



Rubber tree No. 1844, the tree with dark bark, at the foot of which the man stands.

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**HEVEA VERSUS FUNGI.**

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It has long been a commonly observed fact in the history of many crops that at first, with only small and isolated plantings, there is likely to be little if any trouble with diseases and pests. This has often resulted in giving planters ill-founded hopes and false assurances as to the future. As the area planted is extended and large sections of country become occupied with the crop, endemic fungi and insects gradually become adapted to it, and others slowly filter in from abroad. The latter occurrence is quite inevitable in new countries since the people of such countries cannot be convinced of the necessity of strict plant quarantine regulations efficiently administered, until driven to it by bitter experience—too late.

*Hevea* is a conspicuous case in point. A large number of fungi have become adapted to it in oriental plantings, and so far as production alone is concerned, fungi will constitute the limiting factor. It is perfectly characteristic of human experience and human failings, that planters and government administrators cannot be expected to become fully alive to the problems involved and the necessities of the case, until staggering losses have been suffered, or until wholesale infection has occurred. It was only after the coffee industry of Ceylon and Java was doomed that effective work began in the study of the Coffee Rust. It was only after thousands of acres of fine Florida orange groves were destroyed that people awoke to the importance of the Citrus Canker, as a limiting factor in citrus culture. Verily, we are anxious enough to lock the barn after the horse is stolen! But it is not *always* thus! The U. S. Department of Agriculture now has Dr. Weston—an able pathologist—stationed for a year in the Philippines to study the highly destructive oriental corn mildew. Why should this great expense be incurred when there is no corn mildew in the United States? *Because the corn mildew is not wanted there, and because, if it should by chance get there, it may be met with full understanding!* In this manner, active work is not only being done

at home, but in all parts of the earth, for the protection, present and future, of American agriculture.

A great industry like rubber growing representing investments of millions of pounds should be adequately protected. This means thorough and *timely* investigation of every possible prime factor and every related subsidiary factor touching the growing of rubber. It also means the employment of a large force of active and highly trained specialists and the establishment of numerous well equipped laboratories. The Hawaiian Sugar Planters have profited extensively by such an organization. The American Rubber Company in Sumatra evidently intends to do so.

The investigation of rubber diseases has usually proceeded by certain stereotyped methods. From diseased tissue, pure cultures are started in artificial media, the resulting growths inoculated into healthy tissue and the disease reproduced. The vegetative form at least of the specific organism is thus isolated, and then attempts are made to secure the spore bearing form in pure culture, to determine its identity and to determine the original sources and methods of infection. Unless all of this can be accomplished it frequently follows that effective sanitary and remedial measures are impossible to devise. Many fungi refuse to produce their spore-bearing forms in any ordinary artificial culture. However, all of these fungi will fructify freely under certain natural conditions. The perfect form of a certain serious apple disease was not known until finally discovered on small withered and weathered apple-mummies that lay on the ground beneath the tree. Numbers of other important cases of the sort might be cited.

It follows, therefore, that there is another important avenue through which these problems should be approached, and which is usually largely neglected. *Every fungus* growing on or in connection with rubber trees *should be known and its relation to this important crop thoroughly understood*. It is commonly the case that parasitic fungi produce spore bearing forms only after the affected tissues are dead and then, frequently, only under certain natural conditions. It follows that every fungus fruiting on dead Hevea must become an object for investigation. It is not safe to overlook one! Certain forms formerly supposed to be exclusively saprophytes, living only on dead tissue, have been found, under certain circumstances to be actively parasitic. This is true of even such a common saprophyte as *Polyporus hirsutus* Pers. *Trametes badia* Bk. may be purely saprophytic, but I found it in the Botanic Gardens, Singapore, on *Saraca declinata* with its mycelium penetrating living tissue. The life histories of every fungus appearing on Hevea—living or dead, should be clearly traced. From every fungus producing spores on dead tissue, inoculations should be made into living tissue, and in many cases they will be found to take hold with definite parasitic action. If *all* were included I have no doubt that the identity of various obscure fungus diseases would be determined by this indirect method, where other methods had failed. I also have no doubt but that it would bring to light

a number of parasitic diseases not yet known to planter or plant pathologist: and this is where we would like only too well to begin our knowledge of all plant diseases.

During a recent short term of service at the Botanic Gardens, Singapore, in the heart of the oriental rubber region, I began a simple census of the fungi to be found, in fruiting forms, on Hevea. The cutting short of my stay stopped the work almost as it was begun; but the meagre results obtained have been most astounding and indicate the almost complete former neglect of this subject in a country where it should have been receiving, long since, the most intensive attention. Out of the first fourteen fungi encountered, other than Basidiomycetes, *ten were forms wholly new to science and one represented a distinct new genus!* These have been determined by Saccardo, the dean of living mycologists, (in Bull. Orto Botan. R. Univ. di Napoli, VI, (1918), 40-65), as follows:—

On dying leaves.

*Sphaerella heveana* Sacc. sp. nov.

On dead limbs.

*Didymella oligospora* Sacc. sp. nov.

*Neotrotteria pulchella* Sacc. gen. and sp. nov.

*Eutypa ludibunda* Sacc. v. *heveana* Sacc. var. nov.

*Cryptovalsa microspora* Sacc. sp. nov.

*Peroneutypa heteracanthoides* Sacc. sp. nov.

*Nummularia repandoides* Fuch. var. *singaporensis* Sacc.  
var. nov.

*Daldinia concentrica* (Bull.) Ces. v. *escholzii* (Ehrenb.)

*Lembosia glonioidea* Sacc. sp. nov.

*Hysterium heveanum* Sacc. sp. nov.

On rotting stumps.

*Xylaria (Xyloglossa) tuberiformis* Berk.

*Xylaria (Xyloglossa) obovata* Berk.

*Xylaria (Xyloglossa) scopiformis* Mont. v. *heveana* Sacc.  
var. nov.

On rotting trunks.

*Pleonectria heveana* Sacc. sp. nov.

Of course it is probable that some of these are purely saprophytic, though no one *knows* anything about this. It will be recognized that a number of the genera are well known to include active and most serious parasites. On the other hand both saprophytes and parasites may be represented in one fungus genus: and usually nothing final can be said without careful investigation, since, as I have already stated, fruiting forms in dead or even rotting wood may originate from mycelia actively parasitic in living tissue.

The same spirit of inquiry should be directed toward all of the Basidiomycetes growing on Hevea. In the short time at my disposal I encountered the following on Hevea in Singapore:\*

\* All determined by N. Patouillard, Neuilly-sur-Marne (Seine), France.

On dead limbs.

- Favolus spathulatus* (Jungh.)  
*Hexagona cervino-plumbea* Jungh.  
*Hexagona pulchella* Lev.  
*Hexagona thwaitesii* Berk.  
*Lentinus leucochrous* Lev.  
*Lopharia mirabilis* (Bk.) Pat.  
*Polyporus flavus* Jungh.  
*Polyporus grammocephalus* Bk.  
*Trametes lachnea* Berk.  
*Trametes persoonii* Mtg. forma resupinata.

On rotting stumps.

- Polyporus hirsutus* Pers.  
*Polyporus rugulosus* Jungh.  
*Polyporus williamsii* Merr.  
*Trametes persoonii* Mtg.

It seems certain that in view of all the facts, even more rigid sanitation should be required in rubber plantations than among coconuts,—where sanitation is an effective protection against some of the most destructive pests and diseases. In a large and otherwise well managed rubber plantation on Singapore Island, where a considerable amount of thinning had been done some time before my visit, I found that the dead trunks and stumps had been left on the ground long enough to secure the development of vast numbers of fruiting bodies of a large series of fungi, thus insuring the thorough distribution through the plantation of billions of viable spores. To put the matter off by saying that most of the species are probably saprophytic is, I believe, in view of our almost entire lack of knowledge concerning them, merely “flying in the face of Fate.” Our very lack of knowledge should be the soundest possible reason for the most rigidly perfect plantation sanitation! I have long been interested in fungi and have pursued the subject in many countries, but have been always hard pressed to find any time for extensive field work. Yet I have brought together extensive materials in some of the most interesting groups of the Ascomycetes, and this, too, in groups in which good spore bearing material is usually difficult to secure. Much of this has been accomplished by a method which is simplicity itself. In the forest the distribution of spores of a vast number of species is very wide, in fact, almost universal, by reason of wind and rain. Therefore I have only to cut a bundle of fagots of any known tree and expose it to normal forest conditions to secure most of the fungi naturally adapted to that special substratum, both saprophytic and parasitic. Some species fruit only on decorticated wood, some only on young twigs, others only on limbs of special sizes and degrees of maturity and still others only on trunks or leaves; and different seasons will produce different results on all these types of substrata when handled as above indicated. Finding this method of the greatest success in the forest, I began years ago to apply it in garden, field, and orchard, securing in this way very fine fruiting material of a

large number of fungi, many known to be of great economic importance. In view of all of these facts I believe that the plainest common sense will dictate the necessity of the most rigid sanitation in and near rubber plantations.

This is all a look forward. The few plant pathologists who have been privileged to work in the Peninsula have accomplished results of value which should be in no wise discounted. But the "field is so great and the hands so few" that there is no present promise of our being able to compete with nature in this matter. The natural state of the forest is not only one of superabundant life but also one of wholesale and all-pervading death. The successful upsetting of the normal plan of nature, and maintenance of health and vigor in every individual of an extensive plantation, can only come out of comprehensive, intensive, and adequately supported scientific investigation.

C. F. BAKER.

### THE GARDENS' HEVEA TREE No. 1844, — *H. CONFUSA*, HEMSL.

Planted in the exact centre of a small rectangular bit of ground close to the office in the Economic Garden stood a rather small rubber tree which bore the number 1844. Its dark grey bark attracted attention to it; and when it was more closely examined the foliage was seen to differ from that of the neighbouring trees of *Hevea brasiliensis*. Its history was unrecorded: but by the way in which it stood, it suggested that it came by no accident, but was set in its position as something apart from the other rubber trees.

When it flowered in 1917 it was seen that the flowers removed it far from *H. brasiliensis*. The seeds also were found small, though not outside the extraordinarily wide limits in which *H. brasiliensis* varies: when it was tapped the latex was found to be yellow, meagre in amount and to remain tacky, with little elasticity. It appeared to be an undesirable type: but it was determined not to destroy it without enquiry. Flowering specimens were therefore dried and sent to the Royal Botanic Gardens, Kew, where Sir David Prain has been so good as to have it determined as *Hevea confusa*, Hemsl. The tree has now been destroyed on account of its proximity to the seed bearing trees, lest it should bring about cross-pollination; but seedlings have been raised in order that if any purpose is found for it, the species may be available.

*Hevea confusa* originates from British Guiana. It differs in so little from *H. pauciflora*, Muell. Arg., of the same region that to unite the two on botanical eye characters is quite justified; and if united, it takes the second name. Seeds of the tree 1844 had been sent to Dr. P. S. Cramer before flowers could be sent to Kew; and with no more material than this he had suggested *H. pauciflora*