REPORT OF COMMITTEE ON MILLING, MACHINERY AND PRACTICE

A questionaire was sent out on the 1st Febuary, rather late in the season, but 13 mills replied, for which the Committee is very grateful. The questionaire was very fully answered, and the filed returns are a most interesting record.

In continuance of the work two years ago, Table 1 gives particulars of the mills, extraction, etc., and also the feed and bagasse opening of each unit. These openings are given in cubic feet per ton of fibre, and show that the settings have levelled up from previous years. It will be noted that the bagasse and feed openings of milling plants fitted with shredders are much larger than those without shredders. This must affect the work of the mills, and do away with a lot of the benefit of the fine shredding.

The work of checking up mill settings should be done during the crushing season, and by an employee of the Sugar Association or Millers' Association, as it would help to improve milling all round.

Curve 2 gives the capacities of the various milling plants in tons of cane per hour, and fibre per hour plotted on a base of $D^2 \times L \times N$ where

D = diameter of roller in feet,

L = length of roller in feet,

N = number of rollers in train.

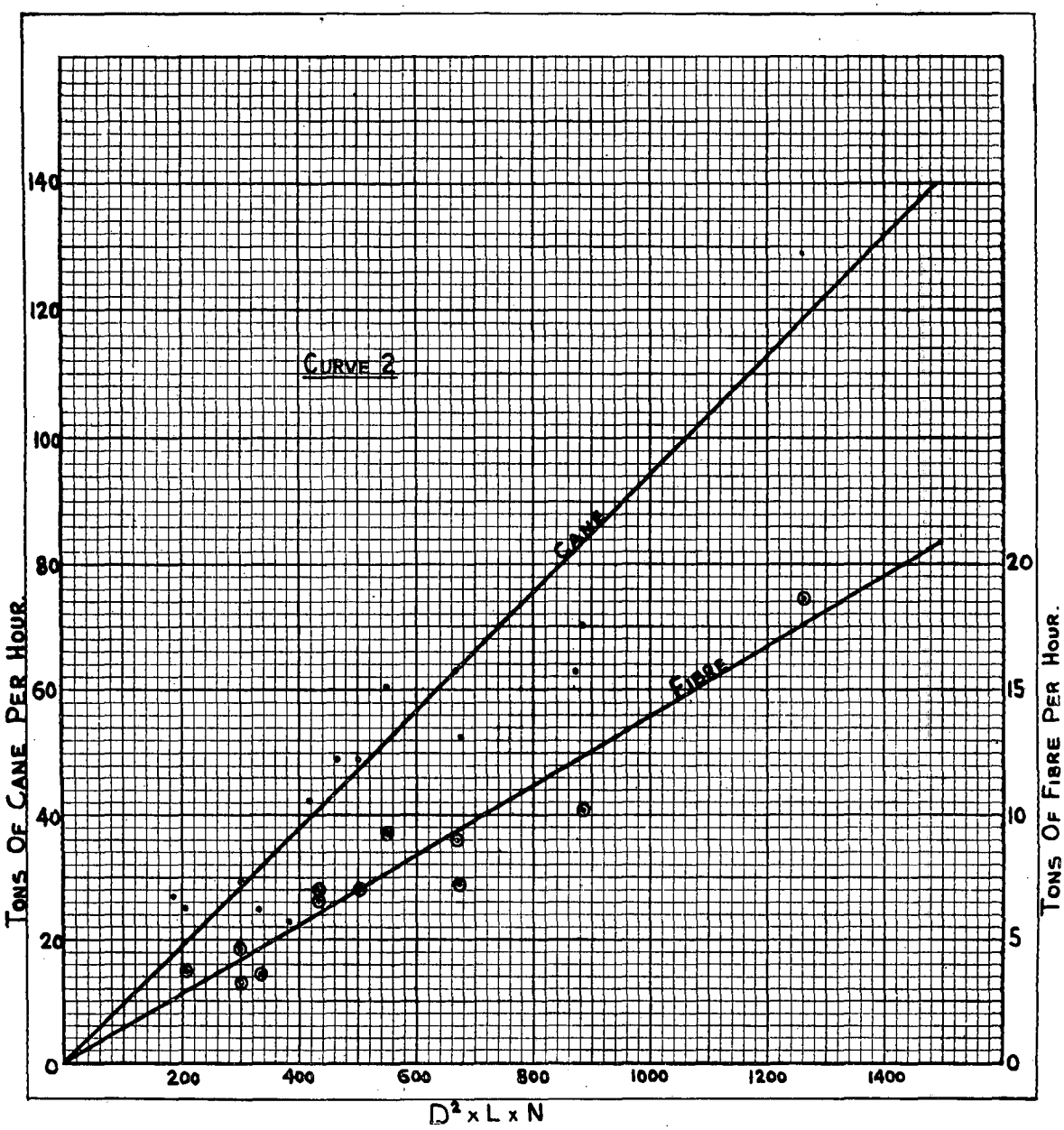


TABLE I.—MILLING FIGURES, 1938 SEASON.

Name of Factory	Tons Cane per hour	Sucrose % Cane	Fibre % Cane	Tons Fibre per hour	Extraction % Sucrose	Sucrose % Bagasse	Moisture % Bagasse	Plant	Size D″ x L″	$D^2 \times L \times N$	No. of Rollers	FIRST MILL		SECOND MILL		THIRD MILL		FOURTH MILL		FIFTH MILL	
												Feed opening per ton Fibre cu. ft.	Bagasse opening per ton Fibre cu. ft.	Feed opening per ton Fibre cu. ft.	Bagasse opening per ton Fibre cu. ft.	Feed opening per ton Fibre cu. ft.	Bagasse opening per ton Fibre cu. ft.	Feed opening per ton Fibre cu. ft.	Bagasse opening per ton Fibre cu. ft.	Feed opening per ton Fibre cu. ft.	Bagasse opening per ton Fibre cu. ft.
	1	2	3	4	5	6	7					8	9	10	11	12	13	14	15	16	17
New Guelderland	24.75	13.90	14.32	3.54	91.57	3.88	47.80	1K 2C 3M	24 x 48	208	13	89	38	77	31	31	12.8	—	—	—	—
Amatikulu.. ..	70.00	13.65	14.44	10.10	93.15	2.72	54.39	1K 1C 1S 5M	34 x 66	882	20	127	56.6	135	59.9	132	49	121	40.8	157	56
Illovo..	52.23	13.62	14.07	7.34	90.40	3.79	54.31	2K 1C 4M	34 x 72	675	14	—	—	—	—	—	—	—	—	—	—
Natal Estates ..	129.09	13.73	14.47	18.67	94.79	2.19	52.87	1K 1C 1S 5M	36 x 84	1260	20	107	42.5	89	44	88	38.8	85	41.5	Not given	Not given
Umzimkulu ..	22.79	14.78	14.37	3.27	91.82	4.00	47.38	1K 1C 3M	2—28 x 56 1—30 x 60	296	11	203	68	125	53	90	10	—	—	—	—
Prospecton ..	27.00	—	14.50	3.91	—	—	—	1K 4M	24 x 48	192	12	115	64	76	38	64	12.8	—	—	—	—
Tongaat	126.00	13.48	14.26	17.96	93.18	2.94	50.75	(*a*) 1K 1C 1S 5M	4—32 x 66 1—36 x 84	854	20	175	57	—	—	—	—	—	—	196	36.5
								(*b*) 1K 1C 1S 4M	4—32 x 66	665	17										
Doornkop	25.00	13.70	14.73	3.68	92.25	3.39	48.60	1K 2C 4M	26 x 54	338	16	138	69	108	50	64	40	59	16.9	—	—
Darnall	97.60	13.60	14.39	14.04	90.04	3.96	52.85	(*a*) 2K 2C 4M	30 x 60	500	16	93	93	80	40.6	63.7	35	55	21.4	—	—
								(*b*) 1K 1C 4M	30 x 60	438	14										
Gledhow	59.92	13.79	14.38	9.20	91.02	3.69	52.20	2K 1C 4M	32 x 66	548	14	180	72	144	45	126	45	72	4.6	—	—
Renishaw	42.81	13.93	15.53	6.66	90.76	3.80	49.47	1K 1C 5M	3M—26 x 54 2M—30 x 60	420	17	202	92	120	55	118	45	95	43	100	27.2
Sezela..	88.00	14.061	14.88	13.08	89.82	4.31	49.86	2 Sets 2K 1C 4M	32 x 66	548	14	127	76	93	57	114	46	101	19.0	—	—

K : Knives. C : Crusher. S : Shredder. M : Mill.

A shredder being taken as three rollers.

This curve gives us the following formulae:—

$$\text{Tons of cane crushed per hour} = \frac{D^2 \times L \times N}{10.6}$$

$$\text{Tons of fibre crushed per hour} = \frac{D^2 \times L \times N}{71.8}$$

These capacities compared with the Cuban *Grinding* Co-efficient, and the Hawaiian tonnage ratio show our capacities are approximately 40 per cent greater than Hawaii, and about the same as Cuba. This accounts partly for our lower extraction when compared with Hawaii.

Figure 3 shows the Milling Plant performance for years 1925-1938. Sucrose % cane and fibre % cane are down from last year. While greatly increased quantities of new canes are being crushed, the sucrose has not risen, but the fibre has definitely gone down.

The mill extraction has risen from 91.53 to 91.93 per cent, but this cannot be credited to new canes as the milling plants have been improved, and much greater attention is being paid to the setting and operation of the mills. Some mills report improved extraction due to the new canes. Many of them, however, could find no improvement in crushing owing to the great variation in fibre in these canes, and the utter impossibility of setting and speeding a milling plant to cover these changes. All mills report they like grinding Co.281 cane, but not Co.290, which is inclined to powder, and is also a bad fuel.

It is to be regretted moistures % bagasse continues to rise 52.01 to 52.16% and this, with the lower fibre % cane, has caused serious fuel trouble at most mills. This position is so serious that many factories are installing air preheaters to recover heat from the flue gases to make up for the loss of heat from bagasse.

The high moisture in bagasse is partly due to the varying % fibre in cane, but it is also due to the large capacities of cane being crushed. Mills which

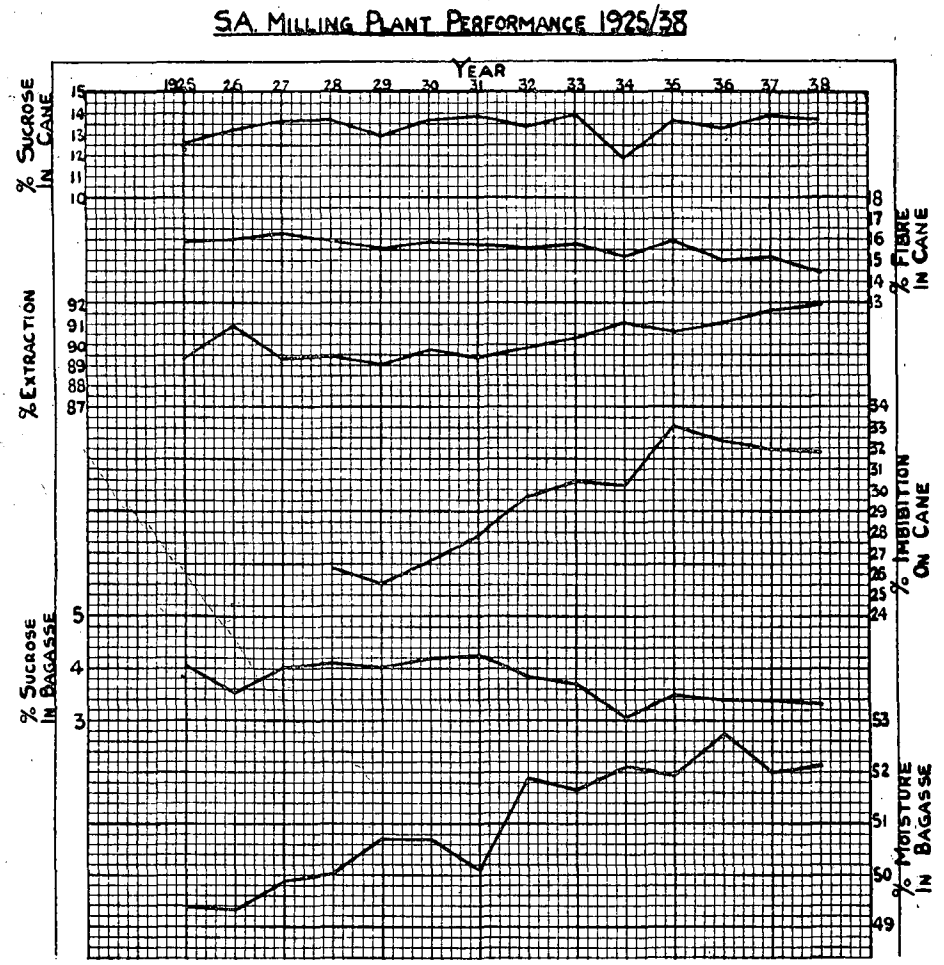


FIG 3

are not overloaded show moistures in bagasse round about 48 to 49%.

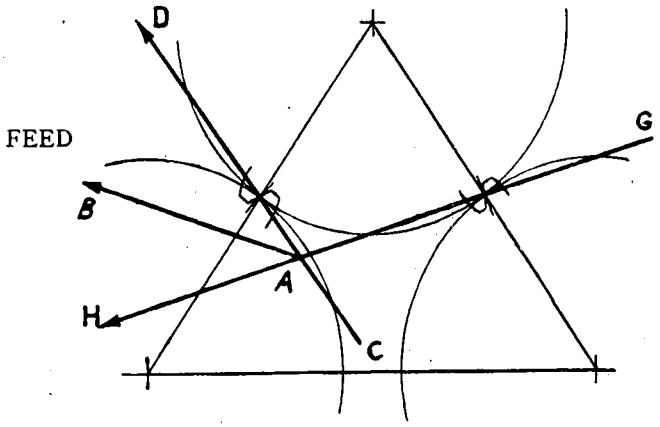
All mills report Messchaert Grooves in the feed rollers, but the general tendency is to have no Messchaert grooves in the bagasse rollers. With the high maceration it is necessary to get about 80% extraction done by the feed rollers to get a decent moisture in bagasse, and to secure this it is indicated pushers are necessary, although some mills tend to instal maceration rollers to compress the bagasse entering the mill, and do away with pushers. Smaller grooving in some mills has reduced the moisture, and this has done very well where the rollers had chevrons consisting of rectangular grooves $\frac{3}{8}$in. or $\frac{1}{2}$in. square cut spirally across the rollers at a pitch of about four inches. These rectangular grooves give a good grip and do not reduce the roller surface like ordinary chevrons. With regard to trash turner metal over 50% of these are of cast steel, balance mainly semi-steel with a few of stainless steel and Abrazo metal, which is a semi-stainless steel, and has given good wearing results. Last report questions were asked about clearances between back of trash turner and bagasse roller. These vary from $\frac{1}{2}$in. to $1\frac{1}{4}$in.

With regard to shredders, one plant added a shredder and they indicate they got $1\frac{1}{2}$% additional extraction. Another plant added a mill and shredder and got an increased extraction of 3%. It appears that the shredders have done quite well, but if a mill had been installed in place of shredders it would give at least $2\frac{1}{2}$% additional extraction, and it appears doubtful if the shredder is the right machine to instal.

The question of getting a better extraction and lower moisture in bagasse is deserving of our immediate and earnest attention, and to further this end, meetings to discuss this matter should be held during the crushing season. These meetings could be held at various mills where the matter could be thrashed out methodically. It would help greatly if this was handled by an expert technologist attached to the Experiment Station to coordinate the efforts of the various engineers, etc., scattered along the sugar belt.

The milling plants are to-day very carefully watched and tended, and it is a constant strain on the technical staff to maintain the figures now obtained.

Mr. RISHWORTH: Mr. Munro is to be congratulated on presenting a paper of a sound, practical nature, dealing with some of the finer points often overlooked, or left to take care of themselves. Attention to these details, as the author points out, all make for better efficiency.



THRUST OF MILL PINION.

Most modern mills have the hydraulic gear with an offset towards the front of the mills to allow for the inclination of the resultant thrust, due to the higher pressure from the back roller. In addition the top gap should be fitted with hard-wearing or rubbing plates, having provision to take up wear between the brass and the plates. The above combination has given excellent results. For years now it has been accepted without question that the pinions exert a big upward thrust. This has been disproved, both theoretically and by actual observation. The diagram shows the pinions and the lines of thrust between them when in average position. The front roller thrust, CD, is upwards at about 53° while the back roller thrust, GH, which is greater, is definitely downwards at about 17°. If the front and back roller pinions gave the same thrust, the resultant on the top roller pinion would be along AB, or about 18° upwards, but as the back roller requires more power to drive it than the front, the pinion thrust of the back roller is much greater. The resultant thrust on top pinions must therefore be well below the line of AB, in fact so near horizontal as to have little or no effect on the rise and fall of the top roller. In view of this it is not necessary to have hydraulic rams of different size on the two sides, with the advantage that all hydraulic leathers, etc., are interchangeable. A magnifying indicator similar to that shown in the paper was used to prove in operation that both ends of the roller rise equally, providing the feed is uniform. It was found that if one side of the roller rose more than the other, the feed to the mill was uneven. It will be seen, therefore, that the correct way to ensure an even top roller is to pay careful attention to the loading of the cane carrier.

Mr. Munro refers to a special type of differential accumulator, which maintains a level top roller. It is assumed that this applies to any condition of feed. In view of what has been stated earlier, the

accumulator referred to above has little or no pinion thrust to take care of, consequently it has only to deal with unequal feed. Assuming an uneven feed in the form of a wedge across the carrier, the roller will lift evenly to some average position, giving a full pressure on the top of the wedge, and practically no pressure at the lower end; this must result in loss of efficiency.

An ordinary type of accumulator does not ensure even lift of the roller, but with uneven feed it is contended that the efficiency will be greater than with a roller which cannot tilt at all, and lifts to some average position.

The conclusion is that, with an uneven feed, no special devices for keeping the top roller level are necessary, and that with uneven feeding, it is better to let the roller take up its own position. With modern methods of loading, the amount of bad feeding is not serious.

Mr. MUNRO: With reference to Mr. Rishworth's remarks, the special type of accumulator used at Doornkop is fitted on the third mill in a train of four.

The feed is reasonably good, and there is no great variation in the thickness of the blanket.

About three years' ago we took tests of this hydraulic gear, and pressure gauges were fitted on both sides.

Simultaneous observations were made, every few seconds, of the pressure applied and the rise of the roller at each side.

I can assure you that under normal working conditions the pressure as applied through the special accumulator was greater on the gear side.

We have had these indicators, with a magnification of 32/1 on the other mills.

They move continuously, one side sometimes higher than the other, which would tend to show that the freely floating top roller is, by means of the ordinary hydraulic gear, following a slightly uneven feed.

I have little hesitation in saying that an accumulator of this new design is an advatange because the indicators on the third mill show a more consistent application of the pressure upon the blanket of bagasse, not always maintaining a perfectly level roll (variation of 1/128 were recorded) but always with more pressure required upon the gear side.

On the other hand, to be perfectly frank, the accumulator had three rods, therefore it had rather more friction than was necessary. Consequently, on the upward movement of the roller, there was rather more friction than was desired. It was sluggish in action. I understand now that an accumulator has been developed with only two rods, and with single S.E.A. RINGS IN THE GLANDS. The friction should be reduced very much, and I do think that an accumulator of this type is a distinct advantage. I hope to be able to see it proved out in one or two mills in the coming season.

Mr. MURRAY: I would like to reply to Mr. Rishworth. Has he ever actually studied the rise and fall of the top roller of a mill. We have found in every case tested that the pinion side of the roller rose more than the pintle side. To overcome this we put larger sized hydraulic rams on the pinion side, but this was not enough to get a free floating roller. At Empangeni we developed the Amps Tailbar with curved ends which greatly improved the free floating of the top roller and giving a much better fitting tail bar in the Couplings. Owing to these difficulties the Hadden Level Roll Accumulator was designed to ensure the top roller would lift evenly. This ensures the mill bearings rise evenly and removes the thrust on the roller flanges which a top roller causes when it lifts unevenly. It also allows of better (less) clearance in the journals, and between flanges and side rollers. A top roller of a mill fitted with the ordinary accumulator tends to jam and causes chokes through not opening fast enough. The level roll accumulator has proved a decided improvement, and improved the design of the mill generally. The first level roll accumulator was installed at Doornkop, but had too much friction. It had 3 rams, and 6 glands with 3 rings of packing each. We have since reduced the packing to 1 ring per gland on this accumulator and the friction is now similar to ordinary accumulators. We have installed at Chakas Kraal a level roll accumulator with only two rams and hope to reduce the friction accordingly.

Mr. Rishworth's diagram is all right in theory, but does not work out in practice.

What happens with worn pinions, different sized rollers, and varying openings when the pinions are not properly geared?

Mr. RISHWORTH: In reply to Mr. Murray's comments, first of all, admittedly the diagram on the board is a theoretical exposition of the case. I suggest whether the pinions are worn or not worn, there is still a line of contact, still a line of force where there are worn or new pinions. I am not condemning the machine itself. I am simply saying there is not the necssity for that type of accumulator.

There is just one thing I omitted to mention, that was that this theory was tried out with an indicator of the type Mr. Munro has used. The results were very carefully watched, and, as I said before, it was found that, whenever the indicators showed unequal lifting of the top roller, it was found to be due to uneven feed. The argument, therefore,

is that the real solution to uneven lifting of the top roller is uneven feeding. If Mr. Munro admits that the top roller floats under all conditions, I re-iterate that in the case of further uneven feed, one side of the blanket must get higher pressure than the other side.

Mr. RAULT: How did you judge of your good or bad results on the whole blanket of the mill: Was one side richer than the other one?

Mr. MUNRO: Observations were made of the rise of each side of the mill and the corresponding rise of the accumulator, and the pressure developed on each side. The actual juice extraction test was not taken.

Mr. MACBETH: I have listened to Mr. Munro's paper with very great interest. He has covered a very large field, and there are quite a number of items mentioned which I confirm. There are just one or two points I wanted to pick out. One is with reference to his remarks about installing a Magnetic separator. I would like to mention that we installed one last year and we found very great benefit from the installation, for the simple reason that in previous years we have had to repair the rollers during the week-end, and it has cost us in the vicinity of £500 per crop, repairing grooves, and so forth. This year, we have not had to repair the rollers of our fifth mill. We have collected over a quarter of a ton of foreign metal, from safety pins up to couplings pins, and I can assure you that the installation of a magnetic separator is worthwhile.

There is another point (here) with reference to surface speed control. He mentions here: "For this surface speed control, variable speed motors are excellent, but the ordinary mill engine can be used to great advantage by fitting a simple type of variable speed governor, its driving motor being controlled by push button from the operator's place of observation on the mill platform." Now we have one on the fifth mill. We find it a very great advantage. The result is we have got something like 40 per cent speed variation on the engine. The only thing is that at the lower speeds, the engine, naturally, with a higher torque, has a tendency to pull up. All the same, it has helped us considerably in the feeding of that mill. In Australia, they have gone one better. The have an arrangement where they automatically control the feed of the mill by the speed of the governor. This is a very simple device, and if there is time after the general discussion of these papers has taken place, and anybody is interested, I would not mind giving a diagram on the board.

Another point. I cannot quite follow this paragraph "Here, again, the user of a roller indicator is beneficial, because a normal operating position can be adopted at the beginning of the crop, which will allow for adjustment to a lower position during the latter part of the season, thus compensating the wear of the trashplate and keeping the distance of the trashplate from the top roller approximately correct." I do not quite understand why it was necessary to allow for roller adjustment. I take it that Mr. Munro is alluding to the trashplates, because what we find is this—that as the season goes on, the tendency is not altogether to lower the position of the trashplates, in most instances we have to raise them. I do not see where it was necessary to allow for packing pieces under the gearing pedestals. I should say that the best arrangement for setting down a mill is to allow for the gear shaft of the mills to be one-eighth of an inch higher than the centre line of your roller shaft. In doing so, this allows for wear on the top brass, and at the same time allows for the lift on the top roller.

There is another point I would like to stress in connection with Milling, which has not been dealt with here, but has been dealt with on previous occasions. It is quite right that some record should be kept in connection with mill settings and in the alterations down to a Mill during the crop. But I find that one of the most essential things with milling plant is to maintain that plant at its highest efficiency during the crop. That has got to be done every Sunday. Take, for instance, the rollers that have chevrons. They should be touched up once a fortnight, or once in three weeks. Messchaert groove scrapers should be attended to every Sunday.

However, the paper has been very interesting, and one must congratulate Mr. Munro in coming forward and adding to the happy band, and not leaving it to one or two, and in that respect I wish to thank Mr. Munro very much.

Mr. MUNRO: With regard to the "normal" position of the roller, the intention was that, at the beginning of the season the feed and bagasse rollers would be set up rather tighter, and so cause the top roller to float up higher.

If this is done the gear shaft should also be packed up to maintain alignment.

Later on, towards the end of the season, when wear has taken place on the trashplate, one feed and bagasse roller can be adjusted outwards, so that, while maintaining the original roller openings, the top roller would assume a lower operating position, and thus compensate the wear on the trashplate.

Low moisture and trashplate adjustment are very closely related, and it is often impossible to raise a trashplate as the teeth come out of scraping contact with the feed roller.

With regard to engines, in Hawaii some engines were fitted with Nordberg Long Range Valve Gear, which might get over a good deal of the trouble mentioned.

The main difficulty is that when we have low fibre cane, and the surface speed is reduced in order to keep the mills fully loaded, and the indicators in the normal working position, the engines were slowed down, and did not develop sufficient power.

The long range gear for Corliss engines will give a cut-off up to five-eights, therefore you can have a slower running engine and still develop the power necessary.

Combine this gear with the variable speed governor with remote control and the available range of speed will be very wide.

I would commend this idea to all mill operators.

There is another point I would like to mention.

On page 108 you will see that there are very large differences in the moisture and the extraction in the figures given.

I anticipated a question on this, but as no one, so far, has mentioned it, I would like to explain that at the time of this test we had a variable speed control governor only on the engine driving the first crusher, and on the engine driving the last two mills. The other two mills and the second crusher were driven by an engine with an ordinary governor, consequently there was a great deal of variation in the efficiency of the milling and the indicators clearly showed it.

We could not keep the intermediate mills under such good control as we did the first crusher, and the last two mills, and the balance of pressure was disturbed. Had we been able to exercise this control, I am certain that the milling figures would have been improved, because the normal position of the top rollers could have been maintained, according to the indicators, pretty closely by varying the speed of the intermediate engine.

Actually, the engine driving the last two mills was varied in speed from 45 to 55 R.P.M., and according to the quantity of the fibre being milled the surface speed varied from 17.5 feet to 22 feet per minute.

I would like, also, to emphasise the paragraph that "Juice Extraction tests be put on the same comparative basis."

That is to say, employ indicators and see that the rollers are always in the normal operating position while taking the juice samples for extraction tests of individual mills.

The indicators are not difficult to instal. They are made from strips of spring steel, and are balanced in knife edges, one of which has a screw adjustment so that the zero position can be set.

It is then only necessary to see that the top roller is running, or floating, up to the predetermined height which gives maximum efficiency.

Referring to Mr. Kopke's article, "that numerous tests were made with roller surface speeds," I feel pretty sure that he did not have them under accurate control by indicator, the top rollers may have been floating all over the place, and giving varying results.

Many extraction test results are disappointing, because we get big variations in moisture and in sucrose in bagasse.

I think we would be on very sound lines if we adopt a method of this kind.

So far, at Doornkop, it has been of an experimental nature, but I have sufficient confidence in saying that it is effective, and if sufficient flexibility can be given to the engines first by variable speed governors, and then by improved valve motion, I think that the problem of cutting down moisture in bagasse can be, to a very large extent solved.

We have a small mill, and the figures quoted are, no doubt, very much emphasised.

In some factories the various canes can be mixed.

Suppose you do mix the canes, unless it is thoroughly done, even two tons of say Co.281 will send the maceration up, and if followed through the mill by some Co.290, the indicators fall again unless the engines are carefully regulated.

The situation almost calls for automatic adjustment of roller surface speed, and perhaps it is something on these lines that Mr. Macbeth is going to tell us about.

Mr. DUCHENNE: There is one point I would like to have made clear. Page 108, fourth paragraph. You have mentioned 80% juice extraction. Does this mean 80% of the juice in the cane, or 80% extraction of sucrose, and is it possible to get 80%?

Mr. MUNRO: Yes, it is possible to get it. If you refer to "Facts about Sugar," there is a new mill up in Mexico, where they are getting about 90% extraction by the feed rollers, and they have done away altogether with Messchaert grooves in the bagasse rollers.

Mr. MACBETH: I have read with interest the report of the Committee on Milling Machinery and Practice.

As a matter of fact I happen to be on this Committee, but I do not wish you to think that I am in any way responsible, or in agreement with all that has been published in the report, far from it (especially when it is stated that a shredder is a doubtful piece of machinery to instal) and as members of the Committee did not have an opportunity to discuss the report before it was published I trust they will now be able to "Air" their expressions of opinions on this subject.

In expressing my opinion on some of the points raised, I mention Mr. Murray's name on two or three occasions, but in doing so I do not wish you to think that I am being personal, I trust the Chairman will not call me to order.

I feel sure that Mr. Murray has been responsible for one or two statements and no doubt they were inserted for my particular benefit, as the matter of shredder versus a mill has become a hardy annual between us.

However, I am pleased to see that Mr. Murray is gradually being converted in easy stages, as it is only a year or two ago that he said a shredder was not to be compared with a mill, but now he says "That the shredders have done quite well. This is also verified by the fact that one concern installed a shredder and the extraction was increased by 1½%. Another factory installed a shredder and an additional mill and the extraction was increased 3%, so therefore at this stage we can assume that a shredder is equivalent to a mill."

This is also admitted in any case in the formula used by Mr. Murray when he states that a shredder should be taken as 3 rollers.

In classifying the shredder as equal to 3 rollers, how was this basis arrived at? Was it due to the fact that it is now recognised that a shredder is equivalent to a mill as it gives increased capacity with improved extraction.

It has been stated on previous occasions that the shredder is merely a unit for preparation, quite so, but in preparing the cane in the manner it does, brings about increased extraction at the mills, surely there can be no doubt about this.

It is to be remembered that the initial cost of a shredder compared with a mill is about 200 to 250% less and further the H.P. absorbed by a shredder is less.

Then there is also the statement in the report which reads:—

"It will be noted that the bagasse and feed openings of milling plants fitted with shredders are much larger than those without shredders. This must affect the work of the Mills and do away with a lot of the benefit of the fine shredding."

I cannot let this pass unchallenged for if the figures shown in Table I. are analysed, they certainly no not prove this exclusievly, if at all, and I fail to see how a comparison can be made between the openings of mills with a shredder and mills without a shredder as according to the formula some of the factories are milling under capacity and others over capacity and conditions generally are not uniform throughout the sugar belt.

Some of the ratios given for mills without a shredder are greater than those with a shredder, for instance take the following examples:—

The Ratios shown at the following factories:—

New Guelderland, Umzimkulu and Gledhow are larger than those of factories with a shredder.

A most interesting point in this connection is the large ratios given for the last mill units of five factories that have no shredders, they are Umzimkulu, Doornkop, Gledhow, Renishaw and Sezela.

In connection with the high moisture content of the bagasse it would be interesting to know from the data supplied by the various factories, whether the factories that have low moistures have:—

1. Messchaert grooves cut in the back rollers.
2. What size grooves have they on the last Mill.
3. What percentage of maceration is applied.
4. What is the surface speed of the rolls.

My contention is that high moistures generally go with high capacities and as larger grooving and higher surface speeds are introduced to obtain larger capacities these factors do not tend to give lower moisture.

The Hawaiian practice certainly proves this.

In conclusion I wish to take this oportunity of expressing my thanks and appreciation to Mr. Murray for all the hard work he has undertaken in compiling the report and although I may have appeared to have been somewhat critical over some of the contents published in the report, it has nevertheless not reduced its value, but added interest to this important subject. Further I wish to congratulate Mr. Murray upon his re-election to the office of President for another year.

Mr. MURRAY: Mr. Macbeth, I have to thank you for your remarks. With regard to shredders. I have been trying for years to assess its value as compared with an extra mill. In plotting the curve of capacities, I had to get a figure for the total rollers in each plant and 3 rollers were added to represent each shredder, but this does not mean that I consider they do so. It has been the conventional method.

With regard to the openings of the mill rollers, you will find from Table I. that the bagasse openings of mills with shredders are much larger than those without shredders. The ratio of the feed to the bagasse opening does not affect this as if the mills without shredders were as open as with shredders, the ratio would not be so great.

With regard to extraction, it is my opinion that a mill would give a greater rise in extraction than adding a shredder and the figures go to support this contention. At Verulam a shredder was put in, the extraction rose about 0.5%, but at the same time a larger crusher with separate drive was installed replacing the old crusher, and it must be credited with some of the extra extraction. With

regard to high moisture in bagasse, I agree this is mainly caused through the large capacities handled, and the larger grooving necessary. It is necessary to get tight settings to get low moistures. The figures given in the report for extra extraction are taken from the Mill's replies to the questionaire.

With regard to Mr. Rishworth's diagram of forces for a mill, Mr. Macbeth and myself intend to conduct tests on bagasse to see what loads are developed under pressure, and we shall then, we hope, be able to calculate the actual loads on the top roller, and get a correct force diagram. We tried working with Mr. Noel Deerr's figures, but found it difficult. It will also assist us with the correct openings for mills as we will then have actual volumes of bagasse.

Mr. MUNRO: With reference to the controversy about the shredder vs. the mill, can anyone operating a shredder tell us whether it has caused an improvement in the maceration efficiency, for instance. Is there any definite proof that the maceration efficiency is better in the earlier stages of Mill, due to the shredder?

Mr. MACBETH: Yes, we have proved all that. For one week we ran without the shredder, and the maceration had to be reduced to 30 per cent, for the simple reason that the bagasse would not absorb properly over that amount.

Mr. RAULT: We carried out some sifting tests on bagasse for every individual mill. Some of us thought that the moment bagasse was finer, immediately we would have lower sugar in the bagasse. I tell you that is not so at any position in the mill stage, in fact we found that at the earlier stage, the first mill, the finer bagasse was much richer than the coarse bagasse. As you went on to the second and third mill, you were levelling up. The bagasse, whatever its size, seemed to be equal, but the moment you go beyond the third mill, or the fourth mill, you will find the finer bagasse gives you lower and lower sucrose, so that when you are shredding very fine, you undoubtedly must get the benefit of the water at some later stage. No doubt if you did not have your shredder to do that fine work, the sugar in bagasse would not come down in the way it has come with the shredder. In our discussions on milling an attempt has been made to suggest a certain formula by which good milling should be judged. It seems that basic component of this formula is the fibre % of the cane, which is supposed to influence capacity per hour, extraction, etc.

It is generally accepted that a rise in the fibre content of cane increases the work to be done by a milling plant and conversely that a drop in fibre corresponds to easier milling, which, in other words, has as a consequence an improved extraction and through put.

The following comparative results of the successive months of the season do not support this dogmatic statement. "Tons of Fibre crushed per hour" is but one factor and not the chief one influencing Milling results, and for this reason the economic value of canes judged by the sole criterion of fibre may be very fallacious. Study of these interesting results shows that notwithstanding a progressive rise in the amount of fibre in cane our factory staff were able to improve the tonnage per hour, moisture in bagasse, sucrose extraction, during the second half of the season. Low fibred canes at the beginning of the season gave indifferent figures in spite of all the attempts to improve them.

MONTH	Sucrose % cane.	Fibre % cane.	Extraction.	Sucrose % bagasse.	Moisture % bagasse.	Tons cane per acre.	% Non Uba canes.	Tons Fibre per hour.
June	12.55	14.04	94.43	2.11	54.7	116.6	73.6	16.4
July	13.44	13.80	94.63	2.22	53.6	126.1	54.5	17.4
August	13.89	13.98	94.83	2.26	53.0	129.0	57.2	18.0
September	14.49	14.91	94.97	2.19	53.2	129.5	55.8	19.3
October	14.41	15.11	95.01	2.16	51.7	138.0	58.8	20.8
November	14.06	15.02	94.83	2.19	51.8	139.1	56.2	20.9
Season	13.73	14.47	94.79	2.19	52.8	129.0	60.0	18.7

Table I. Milling Figures 1938 season contains some interesting information and I have taken these figures a little further and made the taubulation shown here.

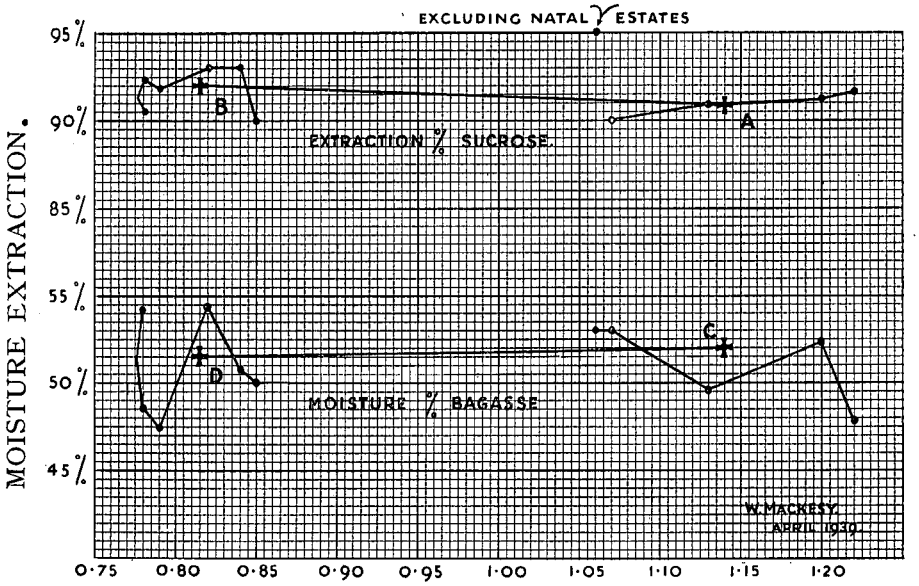
TABLE II.

	Standard Tons/Hr. Fibre 18	Actual Tons/Hr. Fibre 19	Performance Actual Standard 20
1. Prospecton	2.69	3.91	1.45
2. New Guelderland	2.91	3.54	1.22
3. Gledhow	7.67	9.20	1.20
4. Renishaw	5.88	6.66	1.13
5. Darnall	13.13	14.04	1.07
6. Natal Estates ..	17.64	18.67	1.06
7. Sezela	7.67	6.54	0.75
8. Tongaat	21.7	17.96	0.84
9. Amatikulu	12.35	10.10	0.82
10. Umzimkulu ..	4.14	3.27	0.79
11. Doornkop	4.73	3.68	0.78
12. Illovo	9.45	7.34	0.78

Column numbered 18 is the Standard Tons Fibre per hour for each milling plant. This is calculated from the formula $\frac{D^2LN}{71.8}$ and the values of D^2LN stated in the 10th column of the Committee's Table I. are used for the purpose.

In Column numbered 19 is repeated the actual Tons Fibre per hour as stated by each mill and as shown in Column 4 of Table I.

If we divide the actual tons by the standard tons we get a ratio which shows that proportion of the standard tonnage which the mill is crushing. Thus taking No. I. Mill, Prospecton the actual over Standard tonnage is 3.91/2.69 equals 1.45 which means that this mill is crushing at 45% above the standard rate for its plant. At the other end of the table Mill No. 12 is crushing at 78% of its standard rate. Obviously mills crushing much above their standard will find it more difficult to get high extraction and low moisture than will mills which are crushing much below standard.



MILLS CRUSHING RATE AS FRACTION OF ITS STANDARD RATE.

This ratio of actual over standard crushing is further developed in the Graph above in which the sucrose extraction and moisture in bagasse are plotted against each mill's individual crushing ratio. It will be seen that the 12 mills divide naturally into two groups viz: those undercrushing having fractions from 0.78 to 0.85 and those over-crushing having fractions from 1.05 to 1.22.

The centre of gravity of each group is shown by a large cross at ABCD. Heavy lines connect AB and CD showing the tendency of moisture to rise and extraction to fall as one proceeds from under-crushing to over-crushing.

It should be remembered that by shortening a crushing season one travels some way on the road from under-crushing to over-crushing. This may be the correct course from the business point of view. Prospecton is ommitted as not reporting moisture and extraction, and Natal Estates Extraction is excluded as not comparable with any other.

I would congratulate Mr. Murray and the Committee on their report and thank them for a concrete formula and figures on which one can work.

Mr. BECHARD: What Mr. Mackesy has put on the board is one of the points I wanted to touch upon. It is remarkable that New Guelderland and

Umzimkulu, which are the two lowest moistures in the country, are so widely apart in the rating. On the other hand, Amatikulu, which has the highest moistures in the country, has a fairly low rating compared to that. So that it does not seem to follow that the rating and the moisture have gone together. The other point I want to touch upon is the new controversy of shredder vs. one mill. We have heard Mr. Murray and Mr. Macbeth discuss that, and three per cent extraction. We all know that three per cent extraction may mean a lot, or nothing. In other words, the mill that is doing 85% extraction, three per cent extraction is comparatively easy, but the mill that is doing 92 or 93 per cent extraction, to get an amount of three per cent extraction is a different story altogether. Amatikulu installed one extra mill and shredder. The extraction was at a level of 89.9 for a matter of about sixteen years, and that level had hardly altered during that time.

Our extraction last year was 93.15. Last year was the second year of the working of the shredder. The year before we started working with the shredder we started at a fairly low level, and gradually came up to the level of about 93.25. The extraction at Amatikulu upon the introduction of the shredder and one mill was raised 4.25%. I can state that definitely.

On the point of whether the shredder prepares the cane for maceration or not, we have at Amatikulu the same system as at Mount Edgecombe, continuous testing of each individual mill unit throughout one crop. and where, before the introduction of the shredder, we had a ratio of juice in bagasse to juice extracted by the mill approaching 5.1, we have today a ratio of about 6.3. That shows that the water is penetrating the bagasse more today than it did then. Remember that the schredder in our case took the place of a second crusher. The second crusher was moved out and the shredder took its place. That 4.25 extraction was not only 4.25 extraction with the shredder and the last mill, but also it was minus a second crusher. So that in our case it has been amply demonstrated that the shredder has done all we expected it to do.

We are running at a maceration between 29 and 30 per cent. It is quite obvious that before the introduction of a shredder that that quantity of maceration water could not be absorbed by the bagasse, and it was dripping all over the floor. Today the bagasse is taking all the water we have given it.

Mr. MURRAY: I am very interested in Mr. Mackesy's comparison of the various milling plants. I am very glad somebody has made use of these average curves of capacity. A very interesting thing has come up since the start of this Conference. Mr. Bijoux last year wrote a paper on milling values. He evolved a formula for milling efficiency. I asked him to work out the milling efficiency in his formula of the various mills during the last season. Mr. Bijoux gives the efficiency of the various milling plants, as follows—the first one is New Guelderland, 99.53—it has got no shredder, No. 2 is Verulam, No.3 is Doornkop, No. 4 is Natal Estates, No. 5 is Tongaat, No. 6 is Felixton. Out of the first eight places, five of them go to mills without shredders.

Mr. BIJOUX: I must say that this formula was not worked out with the idea of making any comparison between the mills with shredders and without shredders.

Mr. MOBERLY: I just wanted to ask in connection with trashplate settings whether anyone knows anything of the procedure of Killer of the Millaquin Factory in Queensland, in which he fits a piano wire into the feed roller, and has some simple device for measuring tension on the wire? He found the optimum tension of that wire corresponding to the setting of the trashplate. If any thing is known of it, it might be worth the Milling Committee's while to find out something about it.

Mr. MACBETH: I have some information on that. I can demonstrate it on the board.

Mr. Macbeth draws a diagram on the blackboard and explains it.

Mr. RISHWORTH: I would like to make one or two supplementary remarks. The shredder is essentially a preparatory unit, and if it is counted as equivalent to three rollers, why not count cane knives as anything between half a roller or two rollers, depending on their efficiency? The acceptance of the shredder as equivalent to three rollers is an admission of its usefulness in the milling train.

We now come to the paragraph dealing with the gain in extraction. The additional extraction is gained at a fraction of the cost of a new mill, and the speaker believes that this is nearer 2½% than 1½%. This, however, can be left for further investigation by the Milling Committee.

It is contended that the addition of a shredder is the first step, for the following reasons: **A.** Thorough preparation is the first essential for high extraction. It is admitted by most factory engineers that if the extraction behind the first mill is not what it should be, the remaining mills will not be able to make up the lost ground. What better way of attaining this than supplying the first mill with thoroughly prepared cane **B.** The prepared cane is more efficiently macerated. This, coupled with the breaking down of the sugar cells, due to shredding, leaves the mills as purely extracting units. Both the above points are amply proved in the papers presented by Messrs. Macbeth and Rault in 1935, and further strengthened by improvements in milling since that date. **C.** The cost of

the installation of the shredder is, as previously stated, only a fraction of the cost of a new mill, and the speaker contends that the immediate benefit is at least equal to (and in his personal opinion more than) that gained from an additional mill. The former will pay for itself in less than one season. After that, it will help to pay off the expenditure on an additional mill.

It might be of interest to mention that Mount Edgecombe could never have crushed 85 tons per hour in a 33in. x 66in. milling train, with an extraction of 91/92%, were it not for the shredder. Further, it is a significant fact that the leading extraction figures are all from mills with shredder installed.

I should like to associate myself with Mr. Macbeth's remarks in congratulating Mr. Murray on his re-appointment as a President this year, an honour, I am sure, he thoroughly deserves. He can rest assured if I can in any way be of any assistance, I will only be too pleased.

Mr. MURRAY: Thank you Mr. Rishworth. We agree that the capacity of 85 tons per hour with a 66in. milling plant at Mount Edgecombe was very good work, but it cannot be wholly credited to the shredder. Empangeni is pushing 90 tons per hour through 66in. mills since they added 2—84in. Mills at the end of the train, and it is remarkable work. It should be noted this is without a shredder.

Mr. DODDS: I find this table No. I. of particular interest in the Milling Committee's Report. There are two factors here which do not figure in our reports. One of them, as somebody said this morning, because the figures were interesting and worthy of attention, that is Umzimkulu, which has the highest sucrose per cent cane of any factory of the season, and the lowest moisture in bagasse. I would like to know how the fibre per cent cane of Prospecton has been arrived at. I understand they have no regular means of arriving at that figure, or any analytical figure. Another point I would like to ask is what is the origin of the D^2LN formula, why it is put in that way. The surface area of the cylinder surely varies directly with the diameter, not with the square of the diameter. It is merely the surface area of the cylinder we are concerned with, not the cross-section area.

I noticed in that table Mr. Mackesy put up just now, in the main, those factories showing the best performance compared with the theoretical were those with the smallest diameter of rollers, and those who were showing the poorest returns were those with the largest diameter of rollers.

Mr. MURRAY: Prospecton Estate did not give the fibre % cane. I assumed the figure to compare their openings. With regard to the $D^2 \times L \times N$ formula, the capacity of a mill does not go by the surface area of the roller ($D \times L$), but also depends on the strength of the roller which varies as D^3 and the number of revolutions (N). We have found from past experience that using $D^2 \times L \times N$ is a good base, and Curve 2 indicates that this is so to get a simple straight line curve.

The VICE-PRESIDENT: We have had a most excellent discussion. I knew we were going to have a good one. I had no idea we were going to have a super good one, and I think that you owe, not merely to the authors of these papers, but to those who took part in the discussion, a very hearty vote of thanks for an exceedingly instructive afternoon, the result of which will be carried on in next year's Milling Committee. I ask you to accord a very hearty vote of thank to everyone concerned.

Applause.