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December 4th, 1941.

REPORT

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of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1121.

Amalgamation and Flotation Concentration of a Gold-Copper Ore from the Siscoe Gold Mines Limited, Siscoe, Quebec.

NAME

(Copy No. 5 .)



DEPARTMENT OF MINES AND RESOURCES MINES AND GEOLOGY BRANCH

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Shipment:

BUREAU OF MINES DIVISION OF METALLIC MINERALS

ORE DRESSING AND METAILURGICAL LABORATORIES

Six boxes of ore, weighing 400 pounds, were received on September 22nd, 1941, from Mr. A. H. Robinson, Mine Manager, Siscoe Gold Mines Limited, Siscoe, Quebec. Two of these boxes, weighing 130 pounds, were marked "Cyanide Cre" and the remaining four boxes were labelled "Cupriferous Ore".

Location of the Property:

The property of the Siscoe Gold Mines Limited from which the present shipment was received is situated in Dubuisson and Varsan townships, Abitibi county, Quebec.

Sampling and Analysis:

After crushing, cutting and grinding by standard methods, representative samples of the two shipments were obtained which assayed as follows:

	"(lyanido oro"	"Cupriferous Ore"
Gold, oz./ton.	0.27	0.16
Silver, oz./ton.	0.07	0,23
Copper, per cent	0,03	0,51
Sulphur, "	0.12	0,80
Iron, "	2,17	7,36
Arsenic, "	None detected	Trace
CaO, "	2 .93	3.46
MgO, "	1.73	6.15
Pyrrhotite, per cent	Let e	0.31
Acid insol., "	86,92	64.16

Characteristics of the Ore:

Six polished sections, three from each type, were prepared and examined under the reflecting microscope for the purpose of determining the character of the ore.

"Cyanide Ore" -

Metallic mineralization is almost completely absent from the polished surfaces, which exhibit only one or two tiny grains of pyrite embedded in gangue. The latter is a mixture of fine-textured, white quartz and siliceous, dark grey to almost black rock. Both constituents carry abundant carbonate as rather finely disseminated grains which give a moderately strong microchemical reaction for iron.

"Cupriferous Ore" -

Metallic minerals are much more abundant in these sections than in those of the first type. Chalcopyrite predominates as small messes and coarse to fine irregular grains - Pago 3 -

("Cupriferous Ore", cont'd) -

disseminated in gangue. It contains numerous inclusions of gangue and occasional grains of the other metallics. Pyrite is prevalent, largely as medium to coarse isolated grains and granular aggregates scattered through gangue. Magnetite is present in small amount as occasional small masses and irregular grains in gangue, pyrite, and chalcopyrite. A very small quantity of sphalerite is visible as occasional small irregular grains associated with chalcopyrite.

Three irregular particles of native gold were observed and measured. They range from 72 microns (-200+280 Tyler mesh) down to 30 microns (-400+560 Tyler mesh) in size and all occur alone in quartz.

Flotation Concentrates -

Polished sections of four flotation concentrates (Nos. 4-B, 4-C, 4-D and 4-E) assaying 17.7, 19.5, 21.1 and 22.3 per cent copper were obtained from mill tests of the ore samples and were prepared and examined microscopically to determine, if possible, the association of the gold.

The ore had been ground to 60 per cent minus 200 meah and the sections are composed of mineral particles of this size. These particles consist largely of chalcopyrite, pyrite, magnetite, and gangue, and only rarely are they combined. Chalcopyrite and pyrite are the only minerals which are abundant. Magnetite is fairly common and particles of gangue are occasional to rare.

(kold was observed only in the sections from concentrate 4-B where three small grains of native metal are visible. These range from 18 microns (-800+1100 Tyler mesh) down to 12 microns (-1100+1600 Tyler mesh) in size, and each is free and unassociated.

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(Characteristics of the Ore, cont'd) -

Trap Concentrate -

In addition to these microscopic examinations of the polished sections, separate portions of the "cyanide ore" and the "cupriferous ore" were ground in a ball mill to pass 60 per cent minus 200 mesh and the pulp passed through a hydraulic trap. The resulting trap concentrates were examined under a powerful binocular microscope.

In the "cyanide ore" concentrate 12 pieces of free gold were visible. The largest-sized particle was 400-microns in diameter and the average 100 microns. Associated minerals consisted of pyrite and magnetite.

In the "cupriferous ore" concentrate 10 pieces of free gold were observed. The largest size particle was 250 microns in diameter and the average size was 60 microns. Associated minerals were pyrite, chalcopyrite, and magnetite.

Investigative Work:

In his letter of September 8th, 1941, Mr. Robertson stated:

"A very considerable amount of the ore at Siscoe mines contains too much copper, in the shape of chalcopyrite, to allow of its treatment by cyanidation.

We are considering the possibility of grinding in water with traps and possibly blankets in the grinding circuit, followed by flotation of the blanket tails.

We are sending you samples of the easily cyanided ore and of the coppery ore, and we would ask you to be so kind as to carry out tests along the lines we have indicated and also along lines which will occur to your good selves.

We would ask you to test the ores separately, and also as mixtures of the two, using charges containing 20, 30 and 40 per cent of the coppery ore with 80, 70 and 60 (Investigative Work, contid) -

"per cent, respectively, of the easily treated ore."

These suggestions were followed in the test work on these shipments. Portions of the two ores, in mixtures as outlined above, were ground in water and the pulp passed through a hydraulic classifier or trap and the trap tailing passed over a blanket. The combined trap and blanket concentrates were reground slightly and amalgamated and the amalgam residue added to the blanket tailings. This product was then conditioned and a copper concentrate obtained by flotation concentration. By this method, on the "cupriferous ore" some 75 per cent of the gold was recovered by amalgamation and 17 per cent by flotation, the flotation tailing assaying 0.01 ounce gold per ton. Ninety per cent of the copper was recovered. The flotation concentrates assayed up to 25 per cent copper and 1.1 ounces gold per ton.

On the "cyanide ore" and the mixtures of the two shipments, some difficulties were encountered in the flotation owing to the amount of the tale tending to report in the flotation concentrate. This was largely overcome by the addition of caustic starch as a conditioner. In a test using 70 per cent "cyanide ore" and 30 per cent of "cupriferous ore" 80.8 per cent of the gold was recovered by amalgamation and 10.7 per cent by flotation. The flotation tailing assayed 0.01 cunce gold per ton. Ninety-two per cent of the copper was recovered. The flotation concentrate assayed 19.5 per cent copper and 2.6 ounces gold per ton.

In these tests the ball mill grinds were from 60 to 70 per cent minus 200 mesh. The concentrates were ground to 45 per cent minus 200 and 20 per cent minus 325 mesh during the amalgamation.

- Page 6 -

(Investigative Work, cont'd) -

In addition to these amalgamation and flotation tests a number of amalgamation and cyanidation tests were made. These tests showed that a final residue of 0.005 ounce gold per ton was readily obtainable and that the addition of a soluble lead salt to the cyanide grind and a decrease in the strength of the cyanide solution used showed a reduction in the amount of cyanide consumed.

DETAILS OF TEST WORK:

In Tests Nos. 1, 2, 3, and 4 five separate portions of the two shipments were taken:

Α.	ŝ	100	per cent	cyanide	orø				
в.	7 .39	80	11	93	f 9	, 20	per cent	cupriferous	ore.
C.	¢3	70	(1	£\$	19	, 30	12		41 42
D.	A*10	60	51	11	17	, 40	11	11	11
Ε.	9	100	68	cuprifer	rous	ore.			

These designations (A, B, C, D and E) of the different proportions of the "cyanide" and "cupriferous" ores used are adhered to in the test work.

The different pulps were ground in water in a ball mill to pass 60 to 70 per cent minus 200 mesh and the grind . passed through a hydraulic classifier or trap and the trap overflow over blankets. The combined trap and blanket concentrates were reground slightly to pass 45 per cent minus 200 mesh and 20 per cent minus 325 mesh and amalgamated. The amalgam residue was added to the blanket tailing, conditioned, and a rougher flotation concentrate obtained in a Denver flotation cell. This primary concentrate was cleaned in a smaller machine. The different products were assayed for gold and copper.

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(Details of Test Work, contid) -

Test No. 1 (A to E), - Amalgamation and Flotation.

In this test soda ash was used as a conditioner in the amounts as shown.

Results:

CONTRACTOR OF A CONTRACT OF A

	- Gravity Concentration -										
Mix- :	そうそうそう そうしつしょうか マンコウモモ しょう ため たか ロンボ かく たかがか うかかか いごかん だんだだい うみかいのた さって されい かべがた	2 7 ML 7 12 12 12 12 12 12 12 12 12 12 12 12 12	Weight,	:Assays, :I	Distributio	n: Ratio of					
tures:	Product	:	; por	: Au :	of gold,	: concen-					
used ;			; cent	:oz./ton:	per cent	; tration					
A	Trap and blanket Blanket tailing	conc.	3,30 ; 96,70	0.06	78,5 21,5	30:1.					
B	Trap and blanket Blanket tailing	conc.	; 3,20 ; 96,80	0.06	78.7 21.3	31;1,					
C.	Trap and blanket Blanket tailing	conc.	; 3,65 ; 96,35	0,055	77 <u>4</u> 22 6	27:1.					
D	Trap and blanket Blanket tailing	conc.	: 3.00 : 97,00	0,06	74.1 25,9	33:1.					
E	Trap and blanket Blanket tailing	conc.	; 3,00 ; 97,00	0,04	75°7 84°3	33:1.					

Amalgamation of Trap and Blanket Concentrates.

eriturers survive ensures	ASSAVS	, Au oz./ton	ę	Extraction of gold	
	n serieran and Filmer d d	Amal, tailin	G å	by amalgamation,	
	:Head :	and	ю 9	per cent	
REALTHING RELEVENT THREE WAY		blanket tail	ing:	n a sharayan	£2
G 813.0.00 ml fol. 81 2.00 mar	0				
A	:0,27	0.07		74.1	
ĪB	:0.25	0,06		76.0	
Ĉ	:0,235	0,06		74.5	
D	;0,225	0.065		71.1	
21	:0.16	0.03		. 81.3	
<	0 0				E TR

The following flotations of the amalgam residue and blanket tailing show that the use of soda ash as a conditioner tends to lower the grade of concentrate produced on account of the large smount of talcose material in the "cyanide ore". In the "cupriferous ore" (E), however, a concentrate assaying 20 per cent copper was obtained.

(See table on next page)

Mix- : ture : Product	:Weight : per	Asses	rs Cu, ¢	; Distr: ; per	ibution, : cent :	Ratio of: concen= : tration :	Grind, % -200 mesh	Reagents added To primary cell	, lb,/ton feed ; To ;cleaner cell
A ; Conc. A ; Midd.	: 3,52 : 3,52 : 4,56 : 0, 02	1.45 0,27 0.01	0.41 0.09 0.01	70.4 17.0 12.6	52,2 14,9 32,9	28,4:1.	66.4	2.0 Soda ash O.l Butyl Z-8 O.03 pine oil	
A : Talling B : Conc. B : Midd. B : Tailing	: 2,30 : 4,72 : 92,98	1,77 0,285 0,01	3,60 0,39 0,01	64.1 21.3 14.6	74.9 16.6 8,5	43,5:1.	68,2	1.2 Soda ash 0.1 Butyl Z-8 0.03 pine oil	
: C : Conc. C : Midd, C : Tailing	: : 2.45 : 4.71 :92.84	1.46 0.30 0.01	4.67 0.63 0.01	60,5 23,8 15,7	74.6 19.4 6.0	4l:l.	69.4	l.2 Soda ash 0.1 Butyl 2-8 0.03 pine cil	22 37 57
: D : Conc. D : Midd. D : Tailing	: : 2,73 : 4,02 :93,25	1.70 0.23 0.01	7.61 0.58 0.02	71,5 14,2 14,3	90.8 1.0 8.2	36,6:1,	61.8	1.5 Sode esh 0.1 Butyl Z-8 0.03 pine oil	er 57
: E : Conc. E : Midd. E : Tailing	: : 1,98 : 2,40 :95,62 :	0.01 0.01 0.01	20.17 1.22 0.04	56,9 13,4 29,7	85,5 6,3 8,2	50.5:1.	64.4	1.0 Soda ash 0.1 Butyl Z-8 0.03 pine oil	्राच इन्द्रक

FLOTATION CONCENTRATION OF AMALGAM RESIDUE + BLANKET TAILING.

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(Details of "ests, cont'd) -

Summary Test No. 1.

<u>ب</u>		A	B	<u>C</u>	D	E
Gold recovered by amalgamation, per cent	27	74.1	76.0	74.5	71.1	81.3
" by flotation. "	670	21,3	18.6	19,1	23 °6	15°0
Overall recovery of gold.	G. 3	95.4	94.6	93.6	94.7	93.3
Assay tailing loss of gold, oz./ton		0.01	0.01	0,01	0.01	0,01
Copper recovered by flotation, per cent	æ	60.0	87.3	89.1	91.7	90°ð
Assay talling loss of copper, "	÷	0.01	0.01	0°03	0°03	0.04

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Test No. 2 (A to E).

This test was conducted similarly to Test No. 1, with the exception that "Quebracho" was used as a conditioner in place of soda ash. The results of the trap and blanket concentration were approximately the same as in the previous test, the method used being identical.

The amalgamation of the different trap and blanket concentrates resulted as follows:

		In the state of th	and the second
	:Assey	s, Au oz./ton	: Extraction of gold
	6 9	:Amal, tailing	: by amelgamation,
	a a	: and	: per cent
-	:Eead	;blanket tailing	O O NETER OF HIS PARTY AND
CALCULATION PERMIT	2 D	A ADVIDUA STATEMENT CONTRACTOR OF A CONTRACT OF A CONT	
А	:0.27	0.06	77 °B
B	:0,25	0°06	75.5
õ	:0.235	0,06	74.5
D	:0,225	0°022	75,6
E	:0.16	0.05	68.8
4:33	0 3	~~~~	<u>₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩</u>

In the following flotation tests it is apparent that the use of quebracho is not suitable to this type of ore, the sulphides tending to be depressed along with the gangue.

(See table on next page)

M1X-	ç Ç	: Weight	, š <u>A</u> 85	8.YS :	Distril	oution,:	Ratio of	: Grind,	; Reagents added	, 1b./ton feed
ture used	2 Product	: per : cent	: Au, : :oz./ton:	Gu, : per cent:	per (Au	cent : : Cu :	: concen- tration	: % -200 : mesh	: To <u>: primary coll</u>	: To ;cleaner cell
A A A	: Conc. Midd. Tailing	: 0,39 ; 7,09 ; 92,52	0,875 0,68 0,01	0,39 0.13 0.02	5.6 79.3 15.1	5.1 31.5 63.4	256;1,	67.4	0.42 Quebracho 0.10 Butyl Z-8 0.05 pine oil	0.48 Quebrach 0.02 Butyl Z-6 0.01 pine oil
BB	: Conc, : Midd,	; 6.02 ; 3,98	0,79 0,38	1,88 0,13	62.5 19.8	61,9 28,3	16.6:1.		0.15 Quebrachc C.10 Amyl xan- thate	
B	: Tailing	; 90,00	0,015	0,02	17.7	9°8		64.2	0.05 pine oil	-
C C	: Conc, Midd,	4.15 3.70	1.05 0.26	3.84 0.38	64.9 14.4	75.6 6.9	24:1.		0,20 Quebracho 0,10 Amyl xan- thata	-
G	. Tailing	92,15	0.015	0.04	20.7	17,5		59.0	0.05 pine oil	<u>6</u> 27
D D D	: Conc. Midd. Tailing	: 3,49 : 3,97 : 92,54 :	1,02 0,26 0,01	6,25 0,50 0,04	64,5 18,6 16,9	79,3 7,2 13,5	28,6:1,	60,6	0,20 Quebracho 0,05 No, 301 0,05 Amyl xan- thate 0,05 pine oil	क्र — — ~ ~
E) El El	: Conc. : Midd. : Tailing	: 2,63 : 1,67 : 95,70	1,05 0,44 0,015	16.79 2.35 0.04	56.1 14.8 29.1	85.1 7.5 7.4	38 <u>;</u>].	68,4	0,20 Quebracho 0,10 Butyl Z-8 0,03 pine cil	0,20 Quebrach 0,02 Butyl Z=4 0,01 pine cil

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FLOTATION CONCENTRATION OF AMALGAM RESIDUE + ELANKET TAILING.

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- Page 11 -

(Test No. 2, cont'd)

ast No	. 2.
	est No

		A	В	<u>C</u>	D	F
Gold recovered by amalgamation, per cent		77.8	75.5	74.5	75.6	68,8
Gold recovered by flotation, per cent		ຂຸຂ	18.6	18.9	18.7	20.1
gold, per cent Assay telling loss	619 6	80.0	94.1	93,4	94,3	88°8
gold, oz./ton	8	0.010	0.015	0,015	0.01	0.015
flotation, per cent	en	6.6	89,4	80,8	85.0	91,5
of copper, per cent	Ŧ	0.02	0,02	0,04	0.04	0.04

Test No. 3 (A to E).

This test was conducted similarly to the preceding tests, with the exception that lime was used in the flotation concentration as a conditioning reagent.

	Rosul	ts of Amalgan	natî	on .
	ASSAYS	An oz./ton	6 7	Extraction of gold
	s 84	mal, tailing	Ľ.	by amalgamation,
	6 6	end.	0	por cent
	; Head ; b	lankst teilir	18;	
	3 3	ning on line mentionen in structure and an and an and a structure an		, DECENTIVE DA DU ALI CONCENCIÓN DE DUCENCIÓN DE CONCENCIÓN DA CONCENCIÓN DE CONCENCIÓN DE CONCENCIÓN DE CONCENCIÓN
A	:0.27	0.07		74.1
B	:0,25	0.07		72.0
Ĉ	;0,235	0.07		70.1
D	:0.825	0,065		71.1
Ē	:0.16	0,03		81.2
ALL .	a) 7)	-		

In the following flotation results the use of lime as a conditioning reagent is satisfactory as regards the "cupriferous ore" but it was not possible to produce a high grade copper concentrate when using the "cyanide ore", due to the amount of gangue reporting in the different flotation concentrates.

Mix- ture used	40 00 20 20	Product	Weight, per cent	: <u>Assay</u> : Au, : :oz./ton:p	S Cu, : er cent;	Distr per Au	ibution, cent : Cu	Ratio of concen- tration	: Grind, : % =200 : mesh	: Reagents added : To : primary cell	, lb./ton feed : To :cleaner cell
A A A	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	Conc. Midd. Tailing	2,50 7,23 90,27	1,86 0,23 0,01	0,65 0,46 0,005	64.6 22.9 12.5	30.0 61.5 8.5	40:1.	70,2	2.5 lime 0.10 Butyl Z-8 0.05 pine oil	l.O lime
e B B	0 0 4 6 0 0 V	Gonc. Midd. Tailing	: 1,75 : 6,04 : 92,21	2,32 0,35 0,01	4,95 0,39 0,01	57.3 29.7 13.0	72.6 19.7 7.7	57:1.	69,0	2,5 lime 0,10 Butyl Z-8 0,03 pine oil	1.0 lime
G C	C = 0 + 0 C = 0	Conc. Midd. Tailing	: 2,20 : 4,89 : 92,91	1,90 0,37 0,015	6,54 0,27 0,04	56.6 24.5 18.9	74.1 6.8 19.1	45.5:l.	67,4	3.5 líme C.lO Butyl Z-8 O.O3 pine oll	0.5 lime
D D D		Conc. Midd. Tailing	: 1,31 : 4,91 : 93,78	2,60 0,44 0,01	13,16 0,62 0,02	52.5 33.2 14,3	77.8 13.7 8.5	76;1.	65,1	3.5 lime 0.10 Butyl Z-8 0.03 pine oil	l.O lime O.Ol Butyl Z-8 O.Ol pine oil
e E	· · · · · · · · · · · · · · · · · · ·	Conc. Midd.	2,17 2,57	0.80 0.08	21.93 1.84	60.3 7.2	84,8 8,4	46:1.		2,5 lize 0,05 butyl xanthate	l,0 lime
E	4-9 D 0 D 0	Tailing	: 95,26 : :	0.01	0.04	32,5	6,8	asartlet.commenses	70,1	0,02 cresilic acid 0,02 pine oil	53 55

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FLOTATION CONCENTRATION OF AMALGAM RESIDUE + BLANKET TAILING.

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(Test No. 3, cont'd) - Page 13 -

Summary of Test No. 3.

		A	В	C.	D	E
Gold recovered by		17/A 3	70 0	80.0	ר דיעז	01 0
Gold recovered by	10.	1204	16 ₀ V	10.0	f de orde	Will of the
flotation, per cent	m	20,6	80°8	81.1	20°5	12,1
gold, per cent	-5	94.7	92.8	91,1	91,3	93,3
Assay talling loss gold, oz./ton		0.01	0,01	0,015	0.01	0,01
Copper recovered by flotation, per cent	12	48.5	86,9	79.1	88.4	91.9
Assay tailing loss of coppor, per cent	rð	0,005	0,01	0.04	0,02	0.04

Test No. 4 (A to E).

* 1.12

In this test caustic sode was used as a conditioner in the flotation concentration. The trap and blanket concentretion, followed by amalgamation of the resulting concentrates, was similar to the previous tests.

		Rəs	ults of Amalgama	atlon.
Contrading Completence (1997)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Assays	, Au oz,/ton	: Extraction of gold
	3		:Amal, tailing	: by amalgamation,
	2		; and	; per cent
ELPCTREPENDENTS	สาเมือ	Hoad.	:blanket tailing	ang truchisadirah kanagatan kana tana panapang sana sana sa
A	7	0,27	0,06	77.8
B		0,25	0.065	74.O
Ĉ	ŝ	0,235	0.055	76.6
D	\$	0,225	0.06	73.3
Ĩ.	7 3	0.16	0.04	75.0

ane and the second s Second second

The following flotation results, using caustic starch as a conditioner, are satisfactory except in No. "A" where the amount of sulphides in the ore (0,12 per cent sulphur) was not sufficient to permit a clean concentrate being produced.

(See table on next page)

1113	2 0 2	; Weight,	: ASSA	VS 3	Distr	ibution,:	Ratio of:	Grind,	Reagents a	aded,	lb./to	m feed
ture	: Product	: per	: All, :	C12, ;	per	cent :	concen-;	% -200	: To	° 5		To
used		: cent	:oz./ton;	per cent:	Au	; Gu :	tration:	mesh	: primary co	<u>ell</u> :	<u>cle</u>	sner cell
4684947.14.24.2549.2549.2599	1				~ * *						~ · ~	
Ê.	: Conc.	: 0.17	8.46	4.57	81°0	55.5	555:1。		U, 20 STATC	n _	0.10	STATCO
Δ	: Midd.	: 4,32	0.74	0.15	54.2	28.3 -			0,10 Butyl	Z-8	0.02	Butyl Z-8
A	: Tailing	: 95.51	0.015	0.01	24.2	41.2		61.0	0.03 pine (011	0.01	pine oil
		6 5										
B	: Conc.	: 0,58	5,50	17.71	49.5	87,6	172:1.		0.20 stard	h	0.10	starch
B	: Midd.	: 4.27	0 ₅₄	0,23	35.7	8.4			0.10 Butyl	Z-8	0.02	Butyl Z-8
B	: Talling	: 95,15	0_01	0,005	14.3	4.0		59.4	0,03 pine	oil	0.01	pine oil
	, - -	2	-						~			-
C	: Conc.	: 0,63	2,66	19,54	39.8	82,7	147:1.		0.16 stare	b	0.10	starch
Ċ	: Midd.	: 5,66	0_32	0 33	39.8	11.6			0,10 Butyl	Z-8	0.02	Butyl Z-S
Ĉ	: Tailing	: 93,66	0.01	0,01	30 4	5.7		60.4	0,03 pine (011	0,01	pine cil
*	·	-		- v				, in the second s			·	
T)	: Conc.	: 1.03	3,56	21.11	60.6	92.7	97:1		0.16 stard	h	0,10	starch
ñ	: Midd.	: 5.01	0,29	0.25	23.9	້ຄັ້3			0.10 Butvl	Z=8	0.02	Butvl Z-8
ñ	- Dallinc	93,96		0 005	15.5	2.0		57.6	0.03 pins	oil	0.01	pine oil
5	° ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	, 940.044 ,	0,02	0,000	20,00						- 0	
27	ໍ່ດີດກຸດ	- 2 / 2	114.	22 30	59 2	84 4	49 5-1		0 12 stard	ļη.	010	starch
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FLOTATION CONCENTRATION OF AMALGAM RESIDUE + BLANKET TAILING.

(Test No. 4, cont'd)

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- Page 15 -

(Test No. 4, contid) -

Summary of Test No. 4.

		A.	B	Ç	D	R
Gold recovered by amalgamation, per cent	c.	77.8	74.0	76.6	73.3	75.0
Gold recovered by flotation, per cent	<u></u>	7.4	17.5	13.0	20.0	17.2
Cold, per cent	εp	85.2	91,5	89.6	93.3	8S°S
Assay tailing loss, gold, oz./ton	1.29	0.015	0.01	0.Ol	0.01	0.01
Copper recovered by flotation, per cent	4 22	43,0	94.9	92,3	97.6	93,0
Assay talling leas of copper, per cent	ŝ	0.0).	0,005	0.01	0.005	0,03

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Test No. 5. (A and E). - Amelgamation and Flotation Concentration.

In this test, portions of the "cyanide ore" A and the "cupriferous oce" E were ground in water in a ball mill

and the pulps passed over traps and blankets as in the previous tests. The combined trap and blanket concentrates were reground and amalgamated and the blanket tailings were concentrated by flotation. The amalgam residue was not added to the blanket tailings prior to flotation as in the previous tests.

- Trap and Blanket Concentration -

		Test	No. 5-A.	an anns anns anns anns a' suadh anns	1000 1000 1000 1000 1000 1000 1000 100	
Product	:Welsht, : per : ceat	; Assay ; Au, ; :oz./ton:	Cu, Der cent	Distri per Au	bution, ceat : Cu	:Ratic of ; concen- : tration
Poed	;100.00	0,27	0.03	100.0	67	
concentrate	: 2,57	8,04	1 2)	76.5	674	39:1.,
tailing	: : 97.43 :	0,065	23 20 35-01-02-101 / TOTALSTOPHUM	23.5	64 2010-2010-2010-2010-2010-2010-2010-2010	212282224910 328 2-000723 20022 (62) % (22)
	anan mula sura su ancora na	Post	No. $5 = E$.	ل المراجع المرا المراجع المراجع	28 94 64 64 64 72 22 22 24 74 74 74 74 74 74 74 74 74 74 74 74 74	
Feed	100.00	0,18	0.51	0,00 <i>f</i> ,	100.0	
concentrate	: : 3,02	4.01	2.31	75.7	13.7	33:1.
tailing	; ; 96,98	0.04	0,45	24,3	36.3	

- Page 16 -

(Test Nc. 5, contid) -

- Amalgamation of Trap + Blanket Concentrates ~

4.4.914.2AMILIN,57AT	ມານແຂນ. ຍ ເວັ	Assays,	AU	02./	ton	navarana vi D	Extr	action	0 0	Overall.	extraction
Test	÷		1173. • 6 . 7x31443		1	5	of	gold,	° 7	of	gold,
NO.	0	Feed	; Ta	ilin	<u>e</u>))	per	cent	ŝ	per	cent
10.00 (0.00 (0.000 (0.000 (0.000))))	0 0	TANKA LLOUP ALLOTTO SAFE	alar ta constant a s	15-11-12 ANALA	6444212484213	1963 Q. T.C	97.7 A. 196. 57. 57. 57. 57. 57. 57. 57. 57. 57. 57	ana kangananan kangan	0157539.026	ar da kerata da kerata keratar	oral of the state and an and the state of th
5~A	5	8.04		0,13			98.	39		75.	Ş
	ê										
5-E	3	4.Cl.		0.12			97.	0		73.	4
TANK SPECTOR	e o Dirict	an a	andra and a state of the		ತಾನ್ಮಾನಗಳು	EN CANENZA L		TANÀ GUARDANA MAÌ	reasia	an a	and a constant of the second secon

The grinding, accompanying amalgamation, was 45 per cent minus 200 mesh in Test No. 5-A and 43 per cent minus 200 mesh in Test No. 5-E.

FLOTATION OF BLANKET TAILING.

.

<u>ture</u> Used	; ; Product	: Weight : per : Cent	Assa: Au, : Au, :cz./ton:	ys Cu, per cent:	Distr per Au	ibution,: cent : : Cu :	Ratio of: concen-: tration;	Grind, % -200 mesh	:Reagents added, : To : primary cell	lb./ton feed To cleaner cell
A	;Conc.	; ; 0,33	4.60	2°11	24.7	38,4	303:1.		0.20 starch	0.10 starch
A	Lidd.	: : 4,96	0.65	0,10	52.3	21.1			0.10 Butyl 2-8	0.02 Butyl Z-8
A	: :Tailing :	: 94,71 :	0,015	0.01	23,0	40.5		63.0	0.03 pine oil	0.01 pine oil
E	: :Conc.	: : 1.04	1.67	27.73	58.8	77,5	96;1,		0.10 starch	0,05 starch
E	: :Midá	: 4.71	0.06	1.58	9.5	20.0			0.10 Butyl Z-8	0.02 Butyl Z-8
Ε	: :Tailing :	: 94_25 :	0.01	0.01	31.7	2,5		69.0	0.03 pine oll	0.01 pine oil

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Page 17

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- Page 18 -

(Test No. 5, contid) -

Summary of Test No. 5.

F

Α

		673	60-33 2-05
Gold recovered by amalgamation, per cent	5	76.4	73.4
Gold recovered by flotation, per cent	e38	8,8	15.6
Gold remaining in smalgam residue, per cent	42.0	1.2	2.3
Assay tailing loss fold, oz./ton	8 20	0.01	0.01
Copper recovered by flotation, per cent	0	46.5	80.2

Owing to the small amount of mineralization in the "cyanide ore" A, the flotation recovery was low in both the gold and copper. On the "cupriferous ore" E, however, the recovery in both gold and copper was fairly satisfactory.

Test No. 6 (E). - Amalgamation and Flotation Concentration.

In this test three portions of the "cupriferous ore" E were ground in water to pass 68.7 per cent minus 200 mesh. The pulps were then passed through traps and blankets and the combined concentrates amalgamated as in the previous tests. The amalgam residues were then added to the blanket tailings.

In the flotation concentration of these pulps an attempt was made to duplicate actual milling flotation procedure in the small scale test work. After conditioning the first product with caustic starch and floating with butyl xanthate and pine oil, the resulting concentrate was cleaned in a smaller flotation machine and the cleaner middlings were returned to the primary cell and refloated along with the second product. This procedure was repeated for the third product. The assay results of the three flotation tailings showed whether the gold or copper tended to build up in successive tailings and thus reduce the overall recovery.

(Test No. 6, contid) -

	1	Results	of Amalgamati	on,	
	\$	Assays	, Au oz./ton	6 0	Extraction of gold
Product	2		:Amal. tailing	1 1) 1 0	by amalgamation,
	00	Feed	: and	0	per cent
	2	11/1. School and a street from	:blanket taili	ng:	
 Construction of a subject of a subject of a sub- station of a subject of a subject	9 9 9	a an	nnearth anna a' fhaile agus beannan 1974 a' 1994 a	1.5 <i>54 (</i> 7.16),24	an an ann an an Annair an Annair ann an Annair an Annair ann an Annair a
1	n U	0,16	0.03		81,2
2	;	0.16	0.03		81.2
3	00	0,16	0.03		8.1 ° S
Alaratic Accur and activity of the second second	0 	and a series of many fee gives in a	a And Frank Add in a strict build for the strict and the institute in the later of the	777100010010	ሬዚኤን እር በሽመን ጉድ የሽለም የአንግ እር የሚሰር የሚሰው መንሻ የሚሰር የሚሰር የሚሰር የሚሰር የሚሰር የሚሰር የሚሰር የሚሰር

Overall Extraction by Amalgamation (Three Products).

1, 2, 3	3	0.16	0.03	81,2	
	0				

Flotation of Amalgam Residue + Blanket Tailing.

NO. IN TRACK STREET, AND TRACK THE TAKE FROM THE FULL HAVE CAUSED	No. Alte	CONTRACTOR OF A STRATE OF A			APR 1 11	THE REPORT OF THE REAL PARTY	LOWFILLAS	TOT I AT A ANTI DALE		malification and the		an a	occurrence are ser	
	o [t	Seight,	3	A٤	38.	.JS	;D:	lstri	Lbu	tion,	: G3	ind,	;Ra	tio of
Product	0 0	per	, ,	A21,	3	Cu,	3	per	CG	រោះ	370	-200	: 0	oncen-
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	۰					(t)								
Feed	8	.00,00	Ο.	033		0,47	<u>]</u>	0.00]	0,00.				
Flot, conc.	0	1.52	1.	43		25.74	ţ	64.8		83.7			65	.8:1.
Final midd.	* D	1,51	0.	14		1.82		6.3		5.9				
1st F. tailing	0	31.89	Ο.	01		0.04		9.6		2.7	6	58.5		
2nd F. tailing	0	32,69	0,	0].		0.06		9.7		4.2	Ċ	\$7.2		
Final F.	0	32,39	Ο.	01.		0.05		9.6		3.5	7	0.3		
	ő													
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Calculated.

During the primary flotations and cleaning of the flotation concentrates the following reagents were added;

*** LTD101.01.000 ACT 1114	an man to be want to be a product of the second of the state of the second second second second second second s	na an a
	: Reagents added,	<u>lb./ton feed</u>
Product	; Po ;	To
Number	; primary cell ;	cleaner cell
	A 0 0	n an
1	:0.20 starch	0.10 starch
).	:0,10 Butyl Z-8	0.01 Butyl Z-8
Ĵ,	:0,03 pine oil	0.01 pine oil
	ч 0	
S	:0.20 starch	0,10 starch
2	:0,05 Butyl Z-8	0.01 Butyl Z-8
2	:0.02 pine oil	0.01 pine oil
	0 0	
3	:0.10 starch	0.05 starch
3	:0,05 Butyl Z-8	w.44
3	:0,01 pine oil	CC7
	0 4	
WEAREN NEWSCOOL FRANK	non um delectris finteners collecterente allesser fa	nter de la contra de

(Test No. 6, contid) -

Summary of Test No. 6 (E).

Per cent

Gold recovered by amalgamation	tan a	81.2
Gold recovered by flotation	eD	12.3
Overall recovery of gold	15)	93,5
Copper recovered by flotation	3	85 ° 3

The results of this test show no appreciable buildup of the flotation tailings. The assays of the tailings are approximately the same for all three products.

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Test No. 7 (A to E). - Amalgamation and Cyanidation.

Portions of the "cyanide ore" and the "cupriferous ore" were taken, in the proportions as given below, and ground in cyanide solutions of 1 pound NaCN per ten strength to pass 60 per cent minus 200 mesh. 0.50 pound of lead mitrate and 2.0 pounds of lime per ten of feed were added to the grind. The pulps were then filtered and the grinding solutions saved for the agitation periods. After repulping the filter cake, it was passed through a hydraulic trap and the trap overflow over blankets. The combined trap and blanket concentrates were reground and amalgamated and the amalgam residue added to the blanket teilings. This product was agitated in the cyanide solution, saved from the grind, for 24 hours. Enough sodium cyanide was added to keep the strength of solution at 1.0 pound NaCN per ten, and enough lime to maintain protective alkalinity.

Results:

After grinding in cyanide, passing the repulped filter cake through traps and blankets and regrinding and amalgamating the combined concentrates, the amalgam residues (Test No. 7, cont'd) -

were added to the blanket tailings. These products assayed as follows:

M:1.x -	9 9	Assays	Au oz./ton	: Extraction of gold
turo	с 9	1	Amal. tailing	; by amalgamation
used		2 1	and	: + cyanido grind,
TTT- In Strike (P13'Isw	0 0	Feed	blanket tailing	: per cent
111 1		2 19785 14191 14195 1444 14 19181 1415 14	and an and the second	an han die seine ander seine andere en ferste nie is die een die stere stere seine die seine die seine er er e An het die seine andere seine andere er die seine er die seine stere stere seine seine die seine die seine er d
A	0 0	0.27	0,08	70.0
B	80	0.25	0.04	83.7
Ĉ	• • •	0,235	0.04	83.0
D	ĉ	0.225	0.04	82.2
Ē	n Q	0.16	0.04	75.0
	*		un var kar van trykt myden i konst i kensta far teinikkeristikkerist	e para de la composition de la composit

Agitation of Amalgam Residue + Blanket Tailing

IN THIS BY TO INALE LO	-	าสพระสิประการเการกลง	т аладкай жилий наской таталагас й исторок, изо-	West Street Number of	ALL STREAM OF THE ADDRESS OF THE ADD	THE REPORT OF A MARCHINE POLICY	PRIMARY PROPERTY	In the second carry and the second	TATALAN AND A THE WAY WANTS TO TATALAN	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1
Mix	9 5	A.S S	ays,	;Extr	action	Reage	ents	consume	l:Reducing	g:Grind,
ture	8	Au o	z./ton	; of	gold,	; 1b	/ton	feed	; power,	: %
used	ů	Feed	;Tailing	sper	cent	: Na(IN e	Çao	:ml.N/10	: -SOO
	8			6 0 1911 Harristows I (lan Chanadh ann ainmeal a' bhailtean an	3	3 0	and the function of the state of the	:KMnO _i /L	: mesh
on and a state of the state of			to the fight had been the second the second s		LINE GRAZIERANA COLUMN T	**************************************			and the first of the state of t	
A.		80.0	0.005	93	.75	0 .5	53	5.0	14	66 .5
B	0	0.04	0,005	87	,50	Q _ {	53	5.0	50	64.4
C	8 0	0.04	0.005	87	、 50	0.ť	50 - SO	5.0	60	61.3
Ď	ŝ	O°04	0,005	37	,50	0,6	51.	5.0	60	61.5
ŶĒ	0	0.04	0,005	87	. 50 `	Ο。6	33 .	5,1	120	62.7
RENERICANOLOGISMA		WALLANDALL AND	waaraa waxay aha aha hadahaa ah	নগন আনের হিন্দ্রান হয	an a	and the relieved		antero destero contrado	anan mananan merupakan merupakan sebagai sebagai sebagai sebagai sebagai sebagai sebagai sebagai sebagai sebaga	orthe successful and a

ŵ

The cyanide solution assayed 0.08 gram copper per litre.

The actuation period was 24 hours in all cases. The cyanide solutions were kept at a strength of 1.0 pound NaCN and 0.15 pound CaO per ton.

Summary of Test No. 7.

a na the second s	320	TOP . 19 TO 4 S MAR AT . 3 (3.24 S M FOT	1 (++***********************************			
Gold recovered by cyanide print	ព្	A	B	Ç	D	E
* amalgamation, per cent	dar	70.0	83 ,7	83.0	82,0	75.0
Gold recovered by agitation, per cent	هټ	88°J	14,3	14,9	15.6	SI.9
Overall recovery of gold, per cent	da	98,1	98.0	97 , 9	97.8	96,9
Overall tailing loss, Au oz./ton	823	0.005	0,005	0,005	0.005	0,005

- Page 22 -

Test No. 8 (E). - Amalgamation, Cyanidation and Flotation.

In this test a portion of the "cupriferous ore" E was ground in a ball mill in a cyanide solution of 0.5 pound NaCN per ton strength. Three pounds of lime and 0.5 pound of lead nitrate per ton of feed were added to the grind. The pulp was then treated by concentration and amalgamation as in Test No. 7. The amalgam residue and blanket tailings were then divided into two parts and agitated in the cyanide grinding solution of 0.5 pound NaCN per ton strength. In part A sufficient lime was added to give a strength of solution of 0.10 to 0.15 pound per ton and in part B, 0.40 to 0.50 pound per ton. Enough cyanide was added to maintain a strength of solution of 0.5 pound NaCN per ton. After agitating for 24 hours the residue was filtered, washed, and the cakes were sampled separately. The cakes were then repulped together and conditioned in a Denver flotation machine with 0.10 pound of caustic starch per ton and a rougher copper concentrate obtained by the addition of Butyl Z-8 and pine oil. This concentrate was cleaned in a smaller machine. The different products were assayed for gold and copper.

The amalgam residue and blanket tailing assayed 0.02 ounce gold per ton, showing a recovery of 87.5 per cent of the gold by grinding in cyanide plus amalgamation of combined trap and blanket concentrates.

		Feed	- 0.02	ounce go	old per	ton.	
Grind, % -200 mesh	Tailing:E : assay,: : Au :oz./ton:	of gold,: per cent :	Titrat lb./t solut NaCN	ions, : on ; ion ; : CaO ;	Reage consu lb./t NaCN	ents med, con ore Ca0	Reducing power, ml. N/10 KMn04/L
67.4 67.4	0.005	75.0 75.0	0.50 0.50	0.10 0.40	0.60	4.80 7.70	90 100

Agitation of Amalgam Residue + Blanket Tailing.

- Page 23 -

(Test No. 8, cont'd) -

The cyanide solutions assayed 0.054 and 0.057 gram copper per litre. The agitation period was 24 hours.

The cyanide solutions were kept at a strength of 0.50 pound per ton NaCN and 0.10 to 0.15 pound CaO in the first agitation and 0.50 pound NaCN and 0.40 pound CaO in the second.

Flotation of Cyanide Residues.

The two filter cakes were combined, repulped, and transferred to a Denver flotation cell. The pulp was conditioned with caustic starch and a cleaned copper concentrate obtained as follows:

PRODUCTION STATES OF ST	ערייאין אנער געשע געאין איז איזיענעראין איזעענערער איז איזיענער איזיער איזיער איזיער איזיער איזיאייאי איזי איזיער איזיין איזיי		Watcht	0 0	AS	88V8		Distri	bution.	? R	atio of
Product	;	2 00 00	per cent	°	Au, z./ton	; Cu	, cent	: per ; Au	cent : Cu	9 0 0	concen- tration
DEDPENDED CONTRACTOR	ed and a feat water and the state of the second of the	1777-7-4 (*		199416	HI FA WELLEY AND A FARMER CONTRACTOR	TRE SHIELD FRANKERS	CONTRACTOR AND	VELIDDY CONSIGNAT	STATISTICS STRATEGY EL -	ane en	AND IN COMPANY AND ADDRESS
Feed Copper	concentrate middling tailing		1.00.00 0.93 2.51 96.56	00000	.0065 [®] .08 .04 .005	0. 30. 5.	52 [®] 50 25 11	100.0 10.8 15.3 73.9	100.0 54.4 25.3 20.3		107:1.
		, n			-						

⁽⁾ Calculated.

CHARACTER STRATE CONTRACTORS

The additions of flotation reagents was as follows: To primary cell: 0.10 pound starch, 0.10 pound Butyl Z-8, 0.03 pound pine oil per ton.

To cleaner cell: 0.05 pound starch, 0.02 pound Butyl Z-8, 0.01 pound pine oil per ton.

Summary of Test No. 8 (E).

The test was conducted on the sample E of "cupriferous ore".

Gold extracted by evanide grind and		Per cent
amalganation	ę	87.5
Gold extracted by agitation	d79	9.4
Gold recovered in flotation concentrate	5	0.4
Overall recovery of gold	e 2	97.3
Copper recovered by flotation	-12+	68.1

(Test No. 8, contid) -

In this test, as in previous tests, the percentage of gold and copper recovered from the middling product was figured as being the same as the percentage recovery of the concentrate.

Summary and Conclusions;

The test work on the ore shipments indicates that the flowsheet as suggested by the mine management, consisting of a water grind followed by concentration by means of traps and blankets, amalgamation of ensuing concentrates and finally flotation of the amalgam residue and blanket tailings, will be successful in the case of the "cupriferous ore" or in a mixture containing at least 30 per cent "cupriferous" and 70 per cent "cyanide ore".

Using this flowsheet some 77 per cent of the gold was recovered by amalgamation and 14 to 15 per cent by flotation concentration. The final flotation tailing loss was 0.01 ounce gold per ton. A recovery of some 85 to 90 per cent of the copper in the ore was obtained with a flotation concentrate assaying 20 to 25 per cent copper, and about 1.5 ounces gold per ton at a ratio of concentration of from 65 to 100:1. The grinds used were from 60 to 70 per cent minus 200 mesh in the ball mill and a coarse grind of 45 per cent minus 200 mesh in the amalgamation of the trap and blanket concentrates.

A test (No. 5) was also made where the amalgam residues were not added to the blanket tailing prior to flotation. This method worked out fairly satisfactorily for the "cupriferous ore" E. On the "cyanide ore" A, however, owing. to the small amount of mineralization, the recoveries by - Page 25 -

(Summary and Conclusions, cont'd) -

flotation concentration of both the gold and copper were low.

The chief difficulty encountered in the treatment was the tendency of the talcose material in the "cyanide ore" to report in the flotation concentrate. Conditioning was attempted with soda ash, lime, quebracho, and caustic starch. Of these reagents only caustic starch was found to be beneficial in producing a cleaned copper concentrate comparatively free from gangue.

In addition to the emalgamation and flotation tests on the cres, a number of amalgamation and cyanidation tests were made on the different ore mixtures. These tests followed the flowsheet which is at present used in the Siscoe mill. They indicated that the excessive cyanide consumption, due to chalcopyrite in the ore, can be alleviated to some extent by the addition of a soluble salt to the grind and a reduction in the strength of cyanide solution used. By these means a cyanide consumption of 0.50 pound per ton of ore was obtained with an extraction of 97 per cent of the gold and a final cyanide residue of 0.006 cunce gold per ton. On the "cupriferous ore" a flotation copper concentrate was also obtained from the cyanide residue, assaying 30.5 per cent copper with a recovery of about 68 per cent of the copper in the ore.

In the microscopic examination of the polished sections and concentrates all the gold observed was free and no association of the gold with either the pyrite or chalcopyrite was detected.

It is indicated from the test work performed on these shipments that analgamation and flotation procedure - Page 26 -

(Summary and Conclusions, contid) -

can be applied with satisfactory results to the "cupriferous ore" or a 30 to 70 per cent mixture of the cupriferous and cyanide ores but that, dwing to the sparseness of mineralization in the cyanide ore, flotation concentration would hardly be applicable to this type of ore alone or to a mixture containing less of the "cupriferous ore" than the amount indicated. Owing to the comparatively large amount of free gold in the ore, blanketing of the flotation tailings prior to final shipment might be necessary.

The test work also indicated that some reduction in the amount of cyanide consumed may be effected by the addition of a soluble lead salt to the grind and a decroase in the strength of the cyanide solution used.

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HLB:GHB.