DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

IR2038

Ottawa, April 28, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2038.

Amalgamation, Flotation and Cyanidation Tests on a Gold Ore from Golden Arrow Mines Limited, Hislop and McCann Townships, Ontario.

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Note:
This report relates essentially to the samples as received. It shall not, nor any correspondence connected therewith, be used in part or in full as publicity or advertising matter for the sale of shares in any promotion.

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BUREAU OF MINES
DIVISION OF METALLIC MINERALS
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METALLURGICAL LABORATORIES

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Shipment:

A small shipment of diamond drill cores, composed of two sacks (tagged Numbers 27 and 28 respectively) of a total net weight of 19 pounds, was received on February 18, 1946, from the Golden Arrow Mines Limited, 428, 67 Yonge St., Toronto, Ontario.

On March 14, 1946, a letter from Mrs. V. R. MacMillan, President of the company, was received in which it was stated that the company wished a mill test to determine,

1. What percentage of the gold is locked in the pyrite.
2. Recovery at various finenesses of grinding.
3. A tentative flow sheet for the treatment of the ore.
4. Estimate of cost of ore treatment.

Location of Property:

The property of the Golden Arrow Mines Limited from which the shipment was made is in the townships of Hislop and McCann, with Ramore, Ontario, as the shipping point.

Sampling and Analysis:

The contents of the two sacks were combined and samples were taken for the preparation of polished sections for microscopic examination.

The ore was then crushed to minus 20 mesh and a head sample riffled out for analysis.

The remainder of the ore was bagged for test purposes.

The analysis made on the head sample gave the following results:

Gold	-	0.14 oz./ton
Silver	-	0.14 "
Lead	-	None detected.
Zinc	-	0.10 per cent
Iron	-	3.80 "
Arsenic	-	None detected.
Sulphur	-	0.85 per cent
Insoluble	-	86.06 "

A screen analysis of the head sample showed the values, association and distribution of the gold in the various mesh sizes to be as follows:

Mesh	Weight, per cent	Assays Oz./ton Au	Assays Per cent Fe	Assays Per cent S	Distribution, per cent Au	Distribution, per cent Fe	Distribution, per cent S
+48	37.7	0.14	2.60	0.40	32.3	30.1	26.3
+65	12.1	0.14	2.65	0.63	10.7	9.9	13.3
+100	9.4	0.14	3.50	0.44	8.3	10.1	7.2
+150	8.5	0.20	3.45	0.82	10.7	9.0	12.2
+200	7.0	0.18	3.90	0.90	8.0	8.4	11.0
-200	25.3	0.18	4.20	0.68	30.0	32.5	30.0
Totals	100.0	0.158	3.25	0.57	100.0	100.0	100.0

Considering the sizes between 48 mesh and 200 mesh as one group, the gold values appear to be fairly evenly distributed throughout the coarse and fine sizes. While later test work showed a considerable amount of the gold to be "free milling," the screen analysis shows that its distribution also

(Sampling and Analysis, cont'd) -

follows closely to the distribution of the iron and sulphur (pyrite) in the sample.

Microscopic Examination of Ore Samples:

Six polished sections were prepared microscopically for the purpose of determining the character of the ore.

Gangue -

Gangue material ranges from pink to grey granite which carries a small amount of fine, unevenly disseminated carbonate. A microchemical test for iron on the latter was negative.

Metallic Minerals -

Metallic minerals are rather sparingly disseminated through gangue and are represented by pyrite, hematite, chalcopyrite, sphalerite, and native gold. Pyrite predominates as moderately coarse to fine anhedral to euhedral crystals scattered unevenly through gangue, with finer sizes more abundant. It contains a few small inclusions of gangue and rare tiny grains of the other metallics. Hematite, chalcopyrite and sphalerite are visible in very small amounts as occasional to rare tiny irregular grains in gangue.

Three minute particles of native gold measuring eighteen, twelve and four microns (all -800 Tyler mesh) in size, are visible in the six polished surfaces. The two largest are enclosed in apparently dense pyrite and the smallest is isolated (free) in gangue.

Conclusions:

Considering the results of the test work from the standpoint of the information asked for by the Company, from Tests Nos. 1 and 7, 62 to 64 per cent of the gold is amenable to amalgamation and can be considered as "free milling" with the remaining portion, of 36 per cent, associated with sulphide

(Conclusions, cont'd) -

minerals, probably pyrite.

The gold values in the ore appear to become unlocked at medium sizes and the ore should not require fine grinding, as measured by present-day fine grinding standards. As in Tests No. 3A and 3B, the cyanide residue showed the same gold values at 76.6 per cent minus 200 mesh as at 97.0 per cent minus 200 mesh. In Test No. 2, flotation at 89.6 per cent minus 200 mesh gave the same gold values (0.01 oz./ton) in the tailings as did cyanidation. In fact, overgrinding should be avoided in cyanidation, as the ore appears to have a higher than normal cyanide consumption, which increases sharply as the ore is ground finer. This is noted in the results of cyanidation tests Nos. 3A and 3B.

From the results of the various tests made on this ore, a very high percentage of extraction is not to be expected, although on the grade (0.14 oz./ton) an extraction of approximately 93 per cent of the gold must be considered as fairly good.

From the limited number of tests permitted by the small amount of the sample received, it was established that cyanidation of the total ore in some form gave the highest percentage of recovery.

In Test No. 1, by recovering the "free milling" portion of the gold by amalgamation and cyaniding the tailings from this process, an overall recovery of 92.8 per cent of the gold was made.

Where the ore was cyanided directly, as in Tests Nos. 3A and 3B, the recovery was also 92.8 per cent, finer grinding giving no better results than those had at a coarser grind.

While flotation of the ore, as in Tests Nos. 2 and 4, gave the same primary tailing as from the cyanidation tests,

(Conclusions, cont'd) -

it would not appear to be applicable, as cyanidation of the flotation concentrate reduced the overall recovery to 87.7 per cent of the gold. It was expected that the primary flotation tailing would have been lower than 0.01 ounce gold per ton but it is assumed that some unattached gold is difficult to bring up in the concentrate. This is partially substantiated by Test No. 7 where the flotation tailing is 0.005 ounce per ton after the unattached gold has been removed by amalgamation.

It does not seem practical from an economic standpoint to introduce expensive cyanidation treatment on the total ore to treat a product of 0.05 oz./ton as in Test No. 1, or to cyanide the ore direct, if some other efficient method of procedure is applicable. With this in mind Test No. 7 was made in which the amalgamation tailings were floated and only the concentrate treated by cyanidation. Although the overall recovery from this test, 91.3 per cent, was somewhat less than in Tests Nos. 1, 3A and 3B, the practical application of it would involve much less plant expenditure and lower operating costs.

Therefore, plant application of Test No. 7, involving amalgamation, flotation of the amalgamation tailings and cyanidation of the flotation concentrate, would appear logical.

As the reducing power and sulphocyanate determinations on the solution from the various cyanidation tests were low, no trouble should be experienced in the precipitation of the gold from the solution or through fouling. This is partially substantiated by Tests Nos. 5 and 6, which compare quite favourably with the results on solutions from other ores.

While power costs and the cost of supplies per ton of ore remain reasonably the same regardless of tonnage, the cost of labour per ton of ore and the "overhead" charges

(Conclusions, cont'd) -

vary widely according to the tonnage treated.

However, considering the location of the property and with modern equipment and modern plant design, at 200 tons of ore per day, following the procedure as in Test No. 7, the overall milling charges should not be in excess of $1.00 to $1.10 per ton of ore, including crushing.

No flow-sheet for the application of straight cyanidation of this ore is included, as this would follow the standard cyanidation practice established in northern Ontario.

DETAILS OF INVESTIGATIONS:

Test No. 1.

1,000 grams of ore was ground to 87.0 per cent minus 200 mesh and amalgamated in a jar mill with 7 c.c. mercury, 0.5 grams lime, 6 small pebbles, and 1,000 c.c. water.

Results -

Assay heads, oz./ton gold	=	0.14
Assay tailing, " "	=	0.05
Extraction, per cent gold	=	64.3

500 grams amalgamation tailings cyanided without regrinding at 2 to 1 dilution for 48 hours.

Assay amalgamation tailing, oz./ton gold	=	0.05
Assay cyanide residue, " "	=	0.01
Extraction, per cent gold	=	80.0
Additional extraction on heads by cyaniding amalgamation tailings, per cent - -	=	28.5
Overall recovery, per cent gold	=	92.8
NaCN consumed, lb./ton ore	=	0.76
CaO " " "	=	5.00

Test No. 2.

1,000 grams of ore ground to 89.6 per cent minus 200 mesh. Transferred to flotation cell.

Reagents Added:

To Grinding -	Lb./ton
Soda ash	- 0.5
Reagent No. 208	- 0.1
Reagent No. 301	- 0.1
Aerofloat No. 25	- 0.035

(Details of Investigation, cont'd) -

To Conditioning - Lb./ton

Pot. amyl xanthate - 0.20 pH, 10.2 (3 mins.)

To Flotation -

Pine oil - 0.025 (5 mins.)

Results

Product	Weight, per cent	Assays Oz./ton Au	Assays Per cent Fe	Assays Per cent S	Distribution, per cent Au	Distribution, per cent Fe	Distribution, per cent S
Flotation conc.	7.3	1.90	15.8	9.29	93.8	38.3	96.0
Flotation tailing	92.7	0.01	2.0	0.03	6.2	61.7	4.0
Totals	100.0	0.1479	3.0	0.70	100.0	100.0	100.0

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Test No. 3.

500 grams of ore ground to 76.6 per cent minus 200 mesh (3A).

500 grams of ore ground to 97.0 per cent minus 200 mesh (3B).

Transfered to agitation bottles and cyanided at 2 to 1 dilution for 48 hours.

Results:

	Test No. 3A	Test No. 3B.
Assay heads, oz./ton gold -	0.14	0.14
Assay residue, " " -	0.01	0.01
Extraction, per cent gold -	92.8	92.8
NaCN consumed, lb./ton ore -	1.0	1.40
CaO, " " " -	4.48	5.16
NaCNS, per cent -	Nil	0.0005
R.P. (c.c. $\frac{N}{10}$ $KMnO_4$ to 1,000 c.c. soln.)	26	32

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Test No. 4.

2,000 grams ore ground to 94.4 per cent minus 200 mesh. Transferred to flotation cell.

Reagents Added:

To Grinding - Lb./ton

Soda ash - 0.2
Reagent No. 208 - 0.1
Reagent No. 301 - 0.1
Aerofloat No. 25 - 0.035

(Details of Investigation, cont'd) -

To Conditioning -	Lb./ton	
Pot. amyl xanthate	0.20	pH, 10.1 (3 mins.)
To Flotation -		
Pine oil	0.025	(5 mins.)

Results

Product	Weight, per cent	Assays Oz./ton Au	Assays Per cent Fe	Assays Per cent S	Distribution, per cent Au	Distribution, per cent Fe	Distribution, per cent S
Flotation conc.	5.8	2.28	16.90	14.51	93.4	30.2	96.7
Flotation tailing	94.2	0.01	2.40	0.03	6.6	69.8	3.3
Totals	100.0	0.142	3.24	0.86	100.0	100.0	100.0

50 grams of flotation concentrate cyanided at 5 to 1 dilution for 48 hours without regrinding.

Assay conc., oz./ton gold	=	2.28
Assay residue, " "	=	0.14
Extraction, per cent gold	=	93.9
Overall recovery, per cent gold	=	87.7
NaCN consumed, lb./ton concentrate	=	4.60
CaO " " "	=	15.40

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Test No. 5.

350 c.c. of solution from Tests Nos. 3A and 3B combined were precipitated in laboratory apparatus with the addition of 0.1 grams NaCN, 0.1 gram $PbNO_3$ and 0.25 gram. zinc dust.

Pregnant solution, oz./ton gold	=	0.066
Barren solution, " "	=	0.001

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Test No. 6.

350 c.c. of solution as in Test No. 5 but 0.35 gram of NaOH and 0.2 gram aluminium dust used as precipitating agents.

Pregnant solution, oz./ton gold	=	0.066
Barren solution, " "	=	0.001

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Test No. 7.

Two lots of 1,000 grams of ore ground to 87.2 per cent minus 200 mesh and amalgamated as in Test No. 1.

(Continued on next page)

(Details of Investigation, coont'd) -

Products combined and mercury recovered. Pulp filtered.

Results:

Assay heads, oz./ton gold - = 0.14
Assay amalgamation tailings, oz./ton gold = 0.0535
Extraction, per cent gold - =61.8

Filter cake repulped and transferred to flotation cell.

Reagents Added:

To Conditioning -		Lb./ton	
Soda ash	-	0.2	
Reagent No. 301	-	0.1	pH, 10.5
Aerofloat No. 25	-	0.035	(5 mins.)
Pot. amyl xanthate	-	0.20	
To Flotation -			
Pine oil	-	0.05	(5 mins.)

Results

Products	Weight, per cent	Assays Oz./ton Au	Assays Per cent Fe	Assays Per cent S	Distribution, per cent Au	Distribution, per cent Fe	Distribution, per cent S
Flotation conc.	5.3	0.92	17.64	15.44	91.2	31.4	93.4
Flotation tailing	94.7	0.005	2.15	0.06	8.8	68.6	6.6
Totals	100.0	0.0535	2.97	0.87	100.0	100.0	100.0

50 grams of flotation concentrate cyanided at 5 to 1 dilution for 48 hours without regrinding.

Results:

Assay flotation conc., oz./ton gold = 0.92
Assay cyanide residue, " " = 0.14
Extraction, per cent gold = 84.8
NaCN consumed, lb./ton concentrate = 8.40
CaO " " " = 19.60
Recovery from flotation and cyaniding concentrate, per cent gold = 77.3

Additional recovery on heads from flotation and cyanide operations on amalgamation tailing per cent gold = 29.5
Overall recovery, per cent gold = 91.3

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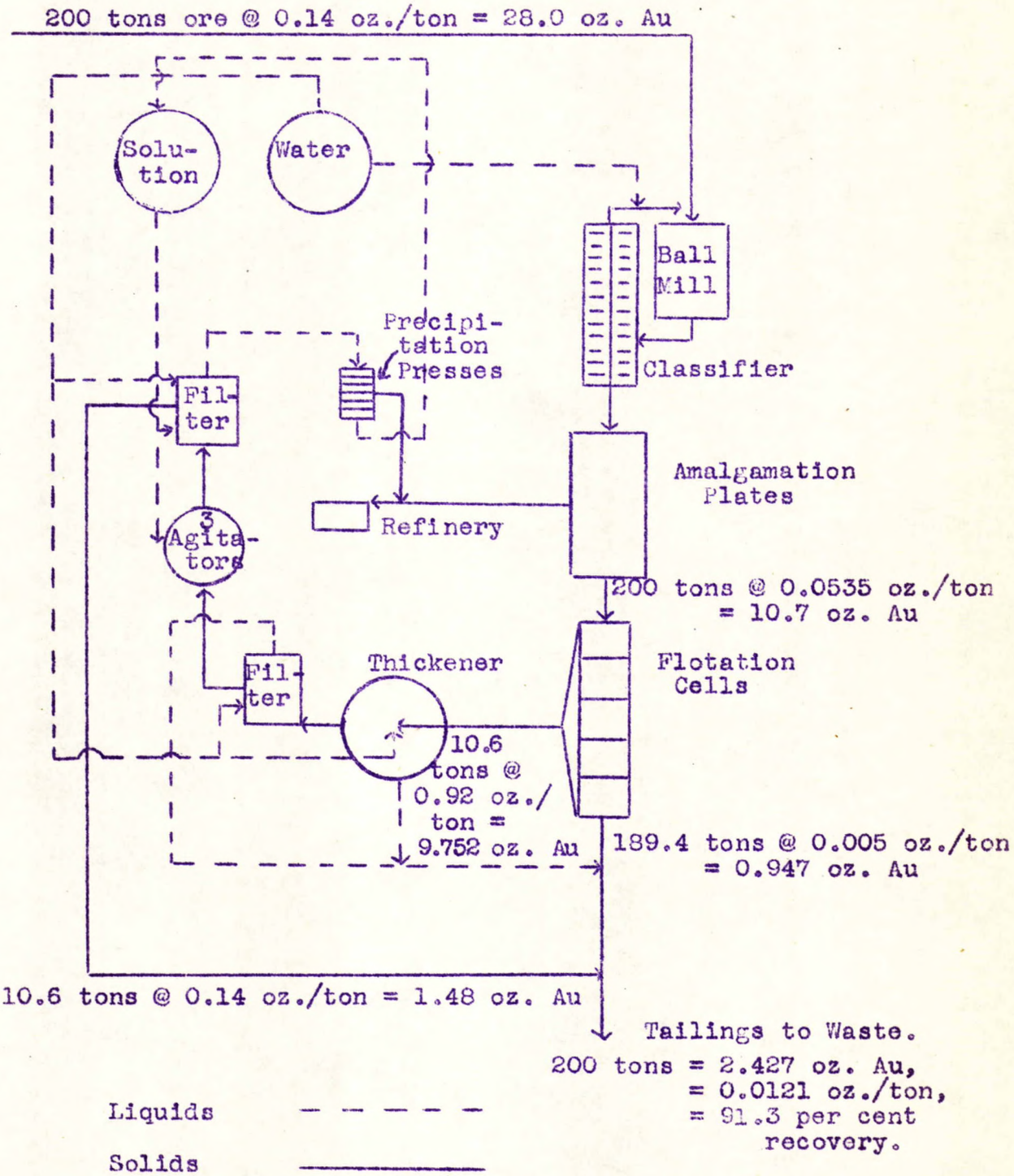
(Page 10, following, contains a suggested flowsheet.

SUGGESTED FLOWSHEET

FOR GOLDEN ARROW MINES,

TO FOLLOW TEST NO. 7.



WH:LB.