REPORT OF THE TRASH INVESTIGATION COMMITTEE

In a general way, engineers and chemists have long been aware of the disadvantages to factory work caused by excessive quantities of trash and other extraneous matter which accompanies the cane delivered to factories. It is obvious, also, that in recent years the quantity of such extraneous matter has been on the increase, and that this state of affairs is likely to continue in the future.

The primary causes of this deterioration in the quality of our raw material are the increasing shortage of field labour and the fact that more and more growers are realising the benefit of conserving trash and no longer burn cane prior to harvesting. Labour shortage has, as is well known, caused much trouble in other sugar-growing parts of the world, and in some countries the consequent mechanisation of harvesting operations has led to an even worse position than that as yet existing in South Africa. A further deterioration in the cleanliness of our raw material (already poor by, say, Australian standards) might well be anticipated with mechanisation of loading, and perhaps cutting, here.

This problem of dirty cane becoming more and more acute, and concrete information on the subject lacking, the Council of this Association appointed, during the year, a committee to gather data and to initiate a general investigation into the matter.

The first action of this Committee was the circulation amongst all members of a survey of the position written by the then convener, Mr. G. S. Moberly. At the same time, suggestions were invited from members as to any aspects they considered should be investigated besides those mentioned in the survey, and any ideas which might help towards solution of the difficulties were also solicited. Unfortunately, there was a disappointing lack of response to this invitation, but this was off-set to some extent by the very useful suggestions and comments contained in the one reply received. This reply, among other comment, drew attention to the fact that, besides tops and trash, sand and dirt should also form subjects for investigation.

The Committee at its first meeting decided to proceed along the following lines :—

(1) For the purpose of the investigation, trash should be considered as only the dry leaves accompanying the cane, and extraneous matter should consist of two other categories, namely, immature top with attached green leaf, and sand or other dirt adhering to the cane.

(2) Tests should be made to give some indication of the proportion of trash and tops in standing cane in the field.

(3) Experiments should be carried out with a power-driven test mill to show differences in test between clean and dirty cane.

(4) Controlled experiments should be conducted at factories to determine the effects of trash on milling.

For various reasons, it was not possible in the time available to complete many tests in each category, but those which were done are shown in this report so that they may be placed on permanent record in convenient form.

TABLE 1.—**Proportion of Trash and Tops in Standing Cane.**

Date of test	16/8/48 and 18/8/48		21st December, 1948				
Locality	Experiment Station		Darnall				**Average all tests.**
Variety	**Uba**	**N:Co.310**	**Co.301**	**Uba**	**Co.281**	**Co.301**	
Per cent. clean cane	73.7	75.0	72.6	75.0	90.8	76.1	77.2
Per cent. dry trash	9.8	11.8	8.4	4.4	4.0	8.4	7.8
Per cent. immature top (normal cutting)	—	—	9.6	11.8	2.6	8.4	—
Per cent. green leaves	—	—	9.4	8.8	2.6	7.0	—
Per cent. top and green leaves	16.5	13.2	19.0	20.6	5.2	15.4	15.0
Per cent. total extraneous matter	26.3	25.0	27.4	25.0	9.2	23.8	22.8

All the samples in the tests shown in Table 1 weighed between 200 and 300 lbs. It will be noticed from this table that there is a wide variation between the components of the extraneous matter. This variation is probably due to varying stages of maturity between samples as well as to experimental error. There are not enough tests to enable one to differentiate between varieties.

TABLE 2.

In each test a bundle of cane was thoroughly cleaned of all trash and tops. The bundle was then sub-sampled into two lots by dividing each stick into two parts and taking alternate top ends and butts for each lot. To the samples marked "trashy" were added a weighed quantity of trash which was fed into the mill with the clean sticks. Both samples were crushed in the power test mill, the feed being regulated to four sticks passing simultaneously, and bagasse from the first crushing was returned for a second crushing.

TABLE 2.—**Test Mill Experiment at Darnall, showing difference in Test due to Trash.**

Date	27th October		28th October		28th October		29th October	
Description	**Clean.**	**Trashy.**	**Clean.**	**Trashy.**	**Clean.**	**Trashy.**	**Clean.**	**Trashy.**
Weight of total cane (lbs.)	49.5	56.0	75.5	87.0	79.0	88.75	58.75	66.0
Variety	**Co.281**		**Co.301**		**Co.301**		**Co.281**	
Trash per cent. total cane	—	14.3	—	11.5	—	9.0	—	5.3
Juice extracted per cent. total cane	64.65	50.9	65.9	55.5	69.3	63.4	67.2	60.6
Juice extracted per cent. clean cane	64.65	59.4	65.9	62.7	69.3	70.3	67.2	64.0
Bagasse per cent. total cane	35.35	49.1	34.1	44.5	30.7	36.6	32.8	39.4
Pol. juice	20.20	19.50	19.62	19.37	19.64	19.28	20.79	20.73
Purity juice	91.8	89.9	92.5	90.1	92.2	90.5	91.6	90.9
Pol. bagasse	11.0	9.0	9.4	8.4	8.8	10.9	10.8	10.3
Sucrose per cent. total cane	16.93	14.35	16.15	14.49	16.95	15.44	17.31	16.86
Sucrose per cent. clean cane	16.93	16.75	16.15	16.38	16.95	16.97	17.31	17.81
Fibre per cent. cane	13.2	21.8	13.6	20.0	12.1	18.6	—	—
Extraction	77.1	69.15	80.1	74.1	80.3	79.1	80.5	74.8
Java Ratio	83.9	73.6	82.2	74.8	86.3	80.1	83.5	81.1

TABLE 3.

In this series of tests a large sample of standing cane was cut, brought to the laboratory and sub-sampled into three portions. In each case the sample was crushed and the bagasse returned and crushed a second time, as was also the case in Table 2. The juices were tested separately, but the Java Ratio is, of course, calculated from the first expressed juice only.

TABLE 4.

In this test the trashy cane did not come from the same field as the clean cane. However, the fields were very close together (almost adjoining), and the canes were of the same age and were both third ratoons. The trashy cane was cut and crushed on the same day, whereas the burned cane (clean cane) had been burned on the 28th October, cut on the 1st November and crushed on the 2nd November—four days after burning.

For each test the milling plant was stopped and emptied of bagasse and juice. The weights of water and juices were accurately checked at the end of the crushing period when the milling plant was again stopped and all bagasse and juice had been emptied

TABLE 3.—**TEST MILL EXPERIMENT AT THE EXPERIMENT STATION, SHOWING DIFFERENCE IN TEST DUE TO TRASH AND TOPS.**

	1			2		
Number of sample	1			2		
Date tested	16th August, 1948.			18th August, 1948		
Field number	—			M1		
Variety	Uba.			N:Co.310.		
Description of sub-sample	Clean cane.	Cane+dry trash.	Cane+dry trash+tops	Clean cane.	Cane+dry trash.	Cane+dry trash+tops
Weight of total cane	219.5 lbs.	294 lbs.	291 lbs.	212.5 lbs.	302.5 lbs.	287 lbs.
Dry trash % total cane	—	11.7	9.8	—	13.6	11.8
Tops+green leaves % total cane	—	—	16.5	—	—	13.2
Juices—	1st Exp. Last Exp. Mixed.	1st Exp. Las Exp. Mixed.	1st Exp. Last Exp. Mixed.	1st Exp. Last Exp. Mixed.	1st Exp. Last Exp. Mixed.	1st Exp. LastExp. Mixed
Brix	20.0 — 20.1	19.9 — 20.3	19.4 — 19.5	22.5 — 22.5	22.8 — 23.0	22.1 — 22.1
Purity	84.8 83.7 83.7	83.6 78.0 81.5	81.8 70.8 79.5	92.4 89.6 92.1	91.9 84.1 90.1	90.5 80.0 89.1
Bagasse % cane	35.8	48.0	54.1	33.6	48.0	48.8
Sucrose % bagasse	9.8	8.5	7.2	11.4	9.0	7.4
Moisture % bagasse	51.0	47.6	48.8	47.0	42.8	43.8
Sucrose extraction	75.1	67.9	64.9	78.2	71.4	73.6
Reducing sugar ratio	6.4	—	7.5	1.4	1.7	1.7
Sucrose % cane	14.38	12.70	11.1	17.59	15.10	13.69
Fibre % cane	13.4	19.9	22.2	13.5	22.3	22.9
Java Ratio	84.7	76.4	69.9	84.9	75.8	69.5

	3			4		
Number of sample	3			4		
Date tested	19th August, 1948.			20th August, 1948.		
Field number	M1			M1		
Variety	N:Co.310.			N:Co.310.		
Description of sub-sample	Clean cane.	Cane+dry trash.	Cane as in field less green leaves	Clean cane.	Cane+some dry trash	Partly topped & trashed high
Weight of total cane	215.5 lbs.	279.5 lbs.	265 lbs.	204 lbs.	223.5 lbs.	232 lbs.
Dry trash % total cane	—	11.1	9.7	—	6.6	6.2
Tops+green leaves % total cane	—	—	13.0	—	—	7.2
Juices—	1st Exp. Last Exp. Mixed.	1st Exp. Last Exp. Mixed.	1st Exp. Last Exp. Mixed.	1st Exp. Last Exp. Mixed.	1st Exp. Last Exp. Mixed.	1st Exp. Last Exp. Mixed.
Brix	22.85 — 22.9	22.7 — 22.9	22.7 — 22.9	22.4 — 22.3	22.6 — 22.7	22.2 — 22.3
Purity	92.7 88.9 92.1	91.5 80.5 90.5	91.3 84.9 89.7	91.7 91.0 91.4	92.3 88.6 91.8	91.7 86.7 90.3
Bagasse % cane	29.5	44.4	51.6	35.0	43.6	43.3
Sucrose % bagasse	9.0	7.4	9.9	11.0	9.8	9.7
Moisture % bagasse	44.0	40.0	45.5	49.5	47.3	48.0
Sucrose extraction	84.9	77.8	66.1	77.4	73.3	73.1
Reducing sugar ratio	1.6	1.9	2.1	2.0	1.6	2.1
Sucrose % cane	17.52	14.81	15.06	17.10	16.00	15.61
Fibre % cane	13.5	22.6	22.1	13.4	18.1	17.7
Java Ratio	83.1	71.4	73.3	83.9	76.8	77.5

TABLE 4.—**Large-scale Factory Test, showing difference in Milling Performance and Analyses due to Trash.**

(Entumeni Sugar Milling Co. (Pty.) Ltd.)
Date of test, 2nd November, 1948. Variety Co. 281.

	Trashy cane.	Clean cane
Tons cane crushed	54.80	90.03
Bagasse per cent. cane	45.71	38.34
Maceration per cent. cane	67.70*	42.55
Per cent. trash on total cane	10.66	—
Hours crushing	4.87	5.42
Time lost	2 mins. (choke)	5 mins. (choke)
Tons per hour	11.25	16.61
Sucrose per cent. bagasse	3.50	3.67
Moisture per cent. bagasse	47.67	48.00
Fibre per cent. cane	21.92	18.29
Java Ratio	70.04	74.78
Sucrose per cent. cane	13.93	13.73
Extraction	88.51	89.75
Purity last mill juice	80.00	85.83
Purity crusher juice	91.80	89.14
Purity mixed juice	87.90	88.61
Glucose ratio mixed juice	4.74	3.64
Tons fibre per hour	2.47	3.04

* Necessary to keep evaporator going.

again. In the case of the clean cane a light drizzle started some six hours previous to and continued until the start of the test.

General Observations.

During the past year work was confined to the gathering of data, and although only a limited number of tests were obtained these were most illuminating. The effects of trash and tops on the analysis of cane are at once apparent, while the loss of milling plant efficiency is indicated by the single large-scale factory test.

The presence of trash has led, as could be expected, to a decrease in sucrose content of total cane, an increase of fibre content and a decrease in Java Ratio. It is not generally realised what this lowering of sucrose content entails. To quote from the general survey sent out on behalf of the Committee :—

> "Under the present system of payment a grower is paid for sucrose which is determined as the product of the weight of his cane, and a sucrose percentage figure which is determined from the analysis of his crusher juice. Since the latter will be largely unaffected by the trash (as distinct from tops) his sucrose will be increased in proportion to his excessive trash. This extra payment will come entirely from the supplier of clean cane. Thus cane containing 13 per cent. sucrose is worth 20s. 6.1d. per ton when the price of 96° sugar is £15. If half the growers send 100,000 tons of such cane in a clean condition and the other half send in the same weight of similar cane accompanied by a 5 per cent. excess of trash, the latter will receive nearly £2,500 which belongs rightly to the suppliers of clean cane, who will receive only 20/0.1d. per ton, a loss of 6d. per ton through no fault of their own."

Trash is known to reduce factory throughput in two ways at least. Its presence in the cane supply results in more fibre to crush, and it is a prolific source of chokes in the milling plant. This reflects back on growers, for the crushing season is thus prolonged, so that more of the crop must be reaped outside the optimum period of sucrose content. While the loss in sucrose extracted due to trash is of immediate import to the factory, it is also of concern to the grower, for in the long run he too is interested financially in the overall efficiency of the factory extraction.

The tests shown above might also be taken as indicating that trash causes a reduction in crusher juice purity, but this would require further proof. There can be no doubt, however, that trash does adversely affect the purity of the mixed juice, and hence reduces the factory boiling-house recovery. In this connection, Balch and Broeg[1] contend that the impurities extracted from dry leaves during milling are more troublesome than those extracted from tops.

It is obvious that tops cause a lowering of the purity of juice from test mills. It would indeed be surprising if this were not the case in factory crusher juice as well.

REFERENCE.

[1] Private communication, 1948.

Before reading the report, Mr. Christianson explainted that he had summarised the work done, as the original convenor was no longer in a position to do so.

Mr. HENRY asked for further elucidation of the term "trashy cane" in Table 4, in which the crushing rate was shown to have dropped from 16.61 to 11.25 tons of cane per hour.

Mr. CARTER, who had carried out this test, replied that the cane had been merely cut and topped and no trashing had been done at all. The reduction in crushing rate was due to the volume of trash.

Mr. MOBERLY said that it was not possible to get the cane crushed faster, for due to the volume of trash, although the carrier was piled as high as could be, the knives could not handle any more.

Another point he had found interesting when carrying out tests in the laboratory power mill at Darnall. A clean stick of Co.281, passed through the mill once, came out crushed but still in one continuous length. With 10 to 20 per cent. of trash

added, the stick was broken up into small pieces, and after being passed through the mill a second time was disintegrated into bagasse similar to the factory product. Trash on cane does help to disintegrate it, apparently due to the trash passing through the mill at a speed different from that of the cane.

The PRESIDENT asked if the percentage of 10.66 of trash on cane shown in Table 4 was calculated on clean or trashy cane, if this figure included tops, and if trash were especially added.

Mr. CARTER replied that the percentage was determined on a sample and calculated on a clean cane basis. The cane was free from tops and no extra trash was added.

Mr. DYMOND considered that enough data had now been gathered . The question should be considered from the financial aspect. This was necessary, for until it could be shown what was lost in extraction and boiling-house recovery in terms of pounds, shillings and pence, the sugar factory owners would not be interested.

Other countries had endeavoured to clean cane at the factories, and he personally thought that to be the only solution. Planters in South Africa would never clean the cane as we desired, especially with their labour troubles, and it was up to the factories to clean the canes. A few minor experiments along these lines had been carried out, particularly at Felixton, where cane was burnt on the carrier. He thought there were possibilities in that idea, but we had no facilities for carrying out such experiments.

Mr. MOBERLY stated that, as the original convenor of the Committee, it was his intention to carry on the experiments until the results could be reduced to financial terms. After the preliminary experiments shown in the report, it was intended to go on until it could be demonstrated clearly how much money the planter and the miller were losing through trash being sent in to the factories. There would then be an incentive to get something done, but up to now it had not been sufficiently apparent to the economic powers what they were losing. In recent years, with the increase of trash, this loss had become more apparent and some experiments had been carried out.

He hoped the industry would look upon the burning of cane on the carrier from a combined agricultural and milling point of view. Agriculturally, just as much harm was done by burning cane in the mill yard as by burning it the field. It would be more helpful to clean cane at the mill, recover the trash and use it to make compost by combining it with filter cake, or in some other way make it a manageable fertilizer, and then return it to the fields.