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Anaconda Copper Mining Company

GEOLOGICAL DEPARTMENT

W A L K E R M I N E

ESTIMATE OF FUTURE OPERATIONS

Letter to

J. O. ELTON, VICE-PRESIDENT

By

PAUL BILLINGSLEY

May 3, 1923

C

Salt Lake City, Utah.

May 3, 1923.

Mr. J. O. Elton, Manager,
International Smelting Co.,
O F F I C E S.

Dear Sir:

The enclosed letter to Mr. Hart will explain fully my conclusions as to the tonnage and grade of ore remaining in the Walker mine. I do not believe Mr. Hart will be able successfully to challenge these conclusions. It is important therefore to forecast future operations on the basis of an assured ore reserve of 580,000 tons of ore divided as follows:

Above 5%	About 165,000 tons
Between 4 and 5%	About 140,000 tons
Between 3 and 4%	About 230,000 tons
Between 2 and 3%	<u>About 45,000 tons</u>
Total above 2%	About 580,000 tons

Average grade - 3.9% - say 4% in round numbers.

The first step is to find out what the mine is paid for. This varies with the grade of the ore, the figures being given in the following table:

T A B L E 1

WALKER MINE

CONCENTRATION RATIOS WITH PRESENT MILL ASSUMING 21% CONCENTRATE
AND .25% TAILS.

% Heads	#Cu in heads	#Cu in Conc.	#Cu in Tails	Formula	Conc. Ratio	lbs. paid for per ton crude
6	120	420	5	$120x = 420 \text{ plus } 5x-5$	3.61	108
5	100	420	5	$100x = 420 \text{ plus } 5x-5$	4.37	89
4	80	420	5	$80x = 420 \text{ plus } 5x-5$	5.46	71
3	60	420	5	$60x = 420 \text{ plus } 5x-5$	7.54	52
2	40	420	5	$40x = 420 \text{ plus } 5x-5$	11.85	33

Pounds paid for in concentrate = 389.

The second step is to ascertain the operating cost per ton, and from this to determine the operating cost per pound of copper paid for. The costs at the mine are reported under the following heads:

Breaking ground,

Drawing,

Milling,

Tramming.

Table 2 gives these items for the period June 1, 1922 to April 1st, 1923.

T A B L E 2

WALKER MINE

OPERATING COSTS

	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Breaking	\$ 9,073	16,824	14,192	15,172	15,033	14,811	23,023	20,890	18,507	N. R.
Tons Broken	3,176	5,158	7,547	8,501	7,000	7,700	15,400	16,500	13,800	15,600
Cost per ton	\$ 2.86	3.26	1.88	1.78	2.15	1.92	1.50	1.27	1.34	-
Producing Ore	\$ 3,411	5,960	6,579	10,466	7,887	8,476	8,172	7,351	6,142	N. R.
Tons Drawn	3,047	4,270	5,717	4,420	5,170	5,402	6,167	6,949	6,417	7,135
Cost per ton	\$ 1.12	1.40	1.15	2.37	1.53	1.57	1.33	1.06	.96	
Milling	\$ 9,678	9,497	13,771	9,860	13,038	19,708	15,657	15,884	14,702	N. R.
Tons Milled	4,575	6,224	6,372	4,866	5,308	4,856	5,118	5,390	5,136	7,469
Cost per ton	\$ 2.12	1.53	2.16	2.03	2.46	4.06	3.06	2.95	2.86	2.17
Tramming	\$2,346	2,418	1,953	3,481	2,440	3,104	2,918	3,008	2,383	-
Tons Trammed	3,330	2,950	2,178	2,934	3,030	2,625	2,145	2,655	2,359	2,070
Cost per ton	\$.70	.82	.90	1.19	.81	1.18	1.36	1.13	1.01	-
Cost per ton of ore drawn	.76	.57	.34	.78	.47	.57	.47	.43	.37	
Total actual cost	\$6.91	6.76	5.53	6.96	6.61	8.12	6.36	5.71	5.53	
Total money spent at mine	\$30,707	36,624	38,256	42,490	42,445	51,557	54,629	47,133	42,549	
Total expense per ton drawn	10.07	8.57	6.69	9.61	8.21	9.54	8.86	6.78	6.63	

This indicates that with no allowance for development maintenance, or miscellaneous expense, a cost of about \$5.00 per ton is within sight with the present equipment. With these items included the total current expense per ton of ore may be brought down to \$6.00 per ton - with present equipment.

Table 3 works out the current cost per pound for the different grades of ore, and goes on to show the net operating profit per pound on copper at various market prices from 12 to 18 cents per pound.

T A B L E 3

WALKER MINE

COST PER POUND COPPER - CRUDE ORE ASSUMING MINING, MILLING AND TRAMMING COST OF \$6.00 PER TON.

NO DEVELOPMENT, CONSTRUCTION OR DEPLETION COSTS.

Grade crude ore.	Tons in reserve	Cost per ton.	Obs. Cu paid for per ton.	Mining & Milling cost per pound paid for.	Net Operating Profit						
					12¢	13¢	14¢	15¢	16¢	17¢	18¢
6% or better	12,000	6.00	108	5.55 cents	2.944	3.944	4.944	5.944	6.944	7.746	8.746
5% or better	165,000	6.00	89	6.74 cents	1.754	2.754	3.754	4.754	5.754	6.556	7.556
4% or better	305,000	6.00	71	8.45 cents	-	1.000	2.000	3.000	4.000	4.846	5.846
3% or better	535,000	6.00	52	11.53 cents	-	-	-	-	.964	1.766	2.766
2% or better	580,000	6.00	33	18.18	-	-	-	-	-	-	-
Net smelter returns per lb. in conc. *					8.494	9.494	10.494	11.494	12.494	13.296	14.296

* Including credits for gold at \$20.00 and silver at 60¢; and deducting treatment charges, penalties, and freight.

It will be noticed that there is no operating profit on the 2% ore even at 18¢ copper, none on 3% ore below 16¢ copper, and none on 4% ore below 13¢. These figures do not include depletion or depreciation charges, nor interest on indebtedness - merely current costs on a basis of \$6.00 per ton for everything.

Table 4 gives the data upon which these depletion and depreciation charges should be based.

T A B L E 4

WALKER MINE

DEPLETION AND DEPRECIATION CHARGES ON BASIS OF 535,000 TONS OF ORE AVERAGING 4.06% COPPER.

Mines and Mining claims	\$1,331,925	
Plant and Equipment	<u>1,021,814</u>	
Total fixed charges	2,353,739	
Development costs should properly be treated as a suspense account to be charged off against total tonnage developed, but in practice they have been charged off currently against ore mined.		
Reduction during past operations	453,780	
Balance of fixed charges to apply against present ore reserve	1,899,959	
Depletion and depreciation	\$3.55	per ton or 5.16¢ lb.
Pounds of copper paid for	36,813,000	
Proposed new mill etc., will cost	382,942	
This means	\$.715	per ton or 1.04¢ lb.
Total proposed fixed charges	4.265	per ton or 6.20¢ lb.

Note - Depletion.

If, according to Table 4, a fixed charge of 6.20 cents per pound is included, no ore will show a profit at less than 16¢ copper and only 165,000 tons can be profitably mined at 17¢. See Table 5. Of course, the situation is not such that this fact is of importance. Actually, the depletion and depreciation charges have been paid represented by expenditures on the mine and equipment. The practical problem is to determine how soon and to what extent they can be earned back out of operations.

This calculation is made in Table 6, combining the proper figures from Tables 1 and 3. Table 7 in turn summarizes the results reached in Table 6.

T A B L E 5

WALKER MINE

ORE THAT CAN BE PROFITABLY MINED IF PROPER FIXED COSTS ARE CHARGED AGAINST IT.

FIXED COSTS TO DATE - 6.200¢ PER POUND.

	Net Operating Profit At different copper prices							
	12¢	13¢	14¢	15¢	16¢	17¢	18¢	
6% or better	2.944	3.944	4.944	5.944	6.944	7.746	8.746	
5% or better	1.754	2.754	3.754	4.754	5.754	6.556	7.556	Ore that can be profitably mined - At 16¢ - 12,000 tons At 17¢ - 165,000 tons
4% or better	-	1.000	2.000	3.000	4.000	4.846	5.846	
3% or better	-	-	-	-	.964	1.766	2.766	
2% or better	-	-	-	-	-	-	-	

T A B L E 6

WALKER MINE

NET OPERATING PROFIT AT DIFFERENT COPPER PRICES WITH PRESENT EQUIPMENT.

Grade	Tons.	Lbs. per ton paid for.	Total Pounds	Total Profit At						
				12¢	13¢	14¢	15¢	16¢	17¢	18¢
6% plus	12,000	108	1,296,000	38,154	51,114	64,074	77,034	89,994	100,388	113,348
5% - 6	153,000	89	13,617,000	238,842	375,012	511,182	647,352	783,522	892,730	1,028,900
4% - 5	140,000	71	9,940,000	-	99,400	198,800	298,200	397,600	481,692	581,092
3% - 4	230,000	52	11,960,000	-	-	-	-	115,294	211,213	330,813
	535,000		36,813,000	276,996	525,526	774,056	1,022,586	1,386,410	1,686,023	2,054,153

The simplest way to consider this total profit, which will be spread out over a number of years, is to determine its present cash value. This eliminates the question of interest - interest on money tied up in broken ore, interest on indebtedness etc., This step is taken in Table 8, assuming the present mill will treat 75⁰,000 tons per year.

These tables are based on the present equipment, with the costs, recoveries, and daily tonnages attained with it.

T A B L E 7.

WALKER MINE

ORE THAT CAN BE MINED AT A NET OPERATING PROFIT, IN ORDER TO REDUCE LOSS ON FIXED CHARGES
ALREADY INCURRED.

THIS IS THE PRESENT ACTUAL PROBLEM.

Price of copper.	Tons.	Pounds paid for.	Average Profit per lb.	Total Profit.
18	535,000	36,813,000	5.58	2,054,153
17	535,000	36,813,000	4.58	1,686,023
16	535,000	36,813,000	3.58	1,386,410
15	305,000	24,400,000	4.19	1,022,586
14	305,000	24,400,000	3.19	774,056
13	305,000	24,400,000	2.19	525,526
12	165,000	14,850,000	1.86	276,996

T A B L E 8.

WALKER MINE.

LIFE AND PRESENT CASH VALUE OF PRESENT ORE RESERVE ASIDE FROM INDEBTEDNESS, AT
DIFFERENT PRICES OF COPPER.

ASSUMING PRESENT MILL WILL TREAT 75,000 TONS PER YEAR.

Price of copper.	Tons that can be mined	Years Life	Average Annual Profit.	PRESENT CASH VALUE Assuming Interest	
				At 6%	At 8%
18	535,000	7.1	289,317	1,633,999	1,528,023
17	535,000	7.1	237,468	1,341,172	1,254,188
16	535,000	7.1	195,270	1,103,976	1,032,375
15	305,000	4.0	255,646	897,255	860,587
14	305,000	4.0	193,514	679,187	651,431
13	305,000	4.0	131,381	461,111	442,267
12	165,000	2.2	125,907	253,077	246,729

It is proposed to expend \$382,942 on improvements that will approximately double the capacity of the plant, and will result in a general reduction of costs. I can find no detailed estimate of the anticipated amount of this reduction, but estimate it as follows:

	<u>Presnet Costs</u>	<u>Best cost with present equipment</u>	<u>Best cost with new</u>
Breaking ground	1.30	1.25	1.25
Producing ore (a)	1.00	.50	.50
Milling	3.00	2.75	2.25
Tramming	.50	.50	.50
Miscellaneous	<u>1.00</u>	<u>1.00</u>	<u>.50</u>
	6.80	6.00	5.00

(a) Includes pulling stopes, sorting, tramming in mine, etc., Now high because much ore comes from sills, etc.,

Table 3 has given the cost and profit per pound of copper at a cost per ton of \$6.00. The following Table 9 gives the same calculations on a basis of \$5.00 per ton cost, which may be attained with the new equipment. Table 10 gives the total operating profit, with the new equipment, at different prices of copper, provided costs are brought down to \$5.00 per ton.

T A B L E 9.

WALKER MINE

COST PER POUND COPPER IN CRUDE ORE

ASSUMING MINING, MILLING, AND TRAMMING COST OF \$5.00 PER TON.

Grade Crude ore	Tons in ore reserve	Cost per ton	#Cu paid for per ton.	Cost per pound paid for	NET OPERATING PROFIT						
					12¢	13¢	14¢	15¢	16¢	17¢	18¢
6% or better	12,000	5.00	108	4.63	3.864	4.864	5.864	6.864	7.864	8.666	9.666
5% or better	165,000	5.00	89	5.62	2.874	3.874	4.874	5.874	6.874	7.676	8.676
4% or better	305,000	5.00	71	7.04	1.454	2.454	3.454	4.454	5.454	6.256	7.256
3% or better	535,000	5.00	52	9.61	-	-	.884	1.884	2.884	3.686	4.686
2% or better	580,000	5.00	33	15.15	-	-	-	-	-	-	-
Net smelter return per lb. in concentrate*					8.494	9.494	10.494	11.494	12.494	13.296	14.296

* Including credits for gold at \$20.00 and silver 60¢ per ounce, and deducting treatment charges, penalties and freight.

T A B L E 10.

WALKER MINE

NET OPERATING PROFIT AT DIFFERENT COPPER PRICES
WITH PROPOSED NEW EQUIPMENT.

Grade	Tons.	Lbs. per ton.	Total Lbs.	TOTAL PROFIT AT						
				12¢	13¢	14¢	15¢	16¢	17¢	18¢
6% plus	12,000	108	1,296,000	50,077	63,037	75,997	88,957	101,917	112,311	125,271
5% - 6	153,000	89	13,617,000	391,352	527,522	663,692	799,862	936,032	1,045,240	1,181,410
4% - 5	140,000	71	9,940,000	144,527	243,927	343,327	442,727	542,127	621,846	721,246
3% - 4	230,000	52	11,960,000	-	-	105,196	224,196	343,196	438,634	557,634
			36,813,000	585,956	834,486	1,187,212	1,555,742	1,923,272	2,218,031	2,585,561

T A B L E 11.

WALKER MINE

LIFE AND PRESENT CASH VALUE OF PRESENT ORE RESERVE,

ASIDE FROM INDEBTEDNESS

ASSUMING NEW MILL WILL TREAT 150,000 TONS PER YEAR.

Price of copper.	Tons that can be mined.	Years Life	Average Annual Profit	PRESENT CASH VALUE	
				At 6%	At 8%.
18	535,000	3.5	738,732	2,301,202	2,216,949
17	535,000	3.5	633,723	1,974,088	1,901,812
16	535,000	3.5	549,506	1,711,750	1,649,078
15	305,000	2.0	777,871	1,445,693	1,411,793
14	305,000	2.0	593,606	1,103,234	1,077,364
13	305,000	2.0	417,243	775,456	757,272
12	165,000	1.1	532,687	545,103	539,156

Table 11 gives the present cash value of the ore reserve as developed at present, at different prices of copper, with the new equipment, and Table 12 shows the additional value gained by the installation of this equipment.

T A B L E 12

PRESENT CASH VALUE OF SAVING BY NEW MILL.

Price of copper.	At 6% interest	At 8% interest
18¢	\$667,203	\$688,926
17	632,916	647,624
16	607,774	616,703
15	548,438	551,206
14	424,047	425,933
13	314,345	315,005
12	292,026	292,427

Since the proposed new equipment will cost about \$400,000, it will achieve a net saving on the present ore reserve if the average price of copper remains above 14¢ per pound. The amount saved above the cost of the new mill, etc., will be:

18	-	About \$275,000
17	-	About 240,000
16	-	About 210,000
15	-	About 150,000

This will be true only if the new mill makes it possible to bring the total operating costs down to \$5.00 per ton. To reach this figure will require the elimination of many expensive features of the past mining methods, notably:

Crooked drifts,

Excessive side swiping,

Irregularly placed chutes due to
crooked drifts,

Cribbed manways,

Sorting at chutes,

Blasting boulders in chutes,

Tramming on intermediate levels.

To correct these points may delay output at present, but such delay will prove highly profitable if it results in increased efficiency in the future.

TO SUM UP:

The Walker Mining Company has an indebtedness of \$1,674,506; against this it owns an orebody, with a plant for its extraction. If the management believes that for the next four years the price of copper will remain above 14¢ per pound, there is justification for expending about \$400,000 more in improving the plant. If this is done, the indebtedness will be about \$2,075,000, and the orebody will be worth, according to the price of copper:

At 18¢	-	\$2,200,000 to 2,300,000*
At 17¢	-	1,900,000 to 2,000,000
At 16¢	-	1,650,000 to 1,700,000
At 15¢	-	1,400,000 to 1,450,000
At 14¢	-	1,075,000 to 1,100,000
At 13¢	-	750,000 to 775,000
At 12¢	-	540,000 to 545,000

* Depending upon whether the assumed rate of interest to be paid on the investment is 6% or 8%.

With the new equipment, therefore, the present developed orebody will show an ultimate slight profit if copper remains above 17¢. This assumes that all the ore left in the mine will be treated by the new mill. Without the new equipment the orebody will not pay off the present indebtedness even at an average price of 18¢ for copper. (See Table 8).

The pressing needs at the mine are:

- 1st - Installation of new mill,
- 2d - Improvement in underground methods,
- 3d - Prosecution of extensive development and exploration work.

Very truly yours,

Faul Billingsley

PB/CH.