5. IMPRESSIONS OF THE BLISTER BLIGHT CONTROL PROBLEM.

(a) F. W. J. LANE (Plant Protection Ltd.)

My terms of reference were to consider and advise you upon the possibilities of large scale tea spraying. I arrived here on the 16th October and have had an opportunity of seeing a number of estates; mainly to study terrain and conditions. Apart from this I have also carried out a number of small scale experiments in order that I could appreciate better the practical side of your difficulties.

In a matter of just over three weeks the most that can be achieved is a general impression of what is involved. I think I can say that I now have a reasonably clear picture of what is involved. On the other hand I can also say that I cannot offer you any ready made solution. I would have no difficulty at all in telling you what couldn't be done but Dr. Greenslade will deal with this point.

My own particular province is studying methods of spraying and from my various estate visits there is one thing that I can definitely state. There is no one method that is applicable to all conditions. These vary not only from estate to estate but also on individual estates. Hard and fast regulations cannot be laid down and much work will have to be done before any particular method can be decided upon for any one estate.

As far as I can see at the moment I would say that estates, or rather areas, can be divided from the point of view of spraying into three rough categories. Firstly, some areas where technically it would be possible to spray but on economic grounds it would be ruled out. Secondly, areas where the knapsack sprayer is now and probably always will be the only answer. Thirdly, some areas where subject to modifications in layout larger machines might be used.

I said earlier that my own particular province was the study of methods of application. Before I start work two things must be known. Firstly, the history of the disease and secondly a chemical that will, if properly applied, give an adequate control. This information has already been obtained by the Tea Research Institute. With this information two problems present themselves with regard to spraying. Firstly, with regard to tea recovering from pruning for which there is a suitable chemical for spray application. Secondly, there is tea in bearing which represents a very much larger acreage and for which no suitable chemical is yet available.

Mr. Loos has given you some brief details of his own experimental work. In addition to these I have carried out experiments on very much the same lines. My experiments were carried out with a battery charging plant and a set of eight pneumatic sprayers. The sprayers were modified by the addition of a small boom to enable two rows of tea to be sprayed in approximately the same time that one is now sprayed using a conventional machine. The booms were fitted with low volume nozzles which reduced the application rate of the spray to 13 gallons per acre. The amount of fungicide was 4 ounces to every 10 gallons of water. The central charge pump was mounted on a lorry to make it as mobile as possible. On what might be described as

average terrain four labourers sprayed five acres in 3¾ hours.

It is admitted that conditions especially with regard to supervision were probably much better than the average estate superintendent has either the time or staff to achieve. If, however, these figures are analysed a little further they will, I think, be found most interesting. On the basis of the acreage sprayed in 3¾ hours the total covered in an 8 hour day would have been 11 acres. Including one man for supervision, one to operate the central charge pump and drive the lorry and the four labourers the total staff amounted to six. Without loss of spraying time the spraying force could have been increased to six leaving only two spare knapsacks for refilling instead of four. With six labourers actually spraying with the same amount of supervision the output would have been 15 acres in 8 hours. This experiment is, of course, open to criticism inasmuch as output per labourer per hour would be less after the first four hours. There were no breakdown of equipment. Water supplies might not always be readily available. Weather conditions might be unfavourable. If, however, to cover these eventualities and varying conditions of terrain we were to reduce the acreage sprayed by 50 per cent the total is still 8 acres per day for a labour force of eight men. With acreage to be sprayed every seven days it might well be possible with a battery sprayer of this size to make eight men responsible for an area of some 45-48 acres.

Organisation of supplies is, as Mr. Ananda Rau has already said, a very large factor in completing the work. Good organisation not only in this case but in every other can make all the difference between success and failure.

I have given figures relating to one unit; it is a simple arithmetical calculation to show how many such units would be required to spray 100 acres or 200 acres every seven days. As I have said before, small scale experiments are open to criticism, but I think that the evidence so far available gives ample ground for large scale experiments to find the best methods of organisation and supply.

Before leaving the subject of knapsack sprayers I would like to comment on Mr. Loos' figures relating to costs. To give a truer picture I think that cost of supervision and cost of depreciation of equipment must be added. I cannot give you figures for each of these three as the conditions vary considerably. However, the following information would be useful in calculating these :—

1. *Supervision.*—This is absolutely essential if you are to ensure that the work is properly done. With a properly deployed spraying team one supervisor should be adequate for every six labourers operating knapsacks.

2. *Depreciation.*—Three factors have to be considered. Firstly, standard of manufacture of the machine; secondly, standard maintenance; and thirdly, the way in which it is handled. From what I have seen the last item is the most important. Some of the methods employed by labourers in handing the equipment leave much to be desired. It is difficult to lay down hard and fast rules but I would suggest that depreciation might be as high as 40-50 per cent

I have talked quite a lot about knapsack sprayers, but I am quite certain that many of you hold the view that using these small machines is not the answer to a big problem. Mr. Morford has asked whether a machine could not be produced that would spray from the estate paths. Such an equipment would, from the general conditions, appear to be the only type that could be used. A machine that would carry the spray from the pathway over a wide area

of crop would be ideal. Two such types of equipment are the fog machine and the mist blower. However, both these types have limitations. In fine weather with still air conditions it is quite possible to distribute the spray over a wide area. Unfortunately, during monsoon seasons the fine weather and still conditions are rarely found, with the result that the range of penetration of the spray is very much curtailed.

From what I have seen of monsoon conditions the range of penetration of the spray would probably be no more than 30-35 feet. I mentioned fog machines and mist blowers. There is a certain amount of confusion with regard to them. They operate on entirely different principles and I think that some definition might help to give a clearer picture.

A fog machine produces very small particles of spray by introducing the material to be atomised into a combustion chamber. The resultant fog is then dispersed from the equipment. A mist blower is a definite attempt to reduce the quantity of spray required by replacing some part of the liquid by air. In addition the air is used to provide the energy to carry the spray to the crop.

Of these two types of equipment I think that a modified form of mist blower might be found suitable for use on a number of estates which are already well provided with paths or on those where, with slight alterations in layout, paths could be provided.

With regard to the fog machine there is no record as far as I am aware of it ever having been used successfully for the application of a fungicide. Apart from this, wind conditions would, in my opinion make the machine entirely unsuitable for use as it would be quite impossible to control the movement of the fog.

Dr. Greenslade will, I think, have something to say about other types of equipment which might possibly be used. However, we are faced with the problem that under the weather conditions experienced during the monsoon, the effective range of not only the mist blower but other types of machines is likely to be only 30-35 feet which means paths should not be more than 60-70 feet apart. As I said before, on some estates it might, without modification or with very slight modification in layout, be possible to use them. The whole question is, however, one of economics and large scale experiments under a variety of conditions is the only way in which the suitability of any type of equipment can be decided.

(b) R. M. Greenslade (Pest Control Ltd.)

When Blister Blight first hit the Ceylon Tea Industry it naturally became the duty of the Tea Research Institute to do something about controlling the disease. I understand that since 1946 several members of the staff, Dr. Gadd and Mr. Loos in particular, have had to give their whole time to the problem with the result that they soon got to know the habits and behaviour of the fungus causing the disease. Without this fundamental information it is impossible to make intelligent attempts to control any disease. If one rushes in wildly with large scale spraying, without this knowledge, it is possible to spend a lot of money applying the wrong fungicide at the wrong time and getting nowhere. One example will demonstrate the practical value of this

detailed study. Mr. Loos mentioned that the blight spores nearly all germinate on the upper surface of young leaves. The fact that it is only necessary to spray the upper surface of the young leaves makes all the difference between a possible operation and a financially impossible one.

When dealing with a fungus disease one first thinks of spraying as a cure. But spraying is an added expense on the cost of production of tea and, as some people forget, a recurring expense. Spraying is to be avoided if the disease can be defeated by some alteration of agricultural practice. You have, therefore, tried the methods described by Mr. Portsmouth and in many cases these alterations in pruning and plucking methods give you adequate control of blister blight.

On other estates where Blister Blight is particularly bad, or where alteration of the pruning cycle causes too much dislocation of the normal routine, it is necessary to consider spraying. The tea industry has been very fortunate in not having to spray before now, but this very good fortune means that there is no background of spraying experience and knowledge in the industry. The Tea Research Institute, therefore, considered it advisable to invite Mr. Lane and myself to study the conditions here and make some suggestions, before they embark upon extensive tests of the available spraying machines.

The spraying of tea resolves itself into two problems, the choice of a suitable fungicide and the choice of a suitable means of application. The first problem is partly solved. For the protection of tea recovering from pruning copper sprays give adequate control. For tea in plucking, as Mr. Lamb has explained, copper sprays cannot be used owing to the risk of leaving too much copper in the made tea. Some non-metallic fungicide must be found. Mr. Loos has tried most of the available forms of non-metallic fungicides with only partial success, but so much research is going into this question that I think it very probable that a suitable compound will soon be found. Mr. Harrison has mentioned a systemic fungicide. This means a chemical which could be sprayed on the tea bush and which would be absorbed by the old leaves and travel in the sap to the new leaves making them resistant to the fungus. This would be an ideal treatment since it would make it unnecessary to spray at such frequent intervals, and once the spray was absorbed into the leaf, no amount of rain could wash it off. I am particularly interested in this type of chemical since I have been associated with the development of systemic insecticides. and my firm's research department are testing materials which may be of use as systemic fungicides. Dr. Horsfall and his colleagues at the Connecticut State Experiment Station have shown that this form of fungicide is technically possible but it is not yet a commercial proposition. Possibly some such compound may be found suitable for Blister Blight but in the present state of our knowledge we cannot hope to adopt this method within the next two or three years.

The second part of the problem of spraying tea, the method of application, would be no problem at all if tea were grown on perfectly flat land. Spraying could be cheaply mechanised and blister blight very easily controlled. Given the existing growing conditions we must consider either spraying with knapsack machines or the development of special machinery for mechanised spraying Mr. Lane has dealt with knapsack sprayers : I need only say that I agree entirely with his conclusions that on many estates knapsack spraying is the only answer to blister blight As Mr. Lane and Mr. Ananda Rau have said, the cost of the operation can be quite

low if close attention is given to details of transport, mixing, water supply and training of labour and supervisors.

Since I have been in Ceylon I have noticed a certain amount of over optimism about what can be done by mechanical sprayers. This is perhaps natural when one's acquaintance with large spraying machinery consists of descriptions and photographs of machines doing jobs for which they were specially designed. As I have had some experience of using special machines on contract spraying where I have had to guarantee results, I have been able to learn some of the advantages and limitations of the various types, and it may be useful if I consider the main types in relation to tea spraying.

On seeing the broken nature of the tea country one thinks first of aircraft, particularly of helicopters, but these have the following disadvantages : the shade trees would keep the aircraft too high above the crop and would intercept far too much of the spray ; the higher estates are above the altitude at which available helicopters could operate with a full load ; most of the blight spraying needs to be done in the monsoon and no aircraft could be expected to fly into the higher valleys in the monsoon rain and wind ; the worst areas of all are the mist belts where no aircraft could ever fly. Aircraft spraying must, therefore, be considered impossible for this purpose.

The next type is the fog machine in which a fine mist of insecticide is allowed to drift long distances in the wind. This is a most excellent way of controlling flies and mosquitoes, but I do not believe it has yet been successfully used to form a protective deposit on a crop, and in any case there is no control over the fog, and in monsoon conditions it would be almost impossible to ensure that it is not blown away.

A third type is the "mist blower." In this case the fine spray is assisted by an air blast. The airblast enables one to project the spray in the right direction and the droplets of spray being larger than fog particles will form a deposit on the crop. Some of these mist blowers have hundred horsepower engines and produce a wind blast of 190 miles per hour. This principle might well be adapted to tea spraying, but any such machine small enough to travel on the ordinary tea paths could not be relied upon to throw its spray more than 30 feet from the path. In still air this might be doubled but at the normal spraying times we cannot expect much still air.

The remaining type of sprayer is the ordinary type used for fruit tree spraying in which the spray is carried by hydraulic force alone without the assistance of air blasts. Spray can be applied at 10 gallons to 20 gallons per acre if coolies using hand spray lances walk down the rows pulling hoses behind them. On some estates this may be quite possible but on others the heavy hoses may do much damage to the bushes. Spray can also be applied by high pressure jets directed by a spray operator from the tea paths, but again the range will be limited to about 30 feet from the path and to get this range considerably more water will be needed to produce a jet which will not be carried away by the wind. This again may be a practical method on some estates. An extreme example of this type of spray would be something on the fire hose principle with which the range could be very considerably extended, probably enough to operate from the ordinary cart roads, but it would be almost impossible to supply such enormous volumes of water and the very dilute spray so applied would be easily washed off in the rain.

I have mentioned three possible types of machines, besides knapsacks, but as Mr. Lane has stressed, to use any of them would involve alteration to the layout of the estate so as to have 3 foot paths every 60

feet across the hill slopes. On many estates this would be no great alteration. on others it would be very expensive or even prohibitive in cost. Whether such expense is justified on any particular estate depends upon the amount of damage being done to the crop, *and to the bushes*, and can only be judged by the man on the spot.

I think, however, that there is a very strong case for large scale experiments, presumably by the Tea Research Institute, to test the effectiveness and cost of these various methods of treatment. If such an experiment could be carried out on a scale large enough to give a true picture of the costs, then individual planters and estate owners would be in a very much better position to estimate the cost of treatment on their own estates.

DISCUSSION.

Dr. Norris then declared the conference open for discussion.

Mr. Lamb stated that as Dr. Greenslade and Mr. Lane had been very sparing with details of their experiences, he would like to mention that Dr. Greenslade had been associated with the team of workers who had developed systemic insecticides while Mr. Lane had taken a very active part in the International Colorado Beetle Campaign in Europe.

Mr. Portsmouth apologised for taking up the time of the members but wished to comment on a few points raised in Mr. Morford's and Mr. Ananda Rau's addresses. Mr. Rau, in his address, had stated that as far as Ceylon was concerned, the danger of carbohydrate deficiency existed only on estates below an elevation of 3,500 feet. Mr. Portsmouth said that during the last week or so he had seen areas of tea well over 4,000 feet in elevation with no carbohydrate in the roots at all. His advice was that such areas must be rested before pruning. During the resting period protection by spraying and supplementary manuring might also be necessary.

Mr. Portsmouth then dwelt with the points raised by Mr. Morford, seriatim :—

(1) *Resting tea.*—Resting must of course be done at any time necessitated by the state of the bushes. This meant that bushes may have to be rested during a period of heavy blister blight attack. If such was the case then spray protection might definitely be desirable.

With regard to the period of rest, all he could say was that resting must be continued until such a time as a healthy cover of foliage had been restored. The bushes might then be brought back into plucking by cutting across at such a height as to leave a good undercover of foliage below the new plucking level.

(2) *Manuring.*—A brief reference to this subject had been made during the morning and he only wished to point out that there was no scientific basis for the idea that either wood or leaf growth could be stimulated separately by varying the fertiliser ingredients. Good wood growth was only one sign of a healthy growing bush to produce which, adequate applications of a properly balanced mixture were required.

The full benefits of resting might not be obtained if growth was limited by manurial shortage.

(3) *Shade.*—Nothing in Mr. Morford's paper suggested any need for departure from the well established T. R. I. policy of judicious control of shade. Shade and green manures were of inestimable value to the tea and should not be cut out unnecessarily. Judicious thinning should, of course, be carried out in those areas where early morning mists hung about so that the sun could get to the bushes and dry them out. These, however, seemed to be mainly transitional areas in which blister blight infection was never very heavy. In bad blister blight areas the fields were shrouded in cloud or rain for most of the South West monsoon so that the presence or absence of shade would have little effect except at the end of the bad weather period.

(4) *Weed-killers.*—There was no known weed killer available, which would not also damage tea.

(5) *Pruning.*—He was only too glad to note that the fine art of pruning as known to some of our earlier planters was disappearing. If the saw was used today to the same extent as it was in the past then he was afraid that we should say good-bye to most of our Up-country tea in a very few years.

Mr. W. H. Attfield (Bosanquet & Skrine) expressed great pleasure at the presence of a representative of the Ministry of Agriculture (in the person of Dr. Pieris) at this symposium, and hoped that he would convey information about the proceedings of the symposium to the Minister.

Mr. Attfield said the Industry would need a great deal of money for the control of blister blight, it had already been allowed a certain amount, but a great deal more would undoubtedly be needed. He suggested that the Government should be approached with a view to getting back the tax levied on estates under the Food Production (Estates) Ordinance.

Mr. Attfield then raised the question of co-operation and enquired whether legislation would be brought in, and blister blight declared a serious disease which all estates should control. If so, about 20 per cent of the estates in Ceylon were non-company owned and steps would have to be taken to ensure that those estates would also control the disease.

Then there was the important question of discipline on estates. Mr. Attfield had reason to believe that there was already a political move to see that discipline on estates, particularly on company-owned estates, was completely destroyed, and enquired what the Government of the country intended doing about this matter.

Mr. Thambipillai (Dickoya District) said that most of the previous speakers had dealt with spraying. However, he now suggested that some volatile substance which was also a fungicide should be given to all the pluckers, so that on their plucking rounds they could impregnate the whole area with this fungicide and thus kill the spores. Mr. Thambipillai said he was surprised that the scientists did not think of this method previously.

Mr. L. B. de Mel (Kelani Valley) enquired whether it would be possible to reduce the strength of the Perenox to such an extent that it could be applied to tea in plucking.

Dr. Norris replied that it might be possible, by improved methods of spraying, to keep spray residues within the limits of tolerance for copper.

Mr. Brodie (Morawak Korale) asked Mr. Portsmouth whether it would be advisable, in view of the threat from blister blight, to open up new clearings at elevations of about 2,000 to 4,000 feet above sea level with seedling plants.

Mr. Portsmouth replied that assuming the areas had no old tea in them (Mr. Brodie confirmed that this was the case) then they would be bound to use seed, but pointed out that if blister blight was prevalent in that area, it would be necessary to protect the new clearings by spraying up to a fairly late stage of their growth.

Replying to a further query by Mr. Attfield with regard to the resistance of seed bearers grown from resistant clones. Mr. Portsmouth stated that, scientifically, there was no reason to suppose that anything, except a very small proportion of seedling progeny would be resistant. It really depended on the factors involved in resistance and he had no information to offer on this. All he could say was that only a very small proportion of the progeny could be expected to show resistant characteristics.

Mr. D. S. Sutherland (Dimbula) enquired whether it was possible for a bush to develop resistance to blister blight after repeated attacks.

Dr. Norris replied that there was no evidence of disease resistance developing in any other plant. The mechanism of disease resistance in plants was very different to that in animals, and it was most unlikely that a tea bush would develop resistance after repeated attacks of blister blight.

Mr. Bolster (Uva) wished to know whether the Institute had rejected any idea of controlling the disease by improving or correcting the nutrition of the bush. According to Mr. Harrison, blister blight was prevalent in North India from the end of the 19th Century, but it was only in the last few years that it had become a serious problem. Mr. Bolster enquired whether this could be attributed to nutritional factors.

Mr. Portsmouth said he had all along tried to emphasise that nutrition was very definitely a most important factor in dealing with any disease. It might not necessarily be that infection would be any less on healthy bushes, but the effect of such infection would be very much less on healthy bushes than would be the case on unhealthy bushes.

Mr. Mayne said that they had recently started manurial programmes and that there were a number of estates where some of the fields had been manured and others not. His experience was that there was a lower percentage of infection, as estimated by a flush count, in the manured fields than in the unmanured fields. It was noticeable that tea in manured fields grew very much faster.

Mr. Harrison said that as far as North East India was concerned, the disease was first found in Upper Assam and had remained there for a matter of 80 years. This area had always been the best fertilised, and from this fact, it would seem that blister blight seemed to have followed increased nutrition.

Dr. Norris pointed out that there were plots on St. Coombs Estate which had received full manurial applications and others which had not received any manure. The results of various experiments had shown that there was no significant difference in the way the various manurial treatments had affected blister blight incidence. If anything, according to these experiments, it would seem that blister blight favoured the manured fields.

Mr. Lamb pointed out that the plots referred to by Dr. Norris included plots manured entirely with compost.

Mr. Morford enquired whether the pruning cycle should be shortened or lengthened. He felt that, when pruning was as light as it was at the time of speaking the cycle should be shortened. He wished to consider the economics of spraying very large areas of tea recovering from pruning in relation to the length of the pruning cycle.

He was of the opinion that estates running a three year or four year pruning cycle could afford to spend far more on spraying than they could if they pruned every two years

Mr. Portsmouth replied that the length of the cycle would still be governed by economics. In other words, if it paid an estate to run a four year cycle instead of a three year cycle then that should be done. But if the crop of that estate was going to fall in the 4th year, then that estate must come back to the three year cycle, irrespective of whether it rested the tea or not. It was quite probable that in many fields, particularly those where a fairly long cycle was adopted, the continuing attacks of blister might so defoliate the bushes and upset the balance of crop, that the cycle might have to be shortened.

Ir. van Emden said he gathered that there was a certain degree of anxiety that blister blight might be due to Ceylon tea being too old and that the bushes had reached the end of their span of life. In this connection he pointed out that Sumatra's tea was only 20 years old and had been rested right through the war years, when production completely ceased. During that period some tea bushes had grown to the enormous height of 20 feet to 30 feet. After the war, tea production was started again, but in spite of this the blister blight situation in Sumatra today was far worse than in those areas of Ceylon which he had seen for himself.

Mr. van der Kiste (Dickoya) said that so far, discussion had been centred on the control of blister by means of spraying. He wished to know whether it was not possible to ascertain exactly what made certain bushes resistant to blister blight. He felt that if the Institute could find out exactly what made certain bushes resistant to blister blight, the particular character or substance might be developed. Mr. van der Kiste was of the opinion that the lines followed at present, viz. that of spraying, were only a very temporary palliative. What should be aimed at was the complete eradication of the disease, and this might be attained once the exact reason for certain bushes being immune or resistant to blister blight was discovered.

Mr. Ananda Rau explained that experiments were being carried out in South India in this connection, but up to date they had not been successful in discovering what made certain bushes resistant to the disease.

Mr. Portsmouth said that Mr. Loos had been very busy with full scale experiments with spraying equipment. This question would, however, be kept in the fore-front of the Institute's future programme and as soon as work on spraying experiments slackened, Mr. Loos would give the matter his attention.

Mr. Cameron (Dimbula) said that at the last conference, held in Kandy, the Chairman had asked if any one present at that conference could give him any figures for loss of crop due to blister blight. Nobody was brave enough to get up and answer that question, but one gentleman said that he could not give any estimate. Mr. Cameron was of the opinion that every planter present at this symposium would, in his own mind, have formed some estimate of the loss that can be attributed to blister blight on his own estate. He sought the opinion of the conference, especially that of the Tea Research Institute, as to whether the recurring attacks of blister blight had a progressively bad effect on the tea bush or whether recovery in the dry weather made the bush as good as a new one.

Dr. Norris replied that the general opinion was that repeated attacks of blister blight must have a harmful effect on the bush. As he had already stated in the morning, deterioration was already evident

on many tea estates but many factors were responsible for that state of affairs. Blister blight must not be made a scape goat.

Mr. Cameron wished to know whether loss of crop due to blister blight would progressively increase with time, and to this question Dr. Norris replied that developments depended entirely on what measures were taken against the disease. That was why resting had been advocated as one method of treatment. In addition, greater attention had to be paid to plucking, pruning, etc. As to how far these recommendations would succeed, especially in the mist belts, could not be predicted, but it was an approach to a possible solution.

Mr. Helling (Dimbula) stated that Mr. Lane had made some very disturbing remarks about rainfall when he had said that in areas having a rainfall of between 30 ins. to 50 ins. of rain per month, spraying would be out of the question. 30 ins. to 50 ins.of rain was quite normal under the monsoonal conditions in several districts in Ceylon, and if spraying could not be carried out during those periods, it would be difficult to carry out any spraying at all for purposes of gaining crop. Mr. Helling also referred to Mr. Harrison's remarks that leaf outgrows the spray and asked for information as to how this affected tea recovering from pruning, if such recovery took place during the season when blister blight was in force. Mr. Helling visualised that a certain number of buds and leaves would have been formed on the tea bush before the next spraying was done, and enquired how often that tea would have to be sprayed and, further, if the tea was recovering when the monsoon was at its peak whether it would be feasible to protect the young leaf to any worthwhile extent. Mr. Helling also enquired whether any experiments had been carried out to discover the effect of infra red and ultra violet rays on the tea bush, as a means of controlling blister blight.

Mr. Mayne pointed out that it was not entirely a question of the total rainfall, but a lot depended upon the form in which the rains came. Speaking of South India, he said that in the S. W. Monsoon in the peak period, when they had something like 100 ins. of rain, their number of dry periods was so small that any applications of fungicides would be washed off with very little chance of any deposit being left on the leaf. He had very little hope of successful spraying under conditions of that order.

With reference to Mr. Helling's query about the further growth of leaf after a spraying was carried out, Mr. Harrison said that was mainly the reason why spraying was carried out at close intervals of seven days or even shorter intervals. Fortunately, in N. India the period over which the blister ripens was only of a short duration. If blister blight appeared they made one application of spray quickly, and continued spraying at weekly intervals until it was possible to tip.

With regard to Mr. Helling's query on the use of infra red and ultra violet rays, Mr. Lamb stated that it was extremely probable that the effect of sunlight on blister blight spores was mainly desiccation but even if it was possible in the laboratory to control growth by ultra violet or infra red rays, the cost of applying treatment in the field would be prohibitive.

Mr. Campbell (a visitor from London) said that they had heard rather depressing news from the two spraying experts, and enquired whether the Tea Research Institute had carried out any experiments with the application of heat to the disease, by the use of hot air. He understood that there were some machines available in America with which it was possible to apply hot air to certain diseases. He appreciated that it would be a very expensive method of control. Nevertheless, he asked the question to broaden the scope of the discussion.

Mr. Portsmouth said that, from the experience he had had in the use of various temperature chambers of the type referred to by Mr. Campbell, viz. Dry Chambers, he could assure Mr. Campbell that the cost would be fantastic.

Mr. Pelham Roberts (Dickoya) enquired whether it was the right policy to pluck hard on blister blight attacked teas. As things stood, he felt that blister blight hit the bush hard, estates in their turn hit it harder, and the plucker hit it harder still. He also enquired whether it was right to stop supplying until such time as estates had no further trouble with blister blight. He was of the opinion that if estates stopped supplying, in a few years' time many estates would have got nowhere in the control of blister blight, and then matters might turn out to be disastrous. Some estates, with the suggestions made by the Tea Research Institute, had been able to put out bushes that had got a certain amount of foliage and he therefore could see no reason why estates should stop supplying.

In reply to Mr. Pelham Roberts, Mr. Portsmouth said that he had tried, in the morning, to make it clear that there were two distinctions with regard to blister blight attacks. Firstly, when the blisters were confined to the leaf only, it was unnecessary to pluck hard. But, in the second stage, when blisters appeared on the stem, probably below the fish leaf, and the whole of the shoot became blackened and died off, no good was done to the bush by leaving the third leaf. Certainly no good was being done to shareholders by not plucking. What obviously must be done was to pluck hard during the period of such stem attack. Afterwards the bush had to be allowed to rest to compensate for loss of foliage leaf.

With regard to Mr. Roberts' second query, viz. supply, Mr. Portsmouth said everyone would be pleased to hear that a certain number of estates in bad areas were still successful with supplies from seed, and where this was being achieved, he saw no reason why it should be stopped. He emphasised, however, that the point he was trying to make in the morning was that, where the percentage of establishment was so small as to be almost negligible the actual cost of establishment in the field would probably, when worked out, prove to be quite prohibitive, although the actual cost of putting out each single plant might be very low. What should be considered was not the number put out, but the number successfully established in the fields two years later. If any planter could succeed in doing this, no matter whatever methods were adopted, then he (Mr. Portsmouth) himself would be all in favour of it.

Mr. Fay (Uva) said he believed that the practice in Darjeeling was to break back young shoots when bushes recovering from pruning were attacked by blister blight, and asked Mr. Harrison whether he could give the meeting any information on this point.

Mr. Harrison said he had no information to offer on this point.

Mr. Lamb stated that when he returned from his visit to North India, he had told Dr. Gadd about the practice mentioned by Mr. Fay. Dr. Gadd had carried out a few experiments on St. Coombs, but Mr. Lamb could not remember whether anything useful resulted from the experiments.

Dr. Norris pointed out that, up to this stage of the proceedings, almost no views at all had been offered from representatives of the Uva District, and asked those representatives present whether they had any points which they wished to ventilate.

Mr. Cathcart (Uva) stated that their district seemed to be fairly well blessed as far as blister blight was concerned, and that up to date estates in the Uva district had

not been troubled very much with this disease.

Mr. Francillon (Uva), however, could not agree with Mr. Cathcart. He said a considerable amount of blister was in evidence on some estates. They were, however, fortunate in that their estates had only one attack during the year, but when blister was in evidence in that district it became a really serious menace and resulted in a certain amount of loss of crop.

Dr. Norris said that quite a number of Superintendents present at the meeting had some experience with Vegetative Propagation work on their individual estates, and the Institute would be very interested to know what success had been achieved in finding resistant bushes. If such resistant bushes had been discovered, the Institute would like to know whether, on putting them into the field, those bushes had maintained their quality of resistance. Any information on this point would be of considerable interest to the Institute.

Mr. Francillon said that he had marked out 100 bushes in recently pruned fields for Vegetative Propagation. He had watched these bushes gradually develop blister until finally the number was reduced to only one bush, and even that one bush had about 15 blisters on it. He had taken cuttings from that bush and put them into the field. It was, however, too early to give any indication of the results. He was of the opinion that the best method was to take cuttings from recently pruned fields, as there was little value in cuttings taken from older areas.

Mr. Bolster (Uva) stated that he had taken 20 cuttings from a resistant mother bush and planted them out last year. 18 of these cuttings had developed blister, and only two had remained immune to the disease. In all, 8 cuttings had come through so far, although they were attacked by blister, but actually only two cuttings showed any real promise of resistance.

Mr. Prichard (Messrs. Harrison & Lister Engineering Ltd.) enquired whether Mr. Loos could give him any information as to the exact time and type of weather conditions particularly favourable for the bursting of the blister. He would, for instance, like to know whether bright sunshine after a long period of mist tended to make the blisters burst. His object was to try and find out, from the practical point of view, if these spores could be tackled while still in the air, as this would give a better chance of fighting the disease than after it had actually settled on the leaf.

Mr. Loos stated that no details were available on this point.

Mr. Lamb stated that it was most unlikely that there was any special time at which blisters were liberated. It was largely a matter of the fungus reaching a certain stage of maturity.

Mr. Laurie (Hewaheta) enquired whether in the case of pruned tea, the Institute would advise that the side branches, which had been left on for a considerable time, should be left as they were, or whether they should be taken off after the 1st or 2nd round of tipping. He said that in one of his fields which was badly attacked by blister blight, the side branches were free from the disease but the central portions of the bushes were heavily attacked.

Mr. Portsmouth asked what the elevation of this particular area was, and Mr. Laurie replied that the field in question was at an elevation of between 3.500 to 4,000 feet, in a mist belt.

Mr. Portsmouth then said he considered that it would be dangerous to remove side branches in this particular case. If attacks of blister continued it was definitely a case for spraying.

Mr. Adams (Nuwara Eliya) said he wished to speak on behalf of an estate near Nuwara Eliya. The estate in question was at an elevation of about 5,000 feet and had about 1,000 acres of tea. The cure of the disease appeared to be worse than the disease itself. Such an estate must lose a good percentage of its crop due to blister blight. The percentage loss of crop was calculated to have risen from 3 per cent in 1947, to 13 per cent in 1948 and 20 per cent in 1949. The yield was undoubtedly more, but given a yield of 500 lbs. per acre for 1,000 acres=500,000 lbs., deduct 1/5 or 20 per cent and the loss was 100,000 lbs. Estates such as this could afford to spend a good deal if only to reduce the loss by half. On this estate, pruning was possible only during one time of the year, and by pruning at this time of the year recovery took place into fine weather, and this period was usually the time for the main crop. Thus, during the crop season, a good percentage of the estate was pruned down. In the first year, at the time of the normal crop, 1/3rd of the estate was pruned, in other words, 1/3rd of the estate's crop was lost that year. In the 2nd year, 2/3rds of the estate was not in full production at the normal crop period, and last year very nearly 3/3rds of the estate was not in full production at the time of normal crop, which must account for the big loss of crop. Mr. Adams pointed out that, unless spraying could be carried out during the wet weather, and pruning done as in the pre-blister days many estates must lose crop due to being pruned at the wrong time of year for crop, but at the safest for blister. He enquired whether the scientists could produce a spray which would assist or ensure recovery from pruning during wet weather so that pruning could be done as before.

In reply to Mr. Adams, Dr. Greenslade stated it would certainly be useless spraying if that spray was to be washed off the bushes immediately after application He pointed out that he had not been in Ceylon long enough to have experienced the full monsoon periods and as such did not possess a complete knowledge of monsoon conditions. But from the short period of his stay in Ceylon, he had seen and experienced enough of general conditions to form a general picture of the situation. Most sprays had to be given at least half an hour to allow them to dry on the bushes, so that they would not be washed off. If it rained within half an hour after spraying, most of that spray would be washed away, and such spraying could never be beneficial to the bushes. For effective spraying, there should be a certainty of reasonable conditions for at least half an hour after the spraying operations. As far as he could see, spraying could never be effectively carried out under continuously wet conditions.

Mr. Lamb stated that Mr. Loos had carried out experiments on St. Coombs to find out whether spraying tea during monsoon periods was feasible. These experiments had been carried out during the last S. W. Monsoon and Mr. Loos had obtained some promising results. Mr. Lamb then raised the question of rainfall distribution. If the estate Mr. Adams referred to had the light, misty type of rain during the S. W. Monsoon, then conditions on that estate would be very similar to those on St. Coombs. During the growing season there were usually some fine periods, sufficient to allow sprays to dry. In continuously wet periods with heavy rain the disease appeared to subside naturally.

Mr. Morford enquired whether there was any information as to the best time to spray, whether spraying should be carried out during bud break into wet weather or tipping into wet weather. He was interested to know which of the above two methods would produce better results.

Mr. Portsmouth replied that the answer to that question had not been found at the

moment. The main point, of course, was that if blister infection was about, then spraying must be started before one got actual signs of bud break. The spray has got to get on to the bush first, i.e., before the spore reaches it.

Dr. Dike (Metalo-Chemical Refining Co.) said he had spent a few weeks in America and has seen many spraying machines in that country. He agreed entirely with Mr. Lane and Dr. Greenslade that the most difficult problem at the moment is to find apparatus which would be suitable for use under conditions prevalent on Ceylon Tea Estates. In America everybody was convinced that the development of good machines had only just begun. Dr. Dike said he had some experience with aeroplane dusting and agreed with Mr. Lane that Helicopter spraying would not be beneficial on Ceylon tea areas. At the moment, however, new types of Helicopters were being evolved in America which are much cheaper and which might be very useful in the future. It would, however, be problematical whether even this new type of Helicopter would be suitable for spraying Ceylon tea areas. He was convinced that at the moment, the only type of machine which could be used with any likelihood of certain results was the knapsack. He informed the conference that in Holland and England they were at present evolving a new type of sprayer, a mist-blower, which had a range of about 120 feet. When this apparatus became available, Dr. Dike felt that it might be a solution to the control of blister blight.

Mr. Groves (Dickoya) asked for information about the weight of the knapsack sprayer, and said that the weight of the equipment was a very important factor to consider.

Mr. Lane replied that the weight of the knapsack sprayer varied according to the size of the machine and its make. The knapsack used in his experiments at St. Coombs carried 2½ gallons of water and had a total weight of 50 lbs. The machine could of course be lightened by carrying a smaller quantity of spray fluid. There were other smaller types of light-weight knapsack sprayers, varying from 25 to 30 lbs. in weight. Of course, no hard and fast rule could be laid down as to weight and different types might be required for varying conditions.

Mr. R. J. S. Bean (Kelani Valley) said that as Blister Blight was a leaf disease, it should be possible to control the disease by controlling the amount of susceptible leaf. He asked Mr. Portsmouth whether it would be possible to eradicate the disease by completely isolating a district in pruning, so that it would in effect mean complete defoliation of an area for a period of 2 or 3 months.

Mr. Portsmouth replied that it would all depend on what complete isolation meant. Theoretically, that is if isolation was complete, there was every reason to believe that eradication of the disease would be possible. Unfortunately, however, it was unlikely that complete isolation was attainable. Previous to 1949, Sumatra and Java were rejoicing in the idea of their isolation from Ceylon, but at this time, from what was said during the morning by representatives from that area, the disease was affecting Sumatra to a worse degree than Ceylon.