Mr. Stretton felt that the analogy was false. In the case of a potash determination the error would arise from the method itself. In polarisation, however, the permissible error of 0.2° polarisation came from a lack of sensitiveness of the eye, and if a number of people polarized the same solution their results would be found to differ by this amount. It was caused by an inability to match exactly the two sides of the field and would be the same whether the actual reading were large or small.

Mr. Floro pointed out that some analysts always read a polarization too high or too low and therefore it would be advisable to have all sugar samples polarised by one analyst.

Mr. Nurse said that though he was not a Chemist, he could appreciate the practical point of the discussion because much the same thing arose in using the Disappearing Filament Pyrometer. With this instrument, a correction was applied to the reading taken on the flame of the candle. The operator found his personal factor which he used when taking a reading.

Mr. Davies pointed out that similar correction was included in the proposed method since it was incorporated in the reading on the quartz control plate.

Mr. Flook raised the question of the sensitivity of the eye. He had found that the two eyes of the same person sometimes differed in this respect, and felt that one should always use the same eye when taking readings.

Mr. Stretton considered that an important point had been raised in introducing consideration of the eye. He found it very necessary when going into the dark room from the well lit laboratory to wait for several minutes in the dark before beginning to take readings. Accurate readings could not be obtained unless this was done.

The Chairman then closed the discussion and asked the Meeting to approve the suggested method.

The Meeting approved Memorandum 4.

The Chairman said he would like to thank the Convenor of the Committee for all the work which he had done in preparing these two memoranda and for leading the discussions. He hoped that all factories would adopt this method during the coming crop.

The President expressed appreciation to Mr. Macdonald for occupying the chair so ably and said that a hearty vote of thanks was due to the Convenor of the Committee for preparing these two memoranda.

INFORMAL DISCUSSION ON "THE TECHNOLOGY OF THE BARBADOS SUGAR INDUSTRY."

H. C. NURSE,
Consulting Engineer, Associated Estates

(Mr. John Munro, in the Chair.)

Mr. Nurse opened the discussion by saying that when he and Mr. Kerr-Jarrett went to Barbados in May/June the main purpose of their visit was to try and find out as much as they could about fuel economy. They had spent a lot of time in the various factories, although it was very difficult to collect all the information in the time which they had at their disposal.

Taking the various factory stations in order, Mr. Nurse went on to describe Barbados practice as follows:—

Cane Handling: Derrick cranes and gantries were in use and most factories preferred to use grabs because capital expenditure was lower than when using cane slings. Feeder carriers were of the inclined feed table type. Carriers and knives were of conventional design. Chokes at knives were controlled by a steam diaphragm reducing valve on the cane carrier engine; this had first been brought out by Mr. Henry Watson, and he believed that it had been patented.

Milling Plant: Crushers were of both the 2 and the 3-roll type with grooving similar to that in use in Jamaica. The mills, however, were grooved half inch pitch which was fairly common practice. Engineers in Barbados were convinced that just as good work could be obtained with this type of grooving as with grooving graded from coarse to fine. One advantage of the half inch grooving was that less damage was done to the rolls by stray metal, as compared with coarser grooved rolls.

Intermediate Carriers: Scraper Carrier chains had been removed in some cases and feeder rolls installed at certain factories. This cut down on maintenance and improved sanitation at the mills. Mr. Nurse suggested that Mr. Campbell might install at Innswood one feeder roll for next crop to note its effect. It had been proved advantageous in Barbados and at Barnett, improving extraction by as much as 1%. It would cost approximately £20 to fabricate.

Drawings: A number of drawings had been obtained during the visit and amongst them was one of an ejector type steam valve for return of maceration juice. It was controlled by a float type valve operating on the steam inlet.

Sanitation of Mill Beds: At one factory the cast iron bed plate had been cut away and replaced by a mild steel pin of improved design which gave better drainage.

Steam consumption: Very close checking was done on the cylinders of prime movers, bores and rings being checked as frequently as necessary to avoid loss of steam. Furnaces were seen in various conditions — some working, others partly clean and others untouched since the end of crop. There was a comparative absence of clinker on tubes and heating surfaces and this was probably due to the high draught used. No soot blowers were used. The draught used at various factories could be seen by reference to Circular No. 155/47. Factories employing the highest draught were noted to have the least clinker. In general the higher the heating surface available the lower the draught used — the average draught was 2"-2½". Flat grates were predominant and these were somewhat similar to those in use at Frome. The distance between great bars was ½"-⅝". There was little dropping of bagasse between the bars owing to the high draught. A cone system of firing was used, the bagasse entering through circular inlets 9"-12" in diameter, one inlet per grate. The principal difference between our practice and that in Barbados was that we used a lower draught and tried balancing it by forcing air into the fuel. — only one factory in Barbados was provided with balanced draught and this was not in operation. Some furnaces that had been built many years ago were seen to be in very good condition, there being no sign of deterioration or erosive action of brickwork beyond normal, due to the high draught used. A feed water heater was in use at one factory which we saw. Heating of the boiler feed was usually done by means of a perforated coil in the hot well where the temperature maintained was 190-195°F. Two types of fan drives were used; one was by means of a flexible coupling and high speed engines for which the operators claimed easier control of draught. The other method was by means of slower speed engines belted to the fan. He personally preferred the latter method. The type of boiler in use was principally the Stirling. There were 6 Babcock boilers in all. One factory with comparable Babcock and Stirling boilers was seen and it was learned that the Stirling was preferred to the Babcock. There was a surplus of

bagasse, and at one factory a briquetting machine was being introduced for 1948 which extruded briquettes 2" in diameter by 10" long for household use. At this factory the boiler heating surface was only 124 sq. ft., per ton cane per hour. The power required for briquetting was 35-50 h.p. The saving of bagasse was very important because no wood was available for fuel.

Juice Heaters: Vapour was bled to at least one heater from a pre-evaporator. Bleeding to the vacuum pans was also practised in some cases. In one case the strike was started with bled vapour and finished on exhaust. As much vapour as possible was used before changing over to exhaust.

Evaporator: The standard figures for Barbados practice are 240 sq. ft. per ton cane per hour for a quad. and 200 sq. ft. for a triple. One evaporator that had been purchased in British Guiana had the original bottoms replaced by bottoms of mild steel. These were very shallow and showed improved performance over the original design. This indicated that in some of our own evaporators dead spots with poor circulation probably existed.

Vacuum Pans: There were no mechanical circulators but several stream flow vacuum pans were in use.

Stills: Steam was injected by means of perforated pipes and we were told that it could be successfully used. On the other hand opinion in Jamaica tended to the view that rum production would be reduced by the injection of steam into the wash. We intend trying the system out at Barnett to ascertain for ourselves what it is like. The reason for this trial being that the fouling of heating surfaces in Jamaican distilleries was very bad — some coils being hammered flat during cleaning. The question of scaling should be considered from every possible angle including the elimination of as much lime as possible in the sugar factory before reaching the molasses stage. At Barnett a brass calandria was being installed in an 1800-gallon still with a heating surface of 110 sq. ft.

Visit to Antigua: The improvements effected in Antigua had been noted and tabulated in the report submitted, but one point called for special mention. At Gunthorpes factory the liming tanks which had originally been 20 yards away from the juice heaters and worked at a pressure of 65-70 lbs. sq. inch had been reinstalled in close proximity to the juice heaters. The working pressure had been reduced to 40 lbs. per sq. inch.

At Antigua Sugar Factory there was one furnace similar to those in use in Jamaica which operated on a natural draught of .8". More clinker was noticed in this furnace than in Barbados yet there was a large surplus of bagasse which created a disposal problem.

The Meeting applauded Mr. Nurse's remarks.

The Chairman said that only by travel and interchange of views could we hope to improve our methods. He agreed with Mr. Nurse that the scaling of still coils should be tackled from the point of view of lime in the molasses, but the water used for mixing the wash was also very important. He said that at Bernard Lodge scale formation on the still coils had been eliminated by changing the source of water. He then declared the subject open for general discussion.

Mr. Henzell said that he had had some experience with scale formation in distilleries. Some years ago at Gray's Inn a good deal of trouble had been experienced with scale in the continuous still and distilled water had been used but made no difference whatever. He was therefore surprised to find on arrival at Caymanas that a water softener had been ordered. This had worked very well in the first year but in the second year of its operation more scale than ever had been formed. One factor which might have affected this was that more lime of poorer quality had had to be used in the second year, but it was evident that scale did not necessarily come from water. In Trinidad the treatment of molasses

before making wash was practised — the molasses was mixed with water to 45° Brix, heated to 200°F and allowed to stand for one hour. Up to 10% of mud was formed. The settled liquor was used for mixing wash. He did not know if this process would give the desired results as regards scale formation but intended trying it at Caymanas next crop. A considerable amount of mud had been formed from molasses at Caymanas in the laboratory.

Mr. Floro referred to the Mercedita Central in Puerto Rico where about 20,000 gallons of molasses were used per 24 hours for the manufacture of rum and alcohol. The molasses was diluted 50:50 with water, sulphuric acid was added to a pH of 4.0-4.2 heated to 160° F and transferred to a reaction tank where it remained for 1 to 2 hours. The mixture was then centrifuged at 1200 r.p.m. with centrifuges running on a 3-hour cycle. The sludge contained 5-6% total sugars and was diluted and run to a continuous clarifier from which the clear liquor was used for diluting the original molasses. The mud contained calcium sulphate crystals and was added to the irrigation water because of a deficiency of calcium in the fields. During the past 4 years of operation of this system the cleaning of the continuous stills had been much easier.

Mr. Owen Clarke enquired if one would have to use any extra fuel if he operated wtihout distilleries.

Mr. Nurse said that in Barbados there was only one factory with a distillery, viz., the Mount Gay Plant. At this plant the surplus bagasse was sufficient for distillery purposes. He went on to say that Stirling boilers predominated in Barbados and were preferred there. The intense draught used seemed necessary for four-pass boilers. Radiation losses from brickwork were reduced because there were fewer units.

Mr. Owen Clarke said that this might represent a saving in capital but enquired if it also meant saving in fuel.

Mr. Nurse replied that by the end of the coming crop more figures would be available on this point from the installations at Barnett.

Hon. F. M. Kerr-Jarrett said that in their report on Barbados no estimate of bagasse saved had been included. They only kept enough bagasse on hand to start the next crop and sent the rest to the fields. He hazarded the view that the surplus bagasse available would be enough to operate a distillery.

Mr. Smedmore enquired on what basis Barbados engineers placed their conclusion that the mill extraction figures in Jamaica were too high. Was it a categorical statement? Were they aware of the extraction figures obtained at the Imperial College of Tropical Agriculture over the last season?

Mr. Nurse was not aware of the basis, but said that this not only depended on the size of the milling train but also on grooving and the way in which the mills were operated.

Hon. F. M. Kerr-Jarrett referring to Mr. Smedmore's enquiry said that chemical control in Barbados had been established long before it had been in Jamaica. Supervision was much better and our bench chemists were not as proficient as those in Barbados. The fact that some of our figures were open to question had been pointed out by Mr. J. G. Davies. Boiling House efficiency figures were now lower since the introduction of improved laboratory and sampling methods. The whole question was mainly one of supervision and methods, and we had to be careful not to fool ourselves into believing that we were doing better than we really were.

Mr. J. G. Davies in reply to Mr. Smedmore's question on pol extraction pointed out that for the past two years the Jamaica Weekly Factory Returns had quoted "pol extraction, f = 12.5". The reason for this was that the fibre content varied so widely and the reduced pol extraction figure was not previously used. He thought that the Barbados engineers may not therefore appreciate that the reduced pol extraction might be 1-1.5% higher than the incorrected pol extraction figure.

Mr. Henzell said that in considering boilers, certain conditions had to be taken into account. The Stirling and the Babcock boilers were both made by the same manufacturers; the Stirling was the radient heat boiler and he illustrated the differences between this type and the Babcock by means of a sketch on the blackboard. He showed that the full length of the first bank of tubes was exposed to the hot gases while in the Babcock the arrangement was entirely different, and the horizontal tubes led to bird-nesting of ash which did not occur in the case of the Stirling. Alterations to furnaces could not alter the design of the boilers with which they were to operate.

Mr. Floro said that the Barbados engineers had referred to the use of injected steam for operating stills. He thought that a matter of such importance to the Jamaican industry should have been qualified by a statement as to whether pot stills or continuous stills were meant. He did not consider the system suitable in the case of pot stills.

Mr. Henzel said that steam injection was used with pot stills in Demerara and the only effect as far as he knew was that it created high peak loads in steam consumption.

Mr. Floro enquired the strength of rum coming from those stills and added that leaking coils would affect the strength of the rum.

Mr. Munro agreed with this view.

Mr. Nurse said that the idea had been given to them and that they were simply going to try it out with a view to cutting down cleaning of coils at week ends.

Mr. Dron asked Mr. Nurse's opinoin as to whether the small northside factories could operate on bagasse alone if they did not have to run a distillery.

Mr. Nurse replied that on many occasions it had been impossible to burn all the bagasse, but at the same time steam conditions were good — in his opinion cane varieties were the cause. He had found that a few sticks of wood in the bagasse improved burning conditions by creating voids in the bagasse to allow the passage of air. In Barbados the bagasse burned around the periphery of the cone where it was thinnest. He added that small differences in draught could make a great difference to combustion conditions as evidenced by the effect of the steam blower installed in the chimney of the Antigua factory.

Hon. A. S. Campbell enquired if atmospheric conditions had any effect on steam production.

Mr. Nurse replied that it did. With the wind in certain directions it was difficult to keep steam. At one factory in Barbados the furnaces were installed below floor level and it had been necessary to make a tunnel to lead air into the grates. At another factory it chanced that a wall was built in a position in which it deflected air to the grates and at that factory an evaporation rate of 10 lbs. water per sq. ft. was obtained. Atmospheric conditions required further study as far as their effect under conditions of natural draught was concerned.

Hon. A. S. Campbell asked if boilers should be placed facing the trade winds.

Mr. Nurse said that in his opinion this should be done — he had noticed at Caymanas that wind blew in opposite directions during the day and at night. Better steaming was obtained at night but this was the case with most installations.

Hon. A. S. Campbell enquired what groovings were used on the Barbados mill rolls.

Mr. Nurse said that Kay grooves and chevrons were employed. Much had been done with the feeder roller and much could be done in Jamaica. The feeder roller enabled the mill to work closer with benefit to feeding and extraction.

Hon. A. S. Campbell asked what was the condition of the cane and whether it was so tough as to make it necessary to have more gripping area on the rolls.

Mr. Nurse did not know if the gripping area had been considered.

Hon. F. M. Kerr-Jarrett referring to the saving of bagasse said that on some days no matter what was done, steam conditions were poor. Barnett Factory was behind a hill but this was not the case at Richmond where there was no steam trouble and little wood was burnt. At Richmond more bagasse was actually carted away than there was wood burnt and the only reason for burning wood was the difficulty of getting enough bagasse back to the furnaces for starting. He asked Mr. Nurse to mention the Messchaert grooves used in Antigua and also referred to the burnability of bagasse. The same variety of cane would differ both as regards burnability and as regards millability on different soils. Many factors had to be considered. They were not trying to introduce Barbados' practice in its entirety in Jamaica but had put it forward to see what could be selected from it for our use.

Mr. Nurse referring to the Messchaert grooving used in Antigua said that they macerated very heavily there and that Messchaert grooves were required. At other factories where less maceration was used coarse grooving might provide adequate drainage.

Mr. Owen Clarke asked how bagasse was stored in Barbados.

Mr. Nurse replied that it was blown out into the yard and stored in heaps. Layers 1 ft. thick were placed on the heap and allowed to dry before more bagasse was added; this avoided spontaneous combustion. The bagasse was brought back by hand to the furnaces. In reply to a question by Mr. Floro he said that rainfall in Barbados was 45 inches per annum in dry and 70 inches in wet areas. There were heavy rains in September.

Hon. F. M. Kerr-Jarrett said that the bagasse ricks were like English hay ricks. In some cases long tops were laid on the surface to facilitate run-off of water — the results were satisfactory. The rainfall from October to January was 10-20 inches. The whole object of inter-crop storage of bagasse was for starting the next crop. Bagasse not kept for this purpose was carted direct to the fields.

Hon. A. S. Campbell asked where lime for clarification was obtained.

Mr. Nurse replied that it was produced locally.

Mr. Henzel added that natural gas was used as fuel for this purpose.

Hon. A. S. Campbell asked what methods were used for cleaning heating surfaces in the boiling houses in the Barbados factories.

Mr. Nurse replied that Sumaloid was used at one factory but at other factories cleaning was done by hand, and that the usual operating period was 6 days per week.

Mr. Collier enquired if binders were used for the bagasse briquettes.

Mr. Nurse replied that no binders were used. He had no details as to cost.

Hon. F. M. Kerr-Jarrett requested Mr. Ian Kerr-Jarrett to give details of the method of stacking bagasse bales in St. Kitts.

Mr. Ian Kerr-Jarrett did so, illustrating the method by means of a sketch on the blackboard. The bales were stored with spaces between them. They kept quite well from one crop to the next.

The Chairman thanked Mr. Nurse for leading the discussion on this subject, which proved most instructive and enjoyable.

INFORMAL DISCUSSION ON "DETERMINATION OF REDUCING SUGARS IN RAW SUGARS."

G. W. P. STRETTON, B.Sc., F.R.I.C.
Chemist, Sugar Research Department, Sugar Manufacturers' Association (of Jamaica) Ltd.

(Mr. H. B. Springer in the Chair).

The Chairman introducing Mr. Stretton, pointed out that the latter had devised a standard method for this determination which was of greater than academic interest. Reducing Sugars played an important part in rum manufacture, and a close check on them was therefore very important during sugar manufacture.

He then called on Mr. Stretton to open the discussion on his paper published in the J.A.S.T. Quarterly Vol. X No. 4 1947, p.p. 23-25.

Mr. Stretton reiterated the salient points of his paper, stressing in particular that an absolutely standard method for this analysis should be strictly adhered to, and followed to the smallest detail.

Mr. Floro said that he would like to see an apparatus devised to make the analysis as simple and foolproof as possible. He asked Mr. Stretton whether he could improve his method by designing special equipment.

Mr. Stretton replied no special equipment had been used. His hot plate and burette were of standard pattern. He pointed out that the hot plate must of course be 'full on' before starting or the rate of heating might be affected with consequent variation in the final result. He himself used pumice powder in the Erlenmeyer flask for better ebullition.

Mr. Davies added that any 'local variations' would automatically be corrected by standardization under the rigid conditions obtaining. He described the design of the hot plate which was used.

The Chairman in drawing the discussion to a close, thanked Mr. Stretton for the great trouble he had taken in performing his work, and publishing his findings. It was a step in the right direction, that a simple standardized procedure for reducing sugars had been added to the Chemists' repertoire.

INFORMAL DISCUSSION ON "SOME EXPERIMENTS ON A POT STILL."

G. W. P. STRETTON, B.Sc., F.R.I.C.
Chemist, Sugar Research Department, Sugar Manufacturers' Association (of Jamaica) Ltd.

(Mr. J. G. DAVIES in the Chair):

The Chairman said that the experiments which Mr. Stretton was about to described were conducted in order that some preliminary information might be obtained as to what took place in the pot and in the retorts during the course of distillation. The experiments were not by any means complete. The collected data, however, had been of great interest to Mr. Stretton and himself. After consideration of it, they had decided on some further experiments which would be conducted when opportunity permitted.

The object in discussing the preliminary results at this early stage was to see whether any of the Chemists had any ideas or suggestions to contribute to the proposed development.

The Chairman then asked Mr. Stretton to open the discussion.

Mr. Stretton: During the 1947 crop, experiments were begun with the object of collecting data which would help to show what actually happened during distillation in the usual pot still with two retorts, and whether any practical steps could be taken to improve heat economy or efficiency of recovery of alcohol.

We were fortunate in obtaining the very ready co-operation of the Hon. Mr. Kerr-Jarrett, and the experiments which are now to be described were carried out at his factory. We wish here to acknowledge with gratitude the assistance and co-operation which we received from him and from members of his staff at Barnett.

At this factory, the vat capacity is 28,800 gallons, in 13 vats. The still has a load capacity of 1800 gallons and the L.W. and H.W. retorts have load capacities of 220 and 180 gallons respectively. The retorts are not heated but are lagged.

The wash is preheated to about 140°F, a tubular heater being used. Samples of wash taken before entering the pre-heater and immediately before passing to the still were analysed for spirit strength by means of the Juerst ebulliometer. No loss of spirit was shown within the limits of accuracy of this method of determination.

The first step was to observe the rate of removal of alcohol from the wash during distillation. A sampling cock was inserted in the side of the pot at a level below that of the wash. By this means, samples of wash were withdrawn from time to time during the course of a run. These were analysed for spirit strength, again by the Juerst ebulliometer.

It was, of course, necessary to take precautions against loss of spirit from the hot liquid emerging from the cock. An ordinary Liebig condenser was fitted to the cock but this was not found to have very much cooling effect because the liquid poured through it too rapidly. In the end, it was thought best to run off about 1 litre of sample rapidly into an Erlenmeyer flask and to cork it up at once. The sample was then allowed to cool in the flask and was analysed.

The results are shown in Table 1.

TABLE 1.

Time	% P.S. in wash	Temperature (°F) in Still	L.W. retort	H.W retort	Remarks
0 mns	9.51	—	—	—	Dead Wash
40 "	9.39	208	—	—	Vapours entering L.W. retort
65 "	7.77	210	190	—	—
80 "	6.90	210	194	180	Rum being collected
90 "	6.58	210	194	180	"
105 "	6.13	210	196	180	"
120 "	5.51	210	200	180	"
135 "	5.08	211	202	180	"
150 "	4.40	211	204	182	H.W. being collected
165 "	3.68	212	207	184	"
180 "	3.21	212	208	186	"
195 "	2.73	212	209	194	L.W. being collected
215 "	2.16	213	210	210	"
230 "	1.61	214	211	210	"
245 "	0.89	215	212	211	"
260 "	0.53	216	212	211	"
270 "	0.44	216	212	212	Still shut off

The yield of this run was 100 gallons at 48 O.P.

It is seen from this, that after the vapours have begun to enter the L.W. retort, removal of spirit from wash bears a straight line relationship to time of distillation.

In the next experiment, the liquid in the pot, the L.W. retort and the H.W. retort, and also the distillate were sampled at five stages during distillation, namely:—

1. At the beginning
2. When rum begins to distil over
3. When all rum is collected and high wines are beginning to flow
4. When high wines have been collected and low wines are beginning to flow, and
5. At the end of the run — "still off."

The results for two such experiments are shown in Table 2.

TABLE 2.

Time	% P.S. in wash	% P.S. in liquid in H.W. retort	% P.S. in liquid in L.W. retort	% P.S. in distillate
Start	7.83	135.76	47.62	—
Rum begins	5.51	133.90	35.96	157.82
High Wines begin	4.29	116.86	19.06	146.72
Low Wines begin	2.54	33.74	5.56	112.98
"Still off"	0.53	1.84	1.38	17.04
Start	8.64	139.4	51.96	—
Rum begins	6.48	138.3	42.96	151.3
High Wines begin	4.61	114.7	17.17	147.5
Low Wines begin	2.63	27.66	5.29	130.2
"Still off"	0.26	1.44	1.14	20.1

The contents of the retorts were sampled by opening the lees pipes for a short while and collecting the emergent liquid in a flask, stoppering it is soon as possible to minimise loss of spirit.

This table illustrates the changes in spirit strength in the different parts of the still as distillation proceeds. But it is not possible with the data which we have so far collected to arrive at an estimate of the actual quantities of alcohol present in the wash, the L.W. retort the H.W. retort and the condensate at any instant during distillation.

Such information, which would give us an idea of the distribution and "flow" of the alcohol during the process, would be very interesting. We are hoping that after further experiments we may arrive at it, but there are certain difficulties to overcome and certain assumptions which may have to be made.

For instance, when these experiments were carried out, the rum produced was collected and transferred to the storage vat in a closed system so that we could not analyze the actual batch produced by a particular distillation except by taking aliquots of the condensate from time to time. Again, the spirit strength of the wash could be measured at any time but its quantity could not. This meant that to estimate the number of lbs. of alcohol in the pot at any time we had to assume that the wash behaved as does an alcohol-water mixture in the laboratory.

Similarly with the two retorts, the spirit strength of their contents could be found but the quantities of liquid which they contained could not be measured at all accurately. For, although they were fitted with water-level indicators, the violence of the ebullition inside them made this device untrustworthy.

However, it is hoped that some of these difficulties will be overcome in future experiments.

I have made some calculations by which distillation in the factory to compared with distillation in a single retort and condenser, taking as an example the wash used in the first of the two runs (Table 2) which consisted of 1800 gallons at 7.83% P.S. For the purpose of these calculations I have assumed that the wash behaves like a mixture of alcohol and water of the same strength.

(i) If this is distilled in a simple still until all the alcohol is removed, the strength of the distillate will be about 36% P.S.

(ii) If this distillate is again distilled it gives a distillate of about 81% P.S.

(iii) A third distillation gives a liquid of abouut 118% P.S.

(iv) A fourth gives about 139% P.S.

(v) And only after a fifth distillation, which gives a liquid of about 151% P.S. do we get rum as normally produced.

Distillation with the pot still and two retorts can, in a way, be regarded as a telescoped three stage distillation, for at the end of the run almost all the alcohol has been removed from the apparatus. The reason why this gives strong rum when five simple distillations would be required may be due to the fact that the liquid in the H.W. retort is heated by the distillate from the L.W. retort, which contains spirit, and the L.W. retort, similarly, is heated by receiving alcohol-rich vapours from the wash. Thus a stronger condensate is produced than would be the case with simple heating or ordinary steam distillation.

This concludes what I have to say about these experiments and the subject is now open for discussion. If I may speak personally, I would like to say that I hope members will discuss this subject on a broad basis and not feel confined by what I have said to a discussion on my remarks only.

The Chairman then declared the paper open for discussion.

DISCUSSION

Mr. Floro asked why the experiment had not been continued until the wash was completely exhausted. He suggested that in future experiments, the temperature of the boiling wash and of the liquid in the low wine retort should be recorded.

Hon. F. M. Kerr-Jarrett asked whether the presence of alcohol in the wash and in the low wine retort at the end of the cycle indicated indifferent distillation and whether the distillation should not have been carried further.

Mr. Stretton agreed.

Mr. Parkin asked for figures of the recovery of rum and the average strength which Mr. Stretton gave.

Hon. F. M. Kerr-Jarrett said that at the time of the experiments the fermentation had not been satisfactory.

Mr. Sweyn-Skinner asked for the recovery of alcohol per gallon of molasses.

Mr. Ian Kerr-Jarrett gave the figure of 1.8 gallons of molasses per proof gallon of alcohol.

Mr. Stretton said that the determination of such figures had not been the object of the experiments which had had the limited objective to determine in what manner the spirit was removed from the wash in four hours of distillation. The object of the second experiment was to find out the variation in spirit content of the liquid in the retorts and in the still, as distillation proceeded. He added that it was intended to determine an "Alcohol Balance" at various stages.

In concluding he said that the experiments were to be continued and suggested that in the ensuing discussions all aspects of the operation of a Pot Still could be dealt with.

Hon. F. M. Kerr-Jarrett raised the question of coils in retorts with reference to the reduction of time in the distillation cycle and the consequent economy of steam. He mentioned that, of course. exhaust steam could be used for heating the liquid in the retorts. He asked Mr. Floro to give his views on the matter.

Mr. Floro stated that he had found the use of coils in retorts to be effective in reducing the time of the cycle but found that it had some effect on the distillation. He personally used the coils in the production of light rum but not in the production of heavy rum. He expressed surprise at the form of curve 1 and said that had all the alcohol been removed from the wash in the first hour or so of the distillation, it might have been possible to re-arrange the cycle.

The Chairman replied that that was also one reason why he and Mr. Stretton had conducted the experiments and he was surprised at the lineal relationship obtained between alcohol % wash and time of distillation.

Hon. F. M. Kerr-Jarrett raised the question of the tendency in Jamaica of running the stills too quickly. He had had no information on this subject from Blairs and suggested that this too speedy operation of the stills was a cause of loss of alcohol.

Mr. Owen Clarke gave his experiences of the use of coils in retorts He had found the temperature difficult to control even with the use of thermometers and had eventually abandoned the using of coils. He had found no decrease in the time of the cycle.

The Chairman brought the discussion to a close and thanked Mr. Stretton for having lead it.

REPORT ON VISIT TO PUERTO RICO.

M. B. FLORO, B.Sc.
Superintedent of Production.
West Indies Sugar Coy., Ltd. Frome.

The visit to Puerto Rico was made at the invitation of The Association of Sugar Technologists of Puerto Rico through the President, Mr. Rafael Pol Mendez, for a Jamaican delegation to attend the Annual Conference to be held at San Juan on December 6th. and 7th., 1947. The delegates who made the trip were Messrs. H. A. Thompson, Paul Bovell, B. V. Bryce and myself. The former three members are primarily interested in Agriculture and Agricultural Research while my chief field is in the Processing and Chemical Control of sugar factory operation. We therefore lacked the valuable help of an engineer member who no doubt could have gathered many useful data and information on equipments and engineering practices in the Industry

We were met at the San Juan Airport on Wednesday December 30th by members of the Association headed by Mr. Rafael Pol Mendez. A complete programme of tours and other activities for the 6 days had been mapped out and our movements during the whole period were in accordance with the programme set.

We have to put on record our very sincere appreciation of the cordial welcome and generous hospitality extended to us by the Puerto Rican Technologists and Sugar Producers' Associations, by the Managers of Sugar Centrals visited, and last but not least by the representatives of the Puerto Rican Machinery Industries.

PROGRAMME OF ACTIVITIES:

I. *Thursday and Friday, Dec. 4th & 5th:—*

Visit to the Northern, Western and South-western part of the Island.

1. Puerto Rico Distilling Co.
2. Cambaleche Sugar Factory.
3. Isabella Agricultural Experiment Station.
4. Igualdad Sugar Factory and Refinery.
5. Mayaguez Insular Experiment Station.
6. Night at Mayaguez — and Supper Party given by owners of Igualdad Factory.
7. Guanica Sugar Factory and Refinery.
8. Puerto Rico Iron Works at Ponce.
9. Mercedita Sugar Factory Refinery & Distillery.

II. *Saturday and Sundry — Dec. 6th. and 7th., 1947:—*

1. Visit to Sucessores Abarco Iron Works
2. Technologist Meeting.
3. Technologist Meeting.

III. *Monday and Tuesday — Dec. 8th. and 9th., 1947:—*

Visit to Eastern and South-eastern parts of the Island.

1. Central Fajardo.
2. Central Pasto Viejo.
3. Central Lafayette and the Butanol Plant.
4. Night at Central Aguirre.
5. Central Santa Juana.
6. Puerto Rico Development Company.

GENERAL OBSERVATIONS.

Due to the limited time available for visits in the different factories observations set out below will be of a general nature and confined more or less to the process end of factory work:—

A. *Government Regulations affecting the Sugar Industry:*

(a) Sugar Factories are classified as Public Utilities.

(b) Minimum Wage Law — A Minimum wage of 40 cents per hour for a 40-hour week with time and one half for any overtime and double time for Sunday.

(c) Law 221 of 1942 — Regulating Colono's Gross Returns on Canes supplied to Factories — % of the Cane Yield.

65% on canes yielding 12% or more of 96° Sugar.

63% on canes yielding less than 12% of 96° Sugar.

50% of Net proceeds from Molasses sales — after deducting handling cost plus 4 cents per U.S. Gallon.

(d) *Mixed Fertilizers:* Mixed fertilizers marketed for the Sugar Industry must conform to several formulae issued yearly by The Department of Agriculture. This Law is receiving severe criticism on the part of Agricultural experts who contend that a great deal of phosphate fertilizers are being wasted on cane land which under the most careful experiments have never shown any response to phosphate applications.

(e) *Land Holding Law:* This limits the amount of land which can be held by any sugar factory to 500 acres, consequently most sugar companies have formed separate companies for their agricultural activities.

The Government now have 2 completely co-operative factories — Centrals Cambalache and Plazuela with a total production of about 72,000 Short Tons of 96° Sugar.

B. FACTORIES.

(a) *Cane Handling in Factories:*

In factories visited, this is mostly done by the use of mill house crane lifting canes in slings from cars to feeder tables. The use of hydraulic tipping table for unloading cane to carrier was only seen at Posto Viejo Factory.

(b) *Bagasse:* Four of the factories visited operate refineries so that no excess bagasse is accumulated during operation. The general practice is to have a big enough enclosed bagasse storage sufficient to supply the requirements of weekly shutdowns and start of the crop.

(c) *Mills:* The general practice is to operate mills at high peripheral speeds sacrificing efficiency in terms of pol. extraction to capacity. The All-Island average Pol extracted % Pol in Cane for 1946 Crop was 93.82%. All the Mills are Steam driven — using Corliss Engines — with the exception of an electrically driven tandem at Central Aguirre. One inch groovings with chevrons in mill rolls are almost standard practice. Messchaert groovings are also universally used on juice rolls.

(d) *Juice Scales:* Automatic Juice scales of about 5,000 lbs. capacity are preferred over the other types of automatic scales.

(e) In two of the factories visited automatic liming devices are in use. They are of the MICROMAX type.

(f) *Juice Heaters:* Multiple pass, high speed heaters are found in all the factories.

(g) *Clarification:* Fractional Liming and double heating are followed in five of the factories visited. pH carried are higher than in Jamaican Factories namely 7.6 to 8.0 pH. Temperature of 1st heating is carried only to about 190°F. Clarifier equipment is of the continuous type. Dorrs both simple and multifeed and Graver Clarifiers. It is the opinion that the latter is more efficient than the Dorr. Clarifier capacities vary from 500 to 90° American Gallons per Short Ton Cane per hour depending on the proportion

of POJ 2878 canes ground. Factory scale experiments have been made successfully in the use of Bentonite, a mineral colloid for Clarification of highly refractory juices. High hopes are being held for the elimination of previous troubles in this department through the use of Bentonite for Crop 1948.

(h) *Filters:* Vacuum rotary filters are used in all factories visited with the exception of Aguirre which work on the Petree process — returning all the muds to the mills.

(i) *Evaporators:* Rates of evaporation attained in terms of water evaporated per sq. ft. of heating surface per hour vary a great deal among the factories and appear to have a direct relationship with the efficiency of clarification. Among factories visited a rate of 8 lbs. seems to be the average.

Pre-evaporators are found in every good sized factory and these are bled for all steam used in juice heating.

Cleaning of heating surfaces is done by chemical treatment — boiling with caustic soda and hydrochloric acid, and in some cases followed by brushing. Time consumed for cleaning varies from 12 hours to 24 hours.

(k) *Vacuum Pans:* Calandria pans with shallow bottoms are in universal use. Central Aguirre has 3 12-ft. Pans with mechanical circulators. The Hawaiian practice of having excess Pan capacity to allow for very slow boiling of the "C" massecuites is finding favour with the Puerto Rican processors. In some pans mechanical discharges operated by steam are installed and give satisfactory service.

The ratio of pan heating surfaces to cubical capacities are higher than those found in the bigger Jamaican factories. They range from 1.75 — 2.25 ft. per cu. ft. compared to our 1.75 sq. ft. at Frome.

(l) *Centrifugals:* High Speed centrifugals of 1600 to 1800 R. P.M. are standard equipment in the "C" Station in conjunction with Stevens' reheating system.

For "B" Sugars no machines higher than 1,600 R.P.M. are used while for "A's." machines of lower speed 1,200-1,400 R.P.M. are favoured.

Mechanical plows are exclusively used.

(m) *Bagging and Weighing:* Commercial sugars are automatically weighed and sewn mechanically. The bags drop into conveyors either to factory warehouse or loaded direct to railway cars for storage in Dock Warehouses.

Central Aguirre which has dock facilities near the factory is installing for crop 1948, warehouses and equipment for bulk sugar shipment. The estimated capital outlay required for storage capacity of 40,000 short tons and facilities for loading 5,000 tons in 24 hours is about $300,000.

It is worthy of note that for bulk shipped sugars special price agreements have to be entered into.

Among the conditions are:—

1. A reduction in price of 12 cents per 100 lbs.

2. A reduction of about 0.300% in weight.
No explanation is given for this reduction.

Bags with 250 lbs. net capacity are universally used. If to be hand-stacked Puerto Rican Law requires 4 men to lift bag.

(n) *Molasses:* The average produced in 1946 was 5.47 U.S. Gallons per short ton of cane with an apparent purity of 30.89 and total sugar content of about 54% as R.S. None of the factories visited operate a distillery and all the Molasses are either disposed of to local distilleries or shipped to continental United States.

C. REFINERIES.

Sugar companies are given quota of Refined Sugar for both local use and for export to U.S.A. Four of the factories visited operate refineries using different processes as follows:—

Igualdad, Santa Juana } Sucro Blanc.

Guanica — Vegetable Carbon — Darco.

Mercedita — Suchar.

D. DISTILLERIES AND BUTANOL PLANT.

(a) The Distilleries visited were:—

1. Puerto Rico Distilling Co. — Distillers and Bottlers of "RON RICO RUM" — Cap. 10,000 Gals. Mol. daily.

2. Serralles Distillery at Central Mercedita — Distillers and Bottlers of Don "Q" Rum — Cap. 20,000 Gals. Molasses daily.

Both distilleries use the column continuous type of stills adequately equipped with Heads and Fusel Oil separators and also equipped for the manufacture of 95% alcohol. Due to the slump in the export market for rum both distilleries were making alcohol during the time of our visit.

No. 1 Distillery operates a 7½ Ton CO_2 Plant.

No. 2 Distillery operates a molasses clarifying plant and yeast recovery plant for manufacture of Dry Yeast used for chicken and stock feeds. This is sold at 6 cents per lb. Rum manufactured by this distillery consists of about 70% of all Rum sold in the local market and without doubt is due to the better flavour obtained from clarified molasses, separated wort and pure yeast fermentations employed.

(b) The Butanol plant is a Government sponsored industrial venture. The capacity of the plant is 10,000 gallons of molasses per 24 hours and average yield of solvents is about 1.5 pounds per U.S. Gallons of molasses containing about 54% total sugars. Of solvents recovered approximately 64% is Butanol, 34% Acetone and 2% Alcohol. It is the general opinion that in time of normal supply it will not be able to compete with synthetic solvents.

E. PUERTO RICO DEVELOPMENT CO.

One of the best papers presented during the Technologists' meeting dealt with the work done by the Puerto Rico Development Co. This is a Government sponsored undertaking whose main purpose is to develop new products out of the by-products of the sugar industry also of any other local products which may help in the establishment of new industries. Its Board of Directors consist of prominent Industrialists and on its staff are specialists — such as Agronomists, Soil Chemist, Bio-Chemist, Organic Chemist and Rum Experts.

Some of the work done has been in the line of pulp production from bagasse, citric acid from bagasse and molasses, manufacture of food yeast from molasses and production of plastics from the aconitic acids isolated from molasses.

F. Other Industries.

(a) Two heavy Iron Works serve the Sugar Industry. These are equipped to manufacture complete equipment for the Sugar Factory — heavy Mill rolls, Evaporators and Vacuum Pans.

(b) A Fertilizer Plant is in operation importing Phosphates from Florida and sulphur from Texas — manufacturing super-phosphates hydrochloric acid and sulphuric acid.

G. The standards of papers presented before the meetings were in deed very high. Besides papers presented by members, Technologist Experts from continental United States have also been invited to outline work and developments in their particular fields. This has the effect of diversifying subjects for discussion. We quote for example — Dr. A. S. Craft's paper on "Herbicides" and Dr. R. F. Phillips' paper on "recent developments in the work of sugar research foundation".

The observations of the agricultural side will no doubt be presented in due course by the agricultural members of the party.

Before closing I want to express my grateful appreciation to the Management of The West Indies Sugar Co. Ltd., for the opportunity given me in attending the Conference in Puerto Rico.