O T T A W A November 28th, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1116.

Gold Ore from the Central Cadillac Gold Mines Limited, Cadillac, Quebec.

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Shipment:

Two sacks of mill feed ore, total weight 385 pounds, were received on September 29th, 1941. The shipment was submitted by Mr. L. A. Traver, Mill Superintendent, Central Cadillac Gold Mines Limited, Cadillac, Quebec.

Purpose of Investigation:

To determine whether any improvement in extraction over present mill results can be obtained through finer grinding or by longer agitation periods; also, to determine the results of preliminary flotation and gravity concentration with regrinding of the concentrates and cyanidation of the whole sample.

Sampling and Analysis:

The sample as received was mixed and crushed to approximately 14 mesh and a head sample for assay and analysis was cut out. The residue was crushed all minus 14 mesh and reserved for the test work. The results of the assay and analysis are as follows:

Gold	-	0.13 oz./ton.
Silver	-	0.16 "
Iron	-	9.03 per cent
Sulphur (pyrite)	-	1.63 "
Sulphur (pyrrhotite)	-	0.02 "
Arsenic	-	0.59 "
Acid insoluble	-	72.41 "
Copper	-	None detected.

The pH of the ore in distilled water was 9.78.

Characteristics of the Ore:

Six polished sections were prepared and examined under the reflecting microscope for the purpose of determining the character of the ore.

Gangue -

In the polished sections, gangue material consists of hard, siliceous, dark grey rock and milky white quartz. Both components carry rather abundant carbonate as coarse to fine disseminated grains and small white patches.

(Continued on next page)

(Characteristics of the Ore, cont'd) -

Metallic Minerals -

In their approximate order of decreasing abundance, the metallic minerals present in the sections are: pyrite, arsenopyrite, chalcopyrite, magnetite, and pyrrhotite. No gold is visible.

Pyrite predominates as small masses and coarse to fine disseminated grains which contain numerous inclusions of gangue. Arsenopyrite is prevalent as coarse to fine irregular grains and subhedral crystals scattered unevenly through gangue. A small amount of chalcopyrite is visible, largely as medium to fine irregular grains in gangue, pyrite, and arsenopyrite. Magnetite is common in one section as streaks or clouds of tiny grains in gangue; also as occasional small inclusions in pyrite. A very small amount of pyrrhotite occurs as rare, tiny inclusions in pyrite and arsenopyrite.

Since neither native gold nor gold minerals were observed in the sections, nothing was learned as to this metal's mode of occurrence.

Experimental Tests:

Four series of tests were conducted. The first was straight cyanidation of the ore; the second was gravity concentration with regrinding of the concentrates and cyanidation of the whole sample; the third was flotation of the sulphides and gold in an endeavour to produce a clean tailing; and the fourth was flotation with regrinding of the concentrates and cyanidation of the whole sample. Identical results were obtained with 48 hours' agitation, when the whole ore was ground 87.0 per cent minus 200 mesh and when a concentrate from the ore was reground through 325 mesh, with an overall

(Experimental Tests, cont'd) -

grind of only 72.5 per cent minus 200 mesh.

SERIES I. - STRAIGHT CYANIDATION.

Tests Nos. 1-A, 2-A, 3-A, and 4-A.

The ore at minus 14 mesh was ground at 60 per cent solids to pass 75.8, 80.2, 87.7 and 93.4 per cent minus 200 mesh respectively. The ground pulps were agitated 24 hours in cyanide solution of a strength of 1 pound NaCN per ton. 2 pounds per ton of ore of lime was added to maintain protective alkalinity. The dilution ratio was 2:1, solution to solids.

Screen tests showed the grinding to be as follows:

Mesh	Weight, per cent			
	Test No. 1-A	Test No. 2-A	Test No. 3-A	Test No. 4-A
+ 65	0.6	0.1	-	-
+100	3.4	2.3	0.5	-
+150	6.2	4.3	2.1	0.7
+200	14.0	13.1	9.7	5.9
-200	75.8	80.2	87.7	93.4
	100.0	100.0	100.0	100.0

Cyanidation.

Test No.	Agitation, hours	Assay, Au oz./ton		Extraction, per cent	Reagents consumed, lb./ton	
		Feed	Tailing		NaCN	CaO
1-A	24	0.13	0.02	84.61	0.4	2.9
2-A	24	0.13	0.015	88.46	0.8	2.9
3-A	24	0.13	0.01	92.31	0.8	2.9
4-A	24	0.13	0.01	92.31	0.8	2.9

The results of these tests show that there is an increase in extraction when the pulps are cyanided for twenty-four hours, as the grinding is changed from 75 per cent to 87 per cent minus 200 mesh, but further grinding gives no increase.

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Tests Nos. 1-B, 2-B, 3-B, and 4-B.

In these four tests the grinding was identical with the correspondingly numbered preceding tests, the grinds being 75.8, 80.2, 87.7 and 93.4 per cent minus 200 mesh respectively. The ground pulps were agitated for 48 hours in cyanide solution of a strength of 1.0 pound NaCN per ton. 2 pounds per ton of ore of lime was added to maintain protective alkalinity.

Cyanidation.

Test No.	Agitation, hours	Assay, Au oz./ton Feed	Assay, Au oz./ton Tailing	Extraction, per cent	Reagents consumed, lb./ton NaCN	Reagents consumed, lb./ton CaO
1-B	48	0.13	0.01	92.31	0.4	3.9
2-B	48	0.13	0.01	92.31	0.2	3.9
3-B	48	0.13	0.005	96.15	0.6	3.9
4-B	48	0.13	0.005	96.15	0.6	3.9

The results of these tests showed that the maximum extraction was obtained at 48 hours' cyanidation when the ore was ground 87.7 per cent minus 200 mesh and that finer grinding did not increase the extraction.

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SERIES II. - GRAVITY CONCENTRATION AND CYANIDATION.

Tests Nos. 5 and 6.

In these tests, ore at minus 14 mesh was ground at 60 per cent solids to 68.3 per cent minus 200 mesh. The ground pulps were passed over the laboratory-size Wilfley table. The concentrates produced were reground to approximately 98 per cent minus 325 mesh. These reground concentrates were combined with the table tailings and agitated in cyanide solution of a strength of 1.0 pound per ton NaCN. In Test No. 5, 2 pounds of lime per ton of ore was added to maintain protective alkalinity.

(Continued on next page)

(Tests Nos. 5 and 6, cont'd) -

Cyanidation.

Test No.	Agitation, hours	Assay, Au oz./ton Feed	Assay, Au oz./ton Tailing	Extraction, per cent	Reagents consumed, lb./ton NaCN	Reagents consumed, lb./ton CaO
5	24	0.13	0.005	96.15	0.6	3.9
6	48	0.13	0.005	96.15	1.0	3.9

Tests Nos. 5-A and 6-A.

These tests were conducted on the final tailings from Tests Nos. 5 and 6. In Test No. 5-A an infrasizer analysis was made on the final tailing from Test No. 5 and in Test No. 6-A a settling test was made on the final tailing from Test No. 6. The results of these are as follows:

Test No. 5-A. - Infrasizing.

Micron size (approx.)	Weight, per cent	Assay Au, oz./ton	Assay S, per cent	Distribution, per cent Au	Distribution, per cent S
200 (mesh)	31.34	0.005	0.22	29.74	4.46
-200(m) +56	1.27	0.001	2.38	0.24	1.95
-56 +40	12.12	0.005	1.67	11.50	13.09
-40 +28	12.78	0.0075	2.08	18.18	17.19
-28 +20	11.66	0.005	2.42	11.06	18.25
-20 +14	8.01	0.005	2.65	7.59	13.74
-14 +10	5.84	0.005	2.35	5.54	8.87
-10	17.01	0.005	2.04	16.15	22.45
Feed (cal.)	100.00	0.0053	1.55	100.00	100.00

It may be seen from the above figures that the gold values follow the particle sizes very closely, while the gold values only show a relationship to the sulphides in the finest sizes. From these results it is apparent that the grinding has freed the gold at all sizes.

Test No. 6-A.

The settling tests were carried out at 1½:1 and 2:1 solution to solids ratios. The ore was 72.5 per cent minus 200 mesh:

(Continued on next page)

(Test No. 6-A, cont'd) -

Ratio, solution to solids	-	1½:1.	2:1.
Alkalinity (CaO) at start of test	-	0.05 lb./ton.	0.05 lb./ton.
Alkalinity (CaO) at end of test	-	Nil	Nil
NaCN at end of test	-	1.52 lb./ton solids	1.44 lb./ton solids
Overflow	-	Slightly cloudy	Slightly cloudy
Rate of settling	-	0.45 ft./hr.	0.85 ft./hr.

In all previous cyanide tests the solution remained very slightly cloudy when the pulp was allowed to settle.

From these figures it may be seen that the thickener area required will be a minimum when the feed is 2:1 solution to solids ratio. A slightly higher lime content in the solution would increase the settling rate slightly.

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SERIES III. - FLOTATION.

Tests Nos. 7 and 8.

In these tests, ore at minus 14 mesh was ground at 60 per cent solids to 68.3 and 80.4 per cent minus 200 mesh respectively. The ground pulps were transferred to a 1,000-gram-size Sub-A laboratory flotation cell and floated at 22 per cent solids. The products were sent for assay.

Screen tests on the flotation tailings gave the following results:

Mesh	Weight, per cent	
	Test No. 7	Test No. 8
+ 65	1.7	0.2
+100	5.5	1.9
+150	10.5	5.0
+200	14.0	12.5
-200	68.3	80.4

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(Tests Nos. 7 and 8, cont'd) -

The reagents used were the same in each test, the amounts used being as follows:

	Lb./ton
In ball mill:	
Soda ash	- 0.4
Butyl xanthate (Z-8)	- 0.10
In flotation cell:	
Butyl xanthate (Z-8)	- 0.14
Cresylic acid	- 0.26
Pine oil	- 0.1

Flotation.

Product	Weight, per cent	Assay Au, oz./ton	Assay S, per cent	Distribution, per cent Au	Distribution, per cent S	Ratio of concentration
Test No. 7.						
Concentrate	10.27	1.10	16.91	83.44	97.97	9.7:1.
Tailing	89.73	0.025	0.04	16.56	2.03	
Feed (cal.)	100.00	0.135	1.77	100.00	100.00	
Test No. 8.						
Concentrate	7.65	1.46	20.34	82.86	96.01	13.1:1.
Tailing	92.35	0.025	0.07	17.17	3.99	
Feed (cal.)	100.00	0.135	1.62	100.00	100.00	

It is indicated by these tests that the gold values are not exclusively with the sulphides but are associated to some extent with the non-sulphide gangue.

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Test No. 9.

Ore at minus 14 mesh was ground at 60 per cent solids to 81.0 per cent minus 200 mesh for this test. The ground pulp was floated at 22 per cent solids. The products were sent for assay.

The reagents used were as follows:

	Lb./ton
In ball mill:	
Soda ash	- 0.4
In flotation cell:	
Copper sulphate	- 0.5
Butyl xanthate (Z-8)	- 0.24
Cresylic acid	- 0.26
Pine oil	- 0.10

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(Test No. 9, cont'd) -

Flotation.

Test No. 9.

Product	Weight, per cent	Assay Au, oz./ton	Assay S, per cent	Distribution, per cent Au	Distribution, per cent S	Ratio of concentration
Concentrate	12.32	0.86	12.98	75.11	97.85	8.9:1.
Tailing	87.68	0.04	0.04	24.89	2.15	
Feed (cal.)	100.00	0.141	1.63	100.00	100.00	

It will be noted that the ratio of concentration is considerably lower in this test than in Tests Nos. 7 and 8 and the recovery of the gold is lower. This is thought to be due to the fact that some gangue particles are activated by $CuSO_4$ while gold is somewhat depressed by this reagent. The recovery of the sulphides is the same in all the tests.

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SERIES IV. - FLOTATION AND CYANIDATION.

Tests Nos. 10 and 11.

In these tests the flotation concentrates were made following the procedure in Tests Nos. 7 and 8. The concentrates were ground to approximately 98.0 per cent minus 325 mesh, recombined with the flotation tailings, and agitated in cyanide solution of a strength of 1.0 pound per ton NaCN. 2.0 pounds of lime per ton was added to maintain protective alkalinity.

The flotation reagents used in both tests were as follows:

	Lb./ton
In ball mill:	
Soda ash -	0.40
Butyl xanthate (Z-8) -	0.10
In flotation cell:	
Butyl xanthate (Z-8) -	0.14
Cresylic acid -	0.26
Pine oil -	0.10

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(Tests Nos. 10 and 11, cont'd) -

Cyanidation.

Test No.	Agitation, hours	Assay, Au oz./ton Feed	Assay, Au oz./ton Tailing	Extraction of gold, per cent	Reagents consumed, lb./ton NaCN	Reagents consumed, lb./ton CaO
10	24	0.13	0.01	92.31	0.4	2.9
11	48	0.13	0.005	96.15	1.4	5.95

(A screen test on the 48-hour cyanide tailings showed them to be 72.5 per cent minus 200 mesh.)

It may be noted that in Test No. 11 the consumption of both cyanide and lime increased considerably even over that shown in Test No. 6. This is thought to be due to traces of the flotation reagents remaining in the pulp.

Summary and Conclusion:

The test results on the sample of ore submitted for investigation indicate that when cyaniding the ore directly it is necessary that the ore be ground to 87.0 per cent minus 200 mesh and agitated for 48 hours to obtain maximum extraction. When a concentrate is made by either gravity or flotation methods and is then reground before cyanidation, the maximum extraction appears to be obtained when the overall grind is 72.5 per cent minus 200 mesh.

The results of the flotation tests did not show that it was possible to produce a tailing sufficiently low in gold values to be discarded without further treatment.

The infrasizer test on a cyanide tailing showed that all but a trace of gold was freed at all sizes.

The average reagent consumption in the various batch tests did not appear to be excessive except in the case of Test No. 11.

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