C O P Y

LAUNCESTON, 11th September, 1944.

ORE DRESSING INVESTIGATION

R 119.

RENISON ASSOCIATED TIN MINES N.L., TASMANIA

EXAMINATION OF MILLING OPERATIONS. 1944.

CONTENTS

Department of Mines Laboratory,
Tasmania.

September, 1944

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LAUNCESTON, 11th September, 1944.

ORE DRESSING INVESTIGATION

RENISON BELL.

RENISON ASSOCIATED TIN MINES - MILL SAMPLING.

Investigation.

A mill sampling campaign was undertaken with the object of obtaining mill samples for investigation of recoveries and performance of the various mill units.

MILL TREATMENT - 2.5 TON ORE PER HOUR/MILLING HOURS PER WEEK - 144.

Reduction.

Present mill treatment consists of primary ore reduction by jaw crusher and sizing by vibrating screen to ¾ inch size. The plus ¾ inch size is fed to stamp batteries fitted with ¾ inch screens and the minus ¾ inch product is fed direct to a 6 feet x 30 inch Hardinge pebble mill. The battery discharge and ball mill discharge are sized in a drag classifier operating in closed circuit with the ball mill. The classifier overflow is stated to be substantially minus 150 mesh size.

Flotation of Sulphides.

Reagents used are copper sulphate, sodium ethyl xanthate and cresylic acid. Reagent addition is made in two stages by batch operation. Separate conditioners are utilized for the addition of copper sulphate and xanthate. The sulphides are floated in 8/26" x 5' M.S. cells operating in series. The sulphide flotation concentrate flows to waste and is referred to in this report as"Sulphide Tailing."

Concentration of Cassiterite.

Concentration of the cassiterite is performed in five major stages. Four stages relate to table concentration, and the fifth stage to the production of finished concentrate.

First Stage.

The flotation tailing referred to as "Table Feed" is classified and concentrated on three Bannister tables; the concentrate flows to the dressing shed for final treatment.

Second Stage.

Middlings and tailings from the first stage of concentration are fed to a grinding pan and the pan discharge after classification is concentrated on three Wilfley tables. Middlings from this tabling is returned to the grinding pan. The concentrates flow to the dressing shed for final treatment.

Third Stage.

Slimes are concentrated on a two deck rotary table. This table makes one revolution on 105 seconds and is fitted with cement decks. The feed to the table consists of:- classifier overflows; slimes from the table treating material from No. 1 spigot and slimes for the 2nd stage of table concentration. The ratio of concentration is low.

Fourth Stage.

The rotary table concentrate is retreated on a Deister table and the concentrate from same is finally treated in the dressing shed.

Fifth Stage.

The table concentrates contain considerable gangue minerals including sulphides and are treated in the dressing shed in two stages. (1) Batch flotation for optimum rejection of sulphides followed by (2) Kieving for the production of a finished concentrate. Portion of the products from the 5th stage are periodically returned to the mill for retreatment.

Sampling.

From 29/5/44 to 3/6/44 a continuous sampling was made of four of the mill products. The installed samplers used for this purpose are automatic and are tipped at intervals by regulated water flow. The cutters travel across the pulp streams approximately at right angles to same.

The intervals of sampling were:-

Sample.	Sampling Interval/Minutes
Mill feed (Classifier Overflow)	4
Sulphide Tailing	2
Table feed	1.5
Gravity Tailing	8

("Gravity Tailing" is the combined tailings from the seven shaking tables and one rotary table).

These sampling periods produced approximately 40 gallons of pulp per 24 hours per sample. Pulps were flocculated, settled for several hours and the clear supernatant liquors siphoned to waste daily.

Other milling operations were sampled for shorter and various periods.

Mill Feed.

During the sampling period the mill feed consisted of a mixture of sulphide ore from the Battery Lode and gossan from the Dalcoath Workings. The ratio was stated to be two of Battery Lode to one of Dalcoath, by volume. Assays over a five day period gave the following results for the mill feed.

Tin	1.07 percent
Sulphur	22.78 "

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Table No. 1.

Summary of Assay Values of all Samples Obtained.

Reg. No.		Percent Tin	Percent Sulphur
259	Classifier Overflow, 29.5.44 to 3.6.44.	1.07	22.78
260	Table Feed " " "	2.43	6.23
261	Gravity tailing " " "	0.66	3.87
262	Sulphide tailing " " "	0.29	33.26
228	Sulphide tailing from No. 2 Cell	0.15	35.7
229	" " " " 3 "	0.15	34.9
230	" " " " 4 "	0.16	34.8
231	" " " " 5 "	0.23	34.3
232	" " " " 6 "	0.66	30.7
233	" " " " 7 "	1.04	26.0
234	" " " " 8 "	0.84	26.5
237	Primary Classifier Feed	3.74	
238	" " No. 1 Spigot	4.76	
239	" " " 2 "	4.08	
240	" " " 3 "	2.87	
243	Deister Feed (Rotary Conc.)	2.00	
244	" Tailing	0.69	
245	" Concentrate	26.10	
248	Pan Feed	0.99	8.4
249	Pan Discharge	1.00	
250	Secondary Classifier No. 1 Spigot	0.88	12.37
251	" " " 2 "	1.06	4.30
252	" " " 3 "	1.23	2.98
253	Rotary Table Tailing	0.55	2.14
254	Ball Mill Discharge	1.27	
263	Rotary Table Feed	0.97	2.11
264	Battery Discharge (-¼")	0.89	
266	Table Concentrates to 27.5.44	18.06	22.62
267	" " 27.5.44 to 3.6 44	17.15	21.61

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Table No. 2.

CONTINUOUS SAMPLES FROM 1 A.M. 29.5.44 TO 1 A.M. 3.6.44

SIZING ANALYSES & TIN DISTRIBUTIONS.

Sizing of the Minus 200 Mesh Product by Haultain Infra-Sizer

Reg. No. 259 Classifier Overflow (Mill Feed)

B.S. Screen Size	Weight Percent	Weight Percent Cum.	Tin Percent	Tin Percent	Distribution Percent Cum.
+ 85	1.13	1.13	0.23	0.24	0.24
+ 100	0.75	1.88	0.26	0.18	0.42
+ 120	1.56	3.44	0.27	0.39	0.81
+ 150	8.06	11.50	0.29	2.18	2.99
+ 200	11.90	23.40	0.47	5.20	8.19
I.S. 1	15.46	38.86	2.08	29.92	38.11
2	14.67	53.53	1.59	21.71	59.82
3	11.67	65.20	1.18	12.82	72.64
4	9.20	74.40	1.10	9.42	82.06
5	6.00	80.40	1.05	5.86	87.92
6	4.60	85.00	0.93	3.98	91.90
7	15.00	100.00	0.58	8.10	100.00
Composite			1.07	100.00	

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Table No. 3.

Reg. No. 260 Table Feed

B.S. Screen Size	Weight Percent	Weight Percent Cum.	Tin Percent	Tin Percent	Distribution Percent Cum.
+ 60	0.34	0.34	0.17	0.02	0.02
+ 85	2.74	3.08	0.18	0.20	0.22
+ 100	1.66	4.74	0.23	0.16	0.38
+ 120	2.46	7.20	0.28	0.28	0.66
+ 150	6.80	14.00	0.44	1.23	1.89
+ 200	11.04	25.04	1.09	4.95	6.84
I.S. 1	9.22	34.26	9.00	34.12	40.96
2	12.74	47.00	4.01	21.01	61.97
3	10.10	57.10	3.01	12.50	74.47
4	8.62	65.72	2.40	8.50	82.97
5	6.64	72.36	1.97	5.37	88.34
6	5.62	77.98	1.64	3.79	92.13
7	22.02	100.00	0.87	7.87	100.00
Composite	100.00		2.43	100.00	

Table No. 4.

Reg. No. 261 Gravity Tailing.

B.S. Screen Size	Weight Percent	Weight Percent Cum.	Tin Percent	Tin Percent	Distribution Percent Cum.
+ 85	1.15	1.15	0.09	0.16	0.16
+ 100	0.90	2.05	0.12	0.16	0.32
+ 120	2.08	4.13	0.12	0.38	0.70
+ 150	5.66	9.79	0.22	1.89	2.59
+ 200	9.66	19.45	0.13	1.90	4.49
I.S. 1	6.93	26.38	0.25	2.62	7.11
2	13.51	39.89	0.25	5.11	12.22
3	10.71	50.60	0.58	9.40	21.62
4	9.93	60.53	1.10	16.53	38.15
5	7.40	67.93	1.51	16.90	55.05
6	6.01	73.94	1.47	13.38	68.43
7	26.06	100.00	0.80	31.57	100.00
Composite	100.00		0.66	100.00	

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Table No. 5.

Reg. No. 262 Sulphide Tailing

B.S. Screen Size	Weight Percent	Weight Percent Cum.	Tin Percent	Tin Percent	Distribution Percent Cum.
+ 85	0.56	0.56	0.18	0.35	0.35
+ 100	0.38	0.94	0.18	0.23	0.58
+ 120	1.14	2.08	0.18	0.70	1.28
+ 150	5.40	7.48	0.18	3.33	4.61
+ 200	10.96	18.44	0.18	6.77	11.38
I.S. 1	18.40	36.84	0.33	20.83	32.21
2	15.00	51.84	0.25	12.86	45.07
3	12.88	64.72	0.22	9.72	54.79
4	9.54	74.26	0.34	11.12	65.91
5	6.10	80.36	0.44	9.21	75.12
6	4.82	85.18	0.49	8.10	83.22
7	14.82	100.00	0.33	16.78	100.00
Composite	100.00		0.29	100.00	

Table No. 6.

TIN DISTRIBUTIONS AND PERCENTAGES OF MILL PRODUCTS.

(Based on the tin values of the four samples)

Product.	Percent Weight	Percent Tin	Percent Tin Distribution
Sulphide Tailing	63.55	0.29	17.23
Gravity Tailing	32.54	0.66	20.08
Table Concentrates	3.91	17.15	62.69
Composite Head	100.00	1.07	100.00

The estimated daily tonnages of mill products based on the stated treatment of rate of 60 tons per 24 hours would be:-

Sulphide Tailing	38.13 tons
Gravity Tailing	19.52 "
Table Concentrates	2.35 "

Interpretation of Sizing Analyses of Continuous Samples of Classifier Overflow, Sulphide Tailing, Table Feed & Gravity Tailing.

Recovery.

The estimated recovery is 62.69 percent with a feed value of 1.07 percent tin. This is equivalent to an effective recovery of 0.67 percent tin. This recovery is not to a finished concentrate but only relates to the production of table concentrates containing less than 20 percent of tin. Investigation of losses in the treatment of the table concentrates to a finished concentrate was not undertaken and would, in view of the batch operations, require retention and sampling of the total products from the dressing shed.

The sizing analysis of the table feed (260) shows a very small percentage of the tin larger than an aperature of 150 mesh screen (1.89 %) and a large proportion amounting to 81 percent in the minus 150 mesh size to infra-sizer fraction No. 4. Derived recoveries in all sizes from -150 + 200 mesh to I.S. 2 are slightly better than 90 percent, declining to 82 percent for I.S. 3, 53 percent for I.S. 4 and 23 percent for I.S. 5 with minor percentages for the remaining fractions. The tin recovery from the table feed amounted to 75.7 percent. Approximately 90 percent of this recovery was obtained from fractions minus 150 mesh to infrasizer fraction No. 4.

Table Showing Nominal Micron Sizes For Cassiterite and Equivalent Screen Sizes.

Infrasizer Fraction	Nominal Grain Size for Cassiterite (Microns)	Equivalent Screen Size (Tyler)
1	76-45	-200 to 325
2	45-30	325 - 500
3	30-20	500 - 700
4	20-14	700 - 1000
5	14-10	1000 - 1600
6	10-8)	- 1600
	)	
7	8-0)	

Classifier Overflow (Mill Feed).

The sizing analysis shows that only three percent of the total tin reported in plus 150 mesh sizes with assay values ranging from 0.23 to 0.29 percent. The most important feature of the sample is the tin distribution in sizes -150 +200 mesh and infrasizer fractions 1 to 4. Seventy nine percent of the tin reported in these fractions with assay values of 0.47, 2.08, 1.59, 1.18 and 1.1 percent tin respectively. It has already been shown that the majority of the recovered tin is from these sizings. A previous investigation (No. 1215/40, sizing analyses of cassiterite in ore specimens and mill products, Renison Associated Tin Mine, Department of Mines, Tasmania) showed that composite grains of cassiterite occurred in most of the sized fractions, but declined sharply after elutriated fraction 3. Determined mean diameters of the cassiterite present as composite grains were 26 microns for -150 + 200 mesh size, and 12 and 8 microns for elutriated fractions 1 and 2 respectively. If this feature should be reasonably consistent in the Renison Bell ores it is indicated that no useful purpose would be served by grinding finer than 200 mesh size for any treatment designed to liberate and concentrate by gravity methods cassiterite present as composite grains in primary table middlings or tailings.

Sulphide Tailing.

Fractions to plus 200 mesh size all contain 0.18% tin and amounted to 11.38 percent of the total tin in the sample. Fifty

four percent of the tin is present in I.S. fractions 1 to 4. Previous investigations have shown that the bulk of the cassiterite in the sulphide tailing is in a "free" condition. Reduction of the cassiterite content in this product can only be beneficial in sizes which can be concentrated by existing methods.

FLOTATION OF SULPHIDES

Table Showing Sulphur Distribution During Five Day Sampling Period. The Sulphur Rejected in the Sulphide Tailing Amounted to 90.94 Percent.

Table No. 7

Product	Sulphur Percent	Sulphur Percent Distribution
Sulphide Tailing	33.26	90.94
Gravity Tailing	3.87	5.42
Table Concentrates	21.61	3.64

ADDITIONAL MILL SAMPLES.

Ball Mill Discharge Reg. No. 254 1. 6.44

A short period sampling of the ball mill discharge was made to obtain a sizing analysis of the product. Percent solids 65.

Table No. 8 Sizing Analysis

B.S. Screen Size	Weight Percent	Weight Percent Cum.	Tin Percent	Tin Percent	Distribution Percent Cum.
+ 60	15.34	15.34	0.8	9.64	9.64
+ 100	21.26	36.6	0.58	9.69	19.33
+ 150	19.64	56.24	0.90	13.89	33.22
+ 200	11.16	67.4	1.83	16.04	49.26
- 200	32.6	100.0	1.98	50.74	100.00
Composite			1.27		

Ball Mill Feed. A sample of the ball mill feed contained 85.6 percent of $-\frac{0}{4}$ inch plus 5 mesh and 5.9 percent minus 150 mesh.

Table No. 8. Reg. No.
Stamp Battery Discharge 264 Fitted with $\frac{1}{4}$ inch screens
Sizing Analysis.

B.S. Screen Size	Weight Percent	Weight Percent Cum.	Tin Percent	Tin Percent	Distribution Percent Cum.
+ 20	31.60	31.60	0.73	26.10	26.10
+ 60	17.00	48.60	0.74	14.23	40.33
+ 100	11.16	59.76	0.77	9.72	50.05
+ 150	7.60	67.36	1.01	8.68	57.73
+ 200	4.84	72.20	1.39	7.61	66.34
-200	27.80	100.00	1.07	33.66	100.00
Composite	100.00		0.88	100.00	

Classifier Overflow.

Several pulp samples gave the following results.

Percent solids	24 to 28
Density of Solids	3.72 to 3.94

Two tests for treatment rate by measurement of C/O pulp flow showed rates of treatment of 2 and 2.6 tons per hour. The stated rate was 2.5 tons per hour.

Sulphide Tailing and Table Feed.

The percentages of solids in these products were determined and found to be approximately 57 and 7.6 percent respectively. These figures are the result of one sampling.

GRINDING PAN OPERATION.
(Feed No. -248, Discharge No.249)

Samples were obtained of pan feed and discharge to determine the performance of this unit. The following sizing analysis shows that this unit, during the period of sampling, ground only an additional 4.5 percent of the feed to minus 200 mesh size and inclined the tin distribution to this sizing an additional 1.46 percent. Percentages of distributions are cumulative.

Table No. 10.

B.S. Screen Size	Percent Tin		Percent Weight Dist.		Percent Tin Dist.	
	Feed	Discharge	Feed	Discharge	Feed	Discharge
+ 85 mesh	0.23	0.28	3.78	1.66	0.87	0.46
+ 100 "	0.21	0.19	6.12	2.58	1.36	0.63
+ 120 "	0.22	0.23	9.94	6.12	2.21	1.44
+ 150 "	0.28	0.28	21.18	16.44	5.39	4.31
+ 200 "	0.35	0.33	39.88	35.38	11.99	10.53
I.S. 1	1.59	1.65	55.30	51.76	36.75	37.41
2	1.30	1.25	69.12	65.04	54.88	53.92
3	1.73	1.64	78.60	75.26	71.43	70.58
4	1.95	1.75	84.48	81.80	83.01	81.96
5	1.80	1.65	88.32	86.08	89.99	88.98
6	1.30	1.26	90.76	89.58	93.19	93.37
7	0.73	0.64	100.00	100.00	100.00	100.00
Composite	0.99	1.00				

Rotary Table Performance. 1 Rev. 105 secs. (Hetherington).

Sampling of products from the rotary table was made over a period of two hours with hand samplers at 15 minute intervals.

Samples of feed, concentrate and tailing were obtained and contained 0.97, 2.0 and 0.55 percent of tin respectively. The

calculated recovery from these results amounted to 59.7 percent to a concentrate of 2 percent tin. The ratio of concentration was 3.45.

Deister Table Performance.

Sampling of the Deister products was performed at the same time as the sampling of the rotary table products as the concentrate from the rotary table represents the feed to the Deister Table and it was desired to obtain information relating to the overall recovery of both units.

The feed, concentrate and tailing samples assayed 2.0, 26.1 and 0.69 percent tin.

The calculated recovery amounted to 67.3 percent to a concentrate of 26.1 percent tin. The ratio of concentration was 19.4.

The recovery of tin from the rotary feed by the combined treatment of rotary and Deister Tables amounted to 40.18 percent. The results of this short sampling period should be accepted with some reserve as installation and operation of mechanical samplers over an extended period is necessary for good sampling procedure.

FLOTATION OF SULPHIDES.

Classifier Overflow No. 259.

Test work was undertaken on a sample of the mill pulp to obtain data relating to removal of sulphides by flotation. Make up water used Launceston Municipal supply, modified by the addition of sulphuric acid to a pH value of approximately seven. Frother used throughout cresylic acid at 0.2 lbs. per ton. pH values of pulp shown were determined at the conclusion of tests. After completion of tests 18, 19, 23 and 24 the effects of additional reagents are recorded and are shown with the letter A affixed to the test numbers.

Flotation times 8 to 10 minutes.

(Flotation Conditions & Results on following page).

Summary and Recommendations.

1. Mill procedure for the preparation of classifier overflow for sulphide flotation consists of treatment in two stages of batch conditioning. The required copper sulphate is added to the 1st conditioner when it is half full of pulp. When full the pulp is very quickly fed to the 2nd conditioner; sodium ethyl xanthate and cresylic acid are added periodically to the 2nd conditioner. This procedure probably causes uneven feed to the flotation machines and thus occasions variable rejection of sulphides. It is recommended that consideration be given to amendments to existing treatment to allow of continuous conditioning and reagent additions. These features could be readily established by provision of controlled and continuous flow of pulp from the 1st to the 2nd conditioner. All reagent feeders could be installed above the ball mill and operated as follows: copper sulphate to the classifier overflow, xanthate and cresylic acid to the launder returning surplus pulp from the constant head tank attached to the flotation unit to the 2nd conditioner. Alternatively a reagent feeder could be installed near the 1st conditioner and the xanthate and cresylic acid fed to the pulp as it flows from the 1st conditioner.

2. Sulphide rejection consists of rougher flotation with eight M.S. cells operating in series. Analyses of sulphide tailings obtained from each cell (No's -228 -234) show a large increase in tin content from the last three cells and amounted to 0.66, 1.04 and 0.84 percent tin respectively. The indicated loss of tin in the sulphide tailings over the five day sampling period amounted to 17.23 percent. At the time of sampling no sulphide tailing was being produced by No. 1 cell. An attempt to reduce the loss of cassiterite in the sulphide tailing can be made at a very small cost by retreatment of the sulphide tailings from several of the last cells. To do this it would be necessary to return the sulphide tailings from these cells to No. 1 cell or the 2nd conditioner; the launder from the constant head tank may be suitable for the latter.

3. Flotation tests have been undertaken in a laboratory cell to obtain data relating to desired flotation conditions. The material used consisted of classifier overflow pulp obtained during the continuous sampling period. The sample was transported to Launceston in a sealed container and flotation tests were performed several weeks after the sample was obtained. Reagents used in the mill are stated to be 1 lb. copper sulphate; 0.6 lb. sodium ethyl xanthate and 0.1 to 0.3 lb. cresylic acid per ton. Test work indicates that flotation with xanthate alone is not good unless xanthate is used to the extent of 2 lbs. per ton. Conditioning with sulphuric acid followed by promotion with xanthate results in good flotation.

Test work using similar reagents to existing mill practice: tests were made with varying times of contact of both copper sulphate and xanthate and results are shown in Table No. 11, page 11. The rejections of sulphur with 1 lb. of copper sulphate and 1 lb. of xanthate ranged from 84.8 to 96.2 percent and by further addition of ½ lb. of xanthate rejections inclined in two tests from 86.8 to 97 and 96.2 to 98.9 percent. As these tests were performed several weeks after the production of the pulp the effects of conditioning periods and quantities of reagents used must be considered with some reserve. Precise information relating to these details can only be satisfactorily obtained by investigations utilizing freshly prepared pulp and mill water supply, if required. The reagents used in the mill produce satisfactory results and samples obtained indicate a sulphur rejection of approximately 90 percent. If it is desired to incline the sulphur rejection additional ethyl xanthate or alternatively a higher xanthate with

FLOTATION CONDITIONS AND RESULTS.

Table No. 11.

Test No.	Reagent lbs. per ton/Conditioning time mins. H_2SO_4	$CUSO_4$	NaEX	T43	pH	Rougher Flotation Conc. % Sulphur	% Sulphur Dist.
1	-	-	1/5	-	6.4	32.2	46.6
2	-	-	1/20	-	6.6	32.6	45.0
12	-	-	1/5	1/5	6.0	34.1	90.5
15	-	½/5	1/5	-	6.7	34.2	70.3
16	-	½/30	1/20	-	6.7	34.5	80.8
4	-	1/5	1/5	-	6.2	33.6	88.5
17	-	1/5	1/10	-	6.0	35.5	85.2
18	-	1/5	1/20	-		35.5	86.8
18A	-	-	-	½/5	6.3	34.7	97.0
19	-	1/5	1/30	-		35.1	96.2
19A	-	-	-	½/5	6.3	34.2	98.9
5	-	1/15	1/5	-	6.2	33.2	84.8
6	-	1/15	1/10	-	6.1	34.1	88.3
7	-	1/15	1/20	-	6.3	34.4	89.2
8	-	1/30	1/20	-	6.0	35.0	88.1
9	-	1/30	1/5	-	6.1	33.8	87.4
24	2/20	1/5	1/5	-		35.3	93.8
24A	-	-	½/4	-	5.3	35.2	95.5
20	1/20	-	1/5	-	5.6	34.6	77.1
21	1/30	-	1/5	-	5.5	35.0	83.2
10	2/20	-	1/5	-	5.2	35.3	90.5
11	2/20	-	½/5	½/5	5.2	35.0	90.2
23	5/20	-	1/5	-		36.0	94.6
23A	-	-	-	½/4	5.0	35.5	98.0

innovations relating to mill control (vide paragraph 1 in summary) should result in optimum conditions. Investigations on several sulphide-cassiterite ores, however, have shown that flotation conditions for maximum removal of sulphides will result in increase in the cassiterite content of the sulphide flotation concentrate as compared with flotation amounting to 90 percent or less. This feature is no doubt mainly caused by the scavenging conditions required for maximum flotation.

4. The percentages of solids were determined in samples of sulphide tailing and table feed and showed that the sulphide tailing was considerably higher in solids that the feed to the flotation unit and consequently the percentage of solids in the table feed was very low. A sample of table feed contained 7.6 percent solids.

Classifiers are fitted with Richards vertes type spigots, but no hydraulic water is at present used in the classifiers. De-watering of the table feed is indicated if hydraulic water is required in classification or if it should be determined that the volume of pulp is excessive for the installed classifiers.

5. Sizing analyses of feed and discharge of the grinding pan show that the grinding performed by this unit at the time of sampling was negligible. The percentage of solids in the feed to the pan is low and the amount of grinding can be increased by thickening of the feed.

6. Table concentration has been summarised under "Recovery" on page 7. The sampling shows very good performance by the combined operations of the three primary and secondary tables followed by the rotary and Deister Tables.

7. Sampling of the dressing shed operations should be undertaken to obtain information relating to losses by flotation and kieving to a finished concentrate. Considerstion should be given to increased capacity for flotation of sulphides.

CHIEF CHEMSIT & METALLURGIST.