REPORT OF THE COMMITTEE ON MILLING AND MILLING PRACTICE

P. MURRAY.

For this past Milling Season there were not many alterations to the Milling Plants except the usual replacing of worn out rollers and renewing existing mills.

Owing to the hard nature of our cane, and the large capacity they are expected to crush, mill rollers only last about 3 to 4 years. This seems to be a much shorter period than in other countries, and it would be interesting to find out how much cane a roller grinds before becoming too small, and also get similar information from other countries. From one Milling Plant of 16 rollers here, the tons of cane ground per 1/16 in. wear on roller gives 26,000 for the feed roller, 15,000 for the bagasse roller and 17,000 for the top roller. Another factory shows 90,000 and 41,000 per 1/16 in. wear. Of course, the life of a roller depends on the design of the mills, many old mills with wide cheeks between the side rollers giving a comparatively small reduction for wear.

Mill Pinions have greatly improved recently, giving a wider range of adjustment without fitting smaller pinions. Intermediate Carriers of the Scraper type are being steadily displaced by Apron Carriers, although these are more costly in upkeep, due to chain wear. Chains of newer design and better material are being fitted, but there is still room for a chain that will stand the wear better. Clutches are also important, and an easily operated clutch saves the operators tempers. Coil clutches are easily operated by a hand lever, and appear to be the best type for heavy mills.

Most mills have now complete compound imbibition, the whole of the water being applied at the last mill. As this now reaches up to 40% on the cane, we are in many cases getting high moistures in bagasse, and care must be taken to leave a large enough area of drainage grooves to cope with the large amount of liquid expressed out. Most of the drainage grooves are fitted with scrapers under the mill, but this is messy, and some have fitted scrapers above the bagasse scraper. This tends to a high moisture in bagasse as the scrapers block the drainage groove and put liquid back into the bagasse.

Moisture in Bagasse.

The continued increase in moisture in bagasse is very disturbing, and again this year we draw attention to it. The accompanying curve No. 5 shows how it has risen during the last ten years. We have also plotted the rise in Imbibition % cane during this period, and this no doubt accounts greatly for this increased moisture in bagasse. Many mills have not a great enough area of juice drainage grooves, and care must also be given to see that the trash turner is far enough away from the bagasse roller to help the juice drainage. Many of the mills have increased this clearance with good results.

These high bagasse moistures have a serious effect on the steam supply. With high moistures it is necessary to run at high draughts in the furnace with consequent reduction in the furnace and boiler efficiency. With drier bagasse the furnace could be run nearer a balance.

Many of the mills would be well advised to try and get their moisture down, before attempting to improve their boilers further. By calculation the loss in heat through high moisture does not appear much, but it is actually a good deal more than it seems from calculation. We reckon that reducing the moisture from 55% to 50% would increase the boiler efficiency by 5%, which on a boiler efficiency of 55% is 9% extra steam, nearly as much as can be obtained by air preheating, and basing on this it would pay mills with high moistures in bagasse to add another mill to act as a drier only, and also increase the sucrose extraction.

Many Mills have been against drainage grooves in the rollers owing to the mess made by the bagasse scraped out of the rollers. To overcome this some of the mills now put in chokeless centrifugal pumps large enough to enable part of the juice from the mill to be returned to wash down the mill bed, the rest of the juice going as imbibition to the previous mill. This has kept a cleaner mill bed, and the pump handles the larger quantity better, and ensures a more equal imbibition to the mill. Chokeless pumps require large passages, and the larger quantity pumped makes a more efficient pump, and it will wear better by reducing cavitation.

With regard to mill settings, it is posible to calculate the openings of various units, and taking the case of Natal Estates, Ltd. we have worked out an example. Natal Estates figures last year were as follows:—

Cane ground per hour ..	114.76 tons
Sucrose % cane	13.94
Fibre % cane	15.42
Extraction	94.62
Sucrose % bagasse	2.16
Moisture % bagasse	52.71
Fibre % bagasse	44.38
Imbibition % cane	42.32

Taking:

Specific gravity of fibre	=	1.35
„ „ „ sucrose	=	1.55
„ „ „ Water	=	1.0

Gives:

Fibre cu. ft. per ton	=	23.77 (solid)
Sugar cu. ft. per ton	=	20.77 (solid)
Water cu. ft. per ton	=	32.09 (solid)

Volume of cane per ton in cu. ft.:

	lbs.		lbs.		cu. ft.
Fibre	2,000 x .1542	=	308.4	=	3.665
Sucrose ..	2,000 x .1394	=	278.8	=	2.895
Water	2,000 x .7064	=	1,412.8	=	22.668
	1.0000		2.000.0		29.228

This is the cane as a solid mass, and the crusher opening should be less than this. Suppose the crusher extracts 40% of the sucrose and water, the volume of bagasse after the crusher would be as follows:—

	lbs.	cu. ft.
Fibre	308.4	3.665
Sucrose	278.8 x .6=167.28	2.895 x .6= 1.737
Water	1,412.8 x .6=847.68	22.668 x .6=13.6008
	1,323.36	19.0028

Suppose each mill extracts 40% of the balance of the sugar and the bagasse have 55% moisture left in after each mill, the volume of bagasse would be:—

After 1st Mill:

	lbs.	cu. ft.
Fibre	308.4	3.665
Sucrose	278.8 x .36=100.36	2.895 x .36=1.042
Water	408.76 x $\frac{55}{45}$=499.59	— 8.016
	908.35	12.723

After last Mill: (5 in Train).

		lbs.		cu. ft.
Fibre	45.1%	308.4	=	3.665
Sugar	2.2%	15.1	=	.157
Water ..	52.7%	360.0	=	5.760
	100.0	683.5	=	9.582

We could have calculated the volume of bagasse at mills 2, 3 and 4 but it is not necessary. Curve No. 6 shows the actual openings at Natal Estates, and those calculated. Those calculated are greater than the actual as is to be expected, as to get proper pressure on the bagasse the opening must be less than calculated, and for actual work the opening should be about 60% of the calculated opening. The Mill feed opening 50% more than the calculated. These will give you a good working milling plant, and everyone should calculate their bagasse volumes as it is the basis of real mill settings.

With regard to the ratio of feed to bagasse opening, we have tried running a mill decidely unbalanced, and it gave definitely worse results than one running nearer a balance.

With regard to hydraulics, it is now possible to get an accumulator that will ensure the mill top roller lifting evenly. One was tried out at a mill here, but the friction load was too high. This has now been corrected, and this accumulator has a good effect in making the top roller lift evenly and save jamming and breaking of flanges.

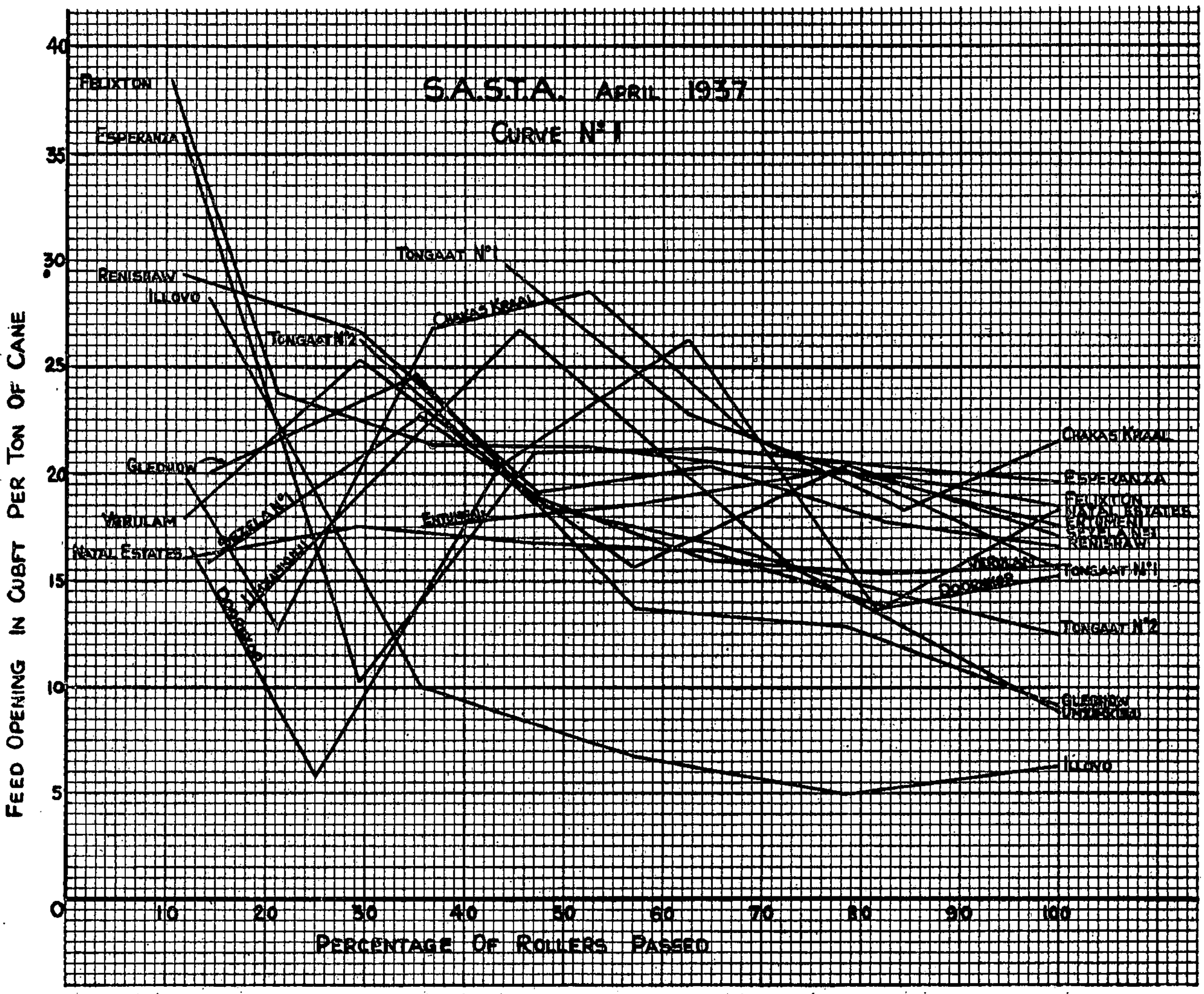
Some mills have fitted remote control on the driving engines and motors. This is most essential owing to the variation in fibre in the various canes, especially at the crusher driving unit. The control is operated from the mill platform. Chokeless pumps of the centrifugal type are installed at many mills saving the screening of the juice from the later mills which is returned as imbibition. Care must be taken in installing these to ensure a large capacity, and that the juice and bagacillo flows steadily down into the pump suction. Accumulations of bagacillo in corners, etc. are liable to choke the pump, when it breaks away and comes in too great a mass. The pumps fitted are of the vertical and horizontal types, but the horizontal type appears the most satisfactory.

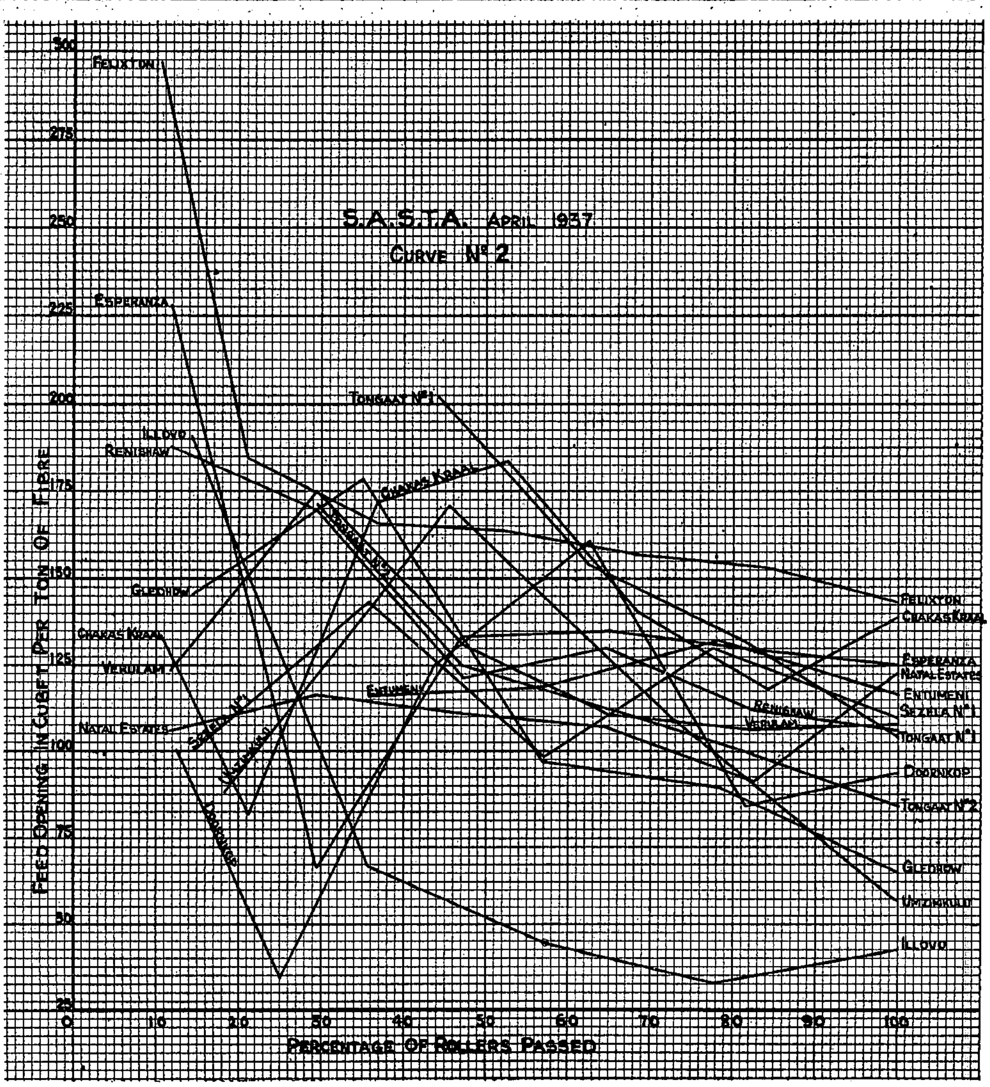
The large grooving of mills appears to have run its course, and we may now see a return to smaller grooving, as it would help the moisture in bagasse. With the fitting of more drainage grooves (Messchaert type) the coarse grooving does not appear so necessary unless the mill is running at too great a capacity.

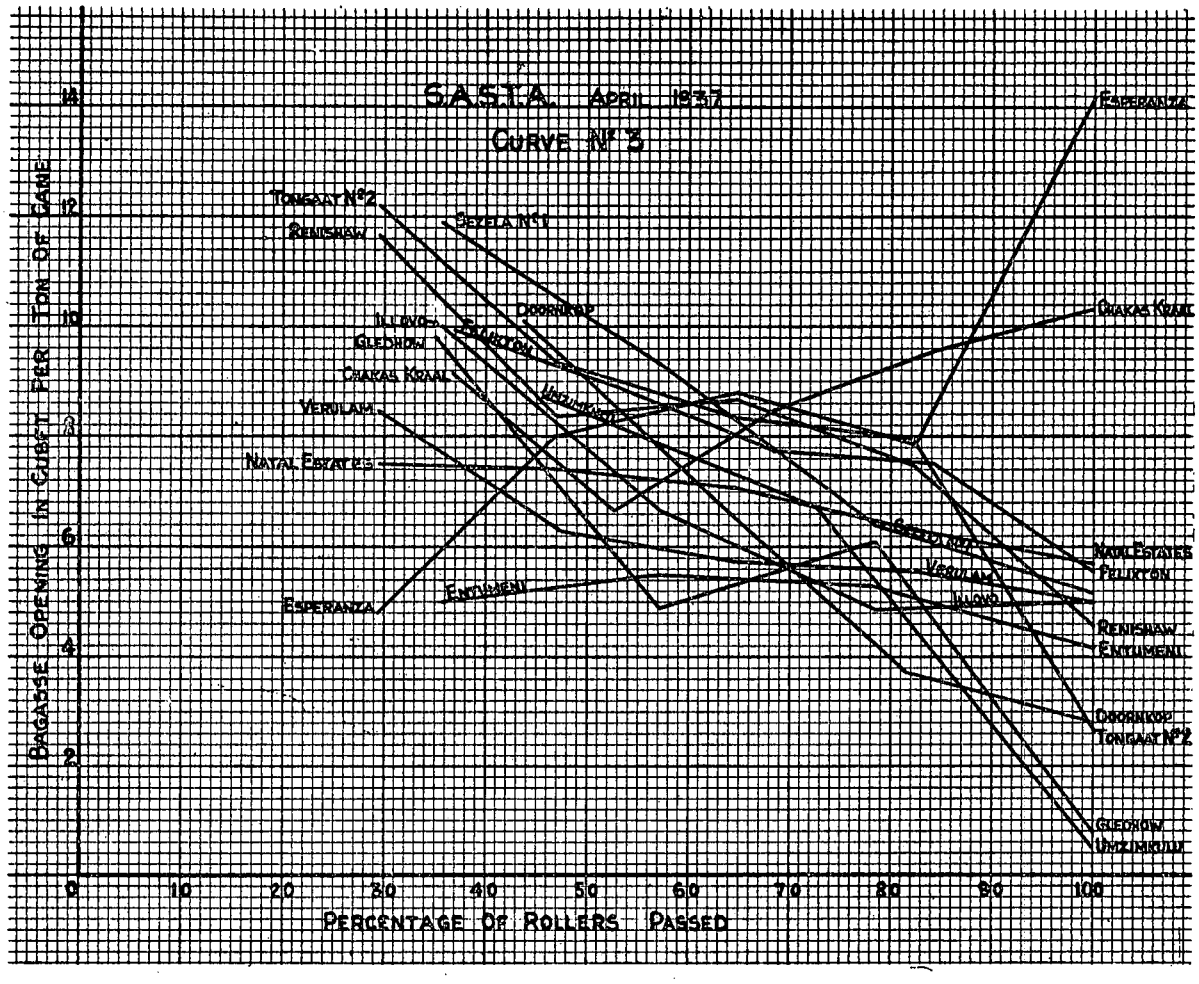
With regard to the mill settings last year curve 1 gives the feed opening per ton of cane, curve 2, feed opening per ton of fibre, curve 3, bagasse opening per ton of cane, and curve 4, bagasse opening per ton of fibre, for a number of mills. These have been plotted on a base of the percentage of rollers passed, in place of the actual number of rollers passed, as it is a more useful method and brings all mills down to a definite basis.

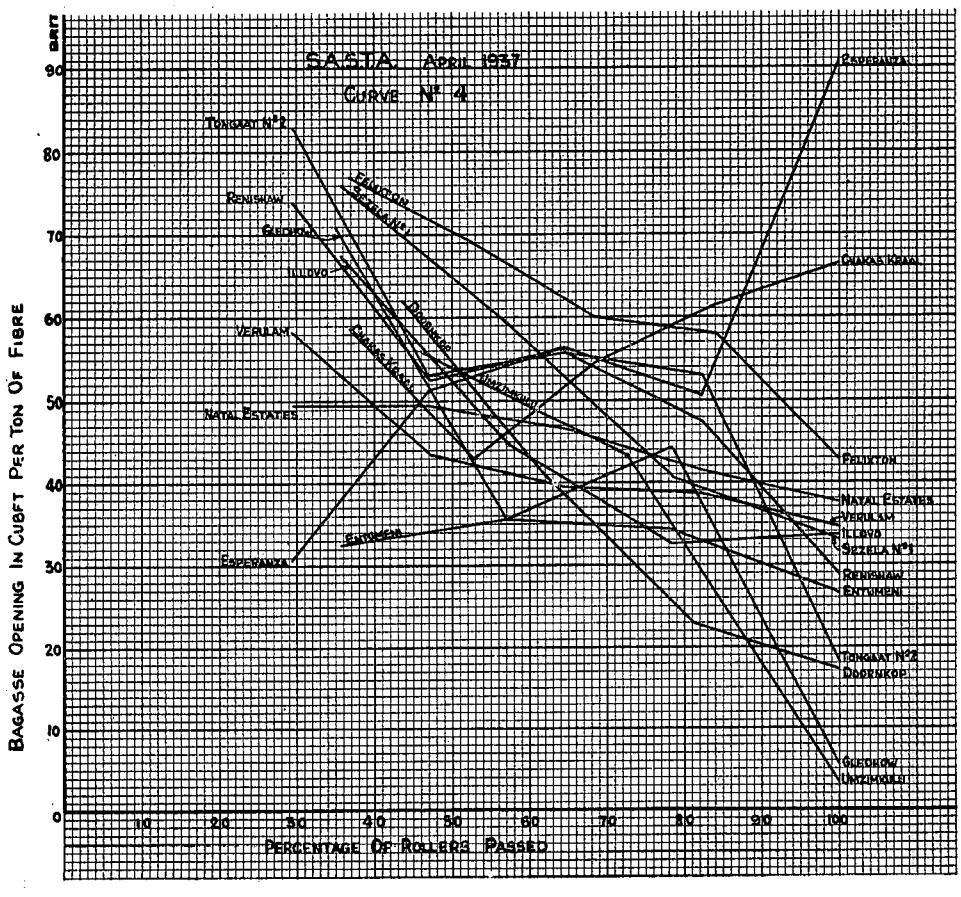
In curve 3, the bagasse opening per ton is actually more (in some cases) than the actual solid volume of the bagasse, and these mills could not have been doing their best work. You will also note on Curve 1 and 2 the feed openings in some cases are much too large. You will again note that the Zig Zag crushers have the smallest openings, and will consequently give the best work.

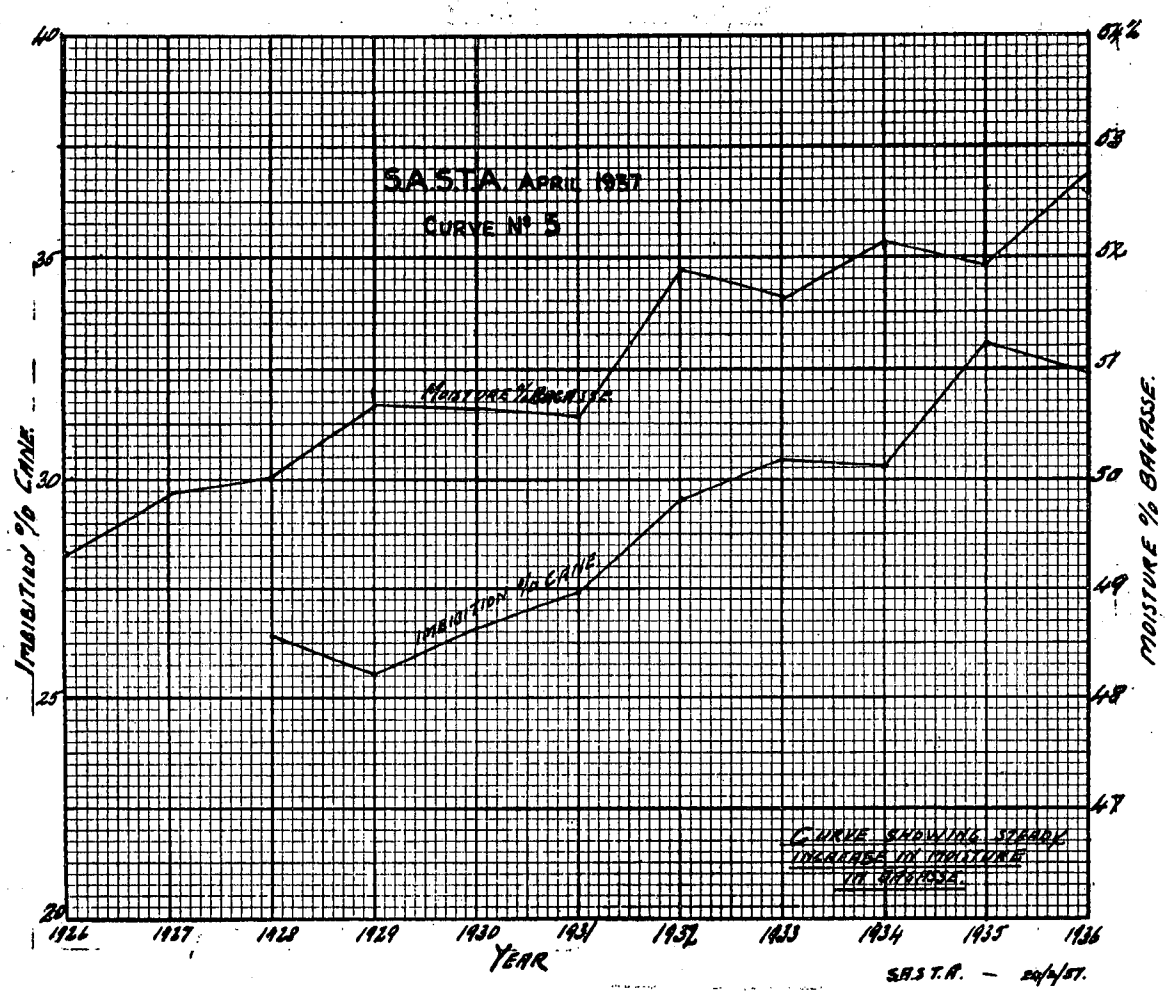
We trust you will study these curves as they entail a large amount of work, and give very valuable information when studied.

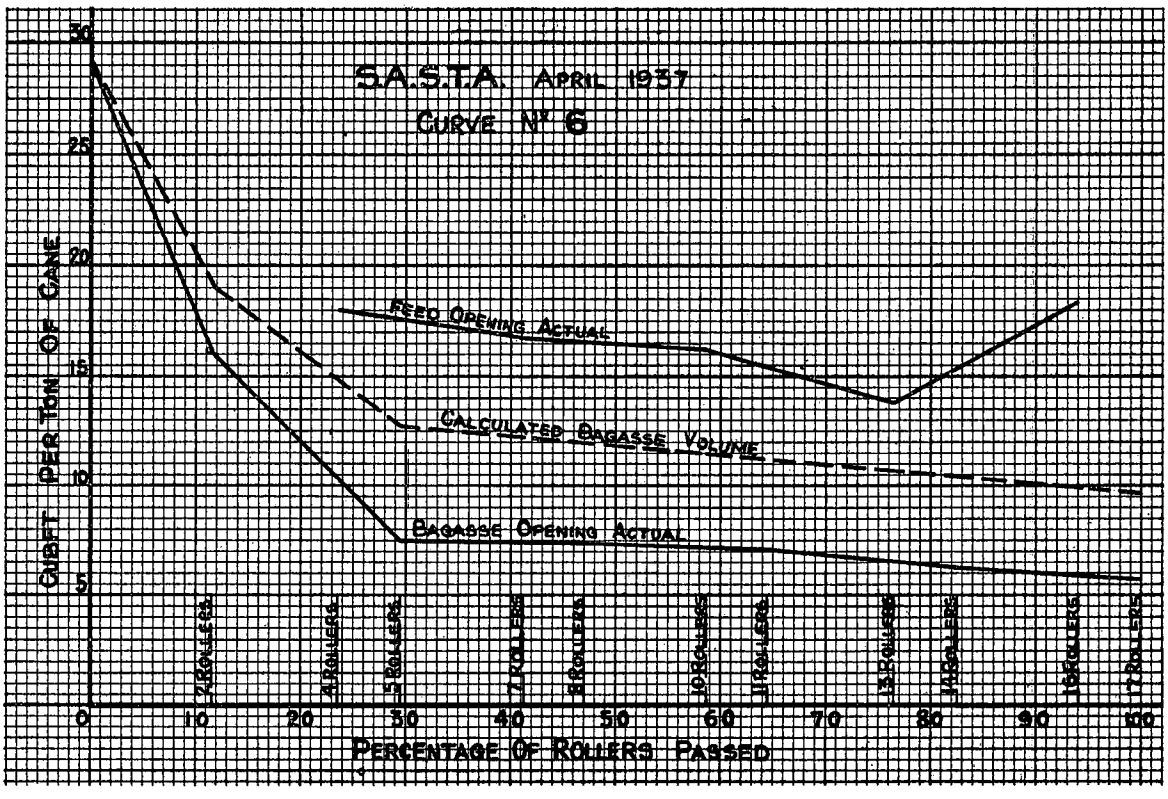

S.A.S.T.A. April 1937
Curve No. 1
Feed Opening In Cubft Per Ton Of Cane
Percentage Of Rollers Passed
Felixton
Esperanza
Renishaw
Illovo
Tongaat No. 1
Tongaat No. 2
Chakas Kraal
Gledhow
Verulam
Natal Estates
Entumeni
Doornkop
Chakas Kraal
Esperanza
Felixton
Natal Estates
Entumeni
Renishaw
Tongaat No. 1
Tongaat No. 2
Gledhow
Illovo


S.A.S.T.A. April 1937
Curve No. 2
Feed Opening In Cubft Per Ton Of Fibre
Percentage Of Rollers Passed
Felixton
Esperanza
Tongaat No. 1
Illovo
Renishaw
Chakas Kraal
Gledhow
Verulam
Natal Estates
Entumeni
Doornkop
Felixton
Chakas Kraal
Esperanza
Natal Estates
Entumeni
Sezela No. 1
Tongaat No. 1
Doornkop
Tongaat No. 2
Gledhow
Umzinkulu
Illovo


S.A.S.T.A. April 1937
Curve N° 3
Bagasse Opening in Cubic Feet per Ton of Cane
Percentage of Rollers Passed
Tongaat N°2
Renishaw
Sezela N°1
Illovo
Gledhow
Chakas Kraal
Verulam
Natal Estates
Esperanza
Entumeni
Doornkop
Umzimkulu
Felixton


S.A.S.T.A. April 1937
Curve N° 4
Bagasse Opening in Cubic Feet per Ton of Fibre
Percentage of Rollers Passed
Tongaat N°2
Renishaw
Gledhow
Illovo
Verulam
Natal Estates
Esperanza
Entumeni
Chakas Kraal
Felixton
Sezela N°1
Doornkop
Umzimkulu


S.A.S.T.A. APRIL 1937
CURVE Nº 5
MOISTURE % CANE
MOISTURE % BAGASSE
YEAR
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
40
35
30
25
20
64%
63
62
51
50
49
48
47
CURVE SHOWING STANDARD INDICATORS FOR MOISTURE IN BAGASSE
S.A.S.T.A. — 20/4/37.


S.A.S.T.A. APRIL 1937
CURVE Nº 6
CUBIC FT. PER TON OF CANE
FEED OPENING ACTUAL
CALCULATED BAGASSE VOLUME
BAGASSE OPENING ACTUAL
PERCENTAGE OF ROLLERS PASSED
30
25
20
15
10
5
0
10
20
30
40
50
60
70
80
90
100
4 ROLLERS
4 ROLLERS
5 ROLLERS
7 ROLLERS
8 ROLLERS
10 ROLLERS
11 ROLLERS
13 ROLLERS
14 ROLLERS
16 ROLLERS
17 ROLLERS

The PRESIDENT: I am sure we are all very much indebted to Mr. Murray for his paper. I see he says that the work entailed in calculating is quite considerable, and he says it is a man's job. Well, a man has done that job. There is one point I would like to mention and that is the question of drainage. When I was over in the States, I spent about four days with Mr. Hurter, the Chief Engineer of the Fulton Iron Works. I got quite a lot of information from him in connection with the Cuban and Hawaiian Mills. I asked him how he accounted for the high extractions. He said: "There is only one answer, and that is adequate drainage." To Mr. Saunders, one of the captains of our Industry, shortly after his return from Mauritius and the Hawaiian Islands, I put the same question to him, as to how they got the high extractions in the Hawaiian Islands. He said, "I mentioned that to one of the eminent engineers over there, and he said 'Mr. Saunders, I could sum up the whole thing in one word, and that one word is drainage'." I see Mr. Murray emphasises that in his paper. The paper is now open for discusion.

Mr. F. B. MACBETH: Mr. President and Gentlemen, although the paper is described as a Report of the Committee on Milling and Milling Practice, I must state that Mr. Murray must be awarded the entire credit for this very interesting and valuable addition to Milling Practice in this Country.

The amount of work entailed alone in the various graphs can be gathered by the amount of data and information that was required to set these out, so I therefore wish to thank Mr. Murray for his excellent contribution.

In touching on the wear on Mill Rollers in this country, there are also other factors which govern the wear, such as the different grades of metal supplied by manufacturers, and this feature has a very considerable effect on the functioning of the Mills and the results obtained. Personally, I prefer to have a medium grained metal, bordering on the soft side, as, from experience we have found that the Mills give better work from such metal in the rollers. The best work is obtained in the 2nd and 3rd year's life of a roller of course, that is with metal referred to above.

Further, it is better to forego a year's life on a roller, than to have rolls polish through hardness of metal, as the extra extraction obtained from good grained rollers would more than compensate one year's loss of life.

With reference to the moisture in bagasse, this subject has given quite a number of us brain waves and incidentally, headaches, but we appear to arrive back at the starting point.

Personally, I have my own views on this much discussed subject. The Milling Practice in this country is entirely wrong, in so far as crushing capacities are concerned, when compared with other Cane Sugar producing countries, where high efficiencies are maintained

In the first place, we have a product with 15 to 18% fibre (and in some instances higher) and as hard as bamboos and our practice is to see how much we can put through the mills. Each year, it is a case of just a little bit more, and as I have mentioned previously we arrive at a point where efficiency must give way to quantity.

About ten years ago, when crushing capacities were on the increase, large grooves and larger settings were introduced to meet the increased tonnages milled, and of course moistures went up, as you are aware large grooves do not tend to give low moistures, especially when 40% of imbibition is applied in front of the last mill, as is the case in one instance. With this percentage of imbibition added, equals 9,600 gallons of water per hour applied to the bagasse, it is obvious that grooves and messchaert grooves of a large size is necessary to take care of this amount of liquid, and as you are aware is acting counterflow to the feed of bagasse entering the mills.

Since my visit to the Hawaiian Islands, I am fully convinced on these points raised, but I will not go as far as to say no further improvement can be made, only, what those improvements are to be I cannot say at present.

There is one arrangement which would, in my opinion, solve the high moisture problem, and that is the installation of an extra mill on the tandem. Where a tandem consists of say five mills, add a sixth mill and then split up the imbibition water in equal proportions on the fifth and sixth mills, this would enable the grooves on these two units to be cut a smaller pitch, and hence reduce the moisture content, but, would the extra outlay, running and maintenance costs, for an extra unit, offset the gain obtained? In my opinion it would.

The graphs are very interesting and show an extraordinary range of settings at the various factories concerned. I did not imagine that such a great variation existed. It would certainly be of value to obtain, if possible, some of the reasons for such a difference in the curves.

One remarkable point is the very little difference between the graphs on per ton of fibre and that of per ton of cane.

In conclusion, I again thank Mr. Murray for his valuable contribution and I am sure we are certainly indebted to him for compiling same.

Mr. JOHN MURRAY: I would like also to thank Mr. Murray for his paper. I am very glad to find that some members of the Murray family have got brains. I may say that I was the first person in this country to introduce messchaert

grooves. I happened to be in Honolulu at the time they introduced the Searby Shredder, from the Jeffrey Company of New York. I preached the gospel of shredders here for a long time.

There is no mistake but this Cuban carrier is the easiest carrier to work with in a mill. We have had the case of Umfolosi. Nearly everyone was getting 51% of moisture. Umfolosi was getting 47%, when they had only four mills. Now they have got six mills, their moisture has gone up, the reason for that was that on the fourth mill at Umfolosi, they had this feed roller and there was any amount of room for the water or expressed juice to get out. That mill never choked, and they reduced the speed of the engine 12 revolutions, and put through about eight tons an hour more, as far as I remember. Umfolosi is so pleased with it that they have put a feed roller in every mill they have got. The Tongaat Sugar Co. are trying it out this year, and I am quite sure it will be satisfactory. The Central Factory, in 1929, was crushing 29 tons an hour with an extraction of 88. To-day, 1936—it is crushing 34 tons an hour; it has got an extraction of about 93.6, or something like that. The only difference in the mill is that the first mill has big grooves, and the drainage in that is good, but the rest of them have messchaert grooves, front and back and the setting is better, but it is remarkable that one man can get these figures, where another man gets inferior figures. Now drainage is attended to in all factories where you see a high extraction.

Mr. McNICHOLL: I think, in my way of looking at it, a lot of the existing mills in this country today, are really in a position that the effective rise of the top roller becomes practically impossible, due to the restricted area of the hydraulic pipes, and the accumulator is generally situated quite a considerable way from the hydraulic cap itself, and the general practice is to have a ¾ inch hydraulic pipe. When the top roller rises, you have got to displace that water and you have got to have an effective discharge pipe for the quantity of water displaced.

So far as Mr. Macbeth's remarks on the metal of the rollers go, I think there is a tremendous lot in that. What people want today, is the longest possible life of a roller, irrespective of what that roller does. Rollers, to-day, are so manufactured that once a satisfactory metal is obtained, it is tested for hardness, and you can always get a repeat of that hardness, or that quality of hardness. That is a very important thing, I think, in the selection of a roller, to know what its hardness was when it was supplied to you. Hardness is a common test today, with all mill roller manufacturers. Having had a test of the roller, you are then in a position to scientifically go back on the roller which has given you the best satisfaction and service.

I think, with a well-designed carrier, there should be no difficulty in getting drainage from the roller. Effective drainage from the roller should not be obstructed. Drainage should be by the roller grooves, and it is only by the roller grooves that effective drainage will be obtained. For many years we have been trying to get down to a narrow trash turner. We have all wanted to reduce friction across the bar as much as possible. Years ago, we cut the bar to within practically one inch on the discharge side of the roller, and we went straight across into the feed roller. That was effective so long as the feed was uniform. When the feed was irregular, then we had a messy crushing, but the drainage was most effective. I do think one of the common failures on the hydraulic gear of mills today is ineffective area through the hydraulic tube system.

Mr. J. B. GRANT: This Report stresses the fact that moisture per cent. bagasse is definitely increasing year by year, and although the higher imbibition applied may primarily be the cause, it is pointed out that we should endeavour to reduce this moisture content to as low a figure as possible, and so increase our boiler efficiency and incidentally our extraction. In discussing the question, the Report says, speaking of the large amount of juice to be expressed; "Care must be taken to leave a large enough area of drainage grooves to cope with the large amount of liquid expressed out." Generally, I take it that the Report advocates Messchaert grooves on both the feed and bagasse boilers. Personally, I disagree with this.

In feed rollers, Messchaert grooves are essential for this reason. The point where pressure is applied between the top and feed rollers is below the highest point of the feed roller, and consequently the juice expressed has to flow upwards through the incoming blanket of partially crushed cane. To overcome this, Messchaert grooves were evolved, and the depth of these should be such that the level of the bottom of the grooves should be as low as the point of maximum pressure, and so allow free exit for the expressed juice. This argument does not hold good in the case of bagasse rollers, where the expressed juice flows downwards from the point of pressure. Further, owing to the high pressure applied between the top and bagasse rollers and the weakening of the bagasse roller shell, through grooving, the damage caused by the tramp iron is excessive. I have seen rollers discarded for this reason after running one crop.

A further point mentioned is as follows: "Care must also be given to see that the trash turner is far enough away from the bagasse roller to help this juice drainage. Many of the mills have increased this clearance with good results." I don't know if this statement is to be taken literally or not. If so, I consider it incorrect, as with large grooved mills I contend that there is ample clearance in the grooves alone to remove all the juice that is expressed by a bagasse roller. That others hold this

opinion can be shown by the fact that I have seen trash-plates grooved at the back to fit into the bagasse roller and the clearance reduced to a minimum. However, that is by the way, and I consider it a very bad practice. It is my opinion that this trash-plate clearance should be as large as possible in an attempt to obtain a condition of no pressure in the blanket after it has left the trash-plate and prior to pressure being applied by the top and bagasse rollers. From this will be seen that there is no resistance to the flow of the expressed juice and that the use of Messchaert grooves with their disadvantages are unnecessary in the discharge roller. In an endeavour to obtain this condition, I have put in a trash-plate this year which is slightly unorthodox. The usual plate is shaped at the back more or less to conform to the shape of the roller, but opening out towards the bottom. I have inverted this and have the opening wide at the top and tapering towards the roller at the bottom.

Mr. CAMDEN SMITH: Although the point has been mentioned before, I think sufficient stress has not been laid on it, that is the nature of the surface made with these rollers. If you cannot get the roller to grip the cane, how can you work at all? The first essential is a good gripping surface, a metal surface which will begin rough and remain rough right through the season. I think if manufacturers of milling plant would only pay more attention to providing rollers with a proper gripping surface, most of our troubles as operating engineers would vanish and we would have a much easier time.

Mr. McNICHOL: Mr. Murray correctly says that in the last ten years, makers of mills have increased the hydraulic pipe area considerably, but don't forget that the mills in this country are more than ten years old, that hydraulic loading is a necessity, and failure to lift in many cases is due entirely to the small piping of the plants supplied to this country, some of which are 25 years old.

Mr. P. MURRAY: I have to thank you for the way you have listened to this paper, and for the criticisms and suggestions.

With regard to roller metal, I agree with Mr. Macbeth; manufacturers are doing their best to meet the varying requirements and conditions. I am afraid roller metal will always be a trouble as it depends on the position of the roller and the work it is doing. I have had a recent case where two rollers of different manufacturers were compared, and I feel that if the roller complained of had been in the place of the other roller, the comparison might have been different due to the closer setting, etc. It is no use placing all the troubles on the hardness of the metal. All rollers are harder outside and get softer as they wear down.

In Queensland, they are discarding rollers before they are near the smaller size, as the metal gets too soft. Here, we wear them down to the limit. With regard to Mr. Grant, Mr. James Smith has been mentioned, he had experience in the early days, with wooden rollers and up to recent times and he said it did not make much difference whether the trash-plate was high or low, but with modern trash turners I am sure it must help the work of the Mill to have a properly adjusted trash turner.

With regard to the intermediate carrier, Mr. John Murray says he prefers a scraper carrier to an apron carrier, I am afraid that is not the experience of most of us. I think we are getting away from scraper carriers. We put scraper carriers at Doornkop, and are now replacing them with apron carriers.

Mr. JOHN MURRAY: With feed rollers?

Mr. P. MURRAY: No, without feed rollers.

With regard to hydraulics, I agree with Mr. McNichol, many mills have too small a pipe connecting the caps to the accumulator. All manufacturers are now putting in larger pipes. With the quick rise of the mill rollers, if the pipe is small the velocity must be great and also the friction retarding the roller rise. I have seen the pressure gauge on hydraulic rise 40 tons before the accumulator moved, due to the friction of the packing in the accumulator and I feel you should give the packing of the accumulator great attention. We have a patent accumulator to give an even rise of the mill top roller; this has three rams and the accumulator was sluggish due to the packing. We have altered this packing and reduced the friction by over 60 per cent.

I hope the curves will be of some use to you and help you in setting your mills. I think it is really useful work, and I think it will help, but I do hope some other body will do the work.

The PRESIDENT: That concludes the discussion on Mr. Murray's paper, which has been very interesting indeed. Mr. Murray has stated that next year this must be the work of some other body. But I don't believe him. Mr. Murray will never get away from this work. We will have him back on the Committee next year, doing the same amount of work. I would like you to join me in a vote of thanks for his excellent paper. (Applause).