CLARIFICATION AND FILTRATION COMMITTEE REPORT

(Read by Mr. J. RAULT.)

Resume of Previous Reports.

The first report of the Committee was read by J. Rault, convenor, in 1927, and was followed by further reports in 1929 and 1931.

The first paper covered the general methods practised in South Africa up to that time, and stressed the peculiar difficulties and conditions associated with Uba juices in Natal and Zululand, together with the many processes, such as Carbonatation, Bach, Defecation, Phosphatation, Defecation Sulphitation, Norit Modification of Javan methods, Petree and Centrifugal processes, which had been tried, with the sole purpose of preparing a juice for the boiling house, possessing similar physical properties to that normally occurring in the more favoured sugar cane countries.

This excellent report was followed in 1929 by another, which showed the general trend of clarification methods suitable for Uba juices. The principles involved may be placed under the following headings:—

1. Pre-screening of the raw juice by various straining devices.
2. Pre-heating of the juice, together with increased use of chemicals.
3. Realisation of the importance of P_2O_5, not only as the limiting factor in cane yields but also in clarification.

At this time interest in methods of clarification was greatly stimulated by the SO_2 enquiry and report on the factors influencing the presence of SO_2 in raw sugars exported to overseas markets, which culminated in a more uniform method of clarification being generally adopted.

The 1930 report of this Committee briefly outlined the method and noted the increased use of pre-screening devices such as Peck Strainers, Hummer and Universal Screens.

Since the last report there has been no general change in factory practice, which cannot be totally ascribed to satisfaction with existing methods. Other factors may be:—

1. World economic conditions limiting outlay even to research.
2. The realisation that Uba juice clarification is essentially bound up with the non-sugars peculiar to this country, and that further improvement is always associated with increased cost.
3. The gradual realisation that easier and less costly clarification must come from improved field methods, new varieties of cane, etc., together with the necessity for extensive study on the effect of such factors as soil conditions, fertilizers, climate and new varieties on juice clarification, recovery and quality of the raw sugar.

Such an investigation would cover a very wide field, would necessitate co-operation, probably subsidization, but would be very much worth while.

In Puerto Rico, simple defecation is all that is necessary. The average pounds of lime used per ton of cane is only 1·215 lbs. for the whole island, resulting in a mud content of only 5% by volume on mixed juice and a filter cake of only 2% on cane, while from an average mixed juice purity of 82 the recovery is 92.

In South Africa we use 7·65 lbs. of lime, 2·43 lbs. sulphur and 1·04 lbs. of phosphoric paste per ton of cane, the volume of mud is approximately 30% by volume and the filter cake average is 4·34% on cane, while from a mixed juice purity of 85·3 the recovery is only 84·09.

It becomes increasingly evident, therefore, that while we may by large capital outlay in factory equipment and costlier methods increase our recovery by one or two per cent., we may automatically obtain five or six per cent. without capital outlay and at much lower cost by concentration on field work, the selection of varieties not only on a yield basis but also on a "workability" basis together with a scientific application of fertilizers, and irrigation wherever possible.

Non-Sugars.

In the first report of this Committee the following statement is made:—

> "The difficulties met with in the treatment of the Uba juice are to be explained not so much by the quantity of the non-sugars, but rather by the quality of those impurities, and possibly the form under which they exist, as it is not uncommon to find canes of high sucrose and purity yielding a very refractory juice."

Now our cane lands have one essential limiting factor, and that is the deficiency of phosphorus. This condition, which is peculiar to this country, is intensified by a low rainfall.

Potassium and Phosphorus.

It has been shown that there is a very definite relationship between phosphoric oxide and potash. Sugar-producing plants hold first place in their potash requirements, its function being, according to numerous authorities:—

1. Organic forms, as citrate and malate, which form soluble complex salts with iron, thereby increasing the chlorophyll content per unit area.
2. Its radio-active energy, which stimulates carbohydrate elaboration. Potash has been definitely proved to increase sucrose contents under given conditions.

All agricultural chemists agree that phosphorus is essential in the transformation of starch into sugar. Our phosphorus deficiency is therefore a likely cause of the starch complexes in our juices, the effect of which may be traced right through the process to the final product.

Starch Complexes.

Haddon first drew attention to these starch complexes and suggested the use of diastatic enzymes for their removal. It is a notable fact that juices which give a drop in clerget sucrose, show a similar lower polarization after treatment with an enzyme.

The effect of such starch complexes is increased viscosity, more molasses and retarded sucrose crystallization.

It is noteworthy that while many eminent chemists such as Badollet, Bardorf, Ball and Zerban believe that wax complexes are chiefly responsible for the lower filterability of our sugars, others, Harman, Nelson and Messrs. Tate & Lyle, believe starch to be the principal cause.

Pepsin Process.

H. D. Lanier, of Cuba, is using a process invented by Herman Schrieber, wherein pepsin is used in the mixed juice. Lanier claims the following benefits:—

1. A definite smaller loss of pH from clarified to final molasses—a more normal condition and one which is conducive to less inversion during the process of manufacture.
2. A remarkable freedom from gums in all three boilings.
3. The production of a sugar almost free from gum, of a higher filtration rate and a hard, durable grain.
4. Final molasses contain 1% less gum, 3·3% undetermined organic matter as compared with 10·2% in simple lime defecation and the same ash content.

The process is in operation at Central San Isidro, Cuba.

Reducing Sugars.

The percentage of reducing sugars in the raw juice varies very considerably in the various sugar countries. A high figure is usually conducive to a low purity of the final molasses.

COMPARISONS WITH OTHER COUNTRIES.

	NATAL.			TRINIDAD.		CUBA.	
	Max.	Min.	Average.	Max.	Min.	Max.	Min.
Reducing sugar ratio mixed juice	6·1	2·2	3·53	9·38	6·16	9·86	4·38
Purity of mixed juice	87·4	82·5	85·30	83·90	79·90	86·30	79·40
Purity final molasses	49·7	37·7	44·30	33·10	30·80	—	—
Recovery	87·0	75·4	84·10	91·25	89·06	95·09	89·36

Total Ash.

Walton and Fort [1] found very little difference between the total ash before and after clarification, but considerable variation in the composition of the ash according to the method of clarification adopted.

The total ash content of cane juices vary very considerable according to soil conditions, fertilizers used, climatic conditions and variety of cane.

Walton and Fort [1] found a maximum of 3·3 ash % brix and a minimum of 2·0, but heavily fertilized P.O.J. canes from an Experiment Station gave up to 6·2 ash % brix.

From 100 samples of crusher juice from various planters in Zululand the ash % brix ranged from 2·24 to 6·23 (conductivity).

Comparative total ash % brix in mixed juice and clarified juice taken over monthly periods for whole seasons varied as follows (gravimetric):—

1929.

	Mixed Juice.	Clarified Juice.
June	2·860	2·88
July	2·760	2·65
August	2·645	2·83
September	2·675	2·54
October	2·840	2·56
November	2·780	2·60
December	2·960	2·65

1930.

	Mixed Juice.	Filtered Juice.	Clarified Juice.
June	2·765	4·41	2·90
July	2·640	5·60	3·09
August	2·710	6·65	2·99
September	2·855	6·17	2·97
October	2·500	4·97	2·74
November	2·870	6·14	2·98
December	3·160	6·43	3·44

The factors which influence the exhaustion of molasses have been the subject of recent investigations by J. G. Thieme[2] in Java. He states: "That cultural conditions, soil and climate, exert a greater influence on molasses than does clarification, that there is only a slight correlation between glucose % non-sugars and exhaustion, but that there is a valuable relationship between glucose ash quotient and exhaustion, though the most trustworthy guide is the ash % non-sugar."

Rise in purity does not necessarily mean more sugar, as it depends on whether the non-sugars eliminated are melassigenic or otherwise.

According to H. Claassen, the melassigenes are chiefly organic potash salts which constitute half the non-sugars. All other non-sugars, organic lime salts, betain, decomposition products of pectins are chemically indifferent to sucrose, though they may retard crystallization.

Constituents of the Ash.

The percentage on 100 brix basis of various ash constituents occurring in the mixed juice in one district, together with the effect of clarification, is shown in the following comparative monthly averages:—

SILICA, SiO_2.	Mixed Juice.	Filtered Juice.	Clarified Juice.
June	0·426	0·035	0·135
July	0·396	0·036	0·118
August	0·349	0·070	0·115
September	0·422	0·078	0·109
October	0·382	0·043	0·121
November	0·425	0·051	0·137
December	0·447	0·032	0·121

IRON AND ALUMINA.	Mixed Juice.	Filtered Juice.	Clarified Juice.
June	0·231	·0115	0·080
July	0·253	0·134	0·081
August	0·256	0·194	0·084
September	0·315	0·320	0·109
October	0·251	0·180	0·115
November	0·306	0·154	0·079
December	0·272	0·242	0·060

LIME, CaO.	Mixed Juice.	Filtered Juice.	Clarified Juice.
June	0·107	1·419	0·484
July	0·078	2·865	0·614
August	0·116	3·573	0·470
September	0·071	3·157	0·454
October	0·072	2·086	0·392
November	0·081	2·798	0·478
December	0·207	3·172	0·578

MAGNESIA, MgO.	Mixed Juice.	Filtered Juice.	Clarified Juice.
June	0·367	0·082	0·264
July	0·210	0·045	0·192
August	0·279	0·062	0·247
September	0·291	0·052	0·248
October	0·304	0·043	0·235
November	0·256	0·093	0·268
December	0·414	0·074	0·302

SULPHUR TRIOXIDE, SO_3.	Mixed Juice.	Filtered Juice.	Clarified Juice.
June	0·326	0·467	0·411
July	0·277	0·573	0·453
August	0·262	0·687	0·374
September	0·274	0·649	0·376
October	0·233	0·446	0·368
November	0·281	0·494	0·373
December	0·343	0·580	0·410

PHOSPHORIC OXIDE, P_2O_5.	Mixed Juice.	Filtered Juice.	Clarified Juice.
June	0·112	0·026	0·018
July	0·108	0·036	0·025
August	0·099	0·044	0·024
September	0·101	0·035	0·018
October	0·107	0·026	0·024
November	0·088	0·031	0·026
December	0·090	0·021	0·027

CHLORINE, Cl_2.	Mixed Juice.	Filtered Juice.	Clarified Juice.
June	0·562	0·626	0·589
July	0·553	0·591	0·627
August	0·524	0·643	0·597
September	0·547	0·640	0·642
October	0·549	0·532	0·609
November	0·588	0·658	0·641
December	0·621	0·780	0·645

UNDETERMINED POTASH, SODA SULPHITES, ETC.	Mixed Juice.	Filtered Juice.	Clarified Juice.
June	0·533	1·44	0·919
July	0·718	1·32	0·979
August	0·803	1·37	1·079
September	0·797	1·24	1·012
October	0·566	1·61	0·874
November	0·451	1·86	0·982
December	0·653	1·53	1·298

A study of these figures shows a fairly constant Silica content of the mixed juice. The highest figure recorded was 0·61 during July of the previous year and the lowest 0·28 for the same month a year before that.

It will be noted that although clarification eliminates a good deal, there still remains an appreciable quantity in the clarified juice.

Iron and aluminic oxides are erratic in their removal, while lime fluctuates widely both before and after clarification.

The highest CaO % ash recorded was 9·55% and the lowest 0·25%, with traces in certain P.O.J. canes. The average over four years was 4·41% ash.

Geerligs and van Giernaken record variable velocity of crystallization, especially in the presence of lime salts.

Magnesia is also a fluctuating constituent, showing only a small reduction during clarification.

The ash from Amatikulu and Felixton varies widely in this constituent.

	Four years average.	Amatikulu average weekly sample.	Felixton average weekly sample.	Flats.	P.O.J.
MgO % total ash ..	7·63%	9·51%	0·49%	Trace	Trace

Thieme observed that high MgO content resulted in the splitting of filter press cloths.

Sulphur trioxide shows an increase after clarification due to oxidation of the sulphites. Great variations of this constituent also occur in different localities.

	Four-year average:	Amatikulu.	Felixton.	Flats.
SO_3 % total ash ..	11·08%	15·15	7·42	27·54

Phosphoric oxide is mostly eliminated after clarification, as was to be expected. As the ease of clarification is largely dependent upon the presence of P_2O_5, it is not surprising that this constituent fluctuates widely in individual samples.

	Four year averages.	Maximum monthly average.	Minimum monthly average.	Felixton Flats.
P_2O_5 % ash	4·28	7·12	2·94	11·85

Individual samples range from a trace on the hills to 0·07% juice on alluvial flats.

Walton and Fort [1] found in mixed juice a minimum P_2O_5 % brix of 0·38 (S.A. 0·09) and a maximum of 0·53 % brix (S.A. 0·112).

Chlorine is usually fairly constant, the Chlorine % ash usually ranging between 16 and 21. The cane from the alluvial flats, however, this year shows only 0·5 Cl. % ash. This condition is probably caused by flood-water washing out the soluble chlorides, which have been accumulating in the top layers of these alluvial flats since the last floods.

Thieme [2] states that a high chlorine is usual from cane grown on humus soil and that a low chlorine frequently yields opalescent juices.

Sodium Aluminate.

Wayne [3] reported on the use of Sodium Aluminate as a clarifying agent.

Up to 4 ozs. per 1,000 gallons were added to the mixed juice, which resulted in a greater elimination of SiO_2, etc. The method was tried out in this country; the results showed a small but definite ash removal, the volume of muds was perceptibly increased, but owing to the high cost of the chemical (£25 per ton) the process was discontinued.

The results were as follows:—

	MIXED JUICE.		FILTERED JUICE.		CLARIFIED JUICE.	
	No treatment.	Sodium Aluminate, 4 ozs. per 1,000 gals.	No treatment.	Sodium Aluminate.	No treatment.	Sodium Aluminate.
Brix	15·60	15·50	10·77	10·09	15·23	14·59
Apparent purity	85·30	85·70	82·10	80·06	87·20	87·35
Total ash	33·97	29·49	64·52	61·47	32·30	31·02
Insoluble in water	13·70	9·79	40·30	38·16	13·59	9·87
Soluble in water	20·27	19·69	24·22	23·30	18·71	21·14
Silica	4·91	3·68	1·46	0·60	1·03	0·84
Chlorine	6·71	6·45	7·58	7·74	6·29	7·06
Iron and Alumina	4·49	2·76	2·74	1·15	1·04	0·61
CaO	1·98	1·15	22·34	22·55	6·99	5·91
MgO	2·14	2·22	0·76	0·61	1·76	1·70
P_2O_5	1·13	1·27	0·57	0·56	0·39	0·32
SO_3	3·38	3·45	5·41	5·12	3·31	3·80
Undetermined	9·22	8·49	23·66	23·14	11·49	10·77

Per Cent. Composition of Ash in Final Molasses of South rican Mills, by Rault.

Clarification Process	CARBONATATION.								SULPHITATION.					
Factory	Mount Edgecombe.					Ottawa.	Ottawa.	Empang	Tongaat.	La Mercy.	Umzimkulu.	Umfolosi.	Sezela.	Tinley Manor.
Year	1922.	1923.	1924.	1925.	1926.	1922.	1924.	1924	1924.	1924.	1924.	1924.	1924.	1925.
SiO_2	0·91	1·79	0·82	0·65	0·52	2·86	5·89	3·5	5·09	2·59	2·57	1·88	4·43	2·65
Fe_2O_3, Al_2O_3	0·83	0·62	0·82	1·09	1·09	2·90	0·52	0·4	0·50	0·81	0·66	0·50	0·55	0·45
P_2O_5							2·48	1·2	1·21	2·34	0·98	2·37	0·84	2·37
CaO	10·95	11·91	15·98	12·26	12·23	22·38	20·02	15·7	15·81	17·62	12·04	16·33	18·69	14·88
MgO	1·04	1·32	0·69	0·25	0·36	5·53	6·73	7·8	4·81	6·32	9·65	3·96	3·65	4·82
K_2O	43·96	42·51	40·48	46·00	45·37	25·49	29·03	33·7	35·77	33·71	Cu O 1·89* 34·80	0·76 36·97	34·45	36·56
Na_2O	3·96	2·02	1·66	2·05	2·30	4·99	2·00	2·4	1·91	2·54	3·39	1·90	1·86	3·58
SO_3	9·28	11·23	7·48	10·92	8·15	12·98	12·46	14·8	15·67	14·67	10·97	11·69	14·54	15·71
CO_2	10·78	9·27	11·35	7·76	10·14	7·66	6·42	2·3	3·05	4·78	6·66	5·94	4·98	13·64
Cl_2	24·45	25·10	26·04	25·42	27·14	19·38	19·60	23·0	20·70	20·49	21·98	23·18	21·70	20·99
	106·16	105·22	105·32	106·40	107·35	104·17	105·15	105·3	104·52	105·87	105·59	105·48	105·69	105·65
Less Oxygen for Cl	5·56	5·64	5·86	5·21	6·10	4·36	4·41	5·1	4·65	4·61	4·94	5·22	4·88	4·72
Total	100·66	100·13	99·51	100·69	101·25	99·81	100·74	100·1	99·87	101·26	100·65	100·26	100·81	100·83

* The two molasses had been left for a long time in copper dishes and corrosion of the metal ha ken place, hence the abnormal presence of copper.

Comparison with Java.

The following ash comparisons can be made from factory averages published by L. Wichers.[4] Figures expressed in grams per litre of juice.

Factory.	Total Ash.	CaO.	MgO.	SO_3.	Cl_2.
Java	7·73	0·100	0·149	1·049	0·977
,, ...	3·20	0·052	0·150	0·670	0·470
,, ...	4·82	0·080	0·046	0·462	0·272
,, ...	3·80	0·050	0·079	·0228	—
Zululand, 4-yr. average ..	4·68	0·206	0·357	0·518	0·890
Amatikulu ..	4·95	0·198	0·471	0·681	0·680
Felixton ..	5·15	0·068	0·025	0·382	0·785
Felixton Flats	6·61	0·016	Trace	1·820	0·035
P.O.J. 2714	2·89	Trace	Trace	0·331	0·430
Darnall ..	4·18	0·315	0·405	0·550	0·730

Thieme[5] observed a rise in ash during periods of abnormally low rainfall, also from the more arid districts. He also points out that P.O.J. 2878 requires more mineral constituents and he observed an appreciable rise in ash in factory juices on introduction of this variety.

Walton and Fort[1] show what great differences in non-sugars occur in juices of the same purity.

The foregoing is an attempt to outline some of the available data on non-sugars and their importance.

In order to further our knowledge on this subject, this Committee recommends that each Sugar Factory collects composite samples of mixed juice, filtered juice, clarified juice and syrup and molasses throughout the ensuing crop, and sends them to the Experiment Station for ash analysis during the next off-crop. The results will not only give valuable data on variations in ash contents along the coast, and their effect in the factories, but will also throw a good deal of light on the soil variations in the various districts.

Continuous Sulphitation.

A paper on continuous sulphitation in Egypt was read at the International Conference at Puerto Rico, and is of particular interest to this country.

An outline of the process is as follows:—

Milk of lime 15° Be. is run into the mixed juice line previously heated to 75° C. just before entering the sulphitation tank, to an average pH of 8·6 (8·0—9·0 pH, depending on quality of the cane).

Sulphitation takes place in a circular tank at the bottom of which is a perforated plate. The juice enters above this plate and the gas below.

Two sets of furnaces are used, to ensure a continuous supply, while the mixed juice is taken from a large supply tank in order to overcome fluctuations of milling. This is a very essential detail and one so far not considered in this country. The juice leaving the sulphitation tank ranges from 7·0—7·4 pH.

They claim a reduction in glucose destruction, as the lime is only eight seconds in actual contact with the juice, easier work throughout the factory, reduction in lime and a 45% reduction in sulphur.

The juices have been very clear and uniform, the settlings have filtered well, yielding good cakes, together with an increased drop in purity in the first massecuite of 3° (25 to 28).

This process is well worth a trial in this country.

Filtration.

A big advance in the filtration of defecation scums is taking place in the West Indies with the introduction of the Oliver Campbell Cachaza filter. A report on this subject will be found in the report on the Puerto Rico Congress.

In the West Indies the standard square foot of filtering area per ton cane hour aimed at is 100.

In Natal, despite the far greater quantity and more difficult material handled, this figure is only slightly exceeded in comparatively few cases. The maximum in Natal is 114 and the minimum 46, with an average of approximately 90.

The filtrability of raw sugars is receiving a great deal of attention in other sugar countries, where special laboratories are being used in this study. This Committee recommends that the Chemical Control Committee should lay down uniform methods for the determination of maximum and starch complexes, colloids, filterability, etc., in order that the result of research may be truly comparative.

In the foregoing report the Committee have attempted to indicate the essential points in a vast field of research, together with opinions and data culled from available sources.

In some ways it may be thought that this report deals with subjects outside the terms of reference, and yet clarification and filtration are the essential principles of all factory practice, and all factors from field practice to the final refinery products are the cause and effect which influence good and bad clarification and filtration in both the raw sugar house and the refinery.

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P. MURRAY.
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M. VIGER.
G. C. DYMOND, *Convenor.*

[1] Facts about Sugar, 1932, **27,** 440.
[2] Inter. S. Jour., 1931, xxxiii., 244.
[3] Facts about Sugar, 1931, **26,** 168-174.
[4] Inter. S. Jour., 1931, xxxiii., 403.
[5] Inter. S. Jour., 1931, xxxiii., 131.

Mr. BECHARD: On page 4 of the report you note a remark by Thieme about the high magnesia content resulting in splitting the filter press cloths, and adjacent to that you give very high magnesia content for Amatikulu, considerably higher than Felixton. In regard to filter cloths, I can't say we have noticed anything like that; at Amatikulu we have been very economical in filter press cloths last season.

CHAIRMAN: I merely stated a fact recorded by Thieme in Java. Unfortunately, as Mr. Dodds pointed out, a lot of valuable information is to be found in the "Archief," which is published in Dutch, and consequently we are only able to take statements that are published in a brief way in the International Sugar Journal. This statement was merely recorded as of interest.

Mr. RAULT: Referring to the magnesia content as an impurity of our juices, it is remarkable that on testing the ash of final molasses, which after all is an indication of how clarification has proceeded, we find on page 5 the Natal Estates figures for the last five years show that the amount of magnesia in the ash of final molasses is barely over 1% in the case of this factory, against anything from 4% to over 9% in the sulphitation factories, showing that by the carbonatation process we do eliminate most of the magnesia content, probably because we are working in an alkaline medium and the sulphitation mills barely touch the magnesia.

Mr. BECHARD: Far from wishing to criticise the analyses figures, which are probably the most useful that have been done in the Sugar Industry so far on the chlorine constituents of juices, I noticed that clarified juice shows always a higher chlorine than mixed juice. Unless chlorine was added, which is not very probable, it seems to me that the analysis of the mixed juice shows less chlorine than was actually the case. We all know the difficulty of preserving chlorine in ashing the mixed juice. It would be very useful for future reference if that point was noted. I personally use calcium acetate in ashing mixed juice. Addition of that throws out the calorimeter determination of ash as adding some ash to it alters the figure. At the same time, we all know that chlorine is an important non-sugar, and it is a point worthy of remembrance that juice that does not contain much lime is liable to lose its chlorine in ashing.

CHAIRMAN: It is quite an interesting point raised by Mr. Rault and Mr. Bechard, and I can only ascribe it to the method employed and the possible entrainment of soluble salts from the different types of ash. Ashing mixed juice is much more difficult than ashing clarified juice, and as the solution was obtained by filtration with water it is possible that as far as mixed juice is concerned all the chlorine was not extracted, which may account for the higher figure noted in the clarified juice.

Mr. BUCHANAN: On the first page is mentioned prescreening of raw juice. Has the Committee found any connection between the cush-cush content of mixed juice and the juice content of the same molasses or massecuite?

CHAIRMAN: Actually we have no figures on that, but it has been shown that by leaving quantities of cush-cush in the mixed juice the subsequent effect of lime and heat gives an increased colloidal content to the clarified juice, and we can only assume that this condition will carry on as far as the final molasses.

Mr. POUGNET: On the first page, before "Non-Sugars," it says: "While we may by large caiptal outlay in factory equipment and costlier methods increase our recovery by one or two per cent., we may automatically obtain five or six per cent. without capital outlay and at much lower cost by concentration on field work, the selection of varieties not only on a yield basis but also on a workability basis, together with a scientific application of fertilizers, and irrigation wherever possible." Do I understand that you condemn the use of that cane or advocate different cane altogether?

CHAIRMAN: The paragraph referred to a condition that your delegates to Puerto Rico were very much impressed with. In these countries it is fundamentally recognised that the place for research is the field, that sugar is made in the field, and that paragraph refers to comparative conditions, and what we might expect by working on the same lines, concentrating on field work as they do in the great sugar countries. (Hear, hear.)

Mr. BOOTH: I would like to thank the Committee for having got up such a very comprehensive report on this subject. Undoubtedly it is a big subject facing us. I take it that the analysis of all our ash is a preliminary step to investigation of new canes. I look upon it that we have to deal with the evils of the Uba as they stand. I don't see, in the short time I have had to study this paper, that we can do very much towards altering the ash content; but from the practical point of view, I would like Mr. Rault or the Chairman to give us first of all some further information about the pepsin process, and secondly, further information about this continuous sulphitation process and the type of cane they have in Egypt. It appears to me that the question of non-sugars in respect of colloidal matter is of very much more importance. I see no recommendation put forward to try out this, and I think that is of vital importance not only as regards easier working but the saving of steam in manufacture and a thousand and one other things, not to mention a lesser quantity of chemicals. I think that clarification of Uba juice stands condemned by the fact that we use something like four times as much of the cardinal agent lime as against some of these other canes, and yet with all our sulphur and phosphoric acid we don't seem to beat the condition at all. We are still at the mercy of climatic conditions. I would like to get further information about the pepsin process.

CHAIRMAN: As regards the pepsin process, Lanier gave me the information which I have included in this report. He referred me to the patentee, Schreiber. I wrote to him for further information, and unfortunately all he would tell me was that he was willing to come to this country and show us how it was done on an

agreed business basis. That is how the matter stands at present. I have personally tried out the effect of pepsin. Probably the pepsin I had was not sufficiently pure, but I found that it had an effect on sucrose, and consequently carried out no further experiments with it.

As regards the continuous sulphitation, there again I have given you all the information that I have. As regards the class of cane grown in Egypt, I think perhaps Mr. Dodds could tell us more than I can. But the process appeals to me as a very practicable one. In this country, as you all know, there is a very definite destruction of reducing sugars due to the long time of contact with lime. This obviates that long contact, and I think that it certainly should be tried out in this country.

Mr. MOBERLY: In that connection, Coates of Louisiana recommended a simultaneous liming and sulphitation process, with a subsequent correcting stage. He stated the main difficulty was excessive frothing, and experiments he tried out had been very largely vitiated by the excessive frothing; but if that could be eliminated he favoured simultaneous liming and sulphitation.

Mr. DODDS: I can give very little more information about the continuous sulphitation process in Egypt, except to confirm that it was found very effective at the Nag Hamadi factory. The variety of cane which is exclusively grown in Egypt is P.O.J. 105, a cane which, as far as I know, is not in general cultivation anywhere else; it is a cane of medium thickness.

Dr. HEDLEY: Mr. Chairman, you sure have said a mouthful, as our American friends say, when in your paragraph on page 5 you say that each factory should collect composite samples of mixed juice, filtered juice, clarified juice, and syrup and molasses during the ensuing crop and send them to the Experiment Station! But the Experiment Station wants the staff. The Experiment Station consists of too small a staff even to absorb that mouthful! Not satisfied with that, on the last page of the paper you say that "the filtrability of raw sugars is receiving a great deal of attention in other countries, where special laboratories are being used in this study. This Committee recommends . . ." and then you go on again! Well, there is no question whatever that whether you have Uba juice or that of the soft canes which we hope will rapidly come into use, this question of clarification and filtration will have to receive greatly increased attention. It is a question which both Mr. Saunders and the President drew attention to, namely, the need for co-operative work. We have had one example of it, and you will hear more about it possibly to-morrow, and that is the co-operative work which has been done by the Boilers and Boiler Practice Committee. That is the first time, if I may say so, that the Millers have shown the necessary interest in the work of the Technologists' Association as a body. They voted a sum of money for plant, and enquired of the results as the results were being obtained. Here is another example of work which should be brought before the Millers by our delegates. You may not know that during the last two months we have had presented to us from the Millers two papers which have called for attention, one on sulphur dioxide and the other on filtrability of our Natal raws. They are showing great interest in this work, and a sub-committee was appointed from the Chemical Control Committee to draw up tentative plans for the investigation of these problems. To this question could well be attached the question of filtration; it is not merely a question of ash. I know of other authorities who do not lay so much stress upon ash but upon colloids, and categorically say that the determination of ash is not so useful. Doubtless a new committee will be formed this year, and it must be the function of that committee to draw up a good scheme so that we can present that scheme to the Millers when the delegates meet them. It does not matter very much whether you are going to have the soft canes in the future or carry on with Uba. Read the literature, it is full of questions; they are never satisfied with the soft canes. There are always problems of clarification. There is one thing Mr. Booth did not bring up, that is an instrument called the Metafilter. There are two papers on it in the International Sugar Journal to which he drew my attention, and I think it would be well worth including in any scheme that the Filtration and Clarification Committee draw up. If it comes up to scratch it seems to be an extraordinarily good filter, and a cheap filter. But that is a question which must be examined by a committee and cannot be examined by a discussion when no experiments have been tried.

Mr. VIGER: About the continuous sulphitation process, the simultaneous liming and sulphitation has been done in Java since 1912, and they found that this simultaneous sulphitation yielded less ash, less colloids, and better boiling juice for the pans.

Mr. RAULT: I want to ask a question which has not a direct bearing on what we are discussing, and I think Mr. Dodds may be able to answer me. Looking at these reducing sugar ratios, we find a fundamental difference between our juices and other countries' juices in the glucose apart from colloidal content and gums, and it seems to be either due to the variety or to the country. I would like Mr. Dodds to tell me whether in the new canes we have introduced he has found the glucose ratio was in any way similar to the glucose ratio found in other countries; if not, whatever the variety of canes we introduce with our climate we will still get the same diffiuclty, because the biggest difference in losses between this country and other countries is the loss in molasses, and the loss in molasses is practically proportionate to the degree of exhaustion we can give, and that is influenced very much by the reducing sugar. Another question for Mr. Dodds regarding the ash content, it is very evident from these figures of Mr. Dymond's, and also from figures I have done for a whole year, that you have practically double the amount of magnesia to lime in the ash of juice, which should show that its requirement in magnesia is rather heavy, and if there is a shortage of magnesia in the soil that ought to influence the growth. Has any work been done on the magnesia to each ratio or any experiment done to fertilise for magnesia?

Mr. DODDS: The low glucose content commonly found in sugar cane in this country is, I think, a climatic factor rather than one associated with any particular variety of cane. We find this low glucose ratio not only in Uba but in other varieties of cane during our cold and dry weather, and we find the same thing in other extra-tropical countries, such as, for example, Louisiana, where also during the cold harvesting season the glucose ratio at certain times falls very low indeed, far lower than we ever find it in the tropics. I think you will find that it is not a factor so much of the variety of cane as of the temperature, just as we find that Uba cane under our conditions develops certain unusual properties, such as abnormal thickness of wax on the stem, leading to difficulty in defecation and clarification, which is not met with to anything like the same extent in other countries, where the wax coating is not formed too copiously. Very little work has been done here with regard to lime-magnesia ratio of soils. It is generally considered that it is an advantage to have a high ratio of lime in proportion to the magnesia present, but, as far as I know, no systematic experimental work has been done on the lime-magnesia ratio in our soils or its effect on the yield and composition of the cane. That is one of the many lines of work among those that Dr. Hedley has pointed out have already been suggested to the Experiment Station.

Mr. RAULT: In answer to Dr. Hedley's query about the study of other impurities apart from ash, I should say that there has been some little work done in the past, although not team work such as a committee usually does. Mr. Farnell and I collected a certain amount of information, which has not been published, because it was probably not systematised and not thorough enough; but we certainly are aware that colloids and gums and so on are of very great importance in the results we obtain in our factories, and we (the Committee) propose to further the study of such impurities. One reason that has stopped us from going ahead is that there is so far no information on the methods of analysis, and the Chemical Control Committee is going to go into it.