SCREENING DEVICES, WITH PARTICULAR REFERENCE TO THE CALLOW REVOLVING BELT SCREEN

"THE EFFICIENCY OF FINE SCREENING DEVICES,

(with more particular reference to the CALLOW REVOLVING BELT SCREEN, as a means of preparing crushed ore for treatment upon the WILFLEY TABLE.")

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John. R. Cox.

In these days of close commercial competition the line between the success or failure of many industrial enterprises is often perilously narrow and their directors must needs either revert to the uncivilized methods of our predecessors - the robber barons - or devise some method of raising the efficiency of their producing plant in order to continue making a reasonable profit.

Mine owners have found this out to their cost as silent mills in many parts of the country bear witness. The cause of their closing down is no doubt not directly traceable to competition, but is in many cases due to the lowering of the grade of ore produced by the mine. In either case the result is the same and their life might have been perhaps indefinitely lengthened by a small increase in efficiency.

The science of ore-dressing has come forward nobly to their aid; in the last twenty years especially, the advance both as regards the invention of radically new methods as well as in devising means of increasing the efficiency of old methods, has been most marked.

Mines which ten -- even five -- years ago in some instances, were regarded as having lived their span of life because the grade of their ore had fallen too low, have now been re-opened, and specially designed mills are profitably concentrating the low grade ore and former waste dumps.

Low grade ore-bodies which a decade ago no man in his senses would have dreamed of opening up, are now successfully worked and the means of livelihood of thousands of men.

One of the causes of these far-reaching and beneficial changes is the improvement in the art of screening. This process, thanks to modern improvements, can now be carried xx economically and with moderate efficiency, several stages further than was hithertofore deemed possible.

Until recent years not much screening was done of material finer than about 1^{mm}. For sizes larger than this some form of revolving trommel is most commonly used, but it has not been found economical to use this type of screen for fine material owing to the expense of the frequent renewal of the large screen areas employed, and the blinding of the screens. Material finer than 1^{mm} was therefore generally treated in some form of hydraulic classifier or system of settling tanks. This method is however open to the objection that more mineral is generally lost in the tailings of concentrating devices using classified feed than is the case where screen sized feed is used; hence many attempts have been made to evolve a screening machine which would economically take the place of classifiers.

In the quest for a good fine screening machine five general types seem to have been evolved:

(1) Shaking Screens

(a) flat, } being 1. Horizontally shaken. or 2. Vertically shaken.
(b) inclined,

(2) Vibrating screens, inclined.—(Likewise called impact screens)

(3) Stationary conical screens having the feed projected upon the screen surface with some force.

(4) Screens fixed in a cylindrical or conical frame, the whole revolving upon an axis usually inclined.

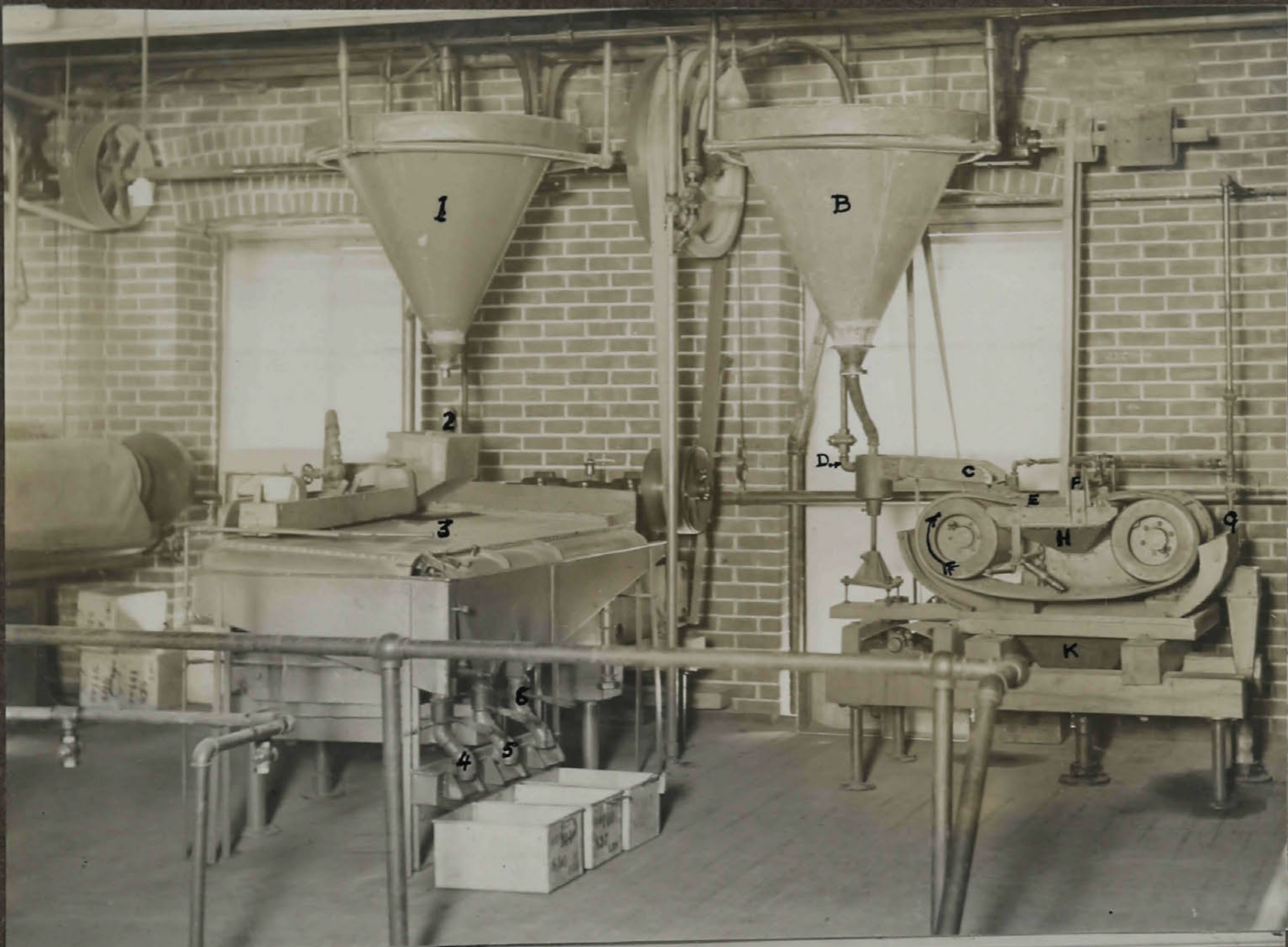
(5) Screens of the belt type.

Very little information of value is to be found as to the work of these screens. Types (1) and (2) do good work and the vertically shaken screens are free from blinding, but both are expensive in upkeep. Types

Key to Photograph.

A. Feed cone for hydraulic elevator.
B. Feed cone for Callow Screen
C. Feed sole - or distributor.
D. Feed water supply.
E. Screening belt.
F. Shaking spray.
G. End cleaning spray.
H. Undersize hopper.
K Oversize hopper.
L Receiving cone for undersize.
M " " " oversize.

1. Feed Cone for Wilfley Table.
2. Feed water supply.
3. Wilfley table.
4. Heads discharge.
5. Middles discharge.
6. Tailings discharge
7. Receiving cone for Tailings.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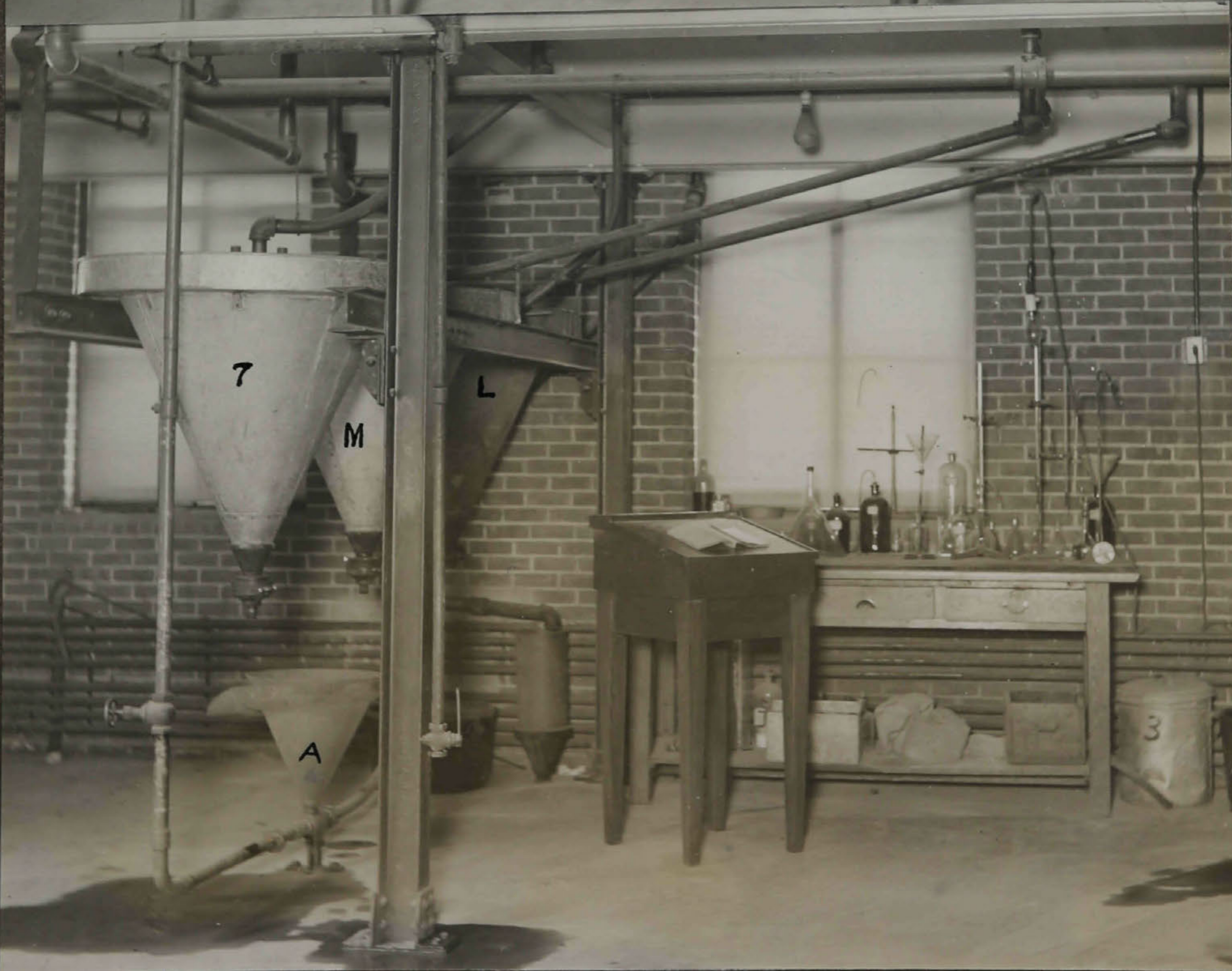
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(3) and (4) are more apt to blind but the screens do not wear out so quickly.

The 5th type does moderately good work, is quite free from blinding and has a large capacity. The Callow screen is of this type, and the following tests were all done upon this screen. It consists of an endless belt of screen cloth (about eight feet in circuit and one foot wide) edged by rubber lips which prevent the sands from spilling off the screen, and take the strain of driving off the cloth. This belt is carried on two overhung horizontal shafts one foot in diameter and travels at from 30 to 120 feet per minute. The sands are distributed across the width of the belt by a slightly sloping feed sole, and fall in the direction of travel of the belt. A shaking spray near the centre of the belt helps to put the undersize through. The oversize is washed off the top of the belt by another spray as it passes over the tail roller. This machine should have a capacity of rather less than a quarter that of the standard Callow screen which has two belts each two feet wide and slightly longer than this one.

DESCRIPTION OF TESTS CARRIED OUT.

Two series of tests were made; one upon barren sands, and one to prepare some ore for concentration on the Wilfley Table.

For the first series a considerable quantity of a pure hard nepheline syenite was obtained from the Forsyth quarries at the back of Mount Royal: This was crushed to a maximum size of about 1 inch and then fed to a Huntingdon mill having an 18# discharge screen.

The pulp from the mill was elevated by a small centrifugal pump to a small desliming cone which took out the major portion of the slimes. A screen analysis of the remaining sands showed the following distribution of sizes:

	Mesh.	% Weight.
On	20	7.0
"	30	17.2
"	40	7.9
"	60	12.4
"	80	15.2
"	100	3.2
Thro'	100	37.1
		100.0

The writer believes that in any system where crushed material is treated on screens or in classifiers, it is the best practice first to remove most of the slimes. No screen or classifier can be expected to do good work on a feed crowded with slimes.

The Callow screen was fed from a cone capable of holding about 500 lbs. of pulp; the pulp was sent up into the cone by means of a hydraulic elevator, the surplus water overflowing from the lip of the cone and carrying a small amount of slimes with it. The water necessary to operate this elevator amounted to about 18 gals. per minute. Unfortunately there was a certain amount of classifying on this account, so that the feed at the beginning of each coneful was generally somewhat coarser than near the end, and the very end of a coneful of sand was always marked by a rush of fines, which in some cases had a noticeable effect upon the run.

The bottom of the cone was provided with a series of interchangeable circular orifices held by grooved side pieces. These orifices varied from 1/4" up to 3/4" in diameter, the difference between each size being 1/16". So long as the size of the pulp and the head of water in the cone was kept the same, the rate of feed from any one orifice remained practically constant.

The amount of water in the feed stream was remarkably constant, no matter what the size of the pulp, at about 35%. Any additional water to bring the ratio of water to feed, up to the required figure, was added from a calibrated cock at the head of the feed sole.

A glance at the screen analysis of the sands, showed that a 60 mesh screen doing perfect work would pretty evenly divide the feed, - there being 55.5% of the sands through 60 mesh. Hence a 60# screen was used for the first six runs and the rate of feed, belt speed, and water varied.

Table I gives the results of these runs.

Table II gives the results of the runs on ore subsequently used for the Wilfley Table.

The capacities given by the manufacturers for the screen are as follows, assuming a 1:1 feed.

Mesh	Tons/24 hrs. Standard Size	Tons/24 hrs. Small size	lbs/min. Small size
20	250	62.5	87.0
30	200	50.0	69.5
40	150	37.5	52.2
60	125	31.2	43.3
100	75	18.7	26.0

It will be noticed that throughout the tests the capacities obtained averaged about one third of these amounts. The writer is of the opinion that both this and the somewhat low efficiencies obtained may be traced to the fact that in all cases the screen cloth used conformed to the standards recently recommended by the Institute of Mines and Metallurgy--that is, the wire used in making the screens is the same size as the space between each wire, so that the percentage of opening is only 25%, whereas the screens ordinarily in use may have a percentage of opening as high as 45% with a disproportionately larger increase in capacity.

The "efficiency" of a screen has been taken as the quantity of undersized material passed through the screen, expressed as a percentage of the amount of undersized material in the screen feed. Thus a screen which left no undersize material in the oversize, would have 100% efficiency.

The factors which affect this efficiency are:-

(1) The thickness of the bed of sands on the screen.

(2) The time this bed is allowed to remain upon the screen.

(3) The ratio of the quantities of oversize to undersize.

(4) The amount of water in the pulp (if wet screening is employed).

(5) The proportion of material which is nearly but not quite small enough to pass through into the undersize.

(6) The percentage of opening of the screen employed.

With regard to (1) and (2) it is obvious that the thinner the bed the quicker the screening will be done, and the greater will be the efficiency, but the smaller the capacity.

A consideration of the third factor brings to light a weakness in the use of the above definition of efficiency as a means of judging the quality of the work done by the screen. Take for instance two lots of sand of say 100 lbs each. Screen analysis shows that Lot 1 has 20% and Lot 2, 60% of particles below a certain screen size. These lots are then screened on the same sized screen under conditions such that the efficiency is the same - say 75% in both cases. The undersize remaining in the oversize after the screening will in the case of Lot 1, amount to $(20 - \frac{75}{100} \text{ of } 20) = 5$ lbs, or 5.88% of the "oversize" produced. In the case of lot 2, it will be $(60 - \frac{75}{100} \text{ of } 60) = 15$ lbs. or 27.3%. In each case the efficiency is the same yet there is a difference of over 20% in the percentages of undersize left in the "oversize", a fact which must be borne in mind when comparing the work of different screens.

(4). Up to the point when the screen begins to get flooded, the more water the better the screening will be done.

(5) Some types of screens rapidly become blinded where there is much material of this class.

(6) The best screening will naturally be done with screens having a large per cent of opening, but such screens wear out quickly and their meshes are likely to become deformed.

TABLE I. - CALLOW SCREEN TESTS.

Test No.	Mesh of Screen Used.	Undersize in Feed. % of Feed.	Wt. Oversize lbs.	Weight undersize lbs.	Undersize left in oversize. % of overs.	Efficiency %	Orifice	Rate of Feed. Lbs/Min.	Belt Speed Ft per Min.	Ratio Water Dry Feed.
Sy.1	60#	55.5	100.0	35.0	40.0	46.7	7/16"	17.5	90	3.6
Sy.2	60#	36.4	126.0	44.0	14.1	71.2	7/16"	15.9	86	3.8
Sy.3	60#	40.2	110.0	43.0	16.9	69.9	7/16"	15.4	86	5.4
Sy.4	60#	39.8	69.0	30.0	13.6	76.2	7/16"	14.3	86	7.2
Sy.5	60#	21.4	135.0	21.5	8.8	64.5	5/8"	31.3	86	3.5
Sy.6	60#	42.4	124.5	52.2	18.2	69.7	3/8"	11.8	86	4.1
Sy.7	100#	35.3	106.0	23.0	13.6	61.5	3/8"	10.7	100	4.9

TABLE II. - CALLOW SCREEN TESTS.

est o.	Mesh of Screen Used.	Under-size in Feed % of Feed.	Wt. Over-size lbs.	Weight under-size Lbs.	Under-size left in over-size % of overs.	Efficiency %	Orifice	Rate of Feed lbs/min.	Belt Speed Ft per Min.	Ratio, Water / Dry Feed.
n.1(a)	100#	13.1	58.5	4.4	7.0	51.7	3/8"	18.0	100	3.2
n.1(b)	100#	5.2	92.0	3.4	1.7	67.7	5/16"	9.4	100	5.9
n.1.	100#	13.9	1659.0#	183.0	4.4	71.4	5/16"	9.0	100	5.9
n.2.	60#	20.2	1462.0#	181.0	10.3	54.5	(7/16" & 3/8")	17.7	90	3.8
n.3(a)	40#	34.4	253.0	42.0	23.5	41.6	1/2"	26.8	80	2.8
n.3.	40#	28.8	1175.0	243.0	14.0	59.6	7/16"	22.1	80	2.9
n.4(a(	30#	42.1	131.0	32.8	27.7	47.4	1/2"	32.0	(80-120)	2.4
n.4.	30#	39.8	911.0	252.0	23.2	54.3	7/16"	23.4	80	3.3
n.5.(a)	20#	73.4	112.0	51.8	61.1	43.2	1/2"	32.0	65	2.4
n.5(b)	20#	76.9	99.0	61.8	62.5	50.0	1/2"	32.0	95	2.7
n.5.	20#	74.5	435.0	326.0	55.6	57.4	7/16"	23.0	80	3.1

Commenting upon the runs individually it will be noticed that the efficiency of Sy.I Table I is only 46.7%. This is in part due to the larger proportion of fines in the feed (55.5%) and in part to a rush of fines at the end of the run, some of which in consequence got carried over into the oversize. In the rest of the tests in Table I the run was always stopped before the sand in the feed cone got too low.

Tests Sy.2, 3 & 4 show the influence of varying the ratio of feed water to feed. With a ratio of 3.8 we get an efficiency of 71.2 per cent. By increasing this ratio 90% to 7.8, we get an increase of efficiency of only 7% to 76.2% (5% absolute).

In Sy.5 the rate of feed was doubled with a decrease in efficiency of only 6.7 from Sy.2. It will be noted however that the percent of fines in the feed was much less - 21.4 instead of 36.4 in Sy.2.

In Sy.6 the reduction of the feed to only 11.8 lbs./ min. failed to give a very good efficiency.

Sy.7 was run to get an idea of the working of the 100# screen before starting to prepare the copper ore for the Wilfley Table.

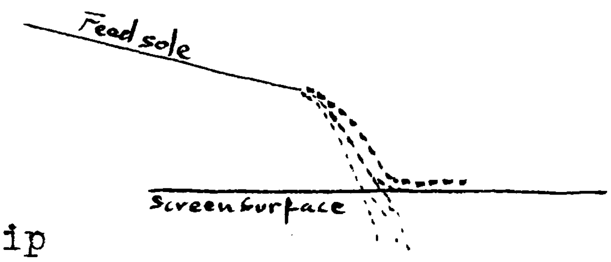
Table II shows the results of the runs on this copper ore. With the exception of Cu.1 the efficiencies are lower than in Table I, chiefly on account of the large amounts of undersize in the respective feeds especially in the coarser sizes. Furthermore the runs in this table had to be carried to the very end of the feed, with the consequent rush of fines at the end.

Runs followed by a letter - e.g. Cu.1.(a) - (b), etc., were test runs as a guide to determining the best working conditions for each screen. The products of these test runs were mixed and added to the feed for the main run.

It will be noticed that the ratio of water to feed is largest with the fine screens and smallest for the coarse screens. It was found to beimpossible to keep the ratio much higher than 3:1 with the coarse screens without flooding them.

Runs Cu.5 (a) and (b) shew the effect of varying the speed of the belt. The increase of speed from 65 to 95 feet per min., thus giving a thinner bed of pulp upon the screen, increases the efficiency from 43.2 to 50.0%. It would seem advisable therefore to use only high speeds, but it has been found in practice that high speeds wear out the belts too quickly, because of the greater strain on the cloth and the rapid bending and unbending of the mesh as it passes over the rollers. It is a great deal owing to this bending of the mesh, that the Callow Screen is so free from blinding. Any grains that may have stuck in the openings are loosened by the bending of the cloth and are at once washed off by the cleaning spray opposite the end of the roller.

The feed sole, which is fan shaped, gives a very even distribution of the feed over the belt, and during the course of the two inch drop from the lip of the feed sole to the surface of the screen a certain amount of separation takes place between the large and small grains which helps the screening action very considerably. The large grains, owing to their greater momentum have a slightly flatter trajectory on leaving the lip



of the feed sole, than have the small grains; consequently the large grains strike the screen a little in front of the small grains.

These latter, unhindered by large grains, immediately pass through the screen. This idea is borne out by the fact that the screening action is practically completed in the first inch after the feed stream strikes the screen. The shaking spray seems to put through very little undersize.

In general the Callow screen is a reasonably efficient machine of large capacity. Screen cloth of the Institute of Mines and Metallurgy standards would however probably not prove economical to use with screening machines of this type, due consideration being paid to capacity and efficiency.

Belt speed should be as high as is consistent with a reasonable charge for screen renewals.

Some form of dewatering device will be found necessary in most cases before screening.

No doubt some learned archaeologist will eventually show us that the advanced civilization of the early Romans or Egyptians has produced a method of screening - long since forgotten - - far more efficient than ours, but however that may be we must for the present put up with our somewhat imperfect methods while looking for a genius who will present us with something equally good.

THE RELATIVE MERITS OF SCREEN-SIZED, CLASSIFIED AND NATURAL FEEDS FOR THE WILFLEY TABLE.

The mill-designer who has decided to concentrate part or all of his ore upon Wilfley Tables, after crushing it fine enough to free most of the mineral from the gangue, has three courses open to him:-

He may (1) Divide it into groups of particles according to size, i.e. by screening.

(2) Divide it into groups of particles according to both size and specific gravity, i.e. by hydraulic classification.

(3) Dispense with both the above methods and treat the crushed ore directly on the tables with no preparation other than to ensure having it fine enough for efficient treatment, and to have the major portion of the slimes eliminated by some desliming device.

Each course has its group of advocates and each group of advocates is equally positive that theirs is the only logical and practical method for progressive mill designers to adopt.

Up to the present very little work has been done to prove definitely which is the better course to follow, and we have had to do the best we can with such data as could be obtained from mills in operation. This was unsatisfactory and inconclusive because it was not possible to find three mills each illustrative of one type of treatment and all working upon identically the same ore.

Some four years ago, R.H. Richards -- the well known ore-dressing expert of the States -- undertook a series of tests in order to throw more light upon this question. The results of these tests have furnished us with much valuable information, but there is reason to believe that the conclusions arrived at would not be confirmed in the event of their application to practical conditions. In the first place the tests were all performed upon a miniature table only 2' x 4' in size, which though provided with sunken riffles in order to prevent undue heaping up of the concentrating area, could hardly be expected to perform the same type of work as the full sized table, or even the half size laboratory table, such as was used in these experiments. The table may have been an exact replica to a smaller scale, but the relative sizes of the grains treated must of necessity remain the same and their behaviour would undergo a change.

Another point to be noted in connection with Richard's results is that the material used for the feed was composed of pure mineral and pure gangue crushed and mixed so that there were no grains consisting partly of mineral and partly of gangue - a condition seldom if ever met with in practice.

Again the feed for his sized-feed runs was very carefully sized between the limiting screens so that in any one size there were no grains left which by right belonged to the next size smaller. With normal practice a particular screen size will contain from 10 to 70% of under-size particles which are bound to affect the results obtained. All the tests following were made with such imperfectly sized material

Furthermore, the quantities used in the various tests were very small - some being less than 1 Kg. and none greater than about 15 Kg. The unavoidable errors at the beginning and end of the runs must have had a large effect upon such small amounts.

For these reasons therefore there seemed ample room for an investigation of the question under conditions more nearly approximating those to be found in outside practice.

For this purpose a lot of about three tons of ore from the Bruce Mines was obtained: This is an exceptionally clean ore consisting of almost pure quartz and chalcopyrite and runs about 2-1/2 per cent copper. This was crushed and fed to a Huntingdon mill having an 18 mesh discharge screen. The pulp from the mill was elevated to a small desliming cone and a large part of the slimes eliminated. The product dried and sampled was divided into 3 approximately equal parts to be used one for Natural Feed, one for Classified feed, and the third for Sized Feed tests:

The Natural feed tests will be dealt with later. The preparation of the Classified feed will be found described by Mr Gibbins.

The preparation of the Sized feed has already been partially described in connection with the Callow Screen tests and the results will be found in Table II.

The unsized ore amounted to 1850 lbs. which was all put over the 100# screen yielding 183 lbs. of undersize which was dried and bagged; the oversize was returned to the feed cone and retreated on the 60 mesh screen, and so on.

Owing to the fact that there was not time to dry and weigh the large amounts of oversize, the actual amounts fed to any one screen, could not, except in the first instance, be determined.

The balance sheet stands therefore as follows:

	lbs.	lbs.
Total ore fed ------------------	1851	
Total of various sizes produced		1620
Feed and screen analysis samples		100
Loss		131
TOTAL	1851	1851

60% of this loss was probably made in the handling, the rest being slimes carried off by the overflow from the hydraulic elevator which no doubt was responsible for the production of a considerable amount of slimes.

Five screens were used, making six sizes, namely, On 20, 30, 40, 60 and 100 mesh and through 100 mesh.

Six products were likewise made with the classifier, the finest product being taken out first and then the coarsest, followed by successively finer sizes.

Up to the present, owing to lack of time, only one run has been made upon Natural Feed, (i.e. Unsized and Unclassified), but Mr Gibbins and myself hope to be able to find time to make four more runs with Natural Feed after the close of term.

The thirteen products above mentioned were concentrated upon the Wilfley Table, and the results will be found tabulated in Tables III to XIII.

Tables III, IV, and V. show the conditions under which the runs were made.

Tables VI, VII, and VIII show the distribution of the copper and the screen analyses of the feed and products.

Table IX shows the distribution of the products and the recovery effected in each product.

Tables X, XI and XII give the recovery effected in each part of each product when split up by screen analysis intosix sizes -- On 20, 30, 40, 60, 100 and through 100 mesh.

Especial care was taken to ensure having a uniform feed and to this end the feed was put into the feed cone by hand, the hydraulic elevator not being used.

In each test the table was adjusted so as to make apparently clean Heads and Tails. The Middles were not returned to the table for retreatment, because they contained a considerable quantity of grains with included mineral; in practice they would be re-crushed and treated on a separate table.

Richards in calculating the feed for his small table assumed that the capacity of a table is directly proportionate to its area. This would hardly seem to be borne out by the figures given in Tables III, IV, and V. The area of the standard table is roughly 95 square feet, that of the table here used, 22 square feet -- 1/4 the area. The average feed for the standard table is 18 tons /24 hours; that of the small table, 8 tons per 24 hours, -- a little less than 1/2.

It seems more likely that the capacity would vary according to the area of the table actually covered by the ore stream, that is, the capacity would vary for all practical purposes according to the diagonal length of the table, or as 7.7 is to 17 = $\frac{1}{2.21}$, which is practically the same as the ratio of the feeds $\frac{8}{18} = \frac{1}{2.25}$

T A B L E III.

OPERATING CONDITIONS FOR WILFLEY TABLE RUNS.

SCREENED FEED

	S 1	S 2	S 3	S 4	S 5	S 6
ight of Feed - Lbs.	435.	335.	250	243	181	182
ble inclination	4°-51	4°-51	3°-52'	3°-08'	2°-00'	Nil
.P.M.	272	272	285	272	278	----
row	7/8"	7/8"	11/16"	5/8"	5/8"	1/2"
ed orifice	3/8"	3/8"	3/8"	5/16"	5/16"	5/16"
me of run	26½'	18¼'	15'	26¼'	27'	60'
te of feed -Lbs/Min.	16.4	17.8	16.7	9.4	6.7	3.0
" " " tons/24hrs	11.8	12.8	12.0	6.8	4.8	2.2
eed water- lbs/min.	27.5	29.7	28.5	27.5	31.0	26.1
ash " " "	52.9	30.6	----	53.5	44.0	75.0
TOTAL	80.4	60.3	----	81.0	75.0	101.1
atio -Water to feed	4.9	3.4	----	8.6	11.2	33.6
dth of Heads	1½"	2½"	4½"	4"	6"	8"
" " Middles	2-5/8"	2-5/8"	2-5/8"	3½"	4½"	12"
eight of Heads lbs	17.4	16.9	17.2	21.6	22.9	23.6
Middles "	19.4	22.2	12.2	14.2	15.4	58.0
Tails "	393.0	295.0	219.0	203.0	140.0	92.0
TOTAL	429.8	334.1	248.4	238.8	178.3	173.6
oss	5.2	0.9	1.6	4.2	2.7	8.4
oss percent	1.2	0.3	0.6	1.7	1.5	4.6

T A B L E IV.

OPERATING CONDITIONS FOR WILFLEY TABLE RUNS

CLASSIFIED FEED.

	C 1.	C 2.	C 3.	C 4.	C 5.	C 6
Weight of feed in Lbs.	259	280	251	296	295	378
Table inclination	4°-50'	5°-01'	4°-28'	4°-09'	2°-45'	1°-25'
R.P.M.	268	272	272	272	276	272-320
Throw	7/8"	7/8"	11/16"	5/8"	5/8"	1/2"
Feed Orifice	3/8"	3/8"	5/16"	5/16"	5/16"	5/16"
Time of run	15'	17'	23'	29'	30'	75'
Rate of feed-lbs/min.	17.2	16.5	10.9	10.2	9.9	5.0
" " " tons/24hrs	12.4	11.9	7.8	7.3	7.1	3.6
Feed Water- lbs/min.	26.6	35.2	36.2	35.2	34.0	57.0
Wash " " "	55.4	32.8	42.8	33.0	41.0	87.0
TOTAL	82.0	68.0	79.0	68.2	75.0	144.0
Ratio water to feed	4.8	4.1	7.2	6.7	7.6	28.8
Width of Heads	6"	3"	2.5"	2.5"	4"	3"
" " Middles	3-5/8"	3-5/8"	3"	3"	2-3/4"	12"
Weight of Heads lbs.	36.1	20.6	13.1	15.4	17.1	15.8
" " Middles "	24.4	23.5	17.6	20.0	20.3	74.5
" " Tails "	196.0	232.0	219.0	257.0	251.0	270.0
TOTAL	256.5	276.1	249.7	292.4	288.4	360.3
Loss	2.5	3.9	1.3	3.6	6.6	18.0
Loss per cent	1.0	1.4	0.5	1.2	2.2	4.8

TABLE V.

OPERATING CONDITIONS FOR WILFLEY TABLE RUNS.

NATURAL FEED.

	N 1.	N 2.	N 3.	N 4.	N 5.
Weight of feed -Lbs	26.8				
Table inclination	3°-10'				
R.P.M.	284				
Throw	5/8"				
Feed Orifice	5/16"				
Time of run	30'				
Rate of feed- lbs/min.	9.0				
" " " tons/24hrs	6.5				
Feed water-Lbs/min	30.0				
Wash " " "	52.0				
TOTAL	82.0				
Ratio - Water to feed	9.1				
Width of heads	2-1/2"				
" " Middles	6-1/2"				
Weight of Heads lbs.	16.7				
" " Middles "	39.7				
" " Tails "	208.0				
TOTAL	264.0				
Loss	3.6				
Loss per cent	1.3				

TABLE VI

WILFLEY TABLE TESTS - SCREENED FEEDS.

		FEED.				HEADS.				MIDDLES.				TAILS.				TOTAL	
TEST.	MESH	Wt.	% Wt.	% Cu.	Lbs. Cu.	Wt.	% Wt.	% Cu.	Lbs. Cu.	Wt.	% Wt.	% Cu.	Lbs. Cu.	Wt.	% Wt.	% Cu.	Lbs. Cu.	Lbs. Cu.	Wt.
S1		430		1.51	6.50	17.4		20.81	3.62	19.4		2.07	0.40	393		0.47	1.85	5.87	430^{0}
	20	192	44.4	1.57	3.02	4.3	24.6	28.20	1.21	0.7	3.9	25.34	0.18	190^{2}	48.2	0.53	1.01	2.40	195^{0}
	30	190^{0}	44.2	1.28	2.43	6.7	38.6	28.25	1.89	8.4	43.2	2.21	0.19	172^{2}	43.8	0.37	0.64	2.72	187^{1}
	40	38^{0}	8.9			3.6	21.0	9.50	0.34	7.6	39.4	0.39	0.03	27^{0}	6.9				38^{2}
	60					2.2	12.4			2.2	11.7			3^{4}	0.8				
	100	10^{0}	2.4			0.3	2.0	2.72	0.07		1.3			1^{0}	0.2				
	-100			1.13	0.54	0.2	1.0	28.10	0.06	0.3	0.4	0.62	0.02		0.1	0.64	0.20	0.72	9.6
		430			5.99	17.3			3.57	19.2	99.9		0.42	393^{4}	100^{0}		1.85	5.84	429^{9}
S.2		334^{0}		2.03	6.77	16.9		28.10	4.77	22^{2}		3.43	0.76	295		0.39	1.14	6.67	334^{0}
	20	6^{7}	2.0				0.9				0.2			6^{3}	2^{2}				
	30	159^{0}	47.6	1.95	3.23	6.8	39.2	30.74	2.09	1.6	7.0	26.34	0.42	149^{8}	50^{8}	0.51	0.79	3.30	164^{5}
	40	103^{0}	30.8	1.99	2.05	5.0	29.7	31.40	1.57	5.1	22.9	5.21	0.26	91^{4}	31^{0}	0.28	0.25	2.08	101^{5}
	60	54^{0}	16.2			3.0	17.9	25.00	0.75	11.0	49.4	0.66	0.07	41^{8}	14^{2}				55^{8}
	100	8^{7}	2.6			1.5	9.0	10.40	0.16	3.6	16.4	0.74	0.03	4^{7}	1^{6}				9^{8}
	-100	2^{3}	0.7	2.11	1.38	0.5	3.2	20.48	0.10	0.9	4.0	3.99	0.04	1^{0}	0.3	0.14	0.07	1.22	2^{4}
		333^{7}	99.9		6.66	16.8	99.9		4.67	22.2	99.9		0.82	295	100.1		1.11	6.60	334^{0}
S.3.		248^{4}		2.48	6.15	17.2		26.80	4.61	12.2		5.02	0.61	219^{0}		0.42	0.92	6.14	248^{4}
	20																		
	30	3^{0}	1.2			0.2	1.2			Tr.	0.2			3^{3}	1.5				3.4
	40	88.9	35.8	2.71	2.49	4.7	27.2	31.60	1.55	1.2	9.7	22.33	0.28	81^{6}	36.8	0.46	0.39	2.22	87^{5}
	60	116.2	46.8	2.34	2.72	7.1	41.2	29.72	2.11	5.2	43.1	6.20	0.32	105^{8}	48.0	0.43	0.45	2.88	117^{6}
	100	35.0	14.0			3.6	21.1	19.07	0.69	4.7	38.2	0.92	0.04	25^{9}	12.3				34^{2}
	-100	5.5	2.2	2.44	0.99	1.6	9.1	14.53	0.23	1.1	8.7	1.20	0.01	2^{8}	1.2	0.31	0.09	1.06	5^{5}
		248.6	100.0		6.20	17.2	99.8		4.58	12.2	99.9		0.65	218^{8}	99.8		0.93	6.16	248^{2}
S.4.		238^{8}		2.98	7.12	21.6		28.10	6.07	14.2		3.02	0.43	203		0.38	0.76	7.26	238^{8}
	20																		
	30																		
	40	1^{7}	0.7			0.1	0.4			Tr.	0.1			1.5	0.7				1.6
	60	116^{2}	48.7	2.89	3.40	8.0	37.3	31.52	2.55	1.9	13.2	13.32	0.25	106.6	52.5	0.37	0.40	3.20	116.5
	100	99^{1}	41.5	2.91	2.89	9.4	43.6	29.00	2.73	9.2	64.9	2.10	0.20	81.8	40.3	0.28	0.23	3.16	100.4
	-100	21^{7}	9.1	3.75	0.81	4.1	18.7	18.37	0.75	3.1	21.9	1.01	0.03	13^{0}	6.3	0.34	0.04	0.82	20.2
		238^{7}	100.0		7.10	21.6	100.0		6.03	14.2	100.1		0.48	202^{9}	99.8		0.67	7.18	238^{7}
S5		178^{3}		4.42	7.87	22.9		28.02	6.40	15.4		3.84	0.59	140^{0}		0.74	1.03	8.02	178^{3}
	20																		
	30																		
	40	0.9	0.5			0.1	0.4			0.1	0.7			0.7	0.5				0.9
	60	3.0	1.7	3.18	0.12	0.4	1.9	27.94	0.14	0.1	0.5	4.77	0.01	2.4	1.7				2.9
	100	118.6	66.5	4.28	5.07	13.6	59.5	30.00	4.08	8.8	56.8	5.35	0.47	97.1	69.4	0.48	0.48	5.18	119^{5}
	-100	55.6	31.2	4.98	2.68	8.7	38.2	24.32	2.16	6.5	42.0	2.08	0.14	39.8	28.4	0.90	0.36	2.66	55^{0}
		178^{1}	99.9		7.87	22.8	100.0		6.38	15.5	100.0		0.62	140^{0}	100.0		0.84	7.84	178^{3}
S6		173^{6}		6.27	10.83	23.6		27.93	6.61	58.0		4.45	2.58	92^{0}		1.83	1.68	10.87	173^{6}
	20					0.2	1.0												
	30																		
	40																		
	60	1.6	0.9			0.5	2.2			0.5	0.9			0.8	0.9				2.0
	100	8.3	4.8	4.41	0.44	1.0	4.2	21.14	0.32	2.4	4.1	3.69	0.01	4.7	5.1	0.39	0.02	0.35	8.1
	-100	163^{5}	94.2	6.35	10.39	21.9	92.6	29.30	6.42	55.1	95.0	4.62	2.55	86.4	93.9	1.74	1.51	10.48	163^{4}
		173^{4}	99.9		10.83	23.6	100.0		6.74	58.0	100.0		2.56	91.9	99.9		1.53	10.83	173^{5}

TABLE VII

WILFLEY TABLE TESTS — CLASSIFIED FEEDS.

		FEED.				HEADS.				MIDDLES.				TAILS.				TOTAL	
TEST	MESH	Wt.	% Wt.	% Cu.	Lbs. Cu.	Wt.	% Wt.	% Cu.	Lbs. Cu.	Wt.	% Wt.	% Cu.	Lbs. Cu.	Wt.	% Wt.	% Cu.	Lbs. Cu.	Lbs. Cu.	Wt.
C.1		256^{5}		4.68	11.97	36^{1}		25.98	9.37	24.4		5.89	1.44	196^{2}		0.71	1.39	12.20	256^{6}
	20	111^{3}	43.4	2.48	2.76	4^{1}	11.3	31.11	1.26	2.2	9.0	27.88	0.61	106^{5}	$54.^{4}$	0.78	0.83	2.70	112^{8}
	30	102^{7}	40.1	4.23	4.34	11^{7}	32.5	31.33	3.67	12.4	51.0	5.88	0.73	78^{2}	34.9	0.66	0.52	4.92	102^{3}
	40	26^{9}	10.5	9.25	2.49	9^{2}	25.5	24.15	2.22	6.9	28.5	1.10	0.08	9^{8}	5.0				25^{9}
	60	11^{8}	4.6			8^{3}	22.9	9.93	1.65	2.4	9.9			1^{3}	0.6				11^{9}
	100	2^{9}	1.1			2^{4}	6.4				0.9								.
	-100	0^{9}	0.3	14.93	2.32	0^{5}	1.5	20.06	0.56	0.3	0.4	0.76	0.02	0^{3}	0.1	0.58	0.06	4.59	3^{5}
		256^{5}	100.0		11.91	36^{2}	100.1		9.36	24.2	99.7		1.44	196^{2}	100^{0}		1.41	12.21	256^{4}
C.2		276^{1}		2.62	7.25	20^{6}		25.30	5.22	23.5		4.08	0.96	232^{0}		0.49	1.14	7.32	276^{1}
	20	79^{7}	28.9	0.83	0.66	0.4	1.8	33.02	0.13	0.3	1.2	25.20	0.08	80^{2}	34.6	0.38	0.32	0.53	81^{0}
	30	120^{1}	43.5	1.44	1.73	2.7	13.0	32.24	0.87	4.9	20.9	10.41	0.51	115^{1}	49.6	0.54	0.62	2.00	122^{7}
	40	42^{8}	15.5	3.73	1.60	4.8	23.1	29.80	1.43	9.7	41.5	2.62	0.25	29^{1}	12.6	0.38	0.10	1.78	43^{6}
	60	25^{1}	9.1	8.79	2.20	8.2	39.9	23.27	1.90	7.3	31.2	0.74	0.05	6^{8}	2.9				22^{3}
	100	6^{8}	2.4			3.8	18.5	22.15	0.84	1.1	4.6			0^{6}	0.3	0.50	0.04	3.00	5^{5}
	-100	1^{4}	0.5	14.75	1.21	0.8	3.7	20.05	0.16	0.1	0.5	0.72	0.01	Tr.					0.9
		275^{9}	99.9		7.40	20.7	100.0		5.33	23.4	99.9		0.90	231^{9}	100^{0}		1.08	7.31	276^{0}
C3		249^{7}		2.03	5.02	13.1		27.03	3.57	17.6		2.51	0.85	219^{0}		0.41	0.90	5.32	249^{7}
	20	32^{6}	13.1	0.30	0.10	Tr.	0.2			Tr.	0.1			33^{6}	15.5	0.30	0.10		33^{6}
	30	105^{9}	42.4	0.72	0.76	0.2	1.8	33.00	0.08	0.6	3.6	18.10	0.11	106^{0}	48.4	0.50	0.53	0.82	106^{8}
	40	53^{9}	21.6	1.61	0.87	1.0	7.5	31.85	0.32	4.4	25.2	7.61	0.34	49^{3}	22.5	0.43	0.21	0.87	54^{7}
	60	38^{9}	15.2	4.82	1.87	4.6	35.5	27.30	1.25	8.7	49.5	3.78	0.33	25^{7}	11.4				39^{0}
	100	15^{2}	6.1			5.5	41.9	25.75	1.42	3.3	18.9	2.06	0.07	4^{2}	1.9				13^{0}
	-100	3^{5}	1.4	12.90	2.41	1.7	12.9	24.11	0.41	0.5	2.7	1.70	0.01	0^{4}	0.2	0.33	0.10	3.59	2^{6}
		250^{0}	99.8		5.91	13.0	99.8		3.48	17.5	100.0		0.86	219^{3}	99.9		0.94	5.28	249^{7}
C.4		292^{0}		1.88	5.50	15.4		26.50	4.07	20.0		4.44	0.88	257^{0}		0.34	0.87	5.82	292^{4}
	20	7^{0}	2.4	0.18	0.01					Tr	0.1			7^{5}	2.9	0.21	0.02		7^{5}
	30	72^{0}	24.6	0.35	0.25	Tr.	0.1			0.1	0.5			78^{2}	30.4	0.23	0.18		78^{3}
	40	77^{4}	26.5	0.29	0.22	0.2	1.1	27.70	0.06	1.0	5.0	5.68	0.06	75^{9}	29.5	0.41	0.31	0.63	77.1
	60	81^{2}	27.8	1.32	1.08	2.3	15.0	30.20	0.66	7.9	39.7	5.44	0.43	70^{5}	27.4	0.40	0.28	1.37	80.7
	100	40^{9}	14.0	6.67	2.72	8.1	52.4	27.91	2.26	8.7	43.8	4.03	0.35	21^{7}	8.5				38^{5}
	-100	13^{4}	4.6	13.55	1.80	4.8	31.4	25.53	1.19	2.3	11.4	2.61	0.06	3^{1}	1.2	0.52	0.13	3.99	10^{2}
		291^{9}	99.9		6.08	15.4	100.0		4.17	20.0	100.5		0.90	256^{9}	99.9		0.92	5.99	292^{3}
C.5.		288^{0}		2.13	6.14	17.0		25.69	4.38	20.3		3.71	0.75	251^{0}		0.38	0.96	6.09	288^{3}
	20	0^{4}	0.2			Tr.	0.1			Tr.	0.1			0^{5}	0.2				0^{5}
	30	11^{1}	3.8	0.52	0.01	0.1	0.4			0.1	0.7			10^{0}	4.2	0.14	0.01		10^{2}
	40	39^{3}	13.7	0.17	0.07	0.1	0.4			0.2	1.0	0.73	Tr.	39^{3}	15.6	0.24	0.09		39^{6}
	60	100^{0}	34.7	0.30	0.30	0.6	3.2	15.89	0.11	2.0	10.0	2.16	0.05	98^{0}	38.9	0.21	0.21	0.47	100^{6}
	100	87^{0}	30.2	2.03	1.76	4.9	28.9	28.29	1.39	9.7	47.7	4.03	0.39	73^{6}	29.2	0.35	0.26	2.04	88^{2}
	-100	50^{5}	17.5	7.80	3.94	11.4	66.9	25.02	2.85	8.3	40.7	4.23	0.35	29^{9}	11.9	0.97	0.29	3.49	49^{6}
		288^{3}	100.1		6.08	17.1	99.9		4.35	20.3	100.2		0.79	251^{3}	100.0		0.86	6.00	288^{7}
C.6		360		2.22	8.01	15.8		26.76	4.21	74.5		2.55	1.90	270^{0}		0.70	1.89	8.00	360^{0}
	20																		
	30	0^{9}	0.2			0.3	1.5	0.73	Tr.	0.1	0.2			0^{7}	0.3				1^{1}
	40	4^{9}	1.3			0.2	1.4	2.10	Tr.	0.4	0.6			4.0	1.5				4^{6}
	60	44^{1}	12.3	0.24	0.11	0.5	2.9	6.23	0.03	3.3	4.4	0.25	0.01	36^{2}	13.4	0.09	Tr.	0.04	40^{0}
	100	133^{0}	36.9	0.62	0.82	2.3	13.5	23.74	0.55	28.4	38.2	0.72	0.20	104^{0}	38.6	0.18	0.19	0.94	134^{7}
	-100	177^{0}	49.3	3.97	7.02	12.6	80.5	28.97	3.65	42.3	56.6	3.86	1.63	125^{0}	46.2	1.37	1.71	6.99	179^{9}
		359^{9}	100.0		7.95	15.9	99.8		4.23	74.5	100.0		1.84	269^{9}	100^{0}		1.90	7.97	360^{3}

TABLE VIII

WILFLEY TABLE TEST - NATURAL FEED - (DESLIMED).

		FEED.				HEADS.				MIDDLES				TAILS.				TOTAL	
TEST	MESH	Wt.	% Wt.	% Cu.	Lbs. Cu.	Wt.	% Wt.	% Cu	Lbs. Cu.	Wt.	% Wt.	% Cu.	Lbs. Cu.	Wt.	% Wt.	% Cu.	Lbs. Cu.	Lbs. Cu.	Wt.
N.1.		264^4		2.57	6.80	16.7		28.91	4.83	39.7		2.95	1.17	208		0.52	1.08	7.08	264^4
	20	37^5	14.2	1.67	0.63	1.2	7.3	30.00	0.36	1.8	4.5	3.20	0.06	33^9	16.3	0.58	0.20	0.64	36^9
	30	69^0	26.1	1.93	1.33	3.1	18.7	31.21	0.97	3.6	9.0	3.01	0.11	61^3	29.5	0.48	0.30	1.38	68^0
	40	48^4	18.3	2.61	1.22	2.9	17.3	31.74	0.92	5.8	14.7	2.30	0.13	39^3	18.9	0.26	0.10	1.15	48^0
	60	46^0	17.4	2.55	1.17	2.6	15.6	29.13	0.76	9.0	22.6	2.19	0.20	33^9	16.3	0.40	0.13	1.09	45^5
	100	33^8	12.8	3.07	1.04	3.8	23.0	26.60	1.01	10.4	26.3	2.13	0.22	22^2	10.7	0.35	0.08	1.31	36^4
	-100	30^1	11.4	4.62	1.39	3.0	17.8	26.48	0.79	9.1	23.0	4.88	0.44	17^3	8.3	1.09	0.19	1.42	29.4
		264^9	100^2		6.78	16.6	99.7		4.81	39.7	100.1		1.16	207^9	100		1.00	6.97	264^2

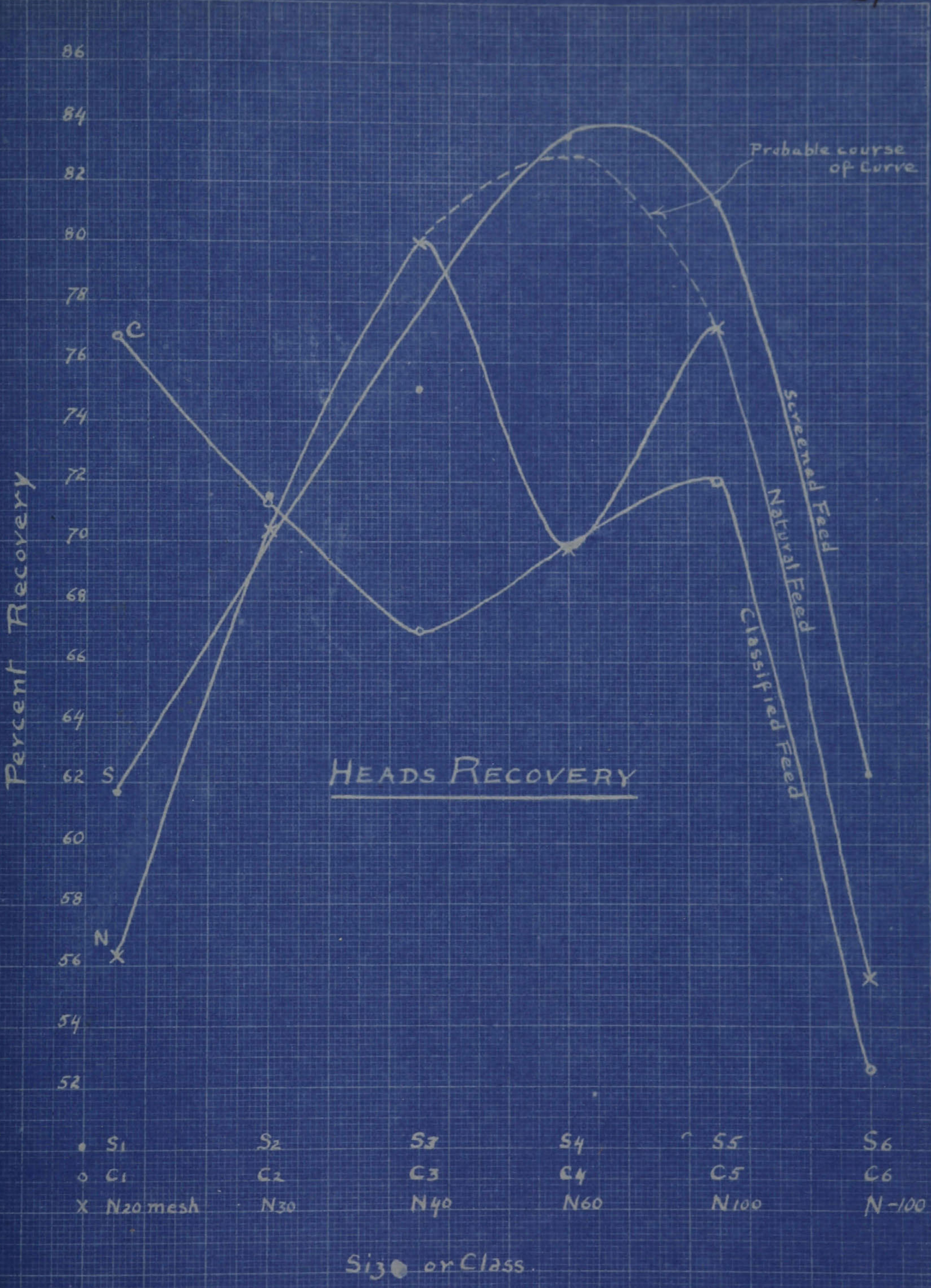
Further screen analyses made to determine the nature of the through 100# material in some of the finer feeds, showed comparitively small amounts of through 200# material.

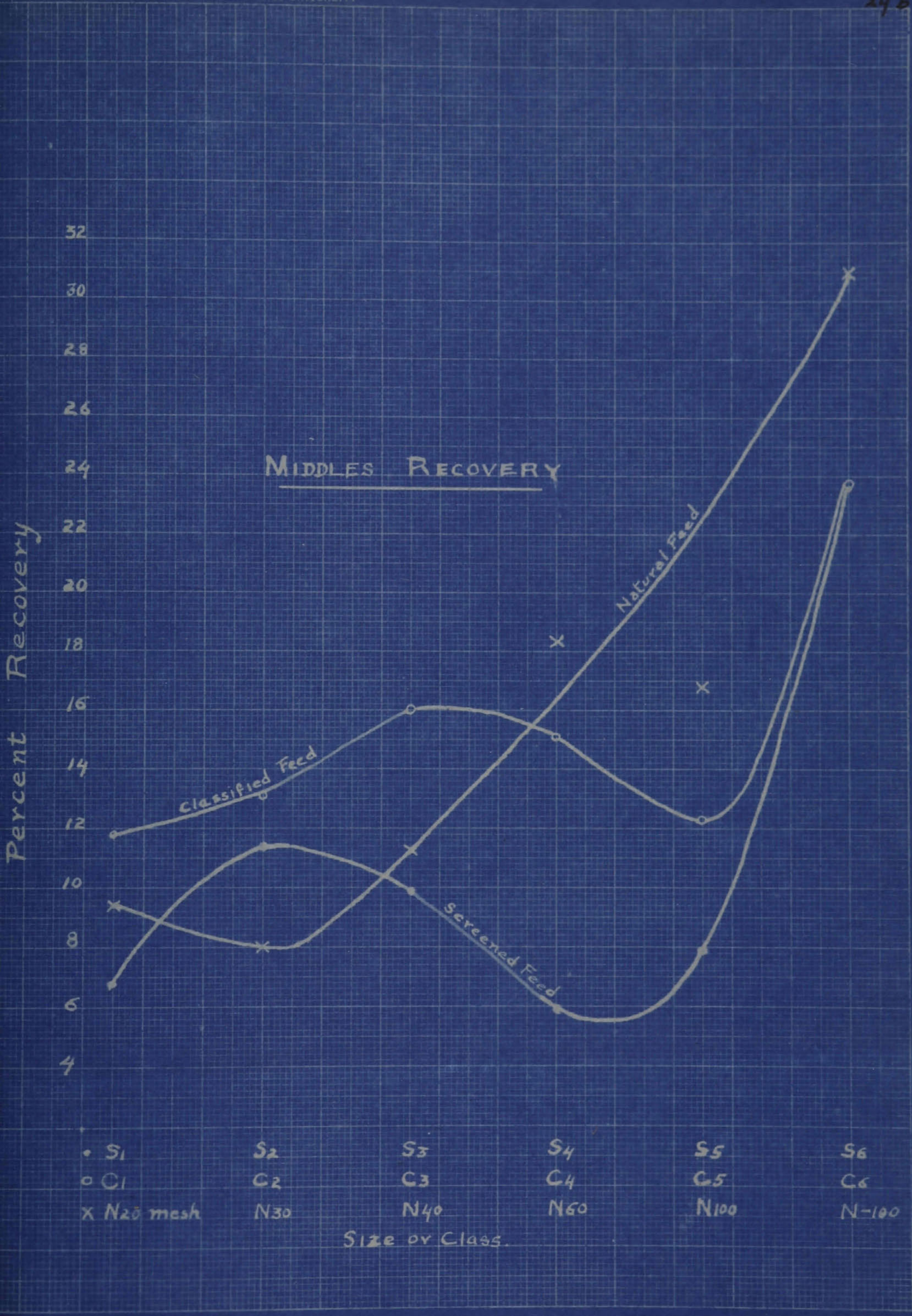
T A B L E IX.

DISTRIBUTION OF PRODUCTS AND RECOVERY.

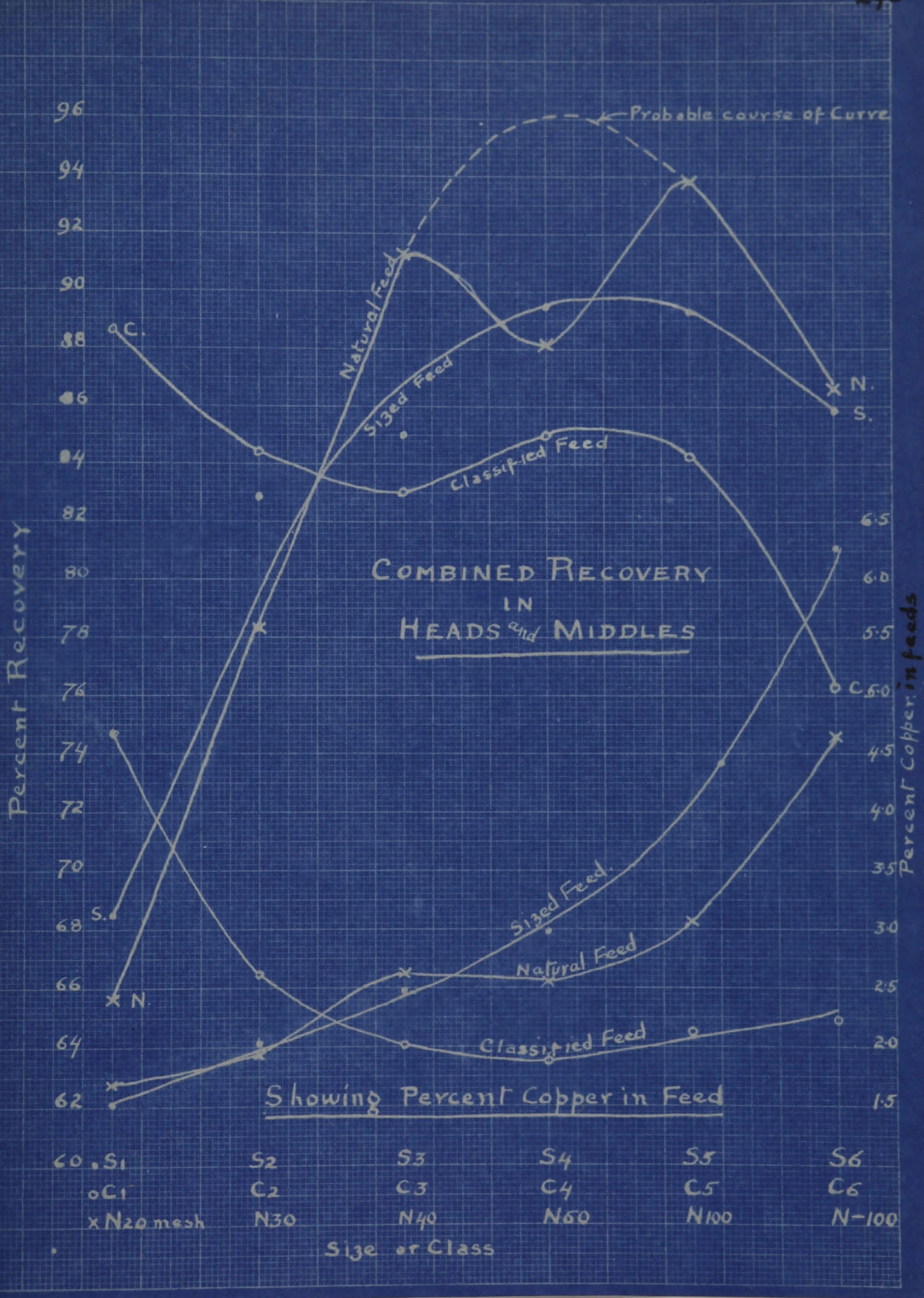
Run No.	Size.	Copper in Feed per-cent.	Percentage of Products: Heads	Middles	Tails.	Per cent of Total Copper: Heads	Middles	Tails	H & M
N.1	Thro' 18#	2.57	6.3	15.0	78.7	68.2	16.5	15.3	84.7
N.2S									
.3S									
.4.C									
.5.C									
.1	On 20#	1.51	4.1	4.5	91.4	61.7	6.8	31.5	68.5
.2	30	2.03	5.1	6.6	88.3	71.5	11.4	17.1	82.9
.3	40	2.48	6.9	4.9	88.2	75.1	9.9	15.0	85.0
.4	60	2.98	9.1	6.0	84.9	83.6	5.9	10.5	89.5
.5	100	4.42	12.9	8.6	78.5	81.4	7.9	10.7	89.3
.6	- 100	6.27	13.6	33.4	53.0	62.3	23.6	14.1	85.9
.1	Coarse	4.68	14.1	9.5	76.4	76.8	11.8	11.4	88.6
.2	↓	2.62	7.5	8.5	84.0	71.3	13.1	15.6	84.4
3	↓	2.03	5.3	7.0	87.7	67.0	16.0	17.0	83.0
4	↓	1.88	5.3	6.8	87.9	69.9	15.1	15.0	85.0
5	↓	2.13	5.9	7.0	87.1	72.0	12.3	15.7	84.3
6	Fine	2.22	4.4	20.7	74.9	52.6	23.7	23.7	76.3

A series of curves has been drawn to shew graphically the ad of the above figures for percent of total copper in the products, and se will be found on pages 29-a-b, c and d, following. On page 29, c, assays of the original feeds have also been plotted, and it will be ted how, in a general way, the recovery increases with the richness of the feed. large amount of copper which has gone into the Middles in the Natural feed runs will also be noticed.


HEADS RECOVERY
Percent Recovery
86
84
82
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
C
S
N
Probable course of Curve
Screened Feed
Natural Feed
Classified Feed
S1
S2
S3
S4
S5
S6
C1
C2
C3
C4
C5
C6
N20 mesh
N30
N40
N60
N100
N-100
Size or Class



MIDDLES RECOVERY
Percent Recovery
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
Natural Feed
Classified Feed
Screened Feed
• S1
S2
S3
S4
S5
S6
o C1
C2
C3
C4
C5
C6
x N20 mesh
N30
N40
N60
N100
N-100
Size or Class.


Combined Recovery
in
Heads and Middles
Probable course of Curve
Natural Feed
Sized Feed
Classified Feed
Showing Percent Copper in Feed
Sized Feed
Natural Feed
Classified Feed
Percent Recovery
Percent Copper in feeds
96
94
92
90
88
86
84
82
80
78
76
74
72
70
68
66
64
62
60
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
C.
S.
N.
.S1 S2 S3 S4 S5 S6
oC1 C2 C3 C4 C5 C6
x N20 mesh N30 N40 N60 N100 N-100
Size or Class

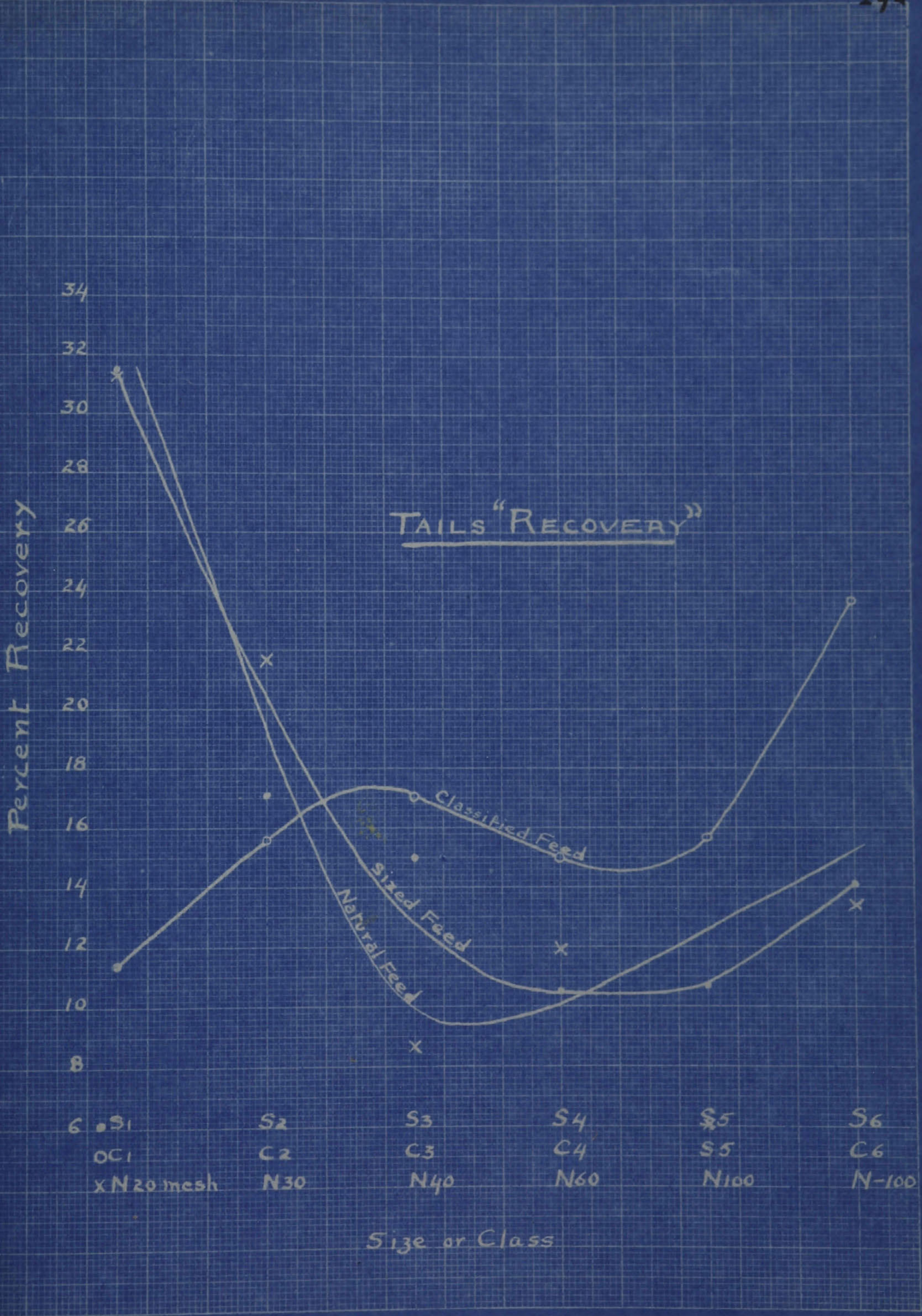

TAILS "RECOVERY"
Percent Recovery
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
Classified Feed
Sized Feed
Natural Feed
• S1
S2
S3
S4
S5
S6
O C1
C2
C3
C4
S5
C6
x N 20 mesh
N30
N40
N60
N100
N-100
Size or Class

TABLE X.

SHEWING RECOVERY BY SIZES.

SCREENED FEEDS.

	S. 1				S. 2				S. 3			
h	H	M	T	F	H	M	T	F	H	M	T	F
20	50.4	7.5	42.1	100.0								
30	69.5	7.0	23.5	100.0	63.4	12.7	23.9	100.0				
40					75.5	12.5	12.0	100.0	69.8	12.6	17.6	100.0
60									73.2	11.1	15.7	100.0
00												
00	65.2	7.0	27.8	100.0	82.7	11.5	5.8	100.0	86.8	4.7	8.5	100.0

	S. 4				S. 5				S. 6			
20												
30												
40												
60	79.7	7.8	12.5	100.0								
00	86.4	6.3	7.3	100.0	81.4	9.3	9.3	100.0	91.5	2.8	5.7	100.0
00	91.4	3.7	4.9	100.0	81.2	5.3	13.5	100.0	61.3	24.3	14.9	100.0

TABLE XI.

SHEWING RECOVERY BY SIZES.

CLASSIFIED FEED.

SH	C 1. H	C 1. M	C 1. T	C 1. F	C 2. H	C 2. M	C 2. T	C 2. F	C 3 H	C 3 M	C 3 T	C 3 F
20	46.6	22.6	30.8	100.0	24.6	15.1	60.3	100.0				
30	74.6	14.8	10.6	100.0	43.5	25.5	31.0	100.0	9.8	13.4	76.8	100.0
40					80.3	14.1	5.6	100.0	36.8	39.1	24.1	100.0
60												
00												
00	96.5	2.2	1.3	100.0	96.7	2.0	1.3	100.0	85.8	11.4	2.8	100.0

	C.4 H	C.4 M	C.4 T	C.4 F	C. 5 H	C. 5 M	C. 5 T	C. 5 F	C. 6 H	C. 6 M	C. 6 T	C. 6 F
0												
0												
0	9.5	9.5	81.0	100.0								
0	48.2	31.4	20.4	100.0	23.4	10.6	66.0	100.0	75.0	25.0	0.0	100.0
0					68.2	19.1	12.7	100.0	58.5	21.3	20.2	100.0
0	86.4	10.3	3.3	100.0	81.7	10.0	8.3	100.0	52.2	23.3	24.5	100.0

T A B L E XII.

RECOVERY BY SIZES, - NATURAL FEED

…ZE	N. 1				N. 2				N. 3			
	H	M	T	F	H	M	T	F	H	M	T	F
…10	58.3	9.4	31.3	100.0								
	70.3	8.0	21.7	100.0								
…10	80.0	11.3	8.7	100.0								
…0	69.8	18.5	11.9	100.0								
…0	77.1	16.8	6.1	100.0								
…00	55.6	31.0	13.4	100.0								

TABLE XIII.

SCREEN ANALYSIS AND ASSAYS OF THE ORIGINAL SANDS BEFORE SCREENING OR CLASSIFYING.

Two entirely separate Samples were taken of the original sands and the close checks of the Screen analyses are remarkable

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MESH OF SCREEN	SAMPLE A Weight 150 gms. Weight	Wt %.	SAMPLE B Weight 150 gms Weight	Wt. %	MEAN OF A & B, PER CENT WT.	PER CENT COPPER	SCREEN FEED WEIGHT LBS.	SCREEN FEED LBS COPPER	CLASSIFIER FEED WEIGHT LBS.	CLASSIFIER FEED LBS COPPER
20	20.0	13.3	20.0	13.3	13.3	1.27	246	3.12	247	3.14
30	39.2	26.2	39.0	26.0	26.1	1.73	484	8.37	485	8.40
40	22.5	15.0	22.4	14.9	15.0	1.84	278	5.11	279	5.14
60	25.3	16.9	25.3	16.9	16.9	2.49	313	7.80	314	7.83
100	22.0	14.7	22.3	14.9	14.8	2.47	274	6.76	275	6.79
200	20.8	13.9	20.8	13.9	13.9	5.15	258	13.22	258	13.30
TOTAL	149.8	100.0	149.8	99.9	100.0		1852	44.38	1858	44.60
	Primary Assay and Weights					2.42	1850	44.75	1855	44.90

DISCUSSION OF RESULTS.

Looking at Table IX. it will be noticed that for the Screen Feed runs the feed gets steadily richer as the size of the feed diminishes, and the proportion of heads obtained increases correspondingly.

The Classified Feeds are richest in the coarsest and finest classes, with the poorest feed in the intermediate classes. The per cent of Heads made in the coarsest class is large, and almost double that of the next smallest class. On the average the proportion of heads made is largest in the Screen sized runs.

The Middles of the screen sized feeds are a smaller proportion of the feed than those of the Classified feeds, except in runs S 5, and S 6, but these two lots of Middles only contain 7.9 and 23.6 % respectively of the copper in their feeds, as compared with 12.3 and 23.7% for runs C-5 and C-6, and the recovery in the heads of S-5 and S-6 is in each case practically ten per cent greater than in the corresponding sizes C-5 and 6.

The poorest recovery in the Heads for sized feed runs is 61.7%, in the coarsest size, S 1. For Classified feeds it is 52.6%, in the finest size, C 6. In both cases these are the largest runs of the series.

The Tails are on the whole better in the sized than in the classified feed runs, though S-1 shows 31.5% of the Cu. in the Tails. This large loss is not due to the poor screening of the 20 mesh size as tables VI and X. show that the greater part of the loss is in the On 20 mesh material. This shows that the fault lies not with the working of the table, but with the small quantity of Middles made.

The sliming action of the table is well shown in Tables VI, VII and VIII; the second column from the right gives the sum of the copper in each size of the H. M. and Tails, and it will be noticed that in practically every run these figures are less in the coarser sizes and more in the finer sizes than the figures in the Feed Samples with which they should agree. Some of this sliming is no doubt due to breaking up of the chalcopyrite by decrepitation and handling during the drying of the sands in the drying oven .

Looking at Tables X, XI, and XII it will be noticed that in the coarse sizes, the tails almost invariably hold a large proportion of the copper in those sizes, and except in the case of S-1 the proportion is very much larger in the Classified feed Tails than in the Screen sized feed Tails, or the Natural feed tails. The copper in these coarse sizes must largely be due to included mineral grains, and it would therefore seem that the table does better work on this class of material with screened feed than with Classified feed.

From Table XI it will be noticed that in the Classified feed runs, the "recovery" in the fine sizes of the Tails is remarkably small, though the assays are high.

An examination of the Middles in Tables VI, VII and VIII bears out Richards' conclusion that they consist of a small quantity of large grains of comparatively ~~fewer~~ pure mineral with a large quantity of somewhat smaller grains of gangue holding very little mineral.

Comparing the runs as a whole, the Screened feed runs show a recovery in the Heads of 71.9% of the copper, the Classified feed runs 69.0% and the Natural feed 68.2%, though it is hardly fair to take the single run on Natural feed as an average run.

In the natural feed runs made by Richards the slimes were left in the feed, and the slimes resulting from the table carried from 1.53 to 12.73 % of the copper. The highest recovery that he made in the Natural feed heads was 51.48%. If we omit the slimes this would be brought up to 58.8% which is still far below the figure of 68.2% obtained in our Natural feed run.

GENERAL CONCLUSIONS.

Screened feed is in almost every particular better than classified feed and though the balance in its favour is but small, it should be ample to repay the greater cost of treatment.

As far as it is possible to judge from one run, Natural feed is only slightly less desirable than either Screened or Classified feed.

The presence of considerable quantities of "included grain" material does not seem to have a deleterious effect where screened feed is used.

The saving effected in the finest sizes is greatest with screened feed, and though the saving in the coarsest size is greatest with Classified feed, the advantage is not so great as to over-balance the generally better work ofthe Screened feed.

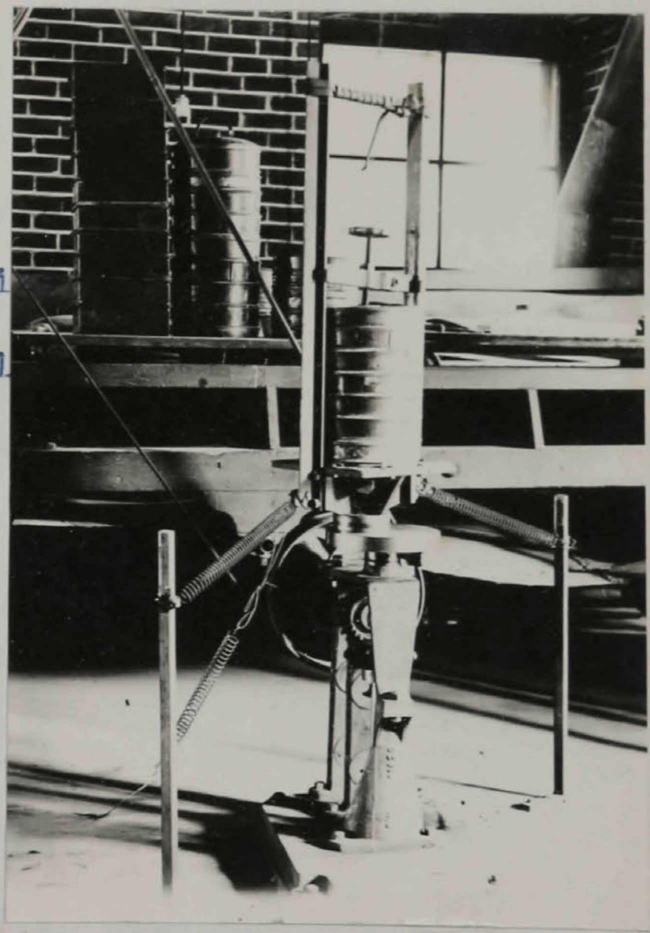
APPENDIX I.

SCREEN ANALYSES.

The screen analyses of the various samples were done almost entirely by machine. This machine consists essentially of a vertical shaft driven by bevel gears from a horizontal shaft connected by belting to one of the regular line shafts in the laboratory. The vertical shaft has a horizontal plate on its upper end, supporting from an eccentrically placed pin, a rack for holding the screens. This rack will hold any number of screens from one up to over a dozen nested together. The pin has an eccentricity of $1\frac{1}{2}$ inches and the shaft revolves about 180 R.P.M., so that the screens get a rapid gyratory motion which while rapidly separating the undersize from the oversize does not tend to blind the screens badly. For these analyses five screens were used:- 20 - 30 - 40 - 60 and 100 mesh I.M.M. standard. It was found that with a 200 gram sample, 30 minutes was sufficient to give practically perfect screening. In only a few cases with the screen sized sands, where one screen held the major portion of the sample, was it necessary to finish off the work of the machine by hand.

The excellent work of this machine is well shown in Tables VI, VII and VIII, by a comparison of the third column on the left with the last column on the right. (The latter giving the addition of the quantities in the various sizes of the H.M. and Tails.)

It should be particularly noticed that in these screen analyses every care was taken to make them as accurate as possible, for upon their accuracy depended the whole value of the assays subsequently made. There is no doubt that a small amount of undersize remains in the oversi at the end of the 30 minutes allowed but it is so very small as to make no appreciable variation in the results, and it is altogether likely that if the screening were continued for any further length of time there would be a very considerable error introduced by the production of fines owing to the wearing down of particles during the screening.



APPENDIX II.

THE ASSAYING OF THE SAMPLES.

Duplicate samples were taken of the various feeds and Table products - one for screen analysis and one to be assayed for copper. The products from the screen analyses were also assayed. All samples were ground to pass a 100 mesh screen.

The method determined upon was the wet assay, titrating with KCN. At first it was thought that it would be unnecessary to precipitate the Copper on Aluminums, but the results obtained did not check well enough.

The method finally employed consisted in dissolving the copper in aqua-regia, evaporating to dryness, taking up with hydrochloric and sulphuric acid and evaporating to strong fumes of SO_3 in order to get rid of all traces of HNO_3. The copper was then precipitated upon Aluminum filtered, washed and dissolved in strong HNO_3. After adding ammonia in excess the solution was titrated with standardized cyanide solution.

Four of the samples showed unmistakable evidence of having been accidentally salted - probably during the grinding. These were the Tails of ~~the~~ S4 and S5, and the Feeds of C3 and C4. The assays of these samples were each rechecked several times so that there was no doubt that the assays were correct.

In all, over 500 assays were made the results of which are shown in Tables VI, VII, and VIII.