HABITATION WASTES AND COMPOSTING IN THE SUGAR BELT.

By G. C. DYMOND.

You may at first wonder what the subject of habitation waste disposal has to do with our Association. I have recently had the privilege of seeing a little of the work being done in this connection, by a few of the townships in the Union, and of discussing the subject with Government extension officers. After that experience, I felt that here is a matter of importance to the Natal Sugar Industry and its townships, both from a health and from an agricultural point of view.

There are to-day 15 townships in the Union actually producing compost from wastes, and there are another 13 under construction. One town, which has been in production for more than a year, has kindly supplied me with the following data. There are others yielding better quality compost at less cost, but at the time of writing the detailed data was not available. The population of this town consists of 3,000 Europeans and 1,086 Natives. The quantity of compost made during the first year was 900 tons. This was obtained from the following materials :—

Nightsoil	approximately 500 gallons daily.
Domestic refuse	3 tons daily.
Extra grass added	6 Scotch carts daily.

In addition, all the blood and condemned offal from the abattoir, together with a large amount of coal ash, are used.

The completed compost (3 per cent. moisture) is bagged and sold at 2s. per bag. The analysis of the material is as follows :—

Moisture...	3.06 per cent.
Total organic matter	30.21 per cent.
Nitrogen...	0.78 per cent.
Total P_2O_5	1.49 per cent.
Lime	4.50 per cent.
Potash	0.11 per cent.

At Ficksburg, experiments and improvements in technique are being carried out by the Government under the enthusiastic direction of J. P. J. van Vuuren. The analysis of the compost produced here is as follows :—

	Average.	Maximum.
Moisture	7.46	14.43 per cent.
Total organic matter	46.95	52.31 per cent.
Nitrogen	1.54	1.74 per cent.
Total P_2O_5	1.00	1.41 per cent.
Potash	1.33	3.19 pr cent.e

I do not propose in this article to discuss the actual practice and technique of waste disposal, except in one respect—its mechanization. At one town the staff consists of one European and 14 Natives, at a probable wage bill of about £900. As this is the price realised for the product, there is no profit. At Ficksburg the comparative capital cost was £400 and the quality, though less in weight, is better.

Now, the principal cost and difficulty in compost-making of any kind lies, first, in the construction of the heaps or piles; secondly, in the turning; and, lastly, in the final stacking for disposal. In England, large quantities of materials are being composted, the pits holding charges of from 1,200 to 2,000 tons of material. No description is, however, given as to whether the bulk is man-handled, or dealt with mechanically. It appears to me, therefore, that if large schemes are likely to come into practice, this aspect of the subject should be considered.

I have in mind two possibilities. The first, some simple adaptation of the gantry and grab common in sugar mills for off-loading cane, and, secondly, the possible use of the mechanical arm.

With regard to aeration, I think that experiments should be conducted to test out the use of compressed air for aerating the heaps. This could to some extent reduce the quantity of turnings required, with the exception of that necessary for fly-control.

SANITATION AND HEALTH.

Fears have been expressed that such schemes may lead to an increase in disease, in particular amœbic dysentery. Actually the reverse is true, provided the process is properly controlled and conducted on scientific lines. I can only deal briefly with this angle, but here are my authorities for such a statement. (Others are appended.)

J. W. Scarff,[3] Chief Health Officer, Singapore, writes: "I am prepared to prophesy that composting of refuse in our villages, kampongs and estates will cause a revolution in the sanitary organization of our rural areas."

The Secretary of Public Health states: "In the opinion of this Department, there is no likelihood of the matured compost, used as a fertilizer, acting as a medium for the dissemination of the infective material of amœbic dysentery and parasitic worms, *provided* the process of composting has been carried out in accordance with instructions issued by the Department of Agriculture and Forestry, where temperatures of 150° to 160°F. are attained in the compost pits for two or three weeks."

The principal diseases which have as their focal point nightsoil, e.g., human stercus and urine, are :—

1. The enteric group of fevers.
2. Cholera.
3. Dysenteries.
4. Helminthic infestations.
5. Tetanus.

All the pathogenic organisms responsible for these diseases would be killed under the conditions of properly controlled composting. Thus, A. L. Thomson[4] writes: "We know that the heat generated by bacterial activity in properly conditioned and managed compost heaps will destroy all pathogenes, whether bacillary, protozoen or helminthic, inhibit fly-breeding and eliminate nuisance."

From a health point of view, therefore, the establishment of these international methods at our factories, estates and villages, is a matter worthy of immediate attention.

AGRICULTURAL VALUE.

The day has indeed gone when we can take Mr. G. Ingham's[1] "pleasing delusion cherished by the makers of compost" seriously.

The mounting evidence, that in properly composted soils there is a "pleasing something" which Sir Albert Howard terms the mycorrhiza association, which, however, cannot as yet be weighed on the chemist's balance, nor added up in simple unit values, is to-day indeed a "pleasing actuality" to the makers of nature's lowly compost.

What is this evidence? I can only give a fraction. I have recently found that Uba cane cures itself of streak disease when treated with compost over a period of four years. It is possible that some of my fellow scientists will not accept this as proof. Years must no doubt pass before science, by tedious tests, will find a name, explain the cause, and finally confirm the facts.

It is a hard thing for agricultural science to do, for it means that all the years and nearly all the work on artificial fertilizers and poison dusts and sprays have been largely wasted in acquiring a vast mass of negative knowledge.

The Western literature on agriculture is full of articles on plant diseases and their treatment. New diseases are constantly being found, and new poisons devised to combat them. Have

we all been going down the wrong garden path ? For if this is nature's law in the West, how is it that the plant life of the Orient has not died out long ago ? Those ancient people have never had any poison sprays, nor powders to combat the "running out" of varieties so common in our enlightened part of the world.

For example, the varieties of grapes grown in Persia, Afghanistan and on the western frontier districts of India, have been cultivated for a very long time, but they show no signs of weakness, whereas in the vineyards of the south of France, new varieties are constantly needed to replace the old.

In the United Provinces of India, indigenous varieties of sugarcanes have been grown mixed for some twenty centuries, as is indicated by the fact that they have retained their Sanskrit names. Why do varieties persist in the East and run out under Western conditions ? Is it not possible that the balance between arable and livestock farming has been upset ? The tractor has maybe much to answer for !

Of China, F. H. King[2] writes : "The average of seven Chinese holdings indicates a maintenance capacity of 1,783 people, 212 cattle or donkeys and 399 swine. That is 1,995 consumers and 399 rough food transformers per square mile of farm land in the rural areas. In the U.S.A. the rural population in 1900 was placed at 61 per square mile of improved farm land and there were 30 horses and mules.

"In China, the maintenance in health of a population of 500 millions depends on the systematic use of vegetable and animal wastes, carefully composted together by age-old skill."

Sir Albert Howard states that in the highly manured areas surrounding the half-million villages in India, which constantly receive dressings of both human and animal manure, he never on any occasion found any trace of disease.

In 1938, I visited Sir Albert Howard at his home at Blackheath. He told me that in 1934 the garden was "a veritable pathological museum"—the fruit trees in particular being smothered with every kind of blight. Steps were taken to convert all the vegetable wastes into humus with the help of stable litter. Even after one year the pests began to retreat. In three years all had disappeared, the woolly aphis on the apple tree being the last to leave. During this period no insecticides were used and no diseased material was ever destroyed. It was all converted into humus." I saw that garden and, as a result, on my return to Africa I commenced my four years' test on streak disease in Uba cane.

One more recent example. Sir Albert Howard grew a collection of Royal Sovereign strawberries, which were badly infected with a common virus disease, alongside with healthy stock. The soil was heavily composted. In 1942 he found no trace of the virus disease. These results have since been confirmed from other sources.

There are many other cases, but to-day composted soils need fewer and fewer advocates. Every farmer who tries it becomes a disciple for life.

The question is often asked, "How can I make compost at a reasonable cost and in sufficient quantities to fertilize my farm ?"

The answer is simple. Start in a small way and work up, with the thought of the 40 centuries of China before you. In regard to sugar, every planter knows more or less what seed cane he will require in the following year. Whatever compost he has, or can make on the basis of 10 to 11 tons per beast per year, should be liberally used in specially prepared seed beds or fields. If this becomes universal practice in the sugar belt, there will be little talk in the future of varieties "running out" and less need for the continuous replacements with new varieties which face our industry under our Western agricultural methods.

There is, however, one danger. "Wars," it has been said, "never settle anything." War, on the other hand, often enforces practices through necessity. Owing to the diminishing artificial fertilizers available to-day, composting has become such an enforced necessity.

It is possible, however, that after the peace bells ring again, our agriculture will again be flooded and may succumb once more to the propaganda of cheap and easily applied artificial fertilizers. Enforced necessity has laid the foundations of composting in the Union. Enthusiastic Government extension officers are doing a great work. Farmers outside the sugar belt are seeing the results for themselves. Let us continue the good work now and after the war, and compost for the future health of plants and beasts and human beings in this land of ours.

References.

[1] Ingham, G. (1941) : Organic Manures, Compost and Artificial Fertilizers. Proc. S.A. Sugar Tech. Assoc., **15,** 70.

[2] King, F. H. : Farmers of Forty Centuries. Jonathan Cape.

[3] Scarff, J. W. (1940) : The Safe Conversion of Village Refuse and Night Soil into a Valuable Manure. J. Malaya Branch, Brit. Med. Assoc., No. 1.

[4] Thomson, A. L. (1942) : Municipal Engineering.

APPENDIX.

1. **Towns and Villages in the Union** where the disposal of habitation wastes is in actual practice or in the course of construction :—

Province.	In production.	In construction.
Transvaal ...	Hercules, Potchefstroom, Heidelberg, Volhard, Alberton, Volksrust.	Belfast, Nylstroom, Potgietersrust.
Orange Free State ...	Ficksburg, Parys, Clocolan, Bethlehem, Ladybrand, Heilbron.	—
Natal and East Griqualand	Howick (?)	Howick, Matatiele, Dannhauser, Vryheid, Glencoe, Colenso, Margate.
Cape Province .	Walmer, Clanwilliam, and others	Cradock, Elliot, Goodwood, Porterville.

2. **Authorities** on the destruction of pathogenes by controlled composting :—

Extracts from a Pretoria Bulletin dated 28th December, 1942 :—

(1) In the Ceylon Journal of Science (vol. v, part 1, Feb. 11th, 1939), by Lucius Nicholls and Samson Gunswardana. (*a*) The temperature of the compost heaps invariably rises to over 50°C. (122°F.) after each change of nightsoil and rises to 60°C. (140°F.) at junction of nightsoil and refuse. (*b*) The ova and larvæ of necator are destroyed when heated to : 40°C. (104°F.) for 24 hours, 42°C. (108°F.) for 12 hours, 45°C. (113°F.) for 2 hours. (*c*) All helminthic ova are rapidly destroyed during this process of composting.

(2) *Year Book of Agriculture*, 1931 (*pp.* 353-335), *U.S. Department of Agriculture*. The maximum temperatures recorded were close to 170°F. but the larvæ and parasites present in horse and cow manure are killed after 10 minutes exposure to a temperature of 125°F.

The results of these tests showed conclusively that after about two weeks' storage, horse manure and cow manure which were originally infested with live parasite eggs and larvæ, no longer contained this infestive material. Such manure was safe for spreading on pastures. (Benj. Schwartz, Senior Zoologist ; E. W. Price, Parasitologist ; Allen McIntosh, Asst. Zoologist (Bureau of Animal Industry).

(3) *A Guide to Human Parasitology* (*Black and Southwell*). Cysts of End. Histolytica remain alive in fæcal material for a few days only. Should they reach clean water they remain alive much longer ; they do not withstand dessication. Low temperatures are required for their survival ; exposure to 50°C. (122°F.) kills them in two minutes.

(4) *Manson's Tropical Diseases*, Philip Manson-Bahr, 9th edn., p. 404. Cysts of End. Histolytica can survive outside the body of man for about ten days if kept moist and cool. Dessication kills them immediately and they survive at a low much longer than at a high temperature.

3. **General References** :—

(1) *An Agricultural Testament*, by Sir Albert Howard, M.A., C.I.E.

(2) *Our Daily Bread*, by Albert Howard. "Gardeners' Chronicle," April 11, 1942.

(3) *Some Gardening Lessons from the Orient*, by Albert Howard. "Gardeners' Chronicle," Nov. 7, 1942.

(4) *A note on the Problem of Soil Erosion*, by Albert Howard. Journal of the Royal Society of Arts, No. 4471.

(5) *A Long-term Policy for British Agriculture*, by Albert Howard. "The Dairy Farmer," March, 1942.

(6) *The School Garden of To-morrow*, by Albert Howard. Grow-more-food Campaign, Oct., 1941.

(7) *Soil Fertility and the Reform of the Manure Heap and of the Temporary Ley*, by Albert Howard. Feb. 23, 1942.

(8) *How Solar Energy is Wasted*, by Albert Howard. "Gardeners' Chronicle," Jan., 1943.

(9) *The Manufacture of Humus by the Indore Process*, by Albert Howard. Royal Society of Arts, Nov., 1935.

INTERNATIONAL SUGAR JOURNAL, articles by H.M.L. :—

(10) *Some further Information on Humus*, Jan., 1938.

(11) *Specialisation, Susceptibility and Symbiosis*, Nov., 1941.

(12) *Humus versus Artificials*, June, 1941, 172.

(13) *Nightsoil in the Tropics*, Feb., 1942.

(14) *Fertility and Humus*, Aug., 1938.

(15) *Humus Manufacture from Cane Trash*, by G. C. Tambe and Yeshwant. D. Wad. I.S.J., July, 1935.

(16) *Thermophilic Actinomycetes and Fungi in Soils and in Composts*. New Jersey Agricultural Experiment Station, July, 1938.

(17) *Soil Organic Matter and Tropical Agriculture*, by D. W. Duthie. Agricultural Journal of British Guiana.

(18) *Soil Fertility, Nutrition and Health*, by Albert Howard. "Chemistry and Industry," Dec. 25, 1937.

(19) *The Manufacture of Humus from the Wastes of the Town and Village*, by Albert Howard. Royal Sanitary Institute, July, 1938.

(20) *Experiments with Pulverised Refuse as a Humus-forming Agent*, by Albert Howard. Institute of Public Cleansing, Scarborough, June, 1939.

(21) *Medical Testament of the Local Medical and Panel Committees of the County Palatine of Cheshire*. "The New English Weekly," April 6, 1939.

(22) *Municipal Compost*, by J. P. J. van Vuren. "Farming in South Africa," Nov., 1942.

(23) *The Manufacture of Compost from Municipal Waste*, by J. P. J. van Vuren. G.P.S. 32167, 1942-43.

(24) *Humus in Sugarcane Agriculture*, by G. C. Dymond. S.A. Sugar Technologists' Proceedings, April, 1938.

(25) *Organic Manures in Mauritius*, by G. C. Dymond. S.A. Sugar Technologists' Proceedings, April, 1941.

(26) *Grow Better Food*, by G. C. Dymond. "Home and Country," April, 1943.

(27) *Compost*, by Dr. L. S. Perold. "Farming in South Africa," Sept., 1942.

(28) *Dealing with the Fertilizer Problem*. "Farming in South Africa," Jan., 1943, p. 41.

(29) *Experiments on the Composting of Sugarcane Trash*, by A. McMartin. S.A. Sugar Tech. Assoc., 1942.

(30) *Composting Garden Refuse*, by P. Robertshaw. S.A. Sugar Tech. Assoc., 1942.

(31) *Farmers of Forty Centuries*, by F. H. King, D.Sc. Jonathan Cape.

The PRESIDENT said that the fact that certain varieties still retained their Sanskrit names did not necessarily imply that the East was free from disease; in fact, Nöel Deerr related to the speaker that the very first reference to red rot he could find was in the Sanskrit.

Mr. VAN VUREN, co-ordinating officer of the compost campaign in this country, said the Government started the campaign of getting the municipalities interested in compost-making from nightsoil, and so far about forty small municipalities were going in for it. The mechanization of the process was, however, essential, not only to reduce costs of production but to make such a scheme possible for large municipalities.

At Ficksburg the temperature of the compost heaps was maintained for three weeks at 157° to 169°F., and where high temperatures over a long period were necessary to kill or destroy pathogenic organisms he considered the compost quite safe. Temperatures of the heaps varied, of course, with atmospheric temperatures, but a drop of 10°F. was very rarely experienced. He had found, however, that nightsoil buried even for five years remained fresh and was still a source of infection.

The cost of production was important, and if mechanical means of turning the heaps could be obtained which would reduce costs, it would be definitely a step forward. Some municipalities sold compost at 10/- per ton, while others who like to make a profit charged as much as £1 per ton. Mealie farmers often judged the effect of fertilizers by the colour of the leaves of plants, and they maintained that compost gave very good results. Properly controlled experiments and statistical analyses of the results were, however, necessary, and it was hoped that such results would shortly be forthcoming from the Department of Agriculture. Sir Albert Howard attached great importance to what he called mycorrhiza association and claimed that the health of plants and animals was improved as a result of composting. If these claims could be substantiated it would leave no option but to use compost most extensively, but he considered it still an open question.

The cane-growing areas of Natal were in a unique position to experiment with compost. Not only were supplies of cellulose adequate for all the available nightsoil, but high rainfall ought to ensure good results. The best results from compost had so far been obtained with irrigation.

Mr. DODDS wanted to know how long the Uba cane that had been cured from streak by repeated treatments of compost remained streak-free. Manganese, for example, helped cane to resist streak for some time, or at least to inhibit the leaf symptoms, but it was no cure.

Certain primitive cane varieties were remarkably resistant towards diseases, not only in the East but everywhere. Creole cane was introduced to the West nine or ten centuries ago, and it still would grow and give reasonably good crops. Nevertheless, authorities in India and elsewhere in the East encourage planters to get away from old natural varieties and to plant new artificially-bred varieties capable of better yields. Overpopulated countries like China and India could not afford to go on with old methods giving poor crops. The development of new varieties of plants and new breeds of live stock, as well as the application of chemical fertilizers throughout the world, had done much to put the world in a position to support its vastly increased population.

Compost field trials were at present being carried out by the Experiment Station staff. Figures were not yet available, but there did not seem to be much more response at Mount Edgecombe to compost compared with plots receiving similar amounts of nitrogen from ammonium sulphate in a stiff clay soil. At Chakas Kraal, however, compost, equally with Karroo manure and filter cake, showed a spectacular increase over control plots without fertilizer in a coarse sandy soil. Dr. Fisher was of the opinion that where farm manure was not available for compost making and legumes had to be resorted to instead, the ploughing-in of the green legume would probably be as good a way as composting it, and it would certainly be more economical. Mr. Dodds considered this worthy of further investigation.

Mr. DYMOND said by "running out" he implied that a cane variety became susceptible to diseases and so was of little further agricultural value. He referred to a paper to be printed in the International Sugar Journal by Sir Albert Howard, in which it was pointed out that in Barbados, after many years of artificial fertilizer application, the running-out of varieties had become so common that it was very difficult to get any suitable variety at all.

In reply to Mr. Dodds, he said that the Uba cane in question was cut yearly. Last year, throughout its growing period of twelve months, it had about 25 to 30 per cent. streak. This year there was no signs of streak and the cane was now eight months old.

The PRESIDENT considered it a pity that Mr. Dymond did not plant a control line of Uba along with the one grown on compost. It was possible for plants to throw off streak. Uba and P.O.J.2725 had been known to do it, and he had also seen a remarkable case where streak in Co.290 had decreased appreciably. A stool of Co.419 badly infected with streak was planted in a pot for identification purposes and it had been growing there now for several years, and was completely root-bound, but there was no streak. The disappearance of the streak in these cases could certainly not be put down to compost applications. In a field experiment with compost it was found that an outbreak of rust affected compost plots and controls to an equal extent. He therefore believed in planting disease-resistant varieties.

Mr. HAYES maintained that Mr. Dymond had made very important claims in his paper, which, if correct, would mean that, given enough compost, we could eliminate disease. Mr. Dymond might be convinced of the efficacy of these age-old treatments, but he thought it would be very difficult to convince farmers and doctors. He was treading on dangerous ground trying to correlate the influence of nutrition against disease resistance. It was a problem that had plant and human pathologists guessing. His own information was to the effect that the 500 millions of China, in spite of all their manuring with compost, were in anything but a state of health and prosperity.

Mr. DYMOND referred Mr. Hayes to the references given, and in particular to "Medical Testament of the Locam Medical and Panel Committees of the County Palatine of Cheshire," in which many cases of the effect of vegetables grown with compost on the health of school children and animals were given. In the London area, for example, the children from three schools were fed for three years on fruit and vegetables grown on composted soils. There were no cases of infectious disease except one that was imported from outside. In all the other schools there were the usual series of infections and epidemics.

Mr. HAYES said that it was estimated that 50 per cent. of the children in India suffered from eye infection and 80 per cent. were due to vitamin A deficiency. The soils on the surrounding areas were heavily manured with nightsoil.

Mr. DU TOIT said the problem of making compost and the effect of compost was very much in the air at present, and he thought that no further papers should be published unless concrete results were given. He was glad that Mr. van Vuren was present, and hoped that the Government investigation would result in something positive. There was, for example, the question as to which carbon nitrogen ratio was necessary for the most profitable results to be obtained from compost applications. The cellulose and pentosan degredation compared with the corresponding lignin accumulation was another problem requiring investigation. He thought that compost might play an important part in manuring, but Mr. Dymond tended to take us back the forty centuries of China and wanted us to start there.

Mr. TAYLOR said that there was a time when the agriculture of Europe was built up on lime and farmyard manure. Since then artificials became almost the exclusive fertilizer, and now the pendulum seemed to be swinging back once more. Without claiming wonders for farmyard manure or compost, it did provide, apart from its manurial value, the necessary minor elements and also hormones.

Fertilizer shortage was the driving force behind the present Government effort in the direction of popularising compost. The human being was a destructive and wasteful animal and the drain from the country of plant-food was tremendous. The manurial value going to waste of all the food consumed or discarded in a city such as Durban was very great. The Government scheme of utilizing such waste material and checking the loss of plant-food discharged by sewers into the sea ought to find application on many sugar estates. Mr. Brevis, of the Cedara College of Agriculture, who had been placed in charge of compost work in Natal, was at the service of anyone interested or wanting further information.

Mr. MOBERLY said that one would feel more pleased and satisfied with the advocacy of compost or natural manures if it were not generally accompanied by an attack on the other line of development, artificial fertilizers. It seemed a human failing for a man to condemn what he was not advocating. Compost and natural manures had an important part to play and should supplement artificials.

Mr. BIJOUX said that he had found that cake from the Oliver filters took a long time after application before showing any beneficial results. He had used immature compost on rose plants with disastrous results. It might have been the result of fermentation, but some of the roses actually died off.

Mr. DYMOND said he discovered the harmful effects of undecomposed Oliver filter cake as a result of pot-tests early enough to warn the sugar estates against its use before composting. Several planters now used their quota of filter cake as well as Karroo manure as a composting medium on their farms. Molasses were sometimes added, but if dilute the fermentation seemed to be too quick.

Mr. FOWLIE suggested that it would perhaps be advisable to scatter the Oliver filter cake on the fields a few months before ploughing it in, so as to allow the sun and rain to decompose it.

The PRESIDENT mentioned the possibility of sowing a green manure crop in among the trash. The green manure crop would grow through the covering and the two could be ploughed-in together.