in 1925 while he was away at Home it was treated with a dose of mineral nitrogen. It was pruned in 1925, and was full of Shot-hole borer. His argument was that the danger was over-stimulation. His contention was that organic nitrogen would create a steady flow of sap the whole time. He thought those were matters that should be given attention to.

MR. JEPSON read from the report of experiments carried out to show that both manures had been tried.

THE DIRECTOR OF AGRICULTURE: The point raised by Mr. Horsfall is one that can be discussed at great length, but I do not intend to enter into a discussion of this kind at this moment. I will only suggest to Mr. Horsfall that he attend the meeting here on Saturday morning, when the question of the nitrification of various manures will be put before the Conference. He will then see that blood meal and other organic manures nitrify extremely rapidly, and there is every likelihood that their effect is not as lasting as the planting community believe at the present time.

MR. WINTER: The appearance of insects is also due to climatic causes, quite apart from manuring. This aspect should not be lost sight of.

BRANCH CANKER OF TEA.

C. H. CADD, D.Sc.,

Assistant Mycologist.

The term " Canker " in plant pathology is applied to wounds which extend to the wood and are surrounded by a callus or cushion of bark. Such cankers when they occur on the aerial part of a tea bush are generally known as Branch Cankers. It will be understood that the general term Branch Canker is likely to include cankers of different types and caused by different agencies, and which have no relationship with one another.

At present we can distinguish at least two types of Branch Canker on tea. There are firstly the small cankers usually found on young or red wood. These are commonly caused by the fungus *Macrophoma theicola* which attacks and destroys small elongated patches of the outer tissues of branches about 1 centimetre in diameter so that subsequently sunken wounds or small cankers are formed. This fungus has become known as the Branch Canker organism.

The second type is unfortunately the commoner type. This occurs on the older branches and is characterised by the presence of rotted wood in the large wounds which extend along the upper surface of horizontal branches. The wound as a rule runs parallel with the sides of the branch and varies in length with the age of the canker. When the rot reaches the main stem of the bush it works vertically downwards towards the collar and sometimes extends below ground level. Frequently the rotten wood is eaten out by scavenging termites and the wounds become filled in with ant earth. The damage is sometimes attributed to termites, by planters, but the Entomologists contend that these termites are merely scavengers and have nothing to do with the actual rotting of the wood. Branch cankers with these characters must be well-known to all tea planters and it is to this type of canker that I shall confine my remarks.

I have recently suggested in a short paper published in the Department of Agriculture Year Book for 1926 that this type of branch canker should be distinguished by the name " wood rot " to distinguish it from the type found on young branches, where usually the rotting of the wood is not evident. It must be admitted at the outset, that the wood rot type may in some cases be the final result of the Macrophoma type, but this in many districts is exceptional rather than the rule. The name " wood rot " fairly describes the large lesions on the horizontal branches and its use would prevent some little confusion.

Wood rot commonly starts at old pruning cuts. The exposed wood at such cuts forms a suitable starting point for the attacks of saprophytic, wood destroying fungi which cause a breakdown or decay of the wood. As far as we know at present these fungi are not parasitic, *i.e.*, they cannot normally gain entrance into the bush through normal, healthy, living tissues; they start on dead tissues. The heart wood of a tree is dead and serves only as a mechanical support. Trees become hollow as a result of the destruction of the heart wood by certain fungi. Such hollowed trees are mechanically weakened but they retain their external sapwood and cambium and can carry on their normal life processes. When a tea branch is pruned the dead wood tissues in the centre of the branch are exposed and it is on these tissues that the fungi make a start and initiate a wood rot. If the branch is vertical, the decay progresses down the centre of the branch so that the branch becomes hollow for some depth, yet there may be no external evidence that the branch is badly decayed. When the rot reaches a horizontal branch the decay continues but usually it comes nearer to the upper surface and ultimately destroys the uppermost wood of that branch. That leaves a thin shell of bark, usually dead above the rotten wood. When this breaks in, the large rotted lesion is exposed.

This rot is in many respects similar to that which occurs in cut timber or fence posts. The difference is that the rotting wood in a tea bush is surrounded by the living tissues of the cortex. It is probable, however, that when the wood rot is established within the bush, it is capable to some small extent of killing some of the living tissues, particularly on the upper side of horizontal branches.

Although I have named pruning cuts as the points at which the rot usually starts, it will be understood that the fungi may commence their activities at any point on the bush at which suitable dead wood is exposed. Consequently they may gain entry through the wood exposed by Macrophoma cankers or at the ends of branches broken through the activities of the Shot-hole Borer beetle. Probably branches broken by the shot-hole borer are better starting points than pruned branches owing to the rough nature of the fracture.

The key to preventive treatment against this disease is the protection of all exposed wood surfaces against infection by the wood rotting fungi. This necessitates very careful pruning. All pruning cuts should be made obliquely and have a smooth surface. Dead branches or die backs must be pruned out and broken branches trimmed up. Then tar or other antiseptic protective covering which will resist weathering should be applied. This must be done with care so that the tar is applied to the wood surface only.

If the tar is allowed to run down the bark it will kill the bark with which it comes into contact. At each pruning the old cuts will have to be retarred in order to maintain the covering. This treatment will increase the pruning costs to some extent but it should prove far less expensive than curative treatment.

Curative treatment necessitates the destruction or removal of the fungus which causes the rot, and some means of preventing reinfection. The simplest way to do this is to prune the affected branches back to sound wood and to tar the cut end. This should be done before the rot reaches the main stem. As Mr. Petch has pointed out in his book on tea diseases, it is not sound practice from an economic standpoint, to undertake a sudden crusade against every cankered branch. He states " For years these wounds have very little effect on the crop. The young wood at the ends of the branches continues to flush, and badly cankered fields, where nearly every horizontal limb has been hollowed out, have regularly yielded a thousand pounds of made tea to the acre. To remove everyone of these branches at the same time would reduce the crop to a very small figure. They must, however, be removed ultimately to prevent the rot descending into the main stem. Under the circumstances it would seem preferable that, as a first treatment, the worst cankered branches should be removed, and the remainder treated by scraping out the dead wood from the wound and applying tar or some other preservative. At the next pruning, the operations should be repeated, the worst branches being removed as before; and this should be continued at each successive pruning until the field is clean."

Where the rot has reached the main stem as it has done on many estates the removal of the diseased tissues would necessitate collar pruning. There are many practical objections to collar pruning, and no doubt there are strong objections to the removal of the main branches of the frame although they bear large cankers. A treatment is required which will not necessitate the entire loss of the main stem nor the entire removal of the larger branches. Experiments have consequently been carried out on several estates to stop the progress of the rot without pruning off the affected branches. This is attempted by (1) scraping out the diseased tissues and (2) the provision of a protection against reinfection. On side branches the protection against reinfection is provided by a coating of tar, or a mixture of tar and wax, or other similar covering which will resist weathering. Where the main stems have been treated the protection is provided by filling the cavities formed by the cleaning out process with such material as cement and sand, asphalt and such like. It is not my purpose to discuss the relative merits of the various stoppings used. I propose to confine my remarks to a few of the theoretical considerations which underlie this treatment and to give briefly the result of some small technical investigations into the subject..

The efficacy of the treatment will depend almost entirely on the thoroughness with wich the diseased material is removed from the wound before the filling is applied. If any fungus which causes a wood rot, is left alive within the wound, the stopping itself will not prevent the progress of decay. Nor will a disinfection of the wound be o fany value unless the disinfectant penetrates the infected wood to the utmost limits to which the

fungus has reached and there kills it. Much therefore depends upon the extent to which the fungus has penetrated the wood. When a wood rotting fungus penetrates into sound wood it starts certain activities which cause chemical changes in the wood cells resulting ultimately in a breakdown or disintegration of the tissues. The process of decay in tea wood is relatively slow and while it is occurring some of the fungus hyphae penetrate further into the sound wood preparatory to a more complete attack upon the cells. The removal of obviously decayed tissues is not sufficient, as if only decayed and partially decayed wood is removed, the fungus in the apparently sound tissues is left to carry on the progress of decay.

The determination of the distance to which the fungus has penetrated into apparently sound tissue is not easy to make. In most wood rots, at the incipient stage the infected wood exhibits colour changes, although to the naked eye it appears to retain its structural characters and has not become softened. Other fungi however cause no discoloration during the early stages of attack. At present we do not know how many fungi can cause wood rot in tea nor whether they all act in the same way. Where there is a discoloration of the wood below a rotting area we may be sure that the fungus is present though we may not be equally certain that the fungus is not present in normally coloured tissues.

A tea bush growing near the laboratory was collar pruned in November, 1924, at about four inches above ground level. The cut surface was clean and healthy and measured 3 to 4 inches in diameter. No protective covering was put on the cut so that wood rot might start. In January, 1926, *i.e.*, 14 months later, the bush was dug out in order that the progress of the wood rotting fungus might be determined. The cut surface was then seen to be corroded irregularly and the completely decayed wood had been removed, apparently by scavenging termites. A longitudinal section through the stem showed that severe rot had progressed irregularly; in places not more than a quarter inch had decayed and been removed, while in others the rot had extended to a depth of 2½ inches. The remaining tissues were hard and similar in texture to normal wood, but the parts adjacent to the rot were faintly discoloured chocolate brown. The discoloration extended to a maximum depth of 2 inches below the severely rotted wood; in other parts the discoloration did not extend beyond a ¼ inch.

Another but smaller bush was treated similarly. The rot in this bush was not quite so severe. Termites had removed the rotted wood to a maximum depth of 1 inch and the maximum length of discoloured but hard wood was 1½ inches.

A microscopic examination was made of the discoloured tissue for the presence of fungus hyphae within the cells. The fungus hyphae in the incipient stage of wood rot of tea are thin and very transparent and are easily confused with hyaline fragments of wood cells. But by suitable methods of staining the fungus was found in all the discoloured tissues but not in any great abundance. The presence of the fungus in these tissues, however, is sufficient for the rot to continue. Hyphae were not found in the normally coloured wood below the discoloured tissues though I would not guarantee from microscopic examination alone that the fungus is not

there. It can be stated definitely, however, that the fungus is present in the discoloured yet hard, unrotted wood.

It would appear essential then, that the cleaning process must include the removal of this slightly discoloured wood. The discoloration is not marked and though it may be easily recognised when seen in a section through the stem I doubt very much whether it would be so readily noticed on the shavings made during the cleaning operation in the field. Moreover this wood in the incipient stage of rot is quite as hard as normal wood and cannot be distinguished by its texture. It seems probable, therefore, that in many treated cases some infected wood will be left within the wounds and this will ultimately lead to further decay. It may be some years before this later decay becomes evident, as no doubt the cleansing of the canker will cause a temporary check to the progress of the rot, and the filling will effectively hide further developments from view.

Many technical aspects of the problem of wood rot of tea remain to be investigated, and the best treatment for this disease has yet to be ascertained. Surgical methods such as the cutting out of diseased wood and the filling of the cavities with cement and sand have been successfully applied to many trees, but whether such methods can be applied equally successfully to a small bush like tea remains to be seen. Bearing in mind the technical and practical difficulties I am not very optimistic about it. Much more information is required before we can arrive at a definite conclusion as to whether the treatment of cleaning out and filling the cavities with various mixtures is likely to prove efficacious on a large scale. One thing yet to be determined is what is actually taking place under the fillings now inserted. The experiments now being carried out on several estates should add considerably to our knowledge of this subject.

At present the surgical methods, *i.e.*, scraping and filling, cannot be recommended for adoption on a large scale, the pruning method as recommended by Mr. Petch is to be preferred.

DISCUSSION.

THE DIRECTOR OF AGRICULTURE said that this paper was presented as a result of the considerable amount of attention that was being given to branch canker of tea, which Dr. Gadd now proposed to call wood rot. A number of experiments had been made on estates—some of them were very expensive, costing between Rs. 60 and Rs. 80 an acre. The research work carried out in the mycological division of the Department indicated that in the wood they had a living fungus, and that it would be difficult to get it out. Dr. Gadd has sounded a note of warning to estates. It was with a view to sounding that note of warning, and to prevent estates from spending a lot of money on a practice, the efficacy of which was in doubt, that Dr. Gadd had presented that paper.

CONCLUSION.

At the conclusion of the programme for the morning, HIS EXCELLENCY THE GOVERNOR said:—This brings the morning's programme to a close, and I am sure you wish me in your name to thank the gentlemen who have read the various papers and those who joined in the discussion. One of the subjects which has been dealt with this morning, that of insect pests, reminds me of a legend concerning an international incident to which the Agricultural Department of Ceylon, while innocent was held to be none the less responsible. Before the war, the German Colonial Government at Samoa addressed the Colonial Government of Ceylon and asked if it would be so good as to send a large consignment of Para rubber cuttings to Samoa in order that they might begin, as rapidly as possible, competing with one of our local industries. The Government of Ceylon which, as you know, spends laborious days in efforts to satisfy and please its neighbours, not always with absolute success (laughter), sent the necessary instructions to the then Director at Peradeniya and told him to select with the utmost care the cuttings in question and see that they were despatched to Samoa in the best possible condition. The instructions were duly carried out, and the cuttings were sent to Samoa. They were packed in earth to preserve them. But unfortunately, and of course, unknown to anybody there lurked in that earth the larvae of the Rhinoceros beetle. You perhaps know the insect in question. I remember the story about a resthouse-keeper in the Western Province when I was here before at the time the Medical Department was making many efforts to deal with the anopheles that prevailed in the island, in the course of which they issued a sheet upon which enormously exaggerated was a picture of the anopheles mosquito about three thousand times its ordinary size. The Resthouse-keeper came to me with the Rhinoceros beetle and asked me whether that was the insect against which the Government was at the moment at war. The Rhinoceros beetle was unfortunately sent to Samoa and it did damage to coconuts and cacao. I am told that the Rhinoceros beetle is here kept within limits owing to certain natural enemies which devour its larvae as they are produced, and the beetle does not do the great damage to the coconut industry as it did in Samoa. In Samoa the natural enemies are not in existence and the result was devastating. No argument or persuasion ever served to convince the Government of Samoa that the destruction of their industry was not a deep design of the British Government. (Laughter.) I do not wish to detain you any longer, but I wish to say that the discussions this morning were most interesting. I may say that Major Oldfield will preside at the afternoon sessions.

THE DIRECTOR OF AGRICULTURE thanked His Excellency for presiding that morning.

MARCH 11TH, AFTERNOON SESSION.

MAJOR OLDFIELD, Chairman of the Planters' Association of Ceylon, presided at the afternoon sessions. And in taking the chair, he said that he had to thank Mr. Stockdale and the members of the Rubber Research Scheme for allowing their officers to lecture to them on these subjects. He said that the scheme was being carried out by private funds and papers referring to their work were treated as confidential. Therefore, it was very public spirited of them in giving the public the benefit of their research work.

METHODS FOR PREVENTION AND CONTROL OF DISEASE IN PARA RUBBER CLUTIVATION.

J. MITCHELL, A.R.C.Sc.,

Organising Secretary, Rubber Research Scheme (Ceylon).

In this address it is proposed to deal only with those diseases which are of primary importance to the rubber industry in Ceylon. Again, it will be presumed that the symptoms of the diseases concerned and the nature of the casual organisms are familiar to all either from practical acquaintance with them in the field or from a careful study of such works as " The Diseases and Pests of the Rubber Tree " by Mr. T. Petch. A copy of this book should be on the desk of every rubber estate Superintendent.

For the purpose of this address diseases will be grouped under three heads: (1) Root Diseases; (2) Stem Diseases; and (3) Leaf Diseases, as methods of prevention and control in each group are closely alike.

Root Diseases.—The primary root diseases in Ceylon are " Fomes Lignosus," " Poria hypobrunnea," " Sphaerostilbe repens," " Fomes lamaoensis " (Brown Root) and " Ustulina zonata."

The root disease caused by " Xylaria Thwaitsii " has been responsible for many deaths on one estate but cannot, as yet, be said to be a primary root disease in Ceylon.

" Fomes lignosus," " Poria hypobrunnea," and " Sphaerostilbe repens " have one feature in common in that they progress by means of well defined threads which in course of time pass from an affected tree to neighbouring trees and thereby lead to infection in ever widening circles. It is this mode of progression of the fungus that has led to the widespread practice of trenching as a means of prevention and control of each of these diseases. On the face of it this would appear to be a very sound thing to do but unfortunately one finds in practice innumerable failures following this method. The reason for this is not far to seek for, in numerous cases, the position of the trench is chosen in a haphazard fashion without regard to the fact that the mycelium of the fungus may already be beyond the limits chosen for the trench. In due course the disease is seen to have spread to neighbouring trees and the process of trenching is repeated. It soon became evident to the more careful observers that there was a flaw in this method and to overcome this a system of guard-trenches was adopted in which a ring of trees adjacent to the affected one was enclosed by a further trench. The obvious disadvantage of this method lies in the fact that under the circumstances these trees were more or less doomed and this has proved to be the