Second Day—Tuesday, 13th April, 1926.

STANDARDISATION OF CHEMICAL CONTROL.

Report of the Sub-Committee of Sugar Technologists' Association.

The Congress resumed at 10 a.m.

Mr. H. H. Dodds, Director of the Experiment Station, read the following paper on STANDARDISATION OF CHEMICAL CONTROL, being a report prepared by a sub-committee of the Sugar Technologists' Association, consisting of Messrs. G. C. Dymond, E. Loumeau, B. E. D. Pearce, J. Pougnet, J. Rault, A. Warner, and H. H. Dodds (convenor).

The work of this committee has been mainly concerned with the necessary preliminary work of collecting and collating information regarding existing practice from the various factories in the sampling and testing of sugar house products. It was believed advisable first to publish comparative data so that existing differences in method in different laboratories might be studied by interested parties before the committee compiled a detailed standard method of procedure recommended for general adoption.

Nevertheless it was considered opportune to recommend tentatively general broad lines of treatment of certain important factors that had received considerable discussion in committee.

1. **Weighing of Sugar House Products.**—It is strongly urged that all factories should provide themselves with means of accurately weighing materials which are involved in the accountancy of the sugar, especially the juice and final molasses. The measure of liquids by volume on a large scale leads to unavoidable inaccuracies which are apt to vitiate the whole of the laboratory results; and it is considered from the point of view of efficiency of the factory that these liquids should be weighed as accurately as the cane entering and sugar leaving the process.

2. **Determination of Sucrose.** The exact determination of sucrose is recommended for the products which enter directly into the sucrose account, which is held to involve the double polarization of mixed or clarified juice, syrup, and final molasses. No particular method of double polarization is definitely laid down at this stage but it is stated that H. Walker's modification of the Clerget method, as recommended in "Methods of Chemical Control for Cane Sugar Factories," published by the Hawaiian Chemists' Association, in which the liquid is heated to 65° before the addition of acid, has been found very suitable. Substances which are tested primarily for the guidance of factory operations and do not enter directly into the sucrose account e.g., crusher or first mill juice, last mill juice, massecuites, molasses for reboiling, etc., should be tested by more rapid methods of single polarization with the recommendation that these should be frequently checked by double polarization.

3. **Frequency of Analyses.**—It was recommended that samples of juices and syrups should be analysed every eight hours with the possible exception of raw mill juices which might be governed by local conditions. It was pointed out that certain abnormal conditions had occurred during the latter part of last season at a Zululand factory in which juice samples were found to be liable to decompose at atmospheric temperatures within a few hours even in the presence of the usual preservatives. In such conditions a method of control is indicated in which composite samples of mill juices are analysed at more frequent intervals.

The committee requests that experiments be carried out next season at each factory where possible to determine the interval at which decomposition sets in under varying local conditions. It is intended to give later a desired procedure for this investigation.

4. **Determination of total Solids.**—It is recommended that standards based on the readings of Brix hydrometers with long spindles be adopted with the request that results based on the refractive index of solutions be also determined for comparison and data collected thereon. The committee has not as yet decided whether 17.5°C or 20°C. is the most suitable temperature for the standardization of apparatus.

5. **Degree of Dilution.**—No general agreement has as yet been arrived at regarding the optimum degree of dilution for testing concentrated products such as syrup, molasses and massecuite.

Manufacturing Results from certain Natal Sugar Factories for 1925-6 Season.

No. of Factory.	Sucrose in Cane. (per cent)	Sucrose in crusher (C) or 1st mill Juice (M) (per cent.)	Sucrose in Cane -:- Sucrose in crusher of 1st mill juice x 100.	Fibre in Cane (per cent)	Sucrose per cent. Cane lost in manufacture.	Sucrose lost in manufacture per cent Sucrose in Cane.	Sucrose in juice per cent of Sucrose in Cane.	Sucrose in commercial product per cent of Sucrose in Cane.	Sucrose in commercial product per cent Sucrose in juice.	Dilution per cent of normal Juice.	Purity of Mixed Juice apparent (A) Clerget (C)	Purity of Final Molasses apparent (A) or Clerget (C).	Sucrose in Bagasse (per cent.)	Moisture in Bagasse (per cent.)	Yield–Tons Cane per ton of Sugar.	No. of Factory.
1	13.24	17.17(M)	77.2	14.58	2.76	20.87	91.82	79.13	86.18	29.23	85.01(C)	40.97(A) 42.50(C)	3.37	49.51	9.52	1
2	12.867	16.87(C)	76.3	—	3.599	27.97	85.75	72.03	84.00	—	86.7(C)*	46.6(C)	4.69	50.7	10.73	2
3	12.851	17.00(C)	75.6	16.31	3.919	30.50	86.50	69.50	80.35	15.88	84.1(A)	48.3(A)	4.883	47.81	11.19	3
4	12.84	17.06(M)	75.3	14.99	3.92	30.56	86.12	69.44	80.60	—	86.13(A)*	46.47(A)	5.16	49.87	11.09	4
5	12.74	16.44(C)	77.4	15.18	3.44	26.99	86.11	73.01	84.78	—	86.07(C)*	42.41(A) 47.96(C)	4.40	48.36	10.64	5
6	12.65	16.41(M)	77.1	14.67	3.25	25.69	91.65	74.31	81.05	16.80	84.1(C)	46.2(A) 50.7(C)	3.37	48.86	10.45	6
7	12.64	16.65(M)	76.0	16.15	3.28	25.99	87.37	74.01	84.71	20.56	84.8(A)	40.9(A)	4.50	48.64	10.61	7
8	12.51	17.01(M)	73.5	15.89	3.64	29.08	89.30	70.92	79.42	30.16	85.2(C) 83.9(A)	44.5(A) 47.9(C)	3.83	49.76	11.22	8
9	12.39	16.72(M)	74.1	17.75	3.70	29.87	89.23	70.13	78.59	25.81	80.97(A)	40.54(A)	3.52	47.13	11.48	9
10	10.62	14.57(M)	73.0	17.81	2.72	25.59	88.78	74.41	83.80	18.58	80.7(A)	39.6(A)	3.06	49.72	12.43	10
11	13.47	17.29(M)	77.9	16.43	4.13	31.3	85.4	68.7	80.4	—	85.1(A)	38 to 41	5.23	50.0	10.8	11

*Clarified Juice

METHODS OF ANALYSIS.

Factory No.	JUICES.	SYRUP.	MASSECUITES.	First and Second MOLASSES.	FINAL MOLASSES.	BAGASSE.	FILTER PRESS CAKE.	SUGAR.
1	10 per cent dilution of liquid used for Brix determination (Schmitz method.) Sucrose determination:—filtered liquid as used for polarization is inverted (H. Walker's method), and polarized in 400 mm. tube. Glucose determined as described by Geerligs ("Chemical Control in Cane Sugar Factories") but methylene blue used as indicator.	Diluted by adding twice its weight of water, Sucrose determined as for juices.	Diluted by adding four times their weight of water. Tested for brix and sucrose content.		Diluted as for first molasses, Polarization is determined in acid medium (sulphurous acid, Pellet's method) and the same liquid is inverted (H. Walker's method). Composite laboratory sample analysed every week for total solids (Brix and refractometer), sucrose and glucose.	Tested every hour for polarization and moisture. 200 grammes boiled with about 1,300 c.c. of alkalined water for 45 minutes. Polarized in 400 mm. tube.	Polarization every hour on composite sample from two machines, 100 grms. mixed with hot water and acetic acid made up to a known weight with water and polarized in a 400 mm. tube.	Tested for polarization once a week.
2	**SOLIDS:** Determined by the refractometer. Standard temperature 20 deg. C. **SUCROSE:** Weigh out 214.5 grammes in a tared beaker, transfer to a 250 c.c. flask, add 5 c.c. of subacetate of lead of 54 degrees brix, and a little Alumina cream. Make up to mark with water, observing the usual precautions, shake, filter. Filtrate A. **DIRECT READING:** Take 100 c.c. of filtrate A in a 100/110 c.c. flask, acidify with acetic acid, add a little alumina cream, make up to the mark with water, filter and polarise. **INVERT READING:** Take 50 c.c. of filtrate A in a 50/55 c.c. flask add 5 c.c. concentrated HCl and heat in a water bath for nine minutes at 70 deg. C. Cool in running water, and when cold, make up loss of water caused by evaporation, add a little Zinc dust (if necessary), filter, polarise and immediately after polarising, take the temperature of the liquid in the tube by means of an accurate Centigrade thermometer graduated in tenths of a degree. $\text{SUCROSE} = \frac{\text{DIRECT POL.—INVERT POL.}}{\text{FACTOR—}\frac{1}{2}\text{ TEMPERATURE.}}$ **GLUCOSE:** Clarify a quantity of the sample with dry neutral Lead Acetate, filter, pipette off 25 c.c. filtrate in a 100 c.c. flask, delead with a 10 per cent solution of Potassium Oxalate add a little alumina cream and then water to the mark; shake, filter and transfer filtrate to a 50 c.c. burette for the titration which is done on 10 c.c. of soxhlet solution, using the volumetric method with methylene blue as internal indicator.	**SOLIDS:** By refractometer. **SUCROSE:** Weigh out 71.5 grammes in a tared capsule, transfer to a 250 c.c. flask, and proceed as described for juices. **GLUCOSE:** Make a 30 per cent solution and then proceed as for juices.	Made up to 50 per cent solution and solids determined by refractometer in this solution. Sucrose determined in 50 per cent solution as described for syrup. Lead subacetate solution of 54 degrees Brix to be used:— c.c. Massecuite No. 1 .. .. 10 Massecuite No. 2 .. .. 20 Massecuite No. 3 .. .. 25 Molasses No. 1 .. .. 15 Molasses No. 2 .. .. 20 Molasses, final 40		Tested for polarization as for first molasses. Glucose test: weigh out 80 grms. of 50 per cent solution for molasses of about 10 per cent glucose and 40 grms for molasses richer in glucose. Transfer to 500 c.c. flask, clarify with neutral lead acetate solution and proceed as for syrup.	**SUCROSE:** Use a DEERR'S apparatus taking such a weight of bagasse that the polarisation in a 600 m.m. tube will give directly the per cent polarisation. The bagasse taken for the analysis is as it comes from the last mill, i.e. it is not comminuted. It is boiled for 2 hours in the DEERR apparatus, at the end of which time diffusion is complete. To neutralise the natural acidity of the bagasse 20 c.c. of a 20 per cent solution of sodium carbonate are used for about 300 grammes of bagasse. **MOISTURE:** 100 grammes for 45 minutes at 110 to 120 deg. C. in Spencer oven or for four hours at 105 deg. C. in ordinary electric oven.	**POLARISATION:** Weigh out 50 grms. of the 50 per cent mixture, transfer to a 200 c.c. flask, add some water and 3 c.c. acetic acid and allow to stand for 1 hour. Clarify with 5 c.c. lead subacetate solution, complete to mark with water, shake, filter and polarise in 400 mm. tube. **MOISTURE:** 10 grammes of the undiluted sample for 1½ hours at 115 to 120 deg. C. in Spencer oven.	**POLARISATION:** — Normal weight in 100 c.c. Clarify with alumina cream only for sugars of 97 and above; below 97 polarisation, in addition to the alumina cream add a little lead subacetate solution. **MOISTURE:** 10 grammes in Spencer oven for 15 minutes at 110 deg. C. or for two hours at 105 deg. C. in ordinary electric oven.
3	**BRIX**—Determined by Brix hydrometer. **SUCROSE**—Determined by Clerget's method, using dry lead acetate for clarification. **GLUCOSE**—Determined by Fehling's solution.	Samples taken from each tank and analysed every 12 hours. **BRIX**—Determined directly by Brix hydrometer. **SUCROSE**—Sample weighed (26.048 grms. in 100 c.c. water) clarified with sub-acetate of lead and sucrose determined by Clerget's method. **GLUCOSE** — Syrup diluted to a 20 per cent solution, then determined by Fehling's solution.	Sample diluted to 20 per cent solution for Brix determination. Sucrose determined as for syrup.	Brix determined directly by hydrometer, without dilution. Sucrose determined as for syrups.	As for first molasses.	**SUCROSE**—52 gms. bagasse plus 600 gms. water, polarised in a 600 mm. tube, direct reading. **MOISTURE**—100 grms. bagasse dried in oven at 100 deg. C.	**SUCROSE**—26.048 grms. in 100 c.c. water, direct reading.	
4	Official methods of Hawaiian Chemists' Association followed.							

5								
6	Solids by Brix hydrometer and refractometer: Glucose and pH.	Composite sample tested every eight hours for total solids (by refractometer), sucrose (Clerget), glucose and p H.	Every strike tested for Brix, polarization and apparent purity.		Full analysis of weekly sample, solids (Brix and refractometer) purity (Clerget and apparent), glucose, and ash.			
7	Brix to be determined with a Hydrometer tested at 17.5 degrees, C. which has been verified and the correction noted. All Mill Juices to be allowed to settle for a quarter of an hour in the trial jar before taking the brix. The Polarisations will be conducted by the Anhydrous Lead Subacetate method.	After thoroughly mixing, the sample is diluted with twice its weight of water. The brix, sucrose, and purity are determined in the same way as for juice analysis. The correction for temperature shall be applied before multiplying by three to bring to the original sample.	The well mixed sample is dissolved in four times its weight of water. Brix, sucrose and purity are then determined as for juices.	Sample diluted to about 18 degrees Brix and purity determined as for juices.	As for first molasses.	**SUCROSE:** Four times the normal weight for a Schmidt and Haensch polariscope, and six times the normal weight for the Laurent in 1,150 grms. of water containing about 15 c.c. of lime water. The mixture is boiled in a copper flask fitted with a condenser for half an hour, then cooled and the weight checked, the solution left in the bagasse to be extracted by a hand press and mixed with the rest of the liquid. A portion of the solution is then clarified and filtered for polarisation. In the case of a Schmidt and Haensch polariscope the reading is to be increased by half. A direct reading is obtained by the Laurent. **MOISTURE.**—A minimum of 100 grms. is weighed off in a tared shallow tray and dried to constant weight in a hot air oven at a temperature of 105 deg. C. to 110 deg. C. **FIBRE.**—To be determined by calculation not by analysis. The purity of the residual juice will be considered as having the same value as the last roller juice.	The Sucrose is determined by treating 25 grams (Schmidt & Haensch) and 16 grams (Laurent) of cake with about 120 c.c. of hot water in a mortar, and washing thoroughly in a 200 c.c. flask. When ol the **mixture is clarified** with basic lead acetate and completed to 200 c.c. It is then filtered and polarised in a 400 mm. tube, the reading obtained shows the sucrose per cent press cake directly.	Sugars for refinery tested for glucose, polarization moisture and ash every week. All other grades polarized only daily.
8	See No. 4.							
9								
10	See No. 7.							
11	Polarized according to Schmitz method.		Diluted to 20 per cent. solution.			Sucrose determined every two hours. Moisture determined every six hours.		Polarization of Sugars—20 grms. made up to 100 c.c. in special conical sugar flask. Alumina cream and lead acetate sol. used as required. Working with a Laurent-Jobin saccharimeter of 20 grammes N. Wt we have made a table of conversion from the 26.048 to 20 and is just as quick as we have 60 to 70 Pol. per 24 hours.
12	Direct polarization (Schmitz method) every 12 hours.	Normal weight diluted to 100 c.c. and polarized every 12 hours.	Analysed every 24 hours except for final molasses (each crystallizer cured). 100 grms. of sample dilute with 400 grms. water, 100 c.c. of this 20 per cent solution made up to 110 with subacetate of lead solution and brix and polarisation determined using Schmitz factor.			100 grams of sample used for test—single digestion method—test every four hours. Moisture determined by drying 100 grms. in oven for 12 hours at 95 deg. C. to 100 deg. C.	25 grms. of average sample made up with water to 200 c.c. in measuring flask-polarisation in 20 m.m. tube. Test every twelve hours.	Average sample from each 50 tons tested for polarization.

SAMPLING OF MATERIALS.

Factory No.	CRUSHER JUICE.	MIXED JUICE.	LAST MILL JUICE.	SYRUP.	MASSECUITES.	TREACLES (1st and 2nd Molasses.)	EXHAUST MOLASSES.	SUGAR	BAGASSE.	FILTER PRESS CAKE.
1	Automatic sample from chute under rollers.	Automatic sample from weighing machine.	Automatic sample from last mill rollers.	Average sample from every tank when full.	Average sample taken from crystallizer, half an hour after dropping each strike.	Samples taken from each tank when full.	Sample taken from each individual crystalliser when curing, for Brix and polarisation. General composite sample kept in laboratory for full analysis once a week.	Average sample from every mark.	Every hour for about 3 mins. sample taken from all over the length of slat delivering bagasse from last mill to bagasse carrier.	Average sample from every machine when opened.
2	Continuous sample from chute through small screen into white enamelled bucket. Sample brought to the laboratory every hour and a fixed measure (about 200 c.c.) placed in bottle as aliquot of composite 9 hour sample.	(CLARIFIED JUICE.) Sampled at weighing machine, a fixed measure per scale is taken for compositing, preserved and analysed as for mill juices.	Sampled automatically by spoon shaped sampler dipping in juice gutter and operated from one of mill rolls. Sample composited preserved and analysed as for crusher juice.	Sampled at scales as for clarified juice, but no preservative is used.	Sampled continuously through hole in the gutter used for the transfer from the pans to the crystallizers. The large sample thus collected is well mixed and a portion taken to the laboratory for the analysis.	Samples taken at tanks and composited according to volume in each tank.	Sampled continuously through small cock in the pipe conveying the molasses out of the factory.	Each bag of raw sugar sampled by means of trier, and sample kept in closed tin. Analysed when sample represents lot of 20 tons or less. For white sugar sample is taken at bin for each lot, one gramme per 10 pockets being taken and sample analysed once a week.	Sample is taken as it has fallen through a trap door extending over the whole width of the carrier into a closed wooden box. It is transferred from this by means of a rake into a container of five cubic feet capacity in which it is brought to the laboratory where it is rapidly mixed and weighed out for analysis.	The whole of the press cake is weighed in trucks of approximately one ton capacity. A sample of about one pound is taken from various parts of the truck by means of a trier extending through the whole depth. About 100 grams of the well mixed sample is taken as aliquot of composite sample and placed in a bottle stirred with a little preservative solution. At end of each shift water is added in sufficient quantity to make 50 per cent mixture which is thoroughly stirred and then analysed.
3	Sampled every 10 minutes, kept in covered bucket and analysed every 12 hours.			Samples taken from each tank and analysed every 12 hours.	Samples taken from each strike.	Samples taken from each tank.			Samples taken and analysed every three hours.	Samples collected from every press.
4	Official Methods of Hawaiian Chemists' Association followed.									
5	As for No. 2.									
6	Continuous sample taken by means of wheel rotating in the chute.				Samples taken from each strike.		Weekly sample taken for full analysis.		Continuous sample taken by allowing it to drop along the full width of the carrier into a closed box underneath, from whence it is removed by a rake every 15 minutes and analysed hourly.	Every press is sampled. Analysis is done every hour on 125 grams. The weight of a cake from a press is found every month for the calculation.
7	Usually automatic, otherwise small samples collected when each measuring tank is full.	Automatic continuous sampling.	Taken from last roller in the manner defined for non-automatic sampling of crusher juice.	As for crusher juice.	Samples taken at pan discharge at intervals during whole strike.	Sampled from subsiders after treatment in blow ups.	Sampled two hours after beginning of curing during a third of the time taken to cure the whole strike.	All classes of sugar are sampled continuously, sub-sampled for each shift and at the end of the day the sample from all shifts mixed together each class of sugar being kept separate. A sub-sample is also kept for complete analysis once a week.	Samples taken at same intervals as the last mill juice across the whole width of the carrier and collected at the spot into an air tight tin containing formalin absorbed in cotton wool. The sample is brought to the laboratory and finely chopped before analysis, in some suitable form of shredding machine.	Representative sample taken from each trolley and collected in covered receptacle.
8	As for No. 4.									
9										
10	As for No. 7.									
11	Samples taken by hand and brought to laboratory everytwo hours, Brix and temperature recorded, 50 c.c. drawn from each sample and preserved in a bottle with the addition of 5 c.c. lead acetate solution.			As for juices but every four hours.	Samples taken from crystallizers of every strike after about 12 hours in order to get representative sample.	No special details given.	Taken in tank receiving runnings from centrifugals, also in laboratory centrifugal as check.		Every two hours for sucrose test—every six hours for moisture test.	Samples from each press brought to laboratory and mixed.
12	Continuous drip sample—sub-sampled and taken to laboratory every half hour.			Sampled from tanks every hour.	Sample from each strike.	Continuous sampling: Sub-samples taken to laboratory every four hours.		Sample taken from each bag and average sample representing each 50 tons polarised.	Samples every four hours.	Samples taken from each press cleaned.

REPLIES TO QUESTIONNAIRE.

The Committee is much gratified at the response to requests for descriptions of laboratory methods in use by the different factories, nearly every mill possessing chemical control having supplied the desired information in more or less detail.

LABORATORY REPORTS.

The Committee also called for copies of final laboratory reports from each factory, but the response to this request was less general. However, a list is appended of certain important data collated from the reports received, and the committee desire to express their thanks to the management of those factories who have kindly co-operated in this matter. This precis of the reports is somewhat incomplete in that neither the output of sugar nor the average polarization of the grade or grades of sugar turned out by the individual factories is quoted. This omission is made in order to avoid disclosing the identity of the factories, to comply with the wishes of the management of one or two of the factories concerned. It is hoped that this table will be more fully representative in following seasons, as the committee confidently believes that the publication of such information will be found to be of great mutual benefit in many ways in this country as it has been in other sugar growing countries.

DISCUSSION ON THE STANDARDISATION OF CHEMICAL CONTROL.

The Chairman asked if all the mills in Natal had chemical control or whether it had only been taken up by certain of the larger groups.

Mr. Dodds replied that of the twenty-five mills in Natal, including Zululand, he thought there were rather more than half, or perhaps two-thirds, which had laboratory and chemical control. He could not give the exact figures offhand but they had had reports from twelve of the methods of sampling and testing and there were one or two which had not responded. He thought there were about 15 or 16 which had chemical control.

Continuing, Mr. Dodds stated he would like to point out that the committee had not had time to obtain the mean results for the whole of the mills recorded. It would be a simple matter to work out an average from the records of manufacturing results submitted but such an average would be misleading because of the different outputs of the different factories. The figures would need to be weighted according to the output of each factory; this was work which necessarily involved considerable calculation and it had not yet been completed.

It was interesting to compare the results so far as they went with those of other countries, the sucrose and fibre for example. The fibre was conspicuously higher than that obtained in most tropical countries. He had the records from one or two other typical sugar growing countries. The average fibre in Cuba from a large number of factories was 10.7% in 1923 and 10.3 in 1925. In Hawaii the average of all factories was 13% in 1920 and 12.7 in 1924. In Mauritius it was 12.2 in 1924, and from single factories in Honduras 11% and in Mexico 10%. The average in Natal was about 16%, perhaps a little less. Similar comparisons could be drawn as regards the other items in the report.

Mr. Townsend in referring to the figures contained in the paper, asked if Mr. Dodds could give them the percentage of variation between plant cane and first, second and third ratoons.

Mr. Dodds replied that he was sorry these figures were not available.

The Chairman asked if it would be an easy matter to get the figures available.

Mr. Dodds replied that it would be easy to get individual tests, but it would be necessary to get the average of a large number of results to get significant results, because the individual results fluctuated so much according to local conditions and circumstances.

Mr. Moberley asked if any provision had been made for obtaining standardisation of chemical instruments. Reference had been made to long stem spindles. It would be useful to have some standardised form of spindles as there was a good deal of variation in these appliances.

Mr. Dodds in reply stated that the question of standardisation of instruments and apparatus used had been considered by the Committee but it was felt that the time had not yet arrived for any definite recommendations to be made. There was a good deal of work to be done and the Committee were beginning in an entirely new field. The practice and type of apparatus used in each factory had sprung up with regard to their own conditions without any thought of any eventual standardisation, but he hoped that would come in time. The hydrometer which the Committee had in mind, and which was in use at one factory giving very good results (factory No. 1) had a spindle 54 centimetres in length, which was longer than those generally in use, but they could be obtained, and with proper methods of reading he believed they would give more reliable and concordant results than the short spindles. The methods of reading the spindle and of immersing it in the liquid was a matter of importance, and no doubt this would be dealt with in due course.

In passing, Mr. Dodds extended a welcome to Mr. Moberley on his return from overseas, and stated that he felt sure Mr. Moberley would be of great assistance to the Technologists' Association and the industry in general. He had had an exceptional experience in sugar factories in other parts of the world and he was pleased to have the opportunity of welcoming him back. (Applause).

Mr. Townsend referred to the figures giving the sucrose in the cane and the loss in the bagasse and asked Mr. Dodds to explain the meaning of these figures.

Mr. Dodds replied that the figures in the first column referred to the sucrose originally found in the cane including that which was retained in manufacture and that which was lost. The figures in the column "Sucrose in Bagasse (per cent)" represented the sucrose which was in the bagasse and had no direct reference to the percentage of sugar in the cane. He referred to the figures in the column "Sucrose in juice per cent of Sucrose in Cane." The figures for Factory No. 1 were 91.82 which meant that of the 13.24% of sucrose in the cane 91.8% of that sucrose was obtained in the juice and the balance represented the loss in the bagasse.

Arising out of Mr. Townsend's question he wished to point out that column five "Sucrose per cent Cane lost in manufacture" represented the proportion of the sucrose in the cane which had actually been lost.

Mr. Townsend: And could not be recovered?

Mr. Dodds replied that theoretically some of it could, but of course there was an economical limit to the recovery of any factory however efficient.

The Chairman asked what was the greatest factor in the matter of recovery of high extraction in sugar milling. For instance they had been told that more rollers was a very big factor, also that more maceration was an enormous factor. He would like to know what Mr. Dodds considered the greatest factor in connection with high extraction.

Mr. Dodds replied that there were many factors which entered into extraction and it was difficult to allocate the importance of any individual one. First of all there was the quality of the cane itself, not only its sucrose content but the ease with which the juice was extracted. They had made an attempt to arrive at an indication of this in the third column, and this was known as the Java ratio. It was the comparison of the sucrose in the cane compared with the sucrose which was obtained in the first crushing unit and that ratio was admitted to be an indication of the milling quality of that particular cane. Then of course the number of crushing units was a very important factor, also the amount of water which was used for dilution. In column No. 10 it would be seen that they had given as far as the figures were obtainable the dilution in the different factories. That of course had a very large influence. At one of the factories in Cuba, to which he had referred the previous day, where they had a surplus of bagasse at the end of the season and used no extra fuel although they only had 10% fibre in the cane, they had a very low dilution not from choice but because the factory was not at that time sufficiently well balanced; that was to say that the boiling house would not be able to cope with the juice received from the mills if it were sufficiently diluted and consequently the extraction suffered. Probably one could say that the most important factor in extraction was the dilution, followed by the nature and power of the crushing units and thirdly by the quality of the cane.

Continuing, Mr. Dodds referred to the figures given in the seventh column, which apparently followed the extent of the dilution, and which would appear to show that to be the principal factor. There were exceptions to that, however, as would be seen. At Factory No. 6 for example they had a high extraction with a comparatively low dilution. In that case he believed it was accounted for by the exceptionally heavy crushing units which they had at that particular factory.

The Chairman remarked that it would appear that as the crushing units increased so the dilution could be decreased, to which Mr. Dodds replied "yes, within limits."

Mr. C. O. Williams (Chief Chemist, School of Agriculture, Cedara), referred to the figures contained in the fifth column under the heading "Sucrose per cent cane lost in manufacture," which varied from 2.78 to 3.92. He took it that this was largely due to better methods, better machinery, and better scientific control. He did not know whether the sub-committee had entered into this question or not. At Factory No. 10 the loss was only 2.72 presumably under the best conditions. Did it warrant the extra expense an against Factory No. 3 or 4 losing 3.92? That was the problem which should be gone into.

Mr. Dodds replied that of course the economic factor was the all important one and that was the question which the individual millers had to decide for themselves. It seemed obvious that the extraction should be as high as possible but of course there was a limit to which one could profitably go to get that extraction. As had been pointed out the previous day a factory could use any quantity of fuel and obtain a higher extraction, and continue to increase the extraction from say 90% up to a much higher figure, but there would come a degree when the expense of doing this would not warrant the results, and the most economical practice of course had to be decided by the factories individually in view of their own particular conditions. But generally speaking one would say that the extraction should be as high as economically possible and certainly higher than some that were recorded in the returns. Mr. Dodds pointed out that in Cuba with a total sucrose of 13% there was a loss of 2.1 total. In Hawaii with a sucrose of 13.3% there was a total loss of 1.5%. In Mauritius it was higher, with sucrose of 12.6 there was a total loss of 2.76 per cent.

In reply to Mr. Williams' remarks it should be pointed out that the relatively low loss of sucrose per cent cane at factory No. 10 was associated with a very low original sucrose in the cane. Taking that into account the extraction at that factory was not conspicuously high.

Mr. Williams stated that it seemed to him that there was a great deal of work needed in this respect, and to his mind the best way of tackling it was for the management of each of the mills to give their figures to such a sub-committee as that of the Sugar Technologists' Association, so as to ascertain which was the most economical method, and to what extent the extraction could go on. He thought that the committee, after comparing all the figures and the processes of the different mills, ought to be able to give them very valuable information and advice on the question. After all a mill might lower its cost of production but there may be a process in that mill which was not an economical one, and the committee in considering the various results should be able to point out these things.

The Chairman stated that they hoped the Technologists' Association would be a very valuable asset to the industry in the manner indicated by Mr. Williams.

Mr. Dodds stated that the system suggested by Mr. Williams was carried out in a good many countries with very great benefits to everybody concerned. In Hawaii there was a special department of the Experiment Station which dealt with these matters. It collected all the figures, very complete records were minutely compared at the Experiment Station by the officials concerned, and as far as possible the most economical procedure was calculated out and arrived at, and then recommended for general use. Similarly in Cuba they had what was called the Cuba Sugar Club, which included the majority of the larger mills in the Island, and that exercised the same functions of comparing the relative efficiency of the different mills and attempted to arrive at calculations of the most profitable results.

Mr. Dodds pointed out that what the sub-committee believed to be a necessary preliminary to all this was the standardisation of the methods of testing and analysing. They would like to have suggestions or criticisms from the various mill chemists. After all they were the people who would be expected to carry out the recommendations of the committee.

The Chairman stated that at the present time he supposed the different mills had different systems; consequently there was a great need for standardisation of the systems.

Mr. Dodds replied that it was so. They had before them the methods from twelve different factories, which were all different except in the case of certain groups which were under the same control.

Mr. Townsend stated that it was difficult to ask questions on a subject of such magnitude bearing in mind the fact that the papers were only laid in front of them when they came to the Congress. Such a question needed studying. It was impossible to grasp the figures at a glance, and he felt that in future some method ought to be adopted so that the papers could be in the hands of those who were prepared to study them, and he considered they should be available to members a week before the sitting of the Congress.

The Chairman in agreeing with Mr. Townsend's remarks stated that he considered it was a wonderful achievement on the part of the Technologists' Association to have laid these figures before them. They had gone to considerable trouble and the thanks of the members were due to them for the trouble they had taken. (Hear, hear and applause).

Mr. Townsend stated that it was in that light that he had passed the remark. He felt that the labours of the Technologists would not be sufficiently appreciated. They had gone to tremendous trouble to collect the data and the members came to the Congress and practically passed them over quite casually. If they had time to study the papers more he felt sure they would appreciate them more.

The Secretary stated that this subject had already had the consideration of the Technologists' Association, as it was recognised that to put in front of a meeting reports of the nature submitted they could not expect enlightened discussion right away, and the suggestion had been made that it might be better when a paper was read and circulated that the discussion on that paper should be taken, say, two days afterwards. He thought that that was the most practical way of dealing with the question, as in his experience it was a difficult matter to get the papers in time to have them circulated a week before the meeting. Every section appeared to take an interest only in its own particular work. There was no doubt that to get the best value of the work that was being done and could be done, the suggestion made was the proper way to deal with it. (Hear, hear).

At this stage the Congress adjourned for tea.

On resuming, Mr. de Froberville asked if it was not possible, now that a lot of the methods of analysis had been described, to have a condensed form of all these analyses and the manner of carrying them out, and to send a copy to each mill for reference and to see if the method of working could be carried out by the various mills. If this could be done he thought it would be for the benefit of everyone concerned. The same applied to the analysis of glucose. He thought Mr. Dodds should be asked to draw up a tabulated form of the correct method of analysis to be adopted.

Mr. Dodds replied that was the next step that the Committee had in mind—the selection of a suitable scheme for sampling and testing with a view to its recommendation and general adoption. But before the committee should produce such a scheme it was considered to be advisable that the existing methods should be circulated and that everybody could see what methods were being used at other factories and whether any of them were apparently improvements or otherwise on their own methods. Then after the subject had been freely ventilated and discussed the committee would be in a better position to go on to the adoption of a definite scheme. As to the choice or decision in regard to what was the best method, they had to be governed by local conditions. What was the best method in another country did not necessarily mean that it would be so here, although there was a strong probability or presumption that it would be. At all events what they wanted to get at was the local special circumstances and difficulties which chemists had to contend with in this country, whether dealing with the properties of the Uba juice as it was found in this country or whatever other conditions there may be. Personally he had never had any experience in a Natal factory although he had in factories in several other countries, and he could contribute experience as to the methods used in other countries which might be adopted here, but it was for those who were actually engaged in mill work in this country to decide whether the methods would be applicable here or not, and that was why they wished to have general team work from the whole of the chemists engaged in the industry. If the subject was properly handled and discussed he had no doubt the Committee would be able to arrive at a definite scheme of sampling and testing which would be acceptable to everybody concerned. That at all events was the hope and wish of the committee. (Applause).

Continuing, Mr. Dodds stated that there was one respect, for example, in which they might have to modify their methods as compared with the methods used in other countries. That was the peculiar nature of the Uba juice as they found it here. Although the experience of other countries which had recently adopted Uba cane was that it differed little from other canes with which they had to deal, there was no doubt that Uba cane in this country did possess certain properties which were not usually met with elsewhere. The wax content for example of the juice of the Uba cane was particularly high, and although there was not much experimental evidence his private opinion was that the wax was formed during the dry season as a protection of the plant against excessive transpiration, and this cool dry season was not met with in other cane sugar growing countries. That was one fact through which they might have to modify their laboratory methods.

Another possible factor which might affect their scheme was the fact that a good many of the factories had to deal with the juice from burnt cane. He remembered that in Cuba when they had a little burnt cane to handle they had found it difficult to deal with by the usual methods adopted in the laboratory for ordinary trashed cane,and it might be that the same difference would be found here and they would have to adapt their method in some way to deal more conveniently with the juice from burnt cane. There may be other local differences also that he was not at present acquainted with and had not taken into account.

The Chairman asked if there was any disadvantage attached to the manufacture of sugar from the juice of burnt cane as against that of trashed cane. Were there far more impurities in the juice of the burnt cane than in that of the trashed cane ?

Mr. Dodds replied that so far as he knew the actual amount of non-sugars was not altered very appreciably but what he had found in connection with burnt cane—not with Uba but with Crystalina cane—that a lot of minute carbonaceous particles passed into the juice and it was very difficult to get rid of them in the laboratory, and it made the testing of juices and proper filtration in the laboratory rather a troublesome matter. That was what he had in mind, not the increase in the amount of impurities, but a change in the character of the impurities in the juice after burning.

Mr. Townsend asked if Mr. Dodds could give them any data dealing with the question of the burning of cane. Mr. Dodds had probably noticed that some planters in burning cane just burnt the trash off, and if what still remained was removed it could hardly be distinguished from ordinary trashed cane, as the burning was carried out slowly and it did not affect the cane, which hardly got warm. Others again formed a ring round the cane and when the fire reached the centre it was hot enough to melt lead, and the canes were found to be twisted and half burnt through. He wished to know if there was any data collected to show that there was a great loss due to the excessive heat applied to standing cane as against gradual burning.

Mr. Dodds replied that this question was dealt with at a previous Congress at which he was not present, but he believed that Mr. Dymond had dealt with the subject and compared the properties of the juice from cane which had been burnt under different conditions. Beyond a few experiments carried out on more or less isolated lines very little work had been done in this country on burnt cane and this was a matter which called for experiment very urgently, and it was one of the subjects which they intended to take up at the Experiment Station. They had already begun experiments in two different localities in comparing burnt cane with adjacent areas of hand trashed cane. It was intended to carry these tests on year after year, both from the agricultural standpoint and the chemical or manufacturing point of view. As the results of these experiments accumulated he hoped they would have some interesting and important results to offer.

Mr. Townsend stated that this was a subject which was a matter of vital importance to them all—the question of burnt cane and the sucrose content. The question in his mind was "does burning affect the sucrose content in the cane. Is the miller losing by crushing cane which had been very badly burnt, or is the planter losing through considerable loss in the weight of his cane?" If so the sooner the people knew it the better. This excessive burning was quite a practice with some planters. He thought they should get to the bottom of this matter as soon as possible as it was a most important one. If it could be proved that there was a serious loss by burning cane under the conditions he had mentioned, it might induce planters to adopt the method of trashing cane which any man with any respect for his soil carried out.

The Chairman stated that this was a very desirable field for investigation and the information was very much needed. He hoped that the Technologists' Association would take the matter up and endeavour to make the information available as soon as possible.

Mr. Dodds stated that he would not have supposed on general grounds that the sucrose content of the cane was materially affected because after all burning, even the fiercest burning, did not usually go very deep into the cane, it was merely a scorching of surface. But of course, as they all knew, there was a penalty on burnt cane fixed by the millers. No doubt they had good reason for doing so, and he imagined that the disadvantage from a milling standpoint was the increase in the impurities to a certain extent, but probably more in the character of the impurities, making the juice more difficult to deal with. He heartily agreed with Mr. Townsend as to the undesirability of purposely burning standing cane especially from the agricultural standpoint. It was a practice which was regarded as hardly credible in other countries.

The Chairman in thanking Mr. Dodds for the very able manner in which he had tackled this subject, said he hoped the good work would be continued. It was very important that the industry should have figures brought before it in this manner, and he felt sure that if this work was continued it would mean nothing but good to the industry. (Hear, hear and applause).

At the conclusion of the discussion on the paper read by Mr. Dodds the Chairman announced that Mr. de Froberville wished to make a few remarks in regard to the furnace shown in the paper on "Types and Designs of Bagasse Furnaces" which the Committee recommended as being suitable. Mr. de Froberville had not been able to attend the Congress the previous day in time to take part in the discussion.

Mr. de Froberville addressed the meeting as follows:—"The main point is the three zones in the furnace for the bagasse. We see the first zone where the bagasse is dried, steam is evolved, and the second zone contains dry bagasse. This dry bagasse is distilled by the heat the same as wood is distilled before burning. In the distillation we have not only the burning, but we have all the organic compounds of the bagasse which are disintegrated or decomposed. We have a lot of these products of carbon and hydrogen which are highly inflammable and which form the main part of the volatile gases. Further on in the third zone when all these volatile substances have been evolved there remains the pure carbon which is burnt and leaves only a handful of ashes. These volatile gases and the carbon having been burnt into carbon monoxide get mixed together with the steam going to what is called the combustion chamber. A thorough mixing of the whole of the gases takes place and from that combustion takes place and the heat goes and strikes the boiler and we get the benefit of it. In the paper which was prepared by the Committee about the utilisation of the heat evolved by the bagasse the Committee has prepared a special scheme or plan which is supposed to be a good plan,—an ideal, if I may use the word.

In this ideal plant—which is not a commercial proposition at all—what we mean is, that all the millers should consider the suggestion made in the paper, that they try to see the defects of their furnaces, perhaps in the steepness of the ladder grate or perhaps in the feed chamber for the bagasse, or perhaps there is not enough room in the combustion chamber for the thorough mixing and combustion of the gases, and furthermore with regard to the speed of the gases going to the chimney. It is very easy to take the suggestions made here, compare them and see what the differences are. A man can say "Well, I see that in my furnace I burn so much bagasse per square foot of grate area; I obtain steam at so much pressure, and I evaporate so many pounds of water per pound of bagasse, and the analysis of the gases show me that I have got so much carbonic acid," proving a good or bad combustion. It has been the aim of the committee in preparing this sketch, to put something before you so that everyone can have a look at it and see what is wrong with his furnace if he is not obtaining the ideal results which he should, and perhaps by a little improvement on one side or another—widening the furnace or increasing the combustion chamber, or diminishing the speed of the gases in the flue—he will have the thorough benefit of the bagasse. That is what we have been aiming at and I hope that everyone will endeavour to see what is the best way to get the most advantage out of the bagasse." (Applause).

Mr. Townsend stated that they had quite a number of furnaces illustrated—all more or less efficient or inefficient. With such a large industry as the sugar industry he could not understand why they did not take the matter up and centralise on one type of furnace which would be proved to be the most economical. He suggested that they should have one man in charge of the experiments to endeavour to arrive at a satisfactory design for such furnace.

He was afraid they would not get the best results if it was left to them individually. They should have one man appointed by the industry to go into every detail and give them something tangible. He could see no reason why they should not have one type of furnace for universal use throughout the mills.

Mr. de Froberville replied that that was the reason why, after having examined all the plans and sketches of the furnace which had been sent in most obligingly by most of the mills, that the types of furnaces had been illustrated in the paper, and after going very carefully into what appeared to be the defects of the various types, the Committee had made up the new furnace which was illustrated on the first page of the paper. There were a good many types of furnaces in use in Natal: some were working well according to the information supplied, others no doubt could do better. Everything had been considered very thoroughly before they had put forward the suggested design, and they wanted everyone to see what defects there were, if any, so that they could be corrected. It was only by so doing that they would be able to arrive at a satisfactory design. He suggested that at any rate one furnace should be constructed so that they could judge by actual results what improvements were needed.

Mr. Ray (Inspector of Factories), asked why they did not pay more attention to the feed as in his opinion most of the trouble originated there. It was of little use going to enormous expense in putting in apparatus to rectify faults which probably would be found in the feed of the bagasse. At most factories he had visited they left the feed of the bagasse to a native, and sometimes not even to a native. Sometimes the furnaces had been found burnt out almost except for the centre. Very little time appeared to have been given to this question and he thought it would well repay investigation.

Mr. de Froberville agreed that what had been said was quite normal in mills. The quantity of bagasse obtained from the Uba cane was enormous and they had no occasion to spare it. If in a well-equipped mill they crushed so many tons of cane they would have plenty of bagasse in the mill. Instead of having a native to feed the bagasse some mills would probably have a special method of driving the bagasse into the furnace by having automatic tipping devices so that the least possible amount of air would be admitted into the furnace. In several of the mills, however, the openings were left open with the result that there was probably 5 or 6% of air going in, which was most injurious to combustion.

In some cases when the bagasse began to slacken they covered up part of the openings. He agreed completely with what Mr. Ray had said. There was not enough attention paid to the feeding of the boilers. If this could be attended to in a thorough manner there would be a real advantage and they would reap the benefit of the bagasse to the full.

Mr. J. Murray stated that in the past the methods of feeding had not been very satisfactory and they often had rather large pieces of bagasse going through, and the machinery could not deal with it properly, but nowadays with shredders and double crushers they obtained a much better class of product from the mills and he thought a machine could be made so as to get over the trouble experienced in feeding.

The Chairman expressed the hope that this matter would be taken up and investigated. The discussion had taught them how necessary it was that investigations and experiments should be carried out on these subjects.

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The following paper on "EXPERIMENTS TO DETERMINE THE EXTENT OF DRYING OUT OF SUGAR STORED AT DIFFERENT ALTITUDES IN THE UNION" was then read by the General Secretary Mr. Duncan M. Eadie.

EXPERIMENTS TO DETERMINE THE EXTENT OF DRYING OUT OF SUGAR STORED AT DIFFERENT ALTITUDES IN THE UNION.

By DUNCAN M. EADIE, General Secretary,

The Weights and Measures Act came into force in April, 1923, when a question arose with the authorities about the definition of the "lawful weight" of a "pocket" of sugar in the regulations to be proclaimed under the Act. The Association decided to adopt 100 lb. and 50 lb. pockets, but a difficulty arose about the practicability of the proposal to adopt 100 lbs. as the "lawful weight" because it was suspected that while the full weight might be packed in the pocket at the factory there was a risk that there would be loss of weight due to drying out if sold after being stored for some time in a dry climate such as that of Johannesburg. It was therefore agreed with the authorities that the regulation fixing the "lawful weight" if a pocket of sugar should be allowed to stand in abeyance till May, 1924, before which time the Industry was to make arrangements for testing if, and to what extent in actual practice, sellers up country were exposed to risks of prosecution on account of drying out in transit or storage up country. The problem set was to determine the variation in weight of sugar due to drying out as between Durban and certain up-country towns. An experiment was organised which gave the required data and consequent upon it the Weights and Measures Department decided to treat sugar for the purposes of the Act as an article not subject to variation in weight owing to climatic influences.