EFFECT OF CHANGES IN THE DESIGN & ADJUSTMENTS OF CONCENTRATING TABLES OF THE WIFLEY TYPE

THESIS

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The Effect of Changes in the Design and Adjustments of Concentrating Tables of the Wilfley Type and the Relation of such Changes to the Character and Efficiency of Operation.

Introduction.

Modern water concentration of sand sizes is practically confined to riffled jerking tables of the Wilfley type. The original Wilfley table was invented in 1895, but long before this time, the essential elements, riffling and jerking, were known to the art of concentration. Tables such as Rittinger's and Lampert's had one or other of these factors, but were never of paramount importance, and it was the combination of these factors by Wilfley, which completely revolutionised table concentration.

Since the introduction of the Wilfley table, many experimenters have investigated more or less thoroughly, numerous problems relating to the efficient operation of tables of this type. As a result of many of these investigations, several new tables were developed, all having the same underlying principles as the Wilfley, but slightly different in their design. Among the more important of these may be mentioned the Deister, and the Butchart.

Notwithstanding the developments which have been made, and the researches which have been undertaken, to partially overcome difficulties appertaining to the original Wilfley table, and to table concentration in general, no successful analysis, of the effects of the different adjustments which may be made to a table in relation to its efficiency, have as yet been published.

Following a consultation with Dr.J.B.Porter, Professor of Mining at McGill University, and Mr.J.W.Bell, Assistant Professor of Mining, it was thought that an investigation of this type might yield some information, both of a practical and theoretical nature, moreso since some doubt was expressed, as to whether the results of Cox and Gibbins, and other experimenters had not been affected more or less by these different adjustments. A series of tests were carried out in the Ore Dressing Laboratory of the University, under Dr. Porter's and Mr. Bell's direct supervision.

The character of the investigation necessitated its division into the following parts:

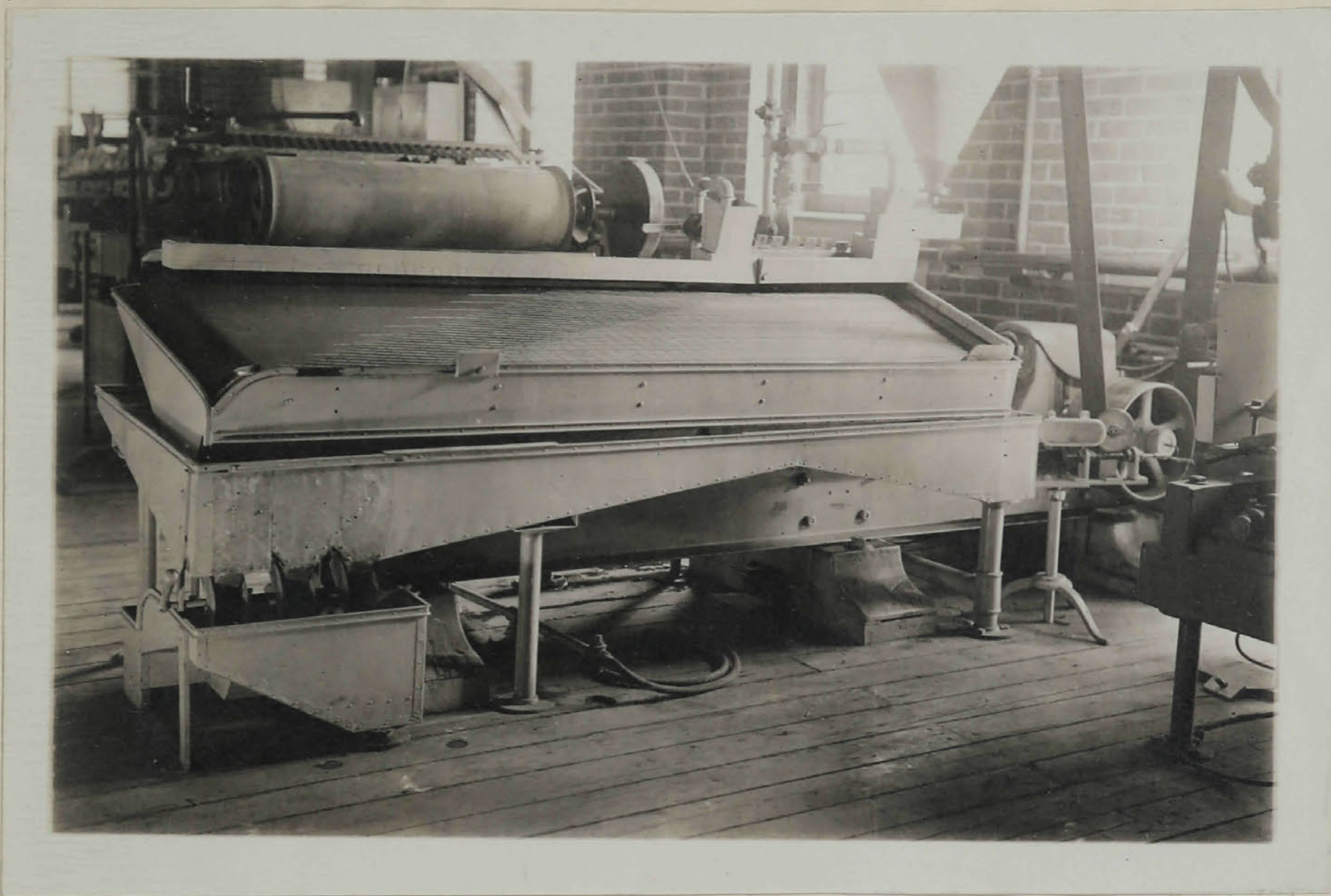
(a) The selection and preparation of an ore suitable for table concentration.

(b) Improvements made to the table to insure a perfect duplication of operating conditions.

(c) The concentration of the various lots of ore and their analysis.

(d) The interpretation of the results obtained.

The actual experimental work could not be very easily divided between the investigators, as both had to work



PHOTOGRAPH SHOWING
BUTCHART HALF SIZE CONCENTRATOR
ORE DRESSING LABORATORY McGILL UNIVERSITY.

together on all the tests made. In the preparation of this thesis however, every effort has been made to individualize the work as far as possible, and although the results of the investigation have been discussed freely, with the exception of this introduction and section 1, which are joint work, the remainder of this thesis is of my own composition.

In conclusion of this introduction, the authors wish to thank Dr. Porter and Mr. Bell for their helpful and much needed advice on the work undertaken. Much appreciation is also due the laboratory staff, who rendered us very material assistance in the carrying out of the tests.

Section 1.
Principles of Action of Tables of the Wilfley Type, with a Description of the Table used in all the Tests.

The principles of action of tables of the Wilfley type, are four in number and are as follows:

(1). Agitation. The effect of agitation is to stratify the ore, the heavy mineral constituents forming a lower layer, while the gangue or lighter material forms the upper layer.

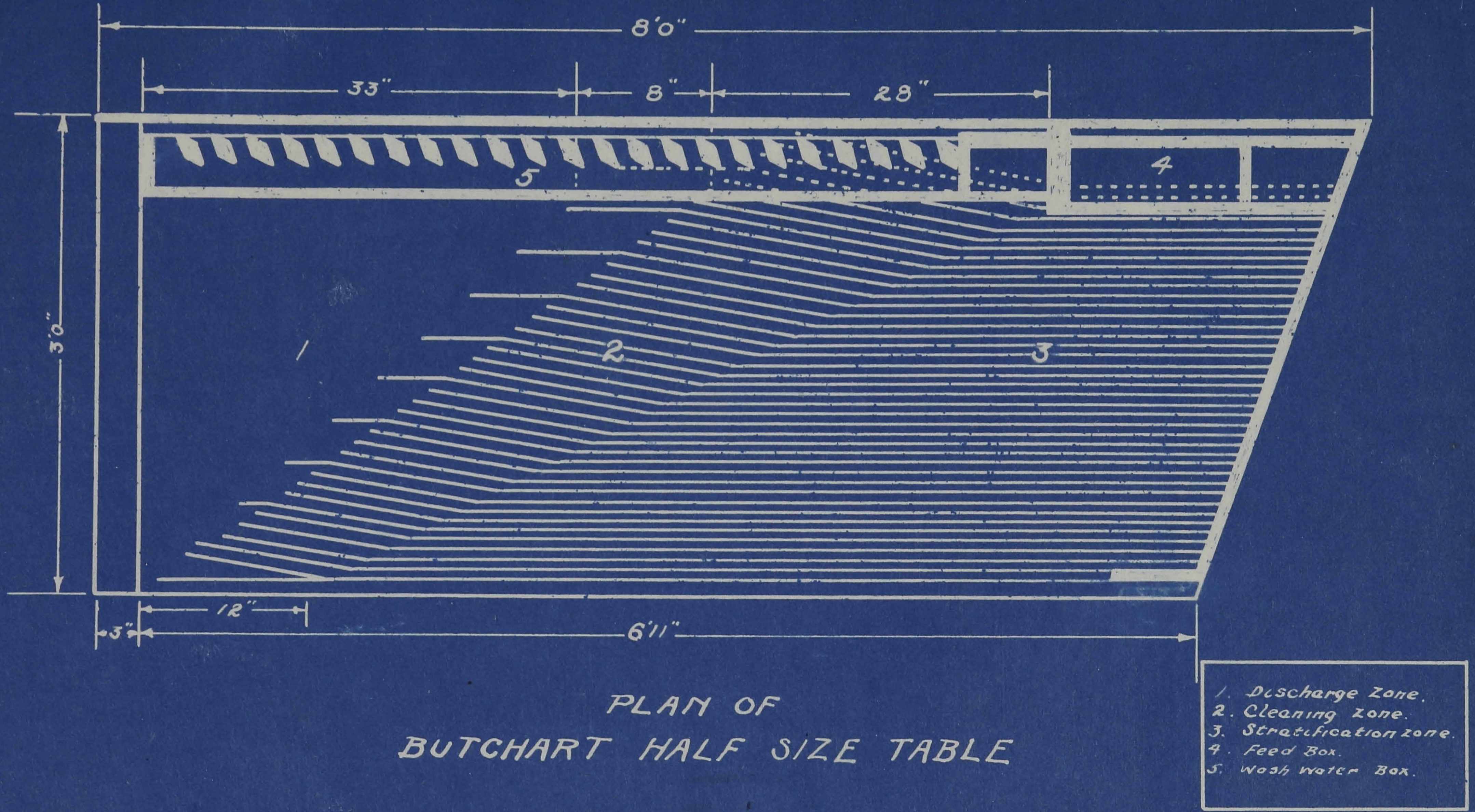
(2). The use of long and narrow riffle grooves.

(3). A jerking motion usually parallel to the riffle grooves. The effect of the jerk is to impel the feed across the table towards the concentrate end, giving a greater momentum to the heavy particles than to the light.

(4). The use of a current of water flowing across the riffle grooves. The effect of this wash water is to force the upper layers of waste material down the sloping table much faster than the under layers of heavy concentrates.

The table used throughout the investigation was a half size Butchart concentrator. This table is one of the most recent, having appeared on the market within the last six years, but it has already proved itself to be a very efficient concentrating machine. A detailed description of the mechanical features of this table is deemed unnecessary and only a general statement of these will be made. It is simply although strongly constructed, has a heavy steel base, fully enclosed drive, and throughout the tests , has operated in a very satisfactory manner.

The primary difference between the Butchart and the Wilfley tables lie in the system of riffling. In the latter table the riffles are straight and terminate in a diagonal line. The riffles on the former concentrator are straight for part of their length, and then have an upward sloping curve. They then straighten out and continue to the concentrate end of the table, the whole surface being riffled, with no smooth washing plane, as in the Wilfley. The system on the half size table that was used in these tests, was intermediate between the ordinary Wilfley and Butchart systems, and instead of the riffles covering the whole surface of the table, they ended in a diagonal line, with the exception of every fourth riffle,which was extended



PLAN OF
BUTCHART HALF SIZE TABLE

PLATE I.

a short way beyond the others. Plate 1 shows a detailed plan of the riffling on the table used.

The table top may be divided into three zones:

(1). <u>The Stratification Zone,</u> in which the riffles are straight and parallel to the head motion, being deepest at the head end of the table. Here the heavy mineral settles to the bottom of the grooves.

(2). <u>The Cleaning Zone,</u> where the riffles curve towards the higher side of the table and are therefore not parallel to the head motion. This causes a transverse agitation which stratifies the ore more perfectly. This oblique shaking, combined with the backward flow of water caused by the upward curves, tends to wash the upper layer or lighter portion of the feed away from the concentrate end of the table.

(3). <u>The Discharge Zone,</u> which is a plane surface and serves to transport the cleaned concentrates across the table into the concentrate launder.

Section 2.

Selection and Preparation of the Ore.

For a series of tests such as were contemplated, an ore was required which would fulfil two purposes. The first of these requirements necessitated its being of sufficient hardness and durability to permit of repeated use, without an appreciable reduction in size, through the wear and tear of the various operations. The second requirement was that the ore should admit of easy and rapid analysis, with a high degree of accuracy. Not having a suitable ore on hand, it was decided to manufacture one which would suit the purpose. The mineral chosen for the concentrate part of the ore was magnetite, while the gangue material used was tinguaite. A quartz gangue would have been preferable, could it have been obtained in sufficient quantity.

Five bags of magnetite already crushed to a fairly small size, were screened over a 20 mesh screen. The through product of the screen was then classified to get rid of a large portion of the finest grains which are unsuited to sand tabling. The spigot product of the classifier was then dried and passed through a ~~dry~~ Weatherill dry magnetic separator. For this operation a medium electric current was used, which together with a very slow rate of feed, produced a magnetite concentrate, practically free from gangue, and possessing a high magnetic intensity.

Detail.	Weight of magnetite thro' 20 mesh...........	366.50#
	Classifier feed water.................	119#/minute.
	Rate of classifier feed...............	9.2#/minute.
	Weight of Weatherill concentrate...........	253.75#
	" " " middlings (to waste)...	53.05
	" " " tailings " " ...	34.90
	" " classifier overflow " " ...	24.80
	Total weight...........................	366.50#

Screen Analysis of Classifier Overflow.

Mesh	Sample A		Sample B	
	Wt.	%	Wt.	%
-200	4.67	93.6	4.49	89.8
-150	0.17	3.2	0.31	6.2
-100	0.15	3.0	0.20	4.0
- 65	0.01	0.2	0.00	0.0
Total	5.00	100.0	5.00	100.0

In the preparation of the magnetite, a difficulty was encountered, which appeared at first sight as if it would prevent the using of such a mineral for the concentrate part of the ore, for on passage through the Weatherill separator, it became highly polarised. This caused the grains to clot together and entirely prohibited their being properly mixed with the gangue material, to produce a uniform grade of ore. After some experimenting, a machine was devised, which completely depolarised the magnetite. As the machine constructed seems to be quite original, a short description of it may well be made. "A hollow brass pipe, 1" in diameter, 18" long, and tapering at one end to 1/2" in diameter, was wound with several layers of copper wire, about 1/8" in size, over approximately three quarters of it's length. The pipe was then in a vertical position, and a feed hopper attached to the upper opening in pipe. The coil was then connected up to an A.C. generator, a current of 60 amperes at 20 volts being maintained. The polarised magnetite was fed into the pipe through the hopper, and immediately became acted upon by a strong A.C. field. As the pipe was of brass there was no tendency for the lines of force to concentrate in the sides, as would have happened had iron been used. Under the action of gravity the magnetite dropped down the pipe, the polarity of any one grain being continually reversed, through the action of the field, which as the grain neared the discharge end of the machine, became weaker and finally dropped to zero. As the field weakened, the pole strength of a magnetite particle was reduced simultaneously. No calculations were made as to a proper length of coil, owing to lack of time, but a sufficient resistance was connected in series in the circuit, to prevent the coil from burning out. From this small machine a capacity of three pounds of magnetite per minute was obtained.

Approximately 3500# of tinguaite were crushed in a stamp battery having a 20 mesh discharge screen. As the material was discharged from the stamps, it was pumped directly to a classifier, where it was partially deslimed. From the classifier the tinguaite was fed to the Butchart table. During the table operation, it was made practically free from slimes, while at the same time, pyrite, magnetite, and other minerals, of which a fraction of a per cent were present, were got rid of by cutting off a small band at the concentrate end of the table. The product of the table was then dried, and passed through the Weatherill separator under the strongest field

Screen Analysis of Tinguaite.

Size of Opening.	Mesh	Gms. A	% A	Gms. B	% B	Av. %
0.0238"	20	0.00	0.00	0.00	0.00	0.00
0.0232"	28	0.94	1.45	1.04	1.62	1.53
0.0164"	35	12.88	20.17	13.67	21.30	20.74
0.0116"	48	12.60	19.73	12.67	19.75	19.74
0.0082"	65	12.50	19.56	12.74	19.90	19.73
0.0058"	100	9.78	15.31	9.33	14.55	14.93
0.0041"	150	9.45	14.79	9.09	14.20	14.50
0.0029"	200	3.47	5.44	3.33	5.70	5.32
- - - -	-200	2.14	3.36	2.27	3.54	3.45
	Total	63.76	100.00	64.14	100.00	

Screen Analysis of Magnetite.

Mesh	Gms. A	% A	Gms. B	% B	Av. %
20	0.99	1.66	1.09	1.91	1.78
28	15.11	24.50	14.55	25.50	25.00
35	13.33	21.51	12.54	22.20	21.86
48	7.95	12.84	7.21	12.61	12.72
65	6.96	11.22	6.11	10.71	10.97
100	5.34	8.66	4.73	8.30	8.48
150	5.38	8.71	4.65	8.17	8.44
200	2.75	4.46	2.40	4.20	4.33
-200	3.99	6.44	3.65	6.40	6.42
Total	61.80	100.00	56.93	100.00	

Screen Analysis of Mixed Feed.

Mesh	Gms. A	% A	Gms. B	% B	Av. %
20	0.08	0.15	0.09	0.18	0.17
28	2.04	3.90	2.00	3.68	3.79
35	11.42	21.87	11.68	21.90	21.88
48	10.15	19.43	10.59	19.57	19.50
65	9.87	18.90	10.19	18.75	18.82
100	7.24	13.86	7.68	14.13	14.00
150	6.97	13.34	7.24	13.32	13.31
200	2.55	4.88	2.65	4.87	4.87
-200	1.92	3.67	1.96	3.60	3.64
Total	52.24	100.00	54.08	100.00	

Table No. 1

obtainable,which removed most of the remaining magnetite. About 2400# of tinguaite was finally obtained.

Mixing. The magnetite was then given a thorough mixing, and was cut down into ten lots, each approximately weighing 25#. Two samples were then taken for screen analysis. The tinguaite was similarly mixed and cut down into ten lots of 225#, and samples also taken for screen analysis. Finally the magnetite was thoroughly mixed with the tinguaite. The ten lots of feed thus obtained weighed in the neighbourhood of 250#, and contained approximately 10% of magnetite. (See Table 1 for detail of screen analyses.)

Section 3.

Improvements and Additions made to the Table,before starting the Tests.

Automatic Arrangement to find Slope of Table.

Slope is given to the table through two pairs of right and left hand screws. These elevating screws are connected by a small shaft, and are raised or lowered by means of a handwheel mounted on one end of the shaft. A steel disc, about 11" in diameter, was mounted on the other end of the shaft,it's circumference being divided into one hundred parts, and every tenth part numbered. Opposite the disc, a pointer was fixed to the foundation of the table. A cord with a pointer and weight attached, was fastened to the shaft, so that as the table was raised or lowered, the cord wound or unwound itself respectively. A slide, divided into parts numbered from 0 to 3.5 was set up so that the weight and pointer moved up and down it. When the table was level, the disc was adjusted to read zero, while the pointer in the slide also registered zero. One complete revolution of the handwheel caused the disc to revolve once, and raised the sliding pointer to division 1. By means of a clinometer, a curve was plotted, with hundredths of a revolution and per cent grade as the coordinate axes. From this curve any required slope could be accurately set, or from any reading the correct grade could be obtained.

Improvement in the Design of the Feed Box.

The dimensions of the feed box are, length 21", width 3", and a depth tapering from 2" to 3". The feed is discharged through nine holes cut in the side of the box nearest the high side of the table. In a preliminary test it was noticed that the feed had a tendency to bank at the far end of the box, and not discharge properly, while the most of the feed water discharged out of the first two or three holes. To remedy this, the discharge side of the box was covered with a copper plate, and square holes were punched in it to coincide with the original discharge holes. Copper gates, with a notch in their lower end, were fitted in slides, so that each gate when closed, completely shut off one of the discharge orifices.

By raising the gates, various size openings, to suit the feed, could be obtained. For most of the tests it was found that four or five discharge holes were sufficient to give an even distribution of the feed.

Graduation of the Spring Pressure Adjustment.

The pull rod which joins the table top to the head motion, was fitted originally with three nuts. One of these, the tension nut,is used to compress the spring, while the other two connect the table top to the pull rod itself. To graduate the tension nut, the table was set in motion; this nut was then screwed up until all knock was taken out of the parts. This was called the zero position of the spring, and was graduated as such. The faces of the tension nut were marked so that variable pressures, corresponding to one, two, or more turns could be accurately set. Additional nuts were put on the pull rod to insure perfect locking conditions; one to prevent the tension nut from loosening, and another to lock one of the attaching nuts. The other attaching nut had a split pin fitted through it and the pull rod, to hold it in place.

Division of Table.

The front sides of the wash water and feed water boxes were graduated in inches. By this means, the widths of the tops of the heads', middles',and tailings',bands,could be recorded for each test. A definite width of middles could also be obtained by moving the middles' cut-off along the front of of the table to the required point.

Discharge Launders.

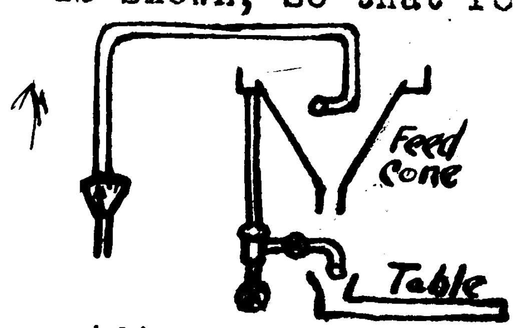
The discharge launders were designed by Mr.J.W.Bell and were so arranged, that at the beginning of a test, while the feed was being adjusted, the products from the table could all be run into one cone. After the various adjustments had been made, by throwing a lever, the heads, middles, and tailings, were discharged into three separate cones, whence they were removed for drying.

Regulation of Wash Water Launder.

The diamond shaped gates on the wash water launder, were loosened and set so that an even flow of water over the table was obtained. To accomplish this, a preliminary test was run, and the upper side of the concentrate band was straightened by adjusting ~~different~~ the openings between successive blocks, or ~~gt~~ gates. The blocks were then screwed down tightly, and kept in the same position throughout all the tests.

Feed Water Arrangement.

The feed water was arranged as shown, so that for any setting of the valve, all the water comes out in the sand feed or overflow~~s~~; consequently by this arrangement, the feed water equals the quantity as per calibration ~~if~~ So long as there is ~~an~~ an overflow, or if the ~~overflow~~ cone level remains constant.



Section 4.
The Concentration of the Various Lots of Ore, and their Analysis.

Forty-two tests were made during the investigation, of which thirty-four were run with the following six table adjustments as variables:

Tests	1-4	Inc.	Spring Pressuse	as variable.
"	5-8	"	Feed Water	" "
"	9-13	"	Wash Water	" "
"	14-15	"	Feed & Wash Waters	"
"	16-28	"	Feed Rate	" "
"	29-30	"	Table Strokes/Min.	"
"	31-34	"	Length of Stroke	"

The seventh adjustment, namely that of Grade %, was necessarily changed to make a proper concentrate cut-off in each test. In tests 35-42 inc. the percentage of magnetite in the feed was reduced to determine just how much the extraction was affected by such a reduction.

Wet analyses were attempted on a preliminary test, but were discontinued owing to the difficulty of getting the magnetite into solution, and the length of time required. More rapid and quite as accurate results were obtained by analysing the table products magnetically. A special magnet was used for this purpose, and the results tabulated as Fe_3O_4, instead of as Fe, as in the wet analyses.

The machine used for this purpose was a stationary electromagnet, mounted on a strong wooden framework. A copper band was fitted around the pole pieces. Underneath the magnet was a sliding copper trough, about the width of the pole pieces and about 1/8" distant from them. A sample to be analysed was placed on the trough and by shaking was forced along under the magnet. As it passed through the field, the magnetite was drawn up against the copper band around the pole pieces. After the sample had passed under the magnet, the current was shut off and the magnetite dropped into an aluminium dish; while the current was on the tinguaite was automatically discharged into another dish. The separated portions were then weighed. The field strength of the magnet was adjusted by means of a lamp resistance board, a current of 3.3 amperes being used.

The general program pursued in running a test was as follows: a lot of ore was thoroughly wetted in the feed cone, and fed to the table. After adjustments had been made, the table products were collected for a definite time. The products were then dried, weighed, and samples of each riffled out. Each sample was weighed, and screen analysed for a period of thirty minutes. The amounts on each mesh were then weighed, divided magnetically into Fe_3O_4 and tinguaite, each part weighed and results calculated.

Section 5.
Interpretation of the Results.

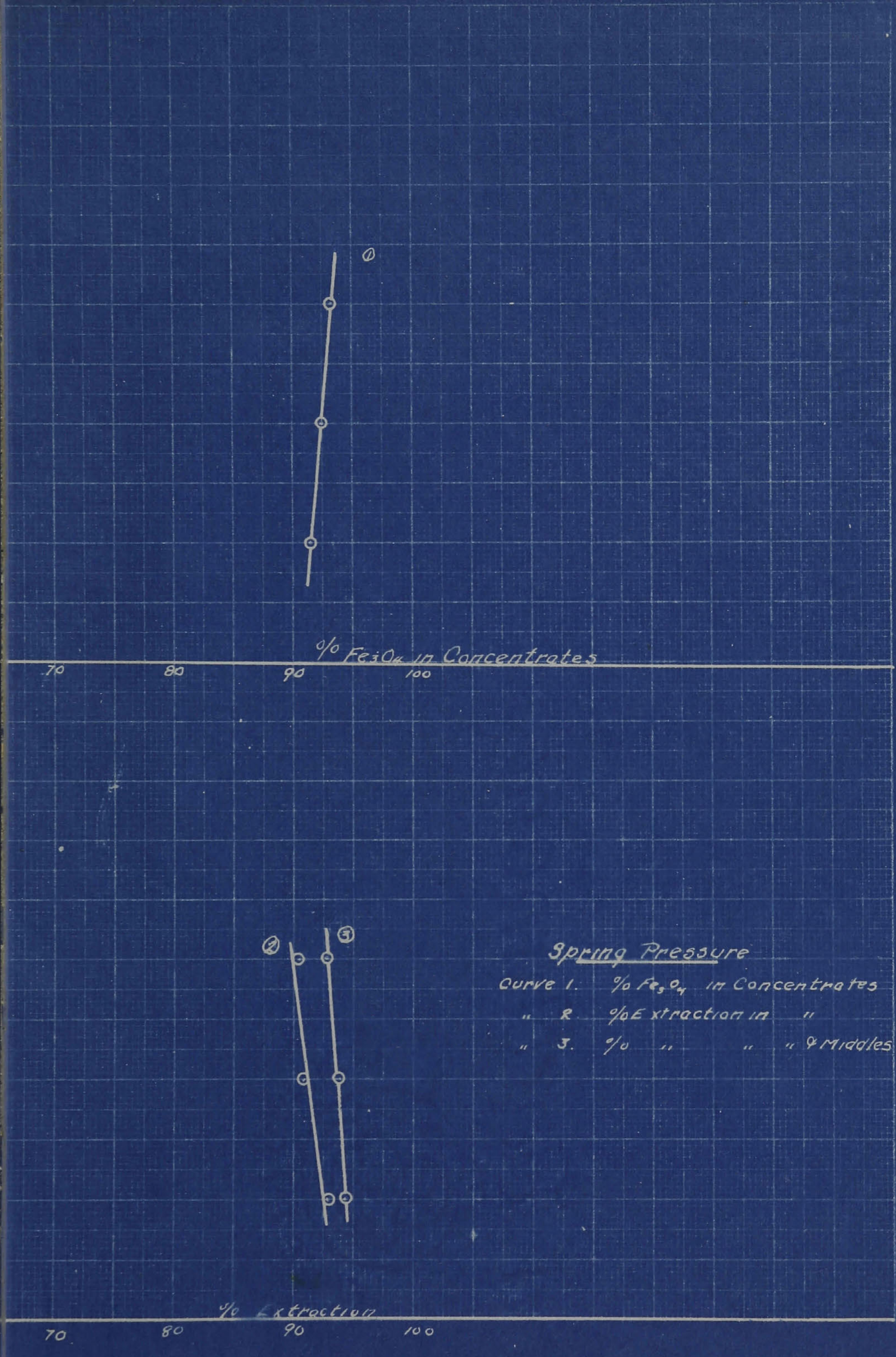
Variable Spring Pressure.

In these tests, the variables, excluding spring pressure, were kept constant, with the exception of the feed water in test 4 which through an error in the setting of the cock, was 55#/min. instead of 40# as in the other tests.

Table No.2

Test No.	Sp.Press Turns	% Mag. in Feed	Feed Tons/24 Hrs	Ratio Ore:Conc	% Grade of Heads	% Extr.	
						Head	Mid
3	-1	10.8	6.5	9.4	94.7	91.0	1.4
1	1	10.1	6.4	9.2	91.5	92.8	1.6
4	2	10.5	6.4	9.4	92.4	90.4	2.3
2	3	10.7	7.1	9.3	93.0	90.8	3.1

In test 1 the concentrate cut-off was made as carefully as possible and the grade was found to be 7.6%, and for the other tests the same grade was kept. Disregarding test 3 for the time being, the result in an increase of spring pressure, seems to be an increase in the grade of the concentrates (see Curve 1). The % extraction in Heads seems to ~~go~~ increase with a decrease in the ratio of ore:conc, but is much more marked if the heads are added in with the middles; therefore if this ratio is kept constant by varying the grade of the table, extractions should be obtained which are more nearly the same. Test 3 acts much the same as an increase in pressure, this test having the highest grade concentrates, 94.7 %, but the lowest extraction in heads and middles, 92.4 %. As in this run there was a bad knock in the table due to the negative spring pressure, the results cannot be taken into account, because such an operating



①
% Fe_3O_4 in Concentrates
70
80
90
100
②
③
Spring Pressure
Curve 1. % Fe_3O_4 in Concentrates
" 2 % Extraction in "
" 3. % " " " & Middles
% Extraction
70
80
90
100

condition would soon put the table out of adjustment. The actual extraction percentages in tests 1,4,& 2, show that spring pressure has very little effect on the saving, but when we take into account the fact that test 1 had the lowest grade of feed, 10.1 %, and also that it had the least spring pressure, which means the smallest power consumption, this looks to be the most efficient test of the series. This bears out Mr. Butchart's statement,"that the most beneficial result would be obtained, where there was just enough tension in the spring to take out all knock in the table.

Variable Feed Water.

Table No. 3.

Test.	Feed Water	% Mag. in Ore	Feed Rate	Grade of Table	Ore to Conc.	% Grade of Heads	% Extr. Head	% Extr. Mid	Mag.Loss -200 Mes
6	20#	10.5	6.8	6.8	9.1	87.2	91.8	1.9	20.8
5	30	10.5	6.5	6.8	9.25	89.7	90.0	3.7	28.4
1	40	10.1	6.4	7.6	9.2	91.5	92.8	1.6	29.7
8	50	10.2	6.8	7.4	9.6	91.5	91.5	1.9	33.6
7	60	10.0	6.9	7.4	10.0	91.6	91.1	1.8	32.8

In the above series of tests the feed water rate was varied between 20# & 60# per minute. The first thing noticeable in the above table is the effect which the feed water has on the grade of the concentrates. Test 6 shows a very poor grade,87.2 %, due to poor settling of the heavy mineral and consequently poor cleaning effect of the wash water. As the feed water rises to 40# in test 1 we get a good settling effect, and with the same wash water as in 6, a correspondingly higher grade of concentrate. Above 40# the grade remains about constant.

The extraction percentage in heads & middles in test 6 is very good notwithstanding the poor grade of concentrates. As the feed water rises from 20# to 40# not only do the concentrates improve but the extraction also increases. Above 40# the extraction begins to drop off, reducing from 94.4 % in test 1, to 92.9 % in test 7. This is probably due to the following facts: As the bed with 20# of feed water is not particularly loose, the intermediate grains of heavy mineral do not settle well. As the bed gets looser these grains settle better, but above 40# of water currents begin to sweep across the table and wash some of the magnetite away. These facts are more intensified, when we note that in test 1 there was the smallest middles band, 2 1/4", ~~than in~~ whereas the other tests which had a band 3" wide. Also since the magnetite in the feed of tests 5 & 6 was 10.5 % we should expect, that other things being equal, the extraction in these tests would be higher than in test 1 with a 10.1 % feed. Another interesting result of these tests may be found in the Size Efficiency tables on the original test sheets. In the -200 mesh, the saving of magnetite which is highest, 79.2 %, is found in the test which has the lowest feed water, 20#. This saving decreases considerably with an increase of feed water and in test 7 with 60# the saving has dropped to 67.2 %. This naturally follows, since these very fine grains settle well in the tight bed, and do not have the same tendency to wash away, as they do in the loose bed. Curve 4 shows this result very well.

The general result of the feed water tests seems to be, that with moderate amounts of wash water, such as were used, higher efficiencies are obtained with large amounts of feed water, provided the amounts are not too great. The limit in these tests was about 50# of feed water; above this amount currents of water flowed across the feed end of the table and naturally swept away some of the valuable mineral in the feed.

Wash Water Variable.

Table No. 4.

Test	Wash Water	% Mag. in Ore	Feed Rate	Grade of Table	Ratio Ore:Conc	% Grade of Heads	% Extraction	
							Heads	Middles
9	20	10.5	6.7	8.3	9.3	89.0	90.2	3.1
10	30	10.0	6.4	8.3	10.0	91.8	91.3	3.0
5	40	10.5	6.5	6.8	9.25	89.7	90.0	3.7
11	50	10.5	6.9	6.7	9.0	87.6	91.1	2.1
12	60	10.6	6.2	6.4	9.7	92.0	88.9	2.3
13	70	10.0	7.2	5.9	10.4	93.0	91.3	3.4

In all the tests on wash water, the feed water was kept at 30# per minute. From the above tests it will be noticed that the extractions are good in all cases with the exception of test 12 which is unaccountably lower than it should be. Nothing of much importance can be said about the above tests except to note that the wash water is the first variable which has much effect on the grade of the table, but here it is seen to be more or less interchangeable with the grade. The results indicate that within certain limits, any wash water may be used without adversely affecting the extraction percentages.

Extra Tests On Wash & Feed Water.

Two extra tests, nos.14 & 15 were run with ~~#%#~~ a feed water of 20# per minute and a wash water of 50# % 60# respectively. Very good extractions of 94.8 % & 94.6 %,were obtained. The large saving in magnetite of -200 mesh was again very much in evidence the results being respectively 82.3 % and 76.2 %. This corroborates the results of test 6 which have been discussed under feed water as variable. The extraction in test 6 was not very good as compared with 14 & 15. It will be remembered in the previous tests that the wash water did not seem to have much effect on the extraction, but in those tests enough feed water to produce fair stratification was used.In tests 14 & 15 however, with a very low feed water, we obtained excellent results. These latter tests not only show a better extraction than test 6, but also the grade of the concentrates has been improved from 87.2 % to 92.5 %.

From the tests on wash and feed water it appears that these are more or less interrelated and that with high amounts of feed water, wash water does not have nearly as great effects, as it does when the feed water is low.

Table Strokes per Minute as Variable.

Two tests nos. 29 & 30 were run on a varying speed. More tests could not be run since the range of speed was limited between 240 & about 265 strokes per minute. In test 29 the speed was 241.5 while in test 30 it was 251.5. The extraction in 29 was 90.7 % while the concentrates were 91.5 % pure. In test 30 the extraction was 91.0 % and the grade of the concentrates 92.2 %. Owing to the fact that a large change in the speed variable could not be obtained, no conclusions may be drawn, although the results of the two tests above, seem to show a balance in favour of the higher speed.

Rate of Feed Variable.

Three series of tests on this variable were run as follows: tests 21,22,& 23, with a feed orifice of 3/8"diam;. tests 16,17,18,24, & 25, with a 7/16" orifice; tests 20,26,27,& 28 on a 1/2" orifice. In each series the wash and feed waters were varied.

Table No.5. 3/8" Orifice.

Test	Feed Rate	% Mag in Feed	Ratio of Feed Water to Feed	Ratio of Wash Water to Feed	Ratio of Ore to Conc.	% Grade of Table	% Mag in Conc.	% Extraction	
								Heads	Middles
22	10.9	9.9	2.0	2.6	10.8	8.2	92.3	88.8	2.5
23	10.5	9.8	2.1	4.1	10.5	6.3	90.0	90.8	2.8
21	10.7	10.2	2.7	3.4	9.6	7.6	91.0	91.0	2.6

Table No.6. 7/16" Orifice.

Test	Feed Rate	% Mag in Feed	Ratio of Feed Water to Feed	Ratio of Wash Water to Feed	Ratio of Ore to Conc	% Grade of Table	% Mag in Conc.	% Extraction	
								Heads	Middles
16	12.8	10.6	1.7	2.3	9.8	7.3	91.0	88.1	3.2
17	12.7	10.5	2.3	3.4	9.8	6.6	93.0	88.7	2.4
18	13.2	10.5	2.2	3.8	9.6	5.9	91.2	89.8	2.3
25	13.7	9.7	2.4	2.6	10.8	5.7	88.9	85.9	2.1
24	13.5	10.5	2.9	3.7	9.6	6.5	89.0	89.0	1.8

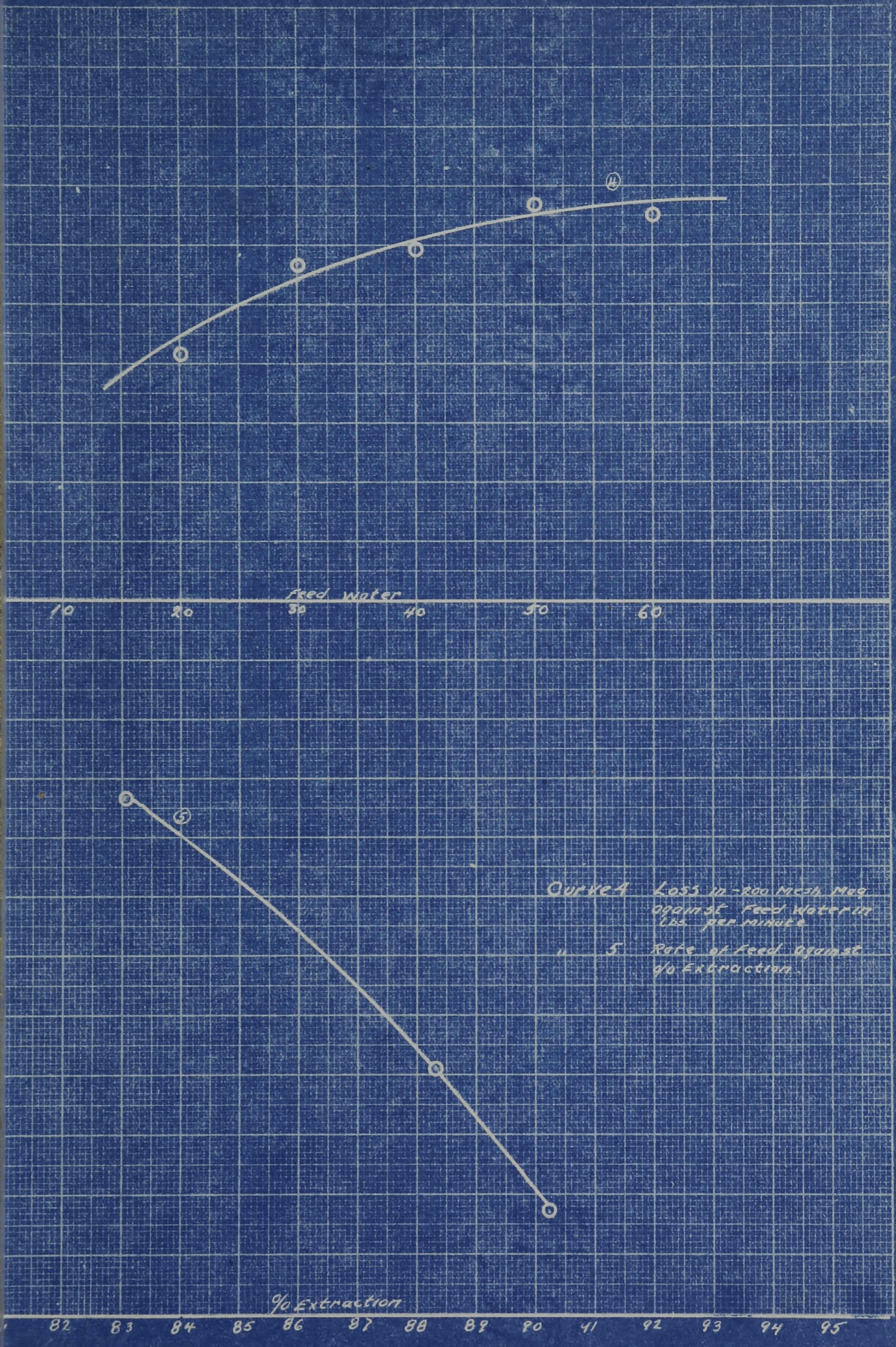
Table No.7. 1/2" Orifice.

Test	Feed Rate	% Mag in Feed	Ratio of Feed Water to Feed	Ratio of Wash Water to Feed.	Ratio of Ore to Conc.	% Grade of Table.	% Mag in Conc	% Extraction Heads	Middles
20	17.9	9.6	1.6	2.8	12.4	5.9	91.5	79.8	3.3
28	17.5	10.4	1.6	2.5	10.7	6.7	90.5	80.6	3.7
27	17.6	10.3	2.0	2.4	9.3	5.6	87.6	89.8	2.0
26	17.7	10.6	2.4	2.8	9.5	5.5	87.3	85.3	2.5

In examining table 5 we find that in tests 22 & 23 the ratio of feed water to feed is the sameas in test~~s~~ 5 ,table 3 and we see that the conclusion drawn there, viz.,that with a low ~~wash~~ feed water , a high wash water must be used to get a good extraction, is here corroborated. In test 22 the extraction is only 88.8 %,with a wash water ratio of 2.6:1, while in 23,the extraction is 90.8 % with a ratio of 4.1:1. In test 21 the feed water was increased, and the wash water decreased the same amount, so that the total water was the same as in test 23. The extraction is practically the same as in~~22~~ 23, differing by only 0.3 %. With the increase in the feed rate it will be noticed that the extraction is on the average, slightly lower than with the feed rate used in previous tests, but is still fairly high.

In the tests in table 6 where the feed rate has been still further increased,to over 13 tons in 24 hours, the same general results are noticed, as were in table 5. Here the extractions are beginning to get rather poor.

In table 7, the tests shown have the highest feed rate tried, being over 17 tons/24 hours. The extractions have

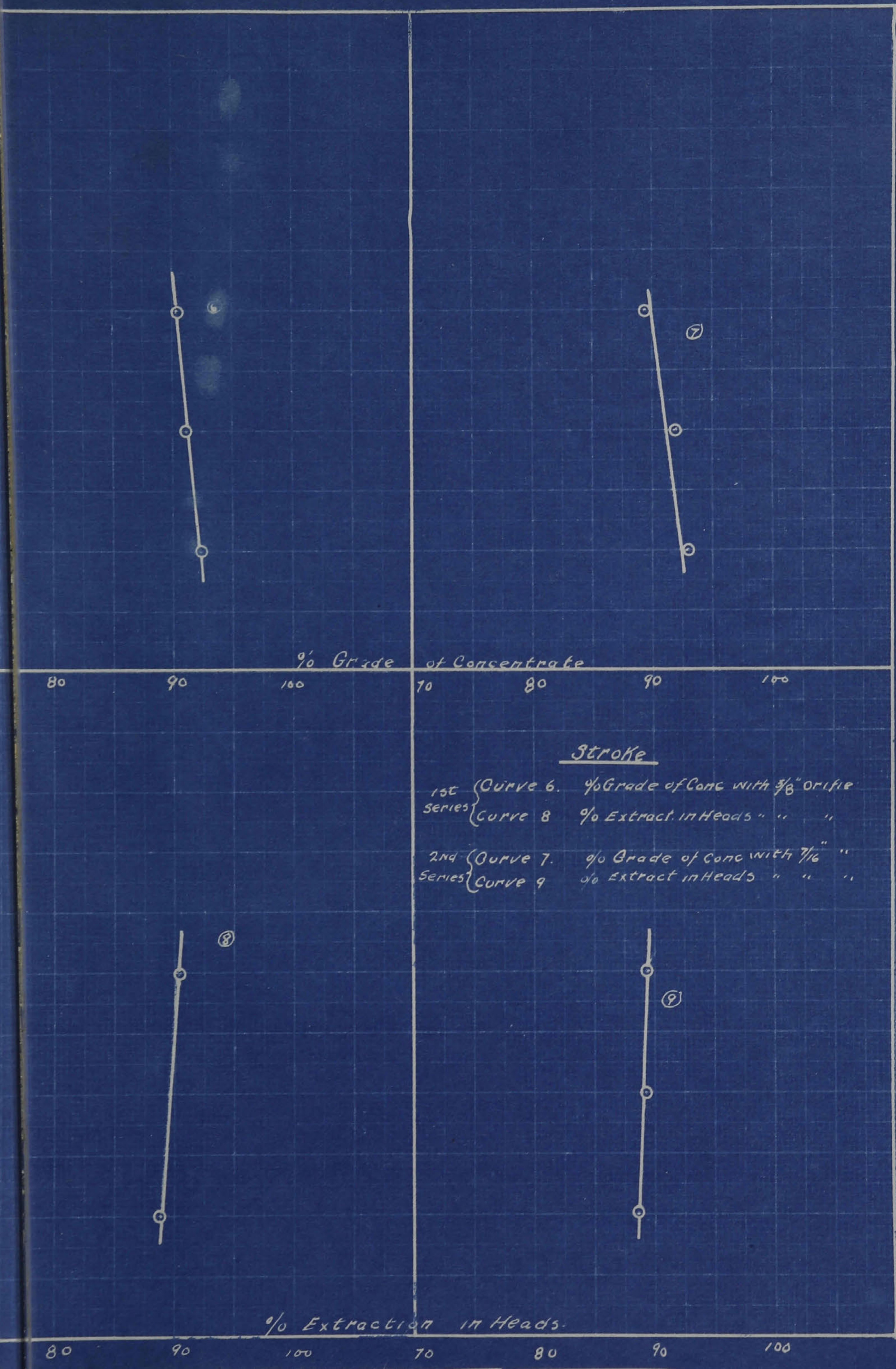

4
Feed water
10
20
30
40
50
60
5
Curve 4 Loss in -200 Mesh Mag against Feed Water in lbs. per minute
" 5 Rate of Feed against % Extraction.
% Extraction
82
83
84
85
86
87
88
89
80
41
92
93
94
95

dropped very much, and with the exception of test 27 which seems to have rather suspicious results, are bad. These low results appear to be due to the low ratios of feed and wash water to feed, although the actual amounts of water used were high. In tests 20 & 28, the extractions are very low, there being only 1.6 times as much feed water as feed. In test 26 the extraction is improved somewhat due to the increase in feed water but is still rather bad.

It is hard to compare the different rates of feed with one another as changes were made in both feed and wash water variables. One feature of the tests standsout,namely: The extraction in the high rate of feed tests is very poor, and to get good results with such rates, volumes of wash and feed water that are beyond the limits of this table would have to be used.The limit capacity of this table for good extractions, appears to be in the neighbourhood of 13 tons per 24 hours, or about half the capacity of a standard table. Curve No.5 shows the average extractions plotted against the various feed rates.

Variable Stroke.

Two series of tests were run as shown in table 8. The first series had a feed rate of 11 tons/24 hours, and 30# of feed water, and 50# of wash water were used. In the second series, the feed rate was about 13 tons/24 hours, and the feed and wash water was 40# &60# respectively. Both series show a slight decrease in the grade of the concentrates, but a



% Grade of Concentrate
80 90 100
70 80 90 100
Stroke
1st Series { Curve 6. % Grade of Conc with 3/8" orifie
Curve 8 % Extract. in Heads " " "
2nd Series { Curve 7. % Grade of Conc with 7/16" "
Curve 9 % Extract in Heads " " "
7
8
9
% Extraction in Heads.
80 90 100
70 80 90 100

corresponding increase in the extraction. The very high ~~%~~ extraction in test 31 seems to have been influenced by the larger decrease in % grade of the table over tests 22 & 33. The increase in the saving in tests 17, 32, & 34 is quite small as may be seen from the table.

In general the actual increase in extractions for both series is slight, and the stroke does not seem to have had much effect, but what effect it has had is in favour of the longer stroke.

Table No.8.

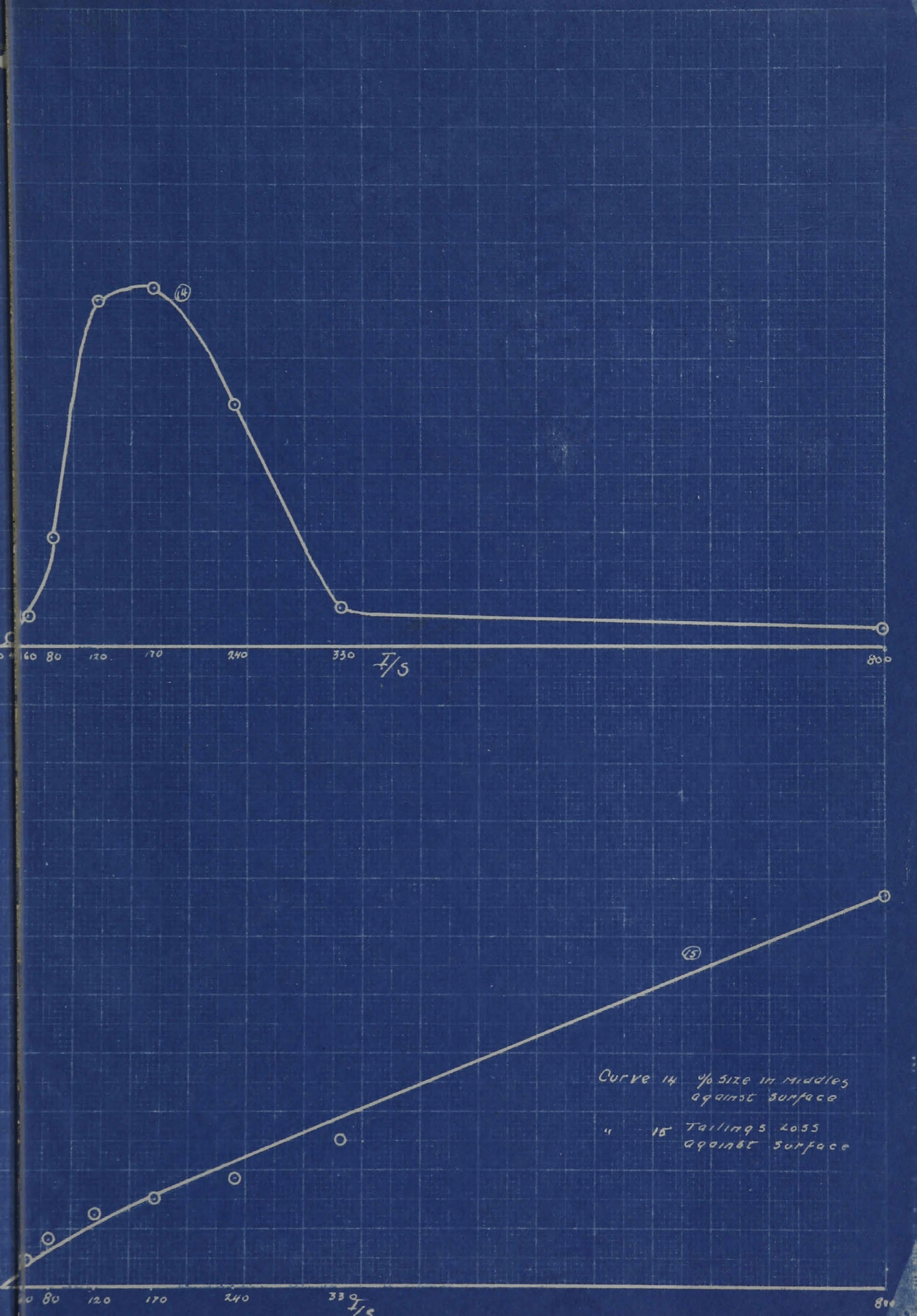
Test.	Feed Rate	Stroke	% Mag. in Ore	% Grade of Table	% Grade of Conc.	% Extraction Heads	% Extraction Middles
22	10.9	5/8"	9.9	8.2	92.3	88.8	2.5
31	10.9	3/4"	10.1	7.9	91.1	91.1	2.9
33	11.0	7/8"	10.1	8.0	90.3	90.3	2.6
17	12.7	5/8"	10.5	6.6	93.0	88.7	2.4
32	13.6	3/4"	10.2	6.7	92.1	89.2	1.7
34	13.3	7/8"	10.3	6.6	89.4	89.4	2.2

Tests 22, 31 & 33.....Feed Water 30#. Wash Water 50#
" 17, 32 & 34...... " " 40#. " " 60#.

Curves Nos. 6 & 7 show % grade of concentrate plotted against stroke, while curves 8 & 9 show the extraction plotted against the stroke.

Tests on Reduction in Percentage of Magnetite in the Feed.

Two series of tests were run as shown in table No.9, one series having a feed water and wash water of 30# & 50#, and ~~t~~ the other 40# & 60# respectively. There does not seem to be a great deal of difference between the two series, but if any the 30-50 series appears slightly more regular. After a study of series the following conclusions may be drawn:


14
80
120
170
240
330
I/S
800
15
80
120
170
240
330
I/S
Curve 14 % size in Middles against surface
" 15 Tailings Loss against surface

(1) Decrease in the grade of feed decreases the extraction in the concentrates, and increases the extraction in the middles.

(2). Decrease in the grade of feed decreases the grade of the concentrates, because the relative amount of silica getting into the concentrates band increases as the width of the band decreases.

The extraction does not decrease in proportion to the decrease in the grade of the feed.

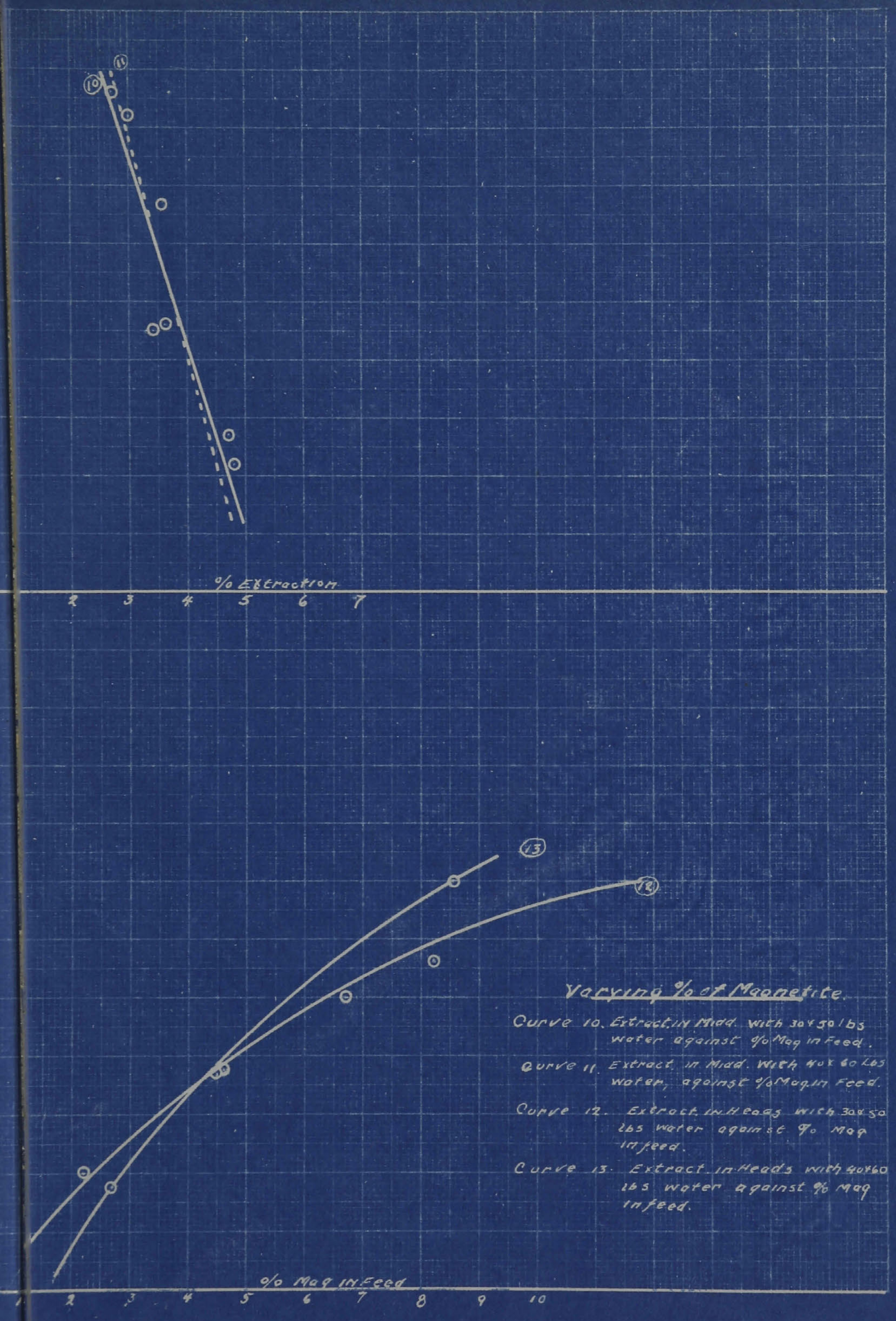
Table No.9.

Test No	Series	%Mag. in Ore	% Grade of Conc.	% Extraction.	
				Heads	Middles.
35	30-50	8.2	92.7	89.0	3.0
37	"	6.7	93.2	82.5	8.8
39	"	4.6	89.8	84.7	3.6
41	"	2.2	75.7	79.9	4.9
36	40-60	8.6	92.4	92.6	2.7
38	"	6.7	92.0	85.4	3.6
40	"	4.5	88.0	84.3	3.4
42	"	2.7	78.8	78.5	4.7

Curves nos. 10 & 11 show the extraction in the middles of both the 30-50 and 40-60 series, plotted against grade of the feed. Curves 12 & 13 show the extraction in the heads for both series also plotted against the grade of feed.

Honda. ~~Agenda.~~

An interesting curve of the relative percentages in the size of the grains in the middles product is shown in curve no. 14. These percentages have been plotted against surface, i.e. the reciprocal of the diameter. This curve shows the proportionately large amount of intermediate size grains



10
11
% Extraction
2
3
4
5
6
7
13
12
% Mag in Feed
1
2
3
4
5
6
7
8
9
10
Varying % of Magnetite.
Curve 10. Extract. in Midd. with 30 x 50 lbs water against % Mag in Feed.
Curve 11. Extract. in Midd. with 40 x 60 Lbs water, against % Mag. in Feed.
Curve 12. Extract. in Heads with 30 x 50 lbs water against % Mag in feed.
Curve 13. Extract. in Heads with 40 x 60 lbs water against % Mag in feed.

which creep into the middles.

Another curve no. 15 shows the increase in losses of magnetite in the various meshes in the tailings, plotted also against the surface. The surface taken corresponding to the -200 mesh was 800.

Conclusions.

A general survey of the results seems to show that the table is not particularly sensitive to small changes in adjustment, although these changes do affect the extraction to a limited extent. Very definite results were obtained in the tests on the decreasing grade of feed, and show that the tailings losses increase very rapidly, as the mineral content is reduced below six or eight per cent.

It is realised however, that this investigation has only been partly carried out, and that studies must be made on such things as, the effect on extraction of minerals of different specific gravities, or the relative efficiency of the Wilfley straight riffles as compared with the Butchart curved riffles, before any hard and fast conclusions may be drawn.

Appendix.

Copies of a few of the actual tests run are attached to this thesis to show the method of working out the results, together with a plate containing a general summary of the results.

No of Test	% Mag	% Ting	Width of Middle Band in inches	Width of Head Band in inches	Tail Band Ends in inches	Feed Orifice in inches	Feed lbs per Minute	Feed Tons per 24 hours	Feed Water lbs per Minute	Wash Water lbs per Minute	Stroke in inches	Strokes per Minute	% Grade	Spring Pressure Turns	Feed Water To Feed(1)	Wash water To Feed(1)	Feed Water To Wash water(1)	Tons Ore to Tons Conc(1)
1	10.1	89.9	2 1/4	9	54	5/16	9.0	6.4	40	40	5/8	263	7.6	1	4.4	4.4	1.0	9.2
2	10.7	89.3	3	9	53	"	9.5	7.1	40	40	"	264.5	7.6	3	4.2	4.2	1.0	9.3
3	10.8	89.2	3	10	66	"	9.1	6.5	40	40	"	265	7.6	-1	4.4	4.4	1.0	9.4
4	10.5	89.5	3	9	60	"	9.0	6.4	55	40	"	266.5	7.6	2	6.0	4.4	1.3	9.4
5	10.5	89.5	4	11	50	"	9.1	6.5	30	40	"	265	6.8	1	3.3	4.4	0.75	9.25
6	10.5	89.5	4	10	46	"	9.4	6.8	20	40	"	260	6.8	"	2.1	4.2	0.5	9.1
7	10.0	90.0	4	10	61	"	9.6	6.9	60	40	"	266	7.4	"	6.2	4.2	1.5	10.0
8	10.2	89.8	4	9	60	"	9.4	6.8	50	40	"	265	7.4	"	5.3	4.2	1.25	9.6
9	10.5	89.5	6	9	54	"	9.3	6.7	30	20	"	267.5	8.3	"	3.2	2.1	1.5	9.3
10	10.0	90.0	"	9	63	"	9.0	6.4	30	30	"	268	8.3	"	3.3	3.3	1.0	10.0
11	10.5	89.5	"	11	54	"	9.6	6.9	30	50	"	262	6.7	"	3.1	5.2	0.6	9.0
12	10.6	89.4	"	11	54	"	9.6	6.9	30	60	"	263.5	6.4	"	3.1	6.2	0.5	9.7
-13	10.0	90.0	"	10	51	"	10.0	7.2	30	70	"	265.5	5.9	"	3.0	7.0	0.43	10.4
14	10.5	89.5	"	10	48	"	9.1	6.5	20	50	"	266.5	7.1	"	2.2	5.5	0.4	9.15
15	10.0	90.0	"	9	45	"	8.3	6.0	20	60	"	261.5	6.7	"	2.4	7.2	0.33	10.1
16	10.6	89.4	"	14	61	7/16	17.8	12.8	30	40	"	266	7.3	"	1.7	2.3	0.75	9.8
17	10.5	89.5	"	13	64	"	17.7	12.7	40	60	"	264	6.6	"	2.3	3.4	0.66	9.8
18	10.5	89.5	"	14	61	"	18.4	13.2	40	70	"	266	5.9	"	2.2	3.8	0.93	9.6
19																		
20	9.6	90.4	"	15	70	1/2	24.8	17.9	40	70	"	266	5.9	"	1.6	2.8	0.57	12.4
21	10.2	89.8	"	12	65	3/8	14.8	10.7	40	50	"	266	7.6	"	2.7	3.4	0.8	9.6
22	9.9	90.1	"	11	68	"	15.1	10.9	30	40	"	267	8.2	"	2.0	2.6	0.75	10.8
23	9.8	90.2	"	11	66	"	14.6	10.5	30	60	"	268	6.3	"	2.1	4.1	0.5	10.5
24	10.5	89.5	"	14	69	7/16	18.7	13.5	55	70	"	265	5.7	"	2.9	3.7	0.8	9.6
25	9.7	90.3	"	12	69	"	19.0	13.7	45	50	"	266	6.5	"	2.4	2.6	0.9	10.8
26	10.6	89.4	"	16	72	1/2	24.7	17.7	60	70	"	266	5.5	"	2.4	2.8	0.85	9.8
27	10.3	89.7	"	15	72	"	24.5	17.6	50	60	"	268.5	5.6	"	2.0	2.4	0.83	9.3
28	10.4	89.6	"	15	71	"	24.4	17.5	40	60	"	264	6.7	"	1.6	2.5	0.66	10.7
29	10.4	89.6	"	14	66	3/8	14.5	10.4	30	50	"	241.5	7.2	"	2.1	3.4	0.6	9.4
30	10.1	89.9	"	13	64	"	14.4	10.4	30	50	"	251.5	7.7	"	2.1	3.5	0.6	10.4
31	10.1	89.9	"	11	61	"	15.0	10.9	30	40	3/4	244	7.9	"	2.0	2.7	0.75	9.6
32	10.2	89.8	"	10	62	7/16	18.9	13.6	40	60	"	260.5	6.7	"	2.1	3.2	0.66	10.7
33	10.1	89.9	"	9	54	3/8	15.3	11.0	30	40	7/8	265	8.0	"	2.0	2.6	0.75	10.4
34	10.3	89.7	"	11	50	7/16	18.4	13.3	40	60	"	262.5	6.6	"	2.2	3.3	0.66	9.5
35	8.2	91.8	"	10	58	3/8	14.9	10.7	30	50	5/8	262	7.3	"	2.1	3.4	0.6	12.7
36	8.6	91.4	"	12	60	"	15.1	10.9	40	60	"	260	6.7	"	2.6	4.0	0.66	11.5
37	6.7	93.3	"	8	60	"	14.8	10.7	30	50	"	263	7.3	"	2.0	3.4	0.6	16.8
38	6.7	93.3	"	7.5	62	"	14.4	10.4	40	60	"	265.5	6.7	"	2.8	4.2	0.66	15.8
39	4.6	95.4	"	6	61	"	14.4	10.4	30	50	"	264	7.5	"	2.1	3.5	0.6	22.7
40	4.5	95.5	"	8	60	"	15.1	10.9	40	60	"	257	6.0	"	2.6	4.0	0.6	20.9
41	2.2	97.8	"	5	65	"	14.6	10.5	30	50	"	258.5	7.6	"	2.0	3.4	0.[illegible]	42.4
42	2.7	97.3	"	5.5	64	"	14.7	10.6	40	60	"	264	6.2	"	2.7	4.1	0.6	35.6

No of Test	ANALYSES % Fe_3O_4 Heads	% Fe_3O_4 Midd.	% Fe_3O_4 Tails	% SiO_2 Heads	% SiO_2 Midd	% SiO_2 Tails	% EXTRACTION Fe_3O_4 Heads	Fe_3O_4 Midd	Fe_3O_4 Tails	SiO_2 Heads	SiO_2 Midd	SiO_2 Tails	WTS OF PRODUCTS Heads	Midd	Tails	Total
1	91.5	6.6	0.7	8.5	93.4	99.3	92.8	1.6	5.5	1.0	2.8	96.2	10.18	2.50	81.19	93.87
2	93.0	14.7	0.7	7.0	85.3	99.3	90.8	3.1	6.1	0.8	2.2	97.0	11.75	2.50	95.60	109.86
3	94.7	6.7	0.9	5.3	93.3	99.1	91.0	1.4	7.6	0.6	2.2	97.2	7.75	1.56	63.50	72.81
4	92.4	11.0	1.0	7.6	89.0	99.0	90.4	2.3	7.3	0.9	2.3	96.8	15.00	3.29	123.18	141.47
5	89.7	5.0	0.8	10.3	95.0	99.2	90.0	3.7	6.3	1.2	4.1	94.7	9.81	3.63	77.25	90.69
6	87.2	4.2	0.8	12.8	95.8	99.2	91.8	1.9	6.3	1.6	4.8	93.6	10.50	4.37	81.25	96.12
7	91.6	5.6	0.7	8.4	94.4	99.3	91.1	1.8	7.1	1.0	3.2	95.8	10.06	3.06	86.31	99.43
8	91.5	6.6	0.7	8.5	93.4	99.3	91.5	1.9	6.6	1.0	3.0	96.0	10.62	3.00	89.12	102.74
9	89.0	5.4	0.8	11.0	94.6	99.2	90.2	3.1	6.7	1.3	6.5	92.2	10.37	5.94	79.94	96.25
10	91.8	6.4	0.5	8.2	93.6	99.5	91.3	3.0	5.7	0.9	4.9	94.2	9.00	4.25	77.38	90.63
11	87.6	4.5	0.9	12.4	95.5	99.1	91.1	2.1	6.8	1.5	5.2	93.3	10.38	4.63	79.44	94.45
12	92.0	6.8	1.0	8.0	93.2	99.0	88.9	2.3	8.8	0.9	3.9	95.2	10.13	3.63	83.87	97.63
-13	93.0	8.3	0.6	7.0	91.7	99.4	91.3	3.4	5.3	0.7	4.0	95.3	9.88	4.00	88.50	102.38
14	88.0	4.3	0.7	12.0	95.7	99.3	92.2	2.6	5.2	1.4	6.7	91.9	8.19	4.69	62.07	74.95
15	92.5	8.3	0.6	7.5	91.7	99.4	91.5	3.1	5.4	0.8	3.9	95.3	8.31	3.25	72.25	83.81
16	91.0	8.8	1.2	9.0	91.2	98.8	88.1	3.2	8.7	1.0	4.0	95.0	5.62	2.12	46.98	54.67
17	93.0	10.9	1.1	7.0	89.1	98.9	88.7	2.4	8.9	0.8	2.4	96.8	9.06	2.13	77.81	89.00
18	91.2	8.7	1.0	8.8	91.3	99.0	89.8	2.3	7.9	1.0	2.8	96.2	9.44	2.50	78.62	90.56
19																
20	91.5	15.3	1.7	8.5	84.7	98.3	79.8	5.[illegible]	16.9	0.7	1.9	97.4	10.13	2.50	112.80	125.43
21	91.0	8.8	0.9	9.0	91.2	99.1	90.1	2.6	7.3	1.0	3.1	95.9	10.88	3.19	90.06	104.13
22	92.3	9.6	0.9	7.7	90.4	99.1	88.8	2.5	8.7	0.8	2.6	90.6	9.19	2.56	87.82	99.57
23	90.0	6.9	0.8	10.0	93.1	99.2	90.8	1.8	7.4	1.0	2.6	96.4	9.01	2.37	83.63	95.01
24	89.0	8.7	1.1	11.0	91.3	98.9	89.0	1.8	9.2	1.3	2.2	96.5	9.75	2.00	82.63	94.38
25	88.9	7.0	1.3	11.1	93.0	98.7	85.9	2.1	12.0	1.1	2.9	96.0	7.94	2.38	75.37	85.69
26	87.3	13.4	1.5	12.7	86.6	98.5	85.3	2.5	12.2	1.5	1.9	96.6	7.25	1.50	66.88	75.63
27	87.6	10.2	1.0	12.4	89.8	99.0	89.8	2.0	8.2	1.5	2.1	96.4	8.06	1.57	65.31	74.93
28	90.5	15.3	1.7	9.5	84.7	98.3	80.6	3.7	15.7	1.2	1.7	97.1	7.13	1.50	68.06	76.69
29	91.5	8.5	0.8	8.5	91.5	99.2	90.7	2.2	7.1	1.3	3.0	95.7	9.75	2.69	79.14	91.58
30	92.2	9.0	0.7	7.8	91.0	99.3	91.0	2.5	6.5	0.7	2.7	96.6	8.25	2.31	75.37	85.93
31	91.1	7.4	0.7	8.9	92.6	99.3	91.1	2.9	6.0	1.0	4.1	94.9	7.94	3.06	65.61	76.61
32	92.1	6.5	1.1	7.9	93.5	98.9	89.2	1.7	9.1	0.8	2.6	96.6	8.56	2.25	78.50	89.31
33	90.3	6.7	0.8	9.7	93.3	99.2	90.3	2.6	7.1	1.0	3.9	95.1	8.94	3.50	80.88	93.32
34	89.4	6.7	1.0	10.6	93.3	99.0	89.4	2.2	8.4	1.2	3.7	95.1	8.13	2.75	66.25	77.13
35	92.7	7.5	0.8	7.3	92.5	99.2	89.0	3.0	8.0	0.6	3.3	96.1	8.13	3.32	91.38	102.83
36	92.4	5.8	0.5	7.6	94.2	99.5	92.6	2.7	4.7	0.7	4.1	95.2	6.88	3.19	69.06	79.13
37	93.2	8.6	0.6	6.8	91.4	99.4	82.5	8.8	8.7	0.4	2.1	97.5	5.25	2.31	81.13	88.69
38	92.0	7.8	0.8	8.0	92.2	99.2	85.4	3.6	11.0	0.5	3.1	96.4	3.56	1.75	51.13	56.44
39	89.8	6.8	0.6	10.2	93.2	99.4	84.7	3.6	11.7	0.4	2.4	97.2	3.62	2.07	76.43	82.12
40	88.0	4.3	0.6	12.0	95.7	99.4	84.3	3.4	12.3	0.6	3.5	95.9	4.25	3.13	82.00	89.38
41	75.7	4.6	0.4	24.3	95.4	99.6	79.9	4.9	15.2	0.6	2.3	97.1	1.94	1.94	78.50	82.38
42	78.8	4.3	0.5	21.2	95.7	99.5	78.5	4.7	16.8	0.7	3.0	96.3	2.44	2.69	81.81	86.94

Spring Pressure

Date 19 Table Test No - 1

Ore No 160 X Description- 10.1% Mag. 89.9% Silicate

Riffles- Butt end Type

	H M S	Revs.
Feed began	12 02 00	35700
Test began	12 20 00	40440
Test ended	12 30 00	
Feed ended	12 31 00	43335

Sketch with dimensions on reverse side of this form, the position of Heads, Middles and Tails bands.

Test made by-

Weight Tested- Lbs.	2444
Feed Orifice- Inch	5/16
Feed- Lbs. per minute	9
Feed- Tons per 24 Hrs.	6.4
No. 4.6 Feed Water- Lbs. per Min.	40
No. 385 Wash Water- Lbs. per Min.	40
Stroke- Inch	5/8
Strokes per Min.	263
Gradienter 2/2 Grade- %	7.6
Spring Pressure- Turns	1.0
Lbs Feed Water : Lbs Feed	= 4.4:1
Lbs Wash Water : Lbs Feed	= 4.4:1
Lbs Feed Water : Lbs Wash Water	= 1 :1
Tons Ore : 1 Ton Concentrates	= 9.2:1

Overall Efficiency.

	Lbs.	Samp. No.	% Wt.	% Fe_3O_4	% SiO_2	lbs Fe_3O_4	lbs SiO_2	% of Total % Fe_3O_4	% of Total % SiO_2
Heads	10.18			91.5	8.5	9.33	0.85	92.9	1.0
Mid'l.	2.50			6.6	93.4	0.163	2.34	1.6	2.8
Tails	81.19			0.7	99.3	0.55	80.64	5.5	96.2
Total	93.87			10.7	89.3	10.04	83.83	100.0	100.0

Size Efficiency.

	+ 10	+ 14	+ 20	+ 28	+ 35	+ 48	+ 65	+100	+150	+200	-200
Heads		99.5	98.7	97.1	94.5	92.7	91.4	90.5	83.4	65.3	
Mid'l.		0.5	0.4	0.6	1.5	2.2	2.4	2.9	3.2	5.0	
Tails		0.0	0.9	2.3	4.0	5.1	6.2	6.6	13.4	29.7	
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

	+ 10	+ 14	+ 20	+ 28	+ 35	+ 48	+ 65	+100	+150	+200	-200
Heads											
Mid'l.											
Tails											
Total											

	gms.	gms Fe_3O_4	gms SiO_2	% Size	wt lbs	lbs Size	% Fe_3O_4	lbs Fe_3O_4	% SiO_2	lbs SiO_2	1
+ 10											
14											
20											
28											
35											Feed
48											
65											
100					152.00						
150											
200											
-200											
Total											
+ 10											
14											
20	1.13	1.13	0.00	1.65		0.17	100.00	0.17	0.00	0.00	
28	15.59	15.59	0.00	22.75		2.32	100.00	2.32	0.00	0.00	
35	14.07	14.07	0.00	20.55		2.10	100.00	2.10	0.00	0.00	Heads
48	8.14	8.07	0.07	11.85	10.18	1.20	99.1	1.19	0.9	0.01	
65	8.07	7.46	0.61	11.75		1.19	92.5	1.10	7.5	0.09	
100	8.33	5.81	2.49	12.13		1.24	71.2	0.88	28.8	0.36	
150	7.80	5.47	2.33	11.37		1.16	70.4	0.82	29.6	0.34	
200	2.35	2.08	0.27	3.43		0.35	88.6	0.31	11.4	0.04	
-200	3.04	2.44	0.08	4.44		0.45	96.9	0.44	2.63	0.01	
Total	68.52	62.62	5.85	100.0		10.18	91.5	9.33	8.5	0.85	
+ 10											
14											Midd.
20	0.02	0.01	0.01	0.06		.0015	50.0	.0007	50.0	.0007	
28	0.18	0.113	0.05	0.57		.0142	62.9	.0089	27.6	.0053	
35	0.42	0.18	0.24	1.18		.0295	42.9	.0126	57.1	.0169	
48	1.33	0.27	1.06	3.74		.0935	20.3	.0190	79.7	.0745	
65	8.40	0.38	8.02	23.60	2.50	.5900	4.5	.0265	95.5	.4635	
100	13.56	0.33	13.23	38.20		.9550	2.4	.0229	97.6	.9321	
150	9.87	0.37	9.50	27.80		.6950	3.7	.0257	96.3	.6693	
200	1.06	0.17	0.89	2.98		.0745	16.5	.0123	83.5	.0622	
-200	0.72	0.49	0.23	2.02		.0505	68.2	.0344	31.8	.0161	
Total	35.56	2.313	33.23	100.0		2.50	6.6	16.30	93.4	23.406	

	gms.	gms Fe_3O_4	gms SiO_2	% size	wt lbs.	lbs size	% Fe_3O_4	lbs Fe_3O_4	% SiO_2	lbs SiO_2	1
+ 10											
14											
20	0.01	0.00	0.01	0.03		0,02	0.00	0.00	100.0	0.02	
28	0.63	0.01	0.62	1.54		1.25	1.40	0.02	98.6	1.23	
35	8.57	0.02	8.55	21.00		17.05	0.30	0.05	99.7	17.00	
48	8.53	0.03	8.50	20.85		17.00	0.30	0.05	99.7	16.95	tails
65	7.99	0.04	7.95	19.60		15.90	0.40	0.06	99.6	15.84	
100	5.75	0.03	5.72	14.10	81.19	11.41	0.50	0.06	99.5	11.35	
150	5.74	0.04	5.70	14.00		11.36	0.50	0.06	99.5	11.30	
200	2.09	0.02	2.06	5.12		4.15	1.40	0.05	98.6	4.10	
-200	1.53	0.10	1.43	3.75		3.05	6.50	0.70	93.5	2.85	
Total	40.84	0.29	40.54	100.0		81.19	0.7	0.55	99.3	80.64	

Total

Fe_3O_4	+10	+ 14	+ 20	+ 28	+35	+ 48	+ 65	+100	+150	+200	-200
Heads			0.17	2.32	2.10	1.19	1.10	0.88	0.82	0.31	0.44
Feed.			0.001	0.009	0.013	0.019	0.026	0.023	0.026	0.012	0.034
tails.			0.00	0.02	0.05	0.05	0.06	0.06	0.06	0.05	0.20
Total			0.171	2.349	2.163	1.259	1.186	0.963	0.906	0.372	0.674

Total

Total

Total

Date	1920	Table Test No -	6
Ore No 160 X	Description- 10.5 % Magnetite 89.5 % Ferrite quartz		

Riffles- Type

H M S	Revs.		
		Weight Tested- Lbs.	250
		Feed Orifice- Inch	5/16
Feed began	10 17 00	Feed- Lbs. per minute	9.4
Test began	10 28 00	Feed- Tons per 24 Hrs.	6.8
Test ended	10 38 00	No. 32.5 Feed Water- Lbs. per Min.	20
Feed ended	10 43 00	No. 38.5 Wash Water- Lbs. per Min.	40

Sketch with dimensions on reverse side of this form, the position of Heads, Middles and Tails bands.

Test made by-

Stroke- Inch	5/8
Strokes per Min.	260
Gradienter 1°91 Grade- %	6.85
Spring Pressure- Turns	1
Lbs Feed Water : Lbs Feed	= 2.1 :1
Lbs Wash Water : Lbs Feed	= 4.2 :1
Lbs Feed Water : Lbs Wash Water	= 0.5 :1
Tons Ore : 1 Ton Concentrates	= 9.1 :1

Overall Efficiency.

	Lbs.	Samp. No.	% Wt.	Analyses % Fe_3O_4	% SiO_2	lbs Fe_3O_4	lbs SiO_2	% of Total Fe_3O_4	SiO_2
Heads	10.50			87.2	12.8	9.15	1.35	91.8	1.6
Mid'l.	4.37			4.2	95.8	0.19	4.18	1.9	4.8
Tails	81.25			0.8	99.2	0.62	80.63	6.3	93.6
Total	96.12			10.3	89.7	9.96	86.16	100.0	100.0

Size Efficiency.

	+ 10	+ 14	+ 20	+ 28	+ 35	+ 48	+ 65	+100	+150	+200	-200
Heads			100.0	98.7	97.5	90.3	89.6	87.7	85.8	80.0	75.1
Mid'l.			0.0	0.4	0.5	1.6	3.5	3.7	3.3	5.0	4.1
Tails			0.0	0.9	2.0	8.1	6.9	8.6	10.9	15.0	20.8
Total			100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

	+ 10	+ 14	+ 20	+ 28	+ 35	+ 48	+ 65	+100	+150	+200	-200
Heads											
Mid'l.											
Tails											
Total											

	Gms.	Gms Fe3O4	Gms SiO2	% Size	Wt lbs	lbs Size	% Fe3O4	lbs Fe3O4	% SiO2	lbs SiO2	
+ 10											
14											
20											
28											
35											
48					153.43						
65											Feed
100											
150											
200											
-200											
Total											
+ 10											
14											
20	0.56	0.56	0.00	1.68		0.18	100.0	0.18	0.0	0.00	
28	7.41	7.41	0.00	22.35		2.34	100.0	2.34	0.0	0.00	
35	6.77	6.72	0.05	20.30		2.13	99.0	2.11	1.0	0.02	
48	3.79	3.75	0.04	11.32	10.50	1.19	99.4	1.12	0.6	0.07	
65	3.56	3.31	0.25	10.65		1.12	93.2	1.04	6.8	0.08	Heads
100	3.69	2.47	1.22	11.06		1.15	62.0	0.71	38.0	0.44	
150	4.37	2.50	1.87	13.10		1.38	57.0	0.79	43.0	0.59	
200	1.37	1.02	0.35	4.12		0.43	74.4	0.32	25.6	0.11	
-200	1.84	1.72	0.12	5.52		0.58	93.5	0.54	6.5	0.04	
Total	33.36	29.46	3.90	100.00		10.58	87.2	9.15	12.8	1.35	
+ 10											
14						0.00	~~50.0~~				
20	0.01	0.005	0.005	0.03		0.00	50.0	0.00	50.0	0.00	
28	0.09	0.06	0.03	0.30		0.01	67.0	0.007	33.0	0.003	
35	0.56	0.09	0.47	1.88		0.08	16.1	0.01	83.9	0.07	
48	2.56	0.17	2.50	8.97		0.39	6.3	0.02	93.7	0.37	
65	8.73	0.26	8.47	29.40	4.37	1.29	3.0	0.04	97.0	1.25	Midd
100	9.43	0.21	9.22	31.70		1.39	2.2	0.03	97.8	1.36	
150	6.58	0.22	6.36	22.15		0.97	3.3	0.03	96.7	0.94	
200	1.15	0.11	1.04	3.86		0.17	9.6	0.02	90.4	0.15	
-200	0.51	0.24	0.27	1.71		0.07	47.2	0.03	52.8	0.04	
Total	29.73	1.365	28.365	100.00		4.37	4.2	0.187	95.8	4.183	

	gms	Gms Fe_3O_4	Gms SiO_2	% Size	Wt lbs	lbs Size	% Fe_3O_4	lbs Fe_3O_4	% SiO_2	lbs SiO_2	
+ 10											
14											
20	0.005	0.00	0.005	0.01		0.01	0.00	0.00	100.0	0.01	
28	0.80	0.01	0.79	1.83		1.48	1.2	0.02	98.8	1.46	
35	9.25	0.01	9.24	21.15		17.20	0.2	0.04	99.8	17.16	
48	9.44	0.03	9.41	21.65	81.25	17.60	0.5	0.10	99.5	17.50	Tails
65	8.70	0.05	8.65	20.00		16.28	0.5	0.08	99.5	16.20	
100	5.93	0.04	5.89	13.55		11.00	0.6	0.07	99.4	10.93	
150	5.78	0.04	5.74	13.20		10.70	0.7	0.10	99.3	10.60	
200	2.12	0.03	2.09	4.87		3.96	1.3	0.06	98.7	3.90	
−200	1.63	0.08	1.55	3.74		3.02	5.0	0.15	95.0	2.87	
Total	43.655	0.29	43.365	100.00		81.25	0.8	0.62	99.2	80.63	

Total

	+10	+ 14	+ 20	+ 28	+35	+ 48	+ 65	+100	+150	+200	−200
Heads			0.18	2.34	2.11	1.12	1.04	0.71	0.79	0.32	0.54
Midd			0.00	0.01	0.01	0.02	0.04	0.03	0.03	0.02	0.03
Tails			0.00	0.02	0.04	0.10	0.08	0.07	0.10	0.06	0.15
Total			0.18	2.37	2.16	1.24	1.16	0.81	0.92	0.40	0.72

Total

Total

Total