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Anaconda Copper Mining Company

GEOLOGICAL DEPARTMENT

W A L K E R M I N E

SITUATION AS OF APRIL 15, 1923

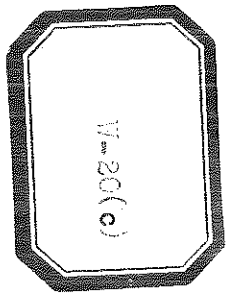
Letter to

V. A. HART, MANAGER

by

Paul Billingsley

May 1, 1923



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PLATES

Plate 1 - Long section showing grade

Plate 2 - Long section showing widths

Plate 3 - Long section showing tonnage

Plate 4 - Composite map showing suggested development

TABLES

Table 1 - Operations

Table 2 - Calculation of tonnage

Table 3 - Calculation of grade

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Salt Lake City, Utah.

May 1, 1923.

Mr. V. A. Hart, Manager,
Walker Mining Company,
Spring Garden, California.

Dear Sir:

During my recent visit to the Walker mine I was much impressed with the extent to which the stoping has encroached upon the ore reserve blocks. A surprising proportion of the ore-body, as viewed on a long section, has already been broken. To check the accuracy of this impression I have made some calculations, regarding which I will be glad to have your opinion.

Width:

Before outlining my ore reserve blocks I determined the average grade of ore for each portion of each level and raise, using the samples on the 20 scale map at the mine. The results are indicated on the accompanying long section (Plate 1). For emphasis I have colored the areas of the different grades. According to the ore samples, therefore, there is an elliptoidal area in which the ore averages about 6%. This area covers only the north end of the 4th level, but extends from No. 2 raise on the 5th to beyond No. 1 Raise, and on the 6th to beyond No. 3. It does not reach the Tunnel level; terminating below the 600 level about 50 feet down No. 2 Raise and 75 feet down No. 3. Above this 6% ellipse, and to the west of it, are areas of 4% and 5% ore, and beyond these in turn are zones of 3% and 2% material.

For the whole ore body below the 300 level, as it exist-

ed prior to stoping, I found an average grade of 4.35% copper - which checks remarkably closely your figure of 4.36% for the same area. (Blocks 4, 5, 6, 7 & 8). The significant point is that this average on which we agree is the result of a lot of 6% ore at the north end balancing a lot of 2% and 3% ore at the south end. Your stoping has thus far been done almost entirely in the 6% area, and the ore drawn from these stopes has averaged about 5.75% (a weighted average of crude and mill ore since June 1st - See Table 1).

TONNAGE:

I laid out my ore reserve blocks as shown on Plate 1, endeavoring within reason to make each block represent material of uniform grade. Following is a list in parallel of your blocks and mine:

ORE BELOW 3rd LEVEL PRIOR TO EXTRACTION.

Hart.			Billingsley.		
3rd - 4th Level.			3rd - 4th Level.		
Block	Tons	Grade	Block	Tons	Grade
4	215,430	4.48%	A	124,327	4.52%
5	2,500	4.48	B	28,437	3.26
			C	30,774	4.56
			D	11,270	2.00
Total	217,930	4.48	Total	194,808	4.00
4th - 5th Level			4th - 5th Level		
6	243,795	4.926	D	54,950	5.40
			E	44,128	5.23
			F	19,600	5.53
			G	27,905	3.27
			Total	156,583	4.86

ORE BELOW 3rd LEVEL PRIOR TO EXTRACTION.

Hart. 5th - 6th Level.			Billingsley. 5th - 6th Level.		
Block	Tons	Grade	Block	Tons	Grade
7	169,866	4.40	H	34,304	6.24%
			I	32,683	5.72
			J	9,454	5.71
			K	26,296	3.38
			Q	5,832	2.00
			Total	108,569	5.12
6th Tunnel Level.			6th Tunnel Level		
8	128,375	3.039	L	17,100	5.47
			M	9,705	3.98
			N	12,072	5.00
			O	18,630	2.00
			P	31,200	3.17
			R	14,114	2.00
			Total	102,821	3.47
Totals	759,966	4.35		562,781	4.35

In calculating my tonnages I used horizontal widths scaled off the 20 scale geologic notes at 20 ft. intervals. The figures are shown on Plate 2. These horizontal widths I averaged and multiplied by horizontal lengths, and the resulting area by the vertical height of the block; the results being the volume of the block. This I divided by a factor representing Cu. Ft. per ton of ore - 10 in the rich blocks, 11 in the medium, and 12 in the lean siliceous south end.

I next endeavored to find out what is left, as of April 15th, 1923. For this purpose I re-measured my blocks from the tops of the stopes, and added a reasonable allowance for pillars. The calculations are given in Tables 2 and 3 and the results in

summary are as follows:

ORE AS ORIGINALLY, AND AMOUNT BROKEN & LEFT

300 - 400	Original Tons	Left Tons	Broken(x)	In Stopes	Percent Broken
A	124,327	110,050*	14,277	2,500	11.5
B	28,427	27,120	1,317	-	4.7
C	30,774	27,272	3,502	-	11.4
S	11,270	11,270	-	-	0.0
	194,808	175,712	19,096	2,500	9.8
400 - 500					
D	54,950	18,698*	36,252	13,674	66.0
E	44,128	16,216*	27,912	11,991	63.3
F	19,600	12,212*	7,388	7,293	37.8
G	37,905	32,016*	5,889	1,262	15.6
	156,583	79,142	77,441	34,220	49.4
500 - 600					
H	34,304	14,359*	19,945	6,451	58.2
I	32,683	13,620*	19,063	9,327	58.4
J	9,454	9,454	-	-	0.0
K	26,296	24,115	2,181	-	8.3
Q	5,832	5,512	320	-	5.5
	108,569	67,060	41,509	15,778	38.2
600 - 700					
L	17,100	17,100	-	-	0.0
M	9,705	9,705	-	-	0.0
N	12,072	12,072	-	-	0.0
O	18,630	17,077	1,553	-	8.4
P	31,200	30,428	772	-	2.5
R	14,114	11,375	2,739	-	19.4
	102,821	97,757	5,064	-	4.9
Total	562,781	419,671	143,110 x	52,498	25.5

* Including pillars.

x Figures for ore broken obtained by deducting Tons Left from Original Tons.

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These figures can be checked against other data, namely, the monthly returns from the mine, as tabulated in Table 1.

From June 1, 1922, to April 15, 1923:

About 110,000 tons were reported broken.

About 60,000 tons were reported drawn.

The tons broken were all between the Tunnel and 800 levels, but this does not include all rock ever broken in this area, since the tunnel, No. 2 Raise, No. 1 Raise, and parts of the 800 and 600 drifts were driven before June 1st. About 25,000 tons should be added to cover these workings, making a total of 135,000 tons broken as compared with 148,000 obtained by deduction.

During this interval 50,000 tons were left in the stopes 3800 tons were in 400 stope previously, making a total of 53,800 as compared with 52,498 above.

The ore drawn came from blocks D, E, F, H, and I. It averaged 5.74% copper, while the average of these blocks is 6.65%. The ore has come from the better parts of blocks D, E, and F, the remaining upper portions being lower grade than those stoped thus far.

If the long section is correct, and it was made carefully from Arieta's stope sections, there can be little error in the percentage which has been broken. It figures out 25.6% - roughly, one quarter. From the mine records it appears that this quarter has yielded about 135,000 tons of broken ore. At this rate the total orebody between the 800 and Tunnel levels will yield about 540,000 tons.

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There is still another angle to be considered. While only one quarter of the total has been broken, this quarter has included the very best ore in the deposit, so that the richer ore has been depleted to an extent far greater than 25%. The following tabulation shows this feature.

Zone Above.	Original below 300.	Left * below 300.	Left * Above 300.	Percent left.
6 %	34,504	14,359	-	41.6
5.5	96,041	49,645	-	51.6
5.0	224,291	115,731	-	50.7
4.5	255,065	141,005	-	55.5
4.0	379,892	251,053	-	66.1
3.5	389,097	260,758	-	67.0
3.0	513,956	374,437	60,700	73.9
2.5	552,701	410,071	60,700	74.5

Average grade of ore left in place - 3.9%

* Including pillars.

w Hart's figures, excluding "probable ore".

The broken ore in stopes is of higher grade and will increase the reserves above 5% by about 50,000 tons, and those between 5 and 5.5% by 47,000 tons.

Including all these items, the following ore will be available for the future:

Above 5%	About 155,000 tons
Between 4½ and 5%	About 140,000 tons
Between 3½ and 4%	About 250,000 tons
Between 2½ and 3%	About 45,000 tons
Total above 2½	About 590,000 tons.

I believe this is the maximum that can be counted on

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unless additional ore is developed. It is therefore essential that development work be vigorously pushed.

DEVELOPMENT:

There are three main areas to explore:

1st - The north mineralized zone already explored on the 3rd level. This was weak and low grade on the 3, only at two places exceeding 5%, but the main orebody shows so much improvement below that level that it is quite possible the north mineralized zone will contain ore on the lower levels. The present work on the north end of the 600 is well calculated to test this possibility. The drift should be run straight, with a course about N 20° W, which will keep it within the vein. Crosscuts should be run to foot and hanging-wall at 100 ft. intervals.

2d - The southward extension of the main mineralized zone. The main orebody becomes weak and lean at its south end, and remains so for 700 or 800 ft, but on the tunnel level there are indications at the extreme south of an improvement in grade. It is possible that still farther south the zone will open out into another orebody. This should be determined by a thorough exploration of the vein south of its intersection with the adit tunnel. The vein must be recovered beyond the fault which there cuts it off, and followed by a drift, with frequent crosscuts to the walls.

3d - The main orebody terminates to the north against a north-west fault, the intersection following closely the line of No. 2 raise. On the lower levels at least this fault

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looks as if it were post mineral. There may therefore be a chance of recovering the vein beyond it.

Other faults have complicated the situation, and have made it doubtful if the missing segment can be found on the upper levels. On the Tunnel Level, however, the chances are better, and I recommend that this level be extended beyond the North-west Fault for about 150 ft.

There is also a slight possibility that the impoverishment found on the tunnel level will not persist below. This should be tested by a winze, sunk from the tunnel level in the best part of the ore shoot. It should be sunk for a depth of at least 200 ft. with appropriate crosscuts and drifts, in order to make a conclusive test.

All the work above recommended is indicated in red on the accompanying composite map.

Very truly yours,

Paul Billingsley

PB/GH.

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TABLE 1

WALKER MINE OPERATIONS

	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	1st half April	Total
Tons broken	3,176	5,150	7,547	8,501	7,000	7,700	15,400	16,500	15,800	15,500	8,000(e)	108,382
Tons drawn	3,047	4,270	5,717	4,420	5,170	5,402	6,167	6,949	6,417	7,155	3,500(e)	58,194
Tons milled (e)	4,575	6,284	6,372	4,864	5,308	4,856	5,118	5,390	5,136	7,459	3,500(e)	58,814
Crude ore	-	-	-	35	715	859	1,041	1,475	1,410	695	350(e)	6,586
% Cu. Heads	5.575	5.650	5.646	5.784	5.180	4.684	4.933	4.555	4.204	4.600	4.600(e)	
% Cu. Crude	-	-	-	10.535	11.865	11.769	11.867	11.182	10.568	11.000[a]	11.000(e)	
% Cu. Mine Run	5.575	5.650	5.646	5.615	5.974	5.738	6.105	5.977	5.574	5.144	5.500(e)	5.746

(e) Estimated

(a) 10,000 tons on stock pile June 1 available for milling in addition to ore drawn.

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TABLE 2.

WALKER MINE

ORE RESERVES

CALCULATION OF TONNAGE IN PLACE

* Exclusive of pillars.

Block No.	TOP Length	TOP Width	TOP Area	BASE Length	BASE Width	BASE Area	Total Area	Ave. Area	Ave. Height	Volume	Cu.ft per ton Factor	Tons*
A	330	40.3	13,299	300	27.4	8,220	21,519	10,760	110	1,183,600	11	107,600
B	110	18.1	1,991	220	15.6	3,432	5,423	2,712	120	325,440	12	27,120
C	210	13.9	2,919	100	20.8	2,080	4,999	2,500	120	300,000	11	27,272
D	130	30.0	3,900	130	32.5	4,225	8,125	4,062	40	162,480	10	16,248
E	140	27.2	3,808	130	22.3	2,899	6,707	3,354	40	134,160	10	13,416
F	65	15.0	825	130	16.0	2,080	2,905	1,452	60	87,120	10	8,712
G	280	18.0	5,050	180	12.8	2,314	7,264	3,632	100	363,200	12	30,266
H	120	28.7	3,444	120	28.0	2,160	5,604	2,802	45	126,090	10	12,609
I	160	16.0	2,560	160	20.0	3,200	5,760	2,880	40	115,200	10	11,520
J	200	10.4	2,080	0	0	0	2,080	1,040	100	104,000	11	9,454
K	160	10.8	1,728	220	17.2	3,784	5,512	2,756	105	289,380	12	24,115
L	120	17.8	2,136	120	20.0	2,400	4,536	2,268	75	170,100	10	17,100
M	120	20.0	2,400	125	23.5	2,938	5,338	2,669	40	106,760	11	9,705
N	165	18.3	3,019	0	0	0	3,019	1,509	80	120,720	10	12,072
O	0	0	0	180	20.7	3,726	3,726	1,863	110	204,930	12	17,077
P	225	17.2	3,870	160	15.5	2,480	6,350	3,175	115	365,145	12	30,426
Q	0	0	0	90	14.0	1,260	1,260	630	105	66,150	12	5,512
R	90	14.0	1,260	90	15.0	1,350	2,610	1,305	105	136,500	12	11,375
S	140	16.1	2,254	0	0	0	2,254	1,127	120	135,240	12	11,270
Total in place												402,871

Original Blocks.											Hart's Factor	Our Tons	Hart's Tons	Hart's Grade
(4) 300-400	800	25.7	20,560	600	22.2	13,200	33,760	16,880	125	2,110,000	10	211,000	215,430	4.48
(6) 400-500	600	22.2	13,200	630	15.4	9,702	22,902	11,451	140	1,603,140	10	160,314	243,795	4.926
(7) 500-600	630	15.4	9,702	550	16.9	9,295	18,997	9,498	115	1,092,270	10	109,227	169,866	4.40
(8) 600-700	550	16.9	9,295	570	18.9	10,773	20,068	10,034	120	1,204,080	10	120,408	128,375	5.04
												600,949	757,466	
											÷ 11 =	546,317		

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T A B L E 5

WALKER MINE

ORE RESERVES

CALCULATION OF GRADES

Block No.	TOP Area	TOP Grade	TOP Product	BASE Area	BASE Grade	BASE Product	Total Product	Total Area	Average Grade
A	13,580	4.12	55,145	7,660	4.58	35,560	90,705	21,040	4.22
B	1,991	3.00	5,973	3,260	3.42	11,180	17,153	5,251	3.26
C	2,919	5.00	14,595	2,288	4.00	9,152	23,747	5,207	4.56
D	4,020	4.47	18,000	3,830	6.38	24,440	42,440	7,850	5.40
E	3,640	4.27	15,560	2,665	6.53	17,427	32,987	6,305	5.23
F	700	5.00	3,500	2,100	5.71	12,000	15,500	2,800	5.53
G	4,770	3.37	16,110	1,728	3.00	5,184	21,294	6,498	3.27
H	3,830	6.38	24,440	2,136	6.00	12,816	37,256	5,966	6.24
I	2,665	6.53	17,427	3,019	5.00	15,095	32,522	5,684	5.72
J	2,100	5.71	12,000	-	-	-	12,000	2,100	5.71
K	1,728	3.00	5,184	3,760	3.29	12,380	18,564	5,488	3.38
L	2,136	6.00	12,816	2,400	5.00	12,000	24,816	4,536	5.47
M	2,400	5.00	12,000	2,938	3.16	9,284	21,284	5,338	3.98
N	3,019	5.00	15,095	-	-	-	15,095	3,019	5.00
O	-	-	-	3,726	2.00	7,452	7,452	3,726	2.00
P	3,760	3.29	12,380	2,480	3.00	7,440	19,820	6,240	3.17
Q	-	-	-	1,260	2.00	2,520	2,520	1,260	2.00
R	1,260	2.00	2,520	1,450	2.00	2,900	5,420	2,710	2.00
S	2,254	2.00	4,508	-	-	-	4,508	2,254	2.00

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