

## BROWN BAST—AN ENQUIRY INTO THE KEUCHENIUS TREATMENT.

The following article is taken from *Recent Developments in the Rubber Planting Industry with special reference to Budding, Brown Bast Treatment, Manuring of Rubber, Etc.*, by Herbert Ashplant, A.R.C.S., *Government Rubber Mycologist, South India*.

The mycologist of the Holland-America Plantations in Sumatra, Mr. Keuchenius, who has been working on the Brown Bast problem continuously since 1917, issued some time ago the results of his investigations. The original paper was written in German, and has appeared only in a German scientific journal. Owing to this, and to the fact that the one other account—a short summary—was published in Dutch, British rubber planters, with few exceptions, have remained in entire ignorance of work which may be regarded as the latest real contribution to our knowledge of Brown Bast.

Some of the results of the above-mentioned investigations appeared to me to be of such importance that I lost no time in bringing them to the notice of South Indian rubber planters. A few estates took up the new treatment straightway, and on others preparations were made for doing so. Disappointment with the results of past Brown Bast work had, however, made planters generally somewhat sceptical of the value of any measure against Brown Bast, and it was felt by certain planters who were keen enough to begin, that before committing themselves to further expense, it would be a good thing to get some first-hand information as to the effectiveness of the Keuchenius treatment. It was one of the objects of the writer's recent tour to obtain this fuller information.

Thanks to the courtesy of the H.A.P.M. Authorities, who gave me every facility, I was able to spend several days on their properties looking into the results of the Keuchenius Treatment. During my visit I was fortunate in meeting Mr. Keuchenius himself, and in being shown by him over the treated area. Mr. Keuchenius demonstrated the method of applying the Isolation Treatment under different conditions and cleared up certain difficulties. Together with him, I inspected treated trees, new and old, and witnessed the Brown Bast gangs in operation.

As it is difficult to give my impressions of the results of the Isolation Treatment without reference to the details of treatment I have thought it advisable to repeat here the summary of Mr. Keuchenius's views of Brown Bast, and method of treatment previously circularised to South Indian planters. Comments on the treatment are made in the course of the description, and further comments follow at the end.

### THE KEUCHENIUS THEORY OF BROWN BAST.

Dealing first with the nature and behaviour of the disease (which Keuchenius still holds is of bacterial origin) briefly, the investigations referred to show:—

- (1) That Brown Bast is essentially an affection of the latex tubes, and is propagated from point to point in the tree solely along the latex tubes.
- (2) In its original incidence, the affection is exceedingly local, and is limited to a very small area.

(3) The subsequent spread of Brown Bast, until it assumes the dimensions usually met with, is due to continued tapping on or in the vicinity of the diseased area. (This transference of the affection from diseased to healthy regions is termed by botanists "metastasis").

(4) The extension of the disease can be prevented entirely by the isolation of the affected zone by means of a deep channel to the cambium.

(5) Provided the isolation is efficiently carried out, tapping can be proceeded with anywhere outside the isolated zone, without any danger of the Brown Bast spreading thereto from the old patch.

That the continued tapping of a diseased tree would be likely to lead to the extension of the affected area is, of course, really implied in point (1), for if Brown Bast is a disease of the latex tubes, and is propagated solely along these tubes, it is easy to understand that tapping, by causing the movement of contaminated latex from diseased to healthy tubes, will, in all probability, set up the affection in these as well. It follows, also, from the same theory that the complete severance of all connections between the latex tubes in the Brown Bast affected zone, and those outside, would prevent the disease passing over.

There is, however, one difficulty which will arise in the minds of most people, and this difficulty I will now anticipate. Admitting, in the light of the theory expressed, the impossibility of the disease crossing the isolation gap, what, it may be asked, is going to happen when the gap has, in the course of time, been bridged by the development of new tissue? Once the connections are re-established, will not the danger of Brown Bast spreading be as great as before?

In answer to this question, it may be pointed out that contrary to popular belief, the latex tube connections, sundered by deep channels of this sort, are never re-established. Latex tubes are slowly regenerated in the new tissue behind the wound, but these are not continuous with the old ones on either side of the gap, and are quite unconnected therewith. The wound tissue, termed by botanists, "callus," which fills the gap, is distinguished entirely from the tissue cut away, and, as one would expect from theory and Keuchenius's observations, confirm, this "callus" forms just as effective a barrier to the passage of Brown Bast as an actual gap.

Keuchenius stated in his original paper, that out of the many thousand diseased trees so treated on the five thousand acres embraced in his experiments, not one case has been observed where the Brown Bast has spread from the isolated patch first affected, to the tissue outside. This statement is not wholly correct, for the writer, during his recent visit, found several instances in which the disease re-appeared outside the isolated zone. The number of cases in which this had happened was, however, infinitesimal, compared with the scores of thousands of trees on which isolation had effectively checked the spread of the Brown Bast, and when looked into, the apparent failures could nearly always be traced to imperfect isolation in the first instance.

Many of these failures find their explanation, it seems to me, in the procedure followed on the H.A.P.M. The control measures against Brown Bast on the H.A.P.M. are so contrived that the outbreaks of the disease

are spotted in the very earliest stages, and treated before they have involved large areas of cortex. Such stress is laid upon promptitude in treatment that at one time it was the custom to gauge the efficiency of the staff (both European and Native) by the proportion of large-area-infections recorded in the fields under their supervision. Where the supervision is good the majority of cases of Brown Bast are spotted and treated before they have spread beyond an area of a square inch or so. Should many cases be found in which the affection has extended, to say, three square inches in area, faulty supervision is suspected.

It is perhaps to be expected that on estates where the principle of keeping the affection to the smallest possible dimensions is constantly insisted upon, the Brown Bast coolies endeavour to make the isolation channel as near to the limits of the disease as possible. The result of this (since Brown Bast in its incipient stages is scarcely visible to the naked eye) is that, in a small percentage of cases the isolation is imperfect.

I draw attention to this feature of the procedure merely in explanation of the misses. I do not criticise it, because this policy of restricting Brown Bast damage to the narrowest possible limits, though risky, has much to be said for it under the conditions of the estates described. The policy insures that the minimum area of bark is wasted, and as the Brown Bast gang returns every 14 days, any imperfectly isolated examples can be dealt with in the following round before they have spread to a serious extent.

It is necessary to say that the policy of running things fine is only applicable under conditions akin to those on the H.A.P.M., where the isolation gangs return frequently and regularly. The irregularity of the disease work on most estates and the lack of the efficient control possible on the H.A.P.M., make it desirable to insist on the isolation channel being cut well to the outside of the disease. The first isolation should be the last one.

#### HOW TREES ARE RID OF BROWN BAST.

There are three conceivable ways in which a tree may be rid of Brown Bast :—

One is to strip the tree bare to the cambium, thus removing all unhealthy tissues. The stripping operation is drastic, but where it has been successfully performed, the new tissues which arise have been found to be free from disease. The defect of the stripping method is that it involves the entire destruction of all the laticiferous layers. As these are only replaced slowly the yields obtained from the renewals after stripping are exceedingly poor.

The second method is the familiar scraping treatment. Although, as originally carried out, this was a drastic operation, aiming also at nothing less than the complete removal of all diseased tissues, scraping seldom achieved its aim in practice, and such scraping as has been performed of late has consisted in the removal of the outer diseased layers only. The deeper layers are left for the tree to throw off—a process which has occasionally been assisted by the application of tar and such like medicaments.

The other conceivable method which is really no method at all, is where the tree is left to cure itself by the unaided agency of its own natural healing forces. Left alone, the tree naturally endeavours to throw off the affection. This it does by forming a layer of cork between the

healthy and diseased tissue. The formation of this cork layer leads to the drying up of the tissues external thereto, and they tend in the course of time to scale off.

Whether there is ~~such a thing as "self-healing"~~ in the case of a *Hevea* tree, affected by Brown Bast, has always been seriously doubted. Keuchenius, however, contends that trees do certainly cure themselves, provided "metastasis" is prevented by the isolation of the affected area, and provided also that tapping is limited to the unconnected zone without. Apart from the isolation operation referred to all that is necessary, in his opinion, is the excision of the burrs which occur occasionally as a secondary phase of the disease.

According to this view the curing process may be left to the tree itself. The repeated scaling off of the outer bark, initiated by the formation of wound cork, will, in time, rid the tree of most of the diseased latex tubes. A few will remain for years, but these gradually undergo necrosis, and after a short, though undefined period, become as so much dead harmless tissue. The position of these necrotic latex tubes quite near to the surface, and the fact that they are functionally unconnected with the newer series of latex tubes, prevents the further spread of the disease from the old degenerated layers to the healthy tubes within. The time taken for the complete necrosis of the Brown Bast tubes may be three, or it may be five or six years, but as soon as this has taken place, the tree may be regarded as cured, and tapping can be resumed with safety on the seat of the old affection.

#### **DOES THE ISOLATION TREATMENT CURE THE AFFECTION?**

Remembering the miraculously rapid cures, claimed by Harmsen and others, as a result of applying hot tar, etc., many planters will be disposed to be sceptical of alleged Brown Bast cures. The more simple a cure professes to be, the more it is suspect. The fact that the treatment described is being practised daily on what are not only the largest, but the most scientifically-run estates in the world would, however, be a guarantee of soundness of the Isolation Treatment, even did not the theoretical case advanced for the treatment hang together.

Whether the cures claimed are beyond all doubt complete cures, only prolonged tapping on the treated zones will finally decide. Since treatment was not commenced until about five years ago, general tapping has not yet been resumed on the sites of the old disease on the treated trees. This much can be said, however, that wherever trial tappings have been carried out on zones, isolated, and believed to be cured, the yield of latex has been good, and the Brown Bast has shown no signs of reappearing.

Such a result, which has been repeated over and over again, is justification for thinking that trees on which Brown Bast is immobilized, so to speak, and prevented by means of an isolation channel from spreading to fresh fields, do throw off the disease in from four to six years. The disease seems to work itself out in the circumscribed patch. The appearance of the cortex, after this period supports this view, as also do the tappings which many estates are now carrying out on areas formerly scraped for Brown Bast, and rested for years. Cases have come within the writer's experience in which trees scraped for Brown Bast six years ago, and since rested, are, to-day, yielding latex freely on the zones previously diseased.

These trees, if one may judge from their yield recovery, and the non-recurrence of Brown Bast must be regarded as cured.

#### WHAT DO WE MEAN BY A BROWN BAST CURE?

The statement just made raises the question as to exactly what one means by "cure." If asked the question, a few years ago, one would have replied that by a Brown Bast "cure," one meant the complete restoration of the healthy tint to the bark as well as yield recovery.

When the problem is looked at a little more rationally, it is clear that this is rather an impossible demand. Once the tissue elements of a tree have been disorganized or converted into permanent structures (as happens, for instance, in Brown Bast cortex wherein the latex vessels degenerate, and many of the surrounding elements become dead stone cells), by no possible manner of means can a tree restore these altered tissues to their original condition. A tree can only recover by replacing all the altered elements by an entirely fresh set through the activity of its cambium. From this new tissue, and not from the rejuvenation of the old Brown Bast affected layers, the latex which we get when trees have "recovered from Brown Bast" is drawn.

With regard to the diseased elements, the tree has no blood to absorb them. They can only be got rid of by scaling. A tree, however, is unable to scale off useless layers in the rapid way animals throw off their old skins after cuticular affections. The scaling in trees is brought about by two factors—one physiological, and the other mechanical. Physiologically, a tree's chief reaction to wounds or disease stimulus is the production of cork. By the production of successive cork layers it continually endeavours to insulate its healthy cortex from the injurious influence of the overlying Brown Bast tissue. Since cork is impervious to water, and prevents the passage of food-stuffs, the effect of these corky barriers is to bring about the starvation of the external tissues.

The reaction described ends the direct physiological attempts of the tree to throw off the disease. The actual scaling off of the diseased layers is an indirect result of further growth. As the tree grows, by the addition of new tissues on either side of the cambium, the outer layers are compelled to spread themselves out over an ever-lengthening periphery. Being unable, owing to the presence of so many dead and inelastic elements, to expand in unison with the internal expansion, like healthy tissues, these layers have to give way.

In this way, through the production of cork, the Brown Bast layers are rendered innocuous; and gradually, under the tangential stresses created by the continued growth of the tree, become scaled off. Although the scaling process can be accelerated by bark scraping, which, as has been described, stimulates the production of a fresh cork cambium every time it is applied, the complete removal of tissues, which in bad cases of Brown Bast, may be half-an-inch in thickness, necessarily takes many years.

I have given this description of the healing process because, without some knowledge of what takes place, one's ideas of what constitutes a cure in the case of Brown Bast, must be rather cloudy. It will be evident from the foregoing, that, in demanding as a proof of cure, the complete removal of

every trace of diseases from the cortex, we have been demanding the impossible. For five, and possibly ten years (more where growth is slow) after the treatment, the bark will still contain discoloured elements.

The existence of mottled elements in the cortices of trees formerly affected with Brown Bast is then not to be interpreted as evidence of "non-cure." Keuchenius's definition of a cure from Brown Bast is the absence of metastasis. If, when the tree is again tapped, no further spread of Brown Bast occurs, the tree is held to be cured. His view, that the old Brown Bast layers become, after a number of years, necrotized, and incapable of setting up further infection, has already been fully explained. Experience of the isolation method on H. A. P. M., and the experience elsewhere of the scraping method, indicate the substantial truth of this view.

Since one must still expect to find in the outer cortex of a cured tree the residual traces of the old Brown Bast, the difficult practical point arises as to how one can tell when these discoloured elements have reached the harmless stage, and tapping can be resumed with safety. Though it is possible to get a fair idea of the stage reached towards recovery by inspecting the outer cortex, and noting whether it still retains the moist rotten apple appearance, which is the active condition, or has attained the dry brown mottled stage, indicative of innocence, the only real test of a cure is to tap the tree and see whether the disease spreads. The application of this test is more easily advised than carried out, and in practice, the best plan will, probably, be to fix a definite period like six years before recovery is assumed, and tapping recommended on the sites of former Brown Bast.

#### **SUCCESS OF THE ISOLATION CHANNEL IN PREVENTING THE FURTHER SPREAD OF BROWN BAST.**

So much for the curative aspects. With regard to the effect of the isolation channel in limiting the extension of the disease, the wide experience of the H. A. Plantations where the treatment has been applied over 20,000 acres or more amply confirm its value: The writer is satisfied from his recent visit and inspection of trees so treated, that the isolation channel, when properly made, entirely arrests the spread of Brown Bast. The great merit of the isolation method, apart from any question of cure, is that it permits of the continued tapping of the tree, whereas, with all other proposed remedies for Brown Bast, trees must be rested indefinitely.

#### **DANGERS OF DOING NOTHING FOR BROWN BAST.**

The foregoing general summary of the isolation treatment and its advantages will, it is hoped, be found useful by estates. For those planters who are still unconvinced of its value, or who prefer to do nothing, the following considerations are suggested:

Brown Bast has been proved to occur in much higher percentages on good than on poor soils. Appreciable additions to the number of affected trees are made regularly, even with alternate-day tapping. Brown Bast, indeed, seems to be an inseparable concomitant of tapping in any form we know of. It must, therefore, eventually involve a larger percentage of trees on the best than on the worst estates. Since the disease is propagated throughout the tree by the latex movements induced by tapping; a policy of *laissez faire* in regard to the trouble will only mean that the Brown Bast, which is increasing every year, will, by and by be spread all over the tapping

surfaces of the trees. The treatment proposed is so simple, and so inexpensive, that it would be foolish not to take advantage of the promise which it offers. The percentage of Brown Bast on the average rubber estate is high, higher, probably, than is generally supposed, and whenever the financial situation justifies it, I would seriously urge upon planters the desirability of taking up the systematic treatment of this trouble. Adverse climatic conditions have hitherto been a barrier to Brown Bast treatment, during the greater part of the year, and the stripping method is totally impracticable in countries like South India, but climate, obviously, is no obstacle to the newer method above outlined.

More or less what the treatment involves will have been gathered from the foregoing, but for convenience the procedure is recapitulated below :—

#### **PRACTICAL TIPS FOR THE TREATMENT OF BROWN BAST.**

(1) With a scraping instrument, determine the outermost margins of the disease. In order to do this, it is necessary to scrape as deeply as is possible without wounding, for frequently, in Brown Bast trees, traces of the disease are met with quite near the cambium.

(2) Having determined, with very great care, the zone where Brown Bast tissue fades into healthy bark, make with a gouge knife, a deep channel around the diseased patch, almost to the cambium. This done, run a sharp knife—a penknife for preference—along the bottom of the channel, severing tissues right to cambium, and completely isolating the disease. A fine knife is used for finally severing tissues to cambium, since this avoids the bad wounding and bumpy renewal which occurs when the gouge tapping knife alone is employed for the purpose. This isolation channel should, for safety, be made a little outside the area actually found diseased. In fact, where there is any doubt about the exact limits of the disease, it is best to go two inches or more outside. *The importance of complete isolation must be emphasized, for if any diseased tissue is left outside the delimited zone the isolation cut is utterly useless.*

Where a lateral root is affected by Brown Bast, it will suffice to isolate it by making a circular cut on the tap root. Once the disease has been isolated, tapping can be proceeded with on a fresh surface outside.

Old cases in which the disease is confined to one half or one sector of the tree, but continues underground, present difficulties, since the removal of the soil from around the roots in order to make the isolation cut below takes time. The most practicable rule to follow here, is to isolate the diseased area completely (top, bottom and sides) only when this can be done without digging away of soil. Where the Brown Bast obviously extends far down into the tap root, the most economical solution is (after isolation of the tap region and sides of affected area above ground), to continue isolation channel right around the base of tree to other side, this isolating part below ground, and preventing disease being drawn up here. To avoid unduly depressing the yield from the healthy sector, the isolation channel made to keep disease from ascending to this region should be made as near to ground as possible. It should follow the outlines of the large laterals where they emerge from ground.

(3) In very old cases, where the disease is found to have extended almost completely around the tree, isolation can be accomplished by a

circular cut, e.g., by ringing the tree above the affected zone. Tapping can afterwards be carried out with safety anywhere above the isolated area, but since the latex tubes have been cut through it will now be necessary to make the cut at least two feet above the isolation channel in order to get a good flow.

(4) Every few months, all treated trees should be inspected for traces of burring, any burrs discovered being removed straightway before they have got too large.

(5) Such portions of the treatment as are indispensable have been described in (1) to (4). Those who so desire, however, can assist the natural tendencies of the tree to self-healing, and bring about a more rapid cure by scraping away all the superficially attacked bark. Although scraping is not absolutely essential, it is always recommended since recovery will thereby be accelerated. The more of the outer diseased layers the tree can be encouraged to throw off, the better, and "scraping" induces bark scaling.

As to the kind of scraping desirable, deep scraping, aiming at complete elimination of all diseased layers, and which requires skilful, trustworthy coolies, is not called for. The rule followed should be to scrape down until slight bleeding shows healthy zone to be reached. Don't worry about the discoloured tissue still remaining. This will scale off in time. Scraping of the kind described can be done by any untrained coolies, and allows of the skilled men being kept wholly on the recognition and isolation work.

(6) Once the treatment of the accumulated arrears of Brown Bast has been accomplished, it will be easy to keep pace with the new infections. For bringing these to light quickly, before the disease has involved a patch larger than a square inch or so, a fortnightly inspection is recommended, or instead of this, tappers could be given some encouragement to report all suspected cases immediately.

#### **COST OF BROWN BAST TREATMENT.**

On the H.A.P.M. Estates, regular gangs are employed for Brown Bast detection and treatment. These follow the tappers in the mornings and mark the trees diseased, returning in the afternoons and carrying out the isolation work. The skill and speed acquired by coolies after they have been employed a short time at this work are surprising. A gang of ten men with maistry suffices to detect and check in its very earliest stages all the Brown Bast occurring on 1,600 acres. This will give some idea of the modest outlay necessary for controlling Brown Bast, when once the arrears have been attended to. An expenditure of one cooly per 160 acres is surely not much to pay for freedom from such a serious disease, particularly when this immediate treatment keeps every tree in the tapping round.

#### **WILL THE SYSTEMATIC TREATMENT OF BROWN BAST INVOLVE LOSS OF CROP.**

The fear has been expressed that the adoption by estates with much Brown Bast of the curative measures suggested will lead to a serious drop in output. Where the work is done unintelligently, of course, this will happen, but there is absolutely no reason why crops should fall to any extent if the new cuts are properly placed, since the great advantage of the isolation method of treatment is that it enables every tree to be kept in tapping.

It is difficult to lay down rules for the subsequent tapping of Brown Bast isolated trees, but the principle followed when placing new cuts, should be to place them at such a height as to give an extra area of tappable bark equal to that temporarily out of access through disease. Where, for instance, Brown Bast has involved the remaining twelve inches of tappable bark on one sector, and this has been isolated, the cut should be changed to the opposite sector at a height at least twelve inches above that at which tapping would normally start. Better perhaps open cut 15 inches higher since the 3 inches of bark above the isolation gap will have little yield value, and is best pared away when reached.

In cases where the whole base of a tree is affected, and has been isolated, a fresh tapping area should be projected above, and the cuts placed at such a height as to permit of eight years' tapping before coming on to the old Brown Bast affected zone.

One may leave out of consideration here trees freshly attacked by Brown Bast, and in which there is plenty of healthy bark below the isolation channel on the sector affected, for it should be clear that in such cases, tapping will be resumed below, after isolation.

From these examples, planters should have no difficulty in placing the new cuts on Brown Bast treated trees in any of the cases which are likely to arise. It may be mentioned that there is no objection to using the vertical isolation groove as the run-off channel for latex in cases where its position will serve that purpose.

If the new cuts are suitably placed on the lines suggested, the amount of crop loss through Brown Bast treatment should be negligible. The high cuts will, of course, yield less than the former low cuts when healthy, but they will in most cases yield as much, or more, than these cuts have done latterly, since becoming diseased. Then, too, must be remembered the fact that many trees which had gone completely dry on their normal cuts, are now, subsequent to isolation, and the opening of new cuts, contributing to the output once more (*Vide Appendix*).

#### APPENDIX.

##### Brown Bast.

Since the writer's visit to the H. A. P. M., a slight modification in the method of treating light cases of Brown Bast has been introduced. The modification has to do with the fresh cases met in routine inspection only, and not with the arrears of advanced cases which have to be dealt with first on all old estates.

The treatment prescribed for such early detected cases depends upon the position of the infection.

(a) When a small infected area is found at either end of the tapping cut, the isolation is effected as described earlier on, *e.g.*, first with gouge knife, and subsequently with penknife.

(b) All other small cases more towards middle of tapping cut, are isolated by means of a V shaped cut, the top of V being left open. In making these cuts, a pen-knife or sharp-pointed knife only should be used (not tapping knife).

The cuts must reach to the wood.

The object of this form of isolation (which is found to be satisfactory for the special cases described) is to permit of tapping being carried out over the entire length of the cut, just as on undiseased cuts.

It is important that the cooly employed in the routine detection and treatment of new cases should follow close behind the tapper, and inspect the cuts before the latex has ceased running.

It is desirable to say that the modifications introduced do not affect the mode of treatment for the outstanding arrears of Brown Bast, which should be dealt with in the manner already described.

As it is difficult to explain clearly, without diagrams, the procedure to be followed in all the special cases encountered in routine inspection for new infections, a separate circular setting forth this will be issued later on to South Indian Rubber Estates.

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