TEA RESEARCH IN CEYLON*

F. R. TUBBS.

Before the Ceylon Association in London, Mr. F. R. Tubbs, M.Sc.. (Lond.), D.I.C., A.R.C.S., F.L.S., Plant Physiologist of the Tea Research Institute of Ceylon, on February 8 gave an address on the work of his department, in the Council Chamber of the Rubber Growers' Association, 19, Fenchurch Street, E.C. By invitation members of the Indian Tea Association (London) and the South Indian Association in London were present.

The President introduced Mr. Tubbs who spoke as follows:—

Mr. President and gentlemen, first I should like to thank your committee and yourselves for providing me with this opportunity of describing to you to-day some of my work and some of the data that have been accumulated in my department since I went out to Ceylon. You are interested in the success of your estates there; our job is to work upon the application of science and improved methods to those estates. Therefore, you are naturally interested in the results achieved and suggestions which we can make for the better carrying on of those estates. Your superintendents in Ceylon have the opportunity, of which advantage is very fully taken, of attending periodical lectures, but you do not have the same opportunities of hearing of our researches. Mr. Baynham has told me that there will be a short time available for questions after I have finished, and I hope you will take full advantage of it and ask me any questions you like. I cannot guarantee to be able to answer them, but I will do my best.

The department of Plant Physiology, of which I am in charge, is the junior department of the Institute, but it has succedeed in getting a certain amount of information of some importance on certain phases of the work which has been going on, although in others five years naturally are far too short a period in which to get conclusive results.

* Report of a lecture given before the Ceylon Association in London on February 8, 1935.

Before discussing pruning problems, which were handed to me as my major line of investigation when I joined the Institute, I will first run briefly over certain other lines of work.

THE SELECTION OF TEA.

First is the selection of tea, which, as you know, is a very important thing. In practically every other crop in the world very far-reaching financial and economic results have followed upon the application of selection to the crop, but in tea we are up against very great difficulties. The tea seed bearer takes so long to fruit that to run over a series of generations would take far more than my lifetime. That is one of our major difficulties.

A second and even more fundamental difficulty is this: that so far there is no known method of estimating the quality of the tea likely to be derived from the produce of a single plant, because you cannot get that produce in sufficient quantities. It is obviously no use just propagating thousands of bushes on the off-chance of one of them being good. You have to go through and select your bush beforehand, and until chemical investigations have progressed considerably further there is little hope of selection making active progress but when that does occur we shall need the vegetative propagation of tea. If we find a bush capable of giving a much better product we shall want to propagate that bush. For that reason the propagation of tea by vegetative means has been examined at the Institute as a side line, because there are other and more pressing problems to be tackled; we have just succeeded in getting our plant house built, and when I get back I hope to get on further with this work.

We have already made progress. For instance, I have worked out certain means of vegetative propagation which will enable me to start testing as to whether it is worth while cultivating for caffeine content or for tannin content. Vegetative propagation I have already shown to result in a considerable reduction in the variability of young plants. I took seed derived from seed bearers of a very high standard and propagated some of the seedlings vegetatively,

and vegetative propagation did result in the production of more uniform plants. Uniformity is of prime importance, and there is no doubt that vegetative propagation will be valuable in this connection For that reason we are carrying on work upon it.

GROWTH OF YOUNG TEA.

Another line of work, over and above the work on pruning, is those factors which affect the growth of young tea. Investigations have been carried on into the effect of the size of the seed. It was found that large tea seed definitely gave better plants, and more rapidly growing plants, than small seed, but that in a practical sample very little variation was to be found due to seed size, this being due to the fact that when the seed is collected all the smaller seed is re-removed. But this work does definitely point the moral that it pays to get good-sized, and, if necessary, to pay a little extra for it.

Shelling the seed, removing the hard outer shell, was also found to increase the growth of seedlings. It is too difficult a process for the coolie, however. That is one difficulty we are up against the whole time. We can advocate methods, but unless the coolie is capable of applying them it is little use for us to advocate them. That, of course, restricts considerably the lines on which we are able to work. However, it does appear that cracking the seed would be an advantageous process when setting down nurseries, leading to more rapid and more even germination.

Experiments have also been carried out in the treatment of two-year-old stumps. Five methods of planting were tested, and the results have been reported in *The Tea Quarterly*.

An interesting point which has emerged from the experiments is that the presence of lateral roots on the stumps had no effect upon either the establishment or the subsequent growth of the plants. Stumping them instead of leaving them standing up as they were in the nursery does reduce growth immediately, but it is possible that it is made up for later.

One conclusion was drawn from that work, and that was that in planting in old tea it was advisable to plant stumps which had not been cut back to six inches, or four inches, or even three inches, but

just to remove the leaves, the lateral roots, and all the green stems, and leave a woody stump, possibly some 3 ft. long, standing up. They establish quite well—as well as ordinary stumps—but they produce new shoots near the top of the stem. The result is that the coolie does not knock them about when plucking, and they are more able to compete with the surrounding big bushes. This is one of the planters' difficulties — the establishment of supplies in old tea. It is a very difficult thing, and a costly one. The process I have mentioned appears to be an advantageous method of tackling the problem, and has already been adopted on a large number of estates in Ceylon, and by the time I get back I shall be able to see whether practical experience has backed up the result of my experiment, as I certainly expect it to do.

Then there is the question of the pruning of young tea. An experiment is now in progress of which there are not yet sufficient results to talk about. Four methods of pruning young tea which are advocated by prominent planters are being compared.

Another line of investigation I took up was carried on in co-operation with the entomologist. He had been told that nettle grub, the largest thorn in the side of some estates in Ceylon, was reducing wood growth. In the field it is impossible to tell. You wander round estates, and it is stated that one man's wood has improved, while another man's wood has gone back, but it is practically impossible to make certain by visual inspection. I tackled the question on a measurement basis. Stripping the bush of its leaves reduces the crop, and the wood growth is reduced considerably.

Here, again, matters of practical policy arise. If a bush has been very badly attacked by insect pests, such as tortrix or nettle grub—especially the latter, which removes all the leaves, old and young, from the bush, other such pests which damage leaves being mosquito blight and Circosporella—it should be rested, levelled off, and then brought into plucking again, but where you are going to prune to try to eliminate the pest, that pruning should be done before new growth starts again. It is not worth while letting the

nettle grub go on for possibly a month before you prune. If you are going to prune to eliminate nettle grub, do it as soon as the attack warrants it. Otherwise you are not going to get such good growth after pruning.

Another point which came up was the effect of the time of year at which pruning is carried out, upon the severity of tortrix attack. To measure the severity of attack is extremely difficult. You cannot very well measure how much leaf it has eaten, or how the grubs increase in size. or anything like that. What we go on is the number of egg masses collected. It was found that in Dimbula pruning at the end of April, at the end of the tortrix season, very considerably reduced the tortrix attack on those plants in the subsequent tortrix season, but only for that one season. The time of pruning, therefore, does influence that attack of tortrix, but only for the one subsequent season. Thereafter things become uniform again.

An interesting point is that, when people say that tortrix has disappeared it has not done so, normally speaking; it is still there. To investigate that question I had collections made on my pruning plots right through one South-West Monsoon—one of the worst we had had for some time—and egg masses, grubs, and an occasional moth were found throughout the period. They were not found, of course, in large quantities, but they were the basis for the subsequent attack when weather conditions became more favourable. It really looks as though it were these that we ought to attack—not to concentrate only upon collecting tremendous numbers of egg masses after an attack has begun, but also to deal with those early egg masses just before the tortrix season begins. It seems as if routine collection over the fields just before the tortrix season might be the most effective preventive.

Another thing which cropped up was the relative inefficiency of the tortrix collection, even on the scale on which I did it, which is more than most estates could afford. I was collecting over nine-day intervals, and if they were being collected really efficiently the attack should have been wiped out, save for reinfection from outside, but it went on through the whole season. The method of collection of the egg masses does not seem to be as efficient as it should be.

RESTRICTED CROP.

Another line of investigation, which came up in connection with restriction, was the effect of alterations in estate programmes in connection with restriction, and the best methods of carrying out that restriction. Resting after pruning is one of those methods. Resting before pruning has been and is being carried out quite a lot in Ceylon; but I am not really in favour of it, except at very low elevations where carbohydrates are low. It seems to me that, in the high elevations if there is anything at all in the idea that you get better quality tea at the end of your cycle, to rest your bushes at the end of the cycle is definitely the wrong policy. Especially is this the case when you take into consideration the fact that, when you rest at the end of the cycle, you increase the wood growth of the bush, but you increase the wood growth on the very portions of the frame which you are going to cut out later when you prune. Surely it is better to rest after pruning and get all the benefits of that rest in wood growth on the new wood that is coming on after the pruning. I definitely suggest that, wherever possible, resting before pruning at the higher elevations in Ceylon should be abandoned in favour of resting after pruning.

The bringing in of the tea after pruning is quite simple. With tipping knives you go across at about the same level at which the bush would have arrived had it been plucked. A lot of people say that a second pruning is a second shock to the bush. All I can say is that my investigations do not confirm that idea in any way. You have rested the bush. You might say the same of a man who goes away for a holiday and has to come back to work again. It is no more of a shock, I think, to bring a bush in after resting. He has benefited by his holiday and will be able to work better afterwards. That, I consider, is what you will find with your tea bushes, and it is certainly what our results are showing. Incidentally, the results I am giving you are all from work carried out under field conditions,

Another point which demanded investigation was the effect of the length of the plucking round. Some people advocate a long plucking round, taking the tip of a long shoot and throwing the

rest away. Others advocate a short round, going round frequently. The results to date show that a seven-day round gives definitely more yield than a fourteen-day round, and that the teas made from it cannot be distinguished in value by the brokers from teas made after a fourteen-day round.

It, therefore, appears that neither the advocate of a short round nor the advocate of a long round can really claim to be supported by my results. They appear to be quite equal as regards the factors which effect the broker in giving a valuation. I have taken that valuation because it seems to be the best all-round measure of the tea. It, therefore, appears that the long plucking round has the advantage in restricting crop. Only experience on the estate will show whether the shorter round will show such an increase of crop as to justify the extra cost,

In addition to such things as these, a large number of investigations have been carried out on various subjects which have arisen very largely directly from planters' queries and troubles. We are always on the lookout. We get a query which sometimes we are able to deal with straight away, but sometimes we do not know, and we have adopted the policy of saying definitely that we do not know. I must say that this attitude is thoroughly appreciated, and planters have been content to wait until we had time to investigate the question.

Manganese toxicity, for instance, came up before the Agricultural Chemist, Mr. Eden. I went on with parallel investigation. We found that an excess of manganese in a nutritive solution gave rise to toxic conditions in young seedlings. Other matters of investigation have been the distribution of branches of flush within the bush, the processes involved in wound-healing in pruning and the effect of resting on the wood growth, the result of which, as I have shown, was to indicate that resting after pruning will greatly increase the wood growth of the bush. That is on all fours with such crops as apples in England. Investigations have also been carried out on the effect of elevation, and the time and type of pruning, on the size

of the flush brought in by the coolie—all things which link up with manufacture. As you see, in these minor problems my department is linked up with other departments of the Institute, just as they link up with me on other problems. In the T.R.I. problems are not kept in watertight compartments. For instance, Mr. Eden and I, being more particularly interested in the agricultural side of things, are constantly in consultation, I with regard to his work, and he in regard to mine.

As I said before, the main line upon which my investigations were to lie concerned the problems arising out of pruning and the various troubles which arise with the tea bush after pruning. I am not going to describe the scientific experiments we made. It would be out of place here, but I will just run through the results.

TYPES OF PRUNING.

Dealing first with effects of the type of pruning, I have here photographs of three types: (1) clean pruning; (2) rim-lung pruning; and (3) cut-across. As I am talking about them you might like to see these photographs, which will enable you to follow what I am saying. Those three types of pruning—clean pruning, rim-lung, and cut-across—describe themselves. The cut-across is just a clean cut across the bush, taking out nothing (except diseased wood) below the surface. The rim-lung has branches—six in my experiments—left standing up above the level of the rest of the bush until the time of tipping. In other words, leaves are left on the bush during the recovery period. The third system results in no leaves being left on the bush, as you all know. That is an important thing. It means that a clean-pruned bush has got to recover entirely by means of what is inside it. The carbohydrates—sugars and starches and such like—are manufactured by the leaves, and if, when you prune a bush, you take off all the leaves, all the new growth until leaves are produced has to come from reserves inside the bush.

I quite agree that in some cases growth comes on quite well, but it is by no means universal. For that reason I made an investigation of the reserves in the roots of the tea bush, and I have here

a graph* showing the results of my observations. It shows the percentages of carbohydrates in the roots of the tea bush plotted against elevations above sea level. As you will see, there is a linear relationship between the amount of carbohydrates in the root and the elevation above sea level. There are various scientific reasons for it, but what it comes down to is that, at low elevations above sea-level, you have only about 10 per cent. of available carbohydrates in the root and the bush cannot make use of some of that reserve. When you get to the elevation of, say, Nuwara Eliya there is 25 or 96 per cent.

For an old bush to come back successfully after clean pruning, 10 per cent is insufficient, and that is why those who are interested in estates at low elevations have to bear such heavy costs in the way of supplying tea; and I might also point out that you lose crop considerably even if the bush has sufficient carbohydrates to recover, At low elevations where there is just sufficient carbohydrates to enable the bush to come back after pruning, its crop is limited by its leaf area until something like one-and-half years after pruning; and if it is on a two-year cycle, it means that it has only six months in which to lay down reserves before the next pruning. In other words, it is living a hand-to-mouth existence. Then comes a worse stage; a bush which has sufficient reserves to produce some new shoots, but not to recover normally. Where that occurs large portions of the frame will die back. I have had cases where I have collected more than 1,000 lbs. of dead wood per acre on an estate at two hundred feet, and that has been far exceeded in certain cases, even at higher elevations. At anything under 1,000 feet this may occur.

Again, you have the third and worst case, in which the bush fails to recover at all. The obvious answer to the problem is to provide the bush with some means of manufacturing those carbohydrates which it demands. To do so you leave branches unpruned at the time of pruning, and remove them later. This method has been found to reduce, in 1932, the number of deaths from 134 per acre in clean-pruned areas to 16 per acre in lung-pruned areas, and

* See T.R.I. Bulletin No. 12. Fig. 1 facing page 32.

in 1933 the number of deaths was reduced from 168 per acre in clean-pruned areas to 22 per acre in lung-pruned areas.

I do not know what you will estimate as the cost of replacing a mature tea bush, but I do not think you can do it under 50 cents. I put that figure forward as a conservative one to the Low-Country Planters' Association, and received no criticism of it whatsoever. Some people told me privately afterwards that they thought it might easily be more. Taking, then, 50 cents as the cost of replacing a dead bush, quite apart from the crop you have lost, it is going to cost you Rs. 59 per acre on the basis of the 1932 figures I have given you, or Rs. 74 per acre on the basis of the 1933 figures. Call it Rs. 60 per acre as a conservative estimate. The extra cost for lung-pruning is going to be about Rs. 6 per acre. Surely it is worth that amount!

Then, again, apart from the replacement of absolutely dead bushes, what about those bushes which are half dead and which, for the greater part of the cycle, are struggling to regain activity, let alone to supply crop? It has been found that lung-pruning will reduce the amount of dead wood found after pruning from something in the neighbourhood of 700 lb. per acre in clean-pruned areas to 330 lb. in lung-pruned areas. That is another thing to add to your Rs. 60 per acre.

Now, let us see what it comes to in the way of crop. Experiments on this estate at 200 feet have shown that over two years there is a difference in yield, between clean-pruned and lung-pruned areas, of over 200 lb. per acre. In other words, it amounts to 100 lb. a year in a two-year cycle. It definitely looks as though the extra money spent on pruning therefore is going to be well worthy of consideration. In fact, I should say there is no longer any doubt left, and that no estate under 1,000 feet should on any account be clean-pruned, but generous lung pruning with plenty of lungs should undoubtedly be adopted. On the basis of my experience I have come to the conclusion that below 1,500 feet you should lung prune: that from sea-level to 1,000 feet the number of leaves left on the bush should be something in the neighbourhood of 300 large leaves per bush; and from 1,000 to 1,500 feet you can reduce that number

to three branches with something in the neighbourhood of 200 leaves per bush, which should be sufficient. From 1,500 feet to 3,000 feet and upwards I advocate either light lung pruning or fringe pruning.

You will notice that fringe pruning means leaving unpruned all the branches on the outside of the bush. You prune to the level, but you do not remove those little whippy shoots. It has been the custom of Ceylon coolies to clean the bush up, and it led to very pretty looking work, but you can clean up the inside of the bush, taking out all the dead wood, and still be able to leave this fringe of young shoots to thicken up outside the bush. In the case of the lower levels, 1,500 to 3,000 feet, these leaves will be of great value in aiding recovery after pruning. In the case of higher levels —and I advocate it for anything from 1,500 feet to the highest levels in Ceylon—in areas where carbohydrate reserves in the root are high and you do not need leaves, I suggest leaving this fringe for a different reason entirely, namely, increase of the size of the bush. You are up against the fact that tea in Ceylon is an old crop, and was possibly planted in the early days in a rather different way to the way we would do it now. For one thing, I think a large part of it was planted too wide, and if you are going in for wide planting, which yet is not sufficiently wide to inter-plant, it means a low yield per acre. The only way to overcome that situation is to increase the size of the bush—to cover the ground more efficiently. It will react in many different ways. Quite apart from the extra yield which can be taken from the bigger bush, you have extra protection for the soil. There is less soil erosion, less deterioration of the soil by loss of humus, which is a problem of the utmost importance out there, and which probably is going to prove one of the main factors putting a limit to cultivation in the tropics: all these things would be rectified, partly at least, by increasing the size of the bush.

I have been told that these young fringe branches do nothing. I perfectly agree that possibly they do nothing for three or four cycles, but in time they will thicken out, and when they have thickened up and are pruned back they will begin to yield. Many of you will have seen, in the flesh or in photographs, big bushes on estates,

pet bushes. Many of those big bushes are got by letting the bush run up high than normal. We do not want to run to that. What we want is a low bush, but with the maximum spread. To get it, it is going to be necessary to stop removing all these young spreading branches.

I cannot go into all these things fully now, but you will see them discussed in *The Tea Quarterly* for 1934, Parts I and II, where are reports of lectures I gave out there when these results first became available. I would point out that fringe pruning involves no additional cost. Inevitably, it costs more on the first field you do, because you alter the estate method, which appears to put up the costs for the time being because the coolies are not used to it; but actually when once they become used to it there is no reason why it should cost more than ordinary clean pruning.

I want to leave plenty of opportunity for you to ask questions, so I will not keep you much longer. This has been a rapid and brief account of some of the data and some of the results I have obtained, and the practical recommendations I have been able to make to your superintendents on that basis. But I would make this appeal. In certain cases our investigations have shown the way to reduction in costs. Take, for example, Mr. Eden's work on manuring. There is no doubt that he has shown a way in which manuring in Ceylon can be rationalised considerably, provided the green manuring policy is kept up adequately and how at the same time considerable financial savings can be effected.

That is the type of recommendation we like to give, naturally, but on other occasions, often more numerous, we are forced to recommend measures which are going to cost more. We have to deal with particularly difficult problems affecting tropical agriculture. I would put it to you that we are not scientists working in a test tube, oblivious to the rest of the world outside. We are looking at problems from the economic point of view, and we try to make sure that any recommendations we make are not uneconomic—that there is a fair prospect of the expenditure being more than returned in subsequent economic advantage.

When, therefore, you consider estimates involving some slight increase in cost—say, Rs. 4, Rs. 5, or Rs. 6 an acre—for pruning in the low-country, or measures for the increase of humus in the soil all over Ceylon, please believe that we have only recommended these measures because we are absolutely convinced that they are necessary for the future prosperity of your estates. (Applause).

The Chairman then invited questions, of which a number were asked and answered as summarised below.

MEMBERS' QUESTIONS

Q. Did Mr. Tubbs agree with an expert who lately wrote that the soils of Ceylon contained potash, which was used in manufacturing carbohydrates; and would it be possible to use potash to restore to the soil the potash of which it was gradually deprived by the growth of the bush?

A. So far as investigations have gone they confirmed the writer's statement, in relation to mangolds and other English crops, and there was no reason to suppose that the same did not hold good in regard to tea. Mr. Eden's experiments on manuring tended to confirm the idea that there were adequate reserves of potash in the Ceylon soil. It was found that no increase of crop followed the application of potash. Reserves of potash were naturally limited and considerable amounts were removed in the form of flush and especially in wood. It was because they were not going to risk running out of potash that they had never advocated omitting potash from manure mixtures, but suggested that it need not be supplied in large amounts.

Q. At what height was cutting across after resting advocated? Experience showed the likelihood of the formation of snags when the cut went into red wood, leading to difficulty in obtaining good clean wood to prune into. Would it be better to have the pluckers go over the field and throw the leaf away so as to get a clean stem for the next pruning?

A. It was not advocated that leaf should be thrown away after spending money to pluck it. It did harm to the bush. To have healthy bushes they should be rested, and if leaf were not wanted,

it should not be plucked. Snags arose from going into the red wood too low down. The cut should be at the height at which the bush would stand after normal plucking. To rest six months after pruning meant having eight or nine inches of good straight wood above the pruning level. In that case, when they pruned again there would be no danger of snag formation.

Q. What conclusions had been formed about the influence of manures on quality in Ceylon ?

A. Experiments had been made comparing the effects on tea of applying 0 lb., 20 lb. and 40 lb. of nitrogen per acre, and the effects of potash had been examined in the same way. There had been no unanimity among brokers to indicate that any change of quality had followed. One difficulty seemed to be method. Tea tasting was essentially individual, and until the matter could be brought down to a fixed standard, judgment was very difficult.

Q. What was the result of investigation regarding the use of organic as against inorganic manures ?

A. There was no reason to suppose that any difference would arise. It might be postulated that an excess of nitrogen, producing rapid growth, might influence quality, but there was no reason to suppose that the form in which the nitrogen entered the soil influenced the quality of the tea produced. The form in which the nitrogen went into the soil had very little, if any, relation to the form in which it went into the bush, which was the important thing.

Q. In connection with nettle grub, tortrix and other pests, had any experiments been made in Ceylon with spraying the bushes after pruning ?

A. The evidence available indicated that the hang-over from one season to another occurred on the leaf, and clean pruning would be the most efficient check to pests. It produced disorganisation of the estate system, however. Spraying reached only the outside of the mature bush, and the objection was the difficulty experienced in making the coolie do the work properly, because to reach the grub the spray must reach the under side of the leaf.

Ordinary soap and water was the best, but it was expensive, costing something like Rs. 16 per acre. Actually, nothing had been done on spraying pruned bushes as a check to nettle grub. It was the pruning which acted as a check.

Q. In Southern India, excellent results had been obtained by dry weather pruning. Would Mr. Tubbs give his views on the possibility of limiting the pruning to the dry weather period?

A. It would be feasible in districts, such as Uva, where there was prolonged dry weather, but the possibility of doing so on the other face of the Island was small, because pruning would have to be crammed into a couple of months, disorganising estate work.

Q. It was suggested that deterioration in the quality of Ceylon teas had been brought about by efforts to increase crops by manuring. By fine plucking quality could be improved. Was it not the case that if a certain proportion of carbohydrates could be allocated to the root and branch system of the tea bush, those constituents could be made to contribute to the quality of the leaf rather than to increase of the yield? The excessive weight of Ceylon tea in the market was one of the causes why it was in its present state of depression.

A. Ceylon's future lay in maintaining quality as apart from quantity. The attitude of the Institute was that Ceylon was not interested solely in yield, but in quality. Their present knowledge of what went on inside the tea bush did not enable the question to be answered, however. Regarding the common association of poorer quality with manuring, much of the blame laid on manures really might be due to the fact that manuring increased yields faster than firms were able to increase their factory accommodation in the early days of manuring. It was being rapidly corrected, but some of the blame might be assigned to that cause. Increasing the manure to 40 lb. of nitrogen per acre had not affected quality in their experience. As to the compounds in the tea leaf influencing quality, no precise knowledge had yet been gained. It was under investigation, but presented a very difficult problem. Every superintendent in Ceylon had been in his factory night and day trying to

improve it in recent years. There was no lack of effort in that direction. On the whole, the standard of plucking had become considerably finer during the last year or two.

Q. Had the T. R. I. any theory about the influence of locality upon quality?

A. They had been early forced to the conclusion that climate—both that in which the tea was grown and that in which it was manufactured — was a predominant factor in the production of quality teas. Environment was more important than the actual make-up of the bush. By environment he meant climate, soil, and all other things peculiar to the district in which the tea was grown.

Q. Sir Albert Howard had advanced closely reasoned arguments for altering the practice of forking green manures into the soil, which he maintained involved asking the soil in Ceylon to do a great deal too much. What were Mr. Tubbs' views?

A. The Institute did not agree entirely with Sir Albert Howard, though they supported him in regard to the districts where his experiments had been carried out—where, on the farms themselves, there were special pits and everything right on the spot for making humus. On such a basis humus could be made very cheaply, and cheaply carried to the field. But under the special conditions of growing tea in Ceylon, it could not be agreed that shifting green manure into pits or growing special growths was economic. It was a very expensive business to carry it to the fields in baskets in many places. For that reason the Institute had started a large experiment on this question. So far as they had gone the opinion was confirmed that it was purely the difficulties inherent in Ceylon which prevented the adoption of this method. For that reason it was better to dig the green manure into the soil *in situ*.

Q. The composting process which they had gone in for in Kenya had been favourably reported upon and might be valuable for Ceylon. Had the T. R. I. turned it down?

A. There was a possibility—he would not call it a probability —that it would be useful, and it was not turned down. Once again, it was a question of recommending what was economic. The matter was being investigated, and no attempt was being made to give a final verdict until the results of experiment were available. At present all that could be said was that it appeared advisable to be cautious in applying this process, because of the cost. Under Sir Albert Howard's system they had to grow, on special areas apart from the tea crop, the material which was to be turned into compost, and this was a very practical and real difficulty in Ceylon.

No further questions being asked, the Chairman, in the name of those present, thanked Mr. Tubbs for his lecture; and the proceedings terminated.