OTTAWA November 26th, 1940.

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of the

## ORIE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 923.

Amalgamation and Concentration of a Gold-Copper-Tungsten Ore from the Slave Lake Gold Mines Limited, Great Slave Lake, Northwest Territories.

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BUREAU OF MINES
DIVISION OF METALLIC MINERALS
ORE DRESSING AND
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## Shipment:

Two bags of ore, total weight 115 pounds, were received on July 26th, 1940, from Mr. J. J. Byrne, Vice-President, Slave Lake Gold Mines Limited, 80 King Street West, Toronto, Ontario.

A shipment of ore from this property had previously

been received, on February 24th, 1937, and had been reported on in Ore Dressing and Metallurgical Laboratories Investigation No. 713 of that year.

# Location of the Property:

The property of the Slave Lake Gold Mines Limited from which this shipment was received is situated on Outpost Island, Great Slave Lake, Northwest Territories.

## Sampling and Analysis:

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

2.36 oz./ton Gold Silver LL.02.01 per cent WOB 3.01 Copper 10 - 11.74 Tron 12 8.39 Sulphur -Arsenic -1.20 Tln trace.

The above analysis indicates that the ore contains approximately 25 per cent sulphides.

#### Characteristics of the Ore:

Six polished sections were prepared and examined under the reflecting microscope. Since the general microscopic character of this ore had previously been reported (1937), the particular purpose of this examination was to determine the grain size and modes of occurrence of the tungsten mineral.

#### Gangue -

The Langue consists essentially of fine-textured, smoky-grey quartz containing small streaks and patches of dark

Metallic minerals, listed in their approximate order of abundance, are: chalcopyrite, pyrite, marcasite, ferberite, cassiterite(?), bornite, and native gold.

Chalcopyrite proponderates largely as small masses and coarse irregular grains in gangue. Pyrite and marcasite are common, predominantly as coarse irregular grains and subhedral crystals usually associated with each other and with chalcopyrite. A very small quantity of a mineral resembling cassiterite is visible as small rounded grains in gangue. Bornite is present in negligible amount as rare tiny grains associated with chalcopyrite. One small particle of native gold was observed in the sections. It occurs alone in quartz and is about 20 microns in size.

A comparatively small quantity of ferberite is present as small masses and irregular grains in gangue. These are infrequently associated with chalcopyrite. Ferberite is being replaced by a gangue mineral to such an extent that most grains and masses present a lace-like pattern consisting of small, irregular residual particles of ferberite down to the limits of the microscope (about 1 micron) in size, in a groundmass of gangue. (See Figure 1).

(Figure 1 is on the next page)

Figure 1.

Showing fine grains of ferberite in a groundmass of gangue and the impossibility of economically making a complete separation.

Forberito - white; Quartz - Q; Gangue mineral - G; and Pits and fractures - black.

Magnification - X 115.

A 200-mesh grid is superimposed.

#### Investigative Work:

The greater part of the work on the shipment was confined to concentration tests on the tungsten contents of the ore. Table concentration of the ferberite gave a recovery of about 45 per cent of the mineral in the concentrate and middling products with a grade of up to 51 per cent WO3 in the table concentrate. Flotation concentration of the table slimes showed a recovery of some 50 per cent of the tungsten in this product, the flotation concentrate assaying 20 per cent WO3, an overall recovery of 67.5 per cent of the tungsten being included in the table concentrate, table middlings and flotation concentrate.

## Details of Test Work:

#### Test No. 1. - Amalgamation and Concentration.

The ore at minus 14 mesh was ground in a ball mill to pass 57.2 per cent minus 200 mesh. The pulp was then passed through a Denver jig and the jig tailing passed over a corduroy blanket. The combined jig and blanket concentrates were then amalgamated with mercury and the amalgam residue added to the blanket tailing. This product was then concentrated on a Wilfley table. The table tailings were dewatered, transferred to a flotation machine, conditioned with 2 pounds of lime per ton, and floated with the additions of 0.03 pound amyl xanthate and 0.025 pound pine oil per ton. The flotation concentrate was cleaned in a smaller machine.

(Test No. 1, cont'd) -

# Results:

		Jig and Bl	anke t	Concent:	ration.	<b>.</b>		
	:Weight	, å A s	S &	A. B	Distri	buti.	on ,	Ratio of
Product	; per	s Au, s	per	cent	e per	cent		concen-
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Feed	:100.00	2.36	127	2.01	100.0	¢,	0.00.0	
Jig and	0							
blanket conc.	: 8.50	20.65 <sup>@</sup>	€2)	$5.78^{0}$	74.4	<b>E</b>	24.5	11.7:1.
Blanket tailing	3: 91.50	0.66	3.00	1.66	25.6	LUT	75.5	
	9							

The amalgam residue from the jig and blanket concentrates was added to the blanket tailings. This product assayed 0.73 cunce gold per ton and showed a recovery of 69.1 per cent of the gold by amalgamation.

Pable	oncentra	ation of	' Blanko	et Tail:	ing + /	lmelgen	n Resid	UO o
Feed Table conc. Table middling Table tailing	:100.00 : 2.56 : 4.71 : 92.73	0.73 <sup>0</sup> 4.04 1.46 0.60		2.29 <sup>0</sup> 24.82 5.45 1.51	100.0 14.2 9.4 76.4	=	00.0 27.7 11.2 61.1	39:1.
Flotation of Table Tailings.								
Feed Flot. conc. Flot. middling Flot. tailing	;100.00 ; 6.36	0.53 <sup>®</sup> 3.26	2.85 <sup>0</sup> 32.42 13.40 0.44	em em em	te e Mary sel Pauldo, s el Tradigitar est ; il	100.0 72.3 13.7 14.0	ESS ESS ESS ESS ESS ESS ESS ESS ESS ESS	15.7:1.
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<sup>©</sup> Calculated.

# Summary of Test No. 1:

	Per cent
Gold recovered by amalgamation and flotation, 69.1 + 13.5 =	82.6
Copper recovered by flotation concentration	76.3
WO3 recovered by table concentration =	38,9

# Test No. 2. - Amalgamation and Concentration.

In this test the ore at minus 14 mesh was ground in a ball mill to pass 52.6 per cent minus 200 mesh. The pulp was then concentrated on a jig and blankets and the concentrates amalgamated as in Test No. 1. A bulk flotation concentrate was then made of the blanket tailing and amalgam residue. This flotation bulk concentrate was cleaned on a smaller machine. The flotation tailing was passed over a wilfley table and a portion of the table slimes concentrated on a Haultain superpanning machine.

#### Results:

	Jig	and Blank	et C	oncentra	tion.			
CT There have a design of the second state of the second state of the second se	:Weight,	: A s s	ау	ន	: Distr	l butic	n,	Ration
Product	; per	a Au, a	Por	cent	; per	cent	ne avaitament taktimist tak	sconcen-
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Feed	:100.00	2.36	ب <del>ن</del> ،	ço.	O.OO.	<b></b>	<b>C</b>	
Jig and	6							
blanket conc.	: 5.50	$30.19^{\odot}$	œ	cfta	70.4	æ	£X1	18.2:1.
Blanket tailing	g: 94.50	0.74	<b>~</b>	Les	29.6	res .	en	
	8	TANK AND A AND A AND A SECOND OF THE SECOND			COLUMN TERMINISTERS AND THE CO	maring and much some sides	- ULT II saad Law	The many to the control of the state of the

© Calculated. The amalgam residues + blanket tailing assayed

0.82 ounce gold per ton, living a recovery of 65.3 per cent

of the gold by amalgamation.

Bulk Flotat	ion of Blan!	ket Tailing + A	lmalgam	Residu	. O.	- Marie Santa Santa	правневать генциализ
	Ď						
Feed	:100.00	0.82 <sup>©</sup> 2.99 <sup>©</sup>	co	100.0	3.00.0	¢+s	
Flot. conc.	: 23.21	2.84 12.16	ezn	80.3	94.3	etn	4.3:1.
Tailing	: 76.79	0.21 0.22	8.89	19.7	5.7	em em	
-	0						

<sup>&</sup>lt;sup>®</sup> Calculated The pulp was conditioned with 2.0 pounds of soda ash per ton and floated with 0.10 pound amyl xanthate and 0.07 pound pine oil per ton.

# (Test No. 2, cont'd) - Results, cont'd -

		Cleaning	of Bulk	: Flota	tion Co	ncenti	rate.	
SCALINICAL SANCE CANADA CONTRACT CONTRA	:Weight	, 8 A E	зау s	)				Ratio of
Product	; per	a Aug	: Per ce	ent	enverse	er cei	at :	concen-
	: cent	:oz./ton	s Cu s	1703	a Au	Cu	: WO3 :	tration
WENTER ANGER AT AN MA COURTE IN MINISTERS AND SPORT SPORTS IN	0		A CONTRACTOR OF THE CONTRACTOR	Same transferred Transferred and				
Feed	:100.00		$18.16^{9}$	<b>4</b> 20	0.001		co	
Concentrate	: 80.54	2.98	13.93	ca>		92.3	en-	
Middling	: 19.46	1.56	4.84	25	11.2	7.7	<b>c</b>	
-	o u						o et mane ar municipalità me anno trèti	man with material description and a second section of the second
Leading a state, Letter i Stroktynentropet frame tich Ad A. Enther Armer	, else f. i suppressed in Suppress Colored in Color St. March of March 1	A	THE RESERVE OF THE PARTY OF THE	The state of the s				
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CONTRACTOR IN A LINE LOS AND	0			<i>a</i> .				
Feed	:100.00			$8.32_{\odot}$	œ	÷	100.0	
Concentrate	: 4.06	0.76	ė:a:	23.86	62	en.	43.5	24.6:1.
Middling	: 7.41	<b>C</b>	<b>©</b>	5.11	ro	⇔	17.0	
Sands	: 44.93	c <sub>r</sub>	wa	0.26	ct	10.7	S. 3	
Slimes	: 43.60	O.lo	EZD.	1.75	em em	62.07	34.3	
	8						ner anno C Cinidad III vir in estado	alla Course of the Course of t
enter the second of the second se	. N. S.	CALLON BOTH ETTENNING SUNDERS AND WEST	CHEST OF DATAS AND	ARTITUDE SERVICE	e Constitution to a financial			
	S	uperpanni	ng of Te	able sl	imes.	hanna efterreb-serterreben)	Carpenagy I TradeCall Specimen	en e
EMPLY MANAGEMENT OF THE PARTY O	0							
Feed	:100.00	O.lo	621	$175^{\circ}$	1.00.0	ro <del>ca</del> 3	100.0	
Concentrate	: 0.20		ھ		11.6	e23	1.4	
Sands	: 71.45	0.10	<b>#</b>	1.41	71.4	1223	57.5	
Slimes	: 28,35	0.06	₩	2.54	17.0	co	41.1	
	ç							

## © Calculated.

### Summary of Test No. 2:

		Per cent
Gold recovered by amalgamation and flotation, 65.3 + 27.8	Pi kys es "Za	93.1
Copper recovered by flotation concentration,	ÇÎNA WAZE	94.3
WO3 recovered by table concentration	e.t.s	60.5
		EXECUTE OF SECULOR PROPERTY OF SECULOR PROPERTY.

Tests Nos. 1 and 2 give a comparison of somewhat different methods of concentrating the gold, copper and tungsten. In both tests the ore was ground in a ball mill and the gold concentrated in a Denver jig and corduroy

- Page 9 -(Comments on Tests Nos. 1 and 2, cont'd) -200 mesh.

The combined jig and blanket concentrates were then amalgamated, giving a recovery of 69.1 per cent of the gold in Test No. 1 when the primary grind was 57.2 per

cent minus 200 mesh and a recovery of 65.3 per cent of the gold in Test No. 2 when the grind was 52.6 per cent minus

In both tests the amalgam residues were added to the blanket tailing. In Test No. 1 this product was then passed over a Wilfley table where some 39 per cent of the tungsten was recovered in the concentrates and middlings. In Test No. 2 a bulk flotation was made of the sulphides prior to concentrating the flotation tailing on a Wilfley table; in this test some 60 per cent of the tungsten was recovered in the table concentrates and middlings. both tests the grade of tungsten was low, however.

In Test No. 1 a flotation concentration of the table tailing in a lime pulp gave a cleaner product assaying 32 per cent copper and 3.2 ounces gold per ton and in the bulk flotation in a soda ash pulp of Test No. 2 a cleaner concentrate was obtained assaying 13.9 per cent copper and 2.9 ounces gold per ton. In both flotations there was a tendency for a large percentage of the gold to report in the middling product.

A superpanning test on the table slimes of Test No. 2 showed that the large portion of the tungsten was in the panner slimes and a microscopic examination of the panner concentrate showed some free gold remaining which did not respond to either amalgamation or flotation concentration.

#### Test No. 3. - Amalgamation and Concentration.

by the mine management and was as follows: After removing the jig and blanket concentrates for amalgamation the blanket tailings were to be conditioned and a bulk flotation concentrate made of the sulphides in the ore, this concentrate to be reground and amalgamated along with the jig and blanket concentrates. After amalgamation the combined amalgam residues are returned to the cells where a high-grade copper concentrate is taken off. The tailing from the primary flotation to be passed over a Wilfley table and the tungsten concentrates obtained.

Acting on this advice the ore was ground in a ball mill to pass 50.4 per cent minus 200 mesh, and the pulp was treated as described. Prior to amalgamation the combined jig, blanket and bulk flotation concentrates were reground to pass 80.0 per cent minus 200 mesh.

### Results:

	Jig e	and Blanke	t Cor				formal to and and another or	
E them to add a core forces are a first of a new absorbed with A. C. for this company of streams	:Welght	98 A B S	e. y	5	: Distr	ibut:	Lon, 8	Ratio of
Product	per:	: Au, :	Per	cent	ner:	cent	3	concen-
	: cent	:oz./ton:	Cu	gow.;	: Au :	Cu	sWO35 8	tration_
	0							
Feed	:100.00	2.36	Cia	2.01	0.001	œ	100.0	
Jig and	<b>n</b>	Ø		65				
blanket conc.	: 5.50	29.16 <sup>6</sup>	27	$6.50^{\odot}$	67.9	¢b	17.3	18:1.
Blanket tailin	g: 94.50	0.80	ca ca	1.76	32.1	é:	82.7	
	0							

<sup>6</sup> Calculated.

The blanket tailings were conditioned with 2.5 pounds of soda ash per ton and floated with 0.15 pound amyl manthate, 0.10 pound pine oil and 1.0 pound copper sulphate per ton.

(Test No. 3, cont'd) - Results, cont'd -

		Bulk Flot	ati.on	of Blar	akot Ta	iling	o	
and assistant account to an in all the construction of the constru	:Weight,	8 A.S.	ауя		ndeid.	ibuti	ons	: Ratio of
Product	; per	s Au,	Per c	ent	e per	cent		: concen-
	cont:	soz./tons	Gu	8 WO3	S AU S	Gu	: WOz	: tration
CAMPAGE STATE SAND STATE STATE STATE SANDS	O O	- Park Barrier & Western Barrier and Processing State of the State of	A niversity of the entertainments between	ERIELLE PROPERTY C. S. PRINCE	A Principle Towns Asker 1 Stations 6	ded fir been to a riser.	2001112-0111111111111111111111111111111	and the second s
Feed	00.00£3	0.80	យា	æ	$300^{\circ}0$	<b>C</b> -3	<b>(27)</b>	
Flot. conc.	; 20.83	$2.91^{\odot}$	ಲ	₩	75.7	ca	erp	4.8;1.
Flot. tailing	3 79.17	0.245	0.21	1.76	24.3	eo	=	
	8							

After regrinding and amalgamation of the jig, blanket and bulk flotation concentrates the amalgam residue assayed 2.57 ounces gold per ton, giving a recovery of 66.7 per cent by amalgamation. This amalgam residue was then conditioned with 2 pounds of lime per ton and floated by the addition of 0.03 pound of butyl xanthate and 0.025 pound pine oil per ton.

	Flot	ation o	f Amelger	n Res	iidue.				
an arministration of the property of the state of the sta	Zangamuti zanamentamizani menintan belan	MANAGEMENT OF THE PROPERTY OF THE PARTY OF T	THE PARTY OF LEAST CONTRACTORS OF THE PROPERTY.	ed will be seen a district	True of the gas day on the delegant	mare enan	PEASTERN THE CONTRACTOR	SOFTEELS IN OUT TO THE FAMILIES.	poets 2
Feed	:100.00	2.57	$11.00^{\circ}$	<b>5</b>	100.0	100.0	ign)		
Flot. conc.	: 49.67	3.77	20.40	ten	73.0	91.9	en	2:1.	
Flot. tailin	g: 50.33	1.375	1.75	<b>53</b>	27.0	8.1	డు		
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Oaloulated.

Tabl.e	Concentrat	ion of Bull	r Flotation Tail	
TO CAST ALL MANAGES AND CONTRACTOR OF THE CAST O	:Weight,:	Assays,	: Distribution:	Ratio of
Product	por :	WO33	s of Wos, s	con con-
	cont :	per cent	: per cent :	tration
Provided the way of the children of \$100 page 100 page 10	0	ASS.	THE DESCRIPTION OF STREET, AND REAL COMMENTAGES OF A 2.3.0 A ST. 3 STATE STREET, S. of ST. S. Of STREET,	the Control of Control
Feed	00.00	1.78 <sup>0</sup>	100.0	
Table concentrate	ະ 2.06	25.28	17.7	48.5:l.
Table middling	; 3.58	8,96	28.0	
Table sands	: 9.92	0.93	5.8	
Table slimes	: 84.44	1.24	59.1	
/	0		The state of the s	rangaring way ng pilipas lika pitura ng paga at pinakirang

O Calculated.

## Summary of Test No. 3:

		Per cent
Gold recovered by amalgamation and flotation,		
66.7 + 24.3	6-12 <b>5</b> 12-13	91.0
Copper recovered by flotation concentration	672	91.9
WO3 recovered by table concentration	nes nes	29.5

(Test No. 3, cont'd) -

Commenting on the results and flow-sheet of this test, it might be pointed out that the ore contains about 23 per cent sulphides, which would report mainly in the bulk flotation concentrate. This concentrate, together with the jig and blanket concentrate, forms a rather large amount of material to handle in the amalgamation barrel, and the results obtained by amalgamation were only about 1 per cent greater than in amalgamating the jig and blanket concentrates separately as in the previous test. It might also be noted that the handling of gold-copper flotation concentrates by barrol amalgamation is not a simple procedure, owing to the fouling produced by the flotation reagents and coppor contents of the concentrate, necessitating a complicated washing.

The low recovery of the tungsten in the table concentration is in part accounted for by the fact that the tailing from the amalgamation residues was not passed over the table due to the fine grinding of this residue rendering such an operation futile.

#### Test No. 4. - Amalgamation and Concentration.

The ore at minus 14 mesh was ground in a ball mill to pass 58.4 per cent minus 200 mesh. The pulp was then passed through a jig and blanket and the combined concentrates amalgamated without regrinding. The amalgam residue was then added to the blanket tailing, conditioned with 2 pounds of soda ash per ton and floated by the additions of 0.075 pound pine oil and 0.15 pound amyl xanthate

(Test No. 4, contid) -

per ton. The resulting flotation tailings were then passed over a Wilfley table. The table concentrates and middlings product were combined and passed over the table a second time in order to raise the grade of concentrates.

### Results:

	Ji.g	and Blan	ket Con	centra	tion.	,		
· St. Market and Company of Company and Company of the Company of	:Wei.ght	S A S	3 8 Y 9	nearon was remarked	: Distr	ibutio	n,	Ratio of
Product	: per	a Au, s	Per ce	nt	req :	cent	dws dwae stores	_:concen-
	: cent	soz./tons	CIO 0	MOS	3 A12 8	Cu	UCS	;tration
	0						v	
Feed	: 100.00	2.36	3.O1	2.01	0.00£	=	es.	
Jig and	o 3		_					
blanket conc.	. 8.50	20.00°	4.95 <sup>6</sup>	6.53®	72.1	ಡು	17'0	11.8:1.
Blanket tailir	ng: 91.50	0.72	2.83	1.59	27.9	tres (tres	eto.	
	0							

The amalgamation of the concentrates, without regrinding, showed a recovery of 61 per cent of the gold by amalgamation, giving an assay of 0.92 ounce gold per ton to the amalgam residue plus blanket tailing.

METALE DISCHMENTS OF WALKERING	Bulk F	'J. 0	tation o	of Ama	lgam Resi	idue + P	31anket	Taili	ng.	
Feed Flot.	conc.	ö	100.00 22.88 77.12		3.01 12.45 0.21	= :	57.3	100.0 94.6 5.4	8.3	4.4:1.
484 SESSESSESSESSESSESSESSESSESSESSESSESSES	Table Con	Ce	ntratio	1 of F	lotation	Tailin <sub>(</sub>	5 0			COLOR DE CONTROL DE CO
Feed		Q	00.00	455	co	2.29 <sup>®</sup>	وينا	දහ	100.0	
Table	conc.	0	1.35	623	dia	48.12	<del>d</del> ;p	ಣ	&.8S	74:1.
Table	middling	00	2.51	en	era-	14.96	<b>6</b> 3	eta	16.4	
Table	sands	0	51.22	es	tura eus	0.46	that.	ansa a	10.3	
Table	slimes	9	44.92	e2	ಡಘ	2.29	49	czo.	44.9	
ev 14.25 trition winningsmare	The second of the second second second section is a second section of the second section secti	() ()		er hall a starren i mil maliana a musi	no ancian delegemento e del estrucción del esco	a supplement to the contract of the	7) What a side of second females	and the second s	a makena Sarad bis karangka anatan	Comment Water than and States

o Calculated.

(Test No. 4, cont'd) ~

# Summary of Test No. 4:

	Pe:	r cont	
Gold recovered by amalgamation and flotation concentration, $61.0 \div 22.3 \approx$	:	83.3	
Copper recovered by flotation concentration	ត្តដា សុខា	94.6	
WO3 recovered by table concentration	6.03 6.03	41.0	
		Care toward them we work are realised to the	•

In this test the grade of tungsten concentrate was raised to 48 per cent WO3 by re-treatment. The gold recovery by amalgamation was lower due to the jig and blanket concentrates being amalgamated without regrinding.

## Test No. 5. - Table Concentration.

This test was made in order to see what grade of tungsten it was possible to obtain on the laboratory-size Wilfley table and at the same time obtain a recovery approximating that of the previous tests.

The ore was ground in a ball mill to pass 52.2 per cent minus 200 mesh and the gold amalgamated and the sulphides floated off as in the previous test. The flotation tailings were then passed over the Wilfley table with the following results:

4 MAKE PERSENTAN SETTEMBER (\$177 DESCRIPTION FOR COMPANY SETTEMBER SETTEMBER SETTEMBER SETTEMBER SETTEMBER SET	:Weight	3 Assay	:Distribution	0 0 0	Ratio of
Product	; per	: Woza	of Woz,	o o	concen-
-	: cent	per cent	e per cont	0	tration
Constituting Constitution and Constituting and Constitution of the	ô				
Feed	:100.00	2.37 <sup>©</sup>	200.0		
Table conc.	: 1.22	52.74	27.1		83;1.
Table middling	g: 3.24	12.48	17.0		
Table sands	37.46	0.55	8.7		
Table slimes	: 58.08	1,93	47.2		
promo 1511年 1575年15月1日 1575年1575年 1575年	O O Outside the state of the st	1000 (1100 PER TOTAL TOTAL CONT. TOTAL CONTRACT OF SELECT AND CONTRACT OF SELECT AND CONTRACT OF SELECT AND CO	4	etimenti.	ang nasakang yanagana sah, a a rahin wayanak amini pista ad ra wasanu dana ng

<sup>\*</sup> Calculated.

(Test No. 5, contid) =

The test shows the probable limit that is possible in raising the grade of concentrate on a laboratory-size Wilfley table. The recovery is low due to the slime losses of the ferberite.

#### Test No. 6. - Table and Flotation Concentration.

In order to avoid the slime losses as much as possible a portion of the ore at minus 14 mesh was dry-ground to pass 100 per cent through a 35-mesh screen. The gold was then amalgamated and the sulphides floated off as in previous tests. The pulp was then passed over a wilfley table and the tungsten in the table slimes concentrated by flotation.

#### Results:

Tab:	le Concer		Flotation T	
MAN SCHOOL SCHOOL AND GAVEN AND CANDON STATE OF A STATE OF STATE O	:Weight	γ ·	:Distributio	n:Ratio of
Product	; per	; wo₃,	s of Woz,	: concon-
ermonistical interpresentations and analysis in the second section of the second secon	: cent	per cont	; per cent	: tration
	9	/2x		
Feed	:100.00	2.38®	100.O	
Table conc.	: 1.35	44.12	24.8	74:1.
Table middlin	g: 3.91	14.56	23.8	
Table sands	° 56.03	0.52	28.2	
Table slimes	: 38.71	2.45	\$9.2	
and the Control of the last of the Control of the last	d o	northwater 2008 y B to Admironary Schrödick House (or United 2005)	o para di composita di composita del composità di composi	every charles which expended the structure is a charle that the structure is a charle to the structure

<sup>©</sup> Calculated.

The slime product from the table concentration was conditioned with 0.3 pound of sodium silicate and 0.03 pound of lead nitrate per ton and floated by the further additions of 0.5 pound of sodium cleate and 0.085 pound of cresylic acid per ton. The resulting concentrate was cleaned in a smaller machine.

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

Friends Commission West Products To Andrews Co. 1 Million	Flotatio	on of Table	Slimes.	
	: Meight	•		1 3 Ratilo of
Product	; ber,	: WO3,	of Wog,	: concon-
Constitute to the second section of the second second second	: cent	sper cent	: per cent	: tration
	<b>4</b>	A.	The state of the s	AND PERCENCION COMPANY OF THE PROPERTY OF THE
Peed	:100.00	2,440	300.0	
Flot. conc.	: 4.94	19.10	38,7	20:l.
Flot. middling	g: 11.58	4.64	22.0	
Flot. tailing	: 83.48	1.15	39.3	
· · · · · · · · · · · · · · · · · · ·		The contestation start the section is the section of the section o	TOWN ACTIVE TO THE	DET : 在专家的156

<sup>®</sup> Calculated.

#### Summary:

					for cont	
gow Bow	recovered	by table o	concentration on "	ETG ETG	48.6 23.8	
	Overall	k recovery	es es		72.4 per	cent.

In this test the amount of slime is reduced somewhat by avoiding laboratory ball mill grinding which produces a product similar to a classifier overflow in mill practice. The summary includes the middling products in both table and flotation concentration.

The primary table concentrate was passed over the Wilfley table a second time in order to bring up the grade.

#### Test No. 7. - Concentration and Infrasizing.

The ore at minus 14 mesh was dry-ground to pass 100 per cent through a 35-mesh screen. The sample was then pulped and the gold removed by amalgamation. The amalgam residue was added to the blanket tailing, conditioned with 2 pounds of lime per ton, and floated by the further additions

(Test No. 7, contid) -

of 0.05 pound butyl manthate and 0.08 pound of cresylic acid per ton. The flotation tailing was then passed over a Wilfley table and the minus 200 mesh portion of the table slimes infrasized on a Haultain infrasizer.

The amalgam residue + blanket tailing assayed 1.02 ounces gold per ton, giving a recovery of 56.8 per cent by amalgamation.

	Flotati	on of An	algam T	siling	+ Blank	et Tai	ling.	
Care Calcherto errorizzone severante in - 1445 de prosente	:Weight	S A s	say	S	: Dist	ributi	on,	:Ratioof
Product	; per	: Au,	e Por	cent	9g :	r cent		_: concen-
	: cent	:oz./tor	ı: Cu	8 WOZ	: Au :	Cu :	1703	:tration
	9		0					
Feed	31.00.00	3.02	$3.31^{\odot}$	ರಾ	100.0	1.00.0	223	
Flot. conc.	: 15.77	3.04	15.54	ರಿದಾ	47.0	73.9	æ	6.5:1.
Flot. middling	g: 4.65	3.28	6.83	cu:	25.0	9.6	613	
Flot. tailing	; 79.58	0.49	0,69	ಜಾ	38.0	16.5	e:3	
STITES TO THE TIME TO THE PROPERTY OF THE PROP	O O Cont file-residence or a result of	of hith think the summer the state of the sum of the su	radau president anglosististis (in mari bin s	This Programe Colonia was disposited to the second colonia with the colonia was also been second colonia with the	e annual and and the second of	MITTO A SEASON S	generativation or publication of	r entromotera di traffici propries 2004 di Tribi

Probably owing to the coarse grind and the lime pulp, a rather large amount of copper and gold reported in the flotation tailing.

Table	Concentration	of Flotation	Tailin	£.	tentinisten number mittel king
g					
Feed :100.00	<del></del>	2.24° -	1433	100.0	
Table conc. : 3.16	- 6.46	29°08 ~	de)	40.9	31.6:1.
Table middling: 3.73	<b>c</b>	5.60 -	සෙ	9.4	
Table sands : 57.27	සා සා	0.33 -	æ	8.4	
Table slimes : 35.84	සා සා	2.59 -	c:	41.3	
D I I A STATE OF THE STATE OF T	ge Cold takken banjan demonsky makylik (1889 och 488 auch 44 fl. liggeffakten littlag fersom (f. 1	医二角性动物 医牙孔 医牙孔 医甲状腺 化二氯化甲酚二甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲	: [520-+#17F1 \#W#\p1372**41	Transfer Suffer Strf june of any or 12 company Surface To School Str	

<sup>©</sup> Calculated.

The table slimes screened 87.8 per cent minus 200 mesh. The plus 200 mesh portion assayed 0.37 per cent 703. The minus 200 mesh product infrasized as follows:

(Test No. 7, cont'd) -

		afrasizing.	(1) (2)		the att wa
Slae,	:Weight,:	Assay,	9	Distribution	
in	per :	WO3 ,	8	of Woza	
microns	: cent :	per cent		per cent	en even en
→56 56 to 40 40 to 28 28 to 20 20 to 14	; 0.3) ; 9.6) ; 19.3 ; 17.7 ; 16.2	0.70 1.31 2.37 3.54	eccana as provides	2.4 8.7 14.3 19.6	
14 to 10 -10	: 8.5 : 28.4	4.26 4.39		12.4 42.6	
~2.4	6 28 o 4:	et elecenses de la companya de la co	**************************************	Tiglified (a) fig.17	
Totals	0.0013	2.92		J.00°0	
CONTRACTOR OF THE SHARE WITH STORY STATES A THE SHARE THE SA	ng victoring order order and a characteristics of the contraction of the characteristics of the contraction	e total A Silitiza part a salar reme perengen e marce A e ( <sub>a</sub> a 1724).	キャルマ マンマン・ビン・サルト	ひょうしゅう しゅうしゅ マン・マン・マン・マン・マン・マン・マン・マン・マン・マン・マン・マン・マン・マ	eras descrip

This infrasizer test on the table slimes emphasizes the tendency of the ferberite to report in the finer sizes of the slime product, the assay going from 0.70 per cent WOz in the coarsest size to 4.39 per cent WOz in the minus 10 micron product.

## Test No. 8. - Magnetic Concentration.

A portion of the ore at minus 14 mesh was pulped and a bulk concentrate obtained in a Denver flotation machine by the addition of 2.0 pounds of soda ash, 0.20 pound amyl xanthate and 0.15 pound of pine oil per ton. The flotation tailing was then passed over a Wilfley table and a large low-grade table concentrate secured. This concentrate was then dried and passed through a Dings High Intensity Magnetic Separator machine. The different products of flotation, table concentration, and magnetic concentration were assayed for WO3.

(Test No. 8, cont'd) -

## Results:

			Concentration	
化二甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基	.Weight,	: Assay,	nolwidiate in	: Ratio of
Product	; per	: Wog,		; concen⊸
	: cent	sper cent	t: per cent	; tration
THE ROOM STOLD WONE THE CASE IN STREET, SAN THE PERSON NAMED BY ASSESSMENT OF THE PERSON NAMED BY ASSESSMENT	0	Carlotte and an amount		
Feed	00.00£	2.01	300.O	
Flot. conc.	: 16.84	0.70	5.9	5.9:1.
Flot. tailing	: 83.16	1.89	94.1	
Programme and the second secon	O O		(1773 年18 年18 年18 年18 年18 年18 年18 日18 日18 日18 日18 日18 日18 日18 日18 日18 日	and a west assumed the assumption where a supplication were seen assump
No. 20 and resemble the production of the second se				
dan.	le Concen	tration o	of Flotation T	ai ling.
	0		# <b>a</b> a a	
Foed	:700.00	189	0.00.E	<i>(</i> ) <i>(</i> ) 9
Table conc.	: 14.61	6,50	42.4	6.8:1.
Table middling		1.42	8.0	
Table sands	: 44.94	0.55	0. LL	
Table slimes	: 27.81	3.11	38.6	
MANATA CANADA BARANGA	O O	a wasan ana ana ana ana ana ana ana ana ana	·····································	Tarka A The Market and Market Annies A The Market Annies A The Market Annies A The Market Annies A The Market A
	_			,
		ttion of	Table Concentr	accommendation
	eight,:	o o	: Assey,	Distribution
Product : :	per :	9	: WO3.	cf WOgs
O	cent : An	merage:V	oltage:per cen	L; bor cone
	A 52.03	0 70	30E 3E 30	פ חוי
lst conc. :	4.36	0.10	125 15.18	
2nd conc. :	6.32	1.10	125 26.74	
3rd conc. :	6.32	2.10	125 25.36	
Tailings :	83.00	5721	4.27	O% • O
0	errotinone es eneñ una manual en escaña.		ncikustesikapenikapenikapenikasikasikasikasika	ini oulange piegnation(kielvarinisiinte

Possibly owing to the small quantity of concentrate available, the products produced on the Dings machine were comparatively low in tungsten and the recovery incomplete.

# Test No. 9. - Magnetic Concentration.

Portions of table concentrates and table tailing from previous work were dried and a "Little Ciant Crucible" hand magnet repeatedly passed over the pulp. The resulting concentrates and tailings were assayed for WO3.

(Test No. 9, cont'd) - (Magnetic concentration)

### Results:

				per cent 1103)
Product	:Weight;	: Assay, :	Distribution	n : Ratio of
	: per	: VO3, :	of WOz,	: concen-
	: cent	:per cent:	per cent	: tration
Feed	;100.00	48.43 <sup>©</sup>	100.0	10.6:1.
Magnetic conc	;9.44	8.48	1.7	
Tailing	;90.56	52.60	98.3	
AND CONTROLLY OF THE ACTION OF	Table T	raillngs.	(Feed, 1.21 r	er cent Wo3)
Feed	:100.0	1.20 <sup>©</sup>	100.0	8,9;1.
Magnetic cone	:11.3	1.46	15.7	
Tailing	:88.7	1.17	86.5	

Another portion of table concentrates assaying 48.1 per cent WO3 was flash roasted at a temperature of 500° C. The calcine was then cooled and troated with the hand magnet in a similar manner as above. Prior to roasting, the table concentrate assayed 44.1 per cent WO3. The calcine showed a loss in weight of 2.7 per cent after roasting.

^	<i>r</i>	
(1m 1 m 1 m m	4.40 (2.51	Roasting.
1.724 1.13 1 1 1 1 1 1 2 3	1. A. U.III	コンしゅうしょほどっ

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Food Magnotic Tailing	:100.00	44.70 <sup>©</sup> 3.19 49.26	100.0 0.7 99.3	10.1:1.
	g g			t and the common where we are presented with the second present the form of the second

<sup>©</sup> Calculated.

A microscopic examination of the magnetic concentrates from the above tests showed the material to be largely composed of magnetite.

## Test No. 10. - Table and Flotation Concentration.

The ore at minus 14 mesh was ground in a ball mill to pass 63.2 per cent minus 200 mesh. The pulp was then amalgamated and the sulphides floated by the additions of 2.0 pound of soda ash, 0.10 pound amyl xanthate, 0.075 pound pine oil, and 0.045 pound Barrett No. 4 oil per ton. The resulting flotation concentrate was cleaned on a smaller machine. The flotation tailings were then passed over a Wilfley table and the ferberite remaining in the table slimes concentrated by flotation. The amalgamation resulted in a recovery of 76.3 per cent of the gold, probably due to the finer grinding (63.2 per cent minus 200 mesh).

#### Results:

		F.	Lotation	of the S	ulphid				
	STOP TO PERSON AND AND ADDRESS OF THE AND ADDRESS OF THE PERSON AND ADDRESS OF THE PARTY TO TAKE A	:Weight	, 8 A 8	вауя	3	Dist	ributi	on ,	:Ratio of
	Product	; per	au,	: Per ce	ent	eq :	er cent	;	:concen-
		: cent	soz./ton	s Cu	W03	: Au :	Cu	1703	:tration
	graphy I Tat I consider a resident common Shirtest of Tables and VI to a relative.	0	erper annual parties de la La Berrando Maria de parties de la Sec	Color theory to Bridge 1 E Line 2 A A Color	Station through the first state of the first state of the	tring and the same	KATHA BATA WATA	Z-DC Dr E-CO-E-DL DR D-	THE MANY CONTRACTOR AND THE STATE OF THE STA
	Feed	:100.00	0.56	3.01	೭,01	100.0	100.0	100.0	
	Flot. conc.	: 13.36	1.50	17.80	ATT	35.8	79.0	2,570	7.5:1.
	Flot. middling	9.84	1.81	5.81	1.45	31.8	19.0	7.1	
	Flot. tailing		0.240	0.080	2.430	32.4	0.8	92.9	
	44 CALIN 6 to 1944. The National December 1988 Served In Calmon a bird trail	0 0	rature de un un est des	2 h. 1 w 10 m 1 m 3 m 2 f 17 2 % A 7 2 7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	waterska kation water	s bertifelig of garefyles Doministed days	elingangangan Silon di kepinggangan	LENGTHAN AND THE CONTRACTOR OF STATE AND THE	Union to the Party Strate Commission of the Comm
	WANTED AND STREET	Table	Concentr	ation of	? Flota	tion Te	dling	) 	omazikizzat zerepanyanak ponyonok zinik zerepe Zerong
		o n							
-	Feed	:100.00	₩.	623	2.429	<b>*</b>	EL37	100.0	
*	Table conc.	: 1.68	63	ca	51.44	¢23	ero.	35.7	87.2:1.
	Table middling	: 1.38	en en	¢74	17.56	G2	15-3	30.0	
_	Table sands	: 44.80	et)	=3	0.55	संक	ety	20.2	
	Table slimes	: 52.14	ous.	group .	2.05	enp	~	44.1	
		0					-TVETAN GONDENSEMENTA		neck and the surprise of home with the high and

<sup>©</sup> Calculated.

The slimes were conditioned with 0.4 pound sodium silicate and 0.04 pound of lead nitrate, and a flotation concentrate obtained by the further additions of 0.7 pound sodium cleate and 0.03 pound of Dupont No. B-23 frother per

(Test No. 10, cont'd) - Results, cont'd -

ton. The concentrate was cleaned in a smaller machine.

	FJ.c	tation of	Table	Slimes.		
Special fractions of the sales is a graph of the first movement and the graph of the sales and second entire the sales in the sales is a graph of the sales in th	0	Assay,	; Di	stribution	8	Ratio of
Product	8	WOB	9	of Wozs	8	concen-
manachtroders parts with the surprises of the solution of the land of the solution of the land of the solution	n n	per cent	<b>6</b>	per cent	9	tration
An with the fact of contract and the first street are an expression of the street of t	0	G <sub>3</sub>	water same and same	A		
Feed	8	1.91		0.00£		
Flot. conc.	9	20.00		49.5		21:1.
Flot. middling	9	3.19		25.2		
Flot. tailing	8	0.64		27.3		
for city to be problem to about a city of money was 1744 in the end for a basis of	0	a ta referent de la	······································	en e	will the sa	1944-meermass perkassiyiyasiinkan taatiiskiiri perifatyistikasiissi

#### @ Calculated.

A hand magnet was passed over the table concentrate, with the following results:

Product	:Weight,: : per : : cent :	Assay, WO3, per cent	:Distribution: : of WO3, : : per cent :	Ratio of concentration
Feed	:100.00	51.23 <sup>©</sup>	100.0	9:1.
Magnetic conc.	:11.24	25.13	5.5	
Tailings	:88.76	54.54	94.5	

<sup>©</sup> Calculated.

## Summary of Test No. 10:

		Per cent
Gold recovered by amalgamation and flotation, $76.3 + 16.0$	rass Rass	92,3
Copper recovered by flotation concentration	AVII IED	98.0
WO3 recovered by table concentration and flotation, 42.4 + 29.8	cas cas	72.2

In this test the amount of gold recovered by amalgamation (76.3 per cent) was due to the fineness of grinding used and a laboratory method of amalgamation which could not be duplicated in milling practice. The WO3 recovery of 72.2 per cent included 6.8 per cent in the flotation mideling product, not all of which would report in the flotation cleaner concentrate.

## Test No. 11. - Table and Flotation Concentration.

This test was made in order to determine the effect of comparatively fine grinding on ferberite concentration. The ore was ground in a ball mill to pass 60.2 per cent minus 200 mesh. The gold was then amalgamated and a bulk flotation concentrate made of the sulphides in the ore. This concentrate, which was 25.93 per cent of the feed, assayed 2.32 cunces gold per ton, 11.4 per cent copper and 0.78 per cent WO3, giving an occlusion of 10 per cent of the ferberite in the concentrate. The bulk flotation tailings were passed over a Wilfley table with the following results:

	Table		
& With States of Additional Court of Aging matrix services in Services and Call Aging	:Welght : Assay	, : Distribution	s Retito of
Product	: per : WO3,	: of Woz,	: concen-
	0	nt: per cent	: tration
and a martinism of extent for each of the property of the second of the	Q Q Christoproving a ferman in the second properties of a second properties of the second party of the sec	THE PLANT BROWN CONTRACTOR CONTRACTOR SETS FOR THE PROPERTY OF	
Feed.	:100.00 2.72	200.0	
Concentrate	: 1.11 55.04	. 22.4	90:1.
Middling	: 2.34 29.74	. 25.5	
Sands	: 35.47 0.78		
Slimes	: 61.08 1.87	·	
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The table slimes were thickened, conditioned with 0.8 pound of sodium silicate and 0.07 pound of lead nitrate per ton and a flotation concentrate obtained by the further addition of 1.0 pound of sodium cleate and 0.05 pound of No. B-23 frother per ton. This concentrate was cleaned in a smaller machine.

and market and an extension of the land and	FIRST SAME AND ASSESSED AND WAS USED BY NOT SHOW.	- Differ States about 1/2012 Transport 1/4 all all and approximations and all all all all all all all all all al	● 电电子电话 (1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	waterwell with place to the Clark of the Same parent as a parent of the contract of the base of the ba
Feed Concentrate Middling Tailing	100.00 4.05 14.63 81.32	1.87 <sup>©</sup> 22.30 3.39 0.62	100.0 48.2 24.9 26.9	25:1.
elemental of the second of the	O O	agigang an giran transportant pada 4 William and Professor (Salistan) and	ранд Грямараў айхун укранская жэральрагостаго ў уракторая г	والمستحدة والمراجعة والمستحدة والمستحد والمستحد والمستحد والمستحدة والمستحددة والمستحددة والمستحددة والمستحددة

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(Test No. 11, cont'd) -

The quantities of flotation reagents added to the table slimes would amount to 0.36 pound sodium silicate, 0.03 pound lead nitrate, 0.46 pound sodium oleate and 0.025 pound of Dupont reagent No. B-23 per ton, when figured on a basis of ball mill feed.

#### Summary of Test No. 11:

		Per cent
WOz recovered in table conc. + middling	සා	43.l 27.6
WOz recovered in flot. conc. + middling	C.3	O CO O
Overall recovery of WOZ	ස	70.7 per cent.

The table concentrate assayed 1.85 per cent tin.

This test shows that a higher grade of table and flotation concentrates is produced by the finer grind, but that the losses of tungsten in the bulk flotation concentrate and table sands, and the larger amount of tungsten in the table slimes, lower the overall recovery of the ferberite.

#### Summary and Conclusions:

The test work indicated that 65 per cent of the gold can be recovered by amalgamation and 25 per cent in a flotation concentrate of the amalgam residue and blanket tailings. Over 90 per cent of the copper can be recovered in the flotation concentrate. Some 45 per cent of the tungsten was recovered in the table concentrate and middlings products and an additional 20 per cent in the flotation concentrate of the table slimes.

from the test work that finer grinding augments the recovery of the gold both by amalgamation and flotation. In the flotation concentration of the amalgam residues and blanket tailings there is a tendency for the gold to report in the middling products and dissociate itself from the copper concentrate. In previous microscopic work on a former

(32.4 per cent copper, as shown in Test No. 1) is obtainable, a large percentage of the gold remaining after amalgamation reports in the middling and tailing products. A bulk flotation concentrate assaying 12.1 per cent copper and 2.8 ounces gold per ton and which contains 94.3 per cent of the copper and 80.3 per cent of the remaining gold was obtained in Test No. 2. Tungsten table concentrates assaying well over

50 per cent WO3 should easily be obtained. A somewhat higher grade can then be made by removing the magnetite in the concentrate by magnetic concentration. A recovery of well over 50 per cent of the tungsten in the ore should be obtained on the larger-sized Wilfley table in mill practice. Flotation of the table slimes recovered about 50 per cent of the tungsten in this product with a grade of 20 per cent WO3. This concentrate could be shipped and treated by a modification of the Oxland process for extracting the tungsten by chemical methods. This flotation recovery of the ferberite should be improved upon by further tests. Unfortunately, owing to the depletion of the ore shipment it was not possible to proceed further along these lines.

The test work on this shipment indicates that

- Page 26 -

(Summary and Conclusions, cont'd) -

the mill flow-sheet presently being installed on the Slave Lake Gold Mines Limited property and which consists of amalgamation of the gold, followed by flotation concentration of the copper and remaining gold, and table concentration of the tungsten, might be amplified to include another set of flotation cells in order to recover the tungsten slime losses.

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