O T T A W A September 22nd, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1097.

Concentration and Cyanidation of a Gold Ore from the Cournor Mining Company, Perron, Quebec.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
ORE DRESSING AND
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CANADA
DEPARTMENT
OF
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Shipment:

Twenty boxes of ore, net weight 6,840 pounds, were received on June 20th, 1941, from the Cournor Mining Company Limited, Perron, Quebec, per F. C. Buckland, Manager.

Location of the Property:

The property of the Cournor Mining Company Limited, from which the present shipment was received, is situated in Louvremont and Pascalis townships, northwestern Quebec.

Sampling and Analysis:

After crushing, cutting, and grinding by standard methods, a representative sample of the total shipment was obtained, which assayed as follows:

Gold	-	0.15 oz./ton.
Silver	-	0.08 "
Copper	-	0.03 per cent.
Sulphur	-	1.14 "
Iron	-	3.62 "
Acid Insoluble	-	77.3 "
Arsenic	-	None detected.

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 -

Gangue material is a mixture of siliceous, light-green to dark greenish-grey and almost black rock, translucent white quartz, and abundant disseminated carbonate. A micro-chemical test for iron applied to the latter gave a rather strong reaction.

Metallic Minerals -

Metallic minerals are only moderately abundant and are represented almost entirely by pyrite. This mineral is present as small masses, irregular grains, and subhedral crystals disseminated through gangue. The grain sizes range from coarse to fine but the larger sizes predominate. It is slightly fractured and contains narrow veinlets and inclusions of gangue. A small amount of chalcopyrite is visible as occasional, small, irregular grains in gangue and in pyrite.

One irregular particle of native gold, about 66 microns (-200+280 Tyler mesh) in size, is visible in the polished sections. It occurs along a gangue-filled fracture in pyrite.

Investigative Work:

Mr. F. C. Buckland, the mine manager, requested that tests be made regarding the advisability of flotation followed by cyanidation of the resulting concentrate. At present the Cournor mill is using a picking belt the rejects of which average about 0.02 ounce gold per ton and are approximately 25 per cent of the hoisted ore. The remaining 75 per cent is subjected to a straight cyanidation treatment.

The small-scale test work showed that at a grind of 60 per cent minus 200 mesh a flotation tailing of 0.005 ounce gold per ton was obtainable, with a ratio of concentration of approximately 25:1 for the cleaner concentrate. On regrinding and cyaniding this concentrate a cyanide residue of 0.02 ounce gold per ton was obtained in 24 hours' agitation. The results showed an overall tailing loss of 0.005 ounce gold per ton.

The remainder of the ore, 6,700 pounds, was concentrated by flotation in our large-scale mill, and batch lots of the concentrates were reground and cyanided as in the small-scale tests. The results obtained confirmed those indicated in the previous small-scale work.

DETAILS OF TEST WORK:

SMALL-SCALE TESTS (NOS. 1 TO 12).

Portions of the ore at minus 14 mesh were ground in a ball mill to different degrees of fineness. Reagents were added to the grind as noted. The pulp was then conditioned and floated in a Denver flotation machine, except in Tests Nos. 1 and 2 where a Fagergren machine was used. In some of the tests the flotation concentrate was cleaned in a smaller Denver machine, while in others the concentrate was reground in cyanide and agitated.

The following table gives the different details and results of the small-scale flotation concentrations:

(Small-Scale Tests, cont'd) -

Details and Results of Flotation Concentrations:

Test No.	Grind, per cent -200 mesh	Assays, Au oz./ton Conc.	Assays, Au oz./ton Tailing	Recovery of gold, per cent	Ratio of conc.	REAGENTS TO GRIND, lb./ton feed: Soda ash	Lime	Barrett No. 4 oil	Aero-float No.33	Amyl xanthate	REAGENTS TO CELL, lb./ton feed: Pine oil	Amyl xanthate	pH of pulp	Remarks
1	86.0	1.59	0.005	97.0	11:1.	2.0	-	0.044	0.035	0.05	0.075	0.05	9.5	Fag. machine
2	84.6	0.81	0.005	97.3	5.5:1.	-	1.4	0.09	0.035	0.05	0.050	0.05	9.2	Fag. machine
3	87.0	2.36	0.0025	98.5	16:1.	2.0	-	0.044	0.035	0.05	0.075	0.05	9.1	
4	86.0	2.37	0.0025	98.5	16:1.	-	1.4	0.09	0.035	0.05	0.050	0.05	8.9	
5	80.2	4.40	0.005	96.6	31.5:1.	2.0	-	0.044	0.035	0.05	0.075	0.05	9.3	Cleaned conc.
6	80.4	3.81	0.005	96.3	27:1.	-	1.4	0.09	0.035	0.05	0.050	0.05	8.8	" "
7	70.0	2.90	0.005	97.3	17.4:1.	2.0	-	0.044	0.035	0.05	0.075	0.05	9.2	
8	69.6	3.12	0.0025	98.5	19.2:1.	-	1.4	0.09	0.035	0.05	0.050	0.05	8.7	
9	69.0	5.26	0.005	96.9	32:1.	-	-	0.09	-	0.05	0.075	0.05	8.3	Cleaned conc.
10	64.6	4.40	0.01	93.9	30:1.	-	-	0.044	0.070	0.05	0.075	0.05	8.4	" "
11	52.6	3.44	0.005	96.7	20:1.	1.8	-	0.09	-	0.05	0.075	0.05	9.4	
12	55.5	2.79	0.0025	98.4	18.2:1.	-	1.3	0.13	-	0.05	0.075	0.05	8.9	

(Small-Scale Tests Nos. 1 to 12, cont'd) -

The flotation concentrates from Tests Nos. 1, 2, 3 and 4 were reground in cyanide to pass 99 per cent minus 325 mesh and agitated for 24 hours. The strength of cyanide solution used was 3 pounds NaCN per ton and sufficient lime was added during the grinding and agitation periods to maintain protective alkalinity.

Results:

Test No.	Grind, % -325 mesh	Agitation, hours	Assays, Au oz./ton: Feed	Assays, Au oz./ton: Tailing	Extraction of gold, per cent	Overall tailing loss, Au oz./ton
1	99.5	24	1.59	0.01	99.4	0.0054
2	99.0	24	0.81	0.01	99.8	0.0059
3	99.5	24	2.36	0.04	98.3	0.0048
4	99.5	24	2.37	0.02	99.2	0.0034

The final titrations of the cyanide solutions were from 2.95 to 3.10 pounds NaCN per ton of solution and the lime from 0.275 to 0.45 pound per ton. The reagents consumptions were erratic and a better picture of these conditions is given in the cyanidations of the concentrates produced from Mill Run No. 1, where much larger quantities of concentrate were available for regrinding and cyanidation.

This concluded the small-scale test work. The remainder of this report gives the results obtained from the large-scale mill runs.

MILL RUN NO. 1.

The ore, crushed to minus ½ inch, was fed to a Denver 30 in. by 18 in. ball mill by a Hardinge automatic feeder at the rate of 150 pounds per hour. The ball mill discharge was fed to an Akins classifier. This classifier was of the submerged type and was 7 ft. by 12 in. in size. The underflow of the classifier was returned to the ball mill and the overflow went to a conditioning tank.

The pulp was then pumped to a battery of Denver Sub-A No. 5 flotation cells. Seven cells in all were used. The tailing from the first cell, which received the flotation feed, was cleaned in the remaining six cells and the concentrate from these cells was pumped back into the conditioning tank. The concentrate from the first cell was stored and the tailing from the final cell was passed over a Wilfley table prior to final disposal. The final flotation concentrate was weighed, sampled, and assayed. Samples were also taken, at regular intervals, of the classifier overflow, flotation tailings, and table tailings. Screen tests were made on the classifier overflow. Batch lots of the flotation concentrate were ground in cyanide and agitated for different periods of time.

The following reagents were added:

		Lb./ton ore
To ball mill:		
Barrett No. 4 oil	-	0.044
Potassium amyl xanthate	-	0.05
To conditioning tank:		
Pine oil	-	0.05
Potassium amyl xanthate	-	0.05
To Cell No. 1:		
Pine oil	-	0.03

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(Mill Run No. 1, cont'd) -

The results of Mill Run No. 1 are as follows:

Feed to ball mill - 1,800 pounds of ore.
Flotation concentrate obtained - 90 pounds.
Pulp density of classifier overflow - 47 per cent solids.
Pulp density of flotation feed - 26 per cent solids.
The grind, taken from samples of the classifier overflow, = 60.8 per cent minus 200 mesh.
pH of flotation feed - 7.6.

Sampling of the different mill products:

Product	Assays, oz./ton	Average assay, Au oz./ton
Classifier overflow	0.08, 0.21, 0.17, 0.11	0.14
Flotation tailing	0.005, 0.005, 0.0075, 0.005	0.005
Table tailing	0.005, 0.0025, 0.005, 0.0025	0.004

The flotation concentrate assayed as follows:

Gold	-	2.91 oz./ton
Silver	-	0.34 "
Copper	-	0.49 per cent
Iron	-	12.60 "
Sulphur	-	11.54 "
Pyrrhotite	-	0.64 "

A screen test on this concentrate showed a fineness of 84.0 per cent minus 200 mesh.

Summary of Mill Run:

Product	Weight, per cent	Assay, Au oz./ton	Distribution of gold, per cent	Ratio of concentration
Feed	100.00	0.15	100.0	
Flot. conc.	5.00	2.91	96.8	20:1.
Flot. tailing	95.00	0.005	3.2	

Batch lots of the flotation concentrate were cyanided, with a strength of solution of 2.0 or 3.0 pounds NaCN per ton. In some of the lots the concentrate was agitated without grinding and in the remainder different finenesses of grinding were used. A lead salt was added in several instances, as noted. Sufficient lime was added to the grind and agitation periods to maintain protective

(Mill Run No. 1, cont'd) -

alkalinity.

Results: (Feed assay - 2.91 Au oz./ton)

Sample No.	Grind, % -200 mesh	Agitation, hours	Tailing assay, Au oz./ton	Extraction of gold, per cent	Overall extraction of gold, per cent	Overall tailing loss, Au oz./ton
1	99.0	8	0.03	99.0	95.8	0.0063
2	No regrind	24	0.18	93.8	90.8	0.0138
3	No regrind	48	0.11	96.2	93.1	0.0103
4	97.6	24	0.02	99.3	96.1	0.00585
5	97.2	48	0.02	99.3	96.1	0.00585
6	No regrind	24	0.07	97.6	94.5	0.00825
7	No regrind	48	0.07	97.6	94.5	0.00825
8	97.5	24	0.02	99.3	96.1	0.00585
9	97.5	48	0.02	99.3	96.1	0.00585

Sample No.	Titration, lb./ton solution NaCN	Titration, lb./ton solution CaO	Reagents consumed, lb./ton ore NaCN	Reagents consumed, lb./ton ore CaO	Reducing power, c.c. N/10 $KMnO_4$/litre	Remarks
1	1.7	0.15	0.60	3.0	180	+$PbNO_3$
2	2.9	0.15	0.51	1.3	180	
3	2.8	0.20	1.11	1.5	340	
4	2.7	0.15	1.38	2.1	300	
5	2.9	0.20	1.70	2.3	600	
6	1.9	0.15	0.63	1.5	170	+$PbNO_3$
7	1.9	0.15	0.70	1.8	380	+$PbNO_3$
8	2.0	0.15	0.80	2.5	290	+$PbNO_3$
9	1.8	0.10	1.08	2.7	360	+$PbNO_3$

In Samples Nos. 1, 6, 7, 8 and 9, 0.50 pounds of $PbNO_3$ per ton was added to the grind.

Several of the pregnant solutions were assayed for copper with the following results:

Sample No.	Copper, grams per litre.
2	0.0647
3	0.1200
4	0.1127
5	0.2400

MILL RUN NO. 2.

In this run, 1.7 pounds of soda ash per ton of feed was added to the grind. Operating conditions, otherwise, including the other reagents added, were similar to Mill Run No. 1.

1,520 pounds of ore were fed to the ball mill at the rate of 125 pounds per hour.

275 pounds of flotation concentrate were obtained.

The pulp density of the classifier overflow averaged 49 per cent solids.

The pulp density of the flotation feed averaged 28 per cent solids.

The pH of the flotation feed was 8.0.

The grind as taken from samples of the classifier overflow was 64 per cent minus 200 mesh.

Sampling of the different mill products resulted as follows:

Product	Assays, Au oz./ton				Average assay, Au oz./ton
Classifier overflow	0.08,	0.13,	0.095,	0.175	0.12
Flotation tailing	0.0025,	0.0025,	0.0025,	0.0025	0.0025
Table tailing	0.0025,	0.0025,	0.0025,	0.0025	0.0025

The flotation concentrate assayed as follows:

Gold	-	0.52 oz./ton
Silver	-	0.16 "
Iron	-	7.00 per cent
Sulphur	-	4.72 "
Pyrrhotite	-	0.08 "
Copper	-	0.11 "

A screen test on this concentrate showed a fineness of 88.0 per cent minus 200 mesh.

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(Mill Run No. 2, cont'd) -

A summary of the mill run was as follows:

Product	Weight, per cent	Assays, Au oz./ton	Distribution of gold, per cent	Ratio of concentration
Feed	100.00	0.15	100.0	
Flotation conc.	18.09	0.82◊	98.7	5.5:1.
Flotation tailing	81.91	0.0025	1.3	

◊ Calculated.

Batch lots of the flotation concentrate were cyanided as in the previous mill run. Results were as follows:

(Feed assay - 0.52 Au oz./ton)

Sample No.	Grind, % -200 mesh	Agitation, hours	Tailing assay, Au oz./ton	Extraction of gold, per cent	Overall extraction of gold, per cent	Overall tailing loss, Au oz./ton
1	No regrind	24	0.035	93.3	92.1	0.012
2	No regrind	48	0.03	94.3	93.2	0.010
3	95.6	24	0.01	98.1	96.8	0.005
4	96.9	24	0.01	98.1	96.8	0.005

Sample No.	Titration, lb./ton solution NaCN	Titration, lb./ton solution CaO	Reagents consumed, Lb./ton ore NaCN	Reagents consumed, Lb./ton ore CaO	Reducing power, c.c. N/10 KMnO4/litre	Remarks
1	1.9	0.20	0.42	1.35	56	No regrind
2	1.9	0.15	0.42	1.45	60	No regrind
3	1.9	0.20	0.57	2.10	74	Reground + 0.5 lb./ton $PbNO_3$
4	2.0	0.20	0.38	1.80	54	Reground

In this mill run a portion of the gold was tied up in the ball mill, as evidenced by the assays of the classifier overflow.

Summary and Conclusions:

The test work on the ore shipment indicates that a flotation tailing of 0.005 ounce gold per ton can be obtained at a grind of 60 per cent minus 200 mesh. This result was secured in the small-scale test work and in Mill Run No. 1. A somewhat lower result, 0.0025 ounce gold per ton, was obtained in Mill Run No. 2, where the ratio of concentration was 5.5:1.

In Mill Run No. 1 a ratio of concentration of 20:1 was used and a flotation concentrate assaying 2.9 ounces gold per ton was obtained. In Mill Run No. 2 a ratio of 5.5:1 produced a lower-grade concentrate, of 0.52 ounce gold per ton.

The regrinding and cyanidation of these concentrates gave overall tailing losses of 0.006 and 0.005 ounce gold per ton. In this connection the use of a lead salt in the grind had a beneficial effect on the cyanide consumption.

Reagent consumption was normal, although some evidence of fouling occurred in the cyanidation of the higher-grade concentrate, which contains 0.49 per cent copper and 0.64 per cent pyrrhotite.

It is apparent from the above summary of the results obtained that this ore is amenable to a flotation-cyanidation flow-sheet and that the present use of a picking belt could economically be dispensed with and flotation concentration substituted.

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