Chute, and this drift will require approximately two months work, and will cost in the neighborhood of \$4,000.00. While the drift is in progress, some ore may be taken from the No. 3 Ore Body, and a portion of the drift will not be in waste, but before we can count on any steady production from the 10th Level (assuming that the ore exists there as it does above), we shall have to carry on all of the development work stated, ^{which} and will represent approximately six months work, and an expenditure of probably \$11,000.00, to which must be added the \$10,000.00 expended for the new hoist and equipment. Everything considered, it will probably be best to figure that the total cost of opening up the 10th Level will amount to about \$22,000.00, and that this level will not be ready to actually produce ore in any quantity for seven months after the time we start sinking operations. In other words, if we start sinking November 1st, we can count on a production from the 10th level by about the 1st of June, 1915.

Now, on the face of the estimate enclosed with this report, we have approximately 185,000 tons of developed ore in the Bluebell Mine, but it must be remembered that a good proportion of this ore is classed as "Probable", and is not positively proved to exist. Moreover, 25,000 tons of the Probable ore is located below the 9th Level, and is obviously not available until the 10th Level shall be opened up. A good proportion of the Positive and Highly Probable ore cannot be classed as immediately available. This is especially true of the pillars and sills in the old No. 1 stopes, and, taken altogether, we have not more than 100,000 tons of easily available ore that we can draw on during the next eight or nine months. Assuming that during that time we extract from 50,000 to 60,000 tons of ore, our available ore will be growing dangerously small, and we shall likely be finding ourselves either short of working faces and necessarily pinched for ore, or obliged to extract some more or less inaccessible material at undue working expense. I

consider it absolutely necessary that the ore reserve of the mine should be maintained and even increased as soon as possible to do so, and in order to carry this out I beg to make the following recommendations, which I hope will receive the attention of the Board at the earliest possible moment: --

1. I recommend that we should place an order for a new hoist capable of operating to 1500 feet depth and handling one-half more load per skip than the present hoist. I would like to be in a position to place this order during the month of October, so that the hoist would be delivered to us in February, and would be installed ready to operate by the 1st of March, 1915. I will endeavor to secure the most favorable terms possible in connection with the purchase of this hoist, and no immediate outlay will be necessary. Presumably we shall have to pay about \$5,000.00 during the month of February and the balance in March and April.

2. I recommend that before the end of October we should begin sinking our shaft and should push this work with all reasonable speed, so that everything will be ready to begin cross-cutting and drifting on the 1000 foot level as soon as the new hoist is put in place. The total amount of money involved in this work and equipment will be, as stated, approximately \$22,000.00, and this expenditure should be spread out over a period of eight or nine months.

I fully appreciate that this is a bad time to ask for new equipment, but I feel that it would be both dangerous and poor policy to hold back much longer in this regard. It is absolutely essential that we should continue to operate at Humboldt on a basis of treating more than 6,000 tons of ore per month. In fact I am desirous of increasing this tonnage to 7000 and 8000 just as quickly as possible. We have at the present time no source of ore supply excepting the Bluebell Mine. It may, of course, seem advisable to open up the De Soto, but in any event I consider that the Bluebell will continue to be our main standby, and that under no circumstances should we risk running short of available commercial ore to keep our plant at Humboldt operating at full capacity.

ESTIMATE OF ORE RESERVES

Attached is a sheet showing the ore reserves as estimated September 1st, with summary of Positive, Highly Probable and Probable ore. This estimate follows for the most part the same lines as the one included in my report of April 27th. In some cases changes have been made necessary by the development of new ore reserves, and by the extraction of some of the ore estimated in April. At some points also after resampling, it was found necessary to change the previous estimate, but in the main the work which we have done to date seems to me to have tended to prove the correctness of the former estimate, and no very radical changes have been found necessary.

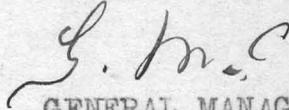
The question of the value of the ore is rather complicated by the lower prices now prevailing for the metals, and the absence of any official price for copper. I have, therefore, not attempted to make any very close estimate of value, as this might obviously change from day to day, but I have assumed silver to be worth about 53¢ an ounce, and copper about 13¢ a pound. In the main I consider that the average of all ore developed as of the ore which we have shipped during 1914, is \$~~12.00~~^{11.00} per ton, with the metals figured at the prices mentioned above.

WORKING COSTS

It is not my intention in this report to dwell at length on the methods of operation or detailed costs of same. We found it advisable to return to the old shrinkage system of stoping in many portions of the mine, and so far we find that this system works out well and economically. Most of the ore which we have shipped in 1914 has been pretty expensive, and cost us at Humboldt more than \$3.00 per ton. A notable decrease was made during the month of

August, when ore was landed at Humboldt for \$2.12 per ton. I believe that it will be possible to maintain a low figure for working costs comparable to the one arrived at in August. The new development which I have outlined in this report will, of course add to our operating expenses very considerably during the next few months, but even so I believe that we shall show a steady improvement over the average to date, and am hopeful that we shall be able to produce and ship ore for \$2.00 per ton or a little less after everything gets working on a smooth basis, and the new hoist is in regular operation.

Yours very truly,



GENERAL MANAGER.

Original "Condensed Data..."
Photocopy in Folder 1 of 2

GEORGE M. COLVOCORESSES
MINING AND METALLURGICAL ENGINEER
~~HUMBOLDT, ARIZONA~~
Phoenix, Arizona

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CONDENSED DATA ON BLUEBELL
AND DESOTO MINES

The Bluebell Mine is a replacement deposit in Yavapai schist. The vein has been developed to a length of over a mile and to a depth of 1570'. The ore is a mixture of chalcopyrite and iron pyrites with a siliceous gangue and occurs in lenses of varying length and width but uniformly with long vertical axes and the shoots are usually continuous from the surface to the greatest developed depth.

The mine has operated intermittently since 1895 and has produced altogether about one million two hundred thousand tons of ore of which around one million tons were taken out from 1913 to 1930 under my management. The maximum annual production of 131,000 tons was made in 1918. The mine was well developed down to the depth mentioned and was equipped for operating on any basis up to 400 tons per day. The equipment has been removed and the water has been allowed to rise to its normal level, which is probably about 400' below the collar of the shaft.

The average value of the ore produced has been around \$2.35 per ton in gold and silver at present prices and slightly over 3% copper.

Before the Bluebell Mine was last shut down a careful estimate of ore reserves indicated that the positive and highly probable ore amounted to 79,500 tons and the partially developed and possible ore to an additional 101,000 tons. Future development may greatly increase these figures since it was never our policy to develop more than one to two years ore supply ahead of production and with one exception none of the six ore shoots appear to have been bottomed.

The average grade of the future output of the mine will probably be similar to the past production in gold and silver content, but somewhat lower in copper.

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The showings on the 1500' level and in the winze below which is still in good ore, make it reasonably certain that this reserve will be substantially increased by a comparatively small amount of development. Looking beyond the developed ore reserves the future of the mine is largely dependent upon the continuation of the ore bodies to greater depth which seems highly probable as the lower workings now appear to be below the zone of faulting which shattered and in some cases cut off the ore between the 1200' and 1500' levels.

The cost of producing copper from the Bluebell ore after crediting gold and silver values varied from a fraction over 9¢ per pound to a considerably higher figure when wages and commodities had risen to the war-time level. Nearly all the ore is very suitable for concentration and if a flotation mill were built at the mine (where a sufficient water supply is obtainable) and modern equipment provided, I think that copper might be produced in future for 9¢ per pound or somewhat less considering the higher credits for gold and silver at present prices.

The cost of reopening the mine and providing equipment for large scale operations would be considerable, and I do not advise any such procedure while the price of copper holds below 10¢ per pound. I believe that a higher price is pretty sure to develop in the future and on that assumption I consider that this is an exceptional opportunity to secure a property with great potential value for an exceedingly small outlay. At present metal prices (copper @ 10¢ per lb.) an operating profit of only 50¢ per ton could be expected but should increase about 50¢ per ton with each additional one cent advance in the price of copper.

The DeSoto Mine is also a replacement in Yavapai schist and the geology is similar to the Bluebell Mine, but the lenses are smaller and located very irregularly in the mineralized zone which has been developed for a length of about 1000' and to a depth

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of 900'. The width of the mineralized zone is considerably greater than the Bluebell and extends on both east and west sides of a steep ridge. The lenses on the east slope of the hill, which has been principally worked to date, do not appear to carry much value below a depth of 700' and 800' where barren quartz replaces the sulphide minerals, but there is good prospect of finding lateral extensions of these ore-shoots in the upper levels of the mine and also chances of opening up additional ore bodies, some of which are indicated by outcrops or shallow workings. The large ore-body outcropping on the western side of the hill has so far been only partially developed and seems likely to prove more persistent and extend to greater depth than any of the others.

The mine was operated on a small scale from 1890 to 1905 when quite extensive work was undertaken, but was interrupted by the panic of 1907 and renewed again from 1915 to 1921. Lessees subsequently operated with success until the drop in the price of copper, coupled with the burning of the lower tramway terminal forced them to discontinue in September, 1930.

Total production of ore appears to have been about 300,000 tons, of which 200,000 has been produced since 1915, but at no one time have the developed ore reserves been large. Exploration was naturally neglected by the lessees and the quantity of ore which can now be measured is relatively small but indications point to the discovery of additional ore, particularly under the WHALE CLAIM and a small expenditure for development work should greatly increase the present reserve.

The average grade of ore produced to date has been \$2.68 value in gold and silver (at present prices) and 3% copper. Some ore of similar grade remains and in addition there is a very substantial tonnage of lower grade material which cannot be considered commercial under present conditions. This ore should all be concentrated and the recovery by flotation is excellent but

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only a small margin of profit could be expected until the price of copper passes 10¢ per pound.

At both the Bluebell and DeSoto there are found near the surface small ore shoots or pockets which are substantially richer than the average and could be profitably worked by leasers on a small scale and without the installation of any expensive equipment or transportation facilities. The royalty which could be obtained from such operations should serve to more than pay the taxes and carrying charges until a better price of copper prevails, and over a period of two or three years, would probably also repay the purchase price of these mines. A record of the actual production of these mines is attached.

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PRODUCTION OF BLUEBELL MINE

YEAR	TONS	AVERAGE GOLD (OZ.) PER TON	AVERAGE SILVER (OZ.) PER TON	AVERAGE % Copper Per Ton
Prior to 1913 (about)	200,000	.06	1.5	4.00
1913	36,792	.0465	1.33	3.76
1914	56,058	.0368	1.27	3.64
1915	82,171	.0340	1.11	2.97
1916	75,070	.0454	1.20	3.28
1917	102,773	.059	1.46	3.18
1918	131,090	.0639	1.55	2.77
1919	122,069	.0603	1.43	2.58
1920	111,749			2.37
1921	NO PRODUCTION BECAUSE OF CONDITION OF COPPER MARKET AFTER WAR.			
1922 (about)	80,000	.05	1.50	3.00
1923	80,811	.035	1.01	3.23
1924)				
1925)				
1926) (about)	70,000	.06 plus	1.50	3.50
(Production reduced by reason of shutting down of mill and smelter at Humboldt in 1924 and 1925.)				
1927)	Worked by leasers, small production of high grade ore.			
1931)				

TOTAL ABOUT 1,200,000 .06 1.5 (over) 3.00
 (Average value in gold and silver at 1936 price of \$3.25 per ton)

PRODUCTION OF DeSOTO MINE

Prior to 1915 about	100,000	.05	1.3	4.00
1915	8,360	.0453	1.14	3.50
1916	34,382	.0421	1.08	3.37
1918	42,870	.0527	1.20	2.58
1919	27,067	.0499	1.09	2.36
1920	18,922			
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 and silver at 1936 prices \$2.68.)

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 HUMBOLDT, ARIZONA

PRELIMINARY ESTIMATE OF CASH EXPENDITURES INVOLVED IN REORGANIZING
 SOUTHWEST METALS CO. AND RESUMING ACTIVE OPERATIONS.

1. Payment of Federal Transfer Tax on stock purchased by Hurst from Sheldon Co.	\$ 534.00
2. Payment of Delaware Corporation Taxes (about)	168.00
3. Payment to U. S. Incorporation Co. of Delaware for services as Statutory Agent	50.00
4. Payment of Delinquent Taxes on Arizona property (Bluebell and DeSoto Mines.)	453.00 X
5. Payment of Arizona Corporation Tax	50.00
6. Expenses incident to Directors' & Stockholders' meeting and transfer of office and books to Arizona, also some additional penalties and interest on taxes. (Approximately)	245.00
7. Legal and other services (approximately)	500.00
8. Required by Mr. Hurst to clear his personal situation in respect to the above transactions	5000.00
9. Option payment on account of purchase of Humboldt real estate including smelter, water rights, etc. of Southwest Metals Co., also buildings with some equipment.	500.00
10. Examination of mines and plant and preparation of documents including auditors, attorneys, and engineers reports necessary to qualify Southwest Co. Stock for sale in accordance with regulations of Federal S. E. C. and Arizona Corporation Commission.	2500.00
TOTAL PRELIMINARY EXPENSES	<u>\$10,000.00</u>

PROGRAM OF PROPOSED FURTHER PROCEDURE AND EXPENSES INVOLVED

1. Complete purchase of Humboldt property at maximum cost of	9,500.00
2. Erect 100 ton concentrating mill at Humboldt for custom ores with bins	60,000.00
3. Rebuild portions of Humboldt smelter and sampling plant for custom ores and concentrates	150,000.00
4. Recondition Bluebell Mine for production of 100 tons of ore per day.	50,000.00
5. Erect 100 ton mill at Bluebell	50,000.00
6. Recondition DeSoto Mine for production of 50 tons of ore per day	30,000.00

PROGRAM OF PROPOSED FURTHER PROCEDURE AND EXPENSES INVOLVED (cont'd)

7. Erect 50 ton mill at DeSoto Mine	30,000.00
8. Working Capital required for proper operation of mines and Humboldt Plant	150,000.00
9. Miscellaneous	5,500.00
	<hr/>
	\$490,000.00
Add preliminary expense	10,000.00
	<hr/>
TOTAL CAPITAL TO BE PROVIDED	\$500,000.00

Time required for all the above may be estimated at eight months and another four months should be allowed to adjust all equipment and put operations on a regular and efficient basis after which the monthly earnings (on basis of 12¢ copper and present prices of gold and silver) may be tentatively estimated as follows:

Mining and milling profit on 3,000 tons Bluebell Ore	\$3000.00
Mining and milling profit on 1,500 tons DeSoto Ore	1500.00
Profit on custom mill operations at Humboldt	4500.00
Profit on Humboldt smelter operations, treating concentrates from Bluebell and DeSoto Mills also custom ore and concentrates	6000.00
	<hr/>
	\$15000.00

Say a net profit of \$180,000 per annum less State and Federal Income Taxes.

This profit should be increased if price of copper advances above 12¢ per pound and will be reduced if the price of copper drops below that figure.

EXHIBITS - which may be examined at my office:

- (a) Copies of Certificate of Incorporation and By-Laws of Southwest Metals Co.
- (b) Letter guaranteeing title of Southwest Metals Co. to Bluebell and DeSoto Mines with description of Mining Claims.

MINING AND METALLURGICAL ENGINEER
 GEORGE M. SOGLOSOVSES

GEORGE M. COLVOCORESSES
MINING AND METALLURGICAL ENGINEER
HUMBOLDT, ARIZONA

The deeds to the property of the Southwest Metals Co., original Certificate of Incorporation and By-Laws, Stock Books, Minute Books and other corporate records of the Company are now in the possession of certain parties in Detroit and can all be obtained upon payment of a certain amount of money thru Mr. Hurst. There are no corporate debts of the Southwest Metals Co. or encumbrances on its property other than the taxes, etc., listed above and the corporate promissory notes of the Company which are included with the 90% of the stock in the purchase made by Mr. Hurst from the Sheldon Company.

G M C
G. M. Colvocoresses
Phoenix, Arizona

September 1938.

