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A REPLY TO SOME OBJECTIONS TO THE INDORE PROCESS AS APPLIED TO THE IMPROVEMENT OF TEA GARDENS.

THE Indore process for the conversion into humus of all the available vegetable and animal wastes is now being tried out, on a large scale, on a considerable number of tea gardens in the Orient. The first year's results have been completed on a group of tea estates in South India and have proved in all respects successful.

Three criticisms have been advanced against this method of increasing the permanent fertility of the land under tea : (1) that the benefits conferred by dressings of humus can be obtained more cheaply by the use of artificial manures ; (2) that a series of replicated plot experiments, coupled with the statistical examination of the resulting figures, are necessary before the method can be welded into estate practice, and (3) that the cost of production of humus on tea gardens—in Ceylon in particular—will be excessive.

The object of this memorandum is to show that these criticisms are founded on a fundamental misconception of the subject, that they are devoid of substance, and are therefore unworthy of serious consideration.

THE NATURE AND COMPOSITION OF HUMUS.

Manures for the most part fall into two classes : (1) inorganic or artificial manures like sulphate of ammonia, and (2) organic manures like humus. Inorganic manures have practically no residual effect and only influence the crop to which they are applied. Organic manures like properly prepared humus, on the other hand, have a two-fold action : they increase the permanent fertility of the soil and at the same time improve the current crop. These fundamental facts must be carefully borne in mind in any comparison which is made between humus and artificial manures.

The rôle of humus in soil improvement is mainly biological and physical and to a minor extent chemical.

(*a*) Biological. Humus provides the soil organisms—fungi and bacteria—with food materials and with energy for such duties as the decay of old roots, the fixation of atmospheric nitrogen both directly and also indirectly by means of the nodules on the roots of leguminous green-manure crops. The biological importance of humus therefore needs no argument.

(*b*) Physical. Humus is essential for increasing the internal surface of the soil (the pore-space) on which the root hairs of the tea plant feed and for maintaining the physical properties of the soil, such as tilth, permeability, moisture-retaining capacity, and temperature.

(*c*) Chemical. During its slow oxidation in the soil, the nitrogen, phosphates and potash in humus help to enrich the soil solution for the benefit of the tea plant.

It is clear therefore that the value of humus by no means depends on its chemical composition as is the case with most artificials. Humus adds to the soil capital, as it were, besides assisting the current crop. Artificials, by influencing the crop to which they are applied, only affect the profit and loss account of the particular year. The two things—humus and artificials—are therefore not comparable. Any attempt at a comparison, on the basis of chemical composition, is like confusing the balance sheet with the profit and loss account—two matters best kept entirely separate.

In view of the different nature of inorganic and organic manures it is not surprising that the character of the growth obtained in the two cases is not the same. This is perhaps most easily demonstrated in crops like vegetables, which are eaten when fresh. Inorganic manures produce crops very liable to disease and moreover deficient in taste and quality. On the London markets, for example, vegetables raised with artificials can only be sold with the greatest difficulty, often at very low prices. Produce raised with humus is not only remarkably free from insect and fungoid diseases, but has firmly established its position on the market by virtue of its superior appearance, taste and quality. Such vegetables have no difficulty in finding a ready market and in commanding good prices.

The Need of Replicated Plot Experiments on the Tea Estates.

If humus were an altogether new substance and if it had been discovered when the Indore process was invented, it would be necessary to try it out on the land by means of plot experiments. Humus, however, is not new. Its importance to the land has been realised from the earliest times and is well understood by all who have to do with the soil. The value of the humus (as prepared by the Indore process) was very carefully tested for many years on 300 acres of land at Indore and the results are summed up in *The Waste Products of Agriculture*, which was published in 1931. The Indore Experiment Station was manured with its own waste products only and at the end of five years stood out like an oasis from the surrounding country. I want to see this Indore experiment tried on every tea garden in the East because I am convinced it will do much for this great industry.

The system of replicated plots is only suitable for an experiment station, where it is commonly employed for such subjects as variety trials and for comparing the effect of artificial manures. A little consideration will show that this method is altogether out of place for finding the value of humus on a tea garden conducted for profit. It will take from three to five years before the full effect of dressings of humus is obtained. During this period the yield of tea will be increased, which increase can be measured by suitable plot experiments. This, however, is only a part of the story. The stored fertility must now be utilised and the land brought back to its original condition. This would take another three to five years. The determination of the value of humus, as far as yield only is concerned, by means of plots and statistics will therefore take from six to ten years in all and will at the same time seriously add to the burden of work thrown on the manager and his staff. In all probability there will be an improvement in quality as well as in yield. Such improvement is best measured by the price obtained. It is clear therefore

that the determination of the precise value of dressings of humus on tea, as compared with artificials, will be a long and a very difficult process and, moreover, one entirely unsuitable for a tea garden. Even on an experiment station I doubt whether the game will be worth the candle.

The Cost of Production of Humus.

It is obviously impossible to estimate on paper what the cost of making humus will be. It is bound to vary according to such factors as season, the situation of the tea garden, the amount of vegetable and animal wastes available, as well as on the capacity of the manager to utilise to the best advantage the facilities and the labour force at his disposal. Nevertheless, attempts have been made to forecast costs. One of these estimates, based on paper calculations only, appeared in a recent issue of the *Quarterly Journal of the Tea Research Institute of Ceylon*. The cost of making compost reached the high figure of Rs. 8 a ton. This calculation was soon shown to be fantastic. An important group of tea estates in Ceylon is making humus at an average cost of Rs. 1·87 a ton. On the High Range in Travancore, the cost varies from Re. 1 to Rs. 2 a ton—a fair average is Rs. 1·50 a ton. On all sides the cost of production is rapidly falling as the managers gain experience and confidence in the work.

So much for the criticisms which have been advanced against the Indore process. Such a process—which is certain to lower the cost of production of tea, to improve the yield, to build up the general fertility of the land and very likely to improve the quality of tea as well—cannot possibly be judged by further discussion or by arguments for and against. A fair and a just verdict can only be arrived at by large-scale trials on the estates themselves, conducted for a period of at least three years. These trials are now being made. The first results have proved far more successful than I anticipated. There is every reason to believe that by the end of 1936 the value of the Indore process will be settled by the one unanswerable argument—success.

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