Certain By-Products from the Sugar Industry.

Their Production and Use in South Africa.

By G. C. Dymond.

When one is confronted with the mass of available references on the By-products of the Sugar Industry, the problem of writing a paper, which shall be short, lucid and a useful basis for discussion, is no easy one. The object of such a paper should be an endeavour to utilise the latest available information, both technical and statistical and apply it to the Sugar Industry of South Africa. Modern scientific technique demands the maximum possible yields, together with the utilization of all by-products. The realisation of these demands has been stimulated not only by their possibilities as commercial propositions, but also by the restrictions laid down by law in many countries prohibiting the indiscriminate disposal of certain waste products as a menace to public health. It is on record that certain firms have been paid to take the molasses away from factories. There are indeed many factors which have created the wide-spread interest in the utilization of molasses, and the products to be obtained therefrom. Chief among all such products alcohol must rank first. The utilization of industrial alcohol in America has within recent years been stimulated by two widely divergent factors—prohibition and the acknowledged inability of the oilfields to supply the ever increasing demand for motor fuel for more than ten years. Meiggs, the chief chemist of the Massachusetts Oil Refining Co., states that the oil fields of the United States will be exhausted by 1935. In 1922, 5,346,953,774 gallons of crude petroleum were imported into the States.

Alcohol and Motor Fuels:

In this paper even a summary of the technique involved in the production of alcohol will not be attempted. All such information can be obtained from the numerous papers, pamphlets and text-books published in recent years. Instead, a short summary is given of the amount available from molasses in South Africa, the advantages and disadvantages of alcohol motor fuels, and the lines on which research work is necessary. An endeavour was made to determine the actual quantity of available raw materials from the Industry without complete success, owing to the absence of figures from all the mills. In order, therefore, to arrive at a basic figure from which to work, averages were calculated from the available data, and the percentages obtained applied to a crop of 2,500,000 tons of cane. In the case of molasses, very few figures are available, and the average yield in this case is assumed to be 5.5 gallons per ton of cane. At this rate we have a yearly quantity of 13,750,000 gallons or 89,375 tons of molasses available, assuming the above crop figure to be a constant. Now, according to Dr. Arnstein 100 gallons of molasses will yield 40 gallons of motor fuel, so that there are 5,500,000 gallons of motor fuel available from molasses in this country. Of recent years a considerable amount of research work has been carried out on the use of Alcohol as a motor fuel, and it is of interest to note the advantages and disadvantages recorded by Freeland and Harry and more voluminously by Dr Arnstein.

Advantages:

1. The raw material is inexhaustible owing to its vegetative origin.
2. The fuel is less heavily rated by insurance owing to the fact that fires may be readily extinguished by water.
3. In petrol engines it develops 10 to 20% more power and gives a greater thermal efficiency than petrol.
4. The temperature of combustion is lower, thereby causing a cooler engine, less cooling water, and less lubrication.
5. More uniform pressure during combustion, thereby causing less vibration, absence of knocking, and smoother operating.
6. Less or total absence of carbon deposit in the cylinder as compared with petrol.
7. Higher compression may be used than with petrol. The best compression for gasoline is about 70 lbs. per square inch and with alcohol 180 lbs. per square inch.

Disadvantages:

1. In cold countries, difficulty is experienced in starting a cold engine owing to its low volatility. This difficulty is not experienced in tropical countries. It is claimed that Natalite or a mixture of alcohol with 20% Benzine overcomes this difficulty.
2. An explosive mixture of alcohol and air is formed in a different ratio to that of petrol and air. In the first case the ratio is approximately 10.5 parts of air to 1 of alcohol and in the latter approximately 19 parts air to 1 of gasoline by weight when under the same compression.

3. Owing to the narrower limits of the explosive mixture of alcohol and air the engine has a much lower speed flexibility.
4. Loss of ether from fuels by volatilization.

The Bureau of Standards tested and reported very favourably on a fuel composed as follows:—Alcohol 33; gasoline 35; benzol 25; ether 7. Dr. Arnstein gives the composition of Natalite as:—

Alcohol (95%)	54	—	60%
Ether	45.8	—	39%
Pyridin or Ammonia	.15	—	.1%
Arsenious Acid	.5%	—	

Freeland points out that the production of motor fuel is in its infancy and that the principal research problems which have still to be solved are:—

1. Use of different raw materials for alcohol manufacture, Ormandy estimates that 5% of the American grain crop would yield sufficient motor fuel to replace the whole of the petrol consumption in America.
2. More efficient methods of fermentation and distillation, thereby lessening the cost of production.
3. Methods of producing Absolute Alcohol. The production of absolute alcohol would lessen many of the difficulties experienced since absolute alcohol will mix with many substances where 95% alcohol will not.
4. *Means of Stabilising Ether*: The amount of ether present gradually decreases through evaporation owing to its high volatility, while autoxidation of ether takes place forming ethyl peroxide, aldehydes and acetic acid.
5. *Composition of Fuel*: Type of fuel produced at present does not give maximum efficiency and better mixtures should be developed.
6. *Denaturants*: The cost of denaturing alcohol is very high and frequently not suitable. A cheap and efficient denaturant is essential.
7. Cause of occasional corrosion and methods of prevention.
8. Adaptation of fuel to existing engines and development of a new type of engine.
9. Regulations regarding manufacture of industrial alcohol whereby the manufactures of beverage and industrial alcohol are put on a different basis.
10. *Marketing*: Means of establishing and maintaining a market for motor fuel should be studied.
11. Regulation of quality of product marketed.

Although the alcohol motor fuel industry is not as yet firmly established, fuel mixtures of alcohol, benzine, etc., are on the market in America. Dr. Arnstein states that a by-product plant is being erected in one of the richest oil districts in America with an estimated production of 10,000 gallons of motor fuel per day. It is important that our South African Industry should keep in touch with the world's advance in the use of motor fuels and recognise that the day is not so far distant when the price of gasoline will soar with its diminishing supply, and before such a state of affairs is reached there is no reason why we should not be in a position to have sufficient available motor fuel in South Africa to supply our own needs.

Carbonic Acid Gas:

On reading through the recent works on the utilisation of carbon dioxide, one is struck by the possibilities attached to what is described as one of the most profitable, but most neglected by-products available from molasses.

One hundred gallons of molasses is capable of yielding 300lbs. carbon dioxide gas so that there are no less than 41,250,000 lbs. of pure gas available in South Africa.

According to Dr. Arnstein liquid carbon dioxide costs less than one cent per lb. to produce and sells for 10-13 cents per lb. This figure, however, is considerably higher than the values recorded for liquid carbon dioxide entering the Union, the amounts and values being as follows:—

Year.	*lbs.*	*Value.*
1922	—	£1,050
1923	—	£1,283
1924	—	£1,274
1925	220,058	£1,265
1926 (10 months)	199,122	£1,293

Taking the 1925 figure the value works out at only 1.25d. per lb.

The uses to which this important article is being put in America are numerous and varied. Recent production figures are not available, but according to experts the increased use of carbon dioxide in America amounts to 1 lb. per day to every 300 inhabitants.

It is used principally for carbonating beverages, refrigerating, fertilizing purposes, conserving and preserving of fruits, etc. The California Grape Growers used to ship their fruit to the East by express trains, their produce being refrigerated during transit at great expense. To-day the fruit is merely gassed with carbon dioxide and shipped through the Panama Canal and it arrives in perfect condition at much lower cost. In view of the value of our own fruit industry the utilization of carbon dioxide gas as a preservative is well worth closer study.

A further development in the use of carbon dioxide gas in the clarification of cane juices yielding results comparable with Carbonatation at much lower cost have been worked out by the author, but the results are not as yet available for publication.

The production of this gas is coincident with the fermentation of molasses and if its use could be assured, a further step in the production of a cheaper motor fuel is assured.

Yeast:

The possible by-products obtainable from molasses seem never ending, and the development of the yeast phenomenal. There are two kinds of Yeast: one is used in the manufacture of bread and in fermentation practice, while the other is used as protein, fodder for cattle, and also for human consumption. You are all familiar with what can be done with Vitae Yeast Tablets, if not, a glance at the thyroid gland-like effect which they produce may be seen in almost any periodical. The yeast industry is essentially a new one. In America, twenty yeast factories are in operation, while in Germany in 1914 there were 502. There are now 525, one of which is capable of producing 418,000 lbs. of compressed yeast every day, and yet the available factories are unable to supply the demand. Thirty-three years ago the first pound of compressed yeast was sold, while the sales of the largest yeast manufacturer in America amounted in 1923, to over $41,000,000.

Five million tons of nitrogenous foodstuffs were imported into Germany before the War. In order to meet this deficiency special yeasts have been cultivated whereby the yield of alcohol on fermentation is considerably reduced with a consequent increased production of yeast. It is stated that Germany will shortly import no nitrogenous fodder at all as the result of her research in this direction. One hundred gallons of molasses may be made to produce 50 lbs. of fodder yeast or 400 lbs. of Bakers' Yeast. Therefore, there are available in South Africa 6,875,000 lbs. of nitrogenous cattle feed or 55,000,000 lbs. of Bakers' Yeast. This use of fodder yeast should be of considerable interest in South Africa. Voeltz obtained surprisingly good results in his feeding experiments with animals. Half of the seed feed for horses was replaced by yeast at considerable saving. With cows fed on yeast it was found that the yeast supplies all the necessary basic materials necessary for the formation of milk, or the development of the young, while cows gave more milk and were free from all infectious diseases as compared with animals fed on a normal diet. To this in fact is due the phenomenal growth of the Yeast Industry. As an article of human food it has been proved to possess highly nutritive properties while claims are made of its successful use in many ailments. Apart from its food value it is used in the preparation of cosmetics and in the manufacture of steel rope and a non-inflammable celluloid substance known as Ernolite.

DUNDER AND WASTE WATERS:

The disposal of these products has in some countries led to litigation. The subject has been a recurrent one in this country for a number of years, while this year the subject apparently is again approaching perihelion. The disposal of dunder or distillery slop is a problem which has been successfully accomplished in other countries where the question of its disposal became acute. The dunder from grain distilleries is very different from that obtained from molasses; the former is an excellent and high-priced cattle food, whereas the latter, owing to its high saline content and indigestible protein is unsuitable as such. Instead, it is burnt in a so-called Porion Oven and the valuable potash which it contains is recovered. In 1911 Germany produced 27,000 tons of charred dunder containing 15,000 tons of potash. In practice 100 lbs. of molasses will yield 4 to 4½ lbs. of charred material containing: Carbonate, Chloride and Sulphate of Potash 61.6% to 78.5%

The open flame ovens which are now in use work very satisfactorily, and apart from the fuel required for heating up the oven, require practically no artificial fuel whatever. The following extract from an article written by Dr. Arnstein describes the practice employed:—

> "The ovens consist of a series of narrow, long chambers, built of fire-proof clay and are placed alongside each other in the oven. The first chamber is the one nearest to the chimney, while at the opposite end of the oven is a small furnace in which at the beginning of the operation, a wood or coal fire is started. The first chamber is filled with slop and the fumes from the burning wood or coal passing over the surface of the slop, heat and cause part of the water to be evaporated. This partially concentrated slop is then conducted to the second and third chambers and the first chamber is filled with fresh slop again. After the major part of the water is evaporated the the temperature of the concentrated slop will increase as it always comes nearer to the burning furnace, untily finally it reaches the point where it will ignite itself. From this moment on, there is no need of any artificial firing, since the organic matter present in the concentrated slop contains more than sufficient units to evaporate the water from the slop in the preceding chambers. Therefore, the oven is continuous in operation, and can be kept up indefinitely without fuel, providing the operation is continuous and not intermittent."

While this method is very profitable, it is nevertheless very wasteful. Ehrlich calculates the loss to be, in Germany 15,000 tons of additional potash and 5,000 tons of sodium cyanate apart from numerous other substances.

A more scientific method of utilizing the dunder has been worked out by Burde and Reichard, and is in actual use in two places in Germany.

The slop is concentrated to 42°Be. and is then subjected to dry distillation in gas heated retorts. The gases emanating pass through chambers where the dust and tarry products precipitate. The fumes are now superheated in towers to 1000°C and then dropped to 600°C. The gas emanating from the dunder contains ammonia, methyl alcohol and trimethylamine, also hydrocarbons, carbon dioxide, carbon monoxide, and hydrogen, and through the high temperature subsequently used, the amines are decomposed to hydrocyanic acid. The gases coming from the superheater contain approximately 10% by volume of hydrocyanic acid and 5-6% of ammonia. The latter is then absorbed by sulphuric acid and the former subsequently by caustic soda. The original, but now charred dunder in the retorts is allowed to slowly burn itself out.

Foth calculates that Europe loses 16,000,000 kilograms of nitrogen which would produce 80,000 tons of ammonium sulphate annually. The Bureau of Soils, U.S.A., states that, utilising all the cane molasses produced in the America's' 140,000 tons of potash would be recovered from the 350,000,000 gallons of molasses available. Based on these figures, therefore, we have 1,500 tons of potash available from our Molasses annually.

Apart from specialised dunder, which is specifically distillery slop, we have refinery waste-waters which are frequently very dilute molasses, wash waters, circulating waters and condensed waters.

Dr. Park Ross defines dunder as an effluent composed mainly of filter press washings, floor washings and waste waters generally, not including condensed water. In order to avoid confusion of thought with distillery slops, the above will be referred to as effluents and circulating waters. It will be noticed that circulating waters are not specifically included. These waters, however, more especially from those mills which produce white sugars, contain appreciable quantities of sulphur apart from traces of sugar, and it is usually the presence of sulphur which leads to the noxious smells complained of. The sulphur cycle is one of great importance in the economy of nature. The sulphur bacteria of which Beggiatoa alba is the most common form, absorb the H_2S produced by fission fungi from sulphate, store up sulphur in their cells, and eventually oxidise it to sulphuric acid, which is then re-converted into sulphates by certain compounds in the soil. It is, in fact, the putrefaction of organic sulphur compounds which is responsible for the evil odour arising from combined effluents, that is, effluents and circulating waters. It is noticeable that where such waters have access to vegetation, such as marshes or vleis, the noxious odours are most noticeable. The treatment of effluents in Europe has long received adequate attention owing to the laws enforcing the purification of such waters. The lines on which such purification has been carried out is said to have attained three objects:—

(a) Prevention of conditions dangerous to health.
(b) Production of a valuable fertilizer.
(c) Recovery of the water.

It is noticeable that the waste waters in Beet Sugar Factories are not treated as a whole, but separately; thus the water used for washing the beets, the waters from the Bone-black treatment and filter presses, and the circulating water require different treatment.

The first requirement in attempting a solution of our own problem is the splitting up of the effluents in a like manner.

1. Dunder or Distillery Slop.
2. Wash Waters generally.
3. Circulating Waters.

The first has been dealt with.

The second presents the greatest difficulty, as the impurities, apart from being very considerable, are varied in character.

In Europe, the only method found suitable is filtration through turf cake and subsequent total purification by the addition of acid magnesium phosphate with a basic iron salt. The reverse is also practised, the precipitated matter being first settled out in special tanks, and the overflow filtered through turf cake. It is said that the value of the fertilizer obtained covers all expenses.

CIRCULATING WATER:

A method of purification is to allow a continuous stream of milk of lime to enter the running water as it enters the reservoirs. The method is effective provided sufficient lime is used, but the quantity necessary is large, and the process is therefore expensive.

Several modifications of this method present themselves. In place of pure lime, the cheaper grades made from dolomite, containing high precentages of magnesia, might be used, or the lime might be mixed with clay which forms, in such waters, a good precipitating medium. Whichever method is employed, the water should pass through settling tanks from which the sludge can be removed at desired intervals.

The foregoing does not present any new features on this vexatious problem, but it is hoped that it may provide a starting point for an extensive discussion.

PRESS CAKE:

The tons of press cake produced during 1925 and 1926 are as follows:—

Year.	*No. of Factories.*	*Tons of Press Cake.*	*Per cent. on Cane.*
1925	9	73,655	5.75
1926	11	78,152	5.10

These figures include carbonatation press cake so that the amounts of Defecation Press Cake are:-

Year.	*No. of Factories.*	*Tons of Press Cake.*	*Per Cent. on Cane.*
1925	8	50,198	4.75
1926	10	53,926	4.03

The average Defecation Press Cake for two years is 4.39% of weight of cane. The amount available from 2,500,000 tons of cane is therefore 109,750 tons, containing say 65,850 tons of dry substance. From analysis done some years ago, the composition of our dried press cake was found to be:—

Nitrogen	1.06%
Tricalcic Ortho-phosphate . .	3.13%
Total Organic Matter	63.3 %

This means that there are 698 tons of nitrogen, 2,061 tons of phosphates, and 41,683 tons of potential humus available from our press cake, and yet many planters will not take it at 9d. a ton, that is, the cost of loading.

Results of manurial experiments and opinions, are to be found in the text-books. It appears to be very suitable for light sandy soils and is usually applied at the rate of 6 to 8 tons per acre. Owing to its high wax content it takes some time to disintegrate into a condition whereby its constituents may be absorbed by the growing plant, and it is possible that the absence of quick results from its use has engendered an apathy towards its popularity.

An important constituent of Press Cake is Cane Wax and it is hoped that this will be dealt with in another paper.

Waste Waters.

By L. Blacklock.

The question of the disposal of residual waters and waste effluent from sugar factories has for many years been worrying managers and officials on the Natal coast. These waters contain enough organic matter and sugar decomposition products to render them liable to fermentation and putrefaction, with the inevitable production of gases and odours which are unpleasant—even if not actually harmful. The universal method is to run this drainage into the nearest stream and hope for the best. When this stream flows through occupied farm lands between the mill and the sea—there arise complaints from the farmers regarding pollution of the source of drinking water for their stock, etc. Where the river flows slowly, and the volume of water is not large, stagnant and stinking pools are formed which infect the neighbourhood and are a menace to grazing cattle—to say nothing of providing ideal breeding places for the mosquito. It becomes necessary, therefore, that each factory should take steps to render its effluent innocuous before discharging to the adjacent land or river, and what these steps should be is largely an individual question for the mill concerned, on account of the varying composition of the waters. Health Boards and Fisheries officials have from time to time made reference to the pollution of the local atmosphere and the water of Durban Bay by the discharge of refuse waters from the sugar refineries. Only about 3 weeks ago an article appeared in the local paper drawing attention to the scarcity of fish in the Bay and pointing out that this state of things was undoubtedly due to the poisonous influence of the effluent from the sugar refineries at the head of the Bay. As a matter of fact I do not believe that any serious pollution of either atmosphere or Bay waters can be laid at the door of the Refinery. Our refuse water at present amounts to something in the region of 500/600,000 gallons per day—say 2,500 tons by weight. This consists mainly of animal charcoal washings together with the waste from the paper pulp washing apparatus. This water is very slightly acid having a pH value ranging from 5.4 to 6.0 and carries solids approximately as follows:—

In suspension	90.3	grains per gallon.
In solution	67.9	grains per gallon.
Total solids	158.2	grains per gallon.

Out of this total there is organic matter:

In suspension	58.8	grains per gallon.
In solution	35.0	grains per gallon.
Total organic matter	93.8	grains per gallons.

Total inorganic material 64.4 grains per gallon.

Taking the volume of effluent at 500,000 gallons per day this means that 6,700 lbs. of organic matter are sent down daily. Of this 700 lbs. represents wastage in the form of finely divided paper pulp. This material is non-settling, unfermentable and practically inert and harmless. Disregarding this, therefore, the daily discharge for the Refinery consists of 3 tons of matter which under favourable circumstances could possibly decompose and become objectionable. Our present methods of dealing with the water are such that these favourable conditions cannot obtain. It is conducted from the Refinery by pipe and enclosed wooden flume to a discharge point in the swamp at the head of the Bay. From this point a canal 2 to 3 ft. wide connects with the tidal water of the Bay direct. The rapid flow in the Canal, 200/300 ft. per minute, prevents any sedimentation occurring and practically the whole of the matter is discharged into the Bay where it is dissipated and lost in the infinitely greater volume of salt water.

However, if the law or the local Health Board do not agree to these methods of disposal, it becomes necessary that suitable treatment of the waste water be undertaken and this, having regard to the volume to be dealt with will become an expensive matter and an item in the cost of production at the Refinery. Having regard to these possibilities a few experiments have been tried in chemical treatment. A very simple treatment was found to be fairly successful in the case of our effluent. This consisted in the addition of slaked lime in the proportion of about 14 grains to the gallon followed by agitation and mixing. This has the effect of forming a flocky precipitate of hydrates and phosphates which settles in 15 minutes and takes down with it all the suspended matter leaving a clear bright supernatant water containing only 55 grains to the gallon of dissolved solids. 28 grains of this are organic but the water after standing for a week is odourless and shows no signs of decomposition. In the case of a treatment of this sort the mud settlings would have to be dealt with, of course. This would amount to over 3 tons per day in our case and if dried and bagged may bring some small revenue as fertilizer. Other mills may find that some simple precipitation treatment of this sort would suffice—or a solution to the difficulty might be found in the installation of septic tanks followed by aeration French drains. The mill chemist will probably be able to decide which line of treatment is best in his particular case after making experiments on the spot.

Blanchard's precipitant is used on char washings in France. This is a mixture of $MgSO_4$, $Ca_3(PO_4)_2$, $FePO_4$. used in conjunction with milk of lime as a precipitant. Any nitrogen is fixed as ammonium magnesium phosphate and the mud settlings are valuable fertilizer. Dr. Koller says in this connection that with regard to the complete disinfection of these char washings, etc. only the compound of acid magnesium phosphate with basic iron salt—the double salt of magnesia and iron already recommended by Blanchard and Chateau—has been found satisfactory. The fact that we have in our effluent small proportions of these or very similar chemical compounds probably accounts for the measure of success attained by the simple lime treatment indicated.

Dr. Park Ross said he had to thank the Association for having given him an invitation and an opportunity to attend this very interesting conference. He must say he was somewhat appalled by it. He thought the Technologists' Association was a small body that sat round a table and discussed various things but here he found present a very representative and large gathering of the sugar manufacturing industry. He understood that the reason why he was asked to be present, was mainly because he had felt it necessary to put a certain amount of pressure on one or two factories in connection with the disposal of waste water, and from Mr. Dymond's paper and the other paper that had just been read, one gathered that at least the Industry had gone a certain length by way of inquiring as to whether there were satisfactory ways of dealing wtih these waters.

Now the first paper—Mr. Dymond's paper—went through a tremendous amount of material; far too much for him to attempt to discuss, anyway, and he did not intend to do so. He would stick to the last part, dealing with the disposal of dunder. There was, however, a mention of yeast. Well, he was going to give them his experience with regard to the handling of yeast in the disposal of distillery effluent; but he noticed there Mr. Dymond has dissertated somewhat on the increasing production of yeast in the Union. While he agreed with him the Vita-Yeast tablets were very valuable—in fact, he was going to start taking yeast himself soon—he might say, however, that the increasing use of yeast in the Union should not mislead one too much in the direction of establishing a large industry.

Its use was certainly rapidly increasing; most of it manufactured in Durban, he understood, proceeded to the Rand and was manufactured into "skokiaan" which, of course, also meant the consumption of sugar; but it had arrived at such a proportion now that they would have to do something with it; they would have to control the sale of yeast. So they must not look out too much for an outlet for their yeast.

Let them now come to the dunder waters. The paper referred mainly to the position at the head of Durban Bay, and he would like to qualify the opinion advanced and then get on to more important business. There was a most damnable smell at South Coast Junction. That smell was mostly noticeable when a hot sun followed a heavy rain. As for the fact that the Bay had never been polluted, well, he must differ, because he had noted the pollution quite strong right down opposite the Esplanade. That was after very heavy rains. Of course, he thought they would agree that the Bay pollution was not a constant matter; it was mainly due to washout from South Coast Junction flats. All the various material that happened to be deposited on those flats got washed out of the sump holes which certain industries had put down with the idea of solving the problem! The Distillery was the chief offender at South Coast Junction. He knew that would be very comforting to the sugar industry; but he was coming to their part of it. Of course everyone said his neighbour was making the smell. The Distillery people were honest enough to admit they were guilty of part of the smell. His argument was, "let us first put your (the Distillery) smell in order, and then we will be able to deal with the other smell." Accordingly the Health Department had certain experiments made by the Distillery and these experiments at the Distillery were mainly directed to precipitation methods with lime. He found that at the distillery the pollution was of two kinds; first, it was due to "Vat Lees' a colloidal mass of yeast cells, and secondly, to still effluent. He objected to the term "slops," in Scotland they called it burnt ale. Vat lees was a most difficult thing to handle. As to burnt ale, if they could put into their stills a wash which had got comparatively few or no yeast cells in it, they would of course diminish the amount of solid matter that was left to go out either in solution or suspension from the stills. They found that the best plan was to precipitate the vat lees, for yeast cells, in bulk, cannot be pumped to the stills. When they got towards the bottom of the fermenting tanks, the trouble began, and they came to a certain period when they could not help pumping out a pretty solid mass of yeast cells into their pipe. He had a paper with him which was a summary of the process used. He did not intend to read it. He was quite willing to hand it over to the technologists to make what they liked out of it.

(Here Dr. Park Ross briefly described the process involved, which ultimately resulted in a fairly good manure being obtained containing a fairly large proportion of lime. It was not exactly a dry powder, but that was because it was made in a crude way over coke beds and with the assistance of the sun; still it was a manure that one could spread).

Continuing, the Doctor stated that at the present time, so far as he knew, there was no market for it. It was not like filter press cake, however; it could be spread or rather scattered. He did not expect to make a profit on it; nor did he expect engineers to make a profit on dunder refuse. Engineers were not the only over-sanguine people.

There were a lot of enterprising individuals in his own profession who tried to make a profit out of sewerage farms. He thought if the industry was able to sell the product at the cost of the materials that were put into it, that was about as much as they could expect; and, in view of the nuisance caused by those things, they as a Health Department, thought it was up to the Industry, if it could be done at all, to tackle the problem, even if at a loss.

He did not propose to go any further into the question as regards distilleries, because, after all, the liquid from the stills had no solid matter in it, practically; it was a very light substance; that gave them matter which was going to be fairly easily treated over the soil when dealing with dunder. He noticed that Mr. Dymond did not like his definition of dunder; but they were all at one over the matter. They knew what they had to do. As long as they could get down to a liquid which had got no solid matter and a comparatively small amount of substance in suspension, he thought it was possible to deal easily with it, for most of them had got sufficient land near their mills to do so; but it was when they started with a whole mass of muddy matter in suspension and clogged the soil, that the smell troubles began.

Regarding some of the mills—he would take dunder first—he saw that Mr. Dymond maintained it was the stuff from the pan waters which produced the most smell. He was not going to quarrel with him on that. Most of them had had more experience of the smell than he (the Doctor) had—and they were welcome to it. (Laughter). But his opinion was that what seemed to give the most trouble at the mill was the filter press washings. The filter cake they could handle fairly easily; it was the filter press and floor washings, which caused the trouble. He merely mentioned the lime precipitation method. There might be other precipitants. His own opinion was that it would be advisable, if they could, to get a precipitant to bring down the sludgy matter with those washings and see what sort of a resultant liquor they could get. He was not going to promise that the Health Department were going to allow the resultant liquor to get into streams. They could not promise anything until they saw what the Industry was going to do. At the same time, he personally did not mind their condenser water getting into the streams or a few fish being killed by heat near the mill; but when they got pollution and destruction for miles, it was hardly playing the game. If their committee could evolve some method of purifying, especially those filter press washings, he would have a very open mind on the disposal of the resultant effluent flowing —not necessarily into the streams, but he could not sanction solid or fermentable matter getting into streams. They must get out that material which was going to ferment; that was the main thing. If they thought the distillery process mentioned by him would be of any use to them, he would like to hear their views. He had written to Messrs. Huletts first about this pollution. He thought on the whole Messrs Huletts were responsible for the greatest amount of pollution. Mr. Warner would bear him out that the smell at the Amatikulu Mill was appalling. He wanted to point out that as a Health Department official he did not come to the Technologists' Committee of the Sugar Association to tell it how to solve the proglem; the Health Department dealt with the sugar mill itself. He had to say to the sugar mills "this pollution canot go on any longer, and it is for you to find a way of getting rid of it. Any help we can give will be given, but primarily it is a question for the sugar mills."

The Chairman thought that after what Dr. Park Ross had just said, it would be better to have the two papers read and have the whole subject discussed as one. There were different methods of precipitation, and so on.

The Chairman's suggestion was agreed to, whereupon he called on Mr. Blewett to read his paper on "THE USE OF BY-PRODUCTS OF THE SUGAR INDUSTRY AS FERTILIZERS."

Mr. Blewett prefaced his paper by saying he felt he should perhaps apologise because after the very interesting and somewhat controversial remarks of Dr. Park Ross, it looked as if they ought to spend most of their time on waste waters and dunder liquors. His, (the speaker's) object was to deal with waste organic materials from the mills and cane lands as fertilisers, although incidentally he dealt with the question of the disposal of dunder. He ought to say too he was afraid that most of the facts and figures he had got there had been already presented to them before in other forms, but he thought the collection of them in handy form would be of some use