MEMORANDUM ON COMPOSTING WITH SPECIAL REFERENCE TO ESTATE AGRICULTURE.

PREPARED FOR SUBMISSION TO THE CENTRAL BOARD OF AGRICULTURE, NOVEMBER 17th, 1938.

T. EDEN

INTRODUCTION

At a meeting held on November 8th, 1934, the Central Board of Agriculture discussed the question of compost manufacture. The Board subsequently decided to review the question from time to time and the following memorandum is intended to provide a basis for discussion:—

At the meeting aforementioned, the questions which received most attention were (1) the potential sources of material; (2) the cost of manufacture; (3) the evidence real and alleged for the superiority of composting over present green manuring practices.

As the possibilities of composting were explored in subsequent months, it became evident that, apart from materials grown in tea, supplies of suitable material were ill-distributed particularly in the heart of the tea district.

> "The centre of the tea area in Ceylon is so closely planted that there is a scarcity of vegetable wastes except prunings and green manure." — (Howard, Roy. Soc. of Arts, Nov. 22, 1935).

Subsequent to his visit, Sir Albert Howard declared that the situation in up-country tea was difficult, though he did not regard it as hopeless.

This state of affairs led to an increasing use of green manures derived from tea land for composting and immediately raised the question of the economics of transporting material to and from the field and of the benefits that might accrue from composting materials rather than using them as green manures.

THE USE OF TEA PRUNING LEAF AND GREEN MANURES

The necessity for composting has been based on a number of theses.

> "Humus is a manufactured product with a carbon-nitrogen ratio of about 10 : 1 prepared from vegetable and animal wastes with a carbon-nitrogen ratio of about 33 to 1. . . . . Besides air, the organisms concerned in the manufacture also need water, a base to neutralise excessive acidity, and sufficient minerals particularly combined nitrogen. . . . Their demands are almost identical with those of the roots of plants . . . . Hence the injurious effects on growth which almost invariably follow the addition of straw and, very frequently, of green manure to the Soil."—(Howard, Roy. Soc. of Arts, Nov. 22, 1935, p. 4.)

In so far as materials of wide carbon-nitrogen ratio are concerned this statement stands. It is obviously untenable with materials of carbon-nitrogen ratio approximating to that of manufactured humus. The investigations of the Tea Research Institute show that the carbon-nitrogen ratio of tea leaf and of green manure loppings are of the same order as that of 'humus' and that therefore on this score the latter part of the statement is irrelevant.—(Annual Report 1936, 39; 1937, 36).

> "In the High Range (of S. India) they used for composting any leguminous plants which might occur naturally in the jungle, but dadap cuttings, grown amongst the tea and having a carbon-nitrogen ratio of perhaps 15 to 1, they did not think worth while to compost. Such were put straight into the soil. They never took green stuff out of the tea area for composting since such was usually of a fine nature with a low carbon-nitrogen ratio."
> —Harler, The Manufactue of Compost in S. India, South Indian Assoc., Sept. 22, 1937.)

This statement agrees with the work of the Tea Research Institute. In discussion of this lecture Sir Albert Howard said:—

"It is very easy to poison land by putting in fresh green stuff." In so far as this is a reference to the nitrogen requirements, the case is met above, but it appears from other evidence to be based on the damaging effect of cacao pods fermenting below cacao trees. In this case large quantities of acetic acid are formed which are injurious, but this condition bears no relationship to practice with tea prunings and green manures on estates. Recent work on soil tilth indicates that a good soil structure is dependent in part on unhumified organic matter.—(Russell, E.W. Soil Structure, Imp. Bur. of Soil Science, Technical Communication 37, p. 33).

The practice of sweeping up tea pruning leaf as recommended in the Bagot process, coupled with the debatable assertion that artificial manuring could be discontinued, led to a deplorable state of affairs with regard to nutrition and soil erosion on estate properties, but the above conflicting views were largely resolved after Sir Albert Howard's visit to Ceylon in January, 1938.

He then recommended that no green manures or tea prunings should be removed from tea lands but that compost derived from waste land should be added to the prunings and loppings before burying *in situ*. This recommendation no longer ran counter to the Tea Research Institute's recommendations which had previously suggested the spreading of cattle bulk if available, before forking.—(Eden, *The Tea Quarterly*, Vol. 9, 1936, p. 13.)

THE PRESENT POSITION

Current practice seems to have moved away from the extreme position that was prevalent a year or more ago. More estates are abiding by the recommendation not to make compost out of 'internal' material, and estates which had abandoned artificial manuring programmes have seen the wisdom of modifying their views. Composting is settling down into a routine practice for the treatment of specially poor areas and for 'supplying' programmes. No estate within the knowledge of the Tea Research Institute is relying solely on compost for manurial treatment.* Concern has been expressed at the startling change induced in patna land whereby maana grass areas have been rapidly changed into less valuable lantana scrub by frequent cutting of grass for composting. There is room for more composting on smallholdings where green manure supplies are frequently not copious enough at a given moment for ordinary green manuring use. One sees quantities of unused and poor quality paddy straw on smallholdings which might be composted and the practice of burning the straw from the yala harvest appears to be wasteful in the extreme.

OTHER POINTS

Several of these have arisen which are of interest.

(1). *Mycorrhiza*.—This term refers to a specialised association of fungus and plant root which is found in many plants including tea, rubber and coconuts. On other crops this habit of growth has been found to be favoured by organic matter. In some cases this association has been found to be beneficial. The analogy in the case of tea remains at present only an interesting speculation worthy

* Since this memorandum was prepared our attention has been drawn to two estates using compost but no other manures.

of testing under adequately controlled conditions. Dr. Rayner, one of the foremost authorities on this subject, draws no distinction between the effect of compost and of green manure.

In her work on conifers, mycorrhizal stimulation was the result of compost application.—(Rayner. Forestry, Vol. 8, 1934, 96). In her studies of citrus fruits whose mycorrhizal habit is comparable with that of tea, the stimulative agency was green manure.—(Nature, Vol. 131, 1933, 399; Vol. 136, 1935, 516). Writing of tea Dr. Rayner says that she is "not actuated by a bias for or against green manuring or compost. It is a matter on which I have an open mind and on which I am not likely to form an opinion without intensive study of comparative material and the opportunity of observing growing plants in the field" . . . . . "Green manuring with a legume crop, *e.g.*, Crotalaria, growing profusely and forming nodules is clearly a special and very favourable case."*

(2). *The Use of Lime and Ash in Compost Making.*—Sir Albert Howard deprecates the use of lime as a base for neutralising acidity in compost heaps on the grounds of the harmful effect of lime on tea. In its place he advocates the use of wood ashes from lines. The distinction drawn between lime and wood ashes is a spurious one.—(Annual Report, 1928, 14; 1936, 36). Both have exactly the same effect. Alkalinity caused by any base is detrimental to tea. All samples of compost are higher in pH value than tea tolerates. Used in reasonable quantities the compost does not raise the pH value of the whole mass of soil to any appreciable extent. Within the last few months the Tea Research Institute has received a steady stream of specimens of basket plants which are either dead or moribund. In all cases the baskets were made up of either compost alone or half compost — half soil, or other high percentage of compost. In all cases the reaction of the soil was at fault and fully accounted for the symptoms. In all cases the cause was excessive use of compost.

(3). *The Value of Compost Analyses.*—Compost has a physical, a chemical and a biological effect and the question of which is predominant is frequently debated. It seems probable that the answer will vary according to local conditions. Chemical analysis can only evaluate roughly the chemical effect and to some extent the physical. That being so the question arises as to whether chemical analyses are worth while. From the point of view of computing the amount of common nutrients available to the plant the analyses are of limited value. The Tea Research Institute analysed a large number of composts in the early days of the controversy but discontinued the

* Private communication to the Tea Research Institute.

practice early in 1936 when they had served their purpose. Tea Research Institute analyses were confined to organic matter, humus, and nitrogen and no attempt was made to determine potash or phosphate, the reason being that these analyses were required merely as a method of detecting or confirming deficient manufacture. These analyses revealed that:—

(a). Excessive adulteration of compost with soil was taking place, with consequent low organic matter contents.

(b). That heavy losses of nitrogen were taking place during manufacture and that this was usually the case when highly nitrogenous residues such as green manures were exclusively used.—(Ann. Rept. 1935, 46; 1937, 36.)

In contradistinction to the view that the nutrient status of compost is of no importance, and that humus is all important may be set the following:—

> "Land can be tested for fertility by means of a complete artificial manure. If the soil is really fertile such a dressing will give no result because no limiting factor — in the shape of shortage of nitrogen, phosphorus or potash — exists. If the soil is not fertile a complete artificial will produce a result." — (Howard, J. Min. Agric. 1938, p. 438).

It is evident from this that the action of compost is in part that of normal nutrition since it satisfies the ordinary deficiencies of nitrogen, phosphorus and potash. Furthermore since, on the so-called infertile land, artificials produce an effect, it is equally evident that humus is not the limiting factor.

(4). *Disease Resistance.*—The claim is made that the use of humus will reduce and finally abolish disease.

> "In a number of cases, in tea and rubber in particular, very striking results followed closely on one dressing of compost applied at the rate of five tons per acre. There was a marked improvement in growth and also in resistance to insect pests such as red spider, *Tortrix* and mosquito blight (*Helopeltis*)." — (Howard, Empire Cotton Growing Review, XV, 1938, 215).
>
> "A fertile soil will enable the plant to carry out the synthesis of proteids and carbohydrates in the green leaf to perfection. In consequence, the toll now taken by fungus, insect and other diseases will at first shrink in volume and then be reduced to its normal insignificance." — (Howard, Empire Cotton Growing Review, XV, 1938, 310).

We may expect healthy cropping conditions to improve plant vigour. With respect to the claim for resistance against Tortrix, this statement has no foundation in fact.

(5) *Modification in Method of Manufacture of Compost.*—Sir Albert Howard recommends a modification designed by Mr. A. F. Bendall of Jagcherra Tea Estate, Sylhet which consists of constructing one or more channels at the bottom of the pit connected to flues at each end which communicate with the open air. The top of the channel is covered with an open work frame. The system is designed to promote more even aeration particularly at the lower depths. As far as our observations go it appears to be successful.