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EDITORIAL.

The present sugar crop has been affected by various factors recently, some of them adverse and some of them beneficial, so that although a record crop is not expected, we cannot be entirely disappointed.

Perhaps the most annoying of our troubles has been due to labour difficulties, for these are solely due to the imperfections of man, and are thus the harder to bear phlegmatically.

The drought last summer and again this spring has of course had the effect of reducing to a certain extent the tonnage of cane harvested, although the latter drought coupled with the exceptionally long cold weather this winter, has given us the best quality juices we have experienced for some years.

Shortage of fertilizers and cultivation equipment last year have of course also prevented our harvesting a record crop, especially as the effects of the drought referred to could have been greatly mitigated with suitable prior cultivation and manuring.

Looking however, to the present which is inevitably linked with the future, we can go forward with some confidence. The amount of sugar which we will be permitted to export from the next two crops has been recently stepped up, and it appears that fertilizers and tractors are already being released to help us reach our new goal. Happily, we already have commercial plantings of two good new varieties of cane which by extensive planting this spring, will help us and as well as this other better varieties will be coming forward, thanks to the industry of the Barbados Cane Breeding Station.

The visit of Mr. Turner at the beginning of the year has given a new impetus to *effective* drainage work on which we must concentrate, as suitable implements become available, for only under conditions of effective drainage can new varieties of cane really show their worth or fertilizers be of maximum benefit.

The corn micro-plot work of the Research Department has luckily progressed far enough for us to know not only what type of fertilizers to use on our soils, but also whether light, medium or heavy dressings will be economic to apply.

When we come to the factory side of the business, we have to welcome Mr. Davies who has come to Jamaica as Sugar Technologist on our Research Staff, and even in the short time he has been in the Island, he has been of the greatest assistance to our chemists and engineers.

We are encouraged to grow and sell more sugar in the next two years. We are beginning to obtain some of the implements and fertilizers to grow it. We have accumulated some of the knowledge to use the implements and fertilizers to best advantage. We have a Sugar Technologist of the highest repute to help us process the cane in the most efficient manner. If we apply all the resources at our command with energy and good will, we may even overcome some of the imperfections of man and progress from one record crop to another to the benefit of everyone serving our Industry.

THE SEVENTH ANNUAL CONFERENCE.

The Seventh Annual Conference of the Association was held at the Junior Centre Hall of the Institute of Jamaica, through the courtesy of the Board of Governors, on Saturday 11th December 1943.

There was a very good attendance, and after the business of the Annual General Meeting had been concluded, Mr. L. B. Whitaker, the newly elected President of the Association, took the chair, and asked Mr. J. B. Cuthill, the retiring President, to open the Annual General Conference by giving his Presidential address. Mr. Cuthill addressed the Meeting as follows:—

"Ladies and Gentlemen: A Presidential address usually takes the form of a survey of the work done during the past year, but it may be of more interest to you if I confine my observations to our recent visit to Trinidad and Barbados and to some notes on present activities and needs.

I presume that you will have an opportunity of seeing the Report on the Technologists' Conference in Trinidad as soon as it is published and I need not detail the subjects discussed. A high light on the field side however, was a paper by Mr. P. E. Turner on Tillage Methods in Trinidad. The results of some of his experiments were unexpected and the necessity for carrying out similar experiments in Jamaica is an urgent one.

This was the first year in which the Agricultural side was included and the interest displayed by the Engineers and Chemists in these discussions was notable. One Chemist expressed his regret that limitations of time made it necessary to have some of the Agricultural subjects discussed in parallel so that he and his colleagues did not have an opportunity to participate.

Next year it is proposed to hold the Conference in Barbados and I would recommend all those, particularly the Agriculturists, who are able to make the journey, to do so. An article recently appeared in the I.S.J. entitled "The Writing on the Wall" in which the author criticised the use of artificial fertilisers and mentioned Barbados as an example of the adverse effects of the system. All the evidence both of the statistics and of the cane fields themselves however, was very much to the contrary, and indeed Barbados is an excellent example of good husbandry which has followed the sound advice of an active Department of Agriculture and Research.

It has to be remembered that Barbados is almost entirely dependent on the Sugar Industry, and although it produces about 130,000 tons of sugar, it has an area of only 170 square miles or less than that of an average parish in Jamaica. Such conditions lend themselves to easy supervision, but a serious problem is the maintenance of the large population of 200,000, that is to say, 1200 per square mile against about 300 per square mile in Jamaica. In consequence, land has to be used for food crops that was formerly in fallow, and some 30% of arable land has to be used for this purpose each year.

We were shown the work done at the Cane Breeding Station which has been under the direction of Dr. McIntosh for the last 10 years or so. We had hoped that he would have given you at first hand some account of his interesting and valuable work, but unfortunately he will not be able to arrive until sometime in January.

Some of us have been a little impatient perhaps at the time lag between the production of new varieties and their distribution to the Industry, but it has to be remembered that some 20,000 new seedlings are produced per year and of these there may only be one or two that appear better than the previous best. The process of elimination is therefore long and laborious, and the final stages must be carried out in the various colonies themselves for obviously varieties which might fail in Barbados might do well in other soils and vice versa.

The fact that these few winners do appear from time to time is of the utmost importance to the Industry, and it is fairly evident that the economy of Barbados is substantially changing as a result of the introduction of new varieties, and particularly B 37161 which is especially suitable to their conditions.

We must be careful however, not to be misled by the publication of the striking results obtained elsewhere by this or that variety. The only criterion is the proven result by experimentation in our own particular soils, and this is especially so in Jamaica where conditions vary so widely from district to district and sometimes even from field to field.

Most of the West Indian Colonies have their own particular pests and diseases and although no survey has been made of these in our Island, the indications are that we are more fortunate than most in this respect. Mosaic disease however, is common to all Colonies and is probably more prevalent in Jamaica than elsewhere. In some parts of this Island it has caused such serious damage that, as you are aware, it has been necessary to grow immune varieties for a period so as to eliminate it. In other parts the cane is more tolerant either because the strain of mosaic is different or because ecological conditions reduce the effect. In these latter parts there is a danger that the growers may become complacent because losses from the disease do not appear to be serious.

As a result of experiments in Barbados it has been established that there is more than one strain of mosaic even in that Island where it is now rare, and there obviously may be many in Jamaica. It will be necessary therefore to set up in Jamaica what may be described as a Mosaic Clinic not only to ensure that we do not extend varieties which may be susceptible to the disease but so as to guide the Cane Breeding Station in Barbados as to the cane parents whose progeny appear more able to resist the disease.

In his address to the Technologists' Conference in Trinidad, Professor Hardy gave an interesting survey of the factors affecting the production of cane sugar. The remarkable feature was that of all the factors, the only ones outside the influence of the human element were the soil parent material and the climate, and even these are subject to some degree of selection.

He paid the Chemists and Engineers the compliment of grouping the whole of fabrication as one factor, thus letting them down more easily than they may have experienced, but the factors affecting the production of sucrose to the point of reaping of the cane were detailed and gave one an impression of the amount of investigational work that remains to be done in the field.

It is not customary at Meetings of Sugar Technologists to discuss economics, but it is necessary to keep in mind that the underlying object of all our efforts is to enable the Industry to keep its place in the economic set up of the Island. Like most other industries now-a-days, we subsist on subsidies and the amount of the subsidies should be such as will provide for a decent standard of living for the people engaged in the Industry. Having regard to the fact, however, that such subsidies must come from consumers and taxpayers, it behoves us to show that our operations are economic and efficient.

An important step in this direction has been the setting up of uniform accounts in the same manner as we have set up factory crop reports. It remains however, to provide means for making the best use of these accounts, and it is interesting to note that in Barbados a large proportion have their costs averaged and these averages are available to all for purposes of comparison. In Jamaica where conditions vary so widely, it would be necessary to classify results according to ecological or other conditions and factory costs would require to be classified according to equipment and size. The only comparisons available at present are those provided by one year's results against another within the same estate or factory. Without other sources of comparison some items of high costs are liable to be condoned through custom or usage.

With regard to factory reports, these have recently been subjected to a good deal of destructive criticism, and it is apparent that there is still great scope for investigational work in the factory. Nevertheless, the reports as they are now set up, do provide essential information, but they should be subjected to classification and an analysis which takes into account the capacity of each unit of plant, the speed of production and any other special conditions. This is already done in individual factories, but much of the value is lost unless comparative figures are available from other factories.

In conclusion it may be useful to set out some directions in which development of our work is immediately required.

I would place first and foremost the necessity for the fullest co-operation in observational and experimental work on new cane varieties. No cane-growing estate can afford to neglect this work for its future economy may be appreciably affected by its success or failure.

Secondly, as already indicated, we must have our Mosaic Clinic established.

Thirdly, we must use to the fullest extent whatever methods are available for the classification and mapping of soil types. This is necessary not only

for the selection of cane varieties, but also for the economic application of fertilisers as soon as these are again procurable.

Fourthly, in view of remarkable results elsewhere, more information is urgently required on the effects of tillage on the various soil types.

Fifthly, on the factory side we require a service for the classification and analysis of reports, and for the application of the results of investigational work to the operation of factories.

Lastly and by no means the least important, we require the analysis and comparison of estate and factory costs.

These are the more immediate requirements which are having the attention of the Committees and Boards concerned, but the list does not include the many minor developments in research which are also in train.

Taking a slightly longer view it would appear advisable to provide in Jamaica a station to develop new cane varieties from fuzz which would be supplied from the Cane Breeding Station in Barbados. The actual breeding would still take place in Barbados, but this provision might reduce considerably the time lag in the receival of new varieties.

I fear, Ladies and Gentlemen, these notes have been rather more lengthy than I had intended or than you had hoped, but I must add that although the year before us may be fraught with difficulties external to our particular studies, we must see to it that the work of this Association goes forward without interruption."

The Chairman then thanked Mr. Cuthill for his able and informative address which showed clearly the great amount of work that Mr. Cuthill had done, not only as President of the Association, but as Chairman of the Research Department. The Chairman then stated that the first subject for discussion at the Conference was "War Time Fertilizers with special reference to Dunder Disposal," and asked Mr. John Munro to open the discussion.

"DUNDER DISPOSAL."

John Munro, Manager, Bernard Lodge, (United Fruit Company)

The question of Dunder Disposal is one which has given very little cause for worry or consideration to the Sugar Factories in Jamaica until the recent order from the Board of Health prohibiting Dunder going into any stream, river or water course. In other Sugar and Alcohol-producing countries a great deal of research work has been going on during recent years in regard to this subject, and there has been a number of references to it in Technical literature.

There are three well known methods of treating the Distillery Wastes:—

(1) Chemical Treatment.
(2) Evaporation.
(3) Filtration.

(1) *CHEMICAL TREATMENT.*

In a paper delivered at a meeting of the American Chemical Society in New York in April, 1935 (printed in the Industrial and Engineering Chemistry 1935) by Hoover and Burr they said.

"A number of Investigators have proposed methods of treating Distillery wastes and because of the nature and content of such wastes, the possibilities of the recovery of by-products of value, appear promising. In addition to stock feeding, two such recovery methods appear to be advisable — evaporation process with or without incineration for the recovery of potash and anaerobic fermentation methods at ordinary or elevated temperatures with the recovery of combustible gases. The usual simpler processes of treatment have in general, been reported as unsuccessful in this country. However, most of these attempts have been made on the undiluted waste.

Chemical treatment of distillery wastes with the ordinary coagulates does not offer advantages commensurate with the expense involved. All tests made point to the conclusion that Chemical treatment of undiluted waste containing suspended matter requires 20—55 lbs. per 1000 gallons of the usual Chemical coagulates and produces after standing one hour a sludge occupying from 40 to 74% of the volume of the original waste. The sludge produced filters more readily than the original suspended matter but is not appreciably decreased in volume."

Two Chemists in Cuba have a Chemical Formula for the neutralization of dunder. Information of this has been given to the Directors of the Sugar Manufacturers' Association.

This process is to mix an equal quantity of dunder and water together and bring it to Boiling Point. The ingredient is then added and the mixture allowed to boil for a further 10 minutes after which the liquid may be run direct to Irrigation drain.

A laboratory test shows that the "sample analysed does not contain any substances detrimental to animals and is practically sterilized."

(2) *EVAPORATION.*

In early days efforts were made to concentrate the dunder in Evaporators and then burn it in a *Porion* Furnace the resulting ash being used as a fertilizer. There was much trouble with scale formation on the heating surfaces of the *Multiple* Effect Evaporators. One Installation in South Africa got sealed up so quickly that they had to stop using it.

A Chemical Engineer in Cuba informed me that he had seen a plant operating in Baltimore, U.S.A. where the dunder was evaporated in a large Pot Still, the residue being burnt and the resultant potash sold as fertilizer.

In another distillery he had visited in the States the dunder was passed through a centrifugal machine, the water drawn off was diluted 10 to 1 and run into the City Sewer. The heavy residue was mixed with Cotton Seed and sold as Cattle food.

In the October number of "Sugar" an article appeared on page 37 by E. B. Liete of Brazil describing the process of evaporation and burning the residue for fertilizer Recovery.

During September our Engineering Department in Boston took up the question of the removal of Solids from dunder by the use of Oliver Filters and then further reducing filter residue by dilution and intermittent Sand and Gravel filtration.

The report was as follows:— Mr. Thompson of the New York Office of the Oliver Filter Company states that Oliver Filters Inc. have carried on extensive experiments along this line for the last three or four years They have been unable to apply their filters for this purpose practically or economically. Still-bottom wastes quickly coat the filter surface with slime, which cannot be overcome without the use of prohibitive amounts of "Filter aid Materials."

Mr. Thompson recommended pond or intermittent filter-bed separation treatment which is employed by Distilleries where still-bottom waste disposal into streams is prohibited.

I met Mr. W. A. Powe the representative for the Oliver Filters for the West Indies and discussed this question with him. He showed me drawings for a flat type Oliver Filter 25 feet long which is being erected in a new distillery in Cuba fitted with scrapers underneath and on to the screen in an endeavour to remove the slime. The plant will not be in operation before January so that nothing can be said regarding it. However, Mr. Powe mentioned that the cost would be about $15,000 so that I dont think many of the Factories here would be interested even if the machinery were available at present.

At this point I would like to say that there may be some Estates in Jamaica where the soil is lacking in Potash then the Dunder could be applied with the Irrigation water, direct to the land. A chemical test of the soil would require to be made before this can be done to ascertain the amount of dunder per acre to be applied.

In the International Sugar Journal of July 1940 an article on the analysis of Mandya Distillery Slops by G. N. Nengar read as follows:—

"The Indian Royal Commission on Agriculture of 1928 observed that the Indian soils were mainly deficient in potash or combined nitrogen. With the advent of the Sugar Industry in India it was found that every acre of land in cane consumes about 150 lbs. of potash while it is recognized that nitrogen deficiency is one of the serious agricultural problems of the country.

It being consequently desirable wherever possible to replace the nutrient elements taken from the soil, it was of interest to consider to what extent soil exhaustion could be met by the utilization in this direction of distillery slops at present being run to waste. Analyses were therefore made on this material as produced at Mandya Distillery using Conventional methods, the following results were obtained.

Specific Gravity °C	....	1.032/26.5	1.035/26 1.03/27
Acidity (as Sulphuric) grams/litre	....	0.76	0.80 1.00
Potash grams %	.....	0.588	0.62 0.65
Phosphate grams %	.....	0.113	0.13 0.12
Nitrogen grams %	.....	1.01	0.12 1.05
Unformented Sugars grams %	.....	0.04	0.06 0.05
Ethyl Alcohol grams %	....	0.004	0.005 0.004
Residue in Evaporation grams %	.....	6.00	6.70 6.50

It can be easily seen that the Mandya Distillery slops can very well serve as a source of fertilizer for the Irwin Canal area. This Distillery produces about 24,000 gallons of slops in a day, hence the amounts of potash, phosphate and nitrogen available are 2,700 lbs., 523 lbs. and 4,617 lbs. respectively. The acidity of the wash does not matter if the soil is alkaline, which is the case in the Irwin Canal cane area.

Unfortunately this easy method of dunder disposal will affect very few of our Estates so that it is necessary to turn to the third method—Filtration —as being possibly the most practicable method for the solution of our trouble.

(3) *FILTRATION.*

On this subject many experiments have been made while numerous references appeared in the various Sugar and Engineering books. In the International Sugar Journal of June 1935 an article appeared on the "Biological Purification of Distillery Slops" by J. A. Cosculluela describing an ammoniacal fermentation and filtration plant which was installed at the Arechabala Distillery Cardenas, Cuba.

I met Dr. Cosculluela who is Professor of Sanitary Engineering at the Havana University and discussed fully with him the question of Dunder Disposal. He informed me that his experience showed that the Anaerobic fermentation with a filter was the most satisfactory process known both for results and economic operation. I showed him the plan I had prepared and he agreed in full with it. His only recommendation was that he thought the filter would operate better using charcoal as a filtrate rather than lime-stone alone. If charcoal was difficult or costly to obtain then he recommended a top layer of one foot thick of charcoal and the balance of lime-stone.

The details of this plant have already been circulated to the Factories but I will outline them roughly for discussion. Dunder from the Still is diluted with water at a ratio of 4 to 1 then run to a pond. There are 3 wooden rectangular boxes and a filter comprising the unit together with a pump. The liquid is pumped to the first tank where an airless fermentation is started. Fermentation may be started with sewerage or stable manure but better results may be obtained from Pig manure as it contains a higher percentage of ammonia. Fermentation will start after a period of 4 days. The dunder is then pumped at approximately the same rate per hour as discharged from the Factory. The liquid will flow from the first to the second tank and then to the third. The overflow from this goes to a gutter set over the distribution pipes to the Filter. Percolation takes place through the Filtering material. The water run off can be discharged into an Irrigation Canal or any river as it is perfectly clear of any organic matter which would be dangerous to fish, animal or human life.

I have here the drawing showing the arrangement of the plant which is proposed for Bernard Lodge.

At Bernard Lodge we use per 24 hours:

5 stills at 1,500 gallons wash each	7,500	gallons
16 stills at 1,390 gallons wash each	22,240	"
Total gallons wash	29,740	"
Less Rum made	1,600	"
Balance	28,140	"
Less 10% Dunder used for setting	2,810	"
Gallons Dunder to Pond	25,330	"
Dilute water ratio 4—1	101,320	"
Total Dilute Dunder to Pond	126,650	"

or 5,277 gallons per hour
or 31 cubic yards per hour.

Filter area 1 square yard = 1 cubic yard dilute with a capacity of 1½ hours.

Size of Filter = 46.5 sq. yds. or 418.5 square feet, say 10 feet wide x 42 feet long x 4 feet 6" deep inside measurements.

With regard to my visit to Cuba I visited many distilleries and breweries and was astonished to find that not one of them used any means either mechanically or chemically in connection with their Dunder disposal. In and around Havana all the Dunder is put into the sewerage main. This is pumped into the sea about 1½ to 2 miles out. Periodically there are complaints about fish being killed and also the bad odours which are blown back to the city. There was a small item about this in the Local paper during the time I was there.

All the other distilleries run their refuse into the sea or rivers. In one or two cases there are "sink holes" to which the dunder is sent. At Baguanos and Tacajo there are a series of ponds where the dunder is sent. It is hoped that seepage and evaporation will help to get rid of most of it but as the Engineer explained "when the last pond is full we simply take the pump and put it into the river." By this method they feel that they are doing something to cut down the amount of dunder sent to the river and this seems to satisfy the Sanitary Authorities.

In many cases I was asked that, should we obtain satisfactorily solution to our trouble in Jamaica we should send them all particulars and then added that they were quite willing to pay for the information if necessary, because everyone in the distillery business in Cuba feels that before very long the Medical and Sanitary Officials in that country will issue orders similar to those issued here by our Government Medical Department.

The question of by-products from the dunder will no doubt be taken up by our Chemical Section but for this Crop I expect that we will all be content if we can get rid of it to the satisfaction of the Government Medical Department in Jamaica.

The **President** thanked Mr. Munro for his very interesting paper, and declared that the paper was now open for discussion.

Mr. Floro also thanked Mr. Munro on behalf of the members of the Conference for the work he had undertaken in investigating methods in practice in Cuba for the treating of distillery wastes. He stated that the possibilities of recovering plant nutrients from dunder and surplus molasses had been closely examined, both the factors of economy and practicability having been carefully considered. While in the past when artificial fertilizers were inexpensive and easy to procure, this question had not been considered seriously, there was an incentive at the present time to find a method whereby the mineral contents of distillery slops could be used profitably as a fertilizer, especially in view of the high potash content of these slops. Use of distillery waste as fertilizer would also to a great extent overcome the problem of dunder disposal which had become a serious one since the proclaiming of Government Regulations to prevent the pollution of rivers. In general the recovery of plant nutrition from dunder could be accomplished in three ways:

1. The application of dunder direct to the soil through irrigation canals after neutralization.
2. Application of dunder to absorbent material for composting or application to the field.
3. Evaporation of dunder in triple or quadruple effect evaporators, the concentrated material being used in two different ways:—
   (a) admixture with absorbent material such as bagasse for composting or for direct application to fallowed fields. The suggested proportion of dunder to bagasse five parts of dunder (concentrated to 50% solids) to two parts of bagasse by weight.
   (b) incineration of the concentrated dunder in regenerative or porion ovens, the resulting ash of high potash content being used directly on the soil as a fertilizer. The incineration of dunder had, in some cases, been effected by injection direct into the combustion chambers of boilers, the resulting ash containing 30—40% of soluble potash.

All the above methods had distinct limitations. Method 1 could only be used on estates with irrigation systems. Method 2 would not be applicable to large distilleries where the amount of dunder was far in excess of the absorbent organic material available. Method 3, the evaporation of dunder,

required a plant for which a high capital outlay would be necessary, and which was estimated to cost between £250 to £300 per thousand gallons of dunder. In regard to filtration process outlined by Mr. Munro, it was possible that the sediment collected in the sedimentation tank could be used for composting with absorbent material.

In conclusion Mr. Floro stated that it would not be possible in Jamaica to generalize on the method required for dunder disposal, and that each factory had specific disposal problems which would have to be solved by methods especially suited to the conditions obtaining at each factory.

Mr. Barnes in referring to the possibility of injecting dunder direct into the boiler furnaces asked whether the acid fumes resulting from such a process would not have a destructive effect on metal in the furnaces. He stated that it was doubtful whether the expensive methods of factory waste disposal in use in other countries could be used in Jamaica. In regard to the evaporation of dunder, it had occurred to him that such evaporation could be effected by passing the dunder through a tower packed with hard limestone, evaporation being effected by means of a counter current of hot furnace gas. The use of hard limestone, apart from presenting a greater evaporation surface, would also result in neutralization of the dunder and the consequent removal of its corrosive properties. It might be possible that such a system would not only overcome disposal problems, but would also make available a form of fertilizer rich both in lime and potash which would be applied direct to the land. He asked that this suggestion should receive the comments of the industrial chemists present at the Conference.

Mr. Barnes also stated, in regard to the general question of dunder disposal, that he felt that the Sugar Industry, which was a very large employer of labour, had received inconsiderate treatment from Government, which was requesting that twenty-seven factories should incur considerable expense because the methods used at only a few factories were unsatisfactory.

The Conference had to regard dunder disposal not only as a nuisance to the community, but in its relation to the food requirements of the island, as its disposal into rivers and into the sea was said to be drastically reducing the fish population, and severely limiting fish breeding grounds in and around the Island.

Mr. Kerr-Jarrett asked whether it would not be possible for the rate of discharge of dunder into streams to be controlled in such a manner as to ensure adequate dilution in relation to the amount of water flowing in the streams.

Mr. Barnes stated that Mr. Kerr-Jarrett's proposal had been investigated at Frome and that by discharging dunder into the main factory drain, through which five thousand gallons of water flowed per minute, and then into the Cabaritta river, which also had a considerable flow, the dilution of dunder was so high that it was rendered innocuous.

Mr. Floro pointed out that while this was so during the period when the factory was operating, the possibility of damage during the dry season would have to be considered as the factory was then no longer in operation and no water flowed through the main factory drain with a consequent increase in dunder concentration.

It was also necessary to consider the possibility of damage occurring when a river mouth became dammed, causing the accumulation of dunder and leading to injury of fish due to the resulting increase in biological oxygen demand.

Mr. Meghoo stated that at Bybrook during the previous crop, dunder had been discharged in the Rio Cobre, and that water examined a few hundred yards down-stream from the point of entry of the dunder, showed no trace of dunder being present.

Mr. Innes stated that he had examined all the available literature on the disposal of dunder, and that there were probably no more than a dozen effective references. Most of the methods mentioned already have been outlined by Mr. Floro. Dunder could be used with a very definite advantage on certain soils in the Island, although these soils occurred over only a limited area. In particular, dunder could be used on the black soils derived from soft limestone occurring along the north coast of the Island, in particular at Rose Hall, Ironshore, Llandovery and Richmond, where analyses had shown that

these soils were extremely alkaline in nature, furthermore a large section of this area was already on the borderline of potash deficiency. The addition of dunder to these soils would reduce the pH to a reasonable level and at the same time would help in alleviating future potash deficiency. In regard to the probable effect of injecting dunder into high temperature furnaces it was doubtful that the acids in dunder would themselves lead to corrosion as they were of an organic nature and would be decomposed at the high temperatures occurring in furnaces. On the contrary it was even possible that dunder might counteract the corrosive effect of siliceous and bagasse ash in contact with iron at high temperatures by forming potash silicates.

Mr. Kirkwood pointed out that the destruction of fish was caused by de-oxygenation, and that such injury could be caused by disposal of distillery water into streams as well as dunder.

Mr. Springer confirmed this statement by quoting a case of the death of a large number of fish in British Guiana by the disposal of distilled water into irrigation channels.

Mr. Edwards stated that disposal of dunder into streams caused not only immediate damage by the destruction of fish in these streams, but that there was, apparently, a cumulative effect rendering a river permanently unsuitable for fish.

Mr. Kirkwood in reply to Mr. Edwards' statement, quoted an example of factory waste disposal into a stream in England which had caused the death of all fish in that stream, but that the stream had been re-stocked with fish which had multiplied rapidly, showing that the factory waste had had no cumulative effect. However, where streams contained weeds and grass on the banks and other vegetable material on the river beds, noxious matter could be retained, creating a higher biological oxygen demand. Such streams required cleaning periodically and when this was done no permanent effect could be said to have occurred.

Mr. Cuthill stated that at the combined meeting of the Chemical and Engineering Sections on the previous day, Dr. Thompson, the Fishery Adviser to the Comptroller had stated that dunder could seriously foul the bed of a river with detrimental effect to fish life, and once there had been destruction of fish in a particular stream by the discharge of dunder effluent over a period of years, fish would not return for breeding purposes. Dr. Thompson had also stated that river beds should be kept clean not only from the point of view of maintaining the Fishing Industry but also in order to prevent any objectionable features which might have a detrimental effect on the post-war tourist trade of Jamaica.

The Chairman asked Mr. McFarlane to inform the Conference as to the measures being taken in regard to dunder disposal at Caymanas.

Mr. McFarlane stated that investigations were still in progress in regard to the disposal problem, and he would be in a better position to give the information required when these investigations had been completed. He was anxious to know whether vegetation in a stream was affected by dunder.

Mr. Kirkwood in reply stated that in England disposal of factory wastes into streams caused fungi to grow on the vegetation in the stream and on the stream bed. It remained on the vegetation for some time after crop.

Mr. Henzell stated that dunder had no adverse effect on the vegetation in the Ferry River.

Mr. Smedmore mentioned the possibility of the injury to fish being caused by the dead yeast cells in dunder.

Mr. Innes stated that the most serious danger caused by dunder was the increased biological oxygen demand of the stream water and possibly the effects of acidity when the amount of water in receiving streams was small. This latter fact, however, could be discounted because of the higher buffer capacity of river water.

Mr. Croucher stated that public health standards in Britain were very high indeed and factories there have had to install elaborate equipment to deal effectively with effluents. Similar methods could be used in Jamaica but the problem to be faced was whether the Sugar Industry had sufficient capital at its disposal to install such expensive equipment.

Mr. Kirkwood stated that the problem would have to be faced in Jamaica as it had been in England, and the problem here, was one of finding the most inexpensive method of disposal.

The Chairman pointed out that it was extremely difficult to import equipment in war time and that the Sugar Manufacturers' Association should again be asked to take up the matter strongly with the Public Health Authorities to ascertain exactly the minimum requirements of the Law so that the Sugar Industry would not be committed to unnecessary expense.

Mr. Cuthill stated that he did not consider that such a course would be practicable as the Public Health Authorities themselves were not in a position to supply such information, and that the only reply that the Sugar Manufacturers' Association would receive, would be to the effect that the dunder should be so treated that no damage would result to fish in streams into which dunder was being discharged.

The Chairman stated that the Minutes of the discussion of dunder disposal would be further discussed by the Executive Committee of the Association, and asked Mr. Holme to give his views on the Economic Use of Fertilizers.

"THE ECONOMIC USE OF FERTILIZERS"

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Mention has been made of the use of Factory by-products as fertilizers for cane and coupled with cattle by-products there is little doubt that they could be a useful source of soil fertility in the absence of fertilizers. But in the case of by-products as in the case of the commercial fertilizers, it would be necessary, in order to get the maximum benefit from them, to know the relative deficiencies of the soils to be manured, so that manurial ingredients could be applied in such quantities that they would be of most benefit. This of course would imply the need for soil mapping in a detailed manner in order that the most economic application of fertilizers could be given to soils of varying nutrient deficiences.

Many ways have been tried throughout the world during the past decades to get reliable soil tests, which would indicate the economic doses of the various fertilizers, but from the fact that new methods are continually being sought it is evident that completely satisfactory methods have not yet been found. It is in order to continue this work of seeking a reliable method for testing soil deficiences, that the corn micro plot technique had been investigated in Jamaica. As has been reported before, corn micro plots are designed to test deficiences of nitrogen, phosphate and potash and are now being laid down regularly across the soils of estates at the rate of about one per acre, the results being recorded on maps of the estate. By shading each of three maps lighter or darker according to the degree of soil deficiency indicated, it is possible to find those fields which are relatively deficient in nitrogen, phosphate or potash compared with those in which the manures give little or no response in plant growth as shown by immature corn. Although immature corn may have a different *absolute* requirement of the chief fertilizers from cane, the *relative* deficiencies of different soils can still be found by the micro plot method, and in fact average increases from, for example, nitrogen, are often found to vary in different soils from a 20% increase to a 200% increase. It is perfectly reasonable to suppose that cane would show under those same soil conditions similarly varying responses, although the magnitude of the response would not necessarily be the same. The cane increase to be expected from any particular fertilizer, under conditions which produce any given corn increase, have not yet been established, but for the time being it is reasonable to apply the nitrogen, phosphate or potash fertilizers which were in such short supply, to the soils in which immature corn showed the biggest gain from those elements. This would also apply to the use of the by-products containing those elements.

In the mapping of soil deficiencies certain facts should be borne in mind. Mineral element deficiencies, that is, phosphate and potash deficiencies, appear to remain fairly constant from year to year, irrespective of ordinary cultivation. Nitrogen deficiency on the other hand appears to vary, within limits, according to surface tillage, for such tillage encourages the formation of available nitrogen at the expense of the soil organic matter. Thus ploughing and fallowing in preparation for planting reduces the amount of organic