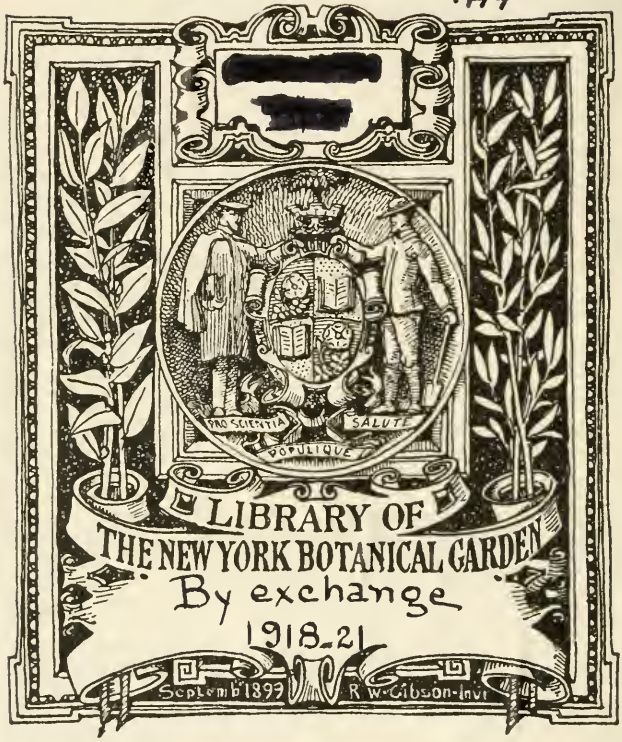
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The

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STRAITS SETTLEMENTS,

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DEPARTMENTAL NOTICES.

Plants of the Avocado or Alligator Pear—*Persea gratissima*,—and Brazil nut—*Bertholletia excelsa*,—to be sold within the Peninsula at fifty cents each.

Seeds of *Hevea brasiliensis*—Para Rubber—as available from trees, twenty-eight years old, to be sold at three dollars per thousand up to the number of ten thousand, and at two dollars and fifty cents for every further thousand on the same order.

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Photos by] [*H. Overbeck, Esq.*

Cycas damaged by *Catochrysops pandava*.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. II. Issued July 4th, 1918 No. I

CATOCHRYSOPS PANDAVA, A BUTTERFLY DESTRUCTIVE TO CYCADS.

Catochrysops pandava, Horsf., is a beautiful little butterfly when seen with its silky lavender blue wings expanded; but it is very destructive in a garden to Cycads: for the caterpillar is a *gourmet* and feeds on the youngest leaves, utterly destroying them, so that the plant is left untidy for the months which pass until it can produce a fresh crop. How untidy it can be, is seen in the accompanying plate. Cycads which had been attacked by the insect and had no young leaves left, produced in the Botanic Gardens a new crop at the end of three months, often only to be attacked again.

The butterfly is 30—35 mm. from tip to tip of its upper wings. The wings are silky lavender blue above shading slightly towards black, then bordered with a narrow line of black, outside a very narrow white line, with a black dot just inside the border on the lower wings and a fine slightly twisted black tail from the edge against it, this tail just tipped with white. Below the wings are dove grey with darker white-bordered wave markings and eyes chiefly in the outer half, and with a black eye marking against an orange patch at the hinder angle of the hinder wings. The body is steel grey below, and with the wings closed the insect at rest is well hidden by the pattern. The female insect is duller in colour above than the male especially by having much more black suffused through the blue on the upper surface of the wings: otherwise its colours are similar.

A female insect laying eggs, walks about the backs of the still curled pinnae of the Cycad leaves, moving the tip of her body up and down and at each light touch attaches a single egg to the surface of the plant.

These eggs are beautiful objects: they are depressed, and there is a slight pit at the unattached pole with round it rings of minute warts connected together by a slight webbing, the meshes increasing in size to the equator. Three or four days after the egg has been

laid a small white caterpillar breaks through outward and commences to feed; for that purpose generally moving to the upper side of the uncurving leaf. It is shaped like most caterpillars are, except for a tendency to draw its head under the body; it has relatively long, pale, but not numerous hairs. Later it changes colour and develops a fold down either side joined, each to the other, in a kind of collar at the back of the head, which quite alters its appearance; for now it is flattened, and the legs and head are hidden. In the course of three weeks, it has grown to a length of 8 mm. with a breadth of 3 mm. It is more conspicuously flattened towards the head and towards the tail than at the center of the body; but nevertheless is flattened throughout. Its colour is a reddish crimson, and the dorsal surface is covered with small black bristles among which over eight segments there are four undefined lines of smaller white clavate hairs; towards the side the bristles are colourless. From the flattened hinder end, two curious scent organs can be exserted; they are colourless and with a few colourless hairs; when exserted they are minute columns; and a kind of irresolute movement is given to them by repeated retractions and exsertions. This red grub can spin a thread at all times.

When mature at 21 days it pupates, on the back of a leaf or in some other sheltered place, into a short plump light green pupa hanging by its tail and girdled by a thread holding it against its support. The eyes come to show reddish and the wing covers look pale.

By the time pupation has been reached the pinnae of the leaf of the food plant have generally been utterly destroyed while the grub has been feeding for the last part of its time by burrowing into the fleshy young axis of the leaf. It moves about a little but never far. What with the gumming resulting from the wounds, and with the raggedness resulting from the dead scraps of pinnae left attached, the beauty of the plant has been utterly destroyed. The lower block on the plate shows about 30 destroyed leaves and five that have more or less escaped,—an evidence of the small distances through which the grubs move, for they had not wandered to the pinnae which had not received eggs.

The butterfly also appears not to move far, for Cycads at a distance no greater than a quarter of a mile from attacked Cycads, have been seen to escape repeatedly.

Two species of Cycas are attacked in the Botanic Gardens, *Cycas Rumphii*, and *Cycas siamensis*.

Other food plants have been looked for but not found. The cause of suspecting that the caterpillar has other foods is that young Cycad leaves are available only at intervals which it may be that the insects cannot always keep. But the length of the life of the butterfly on the wing has not been ascertained: it may be so long as to fill in the interval between its emergence at 5 weeks from the egg-laying and the Cycad's ability to produce a new foliage.

An arsenical spray may be used as a remedy.

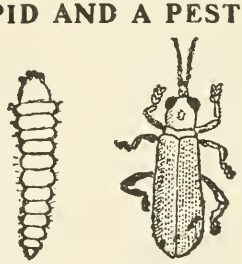
I. H. Burkill.

IDENTITY OF A COCONUT HISPID.

Recently, Mr. R. M. Richards, of Caledonia Estate sent to me specimens of what Peninsular entomologists have been calling *Bronthispa froggattii,* a small but destructive Hispid beetle occurring on coconuts. It can be recognized by its small size, black color, and red pronotum. *Bronthispa froggattii* was originally described from the Solomon Islands, and since there was some question as to the positive identity of the Malayan form, specimens from Mr. Richards and also specimens which I had taken in Singapore were sent to Dr. Gestro in Genoa, one of the best known authorities on the *Hispidae.* Dr. Gestro now replies that he possesses typical specimens of *Bronthispa froggattii* and that our form cannot possibly be associated therewith, on the other hand he states that the Malayan beetle is clearly *Plesispa Reichei* Chap., originally described from Malacca. I do not know how the erroneous determination first got into Peninsular literature.

C. F. Baker.

PROMECOTHECA CUMINGII, BALY, ANOTHER COCONUT HISPID AND A PEST IN MALACCA.



Mature larva and imago of Promecotheca cumingii, enlarged 2½ times.

Upon a visit of inspection to Malacca in July, 1917 it was observed that some pest had been attacking the Coconut palms in a serious way between Malacca town and Tanjong Kling, seven miles distant. The effect of the attack was apparent to any one, even at some distance, by the brown colour of all the old leaves; every palm in the area of attack appeared as if scorched, appeared as if attacked by the moth *Brachartona* which produces this appearance: but on examination of the trees it was obvious that *Brachartona* had not done the damage.

The young leaves were found to be free, for the most part, from any cause of injury, but on the intermediate leaves sharply defined areas of dead tissue were to be seen: and on the older leaves these areas had become confluent, and the tissues were generally dead and often tattered. The cause of the injury was not detected on the first visit, but the limits of its attack were ascertained as above, Malacca town to Tanjong Kling, and inland only about a mile.

Arrangements were then made that an officer of the Department, namely Professor Baker, should thoroughly investigate the attack by an early visit; but advance information to the effect that the Government of the Philippines intended to recall him interfered with the plans in such a way that the next inspection in Malacca only took place in December, when the writer was fortunate enough to find the pest.—a beetle,—mature and on the wing. This beetle proves to be *Promecotheca cumingii.*

Promecotheca cumingii is about 10 mm. long, a flat bright umber beetle shaped as drawn on p. 3, which by day can be found resting on the shaded side of coconut leaves or sometimes on the leaves of other plants. Its food in maturity as well as when immature is the leaf of the coconut, the grub may also be found in the leaves of the Nipa palm and in the leaves of the Sago palm, but, so far in Malacca never abundantly.

The mature insect is apparently not of wide flight for it spreads only a little to isolated groves of coconut palms behind the continuous fringe that skirts the sea. However that it can live at a distance from the sea is proved by its appearance recently at Bringin some four miles inland; and doubtless if sufficiently searched for it would be found at other inland places.

Latterly it has spread along the coast to Pangkalan Balak at a distance of 14 miles from Malacca, as the crow flies. It seems to have in it the power of spreading further, and freely so long as the belt of coconuts is more or less continuous.

In the Philippine islands, this insect is a minor pest. Mr. C. R. Jones in the *Philippine Journal of Science,* Section D. viii., p. 127, after describing it, says that it has many enemies, predacious and parasitic, and that it is probable the parasites keep it in check. At present we have no knowledge that it has any enemies in Malacca, but this is because observation has not yet been made. This much, however, can be said (i) that something appears to have caused the pest to die down in the neighbourhood of Malacca Railway Station and (ii) that a few dead larvae may be found easily within the attacked leaves.

Jones describes the larva as cream-coloured; but I find it in colour between orange and umber. Jones states that the tubercles at the side of the body give rise to setae of six hairs each; I find nothing so regular, but a few hairs down the sides of the body. Jones states that the pupa is hairy; but it appears to me rather to have a coating of microscopic bristles. Except on these small points my observations agree with his; and I may conclude by quoting him, as I am convinced that the insect in Malacca is his. Jones states "This beetle belongs to the subfamily Hispinae of the family Chrysomelidae, which contains our worst leaf-eating beetles. There is little doubt that this species or representatives of this subfamily, occur in all coconut-growing countries. Frogatt reports a species of the family as being a most serious pest in the Solomon islands. The eggs are deposited singly on the underside of the leaflets and generally on the lower leaves of young palms.

The beetle eats a small hole through the lower epidermis of the leaf, leaving the edges of the hole very rough. The egg is inserted into this hole and cemented into place with a yellowish glutinous secretion which turns dark brown upon hardening, and resembles dried leaf tissue. The eggs are flat semielliptical brownish bodies, shaped somewhat like a pumpkin seed. The period of incubation of 286 eggs averaged 13.5 days, of which the maximum was 15 and the minimum 13. Upon hatching the larva eats its way through the egg-wall and directly into the tissue of the leaf, where it spends its entire larval and pupal stages. The larvae are fleshy footless grubs and average about 1.2 mm. in length when newly hatched. The head is the largest segment. The average length of the full-grown larva is 9.54 mm., and the average width of the head cast is 1.54 mm. The average time required in the larval stage is 32 days, twenty eight of these are spent in feeding, and four days without feeding during which time the larva changes into a pupa. During development, the larva feeds upon the parenchyma of the coconut leaf, and except when moulting it can be found at the end of the chamber opposite the egg. The larva eats in one direction only, leaving the old eggshell at the starting point. When moulting and changing into a pupa it recedes to the centre of its chamber. A characteristic habit of the larva is the deposition of its excrement in two rows one on each side of the excavated chamber. The average time occupied in the pupal stage is 7.3 days of which the maximum was twelve and the minimum five days. The pupa is orange-chrome or burnt sienna. The beetles vary from 7.5 to 10 mm. in length and are from 1.6 to 2 mm. in width. The beetles are sluggish and do not fly readily upon being disturbed. They rest by clinging slightly to the under side of the leaf, antennae extended forward, flat against the leaf. They crawl about promiscuously on the leaves of young coconuts and feed extensively upon the tissues between the veins of the leaflets. The injury has the appearance of a slight cut, but does not entirely penetrate the leaf. The injury done by the larva is greater than that of the adult, as a single larva will excavate a place in the leaf from 12 to 16 cm.* long and 1.5 to 3 cm.* wide. The tissue affected soon dies and becomes brown."

Jones, lastly writing of repressive measures suggests hand-picking by children; but so high are most of the attacked trees in Malacca that this is not to be thought of. The same difficulty attends the use of hydrocyanic gas. And indeed the only remedy seems to be promised by protecting or increasing the insect's natural enemies, for which purpose it would possibly be necessary to collect a supply in the Philippine islands.

By Professor C. F. Baker's kind offices, Dr. Gestro has seen specimens and confirms the determination.

I. H. Burkill.

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*There is a mistake on p. 130 of the Philippine Journal of Seince D. viii. in regard to the length of these tunnels, millimetres standing twice for centimetres. A reference to the plate there referred to proves it. Tunnels in Malacca are usually about 10 cm. long and 1 cm. wide; 3 cm. wide is excessive.

A BEETLE WHICH ATTACKS YAMS.

There is a beetle in Singapore of the genus *Lema* or *Criocera* which attacks yams.

Into the bulbils of *Dioscorea bulbifera* when mature it burrows to feed itself; and lives on the plants continuously and may often be seen "in cop." half in these burrows and half out. In the burrows the eggs are laid: they are of a pale yellow at first, but the colour darkens almost to horn-colour. So far as seen the eggs are not more than four or five in number in each group. They seem to take some time in hatching. The young grub is white with a black head and a small black mark just behind it. It has tiny hairs. When mature it is of a dull red and then it leaves the bulbil within which it has fed and presumedly burrows into the earth. The bulbil by this time is in Singapore a putrid mass, tunnelled all through.

So far no economic importance attaches to the insect, because it is only known to attack the aërial bulbils of *Dioscorea bulbifera* which, though eaten in India and Java and elsewhere, are not used in the Malay Peninsula.

I. H. Burkill.

SOME TESTS OF GARDEN VEGETABLES IN SINGAPORE.

The Singapore markets are well supplied with the coarser garden vegetables: they afford fair carrots and beets, coarse sweet potatoes, a fair cruciferous substitute for the cabbage and abundance of the large and very rank Chinese radishes. Small but very good tomatoes are occasionally to be obtained. But certain features of the Chinese cultivation are abhorrent to the European; and he does not use these vegetables with any great zest, even after the most careful methods of cleansing that can be employed.

Most Europeans in Singapore maintain more or less spacious compounds, thus furnishing extraordinarily good opportunities for the establishing of home-gardens. Many have tried to do so, but rarely with any marked success: and moreover when in isolated instances success is achieved, the chance experimenter has forgotten the trade name of the seed which gave him the results, or has not got the name and address of the firm which produced that seed.

For in this matter it must be recognised that a great number of distinct varieties with accepted trade names have been isolated and established by expert horticulturists and are bred practically true for the trade, often through very considerable series of years. Of beans for instance, there are many hundreds on the seed-markets of the world now, and these differ remarkably in form, size, and colour of bean, in edibility of pod, in length of time to maturity and in reaction to soil, climate and disease. Some thrive best in the wet season, others in the drier time. Some prefer very light

soils; while others do very well on heavy soils. Some do as well in the Tropics, as in the temperate regions, while others succumb at once in the hot countries. Thus it may be readily seen that the prospective gardener in the Tropics can have failure after failure by the choice of races unsuited for his season and location, although the same races may be the most highly recommended for another country.

This is not only true for beans, but for all other crops. The solution of the difficulty is very simple, so simple in fact that the less progressive countries never give it the attention needed to secure the most certain results in the shortest time possible. This work in its simplest phase may all be included under the general head of *acclimatisation*. It is work full of the keenest interest, and pregnant with great economic possibilities. Planters and other public-spirited citizens have often not been content to await the laboured and usually long delayed action of government, although this is a natural government-function beyond the means of most private individuals. So we find acclimatisation societies scattered through the tropics and newer countries, which accomplish not a little by united effort and themselves profit by what is accomplished.

To accomplish the most definite and conclusive results, acclimatisation work must be thoroughly comprehensive; that is to say all varieties in the trade must be thoroughly tested on *all* kinds of soil, in *all* seasons, by *all* methods of culture, and in *all* parts of the country. The very variety which the experimenter overlooked, might be the very one to give the greatest success of all. A variety discarded as useless in a valley-plain has, in known cases, proved to be the greatest success in a near-by hill area. A variety neither specially well-known nor highly recommended in the country of its origin, has been found to give far better results under new conditions than some other varieties very highly recommended. Therefore if we are to determine the best bean-varieties for a new country, we must first obtain generous samples of absolutely *all* the varieties in the trade of Europe and of America, with special care to secure all of the varieties grown in the warmer parts of these regions. This will bring us into touch with such great seed-houses as Sutton in England, Vilmorin in France, Shortum, Burpee and Henderson in America. With abundant stocks in hand it then becomes a matter of good head-quarters facilities, wide co-operation and scientific exactness in the arrangement and control of all the work, and in the recording and dissemination of results. This says nothing of plant-breeding work, which naturally follows acclimatisation, and which is also full of the greatest economic possibilities.

It became possible in September, 1917, to put into operation a small preliminary series of acclimatisation trials in the Economic Garden in Singapore. Most countries involved in the Great War have been concentrating all possible energy on stimulating active interest in food crops; and an active and effective campaign in this direction possibly would not have cost the Government of the Settlements nearly so much as War allowances entail, such as have their

cause in the cost of importing food, and besides, the great value of such work would live on with increased significance into times of peace.

For the trials now to be described there was only a limited seed-stock which had been obtained from the College of Agriculture in the Philippines, by exchange, the original stock having come from the well-known seed-house of L. M. Shortum and Co., New York.

Radishes.

Nineteen varieties of the finest trade radishes were employed as follows:—

7121	Scarlet Tipped White Gem Forcing Radish.*
7107	White Strassburg Summer Radish.
7287	Half-long Delicacy Radish.
7124	Early Deep Scarlet Turnip Radish.
7122	Early Scarlet Globe-shaped Turnip Radish.
7276	Half-long White Forcing Radish.
7277	Olive-shaped Scarlet Radish.
7282	
7114	Long Icicle Radish.
7113	Scarlet Chinese Winter Radish.
7111	Long Cincinnati Radish.
7116	Mammoth Tokyo Radish.
7118	Round Black Spanish Winter Radish.
7119	Early Non-Plus-Ultra Turnip Radish.
7283	Long Scarlet Short-top Radish.
7286	Olive-shaped White Forcing Radish.
7279	Golden Yellow Olive-shaped Radish.
7284	Half-long Deep Scarlet Radish.
7120	Early Scarlet Turnip-shaped Radish.

Beds of a light clay soil, such as is typical of Singapore, were thrown up upon a gently sloping hillside; a small amount of manure being thoroughly worked in. More would have been used, but was not available. The seed was planted in rows about eight inches apart, on September 8th, the area given to each variety averaging about one half square yard. The beds were kept clean weeded and the ground between the rows was occasionally stirred. Within four to six weeks several of the varieties gave supplies of good table radishes. Between October 16th and 24th:—

No. 7107	gave	18	ounces	of cleaned	radishes.
No. 7287	..	21½	..	..	..
No. 7276	..	10	..	..	..
No. 7114	..	11¼	..	..	..

Nos. 7121, 7127, 7122 and 7277 did not return one half of the above yields, but produced a fair number of attractive table radishes, showing themselves worthy of a further trial at least on this soil and at this season.

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*The numbers used are the serial culture number of the Philippines College of Agriculture.

Nos. 7111, 7113, 7116, 7118, 7119. 7279, 7283, 7286, 7284 and 7120 gave very poor results, mostly running to tops without any thickening of the roots. Nos. 7282 was a complete failure early in the test.

It should be understood distinctly that such a result does not condemn all the last named varieties for this country, but suggests that they are not suited for it under the seasonal conditions, the soil conditions and the method of treatment, combined, to which the plants were subjected; and one such trial is utterly insufficient to warrant a complete condemnation in any real acclimatisation work. Nevertheless the results are of interest and importance as far as they go, though all the trials should be greatly extended as to season and as to soil, and after the fuller trial the races may possibly show quite a different alignment as regards each other. It can only be said at present that with properly prepared beds and September planting, it is safe to use Nos. 7107, 7114, 7276 and 7287. Of course the ideal arrangement for both radishes and lettuces is a succession of small plantings running through the year and furnishing constant supplies for the table; but we are in no position yet to give specific advice concerning this.

Radishes are much attacked in the Straits by a small leaf folding larva; but it may be controlled easily by a Paris green spray made up in the proportion of one pound to fifty gallons of well limed water.

Lettuce.

Of lettuce, ten varieties were put on trial, as follows:—

7260 Wayahead Lettuce.
7250 White Summer Cabbage Lettuce.
7090 Philadelphia Dutch Butter Lettuce.
7262 Thorburn's Improved Big Boston Lettuce.
7256 White Paris Cos Lettuce.
7258 Giant Crystal Head Lettuce.
7096 New York Head Lettuce.
7086 Mignonette Lettuce.
7274 Deacon Lettuce.
7097 New Orchid Lettuce.

Lettuce cannot be planted directly in the prepared beds under our conditions, since the young plants are very delecate. Hence, the seed were sown in seed pans in burnt earth and lightly covered with clean white sand. Regular, moderate watering was given them. When the sprouted seedlings were large enough to handle, they were "pricked off" into boxes of rich earth spaced an inch and a half or two inches each way. These boxes were given plenty of sun but kept out of all heavy rain. When the plants were two or three inches high, they were set in beds prepared as for the radishes, the plants 4—6 inches distant in rows 8 inches apart. Frames of sticks were placed about the beds and ataps laid on the sloping tops. During the morning hours and in the evening hours these ataps were removed to give the plants plenty of sun.

The response of the lettuces to Singapore conditions was very interesting. Some varieties which in temperate regions make

dense heads of large leaves reverted to a condition akin to the wild form running up slender stems with scattered widely separated leaves; such were Nos. 7250, 7090, 7262 and 7256. Two of the varieties 7258 and 7096 while somewhat leggy gave very good leaves. No. 7086 proved to be a thoroughly good lettuce for Singapore, yielding more than four pounds of first class bunches from five square yards of soil. No. 7274 turned out to be in Singapore a very delicate small smooth leaved lettuce, quite fair for Singapore. No. 7097 is a very peculiar lettuce, having leaves speckled with pale brown. It runs somewhat to stems but produces fair leaves. No. 7260 made a fairly good bunch, of large smooth leaves. Therefore, for this season and soil, Nos. 7086 and 7260 may be used with assurance of obtaining good results. The remainder should be given a further trial.

Tomatoes.

Tomatoes are the most tender plants of the garden and the most difficult to handle successfully. They are extremely susceptible to disease, especially to the so-called "solanaceous wilt" which is widely spread in the tropics and also affects tobacco and some other plants. Most old garden soils are infected with the organisms of this wilt disease. Therefore, for surest success with tomatoes, we must use either virgin soil, or a soil thoroughly sterilized by burning, by steam, or by boiling water. Also tomatoes thrive better on well-manured well-drained light sandy loams than on heavy or soggy soils. All of these well-known facts came out clearly in the course of the trials, here described.

The young plants were handled in the same way as lettuce. They were then divided into lots and planted in a variety of situations and on a variety of soils. Facilities were lacking for sterilising any considerable amount of soil; and labour was lacking for opening up new ground. The plants put out, whatever their variety, on the heavy soggy soils or on the old soils were soon destroyed by wilt. However on one small part of the garden there exist a few well-raised beds of very sandy soil; and on these beds when well-manured, three out of the many varieties developed rapidly into strong plants, only a few among them dying from wilt. On some beds nearby but less sandy, No. 7173 (Early Ruby Tomato) developed far enough to set large good tomatoes before it succumbed to wilt. The varieties which showed the greatest resistance to wilt and the readiest adaptability to the Singapore conditions at the season of their testing were No. 7169 (Buckeye State) and 7146 (Perfection). It seems certain that fine results may be obtained with these two if proper methods are used. While the facilities available did not permit of the trial being properly carried out on a garden scale, interesting result were got on using pots filled with prepared soil. Among these are pot-grown plants there was very much less wilt and at the time of writing they are setting healthy young tomatoes.*

* It is not recorded how many fruits they gave, but No. 7160 gave one fruit weighing 2¾ oz.; two fruits of No. 7176 weighed together 2½ oz, two of 7173 weighed together 2¼ and three of 7147 weighed together 5½ oz., which figures indicate the size. I.H,B.

From the whole series of experiments it is evident that comprehensive trials with varieties of tomatoes would soon lead to very practical results.

Garden Beans.

Coarse beans of various sorts can be obtained almost anywhere in the tropics, but the finer garden beans of temperate regions, such as the Butter and Wax beans and French limas, are usually conspicuous by their absence. We have had remarkable success with certain varieties from each of these types. In the short time available, we were dependent on those which it was possible to obtain from the Philippine College of Agriculture; and these included.

7194 Kentucky Wonder Pale Bean.
7212 Carpenteria Pale Bean.
7205 Kentucky Wonder Golden Wax Bean.
7197 Currier's Rust Proof Bean.
7211 Henderson's Bush Lima.
7210 Siebert's Early Lima.
7207 Giant polded Lima.
7209 Wood's Prolific Lima.
7208 Jackson Wonder Bush Lima.
7192 Pencil-pod Black Wax Bean.
7191 Black German Wax Bean.
7206 Fordham Bean.

Most of these varieties have grown with great vigor on our old garden soils. But No. 7209 turned out to be a poor grower and yielder: and Nos. 7191 and 7192 were practical failures, being poor growers, becoming badly blighted and producing but few pods. The remainder, all successful, can be divided into two groups, the very early, and the very late. Among the latter are Nos. 7212, 7210, 7207, 7208 and 7206. These have all grown well but have not come to cropping at this time.§ No. 7194 grows well, and gives a good early crop of large green snap beans. No. 7205 is a strong grower and produces a large early crop of very large yellow wax beans. No. 7197 produces yellow snap beans on a low bushy plant. Here it is the earliest of all, giving, within a few weeks, an abundant crop of fine yellow wax beans, and dying off rapidly as soon as the crop is made. No. 7211 is a rapid grower, and gives a quick and abundant crop of fine small limas.

Therefore, for quick results in two distinct types Nos. 7197 and 7211 are to be considered first choice. But the other varieties mentioned above can be used to good advantage. By this use of diverse varieties, together with successive plantings, the Singapore resident will probably have no difficulty in obtaining good supplies of the finest garden beans throughout the year. Since this is a matter of great economic importance to the whole people, these trials should be continued and on a more comprehensive scale.

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§The crop matured by the late races was insignificant, and the pods were not well filled. E.H.M.

Soy Bean.

The Soy bean is of enormous importance in Japan, Manchuria and China; and thence a great feature in world commerce. It is now being extensively planted in the United States. It has been said that it could not be grown in the Tropics, and some first trials of it in the Philippines a few years ago led to statements that it could not be successfully grown there. However this was merely a case of the wrong variety for the season in which the planting was done; for there are many distinct varieties of Soy of quite different possibilities; and more comprehensive trials in the Philippine islands developed the fact that certain varieties were suited only to the wet season, others only to a drier period, and some were heavier yielders of hay, others of grain, and so on, it now being recognized that soy is a practicable crop for the country.

Three varieties were brought to Singapore from the Philippines. Two did not germinate. The third gave but few plants, but these grew well and are now setting pods. Great care should be taken to continue and develop this culture† since out of it may arise a real asset to the country. Comprehensive trials of all the soys should certainly be carried out here. The great value of the plant in furnishing direct food for man and beast is but a part of its value, since its secondary products are used the world over. Vast quantities of the famous soy sauce* are consumed yearly in all parts of the world, while bean curds and oil from this source are well known.

Peanuts.

The common peanuts of the Singapore market are small and of the Spanish type. There are a number of varieties in other countries which yield far larger nuts, better for direct eating, though some of these do not give larger total yields under similar conditions, nor larger oil percentages than the small Spanish peanuts. Four varieties were used in the trials under description, viz., San Mateo, Montalban, American and Kinorales, all of which have been grown with success in the Philippines. These were planted in beds similar to the varieties of Radish as described above, there being seed only for five square yards of each variety. The seed Kinorales proved to be bad, the bed yielding but one plant, which, however, as also all plants of the other varieties, grew with great vigor. The seed was put in on August 1st and the crop harvested fifteen weeks later. As the plants were ripening off, the leaves became spotted with the common fungus *Cercospora personata*, which, luckily, rarely attacks the plant in its prime. The yields of shelled dried nuts were as follows:

San Mateo	.. ..	23 oz.
Montalban	.. ..	26½ oz.
American	.. ..	22¾ oz.

† The second crop of Soy bean was for some unknown reason a complete failure. E.H.M.

* Basis also for one of the best known English table sauces.

This seed as well as that produced by the one plant of Kinorales, will be immediately replanted to increase the stock.*

YAUTIAS.

Many varieties of this important tropical root crop, yielded by *Xanthosoma sagittifolium* and *X. violaceum*, are grown in the American Tropics. In Cuba under the name of "malangas" they are standard vegetables. In some respect the yautias resemble the gabis (kladi) produced by *Colocasia antiquorum*. But they are better yielders and produce a vegetable better relished by Europeans, since they lack the slimness of the gabi after cooking; also they can be grown with greater success as a field crop in fields high and dry enough to be readily plowed and cultivated by bullocks. They appear not to be susceptible to the very injurious colocasia mildew which disease is widely distributed in the orient. Nine distinct varieties have been introduced from the Philippines and are now well advanced in growth, as follows:

588 (unnamed).
444 Rolliza.
309 Rolliza blanca.
439 Trinidad Yellow.
586 (unnamed).
443 Grey Jack.
441 Mi Senora.
1521 San Fernando Po.
440 Prieta.

The history of the parents of this stock is as follows:—a series of varieties were brought to California from Porto Rico and carried through one generation after which they were taken to the Philippines where they have been very successfully carried through a number of generations. Our present stock was selected from these Philippine cultures.

The Gardens formerly possessed one variety of *Xanthosoma sagittifolium* and a very robust variety of *Alocasia antiquorum* (Kladi udang). The latter since it possesses an abundance of runners belongs to the group of varieties known as Dasheens. This plant not only furnishes tubercles, and a good pot herb (the youngest tenderest leaves), but the runners can be covered and bleached and make a very fair substitute for asparagus. The new introductions will be put out in beds alongside the two previously planted varieties, so that complete comparisons will be possible within ten months, when the crop is ready. These plants should be multiplied and generally disseminated through the colony.

The dasheens furnish three types of planting stock, runners, side sprouts and trunk tops, hence beds of the Kladi Udang mentioned above, have been separately planted with these in the present cultures in order to determine any possible difference in length of time to maturity or in final yield. C. F. BAKER.

* Except the San Mateo Pea nut, none of the races in the second planting gave results worth recording. San Mateo grew well although planted in rather unsuitable soil; and produced plenty of well filled large pods. But thieves mice and squirrels got at them, and when the bed was dug the results did not represent the produce. It is being replanted. E.H.M.

Host Index.

for

Penzig's and Saccardo's, Icones Fungorum Javanicorum Diagnoses Fungorum in insula Java Collectorum and Raciborski's, Parasitische Algen und Pilze Javas.

Acacia—dead limbs.
Botryodiplodia acacigena, Penz. et Sacc.
Acacia—on Diplodia on.
Nectria episphaerioides, Penz. et Sacc.
Acer laurinum.
Criella aceris-laurini, (Pat.) Sacc. & Syd.
Xymanomyces aceris-laurini, (Pat.) Henn.
Parodiella aceris. Rac.
Schizothyrium aceris. (Henn. & Lind.) Pat.
Synglonium insigne, Penz. et Sacc.
Achyranthes.
Cystopus bliti, (Riv.) de Bary.
Acorus terrestris.
Uredo acori, Rac.
Acroçomia sclerocarpa.
Winterella eutypoides. Penz. et Sacc.
Acronodia punctata.
Aecidium puspa, Rac.
Asterina alpina. Rac.
Acrostichum (Elaphoglossum) *callaefolium.*
Scolecopeltis salacensis, Rac.
Adhatoda vasica.
Oidium tabaci, Thuem.
Agaric.
Spicaria elegans, (Corda) Harz.
Alsophila contaminans.
Hysterostomella contaminans.
Alsophila—dead petioles.
Dasyscypha javanica, Penz. et Sacc.
Amonius.
Hypocrella discoidea, (B. & Br.) Sacc.
Antidesma bunius.
Uredo antidesmae, Rac.
Antidesma dioica.
Uredo antidesmae-dioicae, Rac.
Antidesma heterophylla.
Elsinoe antidesmae, Rac.
Arachis hypogaea.
Septogloeum arachidis, Rac.
Araliaceae—leaves.
Sphaerella longispora, Penz. et Sacc.
Araneae.
Gibellula phialobasia, Penz. et Sacc.

Arenga saccharifera.
Auerswaldia arengae. Rac.
Graphiola arengae, Rac.
Arthrophyllum—dead petioles..
Diplodia arthrophylli, Penz. et Sacc.
Artocarpus incisa.
Rhizopus artocarpi, Rac.
Arundina speciosa.
Caeoma arundinae, Rac.
Arundinaria.
Uredo arundinariae, Sydow.
Arundinaria—young twigs.
Konradia bambusina, Rac.
Asplenium pallidum.
Hymenoscypha asplenii, Rac.
Bambusa.
Didymosphaeria polysticta, (B. & C.) Sacc.
Hymenopsis ellipsospora, (Fuck.) Sacc.
Konradia secunda, Rac.
Bambusa—dead.
Acerbia culmigena, Penz. & Sacc.
Astrocystis mirabilis, B. & Br.
Campsotrichum elegans, Penz. & Sacc.
Chaetosphaeria silva-nigra, Penz. & Sacc.
Comosporium bambusae, Thuem.
Didymella maculosa, Penz. & Sacc.
Didymosphaeria fusispora, Penz. & Sacc.
Didymosphaeria minutella, Penz. & Sacc.
Didymosphaeria striatula, Penz. & Sacc.
Erinella albida, Penz. & Sacc.
Erinella tomentella, Penz. & Sacc.
Eutypa bambusina, Penz. & Sacc.
Harpographium nematosporum, Penz. & Sacc.
Helicosporium intermedium, Penz. & Sacc.
Helotiella myoleuca, Penz. & Sacc.
Heteronectria spirillispora, Penz. & Sacc.
Melanconium sphaerospermum, (Pers.) Lk. subsp. bambusarum, Penz. & Sacc.
Melanomma tornatum, Sacc. & Paol.
Melanomma trochus, Penz. & Sacc.
Melanopsamma patellata, Penz. & Sacc.
Nectria vulgaris, Speg.
Nummularia minutula, Penz. & Sacc.
Ophiobolus javanicus, Penz. & Sacc.
Podosporium tjibodense, Penz. & Sacc.
Pteridospora javanica, Penz. & Sacc.
Rosellinia formosa, Penz. & Sacc., var. flavozonata, Penz. & Sacc.
Scirrhia bumbusina, Penz. & Sacc.
Stilbum longipes, Penz. & Sacc.
Tubeufia javanica, Penz. & Sacc.
Winteria oxyspora, Penz. & Sacc.

Bambusa—dead sheaths.
Clithris arundinacea, Penz. & Sacc.
Rosellinia decipiens, Penz. & Sacc.
Septoria phlyctaenoides, Penz. & Sacc.
Bambusa—living leaves.
Epichloe bambusae, Pat.
Bambusa—young twigs.
Konradia bambusina, Rac.
Bambusa blumeana (Schizostachyum).
Mendogia bambusina, Rac.
Bark—dead.
Amallospora Dacrydion, Penz.
Botrytis monilioides, Penz. & Sacc.
Chilonectria javanica, Penz. & Sacc.
Coryne javanica, Penz. & Sacc.
Cylindrocolla succinea, Penz. & Sacc.
Dendrochium javanicum, Penz. & Sacc.
Haplosporella bogoriensis, Penz. & Sacc.
Helminthosporium gigantosporum, B. & Br. subsp. javanicum, Penz. & Sacc.
Helotium subserotinum, Henn. & Nym.
Humaria umbilicata, Penz. & Sacc.
Hypocrea discolor, Penz. & Sacc.
Hypoxylon annulatum, (Schw.) Mont.
Hypoxylon discophorum, Penz. & Sacc.
Hypoxylon microcarpum, Penz. & Sacc.
Hypoxylon perforatum, (Schw.) Sacc.
Hypoxylon polyspermum, Mont.
Kretzschmaria gomphoidea, Penz. & Sacc.
Lachnea longiseta, Penz. & Sacc.
Nectria ambigua, Penz. & Sacc., var pallens, Penz. & Sacc.
Nectria carneoflavida, Penz. & Sacc.
Nectria coccinea, (Pers.) Fr.
Nectria coronata, Penz. & Sacc.
Nectria nigella, Penz. & Sacc.
Nectria tjibodensis, Penz. & Sacc.
Nectria trachycarpa, Penz. & Sacc.
Nummularia discolor, (Berk.) Ellis.
Nummularia uni-apiculata, Penz. & Sacc.
Oedocephalum macrosporium, Penz. & Sacc.
Ophionectria trichospora, (B. & Br.) Sacc.
Patinella chlorosplenioides, Penz. & Sacc.
Patouillardiella javanica, Penz. & Sacc.
Penzigia macrospora, Penz. & Sacc.
Pezizella convexella, Penz. & Sacc.
Pezizella subceracella, Penz. & Sacc.
Pilacre Petersii, Berk. & Curt.
Physospora spiralis, Penz. & Sacc.
Podosphaeria casuarinae, Penz. & Sacc.
Rhytidhysterium guaraniticum, Speg. subsp. javanicum, Penz. & Sacc.
Sphaeronemella macrospora, Penz. & Sacc.

Sporocybe apiculata, Penz. & Sacc.
Stilbum minutulum, Penz. & Sacc.
Stilbum pallidulum, Penz. & Sacc.
Tympanopsis coelosphaeroides, Penz. & Sacc.
Volutina concentrica, Penz. & Sacc.
Xylaria haemorrhoidalis, B. & Br.
Xylaria pilaeformis, Berk. & Curt.
Xylaria trichopoda, Penz. & Sacc.
Zythia abnormis, Penz. & Sacc.

Bark—living.
Antennaria scoriadia, Berk.
Erinella bogoriensis, Henn. et Nym. subsp. candida, Penz. & Sacc.
Pellionella deformans, Penz. & Sacc.
Stilbum ochroleucum, Penz. & Sacc.

Bixa orellana.
Ovularia bixae, Rac.

Blechnum orientale.
Irydyonia filicis, Rac.

Botryodiplodia longipes.
Botrytis monilioides, Penz. & Sacc.

Branches—see limbs.

Calamus.
Graphiola macrospora, Penz. & Sacc.
Morenoella calami, Rać.
Morenoella gedeana, Rac. var. calamicaba, Rac.
Phymatosphaeria calamis, Rac.

Calamus—dead leaves.
Erinella nivea, Penz. & Sacc.

Calamus—dead sheaths.
Pezizella avellana, Penz. & Sacc. var. macrospora, Penz. & Sacc.

Camellia japonica.
Laestadia theae, Rac.

Canarium commune.
Skierkia canarii, Rac.

Canavalia gladiata.
Elsinoe canavaliae, Rac.

Canna sp.
Uredo cannae, Wint.

Canthium.
Balladyna gardeniae, Rac.

Carica papaya—branches.
Diplodia papayae, Thuem.

Caryophyllus aromaticus.
Trametes caryophylli, Rac.

Caryota—dead leaves.
Exosporium megalosporium, Penz. & Sacc.

Caryota propinqua.
Diplodiella caryotae, Rac.

Castanea vesca.
Pestalozzia monochaeta, Desm.

Castanopsis—spines of rotten fruits.
Lanzia reticulata, Penz. & Sacc.
Phialea glancescens, Penz. & Sacc.
Cecropia schiedeana—rotten wood.
Anthromycopsis broussonetiae, Pat. et Trab. subsp. minor, Penz. & Sacc.
Cercocoma macrantha.
Uredo chonemorphae, Rac.
Chlamydomonas plurialis.
Polyphagus nowakowskii, Rac.
Chonemorpha macrophylla.
Uredo chonemorphae, Rac.
Cinnamomum zeylanicum.
Aecidium cinnamonii, Rac.
Scolecotrichum cinnamonii, Rac.
Clerodendron blumeanum.
Caeoma clerodendri, Rac.
Clerodendron fragrans.
Caeoma clerodendri, Rac.
Coccids—on coriaceous leaves.
Aschersonia javanica, Penz. & Sacc.
Cocos nucifera.
Pestalozzia palmarum, Cooke.
Coix lacryma-jobi.
Phyllachora coicis, Henn.
Ustilago coicis, Rac.
Coleoptera—larva.
Cordyceps citrea, Penz. & Sacc.
Cordyceps obtusa, Penz. & Sacc.
Coleoptera—pupa.
Cordyceps coccinea, Penz. & Sacc.
Colocasia esculenta.
Phytophthora colocasiae, Rac.
Connarus diversifolia.
Stagonospora disseminata, Rac.
Corypha gebanga—dead leaves.
Bonordeniella memoranda, Penz. & Sacc.
Cucurbita.
Oidium tabaci, Thuem.
Culms.
Neopeckia pumila, Penz. & Sacc.
Culms—dead (see stems).
Boerlagella laxa, Penz. & Sacc.
Chromosporium pallens, Penz. et Sacc.
Hypocrea gelatinosa, (Tode.) Fr.
Ophioceras dolichostomum, (B. & C.) Sacc.
Culms—grass.
Torula glomerulosa, Penz. & Sacc.
Curculigo latifolia.
Didymosphaeria impar, Penz. et Sacc.
Puccinia curculigo, Rac.

Curculigo recurvata.
Pucciuia curculigo, Rac.
Cyathea orientalis.
Asterina cyathearum, Rac.
Dendrophthora pentandra.
Puccinia macrocarya, Rac.
Derris.
Puccinia periodica, Rac.
Derris elliptica.
Cryptomyces pongamiae, (B. & Br.)
Triphragmium pulchrum, Rac.
Dianella javanica.
Uredo dianellae, Rac.
Dinochloa tjankorreh.
Mindogia bambusina, Rac.
Phyllachora tjankorreh, Rac.
Desmodium umbellatum.
Cercosporella atropunctata, Rac.
Dioscorea aculeata.
Uredo dioscoreae-aculeatae, Rac.
Dioscorea alata.
Cercospora ubi, Rac.
Uredo dioscoreae-alatae, Rac.
Dioscorea filiformis.
Uredo dioscoreae-filiformidis, Rac.
Diospyros.
Aecidium rhytismoides, Rac.
Diospyros—seeds.
Aspergillus penicillopsis, (Henn. & Nym.), Rac.
Diplodia—on Acacia.
Nectria episphaerioides, Penz. & Sacc.
Dung—buffalo.
Ascobolus latus, Penz. et Sacc.
Saccobolus kerverni, (Cr.) Bond.
Earth.
Barlaeina albo-coerulescens, Penz. & Sacc.
Barlaeina connexella, Sacc. subsp. tjibodensis, Penz. & Sacc.
Helvella lacunosa, Afz. subsp. javanica, Penz. & Sacc.
Lachnea longiseta, Penz. & Sacc.
Peziza citrina, Penz. & Sacc.
Peziza sparassiformis, Henn.
Phaeomacropus fleicherianus, Henn.
Podocrea cordyceps, Penz. & Sacc.
Eichornia crassipes.
Pachysterigma grisea, Rac.
Elaeagnus latifolius.
Aecidium elaeagni, Rac.
Elaeocarpus augustifolius.
Dothidella elaeocarpi, Rac.
Elettaria.
Phyllachora elettariae, Pat.

Schroeteriaster elettariae, Rac.
Trichosporium olivastrum, Sacc.
Elettaria—dead.
Hypocrella discoidea, (B. & Br.) Sacc.
Montoniella polita, Penz. & Sacc.
Orbilia neglecta, Penz. & Sacc.
Elettaria—dead leaves.
Ceuthocarpon tjibodense, Penz. & Sacc.
Cryptothecium javanicum, Penz. & Sacc.
Lophodermium javanicum, Penz. & Sacc.
Oxyspora carneola, Sacc.
Trichopeziza porioides, Penz. & Sacc.
Xenosporium mirabile, Penz. & Sacc.
Elettaria—dead stems.
Acanthostigma nectrioideum, Penz. & Sacc.
Bactrosphaeria asterostoma, Penz. & Sacc.
Botrytis vulgaris, Fr.
Ceratostomella polyrrhyncha, Penz. & Sacc.
Ciliciopodium macroporum, Penz. & Sacc.
Diaporthe javanica, Penz. & Sacc.
Helotiella aurea, Penz. & Sacc.
Melchioria leucomelaena, Penz. & Sacc.
Nectria albo-fimbriata, Penz. & Sacc.
Nectria dolichospora, Penz. & Sacc.
Nectria raripila, Penz. & Sacc.
Nectriella rufo-fusca, Penz. & Sacc.
Nectriella setulosa, Penz. & Sacc.
Pezizella armeniaca, Penz. & Sacc.
Pezizella tjibodensis, Penz. & Sacc.
Phlyctaena variabilis, Penz. & Sacc.
Rhabdospora elettariae, Penz. & Sacc.
Rosellinia formosa, Penz. & Sacc.
Tubeufia coronata, Penz. & Sacc.
Zignoella acervata, Penz. & Sacc.
Zignoella interspersa, Penz. & Sacc.
Elettaria—on Melchioria on.
Nectriella pallidula, Penz. & Sacc.
Entada—dead leaves.
Stegia nitens, Penz. & Sacc.
Equisetum debile.
Stamnaria equiseti, (Hoffm.) Sacc.
Eriodendron anfractuosum.
Ramularia eriodendri, Rac.
Erythrina lithosperma.
Telimena erythrinae, Rac.
Eugenia (Jambosa) *aquea.*
Haplosporella dendritica, Rac.
Eugenia or *Ficus.*
Meliola octospora, Cooke.
Eutypa heteracantha.
Mollisia obconica, Penz. & Sacc.
Ficus. (See also Eugenia).
Hyalodothis incrustans, Rac.

Ficus hispida.
Phyllachora marmorata, Rac.
Ficus leucanthoma.
Phyllachora decaisneana, (Lev.) Sacc.
Filices—dead leaves.
Helotium pteridophilum, Penz. & Sacc.
Filices—dead petioles of tree ferns.
Delpontia pulchella, Penz. & Sacc.
Flemingia lineata.
Parodiella perisporioides, (B. & C.) Speg.
Freycinetia imbricata.
Uredo freycinetiae, Rac.
Fruit—dead rind.
Stilbum fructigenum, Penz. & Sacc.
Vermicularia longiseta, Penz. & Sacc.
Garcinia purpurea—bark.
Pellionella deformans, Penz. & Sacc.
Gardenia lucida.
Balladyna gardeniae, Rac.
Geophila reniformis.
Puccinia geophilae, Rac.
Gossypium herbaceum.
Uredo gossypii, Lag.
Grass culms. See *Culms.*
Torula glomerulosa, Penz. & Sacc.
Griffithia fragrans.
Endophyllum griffithiae, Rac.
Heliotropium.
Oidium tabaci, Thuem.
Helminthosporium—on Elettaria.
Rhabdospora elettariae, Penz. & Sacc.
Heptapleurum.
Triphragmium thwaitesii, B. & Br.
Hibiscus tiliaceus.
Physalospora hibisci, Rac.
Hydrocotyle.
Stigmatea hydrocotyles, Rac.
Hymenoptera—head.
Cordyceps lachnopoda, Penz. & Sacc.
Imperata arundinacea.
Micropeltis alang-alang, Rac.
Inocarpus edulis.
Uromyces inocarpi, Rac.
Insect excrement.
Isaria thyrsoidea, Penz. & Sacc.
Insects. (See also *Coecids, Coleoptera, Hymenoptera, Lamellicorn, Larva, Leaves, Coccids on; Lepidoptera, Mosquitoes, Termites, Vespa*).
Isaria thyrsoidea, Penz. & Sacc.
Ipomoea.
Meliola quadrispina, Rac.

Ipomoea batatas.
Ramularia batatae, Rac.
Ipomoea pes-caprae.
Aecidium ipomoeae, Thuem.
Ipomoea turpethum.
Cystopus convolvulacearum, Otth.
Justicia gendarussa.
Puccinia thwaitesii, B. & Br.
Kentia—dead leaves.
Anthostomella grandispora, Penz. & Sacc.
Kentia.
Pestalozzia funerea, Desm.
Korthalsia—dead petioles.
Phaeodiscula gonospora, Penz. & Sacc. subsp. atrata, Penz. & Sacc.
Lamellicorn—larva.
Cordyceps citrea, Penz. & Sacc.
Lasianthus.
Gibellina concentrica, Rac.
Lasianthus latifolius.
Coccomyces tjibodensis, Rac.
Larva.
Botrytis tenella, Sacc.
Cordyceps fleischeri, Penz. & Sacc.
Isaria alborosea, Penz. & Sacc.
Lauracea—leaves.
Laestadia veneta, Sacc. & Speg.
Leaves—living.
Hypocrella scutata, (Cooke) Sacc.
Pestalozzia leucodisca, Penz. & Sacc.
Sphaerella creberrima, Penz. & Sacc.
Trichosporium arborescens, Penz. & Sacc.
Triphragmium thwaitesii, B. & Br.
Leaves—coriaceous and subcoriaceous.
Botryosphaeria phyllachoroides, Penz. & Sacc.
Ceuthocarpon depokense, Penz. & Sacc.
Erikssonia pulchella, Penz. & Sacc.
Gloeosporium anceps, Penz. & Sacc.
Lembosia diffusa, Wint. subsp. breviuscula, Penz. & Sacc.
Linospora capillaris, Penz. & Sacc.
Lophodermium maculare, (Fr.) de Not.
Micropeltis leucoptera, Penz. & Sacc.
Micropeltis macropelta, Penz. & Sacc.
Pestalozzia leucodisca, Penz. & Sacc.
Rinia spectabilis, Penz. & Sacc.
Venturia euchaeta, Penz. & Sacc.
Leaves—coriaceous—coccids on.
Aschersonia javanica, Penz. & Sacc.
Leaves—coriaceous—dead.
Coccomyces dentatus, Sacc. var. hexagona, Penz. & Sacc.
Dasyscypha albidula, Penz. & Sacc.

Patinella phyllogena, Penz. & Sacc.
Sordaria tjibodiana, Penz. & Sacc.
Leaves—dead.
Actiniceps thwaitesii, B. & Br.
Isaria thyrsoidea, Penz. & Sacc.
Xylaria aristata, Mont.
Leguminosa—leaves.
Parodiella perisporioides, (B. & C.) Speg.
Leguminosa—pods.
Xylaria heloidea, Penz. & Sacc.
Lepidoptera—larva.
Cordyceps atro-brunnea, Penz. & Sacc.
Cordyceps coccinea, Penz. & Sacc., subsp. subochracea, Penz. & Sacc.
Cordyceps deflectens, Penz. & Sacc.
Isaria alborosea, Penz. & Sacc.
Lespedeza cytisoides.
Woroninella vulcanica, Rac.
Leucoxylon—seeds.
Aspergillus penicillopsis, (Henn. & Nym.) Rac.
Lichenes.
Gliocladium pulchellum, Penz. & Sacc.
Limbs—dead.
Anthostoma valsarioides, Penz. & Sacc.
Anthostoma verrucula, Penz. & Sacc.
Arthrosporium tenue, Penz. & Sacc.
Belonidium tabacinum, Penz. & Sacc.
Botryodiplodia longipes, Penz. & Sacc.
Cephalothecium roseum, Corda.
Cladotrichum socium, Penz. & Sacc.
Cylindrum fugax, Penz. & Sacc.
Dasyscypha isabellina, Penz. & Sacc.
Dasyscypha ochrolenca, Penz. & Sacc.
Davincia helios, Penz. & Sacc.
Diatrype princeps, Penz. & Sacc.
Enchnoa chaetomioides, Penz. & Sacc.
Erinella carneola, Penz. & Sacc.
Erinella citrino-alba, Penz. & Sacc.
Eutypa heterantha, Sacc.
Graphium desmazierii, Sacc.
Helotium subserotinum, P. Henn. & Nym.
Hymenula inaequalis, Penz. & Sacc.
Hymenula tjibodensis, Penz. & Sacc.
Hypocrea catoptron, B. & Br.
Hypocrea fulva, Penz. & Sacc.
Hypocrea gelatinosa, Fr. subsp. oligotheca, Penz. & Sacc.
Hypocrea longicollis, Penz. & Sacc.
Hypocrea pulchella, Penz. & Sacc.
Hypoxylon annulatum, (Schw.) Mont.
Hypoxylon anthracoderma, Speg.
Hypoxylon microsorum, Penz. & Sacc.
Hypoxylon rubellum, Penz. & Sacc.

Hysteriographium oligomerum, Penz. & Sacc.
Karschia nigerrima, Sacc. subsp. globuligera, Penz. & Sacc.
Lophodermium hypodermoides, Penz. & Sacc.
Megalonectria pseudotrichia, (Schw.) Speg.
Nectria ambigua, Penz. & Sacc.
Nectria coronata, Penz. & Sacc.
Nectria eustoma, Penz. & Sacc.
Nectria leucotricha, Penz. & Sacc.
Nectria radians, Penz. & Sacc.
Nectria vulgaris, Speg.
Nectria xanthostroma, Penz. & Sacc.
Nectriella aurantia, Penz. & Sacc.
Neopeckia diffusa, (Schw.) Starb.
Neopeckia pumila, Penz. & Sacc.
Ophioceras dolichostomum, (B. & C.) Sacc.
Ophioceras majusculum, Penz. & Sacc.
Patellaria callispora, Penz. & Sacc.
Patinella chlorosplenoides, Penz. & Sacc.
Pezizella glaberrima, Penz. & Sacc.
Rhynchostoma rhytidosporum, Penz. & Sacc.
Rosellinia beccariana, Ces.
Rosellinia bunodes, (B. & Br.) Sacc.
Rosellinia obtusispora, Penz. & Sacc.
Rosellinia pulvis-pyrius, Penz. & Sacc.
Sordaria botryosa, Penz. & Sacc.
Stictis pallidula, Sacc.
Stilbum cinnabarinum, Mont.
Stilbum minutulum, Penz. & Sacc.
Stilbum parviceps, Penz. & Sacc.
Thuemenella javanica, Penz. & Sacc.
Torula heteromorpha, Penz. & Sacc.
Trichosphaeria proxima, Penz. & Sacc.
Trinacrium subtile, Riess, subsp. tjibodiense, Penz. & Sacc.
Tubeufia anceps, Penz. & Sacc.
Valvaria massarioides, Penz. & Sacc.
Vermicularia longiseta, Penz. & Sacc.
Xylaria aristata, Mont.
Xylaria humilis, Penz. & Sacc.
Xylaria oocephala, Penz. & Sacc.

Limbs—living.
Fleischeria javanica, Penz. & Sacc.

Liquidambar sp.?—
Astrosporium chrysocephalum, Penz. & Sacc.

Litsea chrysocoma.
Phyllachora laurinearum, Rac.

Livistona olivaeformis—dead bark.
Zignoella omphalostoma, Penz. & Sacc.

Lonicera—leaves.
Criella lonicerae, Henn.

Mallotus moluccanus.
Cronartium malloti, Rac.

Mangifera indica.
Gloeosporium mangiferae, Rac.
Mangifera kemanga.
Cronartium kemangae, Rac.
Mapania.
Puccinia mapaniae, Rac.
Marattia sambucina.
Morenoella marattiae, Rac.
Melchioria—on Elettaria.
Nectriella pallidula. Penz. & Sacc.
Melocanna.
Konradia secunda. Rac.
Menispermaceae—dead leaves.
Acrospermum foliicolum, Berk.
Metroxylum longispinum—bark.
Lophiosphaeria schizostoma (Mont.) Trev.
Michelia velutina.
Goplana micheliae. Rac.
Scolecopeltis salacensis. Rac.
Monocot—dead bark.
Nectria hypoxantha. Penz. & Sacc.
Calonectria effugiens. Penz. & Sacc.
Monocot—leaves.
Myiocopron affine. Penz. & Sacc.
Monocot—dead leaves.
Cladotrichum mitratum, Penz. & Sacc.
Stilbum candidulum. Penz. & Sacc.
Monocot—dead stems.
Calonectria callorioides, Penz. & Sacc.
Mollisia orbilioides. Penz. & Sacc.
Mosquitoes.
Empusa grylli. (Fres.) Now.
Mucuna.
Parodiella mucunae, Rac.
Uromyces? mucunae, Rabenh.
Musci.
Gliocladium pulchellum, Penz. & Sacc.
Pezizella epibrya. Penz. & Sacc.
Myrica javanica.
Myxosporium candidissimum, Rac.
Myrsine affinis.
Epichloe montana, Rac.
Nephrodium heterophyllum.
Morenoella nephrodii, Rac.
Nephrolepis acuta.
Entyloma nephrolepidis, Rac.
Lembosia longissima, Rac.
Nicotiana tabacum.
Cercospora nicotianae, E. & E.
Phytophthora nicotianae, de Haan.
Pythium complens. Fischer.
Pythium vexans, De Bary.

Nipa fruticans.
Lembosia javanica. (Pat.) Rac.
Oryza sativa.
Napicladium janseanum, Rac.
Ustilaginoidea virens. (Cooke) Tak.
Palm—dead leaves.
Pezizella avellanea, Penz. & Sacc.
Trichobotrys pannosa, Penz. & Sacc.
Palm—dead petioles.
Anthostomella obtusispora, Penz. & Sacc.
Arenaea javanica, Penz. & Sacc.
Arenaea macrospora, Penz. & Sacc.
Aulographum atromaculans, Penz. & Sacc.
Anthostomella obtusispora, Penz. et Sacc.
Davincia tenella, Penz. & Sacc.
Didymobotrium atrum, Pat. var. pachysporum, Penz. & Sacc.
Helminthosporium nodipes, Penz. & Sacc.
Illosporium aureolum, Penz. & Sacc.
Melanconium profundum, Penz. & Sacc.
Melanomma leptosphaerioides, Penz. & Sacc.
Neomichelia melaxantha, Penz. & Sacc.
Oxydothis maculosa, Penz. & Sacc.
Phaeodiscula gonospora, Penz. & Sacc.
Rosellinia marginato-clypeata, Penz. & Sacc.
Sporocybe acicularis, Penz. & Sacc.
Sporodermium bogoriense, Penz. & Sacc.
Teichospora xenochaeta, Penz. & Sacc.
Trichopeziza melleo-rufa, Penz. & Sacc.
Trichosphaeria affinis, Penz. & Sacc.
Palm—dead rachises.
Brachysporum obovatum. (Berk.) Sacc.
Karschia tjibodensis, Penz. & Sacc.
Melanomma leptosphaerioides, Penz. & Sacc.
Palm—dead sheaths.
Belonidium glauco-fuligineum, Penz. & Sacc.
Palm—dead spathes.
Chilonectria macrospora, Penz. & Sacc.
Nectria dolichospora, Penz. & Sacc.
Ophionectria trichospora, (B. & Br.) Sacc.
Pandanus—dead leaves.
Anthostomella pandani, (Rab.) Sacc.
Erinella albo-flaveola, Penz. & Sacc.
Lophodermium javanicum, Penz. & Sacc., var. pandani, Penz. & Sacc.
Solenopeziza mellina, Penz. & Sacc.
Pandanus littoralis.
Hyponectria pandani, Rac.
Panicum.
Paikilosporium bogoriense, Rac.
Panicum formosum.
Capnodium stysanophorum, Penz. & Sacc.

Bemoivskia graminis, Rac.
Phyllachora stenospora, (B. & Br.) Sacc.
Pavetta silvatica.
Endophyllum griffithsiae, Rac.
Phaeomacropoda.
Mycogone echinulata, Penz. & Sacc.
Phaius.
Uredo phaji, Rac.
Phalloid fungus—volva.
Sepedonium chrysospermum, (Bull.) Fr.
Phanera.
Meliola curviseta, Rac.
Phaseolus.
Uromyces phaseoli, (Perk.) Lk.
Phyllanthus.
Oidium tabaci, Thuem.
Phyllostachys.
Uredo arundinariae, Sydow.
Phyllostachys—young twigs.
Konradia bambusina, Rac.
Physaria didermoides Roxb.—sporangia.
Hyponectria raciborskii, Penz. & Sacc.
Pierardia dulcis—seeds.
Aspergillus penicillopsis, (Henn. & Nym.) Rac.
Pinanga.
Kordyana pinangae, Rac.
Pistillaria sp.
Penicillium candidum, Link.
Pithecolobium lobatum.
Eurvachora pithecolobii, Rac.
Uredo pithecolobii, Rac.
Plectocomia—dead petioles.
Boerlagella velutina, Penz. & Sacc.
Plectocomia—dead rachises.
Anthostoma tjibodense, Penz. & Sacc.
Plectocomia elongata—dead stems.
Winterella eutypoides, Penz. & Sacc.
Podocarpus (?)—dead limbs.
Diatrype parvula, Penz. & Sacc.
Polygonum sp.
Ustilago utriculosa, (Nees) Tul.
Polygonum chinense.
Puccinia solmsii, Henn.
Pongamia glabra.
Stigmatea pongamiae, Rac.
Polypodium longissimum.
Parmularia discoidea, Rac.
Psilotum flaccidum.
Myiocopron millepunctatum, Penz. & Sacc.
Psophocarpus tetragonolobus.
Woroninella psophocarpi, Rac.

Pterocarpus indicus.
Aldona stella-nigra, Rac.
Micronectria pterocarpi, Penz. & Sacc.
Ptychosperma—dead spathes.
Oxydothis nigricans, Penz. & Sacc.
Quercus—acorns.
Xylaria carpophila, Fr.
Quercus—dead leaves.
Dimerosporium hamatum, Penz. & Sacc.
Randia scandens.
Endophyllum griffithsiae, Rac.
Rhododendron javanicum.
Coccomyces rhododendri, Rac.
Cryptomyces rhododendri, Rac.
Exobasidium vulcanicum, Rac.
Rhododendron retusum.
Exobasidium vulcanicum, Rac.
Morenoella gedeana, Rac.
Rottlera floribunda.
Anthostomella rottlerae, Rac.
Rubus moluccanus.
Hamaspora longissima, Körn.
Saccharum officinarum.
Apiospora camptospora, Penz. & Sacc.
Hypocrea saccharina, Rac.
Melanconium sacchari, Massee.
Melanconium saccharinum, Penz. & Sacc.
Stictis arundinacea, Pers.
Trichoderma lignorum, (Tode) Harz.
Salacia—leaves.
Phyllachora amphididyma, Penz. & Sacc.
Scaevola koenigii.
Ramularia scaevolae, Rac.
Schizostachyum blumeanum.
(See Bambusa).
Scirpus—dead leaves.
Lophodermium raapianum, Penz. & Sacc.
Scleroderma—peridium.
Hypocrea sclerodermatis, Penz. & Sacc.
Shorea dyeri—leaves.
Meneda purpurea, Rac.
Smilax sp.
Puccinia prainiana, Barel.
Sorghum—culm.
Stictis arundinacea.
Spatholobus littoralis.
Neottispora longiseta, Rac.
Spermacoce.
Puccinia brevispora, Rac.
Spondias acida, borbonica, and *dulcis.*
Dietelia eviae, Rac.

Sponia virgata.
Asternia sponiae, Rac.
Dimerosporium occultum, Rac.
Stems—dead.
Boerlagella laxa, Penz. & Sacc.
Chromosporium pallens, Penz. & Sacc.
Byssonectria delicatula, Penz. & Sacc.
Epicoccum angulosum, Penz. & Sacc.
Helminthosporium bogoriense, Penz. & Sacc.
Nectria arundinella, Penz. & Sacc.
Nectria leucotricha, Penz. & Sacc.
Oxydothis grisea, Penz. & Sacc.
Stilbum perexiguum, Penz. & Sacc.
Torula heteromorpha, Penz. & Sacc.
Vermicularia dematium, (Pers.) Fr.
Xenopus farinosus, Penz. & Sacc.
Zythia abnormis, Penz. & Sacc.
Stephania capitata.
Trabutia stephaniae, Rac.
Sterculia subpeltata.
Lambro insignis, Rac.
Strophanthus dichotomus.
Hemileiopsis strophanthi, Rac.
Symplocos fasciculata.
Exobasidium symploci-fasciculatae, Rac.
Physalospora symploci, Rac.
Talauma mutabilis.
Clypeolum talaumae, Rac.
Tectona grandis.
Uredo tectonae, Rac.
Termites—nests.
Xylaria torrubioides, Penz. et Sacc.
Termites—nymphs.
Cordyceps koningsbergeri, Penz. et Sacc.
Terminalia catappa.
Ramularia catappae, Rac.
Tetracera.
Marssonia tetracerae, Rac.
Tetranthera.
Phyllachora laurinearum, Rac.
Tetranthera amara.
Aecidium litsaeae, Pat.
Thelymitra javanica.
Aecidium thelymitrae, Rac.
Thespesia populnea.
Physalospora hibisci, Rac.
Tinospora cordifolia and *crispa.*
Elsinoe menispermacearum, Rac.
Torenia asiatica.
Puccinia toreniae, Rac.
Tradescantia capitata.
Kordyana tradescantiae, (Pat.) Rac.

Trichia verrucosa—peridium.
Ophionectria trichiae, Penz. & Sacc.
Trunks—dead.
Aspergillus candidus, Link.
Corallomyces brachysporus, Penz. & Sacc.
Coryne javanica, Penz. & Sacc.
Didymobotryum obesum, Penz. & Sacc.
Mollisia viridulo-mellea, Penz. & Sacc.
Penzigia macrospora, Penz. & Sacc.
Podosporium casuarina, Penz. & Sacc.
Xylaria gigantea, Zipp.
Xylaria holodapha, Bk. var. camptospora, Penz. & Sacc.
Xylaria hyperythia, Mont.
Xylaria involuta, Kl.
Xylaria kegeliana, Lév.
Xylaria leucosticta, Penz. et Sacc.
Xylaria nigripes, Kl.
Xylaria polysticta, Penz. et Sacc.
Xylaria scopiformis, Mont.
Xylaria subterranea, (Schw.) Sacc.
Xylaria varians, Penz. & Sacc.
Xylaria xanthophaea, Penz. & Sacc.
Uredo spp.
Tuberculina persicinae, Detm.
Vaccinium teysmannianum.
Ahnella tristis, Rac.
Strumella annularis, Rac.
Vespa velutina.
Cordyceps oxycephala, Penz. & Sacc.
Vitis serrulata.
Elsinoe viticola, Rac.
Wood—rotting.
Acanthostigna scleranthoides, Penz. & Sacc.
Acrostalagmus cinnabarinus, Corda.
Amallospora dacrydion, Penz.
Amphisphaeria atro-grana, (C. & B.) Sacc.
Amphisphaeria callicarpa, Penz. & Sacc.
Arthropodium chrysocephalum, Penz. & Sacc.
Belonidium albo-cereum, Penz. & Sacc.
Bertea moriformis, (Tode) de Not.
Boerlagella velutina, Penz. & Sacc.
Calonectria aurantiella, Penz. & Sacc.
Chaetosphaeria pusilla, Penz. & Sacc.
Cudoniella javanica, Henn. subsp. microspora, Penz. & Sacc.
Excipula oospora, Penz. & Sacc.
Graphium leucophaeum, Penz. & Sacc.
Helminthosporium bogoriense, Penz. & Sacc.
Helminthosporium gigasporum, B. & Br. subsp. javanicum, Penz. & Sacc.
Helotium javanicum, Penz. & Sacc.
Helotium subserotinum, Henn. & Nym.
Hormosperma pusillum, Penz. & Sacc.

Hypocrea lenta, (Tode) Berk.
Hypoxylon bifrons, de Not.
Hypoxylon microstroma, Penz. & Sacc.
Leptosporella gregaria, Penz. & Sacc.
Leptosporella sparsa, Penz. & Sacc.
Letendraea atrata, Penz. & Sacc.
Listeromyces insignis, Penz. & Sacc.
Mollisia cinerea, (Batsch) Karst.
Myriococcum (?) spinuligerum, Penz. & Sacc.
Ophioceras hystrix, Sacc. subsp. tjibodensis, Penz. & Sacc.
Ophiochaeta raciborskii, Penz. & Sacc.
Ophionectria conica, Penz. & Sacc.
Orbilia macrospora, Penz. & Sacc.
Orbilia sinuosa, Penz. & Sacc.
Podobelonium citrino-album, Penz. & Sacc.
Pseudohelotium microcenangium, Penz. & Sacc.
Rosellinia mammiformis, (Pers.) Ces. & de Not.
Sordaria caudata, (Curr.) Sacc.
Sorokina insignis, Penz. & Sacc.
Spegazzinia ornata, Sacc.
Sporodesmium tenellum, Penz. & Sacc.
Stilbum macrosporum, Penz. & Sacc.
Trichosperma griseo-candidum, Penz. et Sacc.
Xylaria axifera, Mont.
Xylaria cupressiformis, (Mich.) Bece.
Xylaria diceras, Lév.
Zignoella eumorpha, Penz. & Sacc.

Wrightia javanica, mollissima and *tinctoria.*
Hemileiopsis wrightiae, Rac.

Xanthorrhoea—rotting wood.
Trichopeziza citrino-alba, Penz. & Sacc.

Zalacca—dead leaves.
Oncospora pezizella, Penz. & Sacc.

Zalacca—dead petioles.
Pezizella isabellino-rufa, Penz. & Sacc.

Zalacca—dead rachises.
Pirottaea versicolor, Penz. & Sacc.

Zea mais.
Peronospora maydis, Rac.

Zingiberaceae—dead stems.
Aleurina substipitata, Henn. var. pleuropoda, Penz. & Sacc.

C. F. Baker.

RAINFALL at the Director's house, Botanic Gardens, Singapore, during the first half of the year, 1917, in inches.
Readings taken always at 8 a.m. and credited to the date in which twenty-four hours begin.

Date.	Jan.	Feb.	March.	April.	May.	June.
1	.01	.01	.14	..	.01	.66
2	..	.11	.59	.02	..	.45
3	.05	..	.01	.12	..	.12
4	.65	trace	..	.55	trace	.05
5	.01	.09	2.79	..	..	2.87
6	.23	.53	2.66	.17	.15	.05
7	..	.21	.79	..	1.54	..
8	1.06	.20	.09	trace	.11	.28
9	3.22	.29	.02	..	.01	.01
10	2.72	.06	.02	.03	.01	..
11	.84	1.96	.92	2.32	.01	.62
12	.06	.37	.08	.51	..	.01
13	2.17	.45	.41	.27	..	..
14	.25	.14	.22	trace	.01	..
15	.55	..	.39	.04	.21	..
16	.08	2.68	.59	..	..	..
17	.16	.48	.57	..	..	..
18	.51	.42	.01	.02	.03	..
19	.01	.02	.15	.14	.05	.03
20	..	..	.06	.04	.01	..
21	.38	1.72	.04	..	.47	.10
22	..	1.61	..	.40	.06	..
23	..	.07	.02	..	..	..
24	.50	.12	.13	..	2.42	.18
25	trace	.58	.85	..	.05	..
26	.25	.01	.01	..	..	.01
27	.10	.05	.04	.02	.29	.01
28	.36	.65	trace	..	.04	.43
29	.41		..	.48	.03	.70
30	.04		.13	.35	..	..
31	.91		.05		..	
	15.43	12.83	11.78	5.48	5.51	6.58

RAINFALL at the Director's house, Botanic Gardens, Singapore, during the second half of the year, 1917, in inches.

Readings taken always at 8 a.m. and credited to the date in which twenty-four hours begin.

Date.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.82	.43	trace	..	1.85	1.64
2	.01	2.63	..	.28	.02	.08
3	..	..	.52	..	..	.27
4	.04	.10	..	..	..	.15
5	.05	.39	..	..	..	.02
6	..	.35	..	..	..	.82
7	..	.38	.95	1.56	.17	.01
8	.35	.12	.37	.51	..	.02
9	.04	.21	..	..	.60	.22
10	..	2.69	..	trace	.02	1.61
11	.08	.01	.08	..	.30	.63
12	.04	trace	.67	.23	.01	.28
13	.07	.51	1.29	.37	..	..
14	.35	1.41	trace	.89	.04	.18
15	.03	.06	trace	1.00	..	.02
16	..	..	1.34	.43	.58	.40
17	.02	.06	trace	.32	.01	.18
18	..	..	2.61	.19	.16	.22
19	..	..	.01	.27	.03	.27
20	..	..	.01	1.75	trace	.32
21	..	trace	trace	.67	..	.05
22	..	1.97	.02	.07	.36	.26
23	.11	1.37	.03	..	.03	.07
24	..	.14	.68	..	.04	..
25	.25	.83	1.63	.25	.02	.02
26	.11	.02	.36	..	..	trace
27	..	.02	..	..	.06	..
28	.03	trace	trace	..	.07	.54
29	..	1.02	.07	.01	.63	.03
30	..	.01	.03	.38	.01	.69
31	..	..		.02		.05
	2.40	14.73	10.67	9.70	5.01	9.05

RAINFALL at the head of the Waterfall Gardens, Penang, during the first half of the year, 1917, in inches.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of Georgetown, Penang.

Date.	Jan.	Feb.	March.	April.	May.	June.
1	..	.04	.38	..	..	..
2	..	.02	.13	..	..	.21
3	..	..	..	..	.20	..
4	..	..	.47	..	..	..
5	.60	..	.12	.41	.08	..
6	.83	..	3.25	.36	.14	.07
7	.30	.44	.60	..	.20	2.20
8	..	.04	.03	..	1.23	.30
9	..	..	.21	..	.13	..
10	..	..	..	.17	.09	.15
11	..	..	..	.61	.55	1.33
12	..	..	.26	1.05	.04	.06
13	..	..	1.17	..	.10	..
14	.15	..	..	..	..	..
15	.10	..	..	.12	.13	..
16	1.02	.19	1.59	1.27	.05	..
17	..	.10	.60	..	..	..
18	..	.46	..	.76	..	..
19	..	..	..	.26	.54	..
20	..	..	..	..	1.90	..
21	..	..	..	.36	.30	..
22	..	.67	.13	.08	..	.40
23	.06	.36	1.62	1.56	..	..
24	..	.13	..	.27	..	.68
25	2.06	.07	..	..	.82	.24
26	.06	.08	..	..	..	..
27	..	.49	..	1.03	..	..
28	.46	.20	..	..	.31	..
29	..		..	.16	.20	2.08
30	..		..	..	..	.11
31	..		..		..	
	5.64	3.29	10.56	8.47	7.01	7.83

RAINFALL at the head of the Waterfall Gardens, Penang, during the second half of the year, 1917, in inches.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of Georgetown, Penang.

Date.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	..	..	..	..	.08	..
2	..	.77	.90	..	1.22	1.88
3	.17	.19	1.23	1.32	..	..
4	1.21	.60	.49	..	..	.58
5	.80	.96	..	..	1.43	..
6	3.77	2.43	..	..	.33	..
7	1.57	..	1.22	.18	6.60	.57
8	.57	.24	.36	.03	.23	.10
9	.23	..	..	..	.73	..
10	..	.25	.20	.07	.03	..
11	..	..	..	1.36	..	..
12	.06	..	..	3.04	..	..
13	.04	..	..	.74	.80	.78
14	.83	.70	..	1.49	..	..
15	..	.55	.49	..	..	..
16	..	.54	.68	.25	..	.03
17	.65	..	.98	.65	.12	.13
18	.11	..	.99	.35	.15	.18
19	..	..	.48	.31	.14	..
20	.16	..	1.03	.97	..	.72
21	..	1.73	.06	.14	.17	.18
22	..	..	..	.79	..	.03
23	.13	.96	.59	..	..	.20
24	..	.10	2.49	..	.63	..
25	..	3.75	.85	..	.47	.64
26	.07	1.73	.39	..	..	..
27	..	.09	.04	..	..	..
28	..	..	.21	.18	..	.02
29	..	..	..	..	1.30	..
30	..	.33	..	..	.55	..
31	.42	..		..		..
	10.79	15.92	13.68	11.87	14.98	6.04

SUMMARY OF RAINFALL.

	SINGAPORE.			PENANG.		
	No of rainy days.	Amount of rain in inches.	Longest Spell without rain.	No. of rainy days.	Amount of rain in inches.	Longgest Spell without rain.
January - -	26	15.43	2	10	5.64	8 (partly in Dec. 1916.
February -	25	12.83	1	14	3.29	7
March - -	28	11.78	1	14	10 56	12
April - -	18	5.48	4	15	8.47	
May - -	20	5.51	2	18	7.01	3
June - -	17	6.58	6	12	7.83	9
July - -	16	2.40	3	16	10.79	4
August - -	25	14.73	3	17	15.92	4
September -	23	10.67	3	19	13.68	4
October - -	19	9.70	4	16	11.87	15
November -	21	5 01	4	17	14.98	3
December -	28	9.05	1	14	6.04	4
Total	266	109.18	—	182	116.08	—

Greatest amount in 24 hours ...	3.22	6.60
,, ,, 48 ,, ...	5.94	6.93
,, ,, 72 ,, ...	7.00	8 36
Excessively rainy periods, more than 5.00 having fallen in 72 hours (January and March.) - - -	2	4 (July, Aug.,Oct. and Nov.)
No. of days when the condition persisted	4	10
Periods of comparative drought less, than 0 02 having fallen in 120 hours - -	2	8
No. of days when the condition existed (3 in June, 1 in July.)	4	26 (4 and 2 and 2 in Jan., 3 in Feb., 8 in Feb.-Mch., 5 in June, 1 in Sept., and 1 in Oct.).

The

Gardens' Bulletin

STRAITS SETTLEMENTS,

Vol. II | Issued August 12th 1918 | No. 2.

CONTENTS.

To be purchased at the Botanic Gardens, Singapore; from Messrs. Kelly and Walsh, Ltd., No. 32 Raffles Place Singapore.

Printed at the Methodist Publishing House, Singapore

DEPARTMENTAL NOTICES.

Requests for yams should be received not later than early September.

Plants of the Avocado or Alligator Pear—*Persea gratissima,*—and Brazil nut—*Bertholletia excelsa,*—to be sold within the Peninsula at fifty cents each.

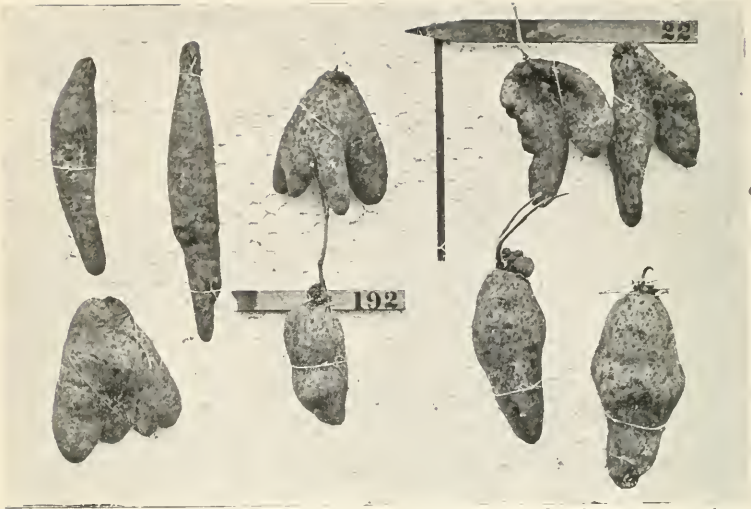
Seeds of *Hevea brasiliensis*—Para Rubber—as available from trees, twenty-eight years old, to be sold at three dollars per thousand up to the number of ten thousand, and at two dollars and fifty cents for every further thousand on the same order.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for a volume of twelve numbers, post free,

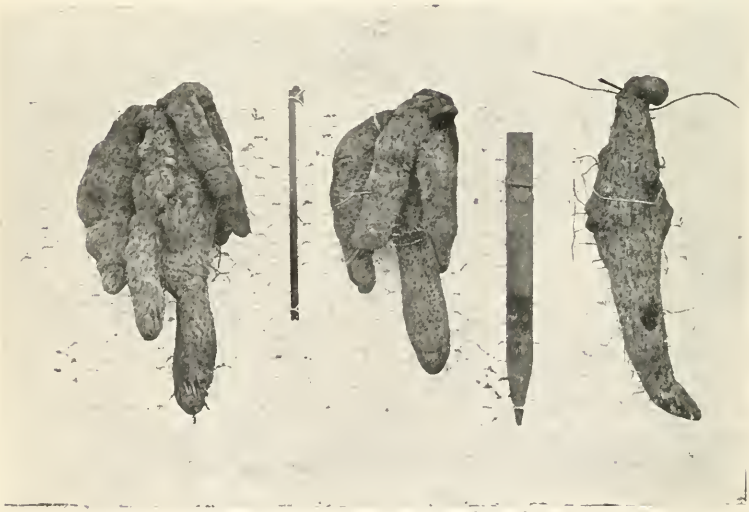
Five dollars in the Straits and Federated Malay States.

Nine and a half rupees in India and Ceylon.

Thirteen shillings in Europe.



Dioscorea alata. Race No. 192 on the left, race No. 22 on the right.



Dioscorea alata. Race No 70.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. II. Issued Augnst 12th 1918 No. 2

A REPORT UPON THE EXPERIMENTAL CULTIVATION OF THE GREATER YAM—DIOSCOREA ALATA—IN 1917.

This is the third of a series of reports upon the cultivation of the Greater Yam in the Gardens, Singapore. The first was printed in this *Bulletin*, vol. I., No. 9, pp. 297-304, and in it outline camera lucida drawings of sixteen races were given. The second report was printed in Vol. I., double No. 11-12, pp. 371-396, with illustrations from photographs of fifteen races upon six plates. In this report fourteen races are illustrated upon four plates, No. 76 appearing upon two of them. Besides these three reports, there is another in the *Philippine Agriculturist and Forester*, Vol. III., 1915, pp. 205-209, with illustrations of seven races. When the first report in the *Gardens' Bulletin* and that in the *Philippine Agriculturist and Forester* were published, the numbering system of the Gardens had not been made consistent, and was not referred to: therefore it is now convenient to draw into one list the races already illustrated,—being in all thirty-eight. This list is printed as an appendix on pp. 42-44.

The plates with this report show successively various morphological features not brought out before. All the figures are on the same scale, which is indicated by a half-metre measure in each block. The upper block of the first plate shows what variation may be found in sister plants: it represents five tubers of an African race called on the Gold Coast Eururuka nkakyi, and in Singapore grown under the number 192, together with four tubers of a race from Manila grown under the number 22. The African race produced tubers varying greatly in relative length, and in branching and in being sometimes flattened and sometimes round in transverse section: the Manila race varied in its tubers being sometimes flattened and sometimes round. It is necessary to ascertain the "why" of this, if the classification is to be perfected; and attention is directed to it accordingly. The lower block of plate i, exhibits four tubers of a race from Manila grown under number 76,

of which two more tubers are shown on plate ii, at the top on the right. These tubers were usually deeply fingered, which is not such as the race had produced in 1916 (vide Plate ii, of the Bulletin, Vol. I, double No. 11-12). It may be that twinning and grouping of tubers is the result of an arrest of the first attempt at tuber-formation in such a case; but this is a guess only to be investigated by experimentally varying the conditions in planting. The upper block of plate ii. illustrates approximately the condition which Sir David Prain and the writer named "farciniformis" or sausage shaped,—a condition common in the Gangetic valley and in other parts of India, which has not been figured in the previously printed plates. It is seen that when the race No. 76, is at one of its extremes, namely that on the right of the Plate ii, it is such as can reasonably be classed as farciniformis but at another extreme it is far away. This observation is a caution against accepting ill-developed tubers as proving their race to belong to "farciniformis."

Race 76 has other characters than those of shape which must be remarked: its flesh is peculiarly firm and of the yellow of old ivory. Cooked it was pronounced fair. It is a heavy yielder, with a prickly stem.

Continuing the comments on the plates, and turning to the middle block of plate ii, four tubers of race 132,—the Fijian "Uvi kaboa"—are seen, above four tubers of the race No. 44, which was received from the Bureau of Agriculture, Philippine islands. These illustrations will serve as references, so that it may be possible in descriptions to point to them saying, "fingered to the degree of No. 132," or "fingered to the degree of No. 44."

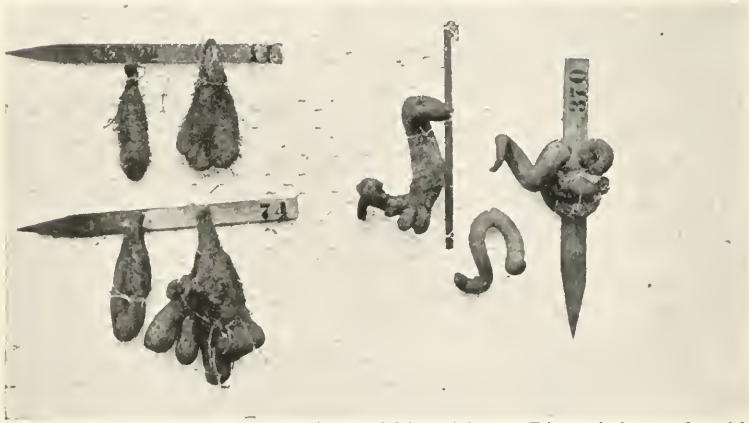
The bottom block of plate ii, has a historical bearing, for it exhibits what Rumphius called *Ubi tangan* or Hand yam, and *Ubi ular* or Snake yam, the first on the left in races 14 and 74, and the second on the right in race 370. All three came from the Philippine islands. To be really like a hand, the tubers must be well grown: fasciation wherefrom the flatness comes not developing unless the tuber is strong enough to branch freely. Therefore the tubers on the extreme left which are not well developed, do not show it. Rumphius hitherto has been much misunderstood in regard to Ubi ular: Roxburgh though it must be a wild yam other than *Dioscorea alata*, and called a most unlike Indian species "Dioscorea anguina" in consequence (Flora indica, 1832, iii, p. 803).

It is quite certain that Ubi ular is *Dioscorea alata*, and as that tuber shows which in the plate is in contact with the half-metre measure, it should be classed along with those races which do not bury their tubers by descending into the earth, but may extrude them,—those which have to be cultivated by earthing-up.

Plates iii, and iv, are both given to illustrate this peculiar group,—the not-burying or apogeotropic group. Plate iv, illustrates it at its extreme; plate iii, shows races which are intermediate between the more usual state and it. Firstly on the upper

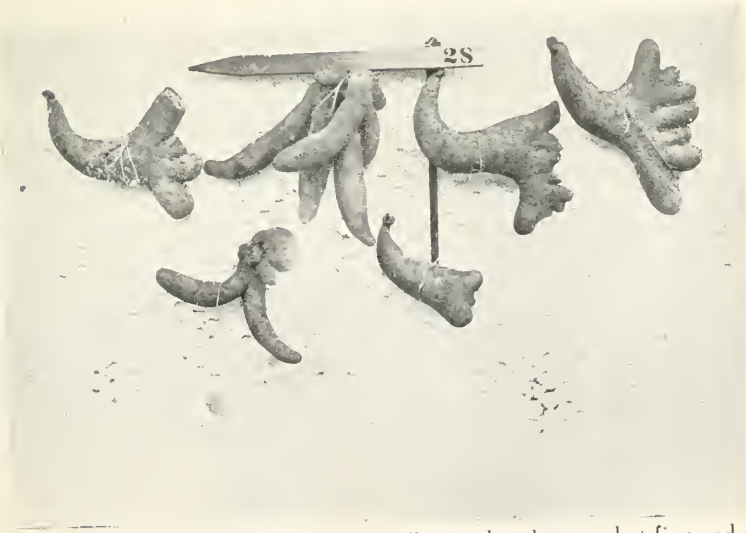
Dioscorea alata. Races Nos. 140 and 76.

Dioscorea alata. Races Nos. 132 and 44.



Dioscorea alata. The flattened tubers of Nos. 14 and 74, and the snake-like tubers of No. 370.

Dioscorea alata. Race No. 174 showing how its fingers tend to be horizontal, and race No. 78 showing fingers which descend.



Dioscorea alata - Race No 28, a curving flattened and somewhat fingered yam.

block of plate iii, are shown tubers of race 174, Khoai tiem from Saigon, in which the fingers diverge, and race 78, a yam from Manila, in which they do not. They are shown together for contrast, as it is easy to conceive transitions whereby the interval between race 174, and races 38 and 72, might be bridged through race 28. In race 28, which was received from the College of Agriculture, Los Banos, Philippine islands, as Tumuktok, the tuber exhibits a tendency to divide into two which curve away from each other, and in the angle between them a series of smaller branches may appear. On plate iv, lower block, one of the tubers photographed shows down its side just such a series of smaller branches as form in race 28.

Race 28 behaved slightly differently in 1916 (vide plate v of the Bulletin Vol. I, double No. 11-12); and that this was so, is interesting, for it suggests how considerable an influence the conditions may have upon the form,—influences at present only to be recognised as operative but to be analysed by further work. It is well known that monstrosities of all kinds in plants appear fixable by selection, but the tendency to exhibit them is suppressed if the plant is weakly or not under the best of conditions. So would it be with regard to these yams; and therefore if their characters are to be brought out, they must be richly cultivated.

This brings us to the conditions of the 1917 crop. An attempt was made in 1917 to get more into the available ground by closer planting than in 1916. Most of the sets were planted 2 feet by 3 feet (only the up growing yams 2 feet by 9 feet) whereas in 1916 they had been 2 feet by 5 feet. This closer planting while agriculturally correct because the yield was hereby increased, was not sound from the botanical standpoint, as the plants competed with each other too much to develop quite freely and fully, the returns from each race at the same time varying inconsistently from those got in 1916. The following are tables comparing the two years.

YAMS, NOT REQUIRING EARTHING UP.

	Year 1916.	Year 1917.
No. of hills	582	520
Area	11330 sq. feet	3120 sq. feet
being of an acre	.260	.072
or of a hectaire.. ..	.105	.025
Sets which failed	23	84
which grew	559	424
Return	1810076 grammes 3989 lbs.	961117 grammes 2118 lbs.
Yield per hectaire ..	17238.82 kilos	38444.68 kilos
per acre	6.89 tons	13.16 tons
Average yield per hill ..	3110 grammes	1849 grammes
i.e. failures included ..	6.85 lbs.	4.07 lbs.
Average yield per plant ..	3238 grammes	2267 grammes
which grew	7.14 lbs.	4.99 lbs.

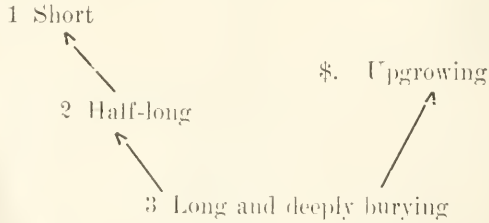
YAMS REQUIRING EARTHING UP.

	Year 1916.	Year 1917.
No. of hills	61	51
Area	1188 sq. feet	918 sq. feet
being of a hectaire ..	.011	.0085
being of an acre	.027	.021
Sets which failed	0	3
Sets which grew	61	48
Return	189259 grammes 417 lbs.	153207 grammes 338 lbs.
Yield per hectaire ..	17205.36 kilos	18021.18 kilos
Yield per acre	6.89 tons	7.18 tons
Average per hill .. .. i.e. failures included ..	3103 grammes 6.84lbs.	3004 grammes 6.63 lbs.
Average per plant .. which grew	3103 grammes 6.84 lbs.	3192 grammes 7.04 lbs.

It is distinctly of interest that these upgrowing yams which in 1917 had wide intervals of nine feet between the rows in which they stood (for the convenience of earthing them up) should have returned scarcely more with these nine feet intervals than they did in the year 1916 when the intervals were five feet; for it indicates that the interval of five feet is quite adequate to prevent competition between the rows under the conditions of soil and climate that they were subjected to.

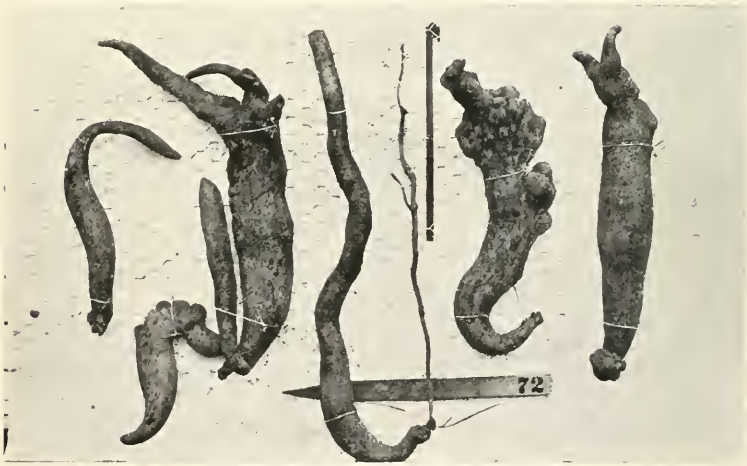
The return of the other yams was, as stated already, reduced when in the year 1917 the rows were approximated.

The year 1917 was a very wet one, and the water table so rose in the soil as to make the conditions very wet at the lower end of the piece of land used. At this lower end were the deeper going yams. The yams were in fact planted in accordance with the scheme which was proposed as a basis for classification in this Bulletin, vol. I, p. 377 in the following diagram.



those to the left occupied one bed with the longer at the lower end, and the upgrowing occupied another bed. The first bed had a gentle slope, so that the deeper going were the more likely to be water-logged.

Dioscorea alata. Race No. 38.



Dioscorea alata. Race No. 72.

The following table suggests, but does not prove that they were placed at a disadvantage.

	In 1916.		In 1917.	
Races with the longest tubers	236 tubers with average weight	3336.99 gr.	125 with average weight	1795.64
Races with shorter tubers	114 do.	4575.17	78 do.	2750.54
Short tubers	106 do.	3543.75	94 do.	2401.95

being a reduction upon the longest of .. .. 46 per cent.
the shorter .. .. 40 ,,
the short .. .. 32 ,,

The figures also suggest that it is not the longest and deepest going which give the largest returns; but that those which are half-long, or perhaps one might say between half-long and long, are the most prolific.

The return per area, but not the relative return was interfered with by thieves who robbed at night but not discriminatingly, taking from the back of the bed where they thought their operations most hidden.

In this Bulletin, Vol. I, p. 306 the advantage to the new plant of using the top of the old tuber for a set was stated, and on p. 307, it was shown by how much these tops give an early start to the new shoot. In 1917 top halves were planted against bottom halves in no less than 56 races, 154 tops against 136 bottoms. In 42 races the average weight of the tubers produced by the tops was greater than the average weight of tuber produced from the bottoms, and in 13 cases it was the reverse.

Most of the races grown have now been tried cooked at least once; but so long as the Gardens are without the use of a laboratory, accurate comparisons are most difficult to make. The opinion has been formed that all the upgrowing yams are excellent for the table when properly cooked. The others vary a little among themselves. Further examinations will be made, especially with a view to desisting from cultivating that which is inferior.

Hitherto the study of the morphology of the tubers has demanded the cultivation of them all.

The classification resulting may be expressed by the following table wherein the numbers given denote the races which have been figured.

Elongation and branching of the tuber.		Combined with flattening of the tubers.	Combined with multiplication of tubers arising from stem-tissue.	Combined with tendency of a stem tissue to produce additional uprising fleshy autumn shoots.
Class 1. Short.				
a. unbranched	26, 70		26	
b. lobulate	24	50, 58, 88. 192		
c. fingered	78, 170, 74	20, 44, 98	22	
Class 2. Half long.				
a. unbranched	8, 132, 192		8,	2, 6, 8, 18, 140
b. with lobe-like branches	10	14, 74		
c. with finger-like ... ... branches	76			
Class 3. Long.				
31 tubers set into stem tissue				
a. unbranched	12, 68, 118, 156		12, 30	16
b. with lobe-like branches				
c. with finger-like branches				
32 tubers attached by a neck to stem-tissue.				
a. unbranched	162			
b. with lobe-like branches...	186			
c. with finger-like branches				
4 **Not burying.**				
a. unbranched	32. 72			
b. with lobe-like branches ...			34, 38	
c. with finger-like branches		28, 36, 370		

A list of the races already figured: the number after the name is that under which they were received.

No. 2, native name unknown, origin a deserted garden on Bukit Timah, Singapore island, Gard. Bull. I, Nos. 11-12, pl. iii.

No. 6. "Ubi merah," origin Singapore market. Gard. Bull. 1, Nos. 11-12, pl. iii.

No. 8. "Ubi, red fingered," origin Luzon, Gard. Bull. 1, No. 9, fig. 1 on p. 299.

No. 10. "Tugui, finger shaped, No. 1057," origin Luzon, Gard. Bull. 1, No. 9, fig. 2 on p. 299.

No. 12. "Ubi, finger shaped, No. 1056," origin Luzon, Gard. Bull. 1, No. 9, fig. 4 on p. 299.

No. 14. "Paquit, No. 3790," origin Luzon, Gard. Bull. 1, No. 9, fig. 8 on p. 299; and II, No. 2, plate ii.

No. 16. Origin Luzon, Gard. Bull. 1, No. 9, fig. 6 on p. 299; and Philip. Agric., 111, fig. 14 on p. 207,

No. 18. "Ubi, red No. 1042," origin Luzon, Gard. Bull. 1, No. 9, fig. 5 on p. 299.

No. 20. "Ubi, red, No. 1031," origin Luzon, Gard. Bull. 1, No. 9, fig. 10 on p. 299; and Philip. Agric. III, fig. 16 on p. 207.

No. 22. "Ubi, white, No. 1019," origin Luzon, Gard. Bull. 1, No. 9, fig. 8 on p. 299; and II, No. 2, plate i.

No. 24. "No. 931," origin Luzon, Gard. Bull. 1, No. 9, fig. 7 on p. 299.

No. 26. "Ubi, white, No. 1055," origin Luzon, Gard. Bull., vol. I, No. 9, fig. 9 on p. 299.

No. 28. "Tumuktok, No. 1095" from the College of Agriculture P. I. Gard. Bull., vol I, No. 9, fig. 1 on p. 301 and Nos. 11-12, plate v; and vol. II, plate iii.

No. 30. "Ubag, No. 960" from the College of Agriculture, P. I. Gard. Bull., vol. I, No. 9, fig. 2 on p. 301.

No. 32. "Tinuque, No. 956," from College of Agriculture, P. I. Gard. Bull., vol. I, No. 9, fig. 3 on p. 301; and Philip Agricult., vol. III, fig. 18 on p. 207.

No. 34. "Ballolong. No. 943," from the College of Agriculture, P. I., Gard. Bull., vol. I, No. 9, fig. 4 on p. 301.

No. 36. "No. 935," origin Manila., Gard. Bull., vol. I, No. 9, fig. 5 on p. 301.

No. 38. "Tamis, Ubi, white, No. 945," from Bureau of Agric. Manila, Gard. Bull., vol. I, No. 9, fig. 6 on p. 301: and Nos. 11-12, plates v and vi, and vol. II, plate iv.

No. 44. "Ubi, red, No. 1025," from the Bureau of Agriculture, Manila, Gard. Bull., vol. II, No. 2, plate ii.

No. 50. "No. 824," from the Bureau of Agriculture, Manila, Philip. Agricult., vol. III, fig. 17 on p. 207.

No. 58. "Binaksan, Ubi, No. 329," from the College of Agriculture, Philippine Islands, Philip. Agricult., vol. III, fig. 15 on p. 207.

No. 68. "No. 1692," from Bureau of Agriculture, Manila., Philip. Agricult., vol. III, fig. 12 on p. 207: Gard. Bull., vol. I, Nos. 11-12, plate ii.

No. 70. "Caroline Islands yam, No. 3793," from the Bureau of Agriculture, P. I. Gard. Bull., vol. I, Nos. 11-12, plate ii.

No. 72. "Sinawang pulo yam, No. 955," from College of Agriculture P. I. Gard. Bull., vol. I, Nos. 11-12, plate vi, and vol. II, No. 2, plate iv.

No. 74. "Ubi from Aringay in La Union Province, No. 937," from the Bureau of Agriculture, Manila, Gard. Bull., vol. II, No. 2, plate ii.

No. 76. "Sinanto, No. 958," from the College of Agriculture, P. I. Gard. Bull., vol. I, Nos. 11-,12 plate ii; and vol. II, No. 2, plates i and ii.

No. 78. "Ubi, No. 938," from the College of Agriculture, P. I., Gard. Bull., vol. II, No. 2, plate iii.

No. 88. "Ubi, red, No. 1041," from the Bureau of Agriculture, P. I., Gard. Bull., vol. I, Nos. 11-12, plate iv.

No. 98. "Khoai Siam," from the Botanic Garden, Saigon, Gard. Bull., vol. I, Nos. 11-12, plate iv.

No. 118. "Fijian yam, No. 20710," from Royal Botanic Gardens, Calcutta, Gard. Bull., vol. I, Nos. 11-12, plate i.

No. 132. "Fijian yam, Uvi kaboa, No. 20679," from Royal Botanic Gardens, Calcutta, Gard. Bull., vol. II, No. 2, plate ii.

No. 140. "No. 35560," from the Royal Botanic Gardens, Calcutta, Gard. Bull., vol. II, No. 2, plate ii.

No. 156. "Fijian yam, No. 20702," from Royal Botanic Gardens, Calcutta, Gard. Bull., vol. I, Nos. 11-12, plate i.

No. 162. "Phan shriew, from the Khasia hills, No. 35606," from the Royal Botanic Gardens, Calcutta, Gard. Bull., vol. I, Nos. 11-12, plate i.

No. 170. From Port Darwin, Australia, Gard. Bull., vol. I, Nos. 11-12, plate iv.

No. 174. "Khoai tiem," from the Botanic Gardens, Saigon, Gard. Bull., vol. II, No. 2, plate iii.

No. 186. "No. 35575, from Lumding, Assam," from the Royal Botanic Gardens, Calcutta, Gard. Bull., vol. I, Nos. 11-12, plate i.

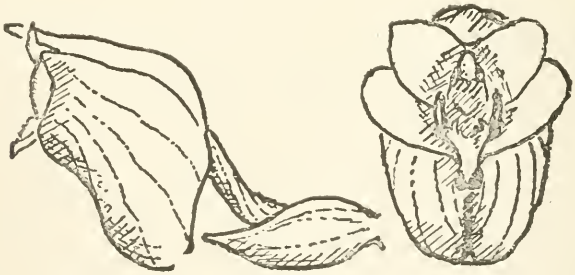
No. 192. "Eururuka nkakyi, No. 17," from the Gold Coast, Department of Agriculture, Gard. Bull., vol. II, No. 2, plate i.

No. 370. Origin uncertain, but almost certainly Luzon, Gard. Bull., vol. II, No. 2, plate ii.

ORCHID NOTES.

Acanthephippium javanicum, Blume.

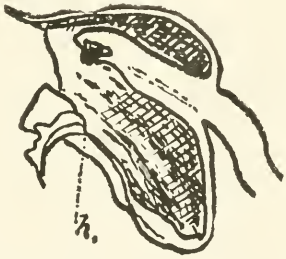
The discovery of this orchid on Gunong Tampin, Negri Sembilan, not only adds a large-flowered species to the list of those known to occur in the Malay Peninsula but adds a genus; for no species of *Acanthephippium* have been found within our borders previously. It occurs on the mountain at about 1800 feet above sea-level in forest about the sides of a stream in a little sandy hollow of unusual conformation. From this spot it has been introduced into the Botanic Gardens, Singapore; where it grows freely.



Flower of *Acanthephippium javanicum*, slightly reduced, viewed horizontally from the side, and from in front.

The plant was first described by Blume who had found it on Gunong Salak in Java. He afterwards published a coloured plate in his *Flora Javae*, Orchidaceae, t. 49 (1858), but before this figure appeared, the orchid was already in English glass-houses, and Lindley in the *Botanical Register*, 1846, t. 47, as well as Sir William Hooker in the *Botanical Magazine*, 1850, t. 4492, had issued plates. The general colouring of the Tampin plant is nearly as in Lindley's and Blume's figures, *i.e.* a dull claret merging to yellowish white, with considerable mottling and streaking, all the colours dull except on the lip which is brightly coloured from claret at the edge of the side-lobes to a clear chrome yellow on the mid-lobe which ends in a deep claret tip. This lip is just like a saddle upside down, but with low spines as the figure shows where a saddle should be at its smoothest; Blume's name for the genus refers to the saddle-like appearance and to these low spines.

The flower is 5.5 cm. from the tip of the dorsal sepal to the bottom of the bucket, and 2.5 cm. across the mouth from tip to tip of the slightly recurved lateral petals; the opening into the bucket, disregarding the degree to which the lip blocks it, is 1.7



Flower of *Acanthephippium javanicum* in section ; h—the hinge of the lip.

cm. across. The lip is finely hinged (h. in the figure) obviously with the object of upsetting the balance of a visiting insect and throwing it against the sexual organs. By the slight projection of the lip from the mouth of the flower and by its conspicuous colouring it is the part offered to an insect for alighting. The drawing shows the saddle fallen forward as far as possible. The side-lobes of the lip which make the flaps of the saddle curve a little and would keep a visiting insect in the middle line and therefore just under the column with its sexual organs.

The interior of the bucket is more spotted than the exterior and deeper in colour. No free honey has been found, and no scent detected.

The flowering season is May, June and July. Up to four flowers have been seen open on the same raceme.

Blume's original locality, Gunong Salak, has been named. Lindley studied the plant in the nurseries of Messrs. Loddiges, and from his account the reader is led to suppose that Loddiges' plant

came from the same place, where Dr. J. J. Smith also has obtained it in recent years. Whence came the much more brightly coloured plant that flowered at Kew and furnished Sir William Hooker with his drawing, is unrecorded.

Dr. J. J. Smith records *Acanthephippium javanicum* as occuring on Gunong Salak, at Tjigombong and Bandongan, and on the island of Telo and in New Guinea (*Orchideen von Java*, 1905, p. 215).

STAUROPSIS BREVISCAPA, ROLFE.

In 1912 Mr. J. W. Anderson, then Assistant Curator of the Botanic Gardens, collected plants of this orchid in Sarawak and brought them alive to Singapore. They flowered very freely in April, 1916.

The plant rises to 3 feet, and bears many inflorescences of 2—6 flowers. The flowers are mustard yellow with rich umber brown markings. They face horizontally. The lip is very lightly hinged and hangs by its own weight: it is thick along the middle line, by reason of a ridge rising near the base, and continuing into a white point. It has brown lines on it, short and parallel, running towards the side lobes which are a little concave. The edges of the sepals and petals are crisped as in so many Vandas.

The following two sheets in the Singapore Herbarium are considered as of the same species:—

Sarawak without locality, *Sahib*, flowered in the Singapore Gardens, 23.4.14.

Bidi, Sarawak, *Mrs. Brooks*, Sept. 28, with the note. "This is a limestone orchid and occurs also at Kuop.

PHALAENOPSIS KUNSTLERI × SUMATRANA.

On May 4th, 1917, Mr. B. K. Saheb brought to the Botanic Gardens for opinion a flowering *Phalaenopsis* which he had obtained in the north of the Peninsula along with *P. sumatrana*. In foliage it exactly resembled *P. sumatrana*, but the flowers were white with a slight green flush, and marked sparingly with chocolate brown. The colouring thus was as in *P. Kunstleri*, Hook. f., but in shape it exactly resembled *P. sumatrana*, while upon the white petals and sepals the shape of the markings was as in *P. sumatrana*, Korth., though they were much less abundantly present. The sepals and side petals had rather the shape of those of *P. Kunstleri*, being shorter and more ovate than in *P. sumatrana*. Altogether there appeared in the specimen a certain amount of evidence for regarding it as a natural hybrid between the two named.

SACCOLABIUM (SARCANTHUS) SECUNDUM, RIDL.

Saccolabium secundum, Ridl. is a rather widely distributed orchid, occurring in the Himalaya of Assam, and southwards to Sumatra, Java and Borneo. Wallich's collectors, F. de Sylva and W. Gomez, obtained it in Sylhet, and Wallich apparently cultivated

it, for he caused a drawing to be made. Griffith in August, 1836, also obtained it at Sadiya in Upper Assam and made drawings and dissections of the flowers.

Flower of *Saccolabium secundum*, × 2½, viewed horizontally from the side, and from in front: and in vertical section.

Wallich appears to have intended calling it *Sarcanthus oxyphyllus*, but Lindley in helping Wallich with the distribution of his collection, by some accident transferred this name to another orchid, substituting *Micropora pallida*, but confusing two species. Griffith headed his description of the plant *Sarcanthus secundus* and McClelland published it after his death in the *Posthumous Papers* III, Notulae, 1851, p. 362. Ridley, in transferring the plant to the genus Saccolabium, rightly coupled Griffith's specific name into the compound *Saccolabium secundum*.

In 1895 under the editorship of Sir Joseph Hooker, Wallich's drawing was reproduced in the *Annals of the Royal Botanic Gardens, Calcutta*, vol. V, plate 77. Griffith's pencil sketch had appeared in 1851, but the plant as it grows in the Malay Peninsula has deeper colours in the flower than Wallich's plate or Griffith's description indicate for the Assam plant; and they are sligthly differently distributed. The annexed drawing shows its appearance, the black on the sepals and lateral petals representing a very dark chocolate brown, the white a pale greenish yellow. Griffith indicated that the Assamese plant has reddish orange where the Malayan plant has chocolate, and Wallich's drawing bears this out. The lip does not possess these colours, but it is lilac fading to white towards the base with yellow within the side lobes on either side.

The lip combined with the column is a very complex structure through not unique in the genus. The median crest of the limb is extended as a partition down the spur, which divides it almost completely into two, ending about mid length at the back and forming a short beak anteriorly. Above the point where the partition ends at the back is the caruncle which is bilobed and sits astride of the margin of the partition in such a manner as almost to close the way to the interior of the spur. Insects seeking honey must pass a proboscis either to right or to left of this caruncle and find it so directed into one half of the interior only. The honey is very abundant, and the walls of the spur are extremely succulent.

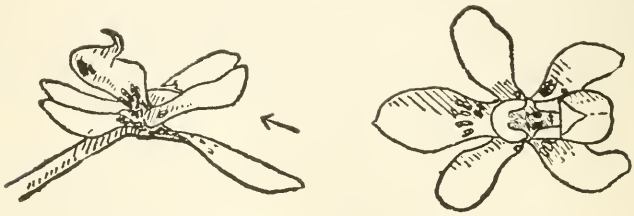
Undoubtedly there is not a little variation in the colouring of the flowers; and Dr. J. J. Smith in his *Orchideen von Java*, 1905, p. 604 states that the sepals and petals may be coloured light or dark brown with greenish blue margin and stripe down the middle.

In the Malay Peninsula as it appears to be found most freely near to the coast.

Saccolabium (Pomatocalpe) Arachnanthe, Ridl.

This orchid is one of the group for which Dr. J. J. Smith uses the name Pomatocalpe. A plant of it has been in the Botanic Gardens for a long time and flowered in April, 1916, and in May, 1918. In both years the month of February was dry.

The most curious thing about the flowers is that they face upwards—a rare occurrence in orchids. In the bud they are packed into a corymb. The flowers are white with a very faint lilac tinge, and with a few deep lilac spots towards the base. The edge of the septum which divides the spur from side to side is visible from the front of the flower over the brim of the spur and between the horns at the side, just as Dr. J. J. Smith figures it in *Die Orchideen von Java*, fig. cdlviii, for *Pomatocalpe latifolium*.



Flower of *Saccolabium Arachnanthe*, × viewed horizontally from the side, and from above.

The flowers fade pale green. They are pleasantly but not strongly scented.

The pollinating insects are unknown; but small bees are indicated by the shape of the flowers as suitable visitors; such insects would be expected to alight on the dorsal sepal and to approach the lip between the obliquely ascending lateral petals in the direction indicated by the arrow upon the figure. Such insects would pollinate the flower after having sought in vain for honey in the dry lower chamber of the lip, by backing over the sexual organs, and in the search for the narrow slit like a ⊥ which leads into the smaller upper chamber where the surface may be just moist.

Cypripedium niveum × Exul.

In the Gardeners' Chronicle, vol. 55, 1914, p. 326, Mr. Ridley described *Cypripedium Pereirae*, as almost certainly a hybrid of *Cypripedium niveum* with another species such as *C. Exul*. The native collector, who got it, has brought from the same part of the coast of the Siamese Malay States, namely the coast not far north of the Kedah border, another plant, which, while not exactly *C. Pereirae*, appears equally to be a hybrid of *C. niveum*. The plant in question fell into the hands of Mr. B. K. Saheb who grew it with *C. niveum* and flowered it in June, 1918.

The leaves of this plant are longer and firmer than those of *C. niveum*, attaining 14 cm. by 2.8. They spread and are dark green without the pale spots of *C. niveum*, but the green is nowhere quite of one colour, yet not waved. The tip is slightly unequally bilobed, and the keel at the back sharp. The single peduncle so far produced was about 10 cm. long, and carried one flower; it was densely pubescent, as also the bract, and the ovary. The fused lower sepals of the flower were 2.6 cm. long. The dorsal sepal when flattened was deltoidly subcordate, 3 cm. long and the same in breadth just above the base; but in life its margin was conspicuously undulate. The lateral petals were almost elliptic when flattened, 3.4 cm. long, and in life conspicuously undulate. All these were softly and rather densely pubescent on the back and the margins. The dorsal sepal was marked with lines of violet dots radiating from the base to mid-distance towards the margins, and with a faint lilac flush among the spots. The lateral petals descended but a little from the horizontal, and had a light violet streak right down the centre fading upwards and towards the tip. The rest of these organs was white. The lip was white and glabrous; nearly 3 cm. to the base of the bucket, slightly compressed laterally, longer in proportion to its width that of *C. niveum*, with the basal lobes well developed and strongly incurved. The column was thick, and its shield not at all cordate, but widened to a little beyond the middle, and then abruptly narrowed to a very short point; at its base it was suffused with very pale lilac, and in the centre with chrome yellow.

The chrome yellow comes from its niveum parentage, and so does the absence of isabelline tints in the flower, but the distribution of the violet to lilac colouring matter comes from the other less obvious parent.

It is the rule for hybrids between the white *C. niveum* and the isabelline coloured species of Cypripedium to be white. Many have been raised in gardens and are so; but *C. niveum* × *Exul* has never been raised. All the hybrids carry more or less of lilac pigment, and by its distribution suggest their second parent. In the case of the plant under discussion, the purple markings suggest *C. Exul* as regards the dorsal sepal, and *C. villosum* as regards the laterals petals. But the shape of the flower is more that of *C. Exul* than of *C. villosum;* and the finding of *C. Exul* in the same region almost establishes the parentage.

Further Evidence indicating that the Pigeon Orchid (Dendrobium crumenatum) flowers eight days after Heavy Rain, and on the flowering of Saccolabium Calceolus.

As the Rainfall statistics for the Botanic Gardens, Singapore, through the year 1917 have been given in the last part, it is convenient to make some remarks upon the flowering of the above-named two orchids in its connection with heavy rain, for the data are available for consultation,

In the Gardens' Bulletin, Vol. I, Nos. 11-12, 1916, pp. 400-405, evidence was produced to show that the Pigeon Orchid flowers about eight days after heavy rain in response to some factor or factors not isolated by experiment. The rainfall was there tabulated for thirty days in advance of thirty flowerings which occurred over the years 1913 to the commencement of 1917.

In the wet year 1917, the orchid flowered on an unusual number of days, namely.

January	17th,	freely
,,	18th,	very sparingly
,,	19th,	rather freely
,,	20th,	very sparingly
February	19th,	sparingly
,,	25th,	very sparingly in the Botanic Gardens, but in great abundance in Singapore town
March	20th,	very abundantly
April	13th,	fairly abundantly
June	2nd,	very abundantly
June	20th,	one flower only
July	7th,	rather abundantly
August	11th,	sparingly
,,	14th,	sparingly
,,	31st,	very abundantly,
September	6th,	rather sparingly
,,	27th,	one plant only
November	8th,	very abundantly,
December	11th,	one plant only in the Gardens, but others in the neighbourhood of the Gardens,
,,	25th,	rather sparingly.

It is to be noted how frequent were these flowerings. Then if the reader will turn to the rainfall tables given on pp. 32-33 it can be observed that the rain which fell on the eighth day before six of the flowerings exceeded an inch or on the ninth day before eight of the flowerings, and that in one case only, out of the whole, did the rain of the eighth and ninth preceeding days fail to exceed half an inch; that one case being December 11th, when more than an inch and a half fell on the tenth of the preceding days. If we add together the rain in the way in which it was added on p. 403 of the first volume we find that on the nineteen days which were the tenth before the flowering 10.03 inches fell; on the nineteen which were the ninth 23.62 inches; on the nineteen which were the eighth 15.17, and on the others in approaching order successively 8.19, 6.75, 5.37, 8.97, 7.98, 7.95, and 8.23. Thus the ninth day before is suggested as the critical day rather than the eighth.

The same general result is obtained if the occasions of abundant flowering alone be considered. Perhaps higher average temperatures lead to the eighth day being the critical one; and lower average temperatures to the ninth.

Mr. H. N. Ridley pointed out some years ago that there is a similarity between the flowering of *Saccolabium Calceolus* and *Dendrobium crumenatum*, stating that the former flowers one day before the latter. This relation however cannot be expressed quite so simply. In 1917 *Saccolabium Calceolus* flowered in the Botanic Gardens, Singapore, on

February 24th, one day before *D. crumenatum*,	by the Plant Houses
March 13th, three days before ,,	generally
April 13th, on the same day as ,,	by the Plant Houses
May 2nd	by the Lake
November 7th, one day before *D. crumenatum*,	by the Plant Houses
,, 29th	generally and freely
December 9th, two days before *D. crumenatum*,	generally and freely
,, 18th	by the Plant Houses
,, 22nd, three days before *D. crumenatum*,	generally and freely

This flowering shows the following relationship to the rainfall, t. meaning a trace:—

12	11	10	9	8	7	6	5	4	3	2	1	day	before
.37	.45	.14	—	2.68	.48	.42	.02	—	1.72	1.61	.07	Feb.	24th.
.14	.59	.01	—	2.79	2.66	.79	.09	.02	.02	.92	.08	Mch.	13th.
—	.02	.12	.55	—	.17	—	t	—	.03	2.32	.51	Apr.	13th.
.04	—	.40	—	—	—	—	.02	—	.48	.35	.01	May	2nd.
—	—	—	.01	.38	.02	1.85	.02	—	—	—	—	Nov.	7th.
.01	.16	.03	t	—	.36	.03	.04	.02	—	.06	.07	Nov.	29th.
.06	.07	.63	.01	1.64	.08	.27	.15	.02	.82	.01	.02	Dec.	9th.
.02	.82	.01	.22	1.61	.63	.28	—	.18	.02	.40	.18	Dec.	18th.
1.61	.63	.28	—	.18	.02	.40	.18	.22	.27	.32	.05	Dec.	22nd.

Eight days before the first, second, seventh and eighth of these flowerings the rain was heavy, and on two of the four occasions the flowering was general in several parts of the Gardens. But it was equally free and general on November 29th and December 22nd when the last heavy rain before the flowering had occurred much earlier,—13 days in one case and 11 or 12 days in the other. Therefore although there must be some common cause predisposing the two orchids towards flowering, it is not clear at all exactly what it is. Observations from other localities would be welcome.

I. H. Burkill.

CONTROL OF DAMPING-OFF.

(The following taken from the *Agricultural News*, West Indies, of August 11th, 1917, Vol. XVI, pp. 254-255, is worth reading and digesting; for in Malaya, damping-off in one of the greatest troubles that a gardener has to contend with. The method recommended in it has been tried in the Botanic Gardens, Singapore; and so far there is nothing to be said against it except the necessity of teaching

the ignorant *lukang kebun* to handle the Sulphuric Acid respectfully; and as the use of burnt earth can be avoided in some measure, pecuniary gain is brought into sight).—*Ed.*

Damping-off is the term applied to the failure of seedlings due to their infection while in a tender state by certain soil-inhabiting fungi. The reason for the name is the association of the trouble with conditions of more or less excessive moisture, which favours the development of the parasite at the same time that it increases or prolongs the tenderness of the plants. Though not necessarily confined to seedlings crowded in boxes or seed-beds, it is amongst such that the affection usually appears and, by progressive infection, is able to cause extensive losses. Merely reducing the density with which the seed is sown is often sufficient, by permitting increased ventilation, preventing the drawing up of the seedlings, and making the spread of infection more difficult, to avoid or reduce the damage.

The longer the soil of the seed-bed has been in use and the more decaying animal or vegetable material it contains, the more likely it is to harbour fungi capable of causing damping-off. Heavy water-retaining soils are more favourable to the affection than those which are light and porous, and provision for rapid drainage is one of the most important precautions against it. Over-shading and close shelter, by maintaining humidity, increase the tendency to it; in these respects, as in the supplying of water, the conditions which favour the seedlings favour the disease, and a mean has to be struck between slow growth and loss.

The trouble occasioned by damping-off in these islands (West Indies) is not so great as might be expected by an agriculturist accustomed to temperate countries, where warm, humid weather, such as is associated with ideas of the tropics, is greatly feared in this connexion.

In the first place nearly all the staple food plants, sugar-cane, bananas, tannias, dasheens, sweet potatoes, yams, cassava, are raised from cuttings of one sort or another. Cotton, corn and pulses, which are raised from seed, are planted a few seeds together, in their permanent positions in the open ground. Of agricultural as distinct from garden crops tobacco, onions, and limes, which are raised in seed-beds, have been the plants to suffer most in the West Indies from the affection under notice.

Notes on the subject, embodying the results of experiments conducted in the United States, were published in Volume XIII, of this Journal (p. 380). A bulletin recently received (*United States Department of Agriculture Bulletin, No. 453*), by Messrs. Carl Hartley and Roy G. Pierce, states the conclusions derived from further studies, made on coniferous seedlings.

The authors point out that the methods of prevention commonly adopted by nurserymen, such as the use of sandy soil, the use of sand or gravel for surfacing the beds, the provision of good drainage and ventilation, while often successful, do not avail

to prevent heavy losses under unfavourable circumstances, while the withholding of water often does as much direct harm as the affection which it is sought to avoid.

The use of imperfectly rotted manure, of lime, of wood ashes, and of a mixture of coal and wood ashes are indicated as having had bad effects.

The one means so far discovered which can be relied upon to give satisfactory results under any reasonable conditions is the disinfection of the soil. The question remains as to which of the various methods available for this purpose it is most convenient to adopt. The use of steam or of formaldehyde has been widely recommended, but these methods are so expensive as to be impracticable except for relatively small quantities of valuable material, as in green-houses or market gardens.

For the broader requirements of nurserymen the treatment finally adopted by the authors of the bulletin under review consists in the application in standard soils of three sixteenths of a fluid ounce of commercial sulphuric acid to each square foot of seed bed, applied in solution in water immediately after the seed is sown and covered. This has proved more reliable than the more expensive methods mentioned above.

The amount of water used to carry the disinfectant does not appear to be a matter of importance, provided that the necessary amount of the acid is applied to each unit of area. The quantity used by the authors varies from 1 pint per square foot when the soil is wet to 2 pints when the soil is dry. There is a possibility, especially in light soils, of a concentration of the acid by evaporation to a strength injurious to the root-tips, which in practice has been found to be completely avoidable by watering the beds frequently during the period of germination. When the root-tips have penetrated to a depth of half an inch this is no longer necessary.

There are differences in the amount of acid required for successful results in different soils. In sandy soil which was probably somewhat alkaline, a heavier application, one-fourth to three-eighths of an ounce, was indicated. In a fine sandy soil which was probably already acid, chemical injury to seedlings was more difficult to avoid, and reduction of the acid to one-eighth of an ounce was advisable. On heavier soils the use of five eighths of an ounce produced no injury, and reduced losses by damping-off to less than 1 per cent.

On a soil with a high carbonate content, evidenced by a vigorous effervescense when the acid was applied, the method was found to be ineffective. On this soil the use of copper sulphate, one-fourth ounce per square foot, gave good results. This substance was applied in the same way as the acid, and the same precaution to avoid chemical injury was found necessary.

An interesting indication was given by the experiments of the effectiveness of cane sugar, 2½ oz. to the square foot, in the control of damping-off. The authors point out that if some un-

refined sugar-bearing substance were available, it is possible that for certain soils the application of sugar would become an economically satisfactory treatment. Experiments on this subject might well be carried out in the West Indies.

There are secondary advantages to be expected from sulphuric acid disinfection which may be of considerable importance in some cases. Under appropriate circumstances a larger germination percentage is secured, the number of parasites in the soil is reduced, and the well-known effect of disinfection on fertility results in increased growth. Another valuable effect has proved to be the reduction of weeds owing to the greater susceptibility of their seeds.

In considering the application of the methods to local conditions, it is necessary to emphasize the fact that the results stated have been obtained with the seedlings of a definite group of plants, the conifers. It will be necessary to find by experiment how far they are transferable to the seedlings of unrelated plants. In view of the difference of soils, moreover, such experiments must be carried out in the situation where the seedlings for which it is proposed to adopt the method are raised.

Some hints are given as to the method of handling the acid. It should always be dissolved by pouring it into the water; reversing the process may cause a serious accident. The solution should be made up in wooden or earthen containers and applied with watering cans which have been coated inside with paraffin wax. Boots may be protected by being heavily greased. Wooden containers should be washed out, immediately after use, with water containing washing soda.

W. N.

PROPAGATION OF HEVEA FROM STAKES.

On page 251 of the first volume of the Gardens' Bulletin reference was made to the difficulties experienced in propagating *Hevea brasiliensis* by means of cuttings. Experience in Ceylon and in the Malay Peninsula was quoted; and Mr. Petch's suggestion that Thwaites had been deceived when he claimed it to be easy was cited.

Fresh experiments were then made with cuttings from young twigs, without success; and when it happened, in 1917, that a big wind destroyed many rubber trees in the Economic Garden, stakes were cut from them for supports in the yam beds, so that the misfortune of losing many rubber trees gave the opportunity of trying propagation from branches 1—2 inches in diameter.

These branches were cut diagonally with a sharp knife at the end, thrust into the ground, and wired together at six feet in the way which is seen in Plate VI of the first volume of the Bulletin Nos. 11-12 (opposite p. 394).

Out of a total of 1489 stakes so taken, 18, or 1.21%, took root and produced leaves.

The weather was wet when in January and February the stakes were set in the ground.

I. H. Burkill.

THE ESTABLISHMENT OF THE BOTANIC GARDENS, SINGAPORE.

The year 1919, the centenary of the founding of the settlement of Singapore, brings in the sixtieth year of the Botanic Gardens; and their early history is becoming obscure. Moreover the records are only in the two older Singapore newspapers, which it is laborious to consult, and of which single files exist. These are reasons enough for reproducing here six reports, and for bringing them into one view by a brief introduction, with quotations from the old papers.

The Straits Times under the date 12th November, 1859, has the following paragraph:—

"We understand some of our enterprising citizens have resolved to establish a Floricultural and Horticultural Society, which will receive our hearty concurrence and support. This will be the third attempt to organise a really useful association, and we trust it will succeed."

Who these citizens were is not recorded: but from subsequent papers it appears as if Mr. J. E. Macdonald and Towkay Hoh Ah Kay, better known under his trade name of Whampoa, were two; and it is fairly apparent that the Governor, Colonel O. Cavanagh, had been consulted and had offered his support.

Although called Floricultural and Horticultural in this first notice, Agriculture was in its purview from the very start, its proper title being The Singapore Agri-Horticultural Society.

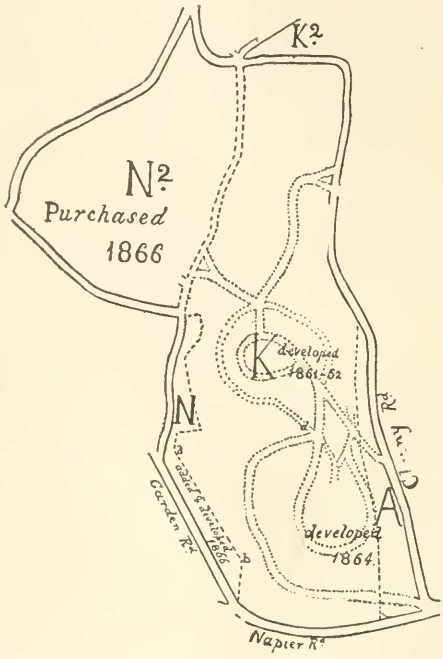
Within six weeks from this notice the Government of the Colony, glad exceedingly that some of its 45,000 acres of abandoned lands should be cultivated, had provided for the Society's operations through an enchange with Whampoa, by giving a piece of low-lying Government land in the River valley to him in return for an area of 56 acres (subject to a subsequent slight rectification) between Napier, Cluny and Garden Roads, the last a track only at the time (Straits Times of 24 Dec., 1859). The Government further promised convict labour within its power of giving: and the Society at once set to work to raise funds for superintendence, stores, tools, seeds, etc.

Members were enrolled on paying $25, and retained membership by a monthly subscription of $1 commencing on January 1st. 1860. Others might enjoy the use of the Garden, if residents, by paying $1.25 per mensem as second class subscribers. Strangers, if not from the very first, at least from an early date, were admitted into the Garden free.

Having got a membership of 77, the Society was provided thus with over $1900 as capital; and the subscriptions, we are told, averaged $74.25 over the first eighteen months (Appendix 2).

The outline map produced here, was drawn with the use of contemporary documents in the Land Office; it gives the whole present area of the Botanic Garden, the Economic Garden excluded, with the three original properties out of which it is made, marked separately

by letters N. K. & A. The areas K. and A. in the map were those which were put at the service of the Agri-Horticultural Society in 1859; the area N. was added in 1866. The chief part of the area of the Garden is seen to be made up of K, which had been granted by the administration in 1852 to one William Graham Kerr.



On the east of this Kerr property was property granted by the administration to one Gilbert Angus in 1848, and on its west property granted similarly in 1853 to one William Napier. When the Cluny road, now a Garden boundary, came to be constructed, it cut through a part of the Angus property, and a part of the Kerr property; the edge of the Angus property, marked A on the map, passed into the same ownership as the Kerr property, while the part of the Kerr property cut off (K2) passed away from the ownership. Again later when the Garden Road came to be made in 1866, it cut a strip off the property of the Napier grant which the administration acquired from Adam Wilson who had bought it from Whampoa and he from Napier, and this strip marked N. on the map, was attached to the land in the hands of the Agri-Horticultural Society. The records show that these lands had changed hands several times within the few years from the original granting; and as we know that in the middle and later part of the fifties, speculation in property about Tanglin was considerable —such landed property as was suitable for country houses,—it is fairly evident that the owners were not in the course of farming what they had come by, but were holding it up for such an

appreciation as accrued considerably in 1856, 1857 and 1858. A surmise only can be made that the southern part of the Kerr property had once been cultivated—say for gambier,—and had reverted to blukar: but virgin forest certainly existed on the northern part, for that forest still persists—a most valuable asset to the Gardens, and there is a little more of it just outside the Gardens on that part of the Kerr property marked in the map K2, which, as said, on the making of Cluny Road was cut off from the rest. The trees growing on both bits of land attest to the forest being primitive: for there are among them such as do not return through blukar, into forest younger than a hundred years. The eye of Sir Stamford Raffles for instance, therefore, saw forest where we see it still. But south of the Bandstand hill there seems to be scarcely a tree which could have been standing in 1860.

We are told (Appendix 2) that the Society spent $1448.10 out of its capital on the clearing of the southern part of the land and on roading.

The first roads made appear to have been what we now call the Office Gate Road and the Ring Roads, the Liane Road, and the Maranta Avenue. The present Main Gate the Society did not make their principal entrance; nor do they seem at first to have made the Main Gate Road. That Road was a later construction, as the abruptness of its junction (at d. on the map) with the first system of drives indicates. The hollow where the lake now is, must have been a swamp down the centre of which the boundary of the Kerr property, (from 1859 to January 1866 the boundary of the Society's property), made the straight line a-b on the map.

Probably for the sake of getting all the influence possible, the Committee was made very large. Fourteen sat on it, with His Honor the Governor as Chairman, and with Mr. J. E. Macdonald as Treasurer: and on September 13th 1860, this large Committee was enlarged to twenty one, five in rotation taking control of affairs along with the Treasurer, who henceforward was to be called Secretary as well.

When the first Committee of fourteen was appointed, and who were elected to it, are unrecorded; but in the first appendix (below p. 64) we find the names of eight who were present at a Committee meeting, together with the names of seven others who were then added to the Committee to make up the number to twenty-one.

Though hoping to benefit local agriculture, the Committee set as its first object the creating of a pleasure garden, as an alternative to the Esplanade, which was then the only resort for the evening drive. The Committee's efforts consequently began by providing a place where a band could play; and the hill top which is 109 feet

*Some trees on the Bandstand hill break the continuity of the terraces, as if spared when the terraces were made; and the southernmost of them are on the west a tree of *Artocarpus rigida*, the Monkey Jack, and on the east a tree of *Artocarpus lanceaefolia*. Everything south of them except the Sagos by the Lily-pond and perhaps two other trees, appears to have been planted since Gardens were laid out.

above sea level was chosen.* Terraces were planned flanking Ring Roads made on it; and through 1861 work upon them was in progress. This is what a visitor from Penang wrote in the Penang Gazette, "I rode over to the new Botanic Garden. By the time it is finished it will be a very nice place. From what I saw of it, part is intended to be laid out in the common terraced English style with drives round the grounds which are of some extent." The Singapore Free Press of January 1862 in reviewing the year then just finished, stated that the progress made in the Garden was considerable.

In 1861, if not also in 1860, a regimental band played in it; so that it had become an evening promenade. The band played once a fortnight (Appendix 2), and the day was at one time a Monday (Singapore Free Press of August 21st, 1862) then changed by public request to a Saturday (Singapore Free Press of September 4th, 1862),—the second and the fourth Saturdays in each month. But it is evident that the terraces were not completed, for in August 1862, work on them was still proceeding (Appendix 2).

It is recorded that in 1862 the Society engaged two Chinese gardeners to grow vegetables, hoping soon to be able to distribute plants and seeds among the members (Appendix 2); but reading in the Singapore Free Press of November, 1863 a regret that the Society was not able as yet at that date to supply fruit and vegetables, it is evident that the experiment went amiss.

While the Society's Garden was thus being made, the Society organised Flower shows in the hope of encouraging local cultivation. The first show was advertised in the Singapore Free Press of May 11th, 1861 and July 20th, 1861, and took place upon the Esplanade on the afternoon of Saturday, July 27th, 1861, in a tent "fairly decorated with bouquets of cut flowers from the Garden" and from exhibitors.

A second show was held in December, and others followed in subsequent years.

The Society had obtained the part-time services of Mr. Lawrence Niven as Superintendent. It was easy for him to combine this work with his other work, for he was employed as Superintendent of an adjoining nutmeg plantation; and he asked very little for it. It is quite evident that he did his part well, for he earned the Committee's thanks "for his taste in laying out the Garden" (Appendix 2), and Buckley (Anecdotal History, Singapore, 1902, ii. p. 732) says that he made the Garden attractive by large beds of pretty flowers; and further praise is given to him in the Gardens' Guide published in 1889.

The Government provided ten convicts for the Garden; and they were housed in lines built, if not at the very first, at least before 1866, up against the Napier property where the Lake now is. The Committee employed a further ten men, and added again another ten in 1863 in order to push on the work. But the expense of this free labour was more than the normal revenue of the Society could

* There is a point in the Gardens jungle recorded as 108 feet above sea level; and the Director's house is recorded as at 116 feet.

bear; whereupon thirty-one members came forward with donations of twenty-five dollars each (Appendix 3), and then again in the next year another fourteen members (Appendix 4). The further to add to the Society's funds a Fancy Fair was next organized in conjunction with a Flower Show, which took place on December 28th, 1864, and then again another Fair was held in 1866.

Although a hope had been expressed of dispensing with the second gang of ten free labourers, the report for 1864 (Appendix 4) shows that 17 men were being employed under a mandor, and that the Government had been able to increase the number of convicts to fifteen. It was under these circumstances that the second fourteen subsidiary donations were given.

The Bandstand Hill at the end of 1862 or in 1863 had become so far transformed that it was decided to turn attention towards the southern corner and to construct a new entrance "at the nearest part to town" where the present Main Gate stands. The Society somehow still possessing a little bit of land, cut off from the Kerr property in the making of the Cluny Road, and for that reason of no real use to them, exchanged it for considerations with the Nassim estate, one of which was that a corner of Nassim land should be thrown into the Napier and Cluny roads at their junction in order to improve the approach to the new gate. This was done.

The realignment of Garden Road had meanwhile been under the consideration of the Government, and as its construction promised to add a narrow strip to the Garden along its west edge, the making of the Lake, as it now is, became possible. This possibility may have been foreseen for two or three years, for the Main Gate Road which runs along the Lake bank had assuredly been laid down when in 1864 the new gate was opened, and there are no signs of any subsequent realignment to fit its course to the lake; but that the Lake was not part of the plans made in 1860 must be the case, for all the land was not in the Society's possession, and the Main Gate Road which takes visitors to the Lake, as said on p. 57, was not in the first plans. The Gardens were in fact laid out in four stages, each more or less independent; first there was the Band promenade with an approach from Cluny Road, and a means of driving through to the Rogie gate or the Garden Road; next, hinged on to the Bandstand to its south, was made the Herbarium Ring Road and its connecting paths, very carefully and symmetrically planned; then came the Main Gate, with its road; and lastly came the Lake, depending for its existence upon the acquisition from Adam Wilson in January, 1866, by Government of a bit of the Napier property. The Government supplied convict labour for work on the lake; but this had to be supplemented by free labour (Appendix 5).

Meanwhile Lawrence Niven found that the service demanded from him by his growing charge was inadequately paid for, and asked for more than he was receiving. The Committee considered it his due, but not feeling certain of having the means of granting it; they applied in August, 1865, to the Government for an allowance of fifty dollars per mensem, being the amount that they found

would retain Niven; and the Government sent the application forward to India for favourable consideration. A long interval passed with no reply, and the Society becoming very insistent, the Governor took it upon himself 13th July, 1866, to grant the sum asked for with effect from May 1st, 1866, subject to approval, only to find himself overruled from Simla by an order which he received the very next day. Yet somehow the Society did get this grant of $50 and in the same year, it being the first direct payment on the part of Government to the Gardens (vide Appendix 5).

There is a statement appended to the report of the Society for 1866 which is not reproduced here, wherein the names of the members of the Society are given and the amounts of their donations; we learn from it that 133 had joined, paying their $25 entrance fee and some of them giving another $25 later. We know that 77 of these were original members or members who had joined in the first year, and that 9 new members were obtained in the first half of the second year. If we distribute the balance of 47 over the remaining five and a half years, say thus, 5 for a half year, 8, 8, 8, 9, and 9; and collect together the other declared sources of income, assuming this only that the first Fête brought in $1000, we find that the Society obtained funds as follows:—

year	entrance fees	special donations	proceeds of fêtes	subscriptions, gate money, etc.	Total as recorded
1860	$1925	$—	$—	$624	$2348.75
1861	350	—	—	1296	1646.50
1862	200	—	—	985	1185.50
1863	200	775	—	945	1920.00
1864	200	350	—	1335	1884.75
1865	225	—	1000	2140	3364.62
1866, 10 months only	225	—	1717	3135*	5079.41

The increasing figures were evidently held by the Committee as justifying larger expenditure: they considered that they were beginning to get a return on their outlay, and would on a yet larger outlay. The Governor, moreover, in his Progress Report (dated 1867) remarked the taste in which the Society's land had been laid out. With a great faith in their mission, they proceeded to stabilise the undertaking: they raised Mr. Niven's pay again to retain his services (Appendix 5); they obtained from Government a grant in perpetuo of the land§ which they had been holding by its goodwill, so long as it should be used for public purposes; and to provide a site for a house for their Superintendent, and for other purposes they bought on March 9th, 1866, upwards of twenty-five acres of land† of the old Napier estate from Adam Wilson, who had bought it from Whampoa,—the land N2 on the plan. This exhausted their funds, leaving nothing for building: but they raised $1500 by a mortgage (Appendix 5).

* includes $250 from Government *i.e.* $50 p.m May to September.

§ 55 acres 3 roods and 28 poles.

† 24 acres 1 rood and 19 poles.

Up to this date the Society had had two Secretaries, firstly Mr. J. E. Macdonald, and secondly Mr. E. J. Leveson. Both had somehow through considerable difficulties, procured funds for the Society's Garden, and worked most assiduously, especially the second. From its foundation to 1867, when he retired, Major-General Cavanagh had showed the greatest interest. He took the chair at the meetings and was active with all the help he could give. The public to this date had put $17,430 into the creating of the Garden. The third Secretary Mr. C. H. H. Wilsone was not so fortunate. He entered into a contract* in 1867 with a Chinamen for the building of a Superintendent's house,—now the Director's house,—for the sum of $2400, and left the Society with a debt of over $700 being largely the difference between the sum raised by the first mortgage and the cost of the house. The last appendix here printed shows that in his non-extant report for 1868 these debts were overlooked, and a very false idea of security presented.

The Committee in 1869 when they realised their position asked and prevailed on the Government to allow them one hundred dollars monthly instead of fifty: and Sir Harry Ord, who was Governor, made a bargain that in return the Society should exhibit in the Garden living economic plants; for he had noticed that travellers making but a short stay would seek in vain for gambier, pepper, and other similar useful objects whose cultivation was no longer carried on near to the town. The better to watch the spending of the increased grant, which, consequent upon the falling off of subscriptions made 43 per cent of the Society's income, the Governor decided to appoint a member on to the Committee officially and chose Mr. H. F. Plow, Clerk of Councils, to represent him. At the same time he suggested the formation of a Zoo as an additional and educational attraction, like the economic plants: and he offered to present some animals.

The transactions of the years which follow between 1870 and 1874 are obscure, because the Agri-Horticultural Society went to sleep again. In a speech upon the Budget for 1875, made on December 18th, 1874, and reported in the Singapore Daily Times, of December 24th, 1874, Dr. R. Little stated that the Society had not carried out its part of the compact with the Government to grow economic plants, and that Committee and Management had alike lost interest. The Committee indeed had failed to raise adequate funds, except by increasing the 8% mortgage on its property to $4000. When in August 1874 this had been run through and the Treasurer found himself with a very adverse balance, a meeting was called which resolved:—"That the Honorary Secretary be instructed to acquaint Government with the willingness of subscribers to hand over the Agri-Horticultural Gardens for future maintenance, reserving to subscribers the same privileges that they now enjoy." This resolution Mr. R. Campbell, as Secretary, forwarded to the Colonial Secretary on August 13th, 1874.

Three months earlier, on May 14th, 1874, the subscribers to the Raffles Library had passed a similar resolution, praying the Government to take over their property with their debts, and to

* The specifiation and approximate plans are in the Gardens' records.

maintain the Library: and this request the Government had acceded to, and had appointed a very strong Committee, with Dr. Robert Little as Chairman, and Dr. N. B. Dennys as a member, to carry on. The Government, it happened, had been asked just before this by the Secretary of State if their control over the Library and over the Gardens was at all commensurate with the large sums of money that were being spent (at the time mostly on the Library). Change thus came from two sides: for both institutions had asked the Government to take them over: and of both institutions the Secretary of State had enquired if the Government was controlling them. The subscribers to the Library had acted first: the change was made promptly, and the new Committee immediately got under way. They engaged the services of a Dr. James Collins, who had come eastwards with recommendations from the Secretary of State, Sir Joseph Hooker and others, on a salary of $150 per mensem, to travel and investigate, to collect for the Raffles Museum; and to his duties was added that of getting together objects for an Exhibition in London: at the same time he was to carry on the Committee's correspondence, accounts, etc., in Singapore. Then when the members of the Agri-Horticultural Society made their petition, the Governor requested this Committee, if they could, to take charge also of the Garden; and they consented to do so. Thus the Garden passed temporarily under the same control as the Raffles Museum.

We find in the speech made upon the Budget estimates for the next year by Dr. Little, already referred to, and in some letters preserved in the Library the Committee's proposals for the future. Dr Little in these explained that it would not be advisable to add to Dr. Collins' work, but that another officer should be obtained from Britain, who could join Dr Collins in his explorations, the results of the two working together, bringing "immense gains to the scientific world."

The Governor now advised the Secretary of State that legislation would be necessary, for the Garden was property vested in the Vice-President and Treasurer of the Agri-Horticultural Society, and therefore could only be held for them by the Raffles Library Committee; and an act was needed that they might be transferred completely to the Government. For the purpose one was drafted immediately, but not put through. Meanwhile reorganisation was commenced; on the recommendation of the Committee, Government agreed to the retention of Mr. Niven on his pay of $80 per mensem with the title of the Manager, giving him permission to undertake besides their work other business; and the proposed Superintendent was sought from England by the Committee in correspondence with Sir Joseph (then Dr.) Hooker, as Director of the Royal Gardens, Kew. This Superintendent, the Committee stated, was to be a practical as well as a systematic botanist, and to travel in the Malay Peninsula not a little for the purpose of investigating its vegetation. At the same time an officer, found locally, was appointed to the charge of the animals in the Garden. Dr. Little obtained in the place of the sum of $1200 which was passed by the Government in the estimates of 1870, 1871, 1872, 1873, and 1874, as a grant to the

Botanic Garden, in 1875 $11,324; and in the three years following the Government budgeted annually $7580 for the Botanic Garden and $2400 for the Zoological Garden.

In the Singapore Daily Times for December 19th, 1874 and for the following days, there may be found an advertisement of the taking over of the Garden by the Government and of it being open now to all under the rules given, the right to receiving cut flowers, etc., being reserved to the subscribers within the Garden's means of supplying them.

At this date the Garden they may well have been quite a pleasant place to wander in,—a park in fact, but they had no scientific value whatsoever, for the number of species of plants cultivated was about 500 (Guide, 1889) and the animals were only a small collection of birds. The Society had lost way, though in the few years before they had been useful at times to the Government for the supplying of seed-coconuts to Mauritius and of seed of cocoa, cloves and pepper to Queensland, in answer to official requests from those colonies; but it would seem that the staff of the Garden collected what was needed from outside; and the Garden itself played no part in the service.

Then to the Library Committee in answer to the request for a Superintendent, Sir Joseph Hooker sent out an energetic, but very young man, in James Murton, who, arriving in Singapore in October, 1875, with a large supply of new plant-introductions, chiefly from Ceylon, converted with these and with later supplies from Kew, Mauritius, Brisbane, etc., the Agri-Horticultural Society's park into a working Botanic Garden; while William Kröhn, employed by the Committee, built up the collection of animals. Lawrence Niven now took leave, and died while away. His work,—the landscape gardening and terracing,—had been well done, so well done that little has been altered since: whether the plans were his entirely, or were not, is unrecorded: but it is evident that he greatly influenced them: and the smallness of the pay given to him suggests that he undertook the work largely for the love of it.

I. H. Burkill.

APPENDIX 1.

From the Singapore Free Press of 13th Sept., 1860.

A meeting of the Committee of the Singapore Agri-Horticultural Society was held on the 28th ultimo, the Honourable the Governor, President of the Society, being in the chair. The following members were present:—Messrs. J. d'Almeida, C. H. Harrison, Whampoa, C. R. Rigg, J. E. Macdonald, M. F. Davidson, and Capt. Burn. The Treasurer's accounts, showing a balance of $36.49 in favour of the Society, having been examined and passed, the following resolutions were adopted:—

1. That the Treasurer be requested to collect the monthly subscriptions from the 1st January last and in future that they be collected quarterly in advance.

2. That the members of the Committee be augmented to twenty one members, and that the following gentlemen be requested

to act so as to make it up to that number, viz. Messrs. Jose d'Almeida, James Murray, Tan Kim Seng, W. Paterson, W. Mactaggart, J. H. Campbell, and C. H. Wilsone.

3. That the Committee be divided into four Subcommittees who will by turns undertake the general management of the Society for three months at a time, and that the following gentlemen be requested to form the first Subcommittee from the 1st September next:—Messrs. C. H. Harrison, M. F. Davidson, C. R. Rigg, J. d'Almeida, and Captain Burn.

4. That the Committee as early as possible put themselves into communication with the Botanical and other Societies of Calcutta, Batavia, Mauritius, Penang, and other places for the purpose of obtaining supplies of plants and seeds.

5. That a Show of Flowers, Vegetables, and Fruit be held in March next, and that the Subcommittee for the time being make arrangements for the same.

6. That to enable the Society to avail itself of a gang of convicts as sanctioned by the Government, the necessary accommodation be provided for their reception within the limits of the Garden.

7. That Mr. Macdonald who has so kindly acted as Treasurer to the Society since its formation be also requested to undertake the duties of Secretary,—a combination of the two offices being considered desirable.

8. That Messrs. Whampoa and Tan Kim Seng be requested to afford the Society their valuable assistance in inducing their countrymen in Singapore to join the Society.

9. That each successive subcommittee on being relieved be requested to furnish a brief report of their proceedings to be laid before a quarterly committee meeting.

APPENDIX 2.

From the Singapore Free Press of August 15th, 1861.

This being the first general meeting since the formation of the Society in November 1859, the Committee of the Society desire to report proceedings to the Subscribers.

There are now 67 first class subscribers and 8 second class subscribers. Since the formation of the Society, 19 first class subscribers and 1 second class subscribers have withdrawn or left the Settlement. In the above 67 there are 9 new members since the commencement of the year.

From the account current to 30th June, produced by the Treasurer, there appears to be a balance on hand of $167.01.

The monthly income from subscriptions is $74¼ while the expenditure has averaged $176 per month, for a period of 18 months. This sum, however, includes $1,448.10 paid for contract work for clearing land, making roads, and erecting gate-posts, and bridges, leaving about $90 per month to the general working expenses of the Garden, being an excess of expenditure over receipts of 15¾ per month. The bringing of the Band to the Gardens once a fortnight

involves an outlay of $14 per month, but your Committee think that it is advisable to continue this expense, as the presence of the Band is a source of attraction to a considerable number of the community, and has added somewhat to the number of subscribers, and it is expected it may be the means of adding still further to the number.

There are now employed on the Garden a mandore and 10 coolies, and the Government allows a gang of 10 convicts. The quantity of work performed may appear to be less to the subscribers than they may have expected from the number of men employed, but the heavy nature of the work, which has consisted mainly of the formation of the very extensive terrace near the bandstand, fully accounts for this.

The first show was held on the 27th July, and although the products shown were not numerous, they were certainly as many as could reasonably have been expected. As a first attempt, and seeing the interest taken by the natives on this occasion, your committee are sanguine that much good will result from it.

Two Chinese gardeners have lately been engaged for the purpose of cultivating vegetables under the Superintendent, and it is hoped that in a few months the sale of vegetables will be a source of profit to the Garden, as well as a stimulant to men of their nation to rear a better cultivated vegetable; and to introduce a greater variety than the European community have hitherto enjoyed.

Your committee are much indebted to Mr. Niven Jr. for the taste displayed in laying out the Garden, and for the attention he has given generally.

Supplies of seeds have been received from the Agri-Horticultural Society of India, and also from England and from the Botanical Gardens of Batavia. Two boxes of plants and orchids and several contributions have been made by residents. And your committee hope ere long to be in a position to distribute plants and seeds among the subscribers, and cannot conclude this their first report without congratulating them on the success of the Agri-Horticultural Society of Singapore.

APPENDIX 3.

From the Singapore Free Press of Nov. 19th, 1863.

A general meeting of the Agri-Horticultural Society was held on Thursday the 12th instant (November 12th, 1863) at the Exchange Rooms, His Honor the Governor in the chair.

The Honorary Secretary read his report and the same was passed and approved.

The Treasurer submitted his report showing a balance in favour of the Society of $284.92, out of which the expenses of November and December have to be paid.

He at the same time brought to the notice of the meeting that out of 95 original members 4 have left Singapore, of these remaining 31 have already paid a second donation of $25 and this payment alone has prevented the Society from becoming insolvent.

The total income for the first half-year was $634.50 and the expenditure $762.42 showing a deficit of $22 per month, whilst for the current half-year the income is likely to be $522 and the expenditure $822 showing a deficit of $50 per month. This deficit has been mainly caused by the 10 extra coolies which it has been necessary to retain in order to complete the work now in progress. These however will in all probability be discharged early next month when the income is likely to be nearly enough to cover all Expenditure with the exception of the carriages for the Band.

The Treasurers report was then passed and approved.

The following resolutions were then proposed and carried.

1st Resolution—Proposed by Joachim d'Almeida, Esq., seconded by Captain Protheroe.

That the following Gentlemen be requested to form the Committee for the ensuing year:—

Jose d'Almeida, Esq., C. P. Lalla, Esq., Captain Macnair, J. Murray, Esq., C. R. Rigg, Esq., D. Rodger, Esq., H. M. Simons, Esq., Syed Abdulla, Esq., Tan Kim Ching, Esq., Whampoa, Esq., E. J. Leveson, Honorary Secretary and Treasurer.

2nd Resolution—Proposed by H. M. Simons, Esq., seconded by J. d'Almeida, Esq.

That an application be made to the Government in hopes of being able to obtain further assistance in the way of Convict Labour.

3rd Resolution—Proposed by the Honourable the Resident Councillor, seconded by Captain MacNair.

That with a view of increasing the members the monthly payment of the Second Class Subscribers be reduced to 50 cents, and the privilege hitherto granted to the Public of resorting to the Society's gardens on 3 days a week be withdrawn and the Gardens hereafter to be open only to Members, Subscribers, and Strangers, and Messrs. J. Little & Co. are kindly requested to receive Subscriptions and Donations.

4th Resolution—Proposed by H. M. Simons, Esq., and seconded by E. J. Leveson, Esq.

That the best thanks of this meeting be voted to His Honor the Governor for his kind assistance in taking the chair and for his valuable suggestions.

APPENDIX 4.

From the Singapore Free Press of Nov. 17th, 1864.

The annual meeting of the Members of the Agri-Horticultural Society was held at the exchange rooms on Thursday November 10th, 1864.

The Honourable Colonel Orfeur Cavenagh, Governor of the Straits Settlements, in the chair.

The Honourable the Governor read the annexed report of the Hon. Secretary and Treasurer.

After some preliminary remarks from the Chairman, the following resolutions were put to the meeting and carried unanimously.

1. Proposed by the Honourable the Governor, seconded by H. M. Simons, Esq.

That the accounts and report of the Honorary Secretary and Treasurer be passed and confirmed.

2. Proposed by the Honourable Col. Macpherson, seconded by C. H. Wilsone, Esq.

That the following gentlemen be requested to form the Committee for the ensuing year.

S. J. G. Jellicoe, Esq., C. P. Lalla, Esq., Captain Macnair, Captain Mayne, J. Murray, Esq., D. Rodger, Esq., H. M. Simons, Esq., Tan Beng Swee, Esq., Lieut.-Col. Warden and Whampoa, Esq.

3. Proposed by the Honourable the Governor, seconded by the Honourable Col. Macpherson.

That E. J. Leveson, Esq. be requested to act as Honorary Secretary and Treasurer for the ensuing year.

4. Proposed by the Honourable Col. Macpherson, seconded by E. J. Leveson, Esq.

That the proposition of the Committee to increase Mr. Niven's salary to $50 per mensem be carried out.

5. Proposed by H. M. Simons, Esq., seconded by J. S. Atchison, Esq.

That this meeting approves of the decision to hold the proposed Fête and Fancy Fair at the Mess House, Tanglin, in preference to the Gardens.

6. Proposed by H. M. Simons, Esq., seconded by Lieut.-Col. Warden.

That the best thanks of this meeting be presented to His Honour the Governor for taking the chair, and for the kind assistance he has always rendered, and the interest he has always taken in the Society.

Report.

The current account to the 30th June last, shows a debit balance of $66.76, and that to the 30th of last month, a balance in favour of the Gardens of $366.15, which will cover the ordinary expenses to the end of the year.

At the last annual meeting it was proposed to reduce the 3rd class subscription to 50 cents per month, but as this arrangement was not availed of to any extent, the committee decided to give up the 3rd class subscriptions altogether.

The monthly income from subscriptions during the first six months averages $100, and the expenditure $154, and during the present half-year the subscriptions have amounted to $144 against an expenditure of $184 per month. To meet however, the surplus of expenditure over income there have been fourteen donations of $25,

The officers of the 34th Regiment having kindly volunteered to subscribe $80 a year to the Society, the Committee felt justified in asking them to allow their Band to come again to the Gardens once a fortnight, a boon which has been highly appreciated by the subscribers.

We have now one mandore and 17 coolies employed regularly in the Gardens, and the Government allow 15 convicts, part of whom are employed in laying out the new grounds.

Mr. Niven has been unremitting in his attention and superintending the Gardens generally. He has shown great taste in carrying out the improvement going on, and it seems now quite time for the Society to show their appreciation of his services by an increase of salary, his present one being barely sufficient to cover the expenses consequent on his daily attendance; and the Committee recommend that his salary be increased to $50 a month. Considerable attention has been paid to the drainage, and a new grand entrance has been commenced at the nearest point to the town, the whole of which expense has been borne by the Government.

A strip of land belonging to the Nassim estate, and bordering on the Gardens has been exchanged for a similar piece of ground which formed part of the Gardens, but was of no use as it lay on the opposite side of the road, and to enable us to widen the principal approach, the Trustees of the Estate kindly allowed the corner of the Castle property to be thrown into Napier and Cluny Roads.

Although the residents have subscribed very liberally to the Gardens, it was found impossible to complete the laying out of the new ground without further means, and the Committee therefore have decided to hold a Horticultural Fête and Fancy Fair on the 28th of next month, when they expect that a considerable addition will be made to the funds of the Society.

In addition to promised contributions from the residents of Singapore, orders have been sent to Europe, India, China, Manila, and Japan for articles for sale the outlay for which, amounting to $1000 has been guaranteed to the Treasurer by the Committee.

APPENDIX 5.

From a Printed Paper Distributed to the Members of the Society in 1866.

Proceedings of the Annual Meeting of Subscribers.

The Annual Public Meeting of Subscribers to the Singapore Agri-Horticultural Society was held in the Exchange Rooms on Monday, November 19th, 1866.

The Hon'ble the Governor in the chair.

The Report was read by the Hon'ble the Governor.

Proposed by the Hon'ble the Governor, seconded by W. Paterson, Esq., that the Report now read and the Treasurer's accounts be passed and confirmed.

Proposed by Captain Protheroe, A. D. C.; seconded by Jose d'Almeida, Esq.; that the following gentlemen form the Committee for the ensuing year.

Brigadier Ireland, Colonel Cooks, J. Bennett, Esq., Hoh Ah Kay, Esq., F. van der Heyde, Esq., J. Murray, Esq., D. Rodger, Esq., S. J. G. Jellicoe, Esq., C. H. H. Wilsone, Esq., W. B. Smith, Esq.

That this meeting records its hearty thanks to Mr. Leveson for his services as Secretary and Treasurer of the Society, and requests Mr. Wilsone to act in that capacity for the ensuing year.

Proposed by D. Rodger, Esq., seconded by J. S. Atchison, Esq.

That the Vice-President and Treasurer of the Society for the ensuing year and their successors be and they are hereby appointed Trustees of the Society.

Proposed by E. J. Leveson, Esq., seconded by J. Cameron, Esq. and carried with acclamation.

That the best thanks of this meeting be given to His Honour the Governor, for his presence at this meeting and the interest which he has always taken in the welfare of the Society.

Annual Report of the Singapore Agri-Horticultural Society for 1866.

The extensive improvements in the Gardens and the expenditure requisite for completing the lake, having necessitated a considerable outlay, the members will be aware that at the last annual meeting it was decided to hold a second Fête and Fancy Fair, which was accordingly done in the month of May last and the result again proved very satisfactory, the net profit to the Gardens being $1717.21;—and the Committee takes this opportunity of thanking the members and their friends, particularly the ladies, for their kind assistance and support on that occasion.

The Committee have great pleasure in informing the members and subscribers that the Government has been pleased, on application, to grant $50 per mensem towards keeping up the Gardens, which will be of material assistance, seeing that the income of the Society only averages $120 per mensem owing to a falling off in donations and subscriptions.

From a statement which is laid before you this day it will be seen that no less a sum than $17,429.78, has been voluntarily raised in Singapore since the formation of this Society in 1860, of which amount $3749 have been Donations, and, as a great part of that amount has been necessarily devoted to laying out the grounds, which will ere long be completed, the income will in future be available for the actual development of Horticulture and Agriculture.

The Government has kindly allowed the services of 60 prisoners from the House of Correction to carry out the excavation of the lake, but owing to the small number of prisoners in Jail not more than an average of 30 have been available, and of late not more than

10, so that your Committee have been obliged to contract for Chinese coolies to complete the excavation; it is however highly probable that in the course of a week the number may be increased to 25, in which case, as the sluice to let off the water is to be commenced at once, the Committee expect that the lake will be ready to be filled by the end of the year: meanwhile the land on both sides is being tastefully laid out by the able Superintendent, whose exertions have been most meritorious, and Garden Road has been entirely re-metalled, and again opened to the public.

As the lake occupies the only situation where the Coolies employed in the Gardens can live, and as a residence is required for a Superintendent, your Committee have bought the adjacent property, lately belonging to Adam Wilson, Esq., for $1,700 and empowered the Trustees to raise $1,500 on mortgage of the newly acquired land and Superintendent's house to be erected thereon, which has been carried out accordingly.

To construct the Superintendent's house, the Government have kindly consented to allow the Society to be supplied with Bricks from the Government kilns at cost price, and as there will be no immediate necessity for the payment until the Society is in a position to make it, a contract will at once be entered into for the building.

One of the intentions of the Society being to supply members and subscribers with European vegetables, and "to secure improvements in the vegetable products of the island," part of the newly purchased property has been already planted, and as soon as regular fresh supplies of seeds now on the way begin to arrive your Committee expect to be in a position to carry out the object in view.

The plan of the Gardens is now complete, and the titles have been duly received from the Government and are laid before you.

To enable a Government Grant of the land to be made out it was necessary to have two trustees, and consequently your committee have appointed the Vice-President and Treasurer of the Society for the time being, and their successors, in that capacity, which appointment you will be this day asked to confirm.

The Treasurer's accounts are laid before you, showing a balance at credit on the 1st instant of $1,479.44, and the same are submitted to you for confirmation.

It has been brought to the notice of your Committee that some of the residents of Singapore who are not subscribers avail themselves of the Gardens of the Society, although they must be aware that only Members, Subscribers and Strangers have the right of admittance, and the Committee trust, as the funds of the Society depend chiefly upon subscriptions, which just at present are much needed, that all will see the necessity of lending their aid.

The Committee take this opportunity of expressing their thanks to the Government for the ready assistance which has been invariably given whenever asked for.

In conclusion your Committee beg to state that in consequence of the great satisfaction Mr. Niven has given in the discharge of his duties as Superintendent they propose to increase his salary to $80 per mensem from the 1st of January next.

APPENDIX 6.

From Manuscript, being the Draft of a "Report to be Presented to the Society at a Meeting of Feb. 24th, 1870."

At the last general meeting held on the 2nd June, 1868, the late Hony. Secretary stated that the income of the Society for the ensuing year might be considered fully equal to $200 per month, which would be sufficient for all current expenses; but Mr. Wilsone appears to have forgotten that a large balance was still due to the builder of the Superintendent's house, which with other items of expenditure already sanctioned ultimately amounted to $722.57, and it soon became apparent that the revenue would fall far short of the necessary expenditure.

Under these circumstances your Committee found that the Society was rapidly getting into debt, and that either some means must be devised to increase the revenue or a portion of the Gardens must be allowed to relapse into jungle.

It was considered inadvisable to raise the rates of the annual subscriptions, these being already as high as people are likely to pay, and it was feared that subscriptions would decrease rather than be augmented thereby.

At the same time it was not deemed proper to resort to the means of a Bazaar, as had been done formerly to raise extraordinary sums for special purposes, as the Gardens might now be considered so far complete that a true estimate could be formed of the annual expenditure, and this should be provided for in some way permanently, as no committee could take upon themselves the responsibility of providing funds annually by such precarious means as Bazaars.

It was therefore decided that as the public voluntarily subscribed as much as they could afford, the Government should be requested to increase the then small grant from $50 to $100 per month, and after some correspondence upon the subject the application was favourably considered by the Legislative Council and the extra grant conceded, with the condition that the Government should nominate one official member of the committee, which was readily acceded to and H. F. Plow, Esq., Clerk of Councils, has been duly appointed accordingly.

Your committee in applying for the increased grant expressed their intention of making the Gardens more generally useful; by keeping a nursery of flowers, plants, shrubs, etc., and also raising European vegetables for distribution to members, subscribers and others, and they regret that circumstances have so far prevented them from more than partially carrying out their views, but they expect in the course of the current year to be able to effect all these objects successfully.

By the accounts now laid before you it appears that the gross receipts of the Society during the 18 months between 1st July, 1868, and 31st December 1869, amounted to $4420.86 and the expenditure to $4396.06 showing a balance of $24.80 to the credit of the Society. The income for the next twelve months is estimated as follows, viz:

Subscriptions about	$1600
Government grant	1200
	$2800

and the expenditure for Superintendent's salary, wages, etc., at $2520 leaving a small balance for contingencies and for further improvements in the Gardens.

During the last 18 months the Society has corresponded with and supplied plants to the Gardens at Saigon, Mauritius, South Kensington, etc., and thanks are due to Captain Caldbeck and the P. and O. Company for their kindness in carrying boxes of plants and seeds both ways free of charge, and also to Dr. Scheffer, Director of the Botanic Gardens, Buitenzorg, for the gift of many valuable and interesting plants.

H. E. the Governor having offered to present a certain number of wild animals to the Society in case they should be disposed to form a Zoological collection in the Gardens, your Committee considered the question too important to be settled by them alone and have therefore intimated in the advertisement calling this meeting that they would submit the matter to the whole body of members and subscribers, and you are now invited to decide whether you consider such a course to be practicable and advisable.

The

Gardens' Bulletin

STRAITS SETTLEMENTS,

Vol. II Issued November, 11th 1918. No. 3

CONTENTS.

To be purchased at the Botanic Gardens, Singapore; from Messrs. Kelly and Walsh, Ltd., No. 32 Raffles Place Singapore.

Printed at the Methodist Publishing House, Singapore.

DEPARTMENTAL NOTICES.

A new List of Plants, which may be purchased from the Botanic Gardens, Singapore or Penang, is in the press.

Requests for yams should be received at once.

Plants of the Avocado or Alligator Pear—*Persea gratissima*,—and Brazil nut—*Bertholletia excelsa*,—to be sold within the Peninsula at fifty cents each.

Seeds of *Hevea brasiliensis*—Para Rubber—as available from trees, twenty-eight years old, to be sold at three dollars per thousand up to the number of ten thousand, and at two dollars and fifty cents for every further thousand on the same order.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for a volume of twelve numbers, post free,

Five dollars in the Straits and Federated Malay States.

Nine and a half rupees in India and Ceylon.

Thirteen shillings in Europe.

PLATE V.

Hibiscus Sabdriffa, a crop raised in the Economic Garden, Singapore.

THE

GARDENS' BULLETIN.

STRAITS SETTLEMENTS.

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THE ROZELLE—HIBISCUS SABDARIFFA.

In March, 1916, seeds of several races of the Rozelle were received in the Botanic Gardens, and in 1917 one of them,—a race called "Archer"—gave in the Economic Garden the splendid crop here figured. It was the second generation of the race grown in Singapore.

As the Rozelle has been described in the *Agricultural Bulletin of the Federated Malay States* so recently as 1913 (J. Lamborne, in vol. II, p. 57) no general account is called for here: but the means by which this enormous crop was got will be detailed. The seedlings were raised in seed pans and were planted out on low ridges two feet apart, the rows being three feet apart, in March. The planting was too close and there appeared no signs of fruit for a long time. Then to hurry the plants every other row was removed in July, and every other plant in the rows, whereupon the flowering commenced.

Before this happened plants which had been grown in pots had produced a small crop of fruits—say 25 to a plant,—at 6 months and had died. What they produced was not a tithe of what the bed outside produced. The excellent result with it is ascribed to the conditions having caused the flowering to be held back until the full vegetative vigour of the plants was established. In pots flowering commences while the plants are weak.

No records were kept of the return; but the photograph was taken when the plants had already been much picked over.

Jelly was experimentally made and with success, and fruit widely distributed in Singapore.

"Archer" is a white-fruited race. Therefore a little cochenille is desirable in the jelly to improve its appearance when it is intended to be used as an alternative for Red Current Jelly.

Mr. P. J. Wester in the Philippine Agricultural Review, VII, 1914, p. 267, says he had received the race "Archer" from Mr. A. S. Archer, of Antigua, British West Indies, in 1913.

I. H. Burkill.

NOTES ON COLA TREES IN THE ECONOMIC GARDEN, SINGAPORE.

In the Economic Garden are to be found fourteen trees of the genus *Cola*. There were more: but the plantation, on the hill top, which grew badly was in chief part removed in 1917. Five of the trees are thick and bush like, 7—8 feet high, their branches dense and entangled, and carrying leaves down to the ground: they belong to the species *C. acuminata*, using the name as used by MM. Chevalier and Perrot in their "Végétaux utiles de l'Afrique tropicale française," VI, 1911. The other nine trees, judging by their bearing, belong to the species *C. nitida*: but as yet the flowers and fruits of one only have come under observation for full determination. They are 30-40 feet high, with rather sparse branches and foliage. All have suffered from the poorness of the soil and from want of manure. They have fruited at times; but, with the one exception, not in 1918. The tree that has fruited and on which most of the following observations have been made, is 40 feet high: its fruits were ripened continuously through May, June and July to the number of about 130, which contained 314 seeds—the Cola nuts of commerce. This is by no means its first crop; but it is the first that has been systematically harvested. The history of the tree is unknown. The records of the Botanic Gardens show that Cola was introduced in 1879 (Report for that year, p. 3), and again in 1881 from Kew (Report for 1881, p. 6), and again from Kew in 1893 (Report for 1893, p. 2). In the Report for 1884, it is recorded that the "African Cola nut planted in the Experimental nursery.....grew well in the alluvial soil there." Now Cantley's Experimental Forest Nursery was on the alluvial soil of the Economic Garden, and it is quite evident that the tree or trees to which his report referred, were where the Colas—some of them—are now; but it is difficult to make a connection between any of them and Cantley's statement. One Cola tree in that neighbourhood flowered but did not fruit in 1892 (Report for the year, p. 2). In the year 1907 a tree, probably the same one, fruited heavily; and, if the memories of men who have served long in the Gardens are to be trusted, that tree was the one which has fruited in the current year. It is *Cola nitida*: and therefore the introduction of Cola seed in 1881 would probably be of *C. nitida*. The entry is of "Cola acuminata," a consequence of the confusion which has existed in the nomenclature of the Colas, whereby more than the true *C. acuminata* passed under that name.

Chevalier and Perrot explain the nomenclature thus. Ventenat, while employed in describing the plants cultivated in the gardens of the Malmaison palace, examined the dried material in the Herbaria available to him, and found what he considered to be, as others also would have done at the time, a *Sterculia* cultivated in Mauritius, and new to science. He described this plant as *Sterculia nitida*, the description appearing in 1803. At a little time before this, Palisot de Beauvois had been in Benin and had got another plant which he described, about the same time, *i.e.* in 1803,

as "Sterculia acuminata," and which, he said, gave the Cola nuts of Sierra Leone. Now, say MM. Chevalier and Perrot, the one Cola of Benin is not that which gives the Sierra Leone nut, whereas the plant, which Ventenat had from a garden in Mauritius, is: so that Ventenat had described as *Sterculia nitida* the true Sierra Leone Cola without knowing that he was doing so, but Palisot thinking he was, was in reality fixing the nut of commerce on to a wrong tree which he was calling *Sterculia acuminata.* Not long after this the Colas were separated from the Sterculias and *Sterculia acuminata* became *Cola acuminata*, while *Sterculia nitida* became *Cola nitida.* MM. Chevalier and Perrot maintain that, the last is the right name for much that has passed as *C. acuminata.*

According to this classification, *C. nitida* embraces the Colas having only two cotyledons, whereas *C. acuminata* refers to the Colas having more than two cotyledons.

The nuts with two cotyledons are reputed to be the best, and the Natives of West Africa, where the Cola nut is largely consumed prefer them to the polycotyledonous ones, and pay more for them.

Three varieties of *C. nitida* are mentioned, viz:

1st. *C. nitida, alba* which produces white nuts.
2nd. *C. nitida, rubra* which produces red nuts.
3rd. *C. nitida, mixta* which produces both white and red nuts.

The tree, which we are dealing with at present, belongs to the last variety; for although by far the greater number of the nuts were found to be of a light pink, almost white, tint, some were also found of a deep ruby colour, or of a wine-purple colour.

The piece of land, in which it grows, with three others of its kind, adjoins the present vegetable growing plot; it had been left in recent years untilled: but in February last, it was taken in hand, stumped, cleared and dug: the present crop is perhaps the response to this beginning of cultivation.

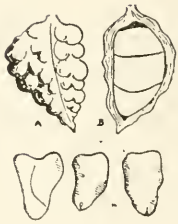
Be this as it may, the tree has given a crop, and following upon the further cultivation and manuring which it has since received, along with its three companions, we may reasonably look forward to an increased crop towards the beginning of next year, as the Cola tree gives two crops a year.

The Cola Nut.

The fruit on the tree is a rugged warty green pod, some 2 to 4 inches long, and about 2 inches in diameter—more or less egg-shaped, but terminating with a point slanting to one side.

The pods open a few hours after falling from the tree; but several were collected already open, showing through a slit the white waxy seeds inside. The number of the seeds varies, as far as I have observed, from one to five, the latter rarely, and the average being three. The sketch attached is a reproduction, as

well as I can make it, of the largest fruit amongst those which were gathered.



Fruit, fruit in section, and seeds of *Cola nitida*, one quarter natural size.

The seeds are surrounded by a tegument of cream-coloured waxy pulp resembling that of the durian, and which is sweet and not unpleasant to the taste. This sweet waxy pulp is very attractive to ants which, as soon as the pods open, quickly dispose of it.

When kept stored for a couple or three days, the pulp gives off, in the process of fermentation, the sweetish smell which is characteristic of alcoholic fermentation, and this leads me to believe that, like other substances containing sugar, alcohol could be obtained by the distillation of the pulpy tegument. This has a bearing on the possibility of Cola as a remunerative cultivation of the future, as, in the case of alcohol being obtainable from the pulp, a ready and inexpensive means would be at hand for making locally the extract of Cola from fresh nuts, which contain all the valuable principles of the nut, instead of shipping to Europe more or less mouldy nuts with a loss of much of their active principles, as I shall presently show.

The nuts are very irregular in size and in shape: and the manner in which they are wedged one against the other in the shell varies also greatly.

The same remark applies to the arrangement of the cotyledons which are packed together in the most intricate convolutions, one sometimes almost encircling the other.

After they have been divested of their sweet pulp, which rubs off easily, the seeds are found wrapped up in a thin papery envelope, which, like the pulp, is easily detachable. The naked seed then remains, of a fresh light pink colour, with slightly outlined brown wavy lines, which mark the line of division of the two cotyledons. A few of the seeds are of a deep ruby or purple colour; but they are otherwise indistinguishable from other seeds, although I have seen it stated that such nuts, as well as the pure white ones, are preferred by the natives of Africa.

After a week's exposure in a well aired place on my verandah, the nuts, previously divested of their envelopes, began to open, just like an oyster would, the two cotyledons parting slightly; and, with a little effort, they can then be completely separated from each other. If left in that state, that is to say, only partly opened, it is found that mould collects in the centre of the nut, at the point

of attachment of the two cotyledons, instead of on the surface, from the fact, no doubt that the inner moisture of the nut finds an exit at that central spot, where for lack of ventilation, mould gathers. This explains the practice of shipping to Europe nuts which are split in halves, so as to avoid the gathering of mould between the cotyledons and, hence it is that we see in the records of sales of Cola nuts, as in the Trade Report of the "*Chemist and Druggist*" of May 11th, 1918, the following:

"*Cola.* 3 bags of fair dried Jamaica *halves,* sold at 11 pence, "being about steady.—207 bags slightly mouldy African qualities "were limited at 11*d.*"

The storage of Cola nuts offers some little difficulty, as, oxydation keeping pace with dessication, the nuts become not only lighter and lighter in weight, but they also take a very dark colour, and are apt to become the feeding-ground of a tiny, but fat, white maggot, which riddles the surface of the nuts with wavy furrows and renders them "*wormy*"—greatly depreciating their value. The best way to preserve the nuts in a fresh state, as far as I can judge, is to put them in air-tight tins, and to give them an airing once a week. By this means, the nuts do not lose weight so fast, and they keep their pink colour longer; but after a month, brown spots appear and the nuts, bye-and-bye, assume the objectionable dark colour. The problem of landing nuts in Europe in the fresh state, can be, it is said, solved by sterilising the nuts, but I am not aware that this is carried on to any extent, and, at any rate, it must result in a big increase in the cost of marketing the nuts.

My weighings of Cola nuts, fresh and dry, give the following figures:

18	fresh large nuts weigh ..	..	16 ounces.
21	,, medium ,, ..	..	16 ,,
24	,, nuts at random ..	..	16 ,,
26	nuts after 6 days' drying	..	16 ,,
32	,, ,, 3 weeks ,,	..	16 ,,
33	,, ,, ,, ,,	..	16 ,,
36	,, ,, 4 weeks ,,	..	16 ,,
40	,, ,, 45 days ,,	..	16 ,,

These weights do not agree with those given by August Chevalier and Perrot, who put down 12 grammes as the average weight of fresh nuts, which would make about 39 required to the pound. But the nuts referred to in their book are from Dahomey or French Guinea and therefore not *C. nitida;* and it is stated that the nuts of the Ivory Coast, where *C. nitida* occurs, are larger and weigh on the average 25 grammes *i.e.* about 18 to the pound.

The active principles of Cola, on which depend its physiological and stimulating properties are:

1st. Caffeine of which it contains from 2% to 2.5% *i.e.* much more than coffee itself.

2nd. Theobromine, the alcaloid found in the cocoa beans.

3rd. Kolatine, a substance as yet imperfectly known.

4th. Betaïn, an alcaloid found in beet and other plants "slightly diuretic and non toxic" (Henry).

The Cola nut contains moreover a large amount of starch, *i.e.* about one third of its weight which gives it a high nutritive value. As a matter of fact, it is largely used as a food in Africa, mixed with milk and honey. In Jamaica it is used as cocoa and chocolate, prepared by grating the dry nut into powder and mixing in boiling water, with milk and sugar. "Some people use the Cola "nut regularly at breakfast in this manner, and consider it superior "to everything else of the kind." (Kew Bulletin, 1890).

Chemical Composition.

The chemical composition of Cola nuts, dry and fresh, is variously given, as follows:

	Water	Free alcaloid	Combined alcaloid	Total
By Knox and Prescott:				
Dry nuts	6.16	1.84	1.82	3.66
Fresh nuts	53.90	1.15	1.92	3.07

	Water	Free alcaloid Caffeine	Fatty matter	Ash
By Dietrich:				
Dry nuts	13.86	1.77	1.67	2.50
Fresh nuts	57.29	1.43	3.33	1.56

	Free alcaloid Caffeine
By Ballande:	
Dry nuts	3.11
Fresh nuts	2.75

Dr. Frankland Dent, Government Analyst, Straits Settlements, who kindly undertook the analysis of four nuts from the Economic Gardens, found that they contain:

Water	42.76%
Caffeine containing a trace only of Theobromine, calculated on the dry sample	1.61%

It should be stated that these nuts were not fresh from the tree, but had been kept for some time in a closed tin, which would account for the water-content being lower than appears in the above analyses.

Referring now to the weight of nuts, dry and fresh, in my weighings as given above, which average:

fresh 21 nuts to 16 ounces or 454 grammes
dry 33 nuts to 16 ounces or 454 grammes

it will be found, according to the figures of Knox and Prescott, that:

	grammes.
100 fresh nuts weighing 2162 grammes contain of Caffeine free and combined	66.37
100 dry nuts weighing 1375 grammes contain of Caffeine free and combined	50.36

100 dry nuts, therefore, lose in the process of drying of their free and combined alcaloids 16.01

The drier the nuts, the greater the loss.

This would be the actual loss on nuts dried locally, but otherwise sound. What the loss may be after a week or two in the hold of a ship—with the additional deterioration caused by mould, I have no means of knowing.

The number of dry nuts, viz: 33, on which the above calculation is based is the number of nuts to one pound weight, after 3 week's drying—*i.e* a period that corresponds to the length of the voyage from the African Coast to Europe. But the degree of dessication can go much further, for I have found that after a couple of months as many as 100 halves (= 50 whole nuts) go to one pound.

On the other hand, reverting to the previous figures, 100 fresh nuts would have to pay freight (57.30%) on 1238 grammes of water—where 100 dry nuts would only pay (13.86%) on less than 200 grammes. In other words, one ton of fresh nuts would pay for more than half a ton of water—whereas one ton of dry nuts would only pay on about 3 hundredweight. Whether the gain in alcaloids, in shipping fresh nuts, would not be balanced by this surplus on freight, is a question which, for the present, must remain open.

Trade.

The uses to which the Cola nut is put in Europe and America are many and varied. It enters in the composition of tonic wines and liqueurs—of confectionery, of chewing gums, in certain well-known therapeutic preparations: a use is found for it in dysentery, combined with bismuth and salol as, "with this medicine a patient "can go a considerable time without food and thereby the stomach "obtains its needed rest." ("*Chemist and Druggist*," 20th Nov., 1915.)

But the greatest use to which the Cola nut is put is for mixing with cocoa, a use for which it is especially well adapted, as, owing to its small content of fatty matter (only 1.67% of the dry nut), it forms a very suitable mixture with the powder of the cocoa bean: the latter containing an excess of fat, or cocoa-butter, which has to be removed in the manufacture of pure cocoa. I presume that it is to this capacity of being used as a part substitute for Cocoa, and to the increased demand created thereby, that the present favourable position of the Cola market is mostly due.

But it is impossible to say how far war conditions have shared in this advance, as the export figures (see below) do not carry us beyond 1915, and, moreover, they do not discriminate between the exports to Europe, and the Coastal exports to the neighbouring French and Portuguese Colonies, which, we know, are very important.

Freights must have influenced the rise in prices, but, even computing on a freight of two pence per pound, the margin between pre-war prices ($1\frac{1}{2}d$ to $3\frac{3}{4}d$ per pound) and the actual price of 11

pence per pound in May, 1918, is so great, that it can only be the result of a vastly increased demand, coupled with a higher grade of the nuts shipped to Europe. This is borne out, I think, by the description of the nuts marketed since 1915, which are no longer catalogued merely as "dark, mouldy or wormy," but as "good bright halves," or "fair dried halves."

How far this increased demand will persist after the war, the future will decide, but it is not unlikely that when the valuable properties of Cola are better known in Europe, the demand for it will expand more and more.

But, be this as it may, the chief mainstay of the prosperity of the Cola planting industry will yet remain, for a long time to come, what it is now,—viz: the Native African consumption, which far exceeds the boundaries of the Countries of production; for the use of the nut is fast spreading to all the Mussulman lands of Northern Africa and it has found its way to Morocco—Algeria—Egypt—Tripoli and as far as Turkey and Malta.

The figures below show that the trade in Cola nuts is taking a greater extension every year. It stands, now, second (after Cocoa) on the list of the exports of the Gold Coast, the figures for the last six years given by the Report of the Government of the Gold Coast being as follows:

							d.		
1910	5,156,500	pounds	value	£	77,716	or	3.6	per	lb.
1911	5,791,931	,,	,,	,,	93,099	,,	3.85	,,	,,
1912	7,133,165	,,	,,	,,	134,231	,,	4.32	,,	,,
1913	7,024,866	,,	,,	,,	144,705	,,	4.94	,,	,,
1914	7,862,414	,,	,,	,,	142,190	,,	4.34	,,	,,
1915	8,267,100	,,	,,	,,	139,163	,,	4	,,	,,

The last figures for Sierra Leone that I can find relate to the year 1909 when (exclusive of exports to Europe) the exports to the neighbouring French and Portuguese Colonies amounted to 1444 tons of a value of over £100,000.

Cola nuts also occupy the second place, after palm-kernels, in the exports of Sierra-Leone.

In his book "*Sierra Leone; Its People and Products,*" Osman Newland states that at Freetown, the price of the nuts varies from £6.10 to £13 per measure of 176 pounds, which corresponds to a price of 8¾*d* to 17½*d* per pound and he adds: "the annual value of "the Kola nuts exported exceeds £100,000, but only the throw-outs "and undersized nuts reach Liverpool or London, where, selling at "2½ to 4*d* per pound, they are used as an adulterant for cocoa."

In Lagos, according to Dudgeon (Imperial Institute handbooks) the price paid for nuts varied from 1*s.* 3*d.* to 5 shillings per hundred i.e. from 3d to 11d per pound, but in 1907 the value reached £150 per ton, i.e. 16 pence per pound.

The higher prices must be understood to apply to fresh nuts which are used locally by the natives, and by the neighbouring colonies where a huge and constant demand exists, keeping pace

with the enormous production, which is said to be about 20,000 tons.

The market quotations of the Cola nut in Europe have been subject to somewhat remarkable ups and downs, as will be seen from the Trade Reports of the "Chemist and Druggist" which are extracted at random from old numbers of that paper.

1890 October 18. Kola nuts have much advanced this week, and in Liverpool, up to 2/9 is now asked for good dry seeds.

1909 December 25. The lower prices now range from 56 to 60 marks per 100 kilos on the spot (Hamburg).

1913 November 29. Kola slightly easier 3*d* to 3¼*d* was obtained for fair small to bold dried West Indian. 2½*d* for darkish slightly wormy and 2*d* for dark mouldy.

1914 June 13. Kola 3 bags dark Ceylon sold at 2½*d* per pound.

1914 December 19th. Kola. At the spice auction, 4 barrels dried sold at 1½*d* to 1¾*d* per pound.

"*The Chemist and Druggist Diary 1918*" gives the following under:

Cost of Drugs and Chemicals during the War.

Kola	January 1	Dec. 31	June 30	Dec. 31	July 31
West Indian	1915	1915	1916	1916	1917
per pound	3*d*	4¾ to 6*d*	5¾ to 6*d*	6*d*	5 to 6¼*d*

For the present year, the prices stand as follows:

1918 April 13. Kola sold at slightly firmer prices from 10*d* to 11½*d*, the latter price being paid for 74 bags West Indian for good bright halves and wholes.

1918 May 11th. 3 bags of fair dried Jamaica halves sold at 11*d* being about steady—207 bags slightly mouldy African qualities were limited at 11*d*.*

The above quotations confirm what I have already pointed out, viz: that up to 3 years ago, the bulk of the exports to Europe mostly consisted of more or less old, dark and mouldy nuts, of "throw-outs," as Newland puts it; and that since 1915, the demand of the European and American market, has been for a greatly improved staple of nuts.

Incidentally, they point to the conclusion that, though very much higher than in previous years, the prices are not yet high enough, taking into account abnormal freights, insurance &c., to secure the very best nuts, which the native insists upon having fresh, and sound, and for which he is prepared to pay the price.

Cultivation and Yields.

The most important centres of production of Cola nuts seem to be the countries skirting the Western African Coast between.

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* The latest record to hand of the Cola market "Chemist and Druggist" of 3rd August is "Kola, 20 bags part mouldy "quarters" were held for 10 pence.

The designation "quarters" applies to the separated cotyledons of the nuts of *C. acuminata*, which have more than two cotyledons.

and including, the Cameroons to the East, and Sierra Leone to the West. In these, countries, it grows under the conditions inherent to native cultivation. It is however, cultivated to a certain extent in Jamaica where it was brought, some eighty years ago, by slave ships. It is therefore fully acclimatised there, and it thrives quite as well as in its own habitat—and an export trade of some importance has been established. It is also cultivated, on a small scale in other islands of the West Indies, in the French Antilles and, also, I believe, in the island of Bourbon. The exports from Java to the Netherlands amounted to: 10937 Kilos in 1909,—13000 Kilos in 1910,—11000 Kilos in 1911 (van Gorkum).

But, except in the case of one Company in the Gold Coast territory, and one in Sierra Leone, I am not aware that the cultivation of Cola has been anywhere undertaken on a large scale, under systematic conditions, such as obtain on our large estates of rubber, cocoa or tea; it seems, so far, to have escaped the keen attention of the planter. Yet, we are not without some data as to its behaviour under cultural treatment. Mr. W. Fawcett, a well-known authority on things Jamaican, speaking from experience, states: " that the Cola tree is propagated from seeds and will begin " to bear after four or five years. There are trees near the Botanic " Gardens at Castleton, which were planted over 50 years ago, still " in perfect health, and bearing fruit regularly." This was written nearly forty years ago.

" The trees should be planted about 20 feet apart.....they " grow about 40 feet in height. Those near Castleton produce " from 500 to 800 pods each crop. If each pod contains, on a " moderate calculation, four seeds, and if we say 50 seeds to a " quart—then a tree with 600 pods will give 50 quarts of nuts twice " a year, or 100 quarts per tree per year (there are two crops in a " year). A quart of dry nuts will weigh a little over $1\frac{1}{4}$ pound = " 125 pounds per tree. A tree in full bearing, and under careful " cultivation, would probably produce 150 pounds of nuts a year" (Kew Bulletin, 1881).

It will be noticed that in the above statement *dry* nuts are specified. The weight of fresh nuts would be about one quarter to one third more.

In the Cameroons, we are told, one hundred trees were planted in 1904, and manured later on, with the result that the trees were in fruit in 1907, and in 1908 the crop was abundant.

In Western Africa, according to various authorities, the gross output of a tree varies in value from 20 francs, in bad years; to 75 francs in good year. In the Cameroons, Dr. Bernegau puts the money value of the crop at 50 marks per year per tree. Newland puts it at 30 shillings in Sierra Leone, and he adds: " Under " proper cultivation a Cola tree should yield double that revenue." i.e. 60 shillings.

The report of the Agricultural Station of Tarquah (Gold Coast) issued by the Government of the Gold Coast, for 1915, says: " The station has 29 acres under Kola, planted in 1909. The " majority of the trees have made excellent growth: the oldest trees

"fruited freely, and 278605 nuts were harvested up to the end of "the year."

These facts, and many others which could be adduced, if space permitted, dispose of the pessimistic outlook of the authors of "Les Noix de Kola et les Kolatiers" as regards the prospects of the Cola tree, as a remunerative, though perhaps, for the present restricted industry. That the trees yield profitably before their fifteenth year is quite satisfactorily established.

That many trees never bear fruit, or very late is not surprising, given the localities in which the authors have mostly seen such trees *i.e.* in dense, overcrowded forest thickets. Planters would find a way to improve upon such conditions, and to provide their trees with the conditions of location, of soil and moisture, supplemented, if necessary, with manures, required for the well-being of so valuable a crop.

We have some indications of what these conditions should be, from the accounts given us by many competent observers.

Mr. Elliott, Forest Officer, Northern Nigeria, says of the nuts found in the Province of Nupé, Northern Nigeria, "this nut is in "great demand throughout the whole of North Africa, and it "fetches locally almost double the price of the kind with 4 or 5 "cotyledons. The trees grow in sheltered valleys at an elevation of "from 450 to 550 feet above the sea. The soil is a deep, black, "sandy loam and is kept in a continuous state of moisture by the "streams that are found in each valley." (Kew Bulletin, 1906, No. 4).

That the Cola tree is a grateful tree under kindly treatment is also evidenced by the following statement of Mr. Dawodu in his report of his tour through the Lagos hinterland, at the request of the Government of Lagos in 1898.

"The Kola tree abounds in these parts. The trees were all in "a most flourishing condition, always bearing heavy and abundant "crops. Indeed, the Ekiti Country is famed for its Kola trees "and the cultivation of them is brought to great perfection by the "natives."

In passing, it will be noticed that in Mr. Elliot's report just quoted, the polycotyledonous nuts are only worth about half the price of those with only two cotyledons. As stated at the beginning of this paper, the species *C. nitida* is the one with two cotyledons, and *C. acuminata* is the species with the plural cotyledons. Thus, the statement that *C. nitida* is the species that supplies the best nuts is here confirmed. A further confirmation of this fact is found in the Report on the Agricultural Department for the year 1914, issued by the Government of the Gold Coast in which it is stated that:

"Only one European Company has given any attention to "this product (Cola) and their plantations are now in bearing. "No particulars are available of the past year's work, but it is "understood that a proportion of their crop is the *white* nut, which "fetches a relatively higher price than the ordinary Colas."

According to the nomenclature of the Cola trees, as given by MM. A. Chevalier and E. Perrot, the trees with all white nuts, and with only two cotyledons, belong to the species *Cola nitida* var. *alba*: this white Cola, then, must be regarded as the best one to propagate.

The great excellence of MM. Chevalier and Perrot's work is unfortunately marred by their pessimistic strictures on the future of Cola as a planting industry, strictures which would almost raise a doubt as to their opportunities of observing the Cola tree under fair conditions of growth, and which, at any rate, are without the least justification.

The authors would have us believe that the Cola tree is absolutely refractory to cultivation: that many of the trees only bear male flowers and never fruit, which is not at all unlikely where, as found by the authors, they grow under unfavourable conditions, either, in the midst of dense forest thickets, or at unsuitable altitudes of 800 metres above sea-level.

Again, we are told: "the fruit pods are far apart from each "other in the tree, and the harvesting must be slow and difficult." Now, the authors may never have thought how the Chinese or natives of this country bring down, with their long poles, bunches of coconuts from 80 to 90 feet up in the air, but it is hardly admissible that they should ignore the fact that the pods of the Cola nuts fall of themselves at maturity, and that the cost of harvesting need only be the cost of picking them up off the ground; for such is the case.

Lastly, we are informed: "Planters at San Thomé have "assured us that the most vigorous trees only yield a few kilos of "nuts in a year and that the crop was not worth the money spent "on it," and, if my memory serves me right, the maximum crop to be expected from a tree, would be some 10 kilos of nuts.

The reports given above from competent observers go some way towards dispelling such unfounded pessimism. But the following extract from the Report of the Government of the Gold Coast for 1914, should effectually dispose of the matter: on page 31, it is said:

"*Cola.*—The white cola trees are making fair progress.... "the 93 numbered trees produced 72,029 nuts. Four trees pro- "duced no fruit at all, and the highest individual yield was 5302 "nuts....one tree produced over 4,000 nuts—4 trees over 3,000— "6 trees over 2,000; and 7 trees over 1,000." These figures lead to conclusions very different from those expressed above and I shall not labour the question further.

But it is an understood thing that the introduction of a new crop in any country has to fight its way against detractors. It was the case of quinine at its first introduction in the East: it was the case of Liberian Coffee in the early eighties; and it was the same with Rubber of which it was said, in the early days, that it would not pay to tap before 8-10-12 years—that plantation rubber was unsuitable for making this and for making that: all cobwebs which time and fact have brushed away.

Possibilities of Cola.

It is probable that, at the present time, even allowing for a great increase of the demand from Europe for Cola, the introduction of its cultivation in a new country would not be without some risk, except on a limited scale. But it is not impossible to conceive in the future, a vast increase in the use of Cola, in these countries, should the natives acquire, as they do, almost to a man, in West Africa, and right away north, in Morocco, and Tripoli, a taste for the Cola nut, as a substitute for the betel-nut. We have in the Countries round us, millions of people who chew the betel-nut and we know how assiduously and how laboriously the practice is carried on, when a perfect quid is desired.

No doubt the areca-nut is not without its virtues: it is regarded by some, as a prophylactic against dysentery: like Cola, it provokes salivation and thereby allays thirst: it sweetens the breath, although it blackens the teeth: these are virtues enough to explain the use of the betel-nut throughout Eastern Countries. But it has none of the exhilarating and sustaining powers, against times of stress, which the Cola nut owes to its component alcaloids caffeine, theobromine and betaïn—to say nothing of the nourishment which its high starch-content affords.

Properties of Cola.

We have all heard of the property of Cola, of making palatable muddy or polluted water; of its well-nigh marvelous effects in allaying the cravings of hunger and of thirst, and enabling those who eat it to endure prolonged effort, physical or mental, without fatigue. The following extracts of a letter of the British Consul at Bahia, to the Marquis of Salisbury, then Foreign Secretary, puts these things in a graphic form:

Bahia, Sept. 6th, 1890.

My Lord,

" I have the honour to bring under your Lordship's notice.... " the great powers of endurance and strength in lifting heavy loads " and transporting them to long distances, in this tropical climate, " possessed by the West African negroes in these parts, which " personal observation.....enables me to attribute to the free use " of the Kola bean. The West African carriers at this port, who " use Kola, are not physically superior to the Brazilian negro, and " yet the African, through constantly masticating Kola, can endure " labour and fatigue which no Brazilian can withstand, and where " it takes 8 Brazilian negroes to carry a load with difficulty, 4 " African porters carry it cheerfully, almost always, even when " ascending a hill, singing and chanting the whole time, as they " trudge along, but never without a bit of Kola bean in their " mouths. The Brazilian spends in rum.....three times what the " African lays out daily in Kola nuts, which are not intoxicating— " not injurious in any way, act as a nutritive, quench thirst and " produce vigour and freshness.

" I have seen a bag of sugar of 80 Kilos (179 pounds English) " carried by an aged African negro, after biting a piece of Kola

"nut, and transported a distance of 4 miles, in an hour and a "quarer, without once taking it off his head."

Signed: George Alex. Stevens, *Consul.*

One would be inclined to believe that the philosophie's stone, or should I say the philosopher's nut, has at last been found, and some of the tribes of far inland African appear to think so, for it is said that the dry powder of the Cola nut is there sold for its weight in gold dust.

Any one wishing to form an idea of the physiological action of Cola on the nervous system, on the digestive organs, on the heart and on the muscular system, will read with profit the exhaustive study thereon by Doctor G. W. Barr (Therapeutic Gazette 1896) which is given at some length in Chevalier and Perrot's work.

Conclusions.

The conclusions which I would draw from the fore-going notes on Cola, are the following:

1st. Nine of the Cola trees growing in the Economic Gardens belong to the species '*Cola nitida*,' which is recognised as the best.

2nd. Although the crop just obtained is a small one, there is reason to hope for larger yields in the future.

3rd. Fresh nuts offer very great advantages, for making Cola extract, over dried nuts such as are perforce used in Europe.

4th. The Cola tree is not refractory to cultural treatment, and, under systematic cultivation, and fair conditions, yields of nuts can be looked forward to in a period of five years.

5th. For the present, the outlook of Cola cultivation in these countries, is limited, but native consumption might, conceivably, gradually create a very large demand: the spread of the use of the Cola nut through northern Mussulman countries tends to show that possibilities exist that way.

6th. Personal trials over a period of two months of the nut under various forms, have convinced the writer that the nut, as produced here, loses little, if at all, of the stimulating properties of the African product. As was shown in the body of this paper, its Caffeine content is as high as that of the African nut.

E. Mathieu.

SOME CULTIVATED YAMS FROM AFRICA, AND ELSEWHERE.

The purpose of this note is to illustrate some unfamiliar cultivated Dioscoreas, namely:—

1. the white or eight months Guinea Yam.
2. the yellow or twelve months Guinea Yam,—*D. cayenensis*, Lamk.

White or eight-months Guinea Yam, Race No. 334 on the left of the half-metre and Race No. 340 on the right.

White or eight-months Yam, Race No. 336 above and Race No. 330 below.

3. a Hai-nan Yam, probably *D. belophylloides*, Prain and Burkill.
4. an African Yam, *D. dumetorum*, Pax.
5. an Indian Yam, *D. pentaphylla*, Linn., var, *Linnaei*, Prain and Burkill.
6. a Malayan Yam *D. pentaphylla*, Linn., var. *malaica*, Prain and Burkill.

7 and 8 Philippine Yams, *D. pentaphylla*, Linn., var. and an ally.

Dioscorea alata, Linn., which of all species is the yam most cultivated in Indo-Malaya, was the subject of an article in the last issue of the Bulletin. It is cultivated in Africa; but it is apparent that the Portuguese who used it for provisioning their ships on the return journey from India deliberately introduced it at their ports of call on the coast of that continent, not so much because they could not get yams in various parts of Africa, as because it was their wont to introduce everywhere everything, whether animal or vegetable, that might become useful. It is not intended to deal here with the races of *Dioscorea alata* now in Africa, but with other species only, and firstly with that Dioscorea which appears always to have had the greatest importance upon the Guinea coast and to be native. No botanical name will be given to it; but it will be called the White or Eight-months Guinea yam. Plate vi, illustrates it.

1. The White or Eight-months Guinea Yam.

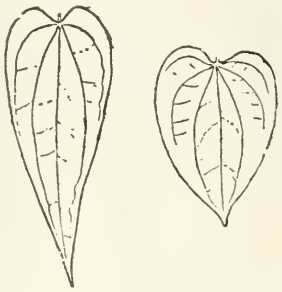
This White or Eight-months Guinea yam has very many races in its own home. A glance at the plate shows that the tubers in some are more elongated than in others. Some, also, more abundantly than others have them protected by thorns on the roots: and again variation also appears in the foliage as the annexed outline drawings show. To enumerate the races is out of the question, and even to suggest a scheme for a classification of them is difficult. Therefore little will be said about their differences.

The tuber of this species has a skin of a dark khaki colour in all the races that have been grown, with white flesh under it; and if there is any sign in the cells of a substance with a magenta colour it is to be found only about the base of the stem at the top of the tuber. The surface of the tuber is generally rather free from rootlets and nearly smooth. The tubers may grow as twins or in small groups.

When the new stem appears above ground, it is thick and of a rather livid colour, with abundant prickles, and pairs of large broadly ovate bracts from the axils of which strictly at right angles stout rapidly tapering branches arise. It is obvious that these branches by their position and their rigidity, serve the purpose of preventing the stem from slipping back through the tangled thickets in which it would grow naturally.

Soon the bracts give place to paired leaves, and the stem becomes less prickly, until it is quite unarmed.

The leaves are of a medium or dark green, and do not spread themselves flat but the sides rise up, particularly towards the base, and the midrib takes a curve backwards. They are cordate-ovate when flattened in most of the races grown, but as the annexed outline drawings of the two flattened leaves show, may be elongated from this. The lower surface is paler than the upper. As all parts of the plant, they are quite glabrous. Usually they are about 10—12 cm. long by 6—7 cm. broad.



Leaves of the White Guinea Yam, one quarter natural size. That on the right the form which most races exhibit; that on the left an extreme leaf of the race Efura.

On the upper parts of the plant the side branches show a tendency to droop from the horizontal, and to die abruptly so as to end with a pair of fully developed leaves. The petioles which are quite as long as the blades carry the leaves raised above the axis bearing them, and from the top of the petiole the blade is inclined downwards, facing towards the light, with the tip decurved towards the earth.

In the axils of the remoter leaves of the branches inflorescences arise. If male there are 1—4 spikes in each axil, attaining 4 cm. in length, and taking a forward direction from the axis which bears them. A spike about 4 cm. long may carry 24 flowers, spaced about their own diameter apart. These flowers take an angle of about 60° to the axis.

The male flowers have a rather broad base, but not so broad as in those Asiatic Dioscoreas where it presses the bract back against the axis: but the bract carries the bud like a bracket. The three sepals are greenish below, and yellow above; they broaden gradually through two thirds of their length, and then narrow quickly and obtusely. The petals are similar, just a little smaller and a little more obovate; they are slightly thicker. In anthesis the sepals part to half their length, and the petals at their tips, making a narrow way to the six introrse anthers which with their short filaments fill the whole of the interior of the flower. The filaments are half as long as the anthers. The flowers are very fragrant.

The female flowers are in spikes about 15 cm. long; the yellowish sepals and petals are broadly ovate. The capsules are

Yellow or twelve months Yam, Race No. 314 on the left of the half-metre measure, and Race No. 338 on the right.

A Yam of Hainan.

glaucous; their wings are broader than the half of a circle, so that the apex of the capsule is cordate: at the base the wing passes by a well marked angle into a wing on the stalk.

This species of *Dioscorea* was received in the Botanic Gardens, Singapore, from the Gold Coast and from Southern Nigeria in February and July, 1915, through the Royal Gardens, Kew. The first Singapore crops were dug in November, 1915 and February, 1916; the second in December, 1916 and the third in December, 1917. From the small beginnings of the first crop the stock has been built up sufficiently to justify a record of the returns got at the third crop. These were:—

Gardens' number and name of race.		number of hills.	average yield per hill.
330 Eyiberi	1st bed	11	1358 grammes or about 3 lbs.
	2nd bed	3	2079 ,, or about 4 lbs. 9 oz.
336 Iwayo o lorum		25	1966 ,, or about 4 lbs. 5 oz.
328 Esinrinmin		28	2228 ,, or about 4 lbs. 15 oz.
316 Puna		12	1047 ,, or about 2 lbs. 5 oz.
340 Oparaga		14	1723 ,, or about 3 lbs. 13 oz.
322 Odee krukupa		3	1861 ,, or about 4 lbs. 2 oz.
324 Batafu entumtu		8	2271 ,, or about 5 lbs. 4 oz.
334 Efura		18	3297 ,, or about 7 lbs. 4 oz.
310 Bayere pa		7	2571 ,, or about 5 lbs. 11 oz.
376 Eururuka apima		11	1477 ,, or about 3 lbs. 4 oz.

2. The Yellow or Twelve Months Guinea Yam.

The upper block of plate vii. represents a race of another species of *Dioscorea*—that which is second in importance upon the Guinea coast. It is believed that it is *Dioscorea cayenensis*, Lamk. Apparently the Portuguese early took it to the New World: and when it fell into the hands of the French botanist Lamarck, he in ignorance of its African origin named it from the colony whence his specimens came. It is a pity that it should have so obtained a misleading specific name. The identity of *D. cayenensis* with *D. prehensilis* which Bentham described when working at the collections made on the Niger Expedition, has recently been declared by French botanists (vide Chevalier et Perrot, Les Végétaux utiles de l'Afrique tropicale française, viii, Paris, 1913, p. 356 and Jumelle, Les cultures coloniales, Legumes et Fruits, Paris, 1913, p. 12).

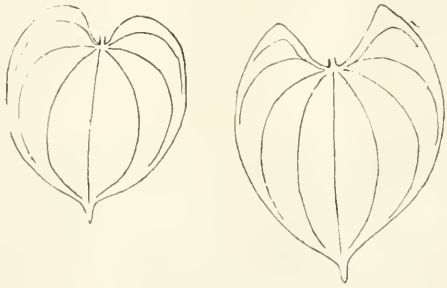
As the plate shows, the tubers of *D. cayenensis* are unlike those of the White Guinea yam in being more irregular and with a thick neck, and somewhat uneven surface. They differ also in being yellow fleshed.

The new shoots are thick and very prickly with dark reflexed prickles: they are of a purplish green, and carry alternate leaves at first, which may have thick branches in their axils in positions such as to prevent the stem from slipping back among the vegetation into which it is climbing.

The leaves are quite unlike those of the White Yam in their flatness in life and greater breadth. They are equally dark green,

and equally paler below. They are cordate-orbicular, and shortly acuminate, quite glabrous, as is the whole plant. The blade lies much more nearly in the plane of the petiole than does the blade in the White Guinea yam. Towards the upper parts of the branches flowers are produced. If male there are 1—4 spikes in the axil of each leaf. These spikes attain 6 cm. in length, and carry about 40 flowers spaced about their own diameter apart set on at an angle of about 70°, so that the angle which they take to the axis is a little larger than in the White Yam. They are sessile and though the base is broad, it is not so broad as to cause the bract to be reflexed. The buds are more stout than those of the White Guinea Yam, from base to apex more pear-shaped but laterally distinctly three lobed from the strong curvatures of the sepals. The sepals are white and they just part in flowering to one third of their length. The petals are brownish and shaped like the sepals, but smaller. Within are six introrse anthers on short filaments.

It appears exceeding probable that the White and the Yellow Yams have been confused in books, which should not be, as they are abundantly distinct.



Leaves of the Yellow Guinea Yam, one quarter natural size. That on the left is the common form; that on the right the form confined to the bases of the stems.

3. A. Hai-nan Yam apparently Dioscorea belophylloides.

The lower block of Plate vii shows the tubers and leaves of a species of Dioscorea which was introduced into Singapore from the Chinese province of Hai-nan by a servant of Mr. G. P. Owen; and Mr. Owen presented tubers to the Gardens. The return that they give is small; and they are uneven so that if peeled for cooking a large part of them is lost; but they are excellent cooked.

This yam has not as yet flowered in Singapore, and there is some doubt as to its name; but it appears to be *Dioscorea belophylloides*, Prain and Burkill.

4. Dioscorea dumetorum.

The top block of plate viii illustrates *Dioscorea dumetorum*, Pax, an African ally of the Indo-Malayan *D. hirsuta* (D. triphylla,

Linn. in part or D. daemona, *Roxb*). Just as *D. hirsuta* is a most important famine food of India and Malaya, so does *D. dumetorum* appear to be a famine food in Africa; but it appears to be more, for whereas *D. hirsuta* has given no cultivated races, *D. dumetorum* has; and the conflicting statements of travellers as to its utility are to be explained in the light of this.

Two very distinct races are in cultivation in Singapore: in the one the tubers are lobed; in the other the tubers are star-shaped. The plate shows both. The bluntly lobed tubers were from a stock received as Nfamko from the Gold Coast; while the star-shaped tubers from one called Esura in Southern Nigeria. With the original tubers of Nfamko was received a memorandum stating that Nfamko is edible but medicinal. Esura has been eaten in Singapore without causing any discomfort, but it is slightly bitter.

Bearing the name of Esura there are again two races distinguished by their colour, the flesh in one being white and the flesh in the other being yellow. That this should be so is most interesting because *D. hispida* exhibits the same variation in colour being sometimes yellow and sometimes white, but as regards it as yet the colour has not been shown to be a racial characteristic.

When *D. dumetorum* sprouts, it throws up a stout prickly shoot, with alternate leaves; and these leaves have the peculiarity that the base of the petiole is bent downwards sharply in such a way as to aid the plant in climbing by preventing the stem from slipping back over its support. It is most interesting to find in *D. dumetorum* as well as the White and the Yellow Guinea Yams—species all of the same region—the need of holding to its support met in a slightly different way.

The leaves of *D. dumetorum* are compound: at the apex of a prickly petiole are three leaflets, which when young are sparingly hispid above, then glabrescent, but on the back at all times densely shortly hispid-pubescent. The middle leaflet is obovate, and usually very long acuminate; the lateral leaflets are of the same shape in the inner half, but as regards the outer are cordate, and often with a lateral lobe. Towards the apices of the stems the middle leaflet is often smaller than the lateral leaflets.

Inflorescences arise in the leaf axils towards the ends of the stems. If male a pyramid of spikes is produced, which may be up to 10 cm. long: the axes and the bracts are densely stiffly pubescent, and the thin glabrous orbicular-ovate sepals peep out from among the hairy bracts. These sepals exposing the green ovate petals open at flowering rather more widely than do those of the flowers of the White or the Yellow Guinea Yam a movement facilitated by thinness: they are ovate and rounded above. The petals are only a very little smaller than the sepals: and there are six introrse stamens within.

The female spike may attain as much as 70 cm. when the fruit is ripening; it carries some 30—40 flowers. The fruits are elongated and very like those of *D. hispida.*

Dioscorea pentaphylla and an Allied plant.

The lower block of plate viii illustrates some Indo-Malayan Dioscoreas of the same section as *D. dumetorum*. First of all there is *Dioscorea pentaphylla*, Linn., var., *Linnaei*, an edible variety of that usually inedible species, cultivated in Southern India and Ceylon. It is the *D. pentaphylla* which Linnaeus had from Ceylon in his Herbarium,—a variety which probably was more commonly cultivated there in his time than now. Cooked properly it is a very good vegetable, but as the figures show it buries so deeply that the labour of digging it up is considerable, and the return is small. It is likely therefore for all time to remain rather a curiosity than a commodity.

The stems and the leaves in this variety are much smaller than those of most of the varieties of *D. pentaphylla*, and it is almost deserving of specific rank. The leaves are relatively small and the stem is wiry, prickly and purple-flecked.

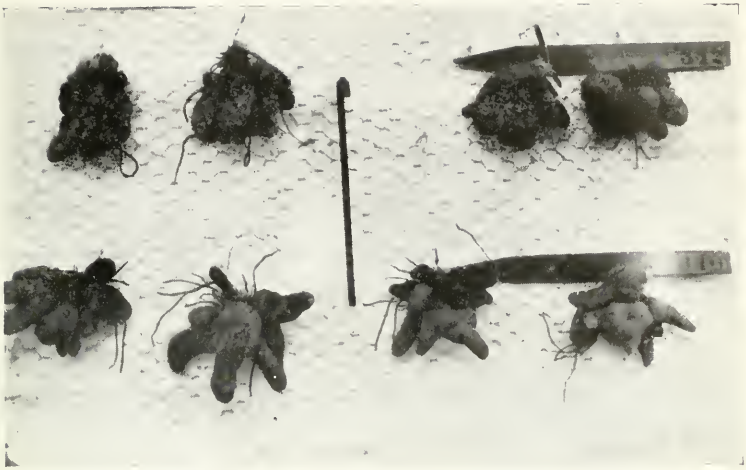
In Singapore, it flowers 6—8 months after the shoot has appeared above ground, and later considerably than the varieties of *D. pentaphylla* from Northern India that have been grown experimentally alongside it.

The four tubers at the top on the right of the same block represent *Dioscorea pentaphylla*, Linn., var., *malaica*. The parent tuber came from a garden hedge in Penang where it was but small; but in the Botanic Gardens, Singapore, tubers weighing up to 9638 grammes or 21¼ lbs. have been raised. The variety may be found here and there through the Malay Peninsula, and usually in garden fences.

The four tubers on the lower row to the right represent two Philippine stocks. They are numbered 196 and 198. No. 196 furnished figure 5 on p. 207 of volume iii of the *Philippine Agriculturist and Forester*; and No. 198 furnished figure 6. The first is certainly ascribable to *Dioscorea pentaphylla*, Linn. Its big clavate tubers have very soft flesh, and keep very badly. It flowers regularly.

But No. 198 refuses to flower. However the stems and leaves exactly match Philippine herbarium specimens which bear the number "Ahearn's collector 1971" from Rizal and these have female flowers; but the female flowers are not altogether adequate to place it and fruits must be sought. It also matches exactly the sterile specimens of Ramos 12176 to which the note is attached "tuber edible." The tubers are most abundantly lobed and with soft white flesh. As it grows in the Botanic Gardens, Singapore, it dies down in 6—7 months, *i.e.* as *D. pentaphylla* var. *Linnaei* is coming into flower. It produces an abundance of bulbils about 1—2 cm. long with a rough brown skin like shagreen.

I. H. Burkill.



Dioscorea dumetorum, Race No. 342 above and Race No 346 below.

On the left of the half - metre measure two tubers of Dioscorea pentaphylla, var., Linnaei, origin Ceylon : on the right above, four tubers of Dioscorea pentaphylla, Var., malaica, origin Penang : on the right below, tubers of two Dioscorea allied to D. pentaphylla, Nos. 196 and 198 origin Luzon.

THE SECOND PHASE IN THE HISTORY OF THE BOTANIC GARDENS, SINGAPORE.

The history of the Botanic Gardens from their foundation in 1859 to the year 1874 was given in the last number of this Bulletin. Up to 1874 the Gardens had been the property of the Singapore Agri-Horticultural Society, which becoming unable to maintain them any more in a fitting condition sought the Colonial Government in that year with a request that their property and their debts upon it should be taken over, and the Gardens maintained out of public funds. To this the Government of the Settlements agreed, placing the Raffles Library and Museum Committee in charge until such time as the legislation which the case required could be passed. The legislation was passed in 1878 as the "Raffles Societies Ordinance, 1878"; and upon January 1st, 1879 a Committee consisting of the Colonial Secretary, the Colonial Engineer, and one unofficial member (Mr. R. Campbell, who had been the last Secretary of the Agri-Horticultural Society) assumed charge of the Gardens for the Government.

But for the four years from January 1st, 1875, to the end of 1878 the Gardens had already been carried on by means of Government funds, and the Government had authorised the Raffles Library and Museum Committee to apply to the Director of the Royal Botanic Gardens, Kew, for a Superintendent. To them Sir Joseph Hooker had sent out a very young man, Henry James Murton, son, it seems, of a Cornish nurseryman; and he had arrived in Singapore in October, 1875. He had halted in Ceylon on the way to visit the splendid Gardens there, and make his first acquaintance with tropical conditions: and he arrived with liberal donations of plants from thence.

He was too young to be over Niven, who had been the Society's Superintendent and now had the title of Manager, yet had to be by the terms of his appointment: this difficulty however was solved by Niven taking leave; and while on leave he unfortunately died. Murton carried on alone for a short time when Niven had gone, until a Head Gardener was appointed from England, named George Smith. Smith arrived in the early part of 1877; but died suddenly in April, 1878. Next in succession, in June, 1879, Walter Fox arrived from England, having been appointed by the Secretary of State to be Murton's second. For the care of the animals of the Zoo Murton had had the help of one, H. Capel, but only from some date in 1876 into 1877.

The buildings in the Gardens when Murton came were, (i) the house that he occupied which is now the Director's, (ii) an orchid house, (iii) a shed with birds in it, and (iv) cooly lines.

The roads were more numerous than now and narrower. They were not well surfaced, and their edges were limited by earth drains: but as many of the visitors were horsemen out for exercise, and visitors of this class had been more in preponderance when the gates were open only to subscribers, a soft road was in some degree suitable. The Main Gate Road was embanked along the

Lake side, the lawn being hollow upon the east of it. Trees were plentiful, especially fruit-trees of the commoner species. The flowering bushes were extensively cut over in order to meet the demand for bouquets to which the subscribers had a right. There was a croquet lawn on the side of the Bandstand Hill; and near by the Gardens Jungle approached the Bandstand a little more closely than now. Bands played regularly, and visitors took advantage of them for a promenade. The property which the Agri-Horticultural Society had bought in 1866 was undeveloped.

Murton entered upon his duties with great energy. Directed by a Gardens Sub-Committee of the Raffles Library and Museum Committee, he corresponded with all the Agri-Horticultural Societies and Botanic Gardens in the East from Hongkong and Brisbane to Mauritius, obtaining exchanges; he corresponded with Kew, and received many plants thence. In exchange he sent out plants of local origin, chiefly orchids. His new introductions he planted all over the Gardens, until in 1878 and 1879 we find him complaining of the lack of space for more. His work was much dominated by the rapid growth of the Zoo, the developed parts of the Gardens becoming dotted with enclosures for animals. He commenced an economic garden upon the undeveloped property, and planted extensive beds for cut flowers near to it.

Unfortunately he was unstable and careless. That which interested him he did; that which did not, he was ready to neglect; and therefore the Gardens Sub-Committee kept a tight hold on him, which the Government Committee tightened. This he resented. He grew absorbed in the Botany of the island, and compiled a manuscript flora, neglecting the Gardens for time to work on it, and neglecting his accounts which were found in confusion, and which he would not attempt to put right. Then followed in 1880 his dismissal. In 1881 he died in Bangkok, his death perhaps hastened by his having burned the candle at both ends.

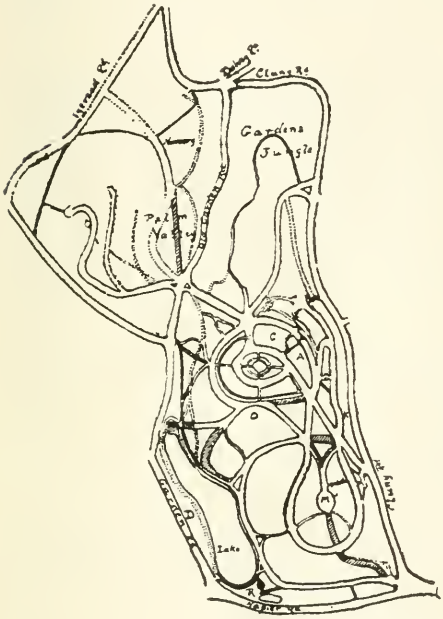
His qualifications had been good. Within five months of his arrival he had determined the cultivated plants in the Gardens, and made a list of them. He had bought from Collins when Collins was dismissed from the Museum, a collection of dried plants, mostly picked out of well-known herbaria and he appears to have increased it by his own collecting; he pressed the Government to buy it, and it appears that they did ultimately, but it had suffered considerably before Mr. Ridley first saw it.* In 1877 he travelled much, first visiting Kedah for plants, then Gunong Pulai in Johore (June), and later, that he might study the sources of Gutta percha at the suggestion of Sir Joseph Hooker, he made under Sir Hugh Low's direction a long journey in Perak, visiting the Taiping Hills, Gunong Bubo and the neighbourhood of Kampar. A full account of this journey was printed in the Government Gazette 1878, pp. 101-110. No later journeys are recorded.

His influence upon the Gardens can hardly be described without first giving some account of the Zoo, as its growth and rapid

* Vide Ridley in the Gardens Report for 1889, p.7.

removal rather adversely operated against him. This is an account of it.

Immediately it was generally known that the Government would maintain a collection of animals in the Gardens gifts poured in. Sir Andrew Clarke presented a Two-horned Rhinoceros, Sir Ernest Birch a Sloth Bear, Messrs. Brinkmann and R. Jamie each a Sambhur Deer, Captain Kirk two Orang-utans, the Acclimatisation Society in Melbourne an Emu, one Great Kangaroo, three Red Kangaroos and a Bush tailed Wallaby,—all in 1875; and in 1876, the King of Siam a Leopard, Mr. Hargreaves a Leopard,



Plan of the Botanic Garden showing the old and new roads. All roads made since Niven went are dotted: all roads closed since he went are cross shaded. R, is where the Rhinoceros' enclosure was: D, the deer enclosure: M, the Monkey House: K, the Kangaroo and Emu pens: A, the old Aviary: C, the first Carnivora house: O, Murton's Office.

the Sultan of Tringganu a Tiger. These were in addition large numbers of gifts a smaller animals. All the large animals needed expensive arrangements for accommodation. For the Rhinoceros an enclosure with a house and a wallow were made near Napier Road by the foot of the lake. For the Deer an enclosure was prepared against Garden Road: for the Kangaroos and the Emu paddocks were fenced adjoining Cluny Road near the Office Gate; the Carnivora were given a house at the north east side of the Bandstand hill where the Agri-Horticultural Society had had an Orchid House. The aviary was erected on the east side of the hill. At the expense of a Chinese merchant of Singapore, Mr. Cheang Hong Lim, an ornamental iron structure was put up as a Monkey House (completed April, 1877) near where the Herbarium now is, to become the centre of the Zoo after Murton had gone.

The expenditure of building all except the Monkey house fell upon the Government grant and was too much for it so that Mr. Kröhn in the Annual Report for 1875 wrote "the money allowed although quite sufficient for the upkeep of a Zoological Garden of fair dimensions, is quite inadequate for the erection of suitable houses for the various animals."

At first two privates of a regiment stationed in Singapore were employed as keepers; then in 1876 Mr. Capel, for whom a small house was built below the Aviary. But Mr. Capel's pay, small as it was, made a large hole in the grant, and in 1877 he asked for a rise, which led to a decision no longer to retain him; Chinese next and then Javanese were resorted to as keepers, the system of using Javanese lasting until the end of the Zoo.

There were big losses among the animals; for instance in 1876 some evil-disposed person or persons killed a Bear, the Emu and a Cassowary in one night; the Rhino* died in 1877 and two Kangaroos, and in 1878 both of the leopards. Losses so large caused the Committee to take the important decision of limiting the collection to small animals†; and they sent the Tiger and Orang-utan and a number of other animals to Calcutta, as exchanges for Indian birds (Report 1879, p. 6). The year 1878, thus, saw the

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* The skeletons of the Rhino, and some other animals are in the Raffles Museum.

† The following footnote is from a MS list of the animals in the Zoo on 27th September, 1877, which shows how large the Zoo was. The Rhinoceros had just died.—

1	Tiger	1	Heron
2	Leopards	3	Manchurian Cranes
2	Dingo Dogs	2	Pelicans
1	Jackal	3	Black Swans
1	Binturong	1	White Swan
1	Sun Bear	2	Water Rails
1	Fish Tiger	30—40	Teal and Mandarin Ducks
1	Civet Cat	2	Wood Pigeons
2	Common Carys	2	Nicobar Pigeons
1	Rabbit	1	Green Pigeon
1	White Rat	3	Ring Doves
1	Flying Fox	3	Common Doves
1	Kangaroo	2	Parrakets
2	Red Deer (Bucks)	1	Blood Brested Pigeon
3	do. (Does)	2	Horned Owls
3	Sambur Deer (Does)	1	Sonnerat's Jungle Cock
1	Sambur Deer (Buck)	1	Large Parraket
2	Opossums	2	Crested Peacock Pheasants
1	Kawoo	2	Fireback Pheasants (Cock and Hen)
1	Orang Outan	1	Pheasant (Cock)
2	Wou-Wous	2	Rufus tailed Pheasants
2	Black Monkeys	1	Golden Pheasant
1	Spider Monkey	4	Ring Neck Pheasants
1	Bear Macaque	4	Guinea Fowls
1	Red face Macaque	2	White Eagles
4	Porcupines	1	Falcon
1	Cassowary	4	Hawks
5	Pigtail Macaque	3	Sparrow Hawks
1	Emu	4	Crowned Goura Pigeons
3	Peacocks	1	pair Argus Pheasants
1	Manila Duck		

end of the ambitious Zoo§ commenced in 1875. Deer were retained, as inexpensive to feed; and when in 1877 the fence of the first enclosure across the lake became rotten (it must have been a wooden structure) they were accommodated in the now empty Kangaroo enclosure temporarily: but it in its turn began to go to pieces in 1878 (Report p. 6): and in 1879 their old enclosure was repaired with a strained wire fence, and within it they remained until much later giving at times a lot of trouble by breaking bounds. Meanwhile the other enclosure for the large animals were swept away more quickly than they had been erected.

The uncontrolled growth of the Zoo, must have made a great difference to the Gardens; and it was well that as it had to go, it went so quickly: by 1879 equilibrium had been reached again. The short stay of the Tigers had caused the old orchid house to be removed and some terracing on a small scale to be done; the short stay of the Rhino had caused some levelling to be carried out, and ultimately its wallow became a Water lily pond: the erection of a house for the Keeper Capel left the Gardens in possession of a building which was afterwards useful for a number of years, as a gardener's house, and then under Cantley for his clerk.

We will take the year 1879 as a convenient one, for a description of the Gardens under Murton. They were then in their twentieth year: Murton had done his best planting; and the Zoo had become stable.

The visitor in 1879, approaching the Gardens from town, found at the entrance what Cantley afterwards called "heavy masses of masonry doing duty as pillars." Passing between them, he would have found two roads—neat roads newly bordered by brick drains* one road leading straight forward, the other ascending to his right, and bordered by a particularly large drain. This road on the right soon after was closed and a pathway laid instead along its line; but in 1879 the visitor who followed it was conducted to the Herbarium Ring Road, and could cross it and proceed first on a path, then on a road, nearly straight to the southern face of the Bandstand hill, and on his way he would have passed the new Monkey house noting there that the roadway had been recently altered.

The other road, leading straight forward from the main gate is that which persists; at a little distance it was joined by a small path, by which anyone approaching from the Barracks could enter the Gardens through a turnstile upon a small bridge. A little further than this small path, the road reached the foot of the Lake and then followed its margin to another fork, the right arm of which now persists as the Main Gate Road, and the left

§ To limit the Zoo to smaller animals was the first decision: to limit it to Malayan animals was a later decision. For an account of the animals in the Zoo when it was Malayan, vide Ridley in the Journal of the Straits Branch of the Royal Asiatic Society, No. 46, 1906, pp. 133-194.

* Murton had been allowed to dig laterite from Goodwood Hill for these roads until the supply of good material there had been exhausted. Turf for the Lawns he was allowed to draw from Fort Canning and Magazine Hills.

as a footpath. The road on the left in 1879 completed a loop with the other of the roads from the Main Gate, while that on the right—the persisting road—led straight towards the Office Gate and on the top of the hill joined the Bandstand-Herbarium Ring system of roads. On the Main-Gate Road near the Gate Niven had had raised beds which obscured the unevenness of the ground; these raised beds had been removed, and a certain amount of smoothing had been done by Murton,—not as much as was subsequently done, but something—which still left the lawn too low on the left. From that lawn, Murton had newly removed large trees and a row of Betel palms which lined the boundary stream: clumps of Sago palms he had allowed to remain, as they persist still: in front of them he had planted many of his new introductions, and where the Betel palms were he had planted a row of palms of the genera *Stevensonia* and *Kentia*. Past the second clump of Sago palms Niven had had two small ponds which Murton had dug into one, at the end of which, had the Zoo grown as its promoters hoped, Alligators were to live: the near half of the pond was occupied by Waterlilies including *Victoria regia*, and the further half by the Lotus lily. Just beyond this pond had been the Rhinoceros enclosure with its wallow. Much levelling had been done to accommodate this animal which lived for such a short time in captivity, and had left the place improved; while the wallow, at first closed up, was later converted into a small pond.

From the Main Gate to this point upon the north of the Road the visitor in 1879 would have found the hill side dotted over with disappointingly young plants, being Murton's new introductions planted in some order, Conifers near the Gate, Cycads near the turn by the foot of the Lake. The trees of *Casuarina sumatrana*, now so effective, were then three years old, and could not have been effective then.

The visitor on arriving at the foot of the Lake found himself in front of the strained wire fence by which the Deer, whose enclosure was between the Lake and Garden Road, were ineffectively prevented from getting loose and doing damage in the rest of the Gardens. No path existed at that time west of the Lake.

The islet in the Lake was occupied chiefly by a large *Ficus*.

Following the Lake side the visitor might have noticed that the Lawn on the right had been newly raised to the level of the road, so as to do away with the old embankment; this Lawn is sometimes called in the older papers the "main Lawn," and by that it may be judged that it was more open than now.

If the visitor had kept beyond the fork of this road to the left, following the Lake side, he would have been led to two small rather unfinished terraces§ upon the side of the Bandstand Hill where Murton had his office and an orchid house, as well as lines for coolies.

The Orchid house was occupied in 1879 by miscellaneous plants, largely annuals, for the orchids had been placed on trees

§ Cantley smoothed them in 1882.

about the Gardens. Beds of annuals were upon the terraces early in 1879; but this form of bedding was stopped during the year on account of the expense.

The Office had big eaves, alike for affording a shelter against rain to visitors, as for ripening off plants of periodic growth. It was damp, and Murton kept no books in it. The orchid house was low and covered with creepers. The neighbourhood had been opened out considerably by removing old trees.

The visitor having reached the office could take the Lower Ring Road in either direction, or ascend the steps to Niven's lower terrace, and so reach the Bandstand, or if he cared he could proceed towards the Main Gate again down an avenue of palms between flower beds to the Monkey House, round which new planting had occurred in order to give shelter to the Monkeys, and where, as said, the road would have been found broken. This break was with the intention of preventing carriages from reaching the Monkey House, pedestrians instead being encouraged by means of four new paths one made out of the old roadway each blocked against carriages by a stone pillar.*

If the visitor had entered the Gardens by the Office Gate, he would have found leading to the left the line of a closed-up road with a row of Araucarias on its south side. Three of these Araucarias still stand. The road had been the end of the Main-Gate Road, unintentionally so constructed as to lead strangers who had entered at the Main Gate out of the Gardens at the Office Gate. Such an arrangement, not unsuitable when the visitors were the subscribers to and owners of the Gardens, and therefore familiar with the turns of the roads, was unsuitable when the Gardens were becoming a resort for anyone and everyone: and the Sub-Committee ordered the closing of the end of the road. The road to the right was that which still persists—being apparently the first road made in the Garden of the Agri-Horticultural Society. Ascending it the visitor passed the end of the Herbarium Ring Road and then had on his left Murton's new palm plantation. On his right were more Araucarias in a row along the side of Cluny Road as far as the old Kangaroo enclosure, and a path led near them and gave a branch up hill to the Aviaries upon Niven's lower terrace.

The visitor would have found the roads about the Bandstand much as they are now. They had been narrower and the Upper Ring Road had been limited by a circular border which Murton had removed, as being an obstruction upon Band evenings; and he had thereafter been able to throw an extra eight feet into the road. He had also done away with many beds upon the upper terrace and substituted Crotons in tubs. The lower terrace was bedded with shrubs. The Aviary was upon it to the east of the Hill; and to the north-east, to which Niven's terracing had not extended, but where

* Two of these stone pillars are still in situ.

the Agri-Horticultural Society had had an orchid house, surrounded by trees, Murton had cleared considerably, and had made small terraces on one of which the Carnivora House had been placed. At its back trees had stood, which up to 1877 were heavily festoned with the beautiful indigenous climber *Thunbergia laurifolia*. Unfortunately it kills its supports; and no sooner had Murton commenced to construct a fernery under the shade of the creeper, than the trees began to fall; he wrestled with the situation by scaffolding, but this perished; and in 1879 there was little but an untidy corner, where the fernery had been commenced. Moreover Murton complained bitterly of the way in which his best ferns were stolen from this place. The Carnivora cages had been removed before 1879; and in their place Murton had planted a collection of Bromeliads. Behind them, across the Lower Ring Road and screening off the Propagating yard, was a tongue of virgin jungle, which is now cultivated for shade plants, and contains Shoreas with other typical forest trees: however the tongue has been lengthened slightly by newer planting.

West of the Bandstand hill the paths were not at all as they are now. Flower-beds were about the head of the Lake; and no screen of trees such as is now, but a plantation of Pomelo trees and trees of the Kenari nut, with behind them cooly lines, and a shrubbery near the Tyersall Gate.

Along the Maranta Avenue was a long border with shrubs. Garden road had not ceased to be a public thoroughfare; and the Palm valley was untidy. Its slope under Garden Road had served Murton for a source of clay when he needed it, and so been bared; then he had smoothed it somewhat and tried to get it grassed over: toward Cluny Road it was covered with *Gleichenia* fern. An old cart track leading into the valley he had filled; and from the top, where he seems to have planted palms, a path was made down to the hollow which he had developed as an Economic Garden. In this Economic Garden in 1879 the visitor would have found patches of coffee,—Arabian, Liberian and Cape Coast,—the latter two being introductions of 1877; the first as elsewhere in the Peninsula was suffering from the attacks of *Hemileia*. He would have found Tea, Cacao and Sugar-Cane. The Canes were good introductions from overseas, and were much pilfered. He would have found Ipecacuanha struggling, and Cardamoms, Avocado Pear, and all the various rubber trees that Kew could send out, including *Hevea*, as well as 4000 pots of the local Gutta Singarip (*Willughbeia firma*) which it was thought had a future, and 2000 pots of Eucalypts. He would have found also Teosinté, Maize, Mahogany and various fruit trees.

There was a raised path limiting the Garden on the north and beyond it swamp forest. If the visitor had followed the path westwards he would have found large beds for flowering shrubs which Murton raised with the purpose of saving the flowers in the more public parts of the Garden from being cut for bouquets.

Murton had for the Garden in the year 1879 from Government $7,580, and by subscriptions and sales a further $370. Out

of it he was able to spend over $3,000 on coolies' labour, so that as the wage was $5 per mensem (and had been $4), he had fifty men in employment besides his overseers, and that is more than the Department has been able to retain in the "Botanic Garden" for very many years up to the present year.

In the year 1879 the Government authorised the Gardens to commence planting a piece of land called the Military Reserve which lies to the north. This land is what is now known as the "Economic Garden." The first occupation of it began at once and a shed for Chinese coolies was erected, and a house for the Road foreman employed in the Gardens.

This Military Reserve was not altogether waste when taken over; its lower parts had been planted in indigo by Chinese, who lived on the slope among fruit trees. The low land seemed to Fox who happened to have been at Kew when Cross had returned from Para with his first Rubber seeds, to be just the kind of ground which Cross described as suited, and he took the young Hevea trees in the Palm valley to it. He set to work also planting on the higher ground, but single handed after Murton's fall could do little,

Murton's last work for the Gardens was the compilation of a Gardens' catalogue which was printed and published; but is not available in the Settlements, because Cantley suppressed it as altogether unreliable (Report for 1882, p. 13).

Nathaniel Cantley, a native of Thurso, N.B., Kew-trained and for a time Assistant Superintendent of the Botanic Gardens in Mauritius, was now appointed to succeed Murton. He arrived in the Colony in November, 1880, but was forced by illness to take leave in March, 1881. Again Mr. Fox acted while Cantley voyaged to England via the Cape. Sick as Cantley was when he went on board, he had some two thousand botanic specimens cut from the trees in the Gardens and their neighbourhood which he dried on the voyage with a view to getting them determined at Kew. It appears that many of these found their resting place in the Kew Herbarium. Cantley resumed charge at the end of 1881, and presented a programme of work to the Gardens Committee which obtained approval. First of all be it said that the Government had the formation of a Forest Department in mind, and with that in view Cantley proposed that the Military Reserve should carry a series of Malayan timber trees. This was approved; and because the space in the Botanic Garden for new introductions was, as Murton complained, restricted, Cantley wove into his series of Malayan trees, all those of his new introductions which had an economic value, until gradually the importations exceeded in number his Malayan trees. At the same time into the Botanic Garden he planted the things that had not an economic interest. Next he made, with approval, two nurseries, one for ornamental plants in the Botanic Garden, and one for forest trees in the Military Reserve. The second covered several acres adjoining Cluny Road and extending back a couple of hundred yards to where traces of it exist still in groups of certain trees. He arranged for the sale of plants from these Nurseries. Thirdly he asked for, and got, a

suitable office building wherein he could house a Herbarium and a library. Then he named the staff required, and the alterations necessary in the Gardens to bring things into order, including the adequate labelling* of the collections over which Murton had complained of considerable difficulty, and for the effective policing of the grounds by day and by night.

Cantley was a great advocate of order. The arboretum he planted in botanical sequence on the system of Bentham and Hooker with one end at the Cluny Road entrance to the Economic Garden and carrying the series eastwards. He had made in 1882-85 from near the foot of the Lake to the Tyersall Gate a series of flower beds‡ whereby the visitor was introduced to this system in ornamental plants; but the impossibility of filling the beds with plants suited to the climate broke his scheme down. Thirdly when Murton's palm collection wanted replanting, he proposed to arrange it according to the "Genera Plantarum." What Cantley meant in 1882 by saying that the Singapore Gardens had never been a "Botanical Garden," was that this botanical orderliness which so appealed to him was not present, nor the plants labelled. He had extensive flower beds on the Lower terrace of the Bandstand Hill, which held no less than 20,000 plants; and in 1886 made more at the Main Gate. In administration this love of order did much for the Gardens: for instance, Murton had left cooly lines in three places, and Mr. Fox had complained that numbers of men were continually walking about at night who when questioned always had the excuse that they were proceeding from the one set of lines to see their friends in another, and that this conduced to thefts: Cantley concentrated the coolies in his new propagating yard partly in new buildings, and partly in buildings left by Murton. Capel's house because the clerk's house. To a place near to the Propagating yard he took the Plant Houses; and to a place near enough also and furthermore conveniently reached by visitors he took the Gardens office. Putting forward the need of a building in which Flower shows could be held he induced the Government to build in 1882 between the office and the Propagating yard the Large Plant House; and it has been used again and again for that purpose, the collection of pot plants within it being removed temporarily.

The Zoo he concentrated in 1885 at the Monkey House, erecting new aviaries like brackets on either side of it: and encircling these again for shelter with trees and shrubs.

Thus Cantley cleared the Bandstand Hill of all buildings; for the office was no longer wanted, nor the little very unsuitable orchid house, nor the cooly lines; and a Rosary was made where they had been: the Aviary also disappeared from the lower terrace. The Rosary beds were just as the beds containing Cannas are now,

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* Murton's labels had been painted by convicts in the jail

‡ There is preserved in the Public Works Office a ground plan with levels showing the Main Lawn covered with flower beds and the curves of the paths to the old Monkey House altered. This plan, which is undated, appears to have been connected with Cantley's desire to maintain a collection of bedded plants illustrating Systematic Botany.

but instead of grass had walks between them. Upon the top of the Hill he planted in 1882 Araucarias and Crotons, and placed ornamental vases and garden seats. At the head of the Lake he launched an undertaking which failed. He removed the flower beds; and a big cistern having been made in 1886, he threw up mounds which were to be irrigated and to support delicate ferns. While this was being done, he altered the footpaths on that side of the hill so as to conduct visitors to the fernery, and he planted trees round the cistern to hide it.

North-east of the Bandstand hill close to where Murton's fernery had fallen, he made another fernery. Here he had forest overhead, and by thinning it, and throwing the surface into mounds into which stone was inserted, he obtained a very suitable place. Funds did not enable him to finish it rapidly and what was started in 1883 was not completed for a long time.

The shrubberies all along the border of Cluny Road to the Large Plant House he first made. New gate posts were erected at the Main Gate in 1885 and topped with globes in 1886. By the kindness of Messrs. Gilfillan, Wood & Co. he was allowed to place a hand pump across the Cluny Road and pump water to the Plant Houses from the head of the little stream that runs there. He did not follow up Murton's scheme of raising flowers for bouquets at the west of the old Economic Garden, but laid out what we now call Lawn R in stiff rectangular beds for the purpose. In the Economic Garden in 1883 he experimented with European vegetables.

Cantley's staff for working the Gardens consisted of himself, Walter Fox, a clerk, a foreman gardener and a propagator, both the latter two selected as being able to read and write, a label-printer a mason and a carpenter. Three constables were quartered in the Gardens each taking a day and a night beat in turn just as the watchmen do now. In the first three years of his service in the Colony the Government grant was $10,000 which was expected to cover all expenses, with the help of $750 to $850 from subscriptions and sale of plants. In 1886 the pays of Cantley and Fox were excluded, and the Government vote put at $7,000. The forest vote maintained the planting upon the Military Reserve.

Cantley, as time went on, became more and more tied by his Forest work. Then at the end of 1887 his health again broke down and he went to Australia on leave where he died. Mr. H. N. Ridley succeeded him in the next year. But before Mr. Ridley had arrived in the Colony a little "Guide to the Botanic Gardens, 1889," had been prepared by Mr. Fox and was in the press. As it gives an account of the condition of the Garden at the age of thirty years, the reader is referred to it. All which here follows will be but a statement of subsequent changes taken seriatim in order that it may be clear what of that on which the eye of the visitor of 1918 rests, was absent in 1889.

Mr. Ridley's service marks the third period in the history of the Gardens: and it will not be reviewed. The four outstand-

ing results of it are: firstly, the excellent Herbarium of the Higher plants and ferns of the Malay Peninsula, whereby he is now enabled to write a Flora of the Peninsula; secondly, the considerable planting of Rubber, whereby as the Peninsula enormously benefitted, so too the Gardens obtained a large income enabling them to be maintained without an increase of the Government's vote although the relative value of the vote was much reduced with the fall of the dollar; thirdly, the housing of the Gardens' staff upon the Military Reserve ground; and fourthly, the commencement of publication of results. He was in charge of Forests up to 1901; but from 1892 the Military Reserve or Economic Garden ceased to be maintained out of a Forest vote.

It is not given to everyone so admirably to round off his service as Mr. Ridley is doing: he will finish his Phanerogamic Flora of the Peninsula in retirement. Meanwhile the Gardens have entered upon their fourth period, with two outstanding objects (1) to extend the study of the Botany of the Peninsula to the Lower Plants, and (2) on the horticultural side to widen the efforts in acclimatisation by the use of all those opportunities which selection and plant-breeding afford. For both purposes officers have been appointed, but the War has delayed the start.

APPENDIX.

Changes subsequent to Cantley's death which have made differences in the appearance of the Gardens.

There is nothing which throws greater difficulties into an understanding of the Annual Reports of the Gardens than their inconsistences in the names of buildings and roads. The same plant house, for instance, is in one year the "Shade-plant house" and in another the "Aroid house": and what is true of the plant houses is still more true of the roads. In 1913 names were given to the important roads, that they might be cited in Police regulations, and they were labelled: since when the whole of the Gardens has been divided into areas which, in the Botanic Garden, are denoted by letters, and, in the Economic Garden, by numbers. In the Botanic Garden the letters denoting each area appear upon the labels to the trees. The accompanying map records them; and the reader may find it a guide to him in running through the following list of the more noticeable changes made since Cantley's death.

Changes near the Main Gate.

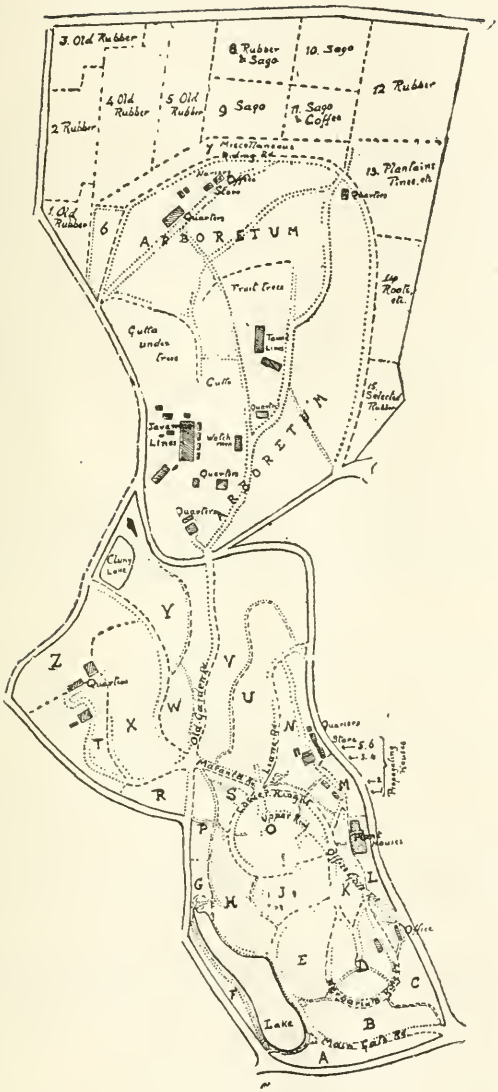
A brick boundary wall with iron railings was erected from the Main Gate to the Office Gate, 1904.

Cannas, first introduced into the Gardens for bedding in 1894, have been made of great use near the Main Gate since 1914.

The little path towards the Barracks across Lawn A. was closed in 1912.

Small paths round the ponds were closed in 1916.

A new coral-bordered outflow was made from the Lake to the Ponds, with falls upon it, 1918.



Plan of the Botanic and Economic Gardens showing the "lawns," "areas," or "blocks" into which they are divided. The Lawns and Areas in the Botanic Garden are designated by the letters of the Alphabet. The Blocks in the lower part of the Economic Garden are designated by numbers. The position of the Gardens' building is indicated. For the fullest preservation of the amoenities of the Botanic Garden, most of the quarters are in the Economic Garden.

Changes about the sides of the Lake.

The embankment of the Lake was raised one foot, 1890.

A path through Lawn F. was made and a collection of Leguminous trees planted along it, 1889.

An oil engine was installed within a clump of trees at the junction of Lawns E. and K., by which water is supplied to the Bandstand Hill, Fernery, Propagating Yard and Plant Houses, 1907.

The islet was planted with the larger plants now on it, 1891, cleared of undergrowth and turfed 1904, but the undergrowth has returned.

A kiosk on Lawn E. was erected as a shelter, 1907.

Changes about the Head of the Lake.

Cantley's mounds for ferns were planted with Sansevieras and other succulents, 1888-89; then trees sprang up on them which were suffered to remain; and when their shade was sufficient, rocks were inserted into the mounds and ferns encouraged, 1904. But as the paths were too narrow, they were reduced in number and the mounds reshaped in 1914; and a hollow walk, coral-bordered, was made upwards through the lower part of the big cistern, 1915. Two pools were constructed in this "Dell," 1915; and they were connected with the inflow from the Tyersall Lakes, in such a way that the muddy rain water from Garden Road and elsewhere should be excluded, 1918.

Changes on Lawn D.

The Aviaries were removed, 1905-07, the Monkey House being left to serve as a shelter until 1913, when it also was removed.

The Herbarium building was erected, 1903. For the history of its contents, see the Annual Report of the Gardens for 1889 and subsequent reports.

Changes on the Bandstand Hill.

A Bulb Garden was made where Cantley's series of herbaceous annuals were, 1888.

A Marantaceous border was planted behind it, 1888.

Sand was supplied first on the Bandstand for the children's play ground, 1902.

Rose beds were made round the tall palms upon the Hill, 1915.

Two additional feet were added to the breadth of the Upper Ring Road by narrowing the border drains and improving them, 1905.

The climbing Thunbergias upon the north side of the Hill, brought down their supporting trees, 1889, just as they had done in 1876, and did again in the neighbouring edge of the Gardens Jungle in 1915.

Changes about the Plant-Houses.

The roof of the Large Plant House (Exhibition House of the older reports) was modified with the object to improving the light, 1897, 1898, and 1918. Its gable was built, 1918. Its central pillar was built, 1898; the coral arch in it was built 1898; its tank was constructed, 1900.

The Annexe to the Large Plant House was built, 1889, and reconstructed 1895-96; its tables were lowered and the house altered, 1904.

Little rockeries were made just to the north west of the Annexe, 1890.

Changes in the Propagating Yard.

The old cooly-lines which were infected with Ankylostoma, were removed, 1899.

Cantley's Orchid House was removed, 1895.

The Roadway to the Propagating Yard from the Large Plant Houses was continued to the Rogie entrance, and its line through the Yard altered so as to give more room on the side where the plants are grown and less upon the side towards Cluny Road: the entrance from Cluny Road close to Lermit Road was closed, 1890.

Propagating House No. 1 was built, 1898, and reconstructed in 1911: No. 2, an old house, was reconstructed in 1896: No. 3 was built for shade plants, 1901: No. 4 was built for orchids, 1908: the Glass-roofed House No. 5, built 1898, was rebuilt in 1906; and the similar house No. 6 was built, 1908.

New unshaded tables were built east of the two glass-roofed houses, 1917 and also north of them, 1918.

A new path parallel to the Lower Ring Road was made to the Fernery, and planted with Aroids, 1889.

A collection of Scitamineae was built up under the Tampoi trees where Cantley had proposed to raise orchids, 1890 forwards.

Quarters for two carpenters built, 1907.

Changes about the Palm-Valley.

The long rectangular beds where Cantley raised flowers for bouquets were closed, 1890.

The old Monkey House was re-erected over the top of the Valley to serve as a shelter for any one caught by rain in this part of the Gardens, 1914.

The entrance to the Gardens' Jungle path was altered so as to pass it, 1914.

The pathway down the Palm Valley was converted into a road and new paths made to east and west of it (that to the west however closed again later), 1891-92.

The plantation of palms commenced by Murton at the head of the Valley, was extended down the valley, 1891 forwards.

The nursery in the hollow was enlarged, 1891.

The swamp against the Tyersall Road was converted into a Lake, the Cluny Lake, bridged for the Roadway, 1891-92. The bridge was converted into an embankment, 1894, and the embankment raised, 1896. The Lake was confined on its southern side, 1912; and the pond, cut off on its west side by the road, was filled, 1914.

Changes about the Director's house.

Beds for cut flowers at the back were changed in position, 1889 and then abandoned gradually.

Tyersall Road having been made, the old path at the back was allowed to become closed up, 1890. The upper corner of Tyersall Road was improved in 1904.

Near the Assistant Director's house, benches were placed for raising annuals, etc., 1915.

A small orchid house was constructed of the iron of the old bear cages, 1917.

A Sun rockery was constructed for Agaves, 1914.

Changes in the Economic Garden.

The Riding road was made, 1899-1900.

A roadway intended to continue the line of Garden Road through the Arboretum and be metalled for carriages, so to bring visitors to much that is of interest in this part of the Gardens, was laid down, 1915.

Blocks Nos. 1 and 3 were planted with rubber, 1886-88.

Block 2 which had been covered with forest trees left from Cantley's forest nursery, was planted with rubber, 1904.

Blocks Nos. 4 and 5 planted, 1884-87, and forwards.

Block 12 planted, 1913.

Castilloa planted in Block 14, 1900.

Ficus elastica planted with coffee in Block 11, 1905.

The Hill-sides dug, planted and returfed in sections, 1894, forwards.

The hill top towards the west planted with gutta, 1897-99.

The neighbouring slope towards Cluny road planted through under jungle with gutta, 1903.

Rubber smoke house, built, 1909.

Quarters for 3 subordinates built, 1891, rebuilt, 1908; and for another 1893: and for another, 1915: and for another 1916.

Economic Garden tool-shed built, 1907.

Economic Garden Office built, 1908.

Lines for Tamil coolies built, 1892; rebuilt 1910, and extended, 1918.

Lines for Javanese coolies built, 1899, and extended, 1918.

Lines for watchmen built, 1899; rebuilt, 1910.

Quarters for an Assistant Curator built, 1910.

The

Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. II Issued July 4th, 1919 No. 4.

CONTENTS.

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DEPARTMENTAL NOTICES.

The new List of Plants, which may be purchased from the Botanic Gardens, Singapore or Penang, can be had on application.

Plants of the Avocado Alligator Pear—*Persea gratissima.*—and Brazil nut—*Bertholletia excelsa,*—to be sold within the Peninsula at fifty cents each.

The Gardens' Bulletin is published as materials become available. Its price is fifty cents a copy, post free, or in advance for a volume of twelve numbers, post free.

Five dollars in the Straits and Federated Malay States.

Nine and a half rupees in India and Ceylon.

Thirteen shillings in Europe.

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

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

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HEVEA *VERSUS* FUNGI.

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 (*Xylogtossa*) *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 maintainance 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*

as the species. It belongs to the section of the genus which has the male flower-buds blunt, as the annexed figure shows, whereas in *H. brasiliensis* they are acute. The female flowers of *H. confusa* are further a little smaller and the male flowers considerably smaller than in *H. brasiliensis*.* But a still more striking difference is in the pose of the male flowers.

On the left a female flower of *H. confusa* with buds of two male flowers (a third has been broken off). On the right a female flower of *H. brasiliensis* and three male buds. Note the smaller flowers of the first and that the male buds bend earthwards.

On the left a male flower of *H. confusa* in section and on the right a large one of *H. brasiliensis* which is very variable in regrad to size of its male flowers. Note the blunt perianth lobes of the first.

The panicle in *H. brasiliensis* carries up to 300 flowers of which, always if well developed, the terminal flower is female; and the better developed the more female flowers are there, terminating the stronger lower branches, up to about 7 in number. Thus a panicle that is weak may be wholly male, and the stronger and larger it is, the more in number are the female flowers on it. All these female flowers take their position as regards the earth from the axis that they terminate, and that position is generally in some measure such that they are directed upwards or obliquely upwards: but the divergence of this angle from the vertical is determined by the angle at which the branch takes off from its parent axis and again this by the angle at which the parent axis stands. The panicles produced by tree No. 1844—*H. confusa*—are narrower than those of *H. brasiliensis*, as much because the angle at which the side axes take off is smaller, as because, at least in tree 1844, they are of lesser size. The weakest panicles are wholly male as in *H. brasiliensis*, and the stronger carry more and more female flowers upon the lower side-branches up to 5 or 6.

* J. Huber, Novas contribuicoes para o genero Hevea in *Boletim do Museu Goeldi*, vii, 1910, pp. 200-216, has discussed at some length the size of the flower, as a character by which species and groups of species may be distinguished f om each other.

The perianth of the female flower in *H. brasiliensis* is of a dull mustard yellow, and if normal consists of five ovate acuminate sepals coherent in their lower third into a cup, which is of a greener tint inside than the lobes. This cup is almost filled by the ovary, around the base of which is a slight circular swelling being the disc which may be just damp with honey; five slight thickenings extend up the cup as the midribs of each part of it. In *H. confusa*, the perianth lobes are ovate and blunt, and the cup extends to half their length; they and the cup are straw-coloured with a magenta line down the middle from the tip or near it to the very base inside. Outside they are covered with short hair. The top of the ovary is conspicuously blunt with sessile stigmas.

Often in *H. brasiliensis* the first flower of a panicle to open is a male flower; but after all the female flowers are over, there are males that follow in considerable numbers. The male of *H. brasiliensis* is like the female in perianth, but smaller and hardly pale green within the cup. The staminal column carries two rings of five anthers. The pose of the flower depends upon the axis which bears it, and it may face in any direction. The male flowers of *H. confusa*, like its female flowers, are smaller than those of *H. brasiliensis*, blunter, different in colour, being straw-coloured: they have fewer anthers, and by the bending of their pedicels they face more or less earthwards. Outside they are hairy. This bending of the pedicels gives a very good distinguishing mark which the herbarium student cannot note so well as the field student.

The seeds are as figured by Hemsley in *Hooker's Icones Plantarum*, plate 2575: but tree No. 1844 gave flowers with blunter perianth-lobes than the figures on plate 2574.

Hevea pauciflora is known to produce hybrids with *H. brasiliensis*, and so far it seems that these hybrids have no value.

A sample of rubber from the tree was submitted to Dr. Frankland Dent, Government Analyst, Straits Settlements, and another to the Director of Agriculture, F. M. S., for kind submission to Mr. B. J. Eaton, Agricultural Chemist in the Department of Agriculture. These two samples on analysis scarcely differed: they contained about 95 per cent of a substance chemically rubber but lacking the physical properties required in commercial rubber, probably as Mr. Eaton suggested a polymer of caoutchouc; and they contained also rather under 2 per cent of resins. The samples were too small for a vulcanization test. They were small because the tree yielded so grudgingly.

I. H. Burkill.

MANGO PESTS IN SINGAPORE.

In no other part of the tropics are mangoes more badly pest-ridden than in Singapore. Locally produced fruit is therefore neither abundant nor of good quality. There is nothing in Singapore to compare with the great quantities of fine "carabao" man-

goes produced in the Philippines. It would be a catastrophe immeasurable if the mango pests of Singapore were introduced into the Philippines.

Among the mango pests of Singapore, three are very conspicuous, one insect—a psyllid,—and two fungi. The psyllid produces a leaf gall the size of a small pea, and these are sometimes so numerous as to occupy a large part of the surface of the leaf. When the insect is mature, the gall splits open at the top, the acute segments recurving. These insects secrete considerable quantities of honey-dew, and this may account for the astonishing growths on the same and neighbouring leaves of a sooty black fungus, *Meliola mangiferae* Earle. This fungus was described from Porto Rico but has been found to be practically pantropical in distribution. Between the psyllid and the fungus, the leaf has little chance of performing its natural function.

Certain trees which have escaped the psyllid and the *Meliola* may have practically every leaf scattered thickly with the small reddish brown nodules of an extremely serious fungus pest, *Zimmermanniella trispora* P. Henn., and under this load the leaf soon dies and falls.

The investigation of these pests should proceed from two points, first beginning with the psyllid, and second to determine the degree of parasitism in the *Zimmermanniella*. It is entirely probable that remedies can be devised to control these and keep the trees clean and healthy.

C. F. Baker.

FUNGI FROM SINGAPORE AND ALSO FROM PENANG.

"Fungi Singaporenses Bakeriani."

[The following enumeration is of fungi, collected with two exceptions, by Professor C. F. Baker during his short service with the Government of the Straits Settlements; and enumerated by Prof. Saccardo in the Bulletino del Orto Botanico Reale di Napoli, Vol. VI, (1918) at the pages given after each name. In the Journal of the Royal Asiatic Society, Straits Branch, No. 78, 1918, pp. 67-72, will be found descriptions of sixteen others under the title of *Some Singapore Boletinae*—a joint paper by M. N. Patouillard and Prof. C. F. Baker: and again in the Bulletin de la Société Mycologique de France XXXIV, 2e fasc. is described by M. Patouillard a further fungus *Echinodia Theobromae* from dead Cacao branches in Singapore.] Ed.

Puccinia clavispora Ell. and Barth. Singapore Gardens, on *Andropogon nardus* v. *citronella* .. .. p. 40

Aecidium balansae Cornu. Penang, Government Hill, on *Agathis alba* (Burkill) .. .. p. 40

Aecidium cassiae Bres. Singapore, Tanjong Pagar, on *Cassia tora* (Burkill) .. .. p. 40

(89 species and varieties, 67 *new*.)

ACCLIMATISATION TRIALS OF LIMA BEANS

(Phaseolus lunatus).

The following varieties of Lima beans were received from Philadelphia U. S. A. on 23rd July, 1918:

No. 1. Siebert's Early.
" 2. Purple improved bush.
" 3. Small Lima or Sieva pole.
" 4. Dreer's Wonder bush.
" 5. Fordham's bush.
" 6. King of the Garden.
" 7. Dreer's improved pole.
" 8. Henderson's bush.

On 31st July, 8 beds, 18 feet by 3½ feet numbered 1 to 8, and labelled, were, after a preliminary liming, sown with 28 seeds of each variety, one for each bed. The soil had been previously manured and had given a crop of maize.

Bed No. 2 showed no sign of germination, a second sowing, and a trial in pots gave a like result.

Bed No. 7 gave only 6 germinations with shrivelled leaves of no vitality. A second sowing gave nothing. The two beds were dug up.

During August and September, the remaining six beds were kept weeded, and stirred, each plant receiving a light earthing up.

In the records kept, the growth of the beds is set down as follows:

No. 1. Siebert's Early.

30th September. "The plants have come up very strong—a strong climber, with heavy foliage and a fair show of flowers. A sparse crop of broad pods 3½ to 4 inches long, with a kink at the tip—with two or three beans per pod, which, I fear, will not develop to full-size seed."

15th October. (76 days from sowing), four mature pods were plucked, but only two beans were found fit for seed.

No. 3. Small Lima or Sieva Pole.

30th September. A thriving plant; a strong and healthy climber, by far the best of all the Limas. Very heavy foliage with abundance of small pods 2 to 3 inches long, ½ inch broad. Not attacked by white fungus, which is prevalent on neighbouring beds. In this case, as in No. 1, the foliage was so dense that it had to be thinned down, and the stakes had to be braced to support the weight. The excessive flowering had also to be checked by pinching back the tops—which also tends to strengthen growth below.

No. 4. Dreer's Wonder Bush.

30th September. As its name implies, does not climb. Only a few beans are showing: they are very broad (one inch) with a pronounced kink at the tip. Spots of rust are noticeable on many pods.

No. 5. Fordham's Bush.

30th September. Abundant flowering, but no pods formed as yet.

No. 6. King of the Garden.

30th September. A climber, but a weak and unhealthy-looking plant. A very few pods are visible of the very broad kind, 4 inches long.

15 October. This bed is now showing a fair number of pods some of which measure 5 inches in length: but many are flat containing no seed, or abortive seed.

No. 8. Henderson's Bush.

A squat, leafy bush with a number of small pods, eight on the average, to each bush: the pods, 2 to 3 inches long, contain mostly 3 seeds. It seems to resist the white fungus which has killed many plants on beds Nos. 5 and 6. This bean is, after No. 3 Small Lima or Sieva Pole, the most promising of the Limas. Yet a second bed, sown on 16th September on a previous ground-nut plot, had failed.

As mentioned, a fungus, taking the form of a white hoar-frost, particularly visible in the early mornings, or after rain, along the lower parts of the stems, had attacked the vines in all the beds except numbers 1, 3 and 8: its effect was deadly on the plants attacked, which gradually dried up and decayed.

All the Limas, except Nos. 1, 3 and 8 were therefore dug up and eliminated from this trial.

The progress of these 3 beds is recorded at length in the Journal; but in order not to unduly extend these notes, No. 1 Siebert's Early may be at once eliminated as a failure, for although it is still growing in the garden, it seeds sparsely and the pods are badly filled.

No. 3. Small Lima or Sieva Pole.

A remarkably prolific vine, without, so far, trace of rust, or of the fungus which has attacked the other beds, and which, after microscopic examination, was identified by Mr. Deshmukh as *Colletotrichum lindemuthianum.*

October 9th. (70 days from date of sowing) plucked a few pods, which gave 16 fairly large, flattish beans which were, soon after, planted on a separate bed.

October 10th. The foliage is so thick that it has to be thinned for the second time, to allow at least a partial access of the sun to the pods.

October 14th, 75 days from date of sowing, collected 70 pods which gave 151 beans, of which 110 were selected for seed.

October 15th to 23rd, the following crop was gathered in daily pickings:

546 pods yielding 1187 beans, of which 814 were selected for seed.

October 24th to 9th November, the following crop was gathered. 255 pods yielding 583 beans, of which 309 were kept for seed.

After 9th November, a large number of pods were picked, but many were found to be empty, or with abortive seeds, or in some cases, germination had already started within the pods. The fungus referred to above had now attacked this bed also, and none of the beans, from that date, were kept for seed.

So far, then, from 14th October when cropping began, to 9th November (*i.e.* from 75 to 101 days from date of sowing) the nett result of the crop was:

871 pods yielding 1921 beans of which 1233 (*i.e.* 64%) were kept for seed. This was obtained from 28 seeds sown at the origin, on the 31st July, 1918, and corresponds to a yield of 31 pods and 68 beans for every seed sown.

November 15th. There are still a number of pods on the plants but they are all, more or less, badly infested with maggots, and very few are fit, even, to eat. The bed is to be dug up. (The bed was not dug up as explained below).

It may here be mentioned that the shells of the Lima bean are quite uneatable, but the bean itself affords a quite excellent dish.

The Lima is, I believe, not much thought of in Europe. Decaisne does not recommend it: but it is held in high estimation in America.

If personal taste may find expression here, the writer's opinion is that the bean is equal to the best French Soissons: it is farinaceous and melting in the mouth—and, in every way, most palateable.

Second Generation.

Of the 1233 beans originally selected for seed, 556 had been sown in 15 beds on the 24th October, 1918; but there were many failures, and, on examining the remainder of the selected seeds, the reason of these failures was revealed. It was found that, by keeping, many of the beans selected as perfect for seed, developed defects, which were not, at first, apparent in the fresh beans. Small specks would appear under the skin of the beans, generally on or near the rim, sometimes also round the eyes, which specks very soon developed into a cancerous growth right through the whole substance of the beans; and, a few days after the sowing of such beans, it was found that, on opening, the two cotyledons were eaten through and through with rot.

This showed the necessity of keeping the beans for sometime before sowing, to give time for the disease to reveal itself, and, henceforth, all the beans underwent at least ten days' drying, during which a second and a third selection was gone through. The drying of the beans must take place in the shade, for the skin of the Lima is not thick, and if put out in the hot sun, the skins are apt to crack.

The failures of the previous sowing were made good, to their original number, namely 556, but of these a good 15 per cent was destroyed, partly by minute larvae, *Melolonthids*, introduced into the soil by immature cowdung, partly by night insects which nip the stems clean off.

The crop, as recorded, day by day, in the Journal, was therefore obtained from about 470 beans of the second generation.

The pickings, begun on 6th January, 1919 were stopped on the 31st March and the result to-date (12th April) is as follows:—

Number of pods picked ..	11174		oz.
Perfect beans selected for seed	9294	weighing	$269\frac{3}{4}$
Imperfect beans but eatable ..	5228	,,	$77\frac{1}{4}$
Uneatable, diseased, maggotty, etc. ..		..	$38\frac{1}{2}$

470 plants have therefore given, so far:

11174 pods containing 14522 beans weighing 347 oz. or 24 pods and 30 beans for each seed put in the ground. As the crop is only half way through, no final figures can be given at present. Pending the early resumption of plucking, the beds are receiving a light hoeing and a mulch of fallen leaves, and prunings of the dead stems.

Before passing on to the record of the new crop *i.e.* that of the third generation now begun, it should be here mentioned that, under local conditions, the Lima bean becomes perennial, that is to say growth is continuous and, on the same plant, may be seen, at the same time, mature and immature pods, and flowers.

In Burmah, where the Lima bean is cultivated as a field crop, the same perennial habit of the plant has been observed by Mr. van Buren (Tropical Agriculturist, June, 1918).

The original bed, sown on 31st July, 1918, which, as previously stated, it was decided to dig up (but which for some reason was not dug up) is still giving crop, and at date of writing, new racemes of flowers are opening (255 days from date of planting).

At first thought, this continuity of growth would appear to be an advantage. The writer himself took it to be so, and seeing the bed put forth new flowers, it was manured and, in due course, new crops of beans came on. But it is a question whether it is not the more profitable course, after the main crops have been taken, to root up the plants, and put the beds to some other cultivation which will get the benefit of the improved soil brought about by the bean cultivation: or again, if the crop is to be beans, whether it is not the better course to dig up the old vines, enfeebled by previous crops, and replant with fresh seed.

In both cases, a thorough tillage of the soil will be necessary, with an application of manure, and there will be no saving on that head, while the crops of the new planting will, I believe, be much greater than if the old plants are allowed to "carry on" as perennials.

There are moreover, other reasons which tend to militate against perennial cultivation of the Lima bean.

The Lima bean has the well deserved reputation of being a very robust plant, branching profusely, and carrying a very dense foliage. If left to grow as a perennial, the beds form a tangle of stems, of branches and leaves, old and new, which it is almost impossible to keep in trim, and if any insect pest or fungoid disease descends on the beds, it is very difficult to cope with. Should moreover, the weather be very wet, which was the case here, these pests take such a hold on the old plants, that on a field scale, many would be killed. It was possible, dealing with only one bed, to keep the disease, anthracnose, in check, but even then, it was only by dint of frequent sprayings that the crop could be saved, and that only partially.

Another effect of the prolonged stay of the plants in the ground, is that, unless the poles, on which the vines are trained, are of wood which resists the wet, they are liable to rot and break down after some months, and it is no easy matter to prop up again in anything like order, the resulting medley of broken sticks and tangled stems.

This last remark does not apply to the case of field cultivation as practiced in Burma where the plants are not grown on poles but left to trail on the ground.

Lastly, the crops fall off, on the old beds, and they are not equal to those obtained from newly planted beds.

Third Generation.

From selected seeds of the second generation accounted for in the preceding pages, which seeds were submitted to further selection after trial in pots, 15 beds were planted with 455 seeds. The planting, begun on 11th January, was finished on the 25th of the same month 1919. It was limited by want of suitable land.

Crops Obtained from 3rd Generation.

1st to 5th April	548	pods gave	968	perfect beans	weighing	22 oz.
7th to 9th ,,	958	,,	2114	,,	,,	48½ oz.
11th ,,	1173	,,	2740	,,	,,	67 oz.
Totals to date	2679	,,	5822	,,	,,	137½ oz.

These figures show, at a glance, a marked improvement on the previous crop and this is brought strongly in evidence if the results of the two crops are put side by side: the figures stand as follows:—

Number of pods.	Perfect beans Weight.	Imperfect beans Weight.	Uneatable Weight.
2nd Generation 11174	4294—269¾ oz.	5228—77¼ oz.	28½ oz.
3rd Generation 2679	5822—137½ oz.	None.	2¾ oz.

In the first crop, each pod contained only 1.3 of beans, whereas in the second crop each pod contains 2.1 beans.

The first crop had 5228 imperfect beans; imperfect in appearance, in shape and colour, defects which, while not rendering them uneatable, would certainly detract of their marketable value. The second crop, although it was examined with greater closeness than the previous one, had not one such bean.

Of beans uneatable, maggotty, etc., the first crop had 38½ ounces for a total weight of 337 ounces or 11 per cent. the second crop had 2.36 for a total weight of 137½ oz. or 1.70 per cent.

Again, if we compare the weights of the two crops we find:

2nd Generation	14522	beans weighing	337 oz.	or 2.32%	beans.
3rd „	5822	„	137½ oz.	„ 2.36%	„

The greatly improved quality of the beans of the latter generation is attributable to better weather conditions, secondly to absence, so far, of fungoid disease, and thirdly to more severe selection of the seeds which, one by one, underwent three sortings before sowing.

The Mature Bean.

The pod of the Lima bean, when approaching maturity, is, at first, of a bright yellow colour, which turns in one day or at the most in two, to a true khaki colour: at this stage, the beans are loose from the shell and, on shaking the pod, are heard to rattle inside. Then, is the time to pick them: if picking is delayed, dehiscence takes place and the beans may fall to the ground. The pods which, at maturity, are not of a true khaki colour, but which show streaks of brown or purple, or which are mottled green and brown, have almost invariably damaged beans, the stains being due to the decomposed state of the beans brought about by maggots or to the cancerous condition induced by *Colletotrichum lindemuthianum*.

The beans selected for seed should be pure white—opaque—not glossy but "mat" to use the French term. Any beans which, after keeping for a week, show a shrivelled skin or any discoloration whatever, or which take a semi-transparent hue, should be discarded: but such beans may be perfectly good to eat.

The beans selected for seed should be firm to the feel, and hard under the nail.

The diversity and irregularity of shape, and of size of the Lima beans has perhaps contributed, as much as anything else, to prevent their more general acceptance in Europe, for this uneven ness necessitates a rather troublesome sorting before marketing. For that reason, some care should be given to this matter of shape in the selection of the beans for seed, with a view to attain a type of true kidney-shape. The two predominating contours, I find, are the boomerang-shape, (but full on the inside) with a rather sharp apex—and the kidney-shape of the ordinary garden bean, but with the inside curve less pronounced.

The boomerang-shaped bean is almost always flat and large; the kidney-shaped is less large but it is rounder, plumper, fuller.

For that reason, given two beans of sound quality and of about the same weight, one of the boomerang-shape, the other of the kidney-shape, the writer would choose in preference, for sowing purposes, the latter one, even if somewhat smaller in size. Time will show whether the type breeds true.

The importance of a severe selection of seeds is very soon realised by planting this bean. From 60 per cent of germinations obtained in previous sowings, the latest sowings in the gardens commonly show from 90 per cent and upward of germinations.

Another very common feature in Lima beans are the striations converging from the rim to the hilum (eye).

These striations, much more marked on some beans than on others, are due to a tendency to reversion to the original red or purple coloured type. Seeds showing that character in a marked degree should be rejected for planting purposes, the purple coloured type containing, it is said, prussic acid.

If the beans are not destined to be planted, but merely for table use, their character may differ, in some cases, very widely, from the description just given. In the first place, the pods should be picked when they are of a light yellow colour, without waiting for the shell to turn to khaki colour. The beans themselves, instead of dead white, may be glossy, and the converging striations do not matter. Lastly, the shape is also of secondary importance although it affects the market value to some extent.

The Bulletin of the Imperial Institute (Vol. 15, No. 4) contains interesting reading on the subject of the Lima Bean or "Rangoon white bean." The following figures speak for themselves:

"Forms of *Phaseolus lunatus* are largely grown in Burma. "The two most common forms grown in Burma are the red-seeded "and the white-seeded kinds."

"In Burma, *Phaseolus lunatus*, is a favourite crop for field "cultivation, 240,000 acres being devoted to the white variety, "and 94,000 acres to the red variety in 1916-1917."

"The quantities and values of pulse, including peas, exported "overseas from the Province during 1916-1917 were: 1,439,000 "cwt. value £791,208."

"Of these quantities, 1,138,000 cwt. were exported to the "United Kingdom."

The large shipments to Peninsular India are not included in the above.

"Seeds are usually dropped into furrows in rows about 1 "to 1½ ft. apart: they are also sometimes broad-casted, mixed "with maize, and are covered with soil by harrowing. When sown "with maize, the stems of the maize plants serve as supports to "the trailing stems of the beans, but when sown alone, the stems "are allowed to trail over the ground. The crop generally takes "five months to mature."

The writer has tried experimentally the planting of Lima beans with maize; but the result was somewhat disastrous, both

the maize and the beans giving returns much below the average; but the chief objection to this mixed planting is that, in twining themselves round the maize stems, the bean stems strangle the maize cobs and arrest their development.

In other respects, also, the practice followed by the writer differed widely from the above.

First of all, the seeds were not sown broad-cast or dropped in furrows, but each bean was sown separately, the most advantageous distances being found to be 20 inches on rows one foot apart with 3 such rows per bed.

Secondly, the plants were not left to trail on the ground but were supported by poles, 4 poles for each 12 plants with transverse sticks on top. Planted on such lines as are here indicated, one acre of land affords room for 250 beds 30 feet long by 3½ feet wide with alleyways, each bed accommodating 45 plants in 3 rows of 15, at the distances specified above. Thus, one acre would accommodate about 11,000 plants, of which 10,000, under favourable conditions (well selected seeds and careful watching for pests) could be expected to reach maturity in three months, and to yield an average of two ounces of beans per plant, resulting in a crop of 1,250 pounds of beans.

It is impossible to draw up an estimate of the cost of a crop of beans to fit all conditions. But, given agricultural land under normal conditions, cleared of jungle and stumps, a land, say, of light secondary growth, which can be cleared and drained at small cost; a land, which can be got ready for the plow, or the changkol at a cost, say, of $20 per acre—then the expenditure could be figured as follows, for one acre:

Clearing and draining	$20.00
Labour; changkoling, raking and earthing up 1½ coolies for 3 months at $15	67.50
Seed beans, 16 pounds (selected) at $0.40	6.40
4,000 stakes at ½ cent	20.00
Fungicides and insecticides	10.00
Tools and appliances	8.00
Superintendence	5.00
Estimated expenditure	$136.90

If the plow is used instead of the changkol, the labour bill would be reduced by about $18.

The subsequent crops would cost less by about $50 but, if the soil is a poor one, manuring would have to be done at a cost of $25 to $30.

The planter would have the option, also, of leaving his crop on as a perennial, or of digging up and re-planting.

Good lallang land might very profitably be put under a bean crop, for it should be observed that by its heavy foliage, the bean supplies a dense cover and, during the 3 months which the crop demands, the lallang will be kept under.

Referring again to the above extract from the Bulletin of the Imperial Institute, it is there stated that the bean crop in Burma takes 5 months to mature.

As a matter of fact, with three successive crops, the writer has found that the crops mature in between 75 to 85 days and the pickings are heaviest between 90 and 100 days.

This is attributable, in the writer's opinion, to the fact that the plants were grown on stakes and not left to trail on the ground, as is the case in Burma. The beans grown on stakes are more open to the action of the air and sun, and the maturing of the pods is therefore much more rapid.

The results amply justify the extra expense of buying and putting up the stakes and, moreover, the beds are better accessible and, in case of outbreak of disease it is much easier to watch and to keep in check. The stakes themselves serve, to a certain extent, to guard the crop against fungus and insects by a smearing of them with strong Bordeaux mixture made adhesive by the addition of treacle, or sago.

Before closing these notes the writer would call attention to the fact that as shown by the crop records given above, three crops were obtained from the 31st July, 1918 to the 12th April, (date of writing) and that the fourth crop now partly planted or being planted, should, if all goes as in the past, be ready for harvesting by the 12th of July *i.e.* four crops in less than one year from the planting of the first crop.

Conclusions.

Whether due to absence of fungus, or to more severe selection of the seed used, or to better weather conditions, the improved quality of the Lima bean at present being harvested is manifest, and it bears proof that the bean has not suffered degeneration through change of climate and of habitat, and it may now be considered as definitely acclimatised.

E. Mathieu.

A PROGRESS REPORT ON THE CULTIVATION OF THE GREATER YAM, DIOSCOREA ALATA—IN THE BOTANIC GARDENS, SINGAPORE.

When reporting upon the cultivation of the Greater Yam in the Botanic Gardens, Singapore, in 1917, attention was called to the circumstance that the plants had been grown spaced 3 by 2 feet, and that in competition between each other at such a distance they had produced smaller tubers than in the earlier years. But space forbad again in 1918 that the distances between them should be increased, and consequently the yields of 1816, for instance, were not attained. Moreover there was not available quite so much manure; and the want of it has also had an effect. The 1918 crop was consequently less abundant than the crops of 1916 and 1917.

The number of races grown together on the ground was 93. The average yield was 3.77 lbs. (1712 grammes) per hill. In the following table the three years are compared:—

DIOSCOREA ALATA, THE GREATER YAM, RACES NOT REQUIRING EARTHING UP.

Year	1916.	1917.	1918.
No. of hills ...	582	520	299
Area occupied ...	11,330 sq. feet	3,120 sq. feet	1,794 sq. ft.
being			
an area ...	.260	.072	.041
of a hectaire ...	.105	.029	.017
Number of sets			
which grew ...	.559	424	273
which failed ...	23	84	26
Return	1,810,076 grs. 3,969 lbs.	961,117 grs. 2,118 lbs.	467,314 grs. 1,030 lbs.
Yield			
per acre ...	6.89 tons	13.16 tons	11.21 tons
per hectaire ...	17.239 kilos	33,142 kilos	27,489 kilos
Average yield per hill			
i. e. failures included	3.110 grammes 6.83 lbs.	1,849 grs. 4,07 lbs.	1,563 grs. 3.44 lbs.
Average yield per plant			
which grew	3,238 grammes 7.14 lbs.	2,267 grs. 4,99 lbs.	1,712 grs. 3.77 lbs.

It is considered that the time has come to discard a large number of the races which have been grown. It is scarcely necessary to give any account of them, for it would serve no useful purpose to do so: they are no longer of much interest. But it will be useful to record the reasons why others have been kept; and this will be done next.

Thirteen races have for the past three years of careful competitive trials, year by year, yielded more than the average. Eleven of these thirteen have been kept, the race No. 132 being discarded as too similar to the race 76 to be required, and the race 140 as too near to the race 128. The eleven retained are:—

Gardens No.	Origin.	Name under which received.	Figured.
22	Philippines.	Ubi, white, No. 1031	G.B.II No. 2 pl.i.
44	do.	Ubi, red, No. 1025	do. pl. ii
50	do.	White Bohol	Philip Agric. III p. 207, fig. 17
52	do.	———	———
64	do.	No. 1040	———
66	do.	Ubi, white, No. 1046	———
76	do.	Sinanto	G.B.I No. 11-12, pl 2, and II No. 2 pl. i an
100	Saigon	Khoai noc trang	———
128	Sylhet, India	No. 35630	———
170	Port Darwin, N. Australia	———	G.B.I. Nos. 11-12 pl. iv.
192	Gold Coast.	Eururuka nkakyi	G.B. II. No. 2 pl.i

These differ greatly among themselves, for instance:—

Magenta sap at all depths in races	Nos. 100, 128.
„ under the skin only	Nos. 22, 44, 140, 170, 192.
„ not present ..	Nos. 50, 52, 64, 66, 76.
Tubers branched distinctly in races	Nos. 44, 100, 170.
„ lobed rather than branched	Nos. 22, 50, 52, 64, 66, 192.
„ neither lobed nor branched	Nos. 76, 128.
„ flattened in races	Nos. 22, 44, 50, 52, 64, 66, 100, 170.
„ not flattened	Nos. 76, 128, 192.

It may be noted that the races with flattened tubers which yield heavily, are in all cases either lobed or branched:

And again it may be noted that none of the long deep going yams are among these races.

In foliage the above eleven varied greatly. No. 76 has a prickly stem.

No. 50 is a yam that has been cultivated for three seasons in the garden of Mr. G. P. Owen, in Singapore; and in the first of them he obtained a tuber weighing 26 lbs. He gave sets from it to Mr. W. E. Hooper who obtained a still larger tuber with a girth of 52 inches and also to Dr. W. F. Samuels who at Tanjong Rambutan, Perak, also got large tubers.

It is believed that the following promise a yield of more than the average, but did not give it because of some mischance: therefore they have been retained as if heavy yielders along with those enumerated above. The mischance is the case of No. 102 was due to the necessity of interrupting the growth of the tubers, in the first season of trial before their time was complete, in order to bring them into the same period of growth as the others; and in the case of No. 10 the mischance arose from thefts: in the case of all the other, the start in 1916 was with undersized sets.

Gardens No.	Origin.	Name under which received.	Figured.
10	Philippines	Tugui, finger shaped No. 1057	G.B. I. No. 9 fig. 2 on p. 299.
48	do.	No. 2712	—
60	do.	Kinampay ubi	—
102	Saigon	Khoai mo.	—
166	Fiji	No. 20705	—

The relation of these to the average (as 100) in the successive years was:

No.	1916.	1917.	1918.
10	183.23	97.13	22.14
48	57.78	84.61	125.00
60	160.41	88.97	165.36
102	39.41	69.17	158.12
166	14.89	80.90	104.21

These five, like the eleven proved heavy yielders enumerated above, vary greatly among themselves. Two have magenta sap at all depths (Nos. 10 and 60), two have it under the skin only (Nos. 102 and 166); while No. 48 is without it. One of them (No. 60) is branched, the others being for the most part neither branched nor lobed.

So far, then, the total number of races, out of the 93 grown in 1918, which have been retained for further cultivation, upon their yield, is sixteen. Selection beyond this has been done upon other characters. In the first place it has been deemed well to keep a few of the very deep going races, because they appear to be among the most excellent for the table; it seems that the cultivators find the compensation for the labour of digging them, in the eating of them. Six have been retained, being:—

Gardens No.	Origin.	Name under received which	Figured.
30	Philippines	Ubag No. 960	G.B. I fig. 12 on p. 301
54	do.	No. 1044	———
68	do.	No. 1692	G.B. I Nos. 11-12 plate ii
108	Fiji	No. 20693	———
118	do.	No. 20710	G. B. vol. I Nos. 11-12 Plate i
186	Assam, India	No. 35575	do.

Nos. 30 and 68 give tubers among the longest which have been cultivated: both appear to be very good table yams, and both have a tendency to produce twin tubers. Nos. 108 and 118 give tubers somewhat more clavate, No. 118 having magenta sap, but not so No. 108. No. 118 is certainly a good table yam. Both, and also No. 54 have very delicate skins, which bruise easily. The shape of the tuber of No. 54 is clumsy and so also is that of No. 186: and both have been retained with some hesitation.

It is well known that, for instance, there is no sale in many markets for oversized lemons. So too many markets take up small neat yams better than large yams: and with the intention of trying to meet such a case it had seemed well to retain two races of the Greater Yam which are noteworthy for the smallness, and neatness of their tubers. They are:—

Gardens No.	Origin.	Name under which received.	Figured.
6	Singapore	Ubi merah	G.B. I No. 11-12 plate iii
70	Careline islands	No. 3793	do. plate ii

They are very unlike each other, and indeed have nothing in common except shape. The ubi merah is well established in the Malay Peninsula, and can easily be got in the Singapore markets. Chinamen grow it about Klang: and it has been seen on sale as far away as Rangoon, near which assuredly it is cultivated. It has an extremely delicate skin which is always bruised before it reaches the market and then the intensely coloured sap below it is very noticeable. Possibly the delicacy of its surface accounts for the circumstance that in 1916 it was badly attacked by white ants in the yam beds in the Botanic Gardens. So far the impression is that it is not a really good table yam.

No. 70 on the other hand has a firm surface, and keeps well in store. It is altogether without magenta sap, and seems to be a good table yam. In foliage it is quite unlike No. 6.

Five lobulate yams have been kept in addition to the heavy yielding races of that class,—Nos. 22, 50, 52, 64, 66 and 192, also one branched yam in addition to the heavy yielding Nos. 44, 100 and 170. These six are, No. 98 being the branched yam:—

Gardens No	Origin.	Name under which received.	Figured.
40	Philippines	Ubi from La Union, No. 943	—
56	do.	Dinogo, No 965	—
62	do.	Ubi long, No. 1023	—
78	do.	Ubi, No 938	G.B. II Nos. 2 plate iii
94	Guam	—	—
98	Saigon	Khoai Siam	G.B. I Nos. 11-12, plate iv.

Nos. 40 and 62 yielded more than the average in 1916 and 1917, but less than the average in 1918:

Nos. 78 and 98 yielded more than the average in 1916, but not afterwards. Because they seem to have good keeping qualities they have been retained for further cultivation, and especially to observe their behaviour comparatively in store. No. 56 also appears to have keeping qualities; but its yield has never yet exceeded the average yield. No. 94 has been kept for a little further study as the best in yield of the yams received from Guam island.

Finally as not yet studied adequately the following have been kept:—

Gardens No.	Origin.	Name under which received.	Figured none
350	S. Nigeria	Ewura	
366	Gold Coast	—	
368	do.	—	
388 †	Nigeria	Adjugo kwami	
390 †	do.	do.	
406	Philippines	Found mixed with No.60	
408 †	Saigon	Selected from Khoai Siam No. 98 in 1917	
410	Philippines	Selected from No. 52 in 1917	
436 *	Papua	Makoda (*a*)	
438 *	do.	Makoda (*b*)	
440 *	do.	Moiva	
444	Klang, Selangor	—	
448	do.	—	

Those marked with an asterisk above are being grown apart from the rest, for it has not been possible to bring them into the same series with the main crop, as the season at which they were received and planted in no way corresponded with the seasons kept by the main crop. They are said to be from wild plants. Those marked with a dagger are also being grown apart, as for various reasons they were planted two months earlier than the main crop.

Upgrowing Yams. The races of the upgrowing yams are few; and five are being retained in cultivation. It is believed that the Gardens numbers 38 and 72 scarcely differ; and of them No. 72 is being kept. Both yield more than the Nos. 28, 32 and 34. Number 28 yields the least of all five; and it is transitional towards the branched yams of the normal type. Number 32 and 34 are very similar to each other, the second however yielding rather more than the former.

All upgrowing yams appear to be good table yams; and all have magenta sap in the tissues.

Gardens No.	Origin.	Name under which received.	Figured
28	Pilippines	Tumuktoh, No. 1095	G.B. I No. 9 fig. 1 on p 301 and Nos. 11-12 pl. V. & II on i pl. ii
32	do.	Tinugue, No. 956	G.B. I No. 9 fig. 3 on p. 301
34	do.	Ballolong, No. 943	G.B. I No. 9 fig. 4 on p. 301.
72	do.	Sinaway pulo, No. 955	G.B. I Nos. 11-12 pl. vi & II No. 2 pl. iv.

I. H. Burkill.

IT NEEDS WANT TO MAKE PEOPLE CHANGE THEIR FOOD-HABITS.

It needs want to make people change their food-habits; so intensely conservative are we in such matters, with some reason, but also with all the prejudice that we can let play. The following paragraphs from the *Gardeners' Chronicle* of February 3rd, 1917, p. 53, on the passing away of a now forgotten prejudice against the potato, are quoted in illustration, and as being appropriate to the present time when the Malay Peninsula is faced with a shortage of rice which must compel a large part of the population to eat something unusual; and that they will resist doing. This is what is written in the *Gardeners' Chronicle*.

"Raleigh we are told at school, introduced the Potato from Carolina: but Raleigh never was in Carolina, nor does the Potato grow wild there, being a native of Peru where it was found by Pietro Cieza de Leon about 1532. This Spanish traveller followed Pizarro, whose conquest of Peru thus directly led to the introduction of the Potato into Europe.† Its welcome in Spain was not warm; for long it was but a curiosity; and it is said, with what truth we dare not say, that the Church frowned upon it seeing in it a competitor with the titheable wheat. In Italy its reception was hardly less cold; and as a food plant its spread on the Continent was everywhere slow.

Its introduction into Ireland is said by many writers to be due to Hawkins,* and if this be established, it seems probable that it was seized on one of his Spanish prizes. It soon became widely grown there, and thence spread to Lancashire, the first part of England to undertake its culture upon a large scale.

† The potato of Falstaff, it should be said, refers to a different plant altogether, a member of the Convolvulus family, whose edible tubers were grown and used when candied as a sweetmeat.

* John Hawkins, Elizabethan navigator, 1253—1595, born in the year of the discovery of the potato by Cieza de Leon.

In England it did not lack supporters, and in 1663† the Royal Society listened to a Mr. Buckland, who spoke long and warmly in its praises. How far this championship succeeded is doubtful. One witness tells us it was common in England in 1698, but a dozen contemporaries give him the lie." If I can't get bread, wrote Richardson in *Pamela* in the year 1740, I will live like a bird in winter upon hips and haws, and at other times upon pignuts and potatoes. The coupling of the potato with so mean a weed as the pignut ranks it very low, while admitting it among familiar country objects. "The general trend of evidence is that the Potato did not come into anything like general use until the distressful years that followed the victory of Waterloo.

Even then it did not lack detractors. Cobbett thundered against the "infamous vegetable" which with the use of tea would reduce the sturdy English labourer to the level of the Irish peasant. The Times in 1829 considered it as "a fit esculent to lower the food of the opulent" but its use among the working classes would lower them to "a nation of miserable turbulent drunkards." In France it was considered "le plus mauvais de tous les légumes dans l'opinion générale. Cependant le peuple qui est la partie la plus nombreuse de l'humanité s'en nourrit." This was written in 1779.

Parmentier,‡ whose name still figures on our menus when potato-soup requires disguising, succeeded in introducing it to higher circles, and even persuaded Louis XVI to wear its flower in his buttonhole.

In Scotland the dearth of 1740 led to its introduction, and here again it met with the usual opposition. "Tatties! tatties!" said one old native, "I ne'er supped on them a' my days, and and 170. These six are, No. 95 being the branched yam:—
winna the nicht." The more philosophical argued that potatoes were not mentioned in the Bible. However the tatties made themselves at home, and have kept many a scotchman from treading the broad road that leads to England.

Potatoes are now a habit." The potato plant has won through; and its cultivation has received not a little further stimulation in the calamity of the Great War. Its history preaches the fact that our food prejudices are enormous, and hard to break.

For some years an attempt has been made from the Botanic Gardens to popularise the use of tubers which are capable of being local substitutes for the potato, with scant success among those who can afford to have prejudices; but the repeated thefts from the crop show that the needy, who cannot afford to have many, will eat them. Unfortunately the needy being unable to propagate them, are merely destructive.

These tubers are certain yams, yautias, and what the French call crosnes,—all easy of digestion if properly cooked.

I. H. Burkill.

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† or close upon 100 years from its introduction into Ireland.

‡ Antoine Auguste Parmentier, 1737—1813.

HOW TO PREPARE MAIZE FOR BREAD OR PUDDING.

Amongst suggestions for the preparation of locally-grown foodstuffs in a circular issued by the Acting Director of Agriculture, Trinidad, the following is worth drawing attention to: "To prepare Indian corn to get best results for several kinds of bread or pudding, it is best to take off the skin. This is done as follows: To 2 lbs. corn allow 2 lbs. sifted ashes and about one gallon water, and boil for one hour. It is sufficiently boiled when a grain squeezed between the fingers pulps out of the skin. Place the pot from the fire under a stream of cold water, and rub the corn with the hands when the skin will easily separate, and the overflow of water will carry away all the ashes and the skin. When clean, drain off the water, add about 1½ gallon clean water, and reboil for about fifteen minutes. The grains must then be crushed into a fine paste, either in a mill or a meat mincer." (Trop. Agriculturist, Ceylon, March, 1919, lii, p. 125).

"PLANTS and SEEDS INWARDS"

of the Botanic Gardens, Singapore.

The following table has a small historic interest; it is of the number of entries year by year in the "Plants inwards" books of the Botanic Gardens; each entry being the name of a plant indicating a receipt,—it may have been in the form of seed or of a plant or plants alive. From the figures we find that Murton upon his coming ran up the number of importations to 673 to fall again, but to be raised to 863 in 1879 as the result of the exchanges for orchids which he established. Cantley in his second year imported 718 and in 1887—his last—1490; Mr. Ridley's receipts average about five hundred annually.

Years.										
1875—1880	—	—	—	—	166	673	197	250	863	89
1881—1890	336	718	477	297	449	689	1490	488	897	1127
1891—1900	498	503	777	630	305	383	404	449	487	336
1901—1910	195	429	436	629	552	545	441	576	832	587
1911—1918	522	621	734	424	407	964	840	1052	—	—

RAINFALL at the Director's house, Botanic Gardens, Singapore during the first half of the year 1918, in inches.

Readings taken always at 8 a.m. and credited to the date in which the twenty-four hours begin

Date.	Jan.	Feb.	March.	April.	May.	June.
1	.01	nil.	nil.	nil.	2.08	nil.
2	.02	.09	nil.	nil.	.05	.01
3	.08	.03	nil.	1.78	nil.	nil.
4	.18	.02	nil.	.29	nil.	nil.
5	.49	.08	trace.	.66	.08	.84
6	.22	trace.	nil.	1.30	.01	.10
7	.27	.39	.21	.04	.05	1.71
8	.59	nil.	.03	1.47	1.05	.79
9	.48	trace.	.73	.05	.98	.13
10	4.62	nil.	.07	nil.	.18	.13
11	5.42	nil.	.23	nil.	.10	.07
12	6.07	nil.	.68	.09	.73	.53
13	.03	.09	.11	.02	.32	.01
14	.29	1.03	.06	1.44	nil.	.19
15	.77	.13	nil.	.02	nil.	.27
16	nil.	.12	nil.	nil.	.30	.02
17	.14	.08	nil.	.52	trace.	nil.
18	.12	nil.	nil.	nil.	.05	.24
19	.05	nil.	nil.	nil.	.20	.02
20	1.33	nil.	nil.	.02	.01	nil.
21	.80	nil	nil.	1.04	.59	2.02
22	.01	nil.	nil.	.03	.03	.08
23	.08	trace.	nil.	.45	1.19	trace.
24	.29	.01	nil.	trace.	.17	2.48
25	nil.	nil.	trace.	.90	nil.	.02
26	nil.	nil.	nil.	trace.	nil.	1.99
27	nil.	nil.	nil.	.15	nil.	nil.
28	nil.	nil.	nil.	.04	nil.	nil.
29	.01		nil.	.43	nil.	nil.
30	trace.		trace.	nil.	.02	.04
31	nil.		.04		.02	
	22.37	2.07	2.16	10.74	8.21	11.69

RAINFALL at the Director's house, Botanic Gardens Singapore during the second half of the year 1918, in inches.

Readings taken always at 8 a.m. and credited to the date in which the twenty-four hours begin.

Date.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.15	.01	.11	nil.	.06	1.88
2	.02	.01	nil.	nil.	.50	.02
3	.17	.11	nil.	nil.	.01	.18
4	.09	.03	trace.	nil.	.02	.02
5	nil.	nil.	.11	nil.	trace.	.02
6	nil.	nil.	trace.	nil.	.01	nil.
7	nil.	nil.	2.21	.02	nil.	.01
8	nil.	.23	2.18	.01	.76	2.18
9	.03	.04	.01	.01	.03	.01
10	.61	nil.	nil.	nil.	nil.	.03
11	.02	.46	.05	.46	nil.	.01
12	nil.	.07	.16	.01	.14	1.27
13	nil.	.02	trace.	nil.	.02	trace.
14	.02	nil.	32	nil.	nil.	nil.
15	1.21	1.07	.02	.79	.70	1.14
16	nil.	.46	1.62	.06	.07	.29
17	nil.	nil.	.02	nil.	.08	nil.
18	nil.	nil.	1.30	trace.	nil	nil.
19	nil.	nil.	nil.	.38	.02	.04
20	.16	nil.	nil.	nil.	.20	nil.
21	.12	nil.	.15	nil.	1.23	nil.
22	nil.	nil.	.06	nil.	.01	.41
23	nil.	nil.	nil.	nil.	.07	.15
24	nil.	2.90	.34	.14	.02	nil.
25	.01	.01	.01	.02	.29	.13
26	nil.	nil.	nil.	.18	.04	.17
27	nil.	nil.	nil.	1.72	.31	.91
28	trace.	.35	.21	.02	.80	.03
29	.91	nil.	nil.	1.23	.39	.03
30	.67	nil.	nil.	1.33	.60	.19
31	.10	trace.		.01		nil.
	5 29	5.77	8.88	6.39	6.38	9.12

RAINFALL at the head of the Waterfall Gardens, Penang during the first half of the year 1918, in inches.

Reading taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of George Town, Penang.

January.		February.		March.		April.		May.		June.	
Date.	Inches.	Date.	Inches.	Date.	Inches.	Date.	Inches.	Date.	Inches.	Date.	Inches.
1	...	1	...	1	...	1	1.90	1	.10	1	1.36
2	...	2	...	2	1.41	2	.15	2	...	2	.04
3	...	3	...	3	...	3	...	3	.37	3	.87
4	...	4	...	4	...	4	1.80	4	.10	4	.19
5	.28	5	...	5	...	5	...	5	1.74	5	.20
6	.08	6	...	6	...	6	1.07	6	.03	6	2.18
7	.08	7	...	7	...	7	.16	7	...	7	.38
8	...	8	.12	8	...	8	...	8	...	8	...
9	...	9	...	9	...	9	..	9	1.24	9	...
10	...	10	...	10	...	10	.21	10	.17	10	...
11	...	11	...	11	...	11	...	11	...	11	...
12	.32	12	..	12	...	12	.24	12	...	12	...
13	.32	13	...	13	...	13	.07	13	.08	13	.05
14	.58	14	...	14	...	14	.19	14	1 53	14	.03
15	.24	15	...	15	...	15	2.75	15	.17	15	.07
16	...	16	...	16	...	16	...	16	1.92	16	...
17	...	17	...	17	...	17	.20	17	1.60	17	.
18	.03	18	...	18	...	18	...	18	.10	18	1.58
19	...	19	...	19	...	19	1.10	19	...	19	.43
20	...	20	...	20	...	20	.14	20	...	20	...
21	...	21		21	..	21	.07	21	.16	21	.06
22	...	22	.	22	.10	22	.49	22	.05	22	...
23	...	23	...	23	05	23	.36	23	...	23	1.92
24	...	24	...	24	...	24	.12	24	...	24	2.15
25	...	25	...	25	...	25	1.05	25	...	25	2.25
26	...	26	...	26	...	26	...	26	...	26	...
27	...	27	...	27	...	27	1.42	27	...	27	...
28	.72	28	...	28	...	28	.09	28	...	28	.22
29	..			29	.08	29	...	29	.48	29	...
30	...			30	1.12	30	1.22	30	.37	30	93
31	...			31	...			31	...		
	2.65		.12		2.76		14.80		10.21		14.91

RAINFALL at the head of the Waterfall Gardens, Penang during the second half of the year 1918, in inches.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of George town, Penang.

July.		August.		September.		October.		November.		December.	
Date.	Inches.	Date.	Inches.	Date.	Inches.	Date.	Inches.	Date.	Inches.	Date.	Inches.
1	.28	1	...	1	...	1	...	1	.12	1	.10
2	...	2	...	2	...	2	.03	2	.10	2	.19
3	...	3	...	3	...	3	1.55	3	1.08	3	.95
4	...	4	...	4	.68	4	2.65	4	.39	4	.05
5	..	5	.24	5	2.42	5	.17	5	.19	5	.16
6	.04	6	.02	6	.14	6	2.30	6	.19	6	...
7	...	7	.62	7	.60	7	.11	7	.25	7	.03*
8	...	8	...	8	...	8	.40	8	.15	8	2.03
9	...	9	.23	9	.72	9	2.08	9	.79	9	..
10	...	10	.09	10	.24	10	.69	10	1.31	10	.05
11	...	11	.26	11	1 05	11	.62	11	...	11	...
12	.33	12	,09	12	.03	12	30	12	...	12	.66
13	.08	13	.72	13	.06	13	...	13	1.53	13	.21
14	90	14	.32	14	.03	14	.11	14	.72	14	...
15	.15	15	.87	15	...	15	.42	15	1.45	15	...
16	.13	16	...	16	..	16	.75	16	.82	16	...
17	.40	17	...	17	1.76	17	.37	17	.12	17	..
18	.44	18	.26	18	87	18	.53	18	...	18	.16
19	.83	19	...	19	...	19	.13	19	.22	19	1 30
20	.38	20	...	20	3.27	20	58	20	1 35	20	.33
21	.07	21	...	21	1 47	21	.26	21	1.18	21	.10
22	...	22	.84	22	.72	22	...	22	...	22	.70
23	...	23	.39	23	1.30	23	.44	23	. 2	23	.09
24	...	24	...	24	.47	24	.24	24	.03	24	.29
25	...	25	1.22	25	.75	25	.13	25	.45	25	...
26	1 25	26	1.64	26	.54	26	.29	26	.16	26	.06
27	..	27	.32	27	.24	27	.24	27	...	27	1 03
28	...	28	...	28	..	28	.03	28	...	28	...
29	.19	29	...	29	..	29	03	29	...	29	...
30	.03	30	08	30	.06	30	.12	30	1.85	30	...
31	.34	31	.32			31	08			31	.
	5.84		8.53		17.42		15 65		14.57		8.49

*More than 8 inches probably fell and by reason of some accident went unrecorded.

SUMMARY OF RAINFALL.

	SINGAPORE.			PENANG.		
	No. of rainy days.	Amount of rain in inches.	Longest spell without rain.	No. of rainy days.	Amount of rain in inches.	Longest Spell without rain.
January - -	25	22.37	4	9	2.65	9
February -	13	2.07	6	1	0.12	21
March - -	12	2.16	10	5	2.76	19
April - -	22	10.74	2	21	14.80	2
May - -	22	8.21	5	17	10.21	6
June - -	22	11.69	3	18	14.91	5
July - -	16	5 29	4	16	5.84	5
August - -	15	5.77	7	18	8.53	4
September -	20	8.88	2	21	17.42	3
October - -	17	6.39	8	28	15.65	1
November -	25	6 38	2	23	14.57	3
December -	23	9.12	2	19	8.49	4
Total ...	232	99.07	——	196	115.95	——

Greatest amount in 24 hours ...	6.07	Uncertain, possibly 8.00 but recorded	3.27
,, ,, 48 ,, ...	11.49		4.74
,, ,, 72 ,, ...	16.11		5.46
Excessively rainy periods, more than 5.00 having fallen in 72 hours (January)	1	(Sept., Oct., Dec.)	3
No. of days when the condition on persisted.	3		3
Periods of comparative drought less than 0 02 having fallen in 120 hours (January, February, March, May, August, October)	7	(Jan. 2, Feb , Mch. 2, May, June., July.)	9
Number of days when the condition existed.	38		45

The

Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. II Issued September 12th, 1919 No. 5.

CONTENTS.

To be purchased at the Botanic Gardens, Singapore ; or from Messrs. Kelly and Walsh Ltd., No. 32, Raffles Place, Singapore.

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DEPARTMENTAL NOTICES.

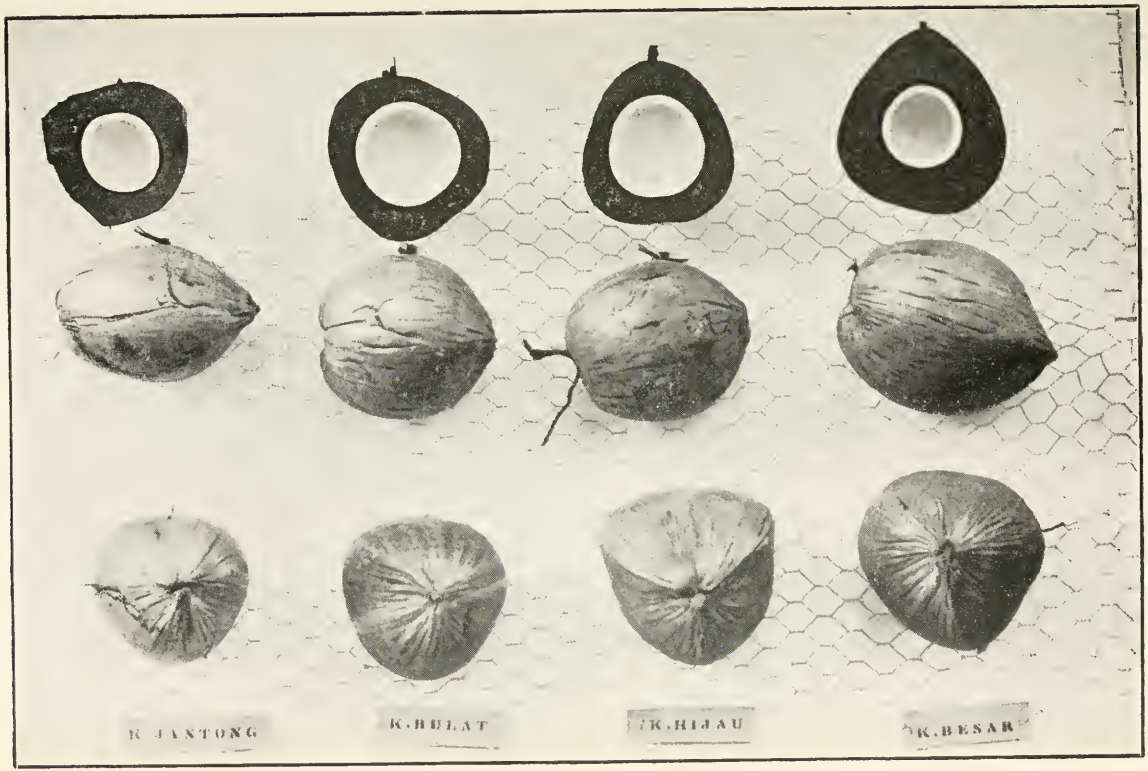
A list of plants which can be purchased at the Botanic Gardens, in Singapore and in Penang, can be had upon application. The same list appears at intervals in the Government Gazette.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for every volume of twelve numbers, post free:—

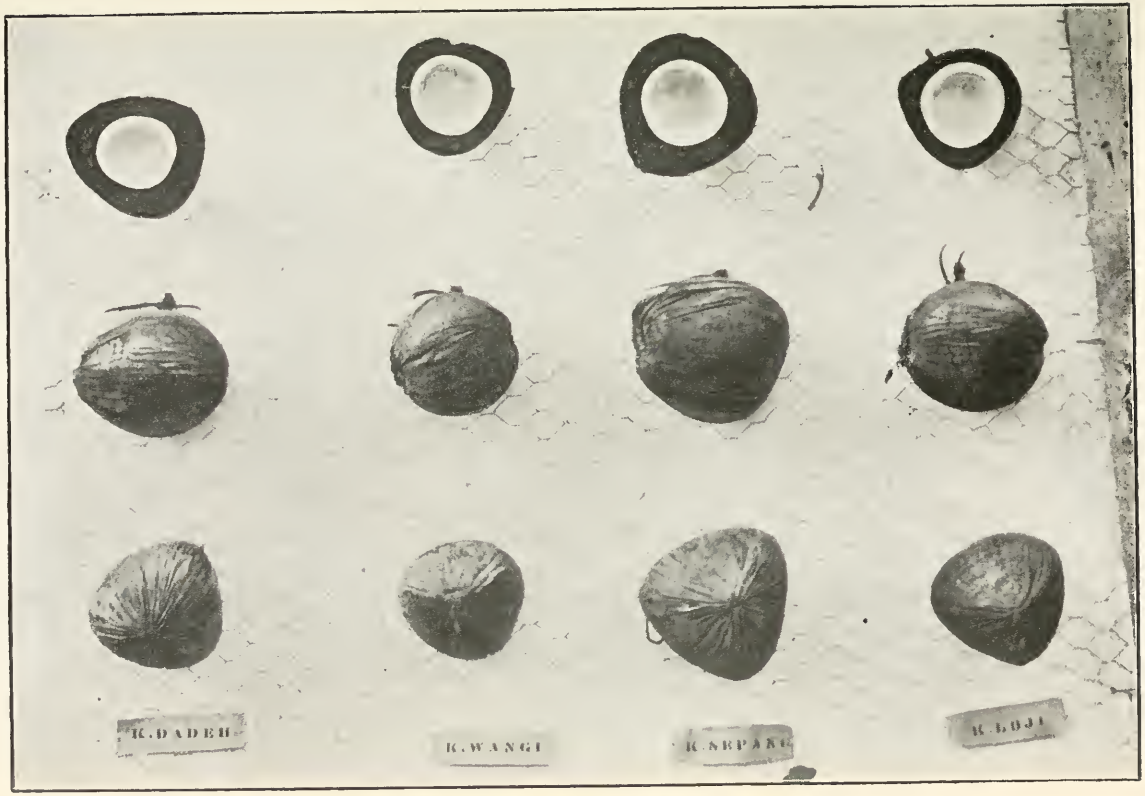
Five dollars in the Straits and Federated Malay States.

Nine and a half rupees in India and Ceylon.

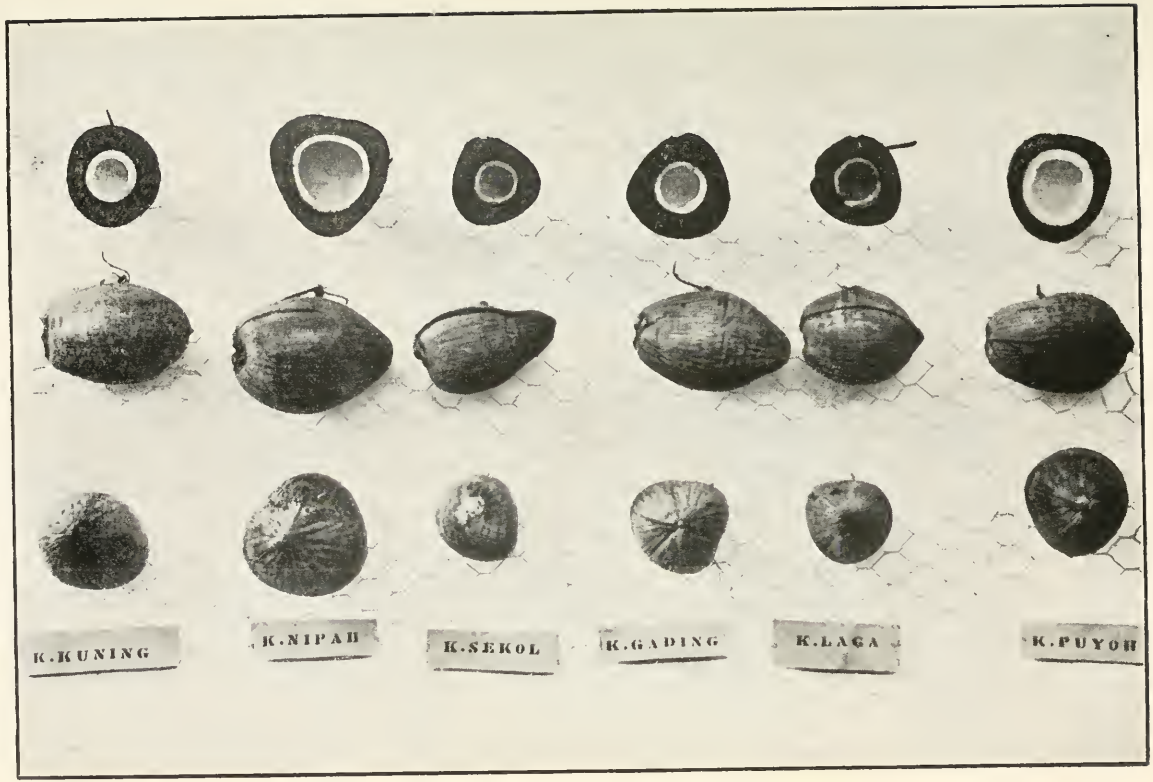
Thirteen shillings in Europe.



Races of the Coconut palms grown in Singapore.



Races of the Coconut palms grown in Singapore.



Races of the Coconut palms grown in Singapore.

THE

GARDENS' BULLETIN,

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RACES OF THE COCONUT PALM.

In a recent number of the *Philippine Agricultural Review*, Vol. XI., 1918, page 13, Mr. P. J. Wester has remarked that existing literature seems to indicate the Coconut palm to have "probably not more than thirty five distinct varieties" and he adds that such is a remarkably small number considering the antiqnity of its cultivation and its wide distribution. Whether this be right or not, investigation only can prove. In Singapore Island fourteen exist, twelve differing from each other in the nut, and two differing also in growth. With this issue of the Gardens' Bulletin figures are given of the nuts of these Singapore races.

The commonest races in the island are known as Klapa jantong, Klapa bulat, Klapa besar, Klapa sepang and Klapa laga; from the first four most of the Singapore copra is made; but Klapa laga is too small for copra and is sold cheaply at about one cent a nut for ordinary domestic use.

The two dwarf coconuts, Klapa puyoh which is green, and Klapa gading which is yellow, are now becoming much more common than they were. This is on account of a preference due to their very early yield: but Klapa gading is still rare enough for seed-nuts to fetch 30-40 cents each.

Klapa nipah seems to promise big yields, but is not common. It and Klapa hijau, which is also rare, are good nuts for copra making.

The others have special uses. Klapa dadeh produces little detached granules of endosperm in the milk—not by any means in every nut but in 4 or 5 per cent, and is eaten with sugar as a delicacy. Klapa kuning has more sugar in the milk than most other coconuts and for that reason is reserved for eating. The nuts of the Klapa loji are eaten young. Those of Klapa wangi are reserved for making medicines as the "meat" has a pleasant scent suggesting pandan.

The shell of Klapa sekol is fancied for cups.

AHMED BIN HAJI OMAR.

ECHINODIA THEOBROMAE, Pat.

(*Translated from the French.*)

This fungus was collected in the Botanical Gardens at Singapore by Professor Baker on dead branches of *Theobroma Cacao*—the Cocoa tree (No. 5410).

It has the appearance of a small cushion, convex, orbicular, about two centimetres in diameter, eight millimetres thick in the centre,, with thin margins applied to the surface towards the base but free and a trifle raised forward, creamy white, bristling with little stilbiform points which are cream coloured or reddish and are scattered regularly over the whole surface.

The body in general of the little cushion or stroma is in consistence coriaceous to corky, and its colour within is a pale ochre increasing in intensity towards the point of attachment. It is made up of tough slender hyphae (4-6 microm.) with thick walls and few septa with the buckles little marked, interlaced into a fairly lax pseudo-tissue, which can be compressed, with angular mesh of 20-30 microm. diameter.

The points which cover the whole surface of the plant are evenly cylindric, slightly enlarged clavately upwards, obtuse at the top, sometimes enlarged at the base, ordinarily simple though rarely provided with one or two lateral outgrowths. They are independent of each other or else united in pairs or threes; their height is about one millimetre, and their thickness as they emerge from the stroma 200-300 microm. The thin marginal part appears fimbriated by quite a series of these points.

Each point taken by itself possesses the constitution of a *Stilbum*, that is to say it consists of an axis of thin filaments very compact, which taking origin at the place where the fungus is affixed upon its support runs right through the stroma, and ends beyond in a little free column covered with fructifications.

The colour of this axis is reddish ochre, and to follow it through the paler general mass is easy.

The hyphae of the periphery of each "Stilbum" diverge towards the exterior and end each in a wreath of conidia.

These are colourless, smooth, ovoid, narrowed to both ends, straight or a little curved at the base, measuring 9-12 × 4-6 microm.

The method of the development of these conidia is very peculiar. The oldest is the lowest. That which follows it appears not at the extremity of it, but near to its summit a little to one side; the third is mounted upon the side of the second and so on with all that follow giving rise to a sympodial wreath of 6 to 10 conidia.

The hyphae themselves of the axis of the "Stilbum" measuring 3 to 5 microm. are septate here and there, and each of their joints arises from that which has gone before on the side near the apex.

As yet we do not know the perfect form of this fungus, but if we take into consideration the general appearance of the plant,—its consistency, the presence of buckles in the filaments,—the supposition that it is derived from a Polypore near to *Coriolus* has nothing improbable in it.

This genus *Echinodia* could be characterised by saying that it is a compound *Stilbum* in which the conidia are produced sympodially.

M. N. Patouillard in the Bulletin de la Societe Mycologique de France, XXXIV, 2nd Fasicle.

LIGHTNING AND HEVEA.

Dr. A. A. L. Rutgers in the *Archief voor de Rubbercultuur in Nederlandsch-Indie*, III., 1919, No. 4, p. 163, ascribes certain cases of bleeding of rubber trees to lightning. His article contains beautiful clear figures illustrating the cases.

Similar damage to a group of trees was observed a few years ago by Mr. F. G. Millar on the Tangga Batu Estate, Malacca, and mycologically examined for me by Professor C. F. Baker, and Mr. R. M. Richards who found no fungal cause. The damage had been done two years before the bleeding began to be noticed; and the bleeding was found to result from the stretching and slight rupturing of the bark by reason of the growth of the wood being excessive over the callus and included rubber of small old wounds. Dr. Rutgers remarks that in certain spots trees may suffer from more than one storm: and if the explanation is correct, as it well may be, one of the damaged trees on the Tangga Batu Estate had been peppered by lightning discharge twice.

I. H. Burkill.

THE COMPOSITION OF A PIECE OF WELL-DRAINED SINGAPORE SECONDARY JUNGLE THIRTY YEARS OLD.

This little study of secondary jungle is a mite only towards the comprehension of the great complex "rain forest" of Malaya. It is an attempt to make use of the clearing of a small area, with a more or less known history, where nature had been for thirty years at her work of reconstruction. Many hundreds of such studies are needed, and the interest in them will grow as the problems to be solved become more and more apparent upon comparison of results. At present such comparison is impossible: for this study is but a beginning.

The study was undertaken in December last in the following way. The area to be cleared was in all about two acres, but to sort and determine all the plants over it was impossible: this being

so, a surface of about one third of an acre in two parts was reserved for analysis, the limits being marked by stretched wires: over the rest an attempt was made to determine all the species established, but not to ascertain their relative abundance. The larger secondary trees, as they were felled, were all measured that the depth of the vegetation might be determined. The work was done under the supervision of a Foreman-Gardener who preserved twigs of every plant for determination. When his men came to the area reserved for special study, they proceeded first to the removal of the smaller undergrowth, sorting the plants into species, and counting the number of each; then of the larger undergrowth in the same way; and lastly of the trees, which in their turn were measured. The seedlings and small plants upon the ground could not be counted as they suffered a good deal from trampling; their numbers consequently were estimated. As will be seen later the result showed nearly 100,000 plants to the acre.

As far as can be ascertained the history of the jungle had been as follows. Not less than fifty years ago forest covered the ground; it was felled with the exception of one tree of *Shorea macroptera*, Dyer, one tree of *Alstonia angustiloba*, Miq., perhaps a couple of trees of *Campnosperma auriculata*, Hook. f., and possibly other trees. Then there followed a planting of *Albizzia moluccana*, Miq., with various fruit trees, such as the Durian (*Durio zibethinus*, DC.) the Mangosteen (*Garcinia Mangostana*, Linn.), probably the Rukam (*Flacourtia Rukam*, Zoll.), and one if not more exotic trees. This may have been fifty years ago. Next thirty five years ago, beds of Gardenias, Ixoras, Hippeastrums, Eucharis, etc., were made over a part of the ground; and kept up for a few years. But secondary jungle was allowed to come in which therefore was about thirty years old, at the clearing in 1918.

The hill slope faces north west, and is well drained.

Naturally the jungle bore some impress of the former cultivation. Most noticeable of all were the big trees of *Albizzia moluccana*, towering above all the others, except the *Shorea* and the *Alstonia*. These Albizzias were in the habit of fruiting freely and dropping innumerable seeds into the bottom of the jungle; but the seedlings of the seeds which germinated could not grow under the shade, so that the *Albizzia* showed no regeneration. The *Shorea*, too, fruited freely and its seed germinated; but no seedlings were found of any size, showing that the conditions were equally unfavourable to it. It is thought that the Albizzia and Shorea failed from quite different causes, the Albizzia seedlings from want of light, the Shorea seedlings from want of deep forest soil and moisture.

An old Mangosteen tree stood dead in the jungle, its foliage space having been closed up. Elsewhere a little circle thirty-six feet across showed where another tree had been until recently. The ground of this circle was occupied by the grass and sedges, *Ischaemum muticum*, Linn., *Scleria sumatrensis*, Retz., and *Scleria hebecarpa*, Nees, into which *Hedyotis congesta*, R. Br., had intruded, and where there were many quite young seedlings of *Anisophyllea disticha*, Hook., and *Macaranga triloba*, Muell. At

a small distance further on stood, newly dead, an exotic Leguminosa (Gardens' No. 1404) which has never been determined. The Gardenias and Ixoras had altogether gone; but *Hippeastrum* had persisted at the foot of some big Albizzia; and *Tacca cristata*, Jack, was in plenty perhaps as a relic from cultivation.

The jungle itself was about forty-five to fifty feet from the upper leaves to the soil, as is shown by the measurements of a number of the larger secondary trees composing it, (vide the annexed table, where they are in the order of their height with their circumference in a second column). The size of the largest tree of each species in the table can be found easily, because the authority for the scientific name is appended only where the species first finds mention. Into the trees climbed a few woody climbers, *e.g.*

Tetracera assa, DC.
Artabotrys suaveolens, Blume.?
Unona discolor, Vahl.
Caesalpinia Nuga, Ait.
Uncaria pteropoda, Miq.
Smilax barbata, Wall.
Smilax megacarpa, A. DC.
Calamus.

A limited number of epiphytes were present, *e.g.*

Psychotria ovoidea, Wall.
Aeriopsis javanica, Reinw.
Pleopeltis sinuosa, Wall.
Drymoglossum piloselloides, Presl.
Acrostichum scandens, Bory.

most of them growing in the forks of the branches of trees of *Arthrophyllum*, but a few on *Adinandra dumosa* and *Fagraea fragrans*. *Pleopeltis sinuosa* was tenanted by ants.

Herbs under the trees were few. *Tacca cristata*, Jack, was the commonest, and, besides *Hippeastrum* in one spot and the grasses and sedges of another spot as given above, almost the only herbaceous plant.

A List of the Trees above 30 Feet in Height, excluding the few large trees which were not felled.

Height of tree.	Girth at breast height.	Name.
97 feet.	106 ins.	*Ficus polysyce*, Ridl.
79 ,,	44 ,,	*Durio zibethinus*, DC.
77½ ,,	40 ,,	do.
68 ,,	36 ,,	*Adinandra dumosa*, Jack.
66 ,,	34 ,,	*Durio zibethinus*.
	32 ,,	*Artocarpus polyphema*, Pers.

Height of tree.	Girth at breast height.	Name.
65½ feet.	29 ins.	*Rhodamnia trinervia*, Blume.
64 ,,	27 ,,	*Elaeocarpus petiolatus*, Wall.
63½ ,,	44 ,,	*Eugenia lineata*, Duthie.
63 ,,	41 ,,	*Rhodamnia trinervia.*
62 ,,	34 ,,	*Lyonanthes reticulata*, Jack.
	32 ,,	*Rhodamnia trinervia.*
61 ,,	32 ,,	*Hevea brasiliensis*, DC.
60 ,,	31 ,,	*Rhodamnia trinervia.*
59 ,,	19 ,,	*Albizzia moluccana*, Miq.
	34 ,,	*Elaeocarpus petiolatus.*
58 ,,	46 ,,	*Artocarpus* sp.
57 ,,	28 ,,	*Arthrophyllum diversifolium*, Blume.
	35 ,,	*Rhodamnia trinervia.*
	22 ,,	*Pithecolobium lobatum*, Benth.
55½ ,,	40 ,,	*Elaeocarpus stipularis*, Blume.
	40 ,,	do.
55 ,,	29 ,,	do.
54½ ,,	26 ,,	*Arthrophyllum diversifolium.*
54 ,,	42 ,,	*Gordonia singaporeana*, Wall.
	33 ,,	*Artocarpus Lakoocha*, Roxb.
	16 ,,	*Pithecolobium lobatum.*
53 ,,	31 ,,	*Arthrophyllum diversifolium.*
	26 ,,	do.
	23 ,,	*Adinandra dumosa.*
	15 ,,	*Symplocos fasciculata*, Zoll.
52½ ,,	34 ,,	*Arthrophyllum diversifolium.*
	28 ,,	*Cupania pallidula*, Hiern.
	22 ,,	*Arthrophyllum diversifolium.*
52 ,,	36 ,,	*Artocarpus Lakoocha.*
	28 ,,	*Symplocos fasciculata.*
51½ ,,	22 ,,	*Arthrophyllum diversifolium.*
51 ,,	38 ,,	*Symplocos fasciculata.*
	32 ,,	*Rhodamnia trinervia.*
49½ ,,	20 ,,	*Hevea brasiliensis.*
	17 ,,	*Arthrophyllum diversifolium.*
49 ,,	24 ,,	*Symplocos fasciculata.*
	22 ,,	*Durio zibethinus.*
	21 ,,	*Arthrophyllum diversifolium.*
	18 ,,	do.
48½ ,,	27 ,,	do.
	20 ,,	*Artocarpus Kunstleri*, King.
48 ,,	22 ,,	*Arthrophyllum diversifolium.*
	20 ,,	do.
	15 ,,	*Artocarpus* sp.
47½ ,,	28 ,,	*Arthrophyllum diversifolium.*
	26½ ,,	*Rhodamnia trinervia.*

Height of tree	Girth at breast height.	Name.
47½ feet.	10 ins.	*Arthrophyllum diversifolium.*
47 ,,	32 ,,	*Adinandra dumosa.*
	24 ,,	*Arthrophyllum diversifolium.*
	23 ,,	do.
	20 ,,	*Symplocos fasciculata.*
46½ ,,	24 ,,	do.
	22 ,,	*Adinandra dumosa.*
46 ,,	29 ,,	*Symplocos fasciculata.*
	26 ,,	*Artocarpus* sp.
	24 ,,	*Arthrophyllum diversifolium.*
	17 ,,	do.
	— ,,	*Litsaea firma,* Hook. f.
45 ,,	28 ,,	*Rhodamnia trinervia.*
	21 ,,	*Arthrophyllum diversifolium.*
	20 ,,	*Durio zibethinus.*
	17 ,,	*Macaranga triloba,* Muell.
44½ ,,	22 ,,	*Symplocos fasiculata.*
	18 ,,	do.
	18 ,,	*Artocarpus polyphema.*
	15 ,,	*Arthrophyllum diversifolium.*
44 ,,	24 ,,	*Pithecolobium lobatum.*
	24 ,,	*Symplocos fasciculata.*
	20 ,,	*Pygeum polystachyum,* Hook. f.
	20 ,,	*Symplocos fasciculata.*
	20 ,,	*Elaeocarpus stipularis.*
	18 ,,	*Gironniera nervosa.* Planch.
	18 ,,	*Pithecolobium lobatum.*
	14 ,,	*Arthrophyllum diversifolium.*
43½ ,,	28 ,,	*Ficus.*
	20 ,,	*Macaranga triloba.*
	16 ,,	*Arthrophyllum diversifolium.*
43 ,,	30 ,,	*Rhodamnia trinervia.*
	25 ,,	*Palaquium bancanum.*
	24 ,,	*Rhodamnia trinervia.*
	24 ,,	do.
42½ ,,	21 ,,	*Arthrophyllum diversifolium.*
	18 ,,	*Artocarpus Kunstleri.*
	16 ,,	*Arthrophyllum diversifolium.*
	12 ,,	*Timonius wallichianus.* Val.
42 ,,	24 ,,	*Arthrophyllum diversifolium.*
	20 ,,	do.
	17 ,,	*Rhodamnia trinervia.*
	16 ,,	*Pithecolobium lobatum.*
	15 ,,	*Arthrophyllum diversifolium.*
	15 ,,	*Nephelium lappaceum,* Linn.
	14 ,,	*Arthrophyllum diversifolium.*

Height of tree.	Girth at breast height	Name.
42 feet.	13 ins.	*Symplocos fasciculata.*
	12 ,,	*Macaranga triloba.*
41 ,,	20 ,,	*Arthrophyllum diversifolium.*
	20 ,,	*Symplocos fasciculata.*
	18 ,,	do.
	17 ,,	*Arthrophyllum diversifolium.*
	14 ,,	*Symplocos fasciculata.*
40½ ,,	20 ,,	*Arthrophyllum diversifolium.*
	12 ,,	do.
40 ,,	16 ,,	do.
	12 ,,	do.
	9 ,,	*Pithecolobium lobatum.*
39½ ,,	16 ,,	*Symplocos fasciculata.*
39 ,,	25 ,,	do.
	20 ,,	*Eugenia simulans,* King.
	16 ,,	*Mangifera foetida.* Lour.
	15 ,,	*Sideroxylon malaccense.* C. B. Clarke.
	14 ,,	*Symplocos fasciculata.*
	— ,,	do.
	— ,,	*Artocarpus.*
38½ ,,	20 ,,	*Rhodamnia trinerria.*
	14 ,,	*Cinnamomum iners.* Reinw.
	10 ,,	*Artocarpus.*
38 ,,	22 ,,	*Ficus alba.* Reinw.
	21 ,,	*Cinnamomum iners.*
	16 ,,	*Artocarpus Kunstleri.*
	16 ,,	*Artocarpus.*
	15 ,,	*Symplocos fasciculata.*
	15 ,,	*Arthrophyllum diversifolium.*
	9 ,,	do.
	— ,,	*Gordonia singaporeana.*
	— ,,	*Pygeum polystachyum.*
	— ,,	*Eugenia variolosa,* King.
37 ,,	18 ,,	*Arthrophyllum diversifolium.*
	18 ,,	*Artocarpus Kunstleri*
36½ ,,	18 ,,	*Eugenia grandis.*
36 ,,	16 ,,	*Gordonia singaporeana.*
35½ ,,	32 ,,	*Flacourtia Rukam.*
35 ,,	20 ,,	*Cinnamomum iners*
	— ,,	*Timonius wallichianus.*
34½ ,,	21 ,,	*Adinandra dumosa.*
	21 ,,	*Cinnamomum iners.*
	20 ,,	*do.*
	16 ,,	*Ficus.*
	14 ,,	*Gordonia singaporeana.*
	— ,,	*Adinandra dumosa.*

Height of tree.	Girth at breast height	Name.
34 feet.	15 ins.	*Cinnamomum iners.*
34 „	14 „	*Gynotroches axillaris,* Miq.
	— „	*Symplocos fasciculata.*
	— „	*Macaranga triloba.*
33½ „	18 „	*Arthrophllum diversifolium.*
	9 „	*Symplocos fasciculata.*
33 „	20 „	*Timonius wallichianus.*
	— „	*Clerodendron disparifolium.*
	— „	*Pithecolobium lobatum.*
	— „	*Timonius wallichianus.*
	— „	*Eugenia grandis.*
32½ „	— „	*Kurrimia paniculata.* Wall.
	— „	*Gynotroches axillaris.*
32 „	22 „	*Ficus.*
	14 „	*Symplocos fasciculata.*
	10 „	*Macaranga triloba.*
	9 „	*Timonius wallichianus.*
	— „	*Adinandra dumosa.*
31½ „	12 „	*Gironniera nervosa.*
31 „	— „	*Cinnamomum iners.*
	— „	do.
30½ „	10 „	*Pithecolobium clypearia,* Benth.

Among these trees *Rhodamnia,* presumably destined to ultimate suppression, was still aggressive.

The tallest *Arthrophyllum diversifolium* in the jungle was 57 feet high. This is probably about its limit, and the further growth of other trees would have tended to its suppression also. Possibly the age of 35 years for this kind of jungle is its zenith.

The tallest *Macaranga triloba* was 45 feet; and it and others showed signs of decay. The zenith of the species appeared to be past, and it seemed mainly to owe a place to the dying of old fruit trees. However large and old, these Macarangas were tenanted by ants.

Melastoma malabathricum had long lost its hold upon the ground.

The means of analysing this jungle over the whole two acres being wanting; two areas were taken respectively of 5800 and 7880 square feet or together nearly one third of an acre. The areas were defined by means of wires, and then from each in turn (1) the six foot high or lesser woody plants were removed, and determined. (2) the 6-18 feet high woody plants and (3) the trees. The plants not attaining two feet were not counted but their number was estimated. Adding the two areas together, there were on this area of nearly one third of an acre:—

378 trees of 18 feet and more.
2,728 woody plants of 2 feet to 18 feet.
about 27,342 smaller plants—mostly small woody seedlings.

30,448 in all.
or to the acre 96,660 plants.

The woody species of two feet in height or more, found on this area, are enumerated in the list opposite. In point of individuals, the following among them were most abundant:—

Anisophyllea disticha	345
Cinnamomum iners	321
Rhodamnia trinervia	242
Elaeocarpus Mastersii	199
Gironniera nervosa	190
Arthrophyllum diversifolium	164
Palaquium bancanum	144
Eugenia grandis	139
Timonius wallichianus	110
Macaranga triloba	107

etc., the rest under 100.

It is particularly worthy of mention that almost all of these have more or less fleshy fruits which are distributed by birds or monkeys.

The orders most in evidence were:—

MYRTACEAE	444
RHIZOPHORACEAE	431
LAURACEAE	348
URTICACEAE	334
TILIACEAE	235
EUPHORBIACEAE	181
ARALIACEAE	164
SAPOTACEAE	163
TERNSTROEMIACEAE	124
RUBIACEAE	121

It is interesting that the Rubiaceae which in species is so varied in high rain-forests is but the tenth order down the list, that the Anonaceae is still further down and that the Ternstroemiaceae which in the damp *Gleichenia*-grown secondary forest of Singapore is so abundantly represented in *Adinandra,* should be but the ninth order of the list. It is probably correct to say that the relatively good drainage of the bit of the secondary jungle under study accounts for the low place of the Ternstroemiaceae and for the abundance of the orders Urticaceae, Myrtaceae, Tiliaceae, Sapotaceae and Lauraceae, as well as for the absence of *Gleichenia, Nepenthes,* etc.

Enumeration of Woody Plants identified upon the two areas selected for Analysis.

(16) DILLENIACEAE.

1	plant.	*Tetracera Assa*, DC.
1	„	*Tetracera sylvestris*, Ridl.
9	„	*Wormia suffruticosa*, Griff.
5	„	*Wormia Scortechinii*, King.

(5) ANONACEAE.

1	„	*Artabotrys suaveolens*, Blume.?
4	„	*Unona discolor*, Vahl.

(2) MAGNOLIACEAE.

2	„	*Kadsura scandens*, Blume.

(57) BIXACEAE.

57	„	*Flacourtia Rukam*, Zoll. and Moritz.

(92) GUTTIFERAE.

7	„	*Garcinia eugeniaefolia*, Wall.
2	„	*Garcinia Mangostana*, Linn.
83	„	*Calophyllum* sp.

(124) TERNSTROEMIACEAE.

96	„	*Adinandra dumosa*, Jack.
28	„	*Gordonia singaporeana*, Wall.

(4) MALVACEAE.

4	„	*Durio ziberthinus*, DC.

(19) STERCULIACEAE.

16	„	*Sterculia rubiginosa*, Vent.
3	„	*Sterculia laevis*, Wall.

(235) TILIACEAE.

36	„	*Elaeocarpus petiolatus*, Wall.
199	„	*Elaeocarpus Mastersii*, King.

(23) LINACEAE.

(1) SIMARUBACEAE.

1	„	*Eurycoma longifolia*, Jack.

(6) BURSERACEAE.

6	„	*Canarium Planchonii*, King.

(2) MELIACEAE.

2	„	*Sandoricum indicum*, Cav.

(4) OLACACEAE.

3	„	*Lepionurus sylvestris*, Blume.
1	„	*Gomphandra penangiana*, Wall.

(4) CELASTRACEAE.

4 „ *Kurrimia paniculata,* Wall.

(1) ILICACEAE.

1 „ *Ilex macrophylla,* Wall.

(2) AMPELIDACEAE.

2 „ *Leea sambucina,* Willd.

(37) SAPINDACEAE.

29 „ *Cupania pallidula,* Hiern.
8 „ *Nephelium lappaceum,* Linn.

(3) ANACARDIACEAE.

3 „ *Melanochyla auriculata,* Hook. f.

(32) LEGUMINOSAE.

1 „ *Pterocarpus indicus,* Willd.
1 „ *Caesalpinia Nuga,* Ait.
4 „ *Adenanthera pavonina,* Linn.
25 „ *Pithecolobium lobatum,* Benth.
1 „ *Pithecolobium angulatum,* Benth.

(2) ROSACEAE.

2 „ *Pygeum polystachyum,* Hook. f.

(431) RHIZOPHORACEAE.

86 „ *Gynotroches axillaris,* Miq.
345 „ *Anisophyllea disticha,* Hook.

(444) MYRTACEAE.

242 „ *Rhodamnia trinervia,* Blume.
139 „ *Eugenia grandis,* Wight.
51 „ *Eugenia simulans,* King.
12 „ *Eugenia variolosa,* King.

(11) MELASTOMACEAE.

4 „ *Pternandra echinata,* Jack.
7 „ *Melastoma malabathricum,* Linn.

(164) ARALIACEAE.

164 „ *Arthrophyllum diversifolium,* Blume.

(121) RUBIACEAE.

2 „ *Uncaria pteropoda,* Miq.
7 „ *Randia anisophylla,* Jack.
110 „ *Timonius wallichianus,* Val.
1 „ *Canthium molle,* King and Gamble.
1 „ *Psychotria ovoidea,* Wall.

(163) SAPOTACEAE.

19 „ *Sideroxylon malaccense,* C. B. Clarke.
144 „ *Palaquium bancanum,* Burck.

(76) STYRACACEAE.

76	„	*Symplocos fasciculata,* Zoll.

(4) APOCYNACEAE.

4	„	*Alstonia angustiloba,* Miq.

(4) LOGANIACEAE.

4	„	*Fagraea fragrans,* Roxb.

(1) ACANTHACEAE.

1	„	*Eranthemum malaccense,* C. B. Clarke.

(11) VERBENACEAE.

3	„	*Vitex pubescens,* Vahl.
8	„	*Clerodendron disparifolium,* Blume.

(348) LAURACEAE.

321	„	*Cinnamomum iners,* Reinw.
9	„	*Alseodaphne ?*
6	„	*Nothaphoebe umbelliflora,* Blume.
11	„	*Litsaea firma,* Hook. f.
1	„	*Litsaea myristicaefolia,* Wall.

(2) THYMELAEACEAE.

2	„	*Gonystylus Maingayi,* Hook. f.

(181) EUPHORBIACEAE.

1	„	*Bridelia tomentosa,* Blume.
1	„	*Cleistanthus heterophyllus,* Hook. f.
2	„	*Glochidion superbum,* Baill.
5	„	*Glochidion brunneum,* Hook. f.
1	„	*Aporosa fruticosa,* Muell.
49	„	*Microdesmis caseariaefolia,* Planch.
2	„	*Baccaurea motleyana,* Muell.-Arg.
13	„	*Baccaurea* sp.
107	„	*Macaranga triloba,* Muell.-Arg.

(334) URTICACEAE.

190	„	*Gironniera nervosa,* Planch.
3	„	*Ficus alba,* Reinw.
10	„	*Ficus Miquelii,* King.
1	„	*Ficus chrysocarpa,* Reinw.
42	„	*Artocarpus Scortechinii,* King.
1	„	*Artocarpus Lakoocha,* Roxb.
2	„	*Artocarpus polyphema,* Pen.
85	„	*Artocarpus superba,* Becc.

(1) CUPULIFERAE.

1	„	*Quercus Lamponga,* Miq.?

(5) LILIACEAE.

1	,,	*Smilax barbata*, Wall.
2	,,	*Smilax megacarpa*, Roxb.
2	,,	*Dracaena* sp.

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34 ,, Undetermined.

Some attention was given to the size of the leaves in the jungle. On the whole none were larger than those of *Macaranga triloba*, which have an average size of 500 square cm. Those of *Ficus* varied from 150 to 350 square cm. Others were measured thus:—

Tacca cristata on the average about	180	square cm.
Baccaurea	170 to 190	square cm.
Hevea brasiliensis	120 to 300	,,
Timonius wallichianus	90 to 100	,,
Cinnamomum iners	60 to 100	,,
Arthrophyllum diversifolium ..	90 to 140	,,
Alstonia angustiloba	90 to 110	,,
Rhodamnia trinerria	40 to 50	,,
Elaeocarpus petiolatus	about 60	,,
Eugenia simulans	60 to 70	,,
Pithecolobium lobatum	20 to 70	,,
Durio zibethinus		
Adinandra dumosa	30 to 40	,,
Vitex pubescens, leaflets	20 to 70	,,
Flacourtia Rukam	25 to 30	,,
Symplocos fasciculata	15 to 18	,,
Psychotria oroidea	about 8	,,
Anisophyllea disticha	1 to 2	,,

These are only a few measurements and a vast array must be collected sooner or later by botanists in order to estabish the relationship of size of leaf to types of forest.

It has been said above that fruit trees had been planted over the ground before the secondary jungle was allowed to spring up. The presence of these trees complicates the history somewhat, but the changes of the vegetation may have been as follows:—

1st stage. Fruit trees standing in Lallang grass (*Imperata arundinacea*).

2nd stage. *Melastoma malabathricum*, bird dispersed, sprang up through the lallang, followed by the equally bird distributed *Rhodamnia trinerris* and *Fagraea fragrans*, while through monkeys visiting the fruit trees all manner of just edible fruits that the monkeys feed on were dropped about them.

3rd stage. In a ring round the fruit trees with their roots partly in the damper soil under the fruit-trees' shade, and their leaves just beyond the shade, sprang up *Eugenias, Symplocos fasciculata, Timonius, Cinnamomum iners, Arthrophyllum diversifolium*. Of these by its quicker growth *Arthrophyllum* prospered.

Macaranga triloba with explosive fruits also appeared, but perhaps its seeds may be able to lie dormant for a long time.

4th stage. *Macaranga* prospered but reaching the limit of its growth, other trees began to shade it, and to cause it to lose place.

5th stage. *Arthrophyllum diversifolium* gained a conspicuous place, like the *Macaranga* to lose it as the associated species of greater height got above it.

This is the point at which the jungle in question, thirty years old, appeared to be. And at it *Gynotroches axillaris* had become the conspicuous small tree of the undergrowth. With years as the ground conditions became more and more those of the permanent forest *Gynotroches* would have lost place to *Anonaceae*, *Myristicaceae* and shade loving *Rubiaceae*, while forest lianes of the *Leguminosae*, *Ampelidaceae*, and *Apocynaceae* would have been able to grow and to add to the density of the canopy. Then ultimately the condition would come in when the giant forest trees of the *Dipterocarpaceae*, *Meliaceae*, *Leguminosae*, *Malvaceae*, etc., are at home. Tentatively I put this at upwards of one hundred years from the upspringing of the first growth of the secondary jungle.

It is interesting to note some of the absentees from the secondary jungle under study. In the first place there were no *Loranthaceae*. It is hard to say why. *Macsa* was absent and the whole of the *Connaraceae*. *Salacia* was expected, but was absent too. The following larger trees were not found, *Xanthophyllum*, *Pyrenaria*, *Glycosmis*, *Ochanostachys*, *Scorodocarpus*, and *Gonocaryum*. The want of regeneration of *Shorea* has already been commented on.

When the ground had been cleared, the rubbish was burned in small bonfires. Immediately a dense growth of seedlings of *Albizzia* sprung up, started into growth by the scorching of their impervious seed-coats. These seedlings had bacterial nodules upon the rootlets, and it is evident that the species could be used as a green manure. A little later weeds came in. *Eleusine indica* was the commonest grass at first, but *Paspalum conjugatum* took possession of the soil with greater rapidity and was accompanied by *Paspalum sanguinale* in patches. Two sedges appeared *Cyperus umbellatus* and *C. Irya* and a supply of the following weeds, *Physalis minima*, *Capparis Hullettii*, *Alternanthera sessilis*, *Pouzolzia indica*, *Melochia corchorifolia*, *Synadrella nodiflora* *Vandellia crustacea* and *Spermacoce ocymoides*, all having small dry seeds except the first. Then spreading like the *Paspalum* appeared *Trichosanthes wallichiana*, *Commelyna nodiflora*, *Merremia hastata* and *Passiflora foetida*. There appeared a few plants of *Clitorea cajanifolia* and of *Blumea balsamifera* and a good sprinkling of the seedlings of the following trees, *Commersonia platyphlla* and *Trema*, with *Melastoma malabathricum* and *Solanum verbascifolium*. There was also plenty of *Clerodendron scandens*.

I. H. Burkill.

TWIN NUTMEG SEEDS.

On a tree of the Nutmeg, *Myristica fragrans*, Linn., growing in the Botanic Gardens, Singapore,, one fruit in about a thousand has been found with two seeds. The seeds, each wrapped in its mace, had flattened each other so as to be completely scaphoid. They stood arising from the base of the ovary with their raphes opposed. It is not known if such a condition has been observed in the *Myristicaceae;* but for two seeds to stand similarly is normal in some genera of the allied order *Anonaceae.*

I. H. Burkill.

DIOSCOREA ALATA, THE GREATER YAM, RACE No. 50.

On p. 131 of the last issue of this Bulletin it was stated that a particularly large tuber of the White Manila Yam, Gardens' No. 50, had been raised in Singapore by Mrs. W. E. Hooper. The opportunity is here taken of figuring it along with some other yams, the figure being the topmost of the three upon the accompanying plate. The tuber weighed 29 lbs. or 13.16 kilograms after being nine months in the ground.

The measure encircling the tuber is in inches.

I. H. Burkill.

DIOSCOREA KEGELIANA, GRISEB., THE "YAM POULE" OF THE WEST INDIES.

Dioscorea kegeliana is a yam of only slight utility, found wild in the island of Trinidad and in British Guiana. Its tuber is a curious disc-like body at the end of a slender root, with a surface thickened in lozenges just as in the South African *Testudinaria,* so as to present the appearance of the shell of a tortoise. The opportunity is taken here of figuring it on account of its botanic interest.

It lies horizontally in the soil and produces abundant secondary roots from its surface. Its flesh is scarcely fit for human food, but in the West Indies is said to be fed to pigs.

I. H. Burkill.

Photo by Mrs. W. E. Hooper.

Dioscorea alata—The Greater Yam, a tuber of large size.

Dioscorea esculenta—the Lesser Yam.-Three Papuan races; 424, "Memu," 428, "Tailukava," & 432, "Diba."

Dioscorea Kegeliana—"Yam poule" of the West Indies.

YIELDS OF THE LESSER YAM AND OF SOME AFRICAN YAMS.

In the Gardens' Bulletin, Vol. 1, pp. 396-399 (1917) an illustrated account of the Lesser Yam—*Dioscorea esculenta*, (Lour.) Burk., was given. The purpose of that account was to indicate its root-characters and to show how the several races, then in cultivation, differed from each other. Those races came from India, French Indo-China and the Philippine islands. Since 1917 three races from Papua have been introduced into the Botanic Gardens, Singapore, by the kindness of His Excellency Judge J. H. P. Murray, Lieut.-Governor of Papua: they bear names ascribed to the Hanuabada language, and are apparently from the country to the west of Port Moresby. These three races are figured on the plate with this issue. One of them is quite unlike any of the races experimentally grown earlier; the other two are like the Philippine race "Buga" in general characters. All three produce male flowers, and are wild in Papua. This production of male flowers in wild races is one of the most curious things about *Dioscorea esculenta*, which otherwise produces no flowers at all. To understand how the female flowers alone should have been lost is impossible with our present knowledge.

The wild and cultivated races which have been grown in the Botanic Gardens are:—

Wild.	Cultivated.
"Buga" of the Mountain Province of Luzon, also called "Carot" in Pangasinan, Luzon.	"China alu" of Assam.
	"Goradu" of the west Deccan of India.
	"Pora alu" of Chittagong.
"Tailukava" of Papua.	"Tugui" of Luzon.
	"Invod" of Palawan.
"Deba" of Papua.	"Khoai tu bua" of Saigon.
	"Khoai chach" of Saigon.
"Memu" of Papua.	"Tu-cu" of Saigon.
	"Moa alu" of Assam.

All the four known wild races produce few and large tubers. That the Papuan races produce large tubers, will be apparent to the reader on glancing at the new plate. They number usually not more than six. But the smaller tubers of the cultivated races are much more numerous. The individual tubers of the wild races have been weighed up to 2722 grammes or 6 lbs.

In the races "Buga," "Tailukava" and "Deba," rootlets are abundant upon the tubers; but in "Memu" they are almost absent. At maturity the flesh is stringy; but if eaten immature they are palatable enough. Moreover a few tubers can be removed at a

time without uprooting the plant which like the "Cut-and-come-again yam" of the West Indies goes on growing. In the race "Buga," the tubers are produced very diffusely upon the ends of certain relatively long slender roots of which they are the terminal parts. But as the slender part does not die at the end of the season a new plant springing from the spot where the old plant stood exhausts the diffusely produced tubers through their "stalks"; and the diffuseness does not lead to a crop of new plants radiating from the old centre, unless pigs or some other animal or some accident may have broken the connection, in which case the isolated tuber gives origin to a new plant upon its own account where it lies. Diffuseness, therefore, is not an immediate means of dispersal but a guarantee against animals uprooting all the tubers and so destroying the plant completely.

So far the Papuan races have shown themselves less diffuse than "Buga."

The duration of the growth of these wild races would seem to be about ten months, when "Buga," for instance, may return two and a half, three or even four kilos by weight of tubers per hill, not edible tubers, but tubers too stringy for the table. The yield of edible tubers should be taken at an earlier date and would be less.

Of the cultivated races, "Khoai tu bua" in character of its tubers approaches the wild races, but yet is quite distinct. It yielded large returns at longer periods than did the wild races,—a matter for study.

In classifying the races it is convenient to put it with the wild races thus:—

Few and large tubers,
- Tubers rooty,
  - Tubers roundish, on long stalks .. Buga 284
  - Tubers roundish, on short stalks .. Tailukava 428
  - Tubers similar but more elongated .. Deba 432
- Tubers not rooty,
  - Tubers turnip-like tapering or toed .. Memu 424
  - Tubers flattened and lobed .. .. Khoai tu bua 288

More numerous and smaller tubers,
- Tubers lobed, rooty
  - (2 Indian and 1 Philippine race) .. Moa alu 286, Goradu 296, Tugui 274
- Tubers sausage-shaped
  - Tubers rooty
    - (1 Indian and 1 Philippine race) .. Tugui 278, Pora alu 300
  - Tubers not rooty
    - Relatively thin
      - (2 races of Indo-China) ..

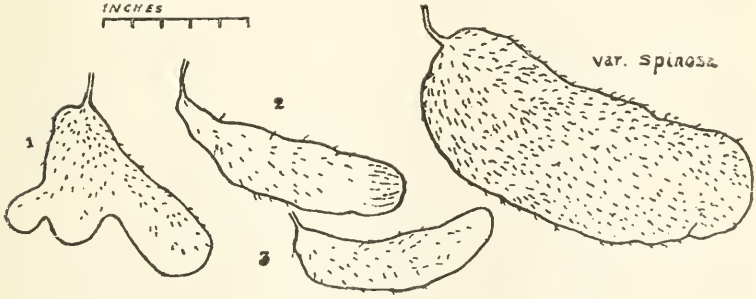
Relatively thick

(2 Philippine races) .. .. } Bulacan yam 276
} Invod 280

In what eastern country *Dioscorea esculenta* took its origin, still remains obscure: but the demonstration that wild Papuan races exist with characters similar to those of the Philippine wild plants, strengthens the idea that eastern Malaya is perhaps its home. Wild plants found in India and Indo-China would then be but relics of cultivation,—a view reasonable enough until or unless it can be demonstrated that India produces wild races which differ from those there cultivated. Greater thorniness is not difference enough; for undisturbed wild plants of the races which produce thorny roots get an accumulation of these thorny roots above them, which gives an impression that they are thornier than neighbouring cultivated races: and it is well to be on guard against a false deduction therefrom.

If left in the ground over their full time, the new plant depletes the old tubers, and any digging at a wrong season results in a loss of return. It seems that the species as a whole divides the year into about two months resting, and ten months growing. If dug at eight months the yield is relatively small, but the tubers are much better for the table. If dug about two months later and in the resting period which follows the yield is at the maximum. If dug soon after new growth has started the yield may be miserable. When the race Buga was left in the soil until new growth had started the return was 500 grammes per root instead of 2000 to 3000: and when left two months longer it was 1700 grammes. So also with other races. It is recognised that some races mature a little earlier than others: but as yet exact information is not available.

The return of the lesser Yam is less than the return of *Dioscorea alata* after the same number of months of growth.



1 Lobed tuber of the race Tuqui 274; 2 3 Sausage shaped tubers of the races Bulucan Yam 276 and Tuqui 278: on the right the large tuber of "Buga."

Average yields in grammes of the Lesser Yam.

Conditions of Planting.				Wild Races.				Cultivated Races.										Remarks.
Months out of the Ground.	Planting Space in Feet.	Planted and Dug.	Months in the Ground.	Buga	Tailukava	Deba	Memu	Khoai tu-bua.	Moa alu.	Goradu.	Tugui 274.	Tugui 278	Pora alu	Khoai chach.	Tu cu.	Bulacan yam.	Luvod.	
?	2 x 2	iv-xi 1915	7½						864									period too short
?	2 x 2	vii-14 -ii 1915.	8					66						227	170			do.
5	2 x 1	iii-xii 1915	9	1020				283				516		567	851	632	756	tubers kept too long.
2	2 x 3	iv-xii 1918	9					1090		1836	900		1534	769	1315	1062	1004	period appropriate.
?	2 x 3	x-17 -xii. 1918	9		1256	1206	1477											period apparently appropirate.
?	2 x 2	iii-15 -i. 1916-	10	2943							1191	867				2069	867	do.

Average yields in grammes of the Lesser Yam.

Conditions of Planting.				Wild Races.				Cultivated Races.										Remarks.
Months out of the Ground.	Planting Space in Feet.	Planted and Dug.	Months in the Ground.	Buga.	Tailukava.	Deba.	Memu.	Khoai tu-bua.	Moa alu.	Goradu.	Tugui 274.	Tugui 278.	Pora alu	Khoai chach.	Tu-cu.	Bulacan. yam.	Invod.	
2	2 x 1	iii 15 -1. 1916	10							1089	much stolen.		much stolen.					spaced too closed. tubers much stolen
½	2 x 2	xii-15 -x. 1916	10	2943				1592		much stolen.	151	741	1740 some stolen.	839	1270	1827	966	period appropriate except for Tugui 274 which was in new growth.
1	2 x 2	i-xi 1916	10						3078									period appropriate.
0	2 x 3	vi-18 -iv 1919.	11		1868	660	1434											on the whole not better at 11 than at 9 months.
1	2 x 3	iv-18 -iv. 1919.	12	519				2767	1055	2037	1085	318	2201	945	1592	1731	1021	Buga and Tugui 278 were dug in new growth.
1½-2	2 x 2	xii-16 -iii 1918	14	1781				2739	984	1406	877	much stolen.	2556	3244	1462	much stolen.	1013	All dug well on in a second growth.

Three tables below give the average yields in grammes of African yams, during the four seasons over which they have been in cultivation. It appears from them that quite as large yields may be got from the White and the Yellow Guinea yams, or even larger than from the Greater Yam of Asia; for the average yields of the Greater Yam as recorded on p. 130 of the last issue of the Bulletin, were in 1916, 3230 grammes; in 1917, 2267 grammes; and in 1918, 1712 grammes.

There are great differences in palatability between the races of the White Guinea yam, but none have been found yet between those of the Yellow Guinea yam. The latter is good to eat, and a large yielder. The extreme length of its period of growth is against it; but the yield and quality have ensured it a home in the West Indies, where it is cultivated as upon the Guinea coast of Africa.

AVERAGE YIELDS IN GRAMMES OF GOLD COAST RACES OF THE WHITE OR EIGHT MONTHS GUINEA YAM.

Gardens No. and Name.	Aug. 1915, to Feb. 1916.	March 1916, to Dec. 1916.	Dec. 1916, to Dec. 1917.	Feb. 1918, to Apr. 1919.
310. Bayere Pa ..	2410	1070	2571	907
316. Punai	421	939	1047	1555
318. Tonto	511	5783	1973	155
322. Odee krukupa ..	765	2036	1389	2059
324. Batafu entumtu ..	326	1971	2271	2595
330. Eyiberi	701	4271	{1358 {2079	2949

THE SAME, OF SOUTHERN NIGERIAN RACES.

Gardens No. and Name.	Feb, 1915, to Nov. 1915.	Jan. 1916, to Dec. 1916.	Dec. 1916, to Dec. 1917.	Feb. 1918, to Apr. 1919.
328. Epinminrin ..	1333	5407	2228	2065
334. Efura	700	5748	3297	1332
336. Iyawo kolorun ..	—	4134	1966	2445
340. Oparaga	671	4734	1723	491
376. Eururuka apima	687	2458	1477	556
378. Auriruka nkostina	64	1651	1102	446

AVERAGE YIELDS IN GRAMMES OF THE YELLOW OR TWELVE MONTHS GUINEA YAM.

Gardens No. and Name.	Feb. 1915, to Nov. 1915 (the last Apr. 1915 to Nov. 1915.)	Jan. 1916, to Nov. 1916.	Dec. 1916, to Dec. 1917.	Feb. 1918, to April 1919.
314. Igangan alo ..	4904	{7544 / 5112}	1819	5856
338. Odo	3175	3142	2273	3111
348. from Paradeniya, Ceylon	1502	4975	1553	4662

AVERAGE YIELDS IN GRAMMES OF DIOSCOREA DUMETORUM, PAX.

Gardens No. and Name	July 1915 to Feb. 1916	Mar. 1916 to Dec. 1916	Dec. 1916 to Jan. 1918.	Feb. 1918 to Apr. 1919.
342. Nfamka	1247	1677	2328	639
	Feb. 1915 to Nov. 1915.	Jan. 1916 to Dec. 1916	Dec. 1916 to Jan. 1918.	Feb. 1918 to Apr. 1919.
344. Esura white ..	2636	2331	2063	1979
346. Esura yellow ..	3090	6126	1180	498
374. do. ..	1361	1417	1123	1764
382. Kamfu yellow ..	—	624	397	4196
392. Kamfu	—	794	936	—

I. H. BURKILL.

SOME NOTES ON THE POLLINATION OF FLOWERS IN THE BOTANIC GARDENS, SINGAPORE, AND IN OTHER PARTS OF THE MALAY PENINSULA.

The daily round in the Botanic Gardens, Singapore, with visits of inspection to Penang or to other places in the Peninsula have afforded scattered opportunities during seven years, of making notes upon the behaviour of insects in regard to flowers. These notes will be brought into one view here.

Apis.

Readers assuredly know what an important rôle the Hive bee, *Apis mellifica*, Linn., plays in the fertilisation of flowers in more northern climates. That domesticated *Apis* is absent from the Malay Peninsula, but *Apis indica*, Fabr., is present and is very similar in size and way of life: it can be domesticated also. It is plentiful in the Peninsula, and is capable of fulfilling the rôle of *A. mellifica* in all points in regard to flowers. It is accompanied in Malaya by the larger *Apis dorsata*, Fabr. and the lesser *Apis florea*, Fabr. The three do yeoman service.

They are common, commoner than the unobservant think, and find the whole of their food in flowers, rivalling the honey bee in diligence, while they raise large broods of young. Because their hunting grounds are so often in the tops of high trees, their occupations are not easily recorded, and their work passes unnoticed, except where their numbers happen to be so great that they attract attention by the hum of their buzzing. Yet it is a common experience to have attention drawn to the flowering of an *Eugenia*, an *Elaeocarpus*, a *Cratoxylon*, a *Kurrimia* or a *Bassia* by the sound of innumerable bees as upon lime-trees in flower in Britain.

The different flowers upon which the three species of *Apis* have been seen are enumerated in the annexed table. In addition unidentified species of *Apis* have been observed upon flowers of the following:—

Cupania pallidula, Hiern.	at Tebong, Malacca.
Erythrina lithosperma, Blume,	in Penang.
Poinciana regia, Bojer,	in Malacca.
Tristania Maingayi, Duthie,	in Penang.

In the Peninsula, *Apis dorsata* has come under observation oftenest as if the most abundant of the three species. It has been timed to visit the flowers of *Antigonum* at the rate of 20 per minute. *Apis indica* at the same time (midday on 18 viii. 1916) was observed to visit 30 flowers per minute. On another occasion various individuals of *Apis dorsata* were seen to visit, one 20 flowers per minute, another 32 flowers per minute, others intermediate numbers (29.i.1916). *Apis florea* upon the same species was seen to go to 20 flowers per minute.

The rate at which the insects work of course depends upon the shape of the flower visited and the number of flowers close together and the time of day. It was recorded in the Journal of the Asiatic Society of Bengal, N. S. ii. 1906, p. 516, that *Apis dorsata* visited varying numbers of flowers of the jute plant, *Corchorus capsularis*, at the average of 28 per minute, and that *Apis florea* visited at the rate 10 to 15, which is less that upon *Antigonum*.

At the rate of 25 flowers per minute in eight hours a bee can effect 12,000 pollinations, or 7,200 pollinations at the rate of 15. These are figures which give an idea of the possible effectiveness of a bee's daily work.

Here and all through unless otherwise stated the insects were sucking honey.

Apis dorsata	Apis indica	Apis florea
Dillenia indica, Linn. collecting pollen in Singapore.		*Pittosporum ferrugineum*, Ait. in Singapore.
Xanthophyllum Curtisii., King, in Singapore, freely		*Elaeocarpus Griffithii*, Mast., freely, in Singapore.
Camellia theifera, Griff. rarely in Singapore	*Durio zibethinus*, D C. in Singapore.	
Roucheria griffithiana, Planch. in Singapore, abundantly.	*Erythroxylum Coca*, Lam. abundantly, in Singapore.	
Kurrimia paniculata, Wall. in Singapore, abundantly.		
Derris thyrsiflora, Benth. in Singapore, freely.	*Derris thyrsiflora*, Benth. in Singapore.	
Peltophorum ferrugineum, Benth. abandantly, in Singapore.		*Peltophorum ferrugineum*, Benth. freely, in Singapore.
Pterocarpus indica, Willd. freely, in Singapore, Penang and Port Swettenham: also abundantly at Taiping by moonlight at 9 p.m.	*Mimosa pudica*, Linn., every now and then, collecting pollen, Singapore and Penang.	
Mimosa pudica, Linn. frequently collecting pollen, in Singapore, Penang, Kuala Lumpur and Port Swettenham.		
Albizzia moluccana, Miq in Singapore.		
Eugenia grandis, Wight, in Singapore.		
Eugenia lineata Duthie, abundantly, in Singapore.		
Eugenia mooniana, Wight, in Singapore.		

Apis dorsata	Apis indica	Apis floreà
Passiflora foetida, Linn , in Port Swettenham.		
Tridax procumbens, Linn. in Port Swettenham.	*Oldenlandia diffiusa* Roxb., rarely, in Singapore.	
Cosmos sulphurens, Cav. occasionally, in Singapore and Malacca.		
Wulffia stenoglossa, DC. sparingly, in Singapore.		
Lactuca , in Port Swettenham.	*Bzumea balsamifera*, DC., Tampin.	
Jacquemontio violacea, Choisy, in Singapore.	*Jacquemontia violrcea*, Choisy, regularly, in Singapore.	
Antigonon leptopus, Hook. *and A. guatemalense*, Meissn. freely, in Malacca.	*Antigonon leptopus*, Hook., and *A. guatemalense*, Meissn. very freely, in Malacca and Klang.	*Antigonon leptopus*,, Hook. and *A guatemalense* Meissn., freely, in Malacca.
Cymbidium finlaysonianum, Lindl ,rarely, in Singapore	*Dendrobium crumenatum*, Sw. rarely, in Singapore.	
Cocos nucifera, Linn freely, in Singapore.	*Cocos nucifera*, Linn. in Singapore.	
Chrysalidocarpus lutescens, Wendl. freely, in Singapore.	*Arenga saccharifera*, Labill. in Singapore.	*Zoysia pungens*, Willd. collecting pollen in Singapore.
Dictyosperma album, W. and D. freely, in Singapore.	*Dictyosperma-aibum* , W. & D., in Singapore.	
Oreodoxa regia, H. B. K., in Singapore.		

Apis however on the palms is overwhelmingly found on male flowers, or on flowers in their male stage, obtaining food without giving what would seem to be an adequate return. It is also interesting to see it collecting pollen from the fallen male flowers of *Arenga saccharifera*. This which it has often been seen to do in the Malay Peninsula, has been described also from Calcutta (*Journal of the Asiatic Society of Bengal* N. S. xii, 1916, p. 264), where both *Apis indica* and *A. florea* were seen doing it; *Apis indica* only has been seen doing it in Singapore. Barbosa Rodrigues (Les noces des Palmiers), has recorded that bees visit fallen flowers of the palm *Gulielma speciosa* in Rio de Janeiro, adding that they fly up into the crowns of the trees subsequently and pollinate the female flowers.

Apis indica has been seen sucking honey from fallen flowers of the Durian, *Durio zibethinus*, DC., in Singapore. *Apis dorsata* has been observed to go from calyx to calyx of *Leucas linifolia*, Spreng., obtaining honey after the corolla had fallen, and at the same time neglecting intact open flowers upon the plants.

In the table of the flowers visited by *Apis* indications are given of the frequence or rarity of the insects upon the plants named. All orchids appear to be but rarely visited. *Dendrobium crumenatum*, for instance, despite its conspicuousness and scent, rarely attracts a bee; but *Apis dorsata* is well suited for the pollination of its stigma and has been seen upon one of the rare occasions of its visits to do it. Another orchid, *Cymbidium finlaysonianum*, is rarely visited by *Apis dorsata*, but when visited the visits are effective. Brooke and Hewett have recorded the insect as a rare visitor to the flower in Sarawak, just as it is in Singapore (*Journal of the Straits Branch of the Royal Asiatic Society*, No. 54, 181, p. 106). Ridley in that Journal, (No. 44, 1905, p. 228) records *Apis dorsata* as a visitor to *Grammatophyllum speciosum*, Bl.

Xylocopa.

Larger than *Apis* and much more obtrusive, are the *Xylocopas*, large bees with strong jaws, by which they tunnel into dead timber to make their nests. The males are unimportant as pollinators, but the females get all their food and the food of their young upon flowers. Two species are common, *i.e.* the large black *X. latipes*, Fabr., and the smaller yellow and black *X. aestuans*, Lepel.: a third *X. coerulea*, Lepel., is not uncommon.

Xylocopa latipes is a great robber of flowers, which it rapidly bites open by means of its jaws, biting usually in the middle line just above the calyx at the nearest available point for the honey. It has been seen systematically biting the following flowers:—

Ipomoea digitata, Linn., in the Botanic Gardens, Singapore, the plant being a native of the Tropics generally.

Bignonia magnifica, Bull, in Singapore, the plant being a native of New Granada.

Tecoma leucoxylon, Mart., in the Botanic Gardens, Singapore, the plant being a native of the West Indies.

Jacaranda ovalifolia, R. Br., in Singapore, Tampin, Malacca, and Jasin, the tree being a native of South America.

Schlegelia parasitica, Griseb., in Singapore, a native of the West Indies.

Thunbergia erecta, T. Anders., in Singapore, a native of East Africa.

Asystasia coromandeliana, Nees, in Singapore and in Penang, a native of the East Indies.

Ruellia macrophylla, Vahl, in Singapore, a native of South America.

When biting the flowers of *Asystasia* it works at the rate of 7 to 11 per minute; and the male insect has been seen doing the same along with the female. When robbing *Ipomoea paniculata* it tears open the buds ready to expand, an act already described by Mr. H. N. Ridley in the *Journal of the Straits Branch of the Royal Asiatic Society*, No. 34, 1905, p. 229, as done by it upon the slightly smaller *Ipomoea palmata*, Forsk., a species also pantropical.

Tubular flowers upon which *X. latipes* has been seen to visit in the intended way are:—

Fagraea fragrans, Roxb., in Singapore.

Fagraea racemosa, Jack, in Penang.

Thunbergia grandiflora, Roxb., in Singapore, Penang and Tebong in Malacca.

Thunbergia laurifolia, Lindl., in Singapore and Penang.

Eranthemum reticulatum, Hort., in Singapore.

Caryopteris wallichiana, Schau., in Singapore.

All these are eastern plants, whereas the tubular flowers which the bee robs are often American. The close connection of the bee with the two Thunbergias has been remarked in the *Journal of the Asiatic Society of Bengal*, N. S. ii., 1906, pp. 511-514 and xii., 1916, p. 245.

Xylocopa latipes seems to be the insect most suited to the upside-down *Leguminosae*, and in Singapore regularly visits the flowers of:—

Canavalia ensiformis, DC.

Centrosema Plumieri, Benth.

Apparently their fruit setting is almost dependant upon the insect.

X. latipes visits many Leguminosae which carry their flowers in a normal way, such as:—

Dioclea lasiocarpa, Mart., in Singapore, freely.
Derris thyrsiflora, Benth., in Singapore, rarely.
Dolichos Lablab, Linn., in Penang and Butterworth.
Cajanus indicus, Spreng., in Singapore.
Pterocarpus indica, Willd., in Singapore.
Peltophorum ferrugineum, Benth., in Singapore, freely.
Cassia corymbosa, Lam., in Penang.
Cassia alata, Linn., in Penang and at Alor Gajah.
Cassia javanica, Linn., in Penang.
Cassia siamea, Lam., in Singapore.
Saraca thaipingensis, Cantl., in Singapore, freely.
Saraca declinata, Miq., in Singapore, freely.
Saraca indica, Linn., in Singapore, freely.

It is a particularly busy insect upon *Dioclea*, *Peltophorum* and the *Saracas*.

It has been recorded as visiting also:—
Cratoxylon polyanthum, Korth., in Singapore.
Pterospermum acerifolium, Willd., in Singapore.
Adinandra dumosa, Jack, in Singapore.
Hiptage Madhablota, Gaertn., in Singapore.
Eugenia zeylanica, Wight, in Singapore.
Melastoma malabathricum, Linn., in Singapore, at Tampin and at Alor Gajah.
Turnera odorata, Rich., at Jasin.
Morinda citrifolia, Linn., at Tampin.
Lantana Camara, Linn., on Government Hill, Penang.
Grammatophyllum speciosum, Blume, in Singapore.

Of these it is common and diligent upon *Cratoxylon* particularly. It is more often seen on *Melastoma malabathricum* than the extremely meagre return of honey would seem to justify. On the flowers of *Grammatophyllum* it is not at home; it tries one or two and in the writer's experience soon quits the plant; but when observed by Mr. H. N. Ridley, in the *Journal of the Straits Branch of the Royal Asiatic Society* No. 34, 1905, p. 228, it commonly visited the flowers, and by its weight so depressed the lip that it did not pollinate them.

It is rather clumsy upon the flowers of *Turnera*, rarely taking all the available honey, because it treats the flower as if bilaterally symmetrical. As a consequence of its considerable weight the flower nods when visited, and the bee then visits either above or below the sexual organs but not both, and does not make a circuit of the five nectaries. The pollen of the plant may thus be caught on the bee's back or on the bee's belly; but it has been seen that quite a sufficient amount may be carried.

Xylocopa aestuans bites flowers just as *X. latipes* does. It settles outside and make a hole in the middle line of most of them; but on *Dolichos Lablab* it may settle and turning to the left bite a hole upon the right side of the calyx where the honey is most

accessible to its short tongue. That it should bite upon the right side and not upon the left is most interesting; for *Bombus haemorrhoidalis*, Smith, a Bumble Bee of the Himalaya has been recorded (*Journal of the Asiatic Society of Bengal*, N. S. ii, 1906, p. 524) as biting upon the right side of the corollas of a *Scutellaria*. Such a development of a left-handedness in Bees might be invoked to account for the peculiar twist found in flowers so distinct from one another as *Dicliptera* in the Acanthaceae, *Pedicularis* in the Scrophulariaceae, *Plocoglottis* in the Orchidaceae, and others. It has been seen to bite the calyces of *Clitorea Ternatea*, Linn., in Malacca, but no record has been preserved of the position of the bite.

X. aestuans has been seen using old holes in the flowers of *Clitoria cajanifolia*, Benth., in Singapore, holes which it may have made in an earlier part of the day, but it was not seen at the biting. These holes were also on the right side of the flower.

It has been seen biting the following flowers in the middle line of the corolla.—

Torenia Fournieri, Linden, in Singapore, the plant being a native of Indo-China.

Bignonia magnifica, Bull, in Singapore, the plant being a native of New Granada.

Barleria cristata, Linn., in Singapore, the plant being a native of India.

Ruellia tuberosa, Linn., in Malacca, the plant being a native of America.

Asystasia coromandeliana, Nees, in Singapore, Penang, Kuala Lumpur, Malacca and at Tebong in Malacca, the plant being Indo-Malayan.

Hosea Lobbii Ridl., in Singapore, the plant being a native of Borneo.

The countries of the origin of the flowers bitten by the two Xylocopas, *X. latipes* and *X. aestuans* have been given above after each name.

Six of the plants are native of the New World, and consequently are new sources of food which our gardens provide to these insects; eight are native of the Old World, being one from Africa and seven from the Indo-Malayan tropics.

Like *X. latipes*, *X. aestuans* has been seen upon upside-down Leguminosae, but on *Canavalia lineata*, DC. only, and this only at Pangkalan Balak upon the coast west of Malacca.

It pollinates other Leguminosae, notably:—

Crotalaria striata, DC., all through the Territory of Malacca, freely.

Derris thyrsiflora, Benth., in Singapore, freely.

Phaseolus lunatus, Linn., in Singapore, freely.

Pachyrrhizus angulatus, Rich., in Singapore, freely.

Peltophorum ferrugineum, Benth., in Singapore, freely.

Pterocarpus indica, Willd., in Singapore.

It has already been recorded as a visitor to *Crotalaria striata*, in the *Journal of the Asiatic Society of Bengal*, N. S. xii, 1916, p. 247.

It visits also the following bilaterally symmetrical flowers:—

Xanthophyllum Curtisii, King, in Singapore, freely.
Hiptage Madhablota, Gaertn., in Singapore, freely.
Melastoma malabathricum, Linn., in Singapore.
Stachytarpheta jamaicensis, Schau., in Singapore, rather freely.
Coleus Blumei, Benth., in Singapore.
Grammatophyllum speciosum, Blume, in Singapore.

The rate at which it works upon the flowers of *Xanthophyllum Curtisii* is 20 to 25 flowers per minute. On *Asystasia coromadeliana* it was observed in Malacca to go to 25 flowers per minute sometimes biting, sometimes using old holes. On *Antigonon leptopus* different individuals have been seen to visit, one 20 flowers per minute, another 34, another 40, another 46, one 50 flowers per minute (2. viii. 1915) and one 52 flowers per minute (8. viii. 1919).

X. aestuans is not at home upon the flowers of *Grammatophyllum speciosum*: but every now and then it may be seen seeking their honey and generally standing on the back of the column where its visit is useless to the flower, pushing its tongue over the shoulder of the column. Mr. Ridley had not seen it to remove the pollinia (*Journal of the Straits Branch of the Royal Asiatic Society*, No. 44, 1905, p. 228), nor has the writer.

It has been seen to go in considerable numbers to the downwardly directed flowers of:—

Adinandra dumosa, Jack, in Singapore.
Mimusops Elengi, Linn., in Singapore.
Ardisia humilis, Vahl., in Singapore.

and also to the following:—

Cleome heptaphylla, Linn., in Singapore.
Hibiscus schizopetalus, Hook. f., at Tampin, collecting pollen.
Connarus semidecandrus, Jack, in Singapore.
Mimosa pudica, Linn., in Singapore and at Tebong, Malacca, collecting pollen.
Eugenia lineata, Duthie, in Singapore.
Eugenia zeylanica, Wight, in Singapore.
Passiflora foetida, Linn., in Singapore.
Passiflora raddiana, DC., in Malacca and in Tampin.
Turnera ulmifolia, Linn., in Singapore.
Turnera odorata, Rich., in Jasin, freely.
Cosmos sulphureus, Cav., in Malacca.
Morinda citrifolia, Linn., in Jasin.
Fagraea racemosa, Jack, in Penang.
Petrea volubilis, Linn., in Penang, freely.
Buckinghamia celsissima, F. v. Muell., in Singapore, frequently.
Antigonon leptopus, Hook., in Malacca, frequently.
Antigonon guatemalense, Meissn., in Malacca.

It is unsuited for pollinating Passifloras, passing under the anthers in making a circuit of the flower. It has been seen seeking honey in vain upon the flowers of *Solanum indicum*, Linn.

Xylocopa coerulea is a much rarer insect than *X. latipes* or *X. aestuans*. It seems to show a preference for flowers which face earthwards, and in Singapore has been seen chiefly upon *Adinandra dumosa*, Jack, from which it appears just able to extract the honey. The angry buzz which it often gives in the attempt would appear likely to cause loose pollen to fall upon it. It visits in Singapore also *Mimusops Elengi*, Linn. On Government Hill, Penang, it has been seen at 2000 feet upon *Adinandra dumosa*. It has been seen near Ipoh upon the very differently disposed flowers of *Lantana Camara*, Linn.

An undetermined *Xylocopa* has been seen on *Vitex trifolia*, Linn. f., near Tampin, sucking honey (27. vii. 1915).

Anthophora.

Anthophora zonata, Linn., which is a bee smaller than the above named species of *Xylocopa*, but larger than the species of *Apis*, has been seen upon the flowers of:—

Derris thyrsiflora, Benth., in Singapore.
Mimosa pudica, Linn., collecting pollen at Ipoh.
Ardisia humilis, Vahl, in Singapore.
Stachytarpheta jamaicensis, Schau., in Ipoh.
Stachytarpheta mutabilis, Vahl, on Government Hill, Penang.

Melipona.

The little bees of the genus *Melipona* are excessively common in the Malay Peninsula, perhaps in greater numbers than *Apis*. They get their food off flowers, making nests in holes with a resinous lining; they may be seen at coagulating latex sometimes trying to carry it off for their homes.

Meliponas have been seen upon the following flowers:—

Dillenia indica, Linn., in Singapore, collecting pollen.
Impatiens Ridleyi, Hook. f., in Kuala Lumpur.
Heritiera macrophylla, Wall., in Singapore, at honey and collecting pollen.
Derris thyrsiflora, Benth., in Singapore.
Cassia fistula, Linn., in Singapore, collecting pollen.
Mimosa pudica, Linn., in Penang, collecting pollen.
Melastoma malabathricum, Linn., in Singapore and in Penang, collecting pollen.
Melastoma decemfidum, Jack, in Penang, collecting pollen.
Baeckia frutescens, Linn., on Government Hill, Penang.
Ardisia humilis, Vahl, in Singapore.
Lantana Camara, Linn., at Tanjong Malim.
Thottea grandiflora, Rottb., on Gunong Tampin, collecting pollen once only.

Antigonon leptopus, Hook., in Malacca.

Dictyosperma album, W. & D., in Singapore.

Oreodoxa regia, H. B. K., in Singapore

Nipa fructicans, Thunb., at Port Swettenham, collecting pollen.

Cocos nucifera, Linn., in Singapore.

Homalonema coerulescens, Jungh., in the Selandar forest, Malacca, imprisoned in closed spathes.

Upon the flowers of such plants as *Cassia* and *Melastoma*, as it visits the stamens only, it does no good in the way of pollinating them.

Small undetermined Apiids have been seen upon:—

Melastoma malabathricum, Linn., in Singapore.

Petrea rugosa, H. B. & K., in Singapore.

Asystasia travancorica, Bedd., in Singapore.

Asystasia coromandeliana, Nees, in Singapore and Malacca.

Ipomoea pes-caprae, Sweet, on Pulau Tiuman.

Mimosa pudica, Linn., at Batang Malaka, Malacca.

Antigonon leptopus, Hook., in Malacca and Klang.

Vespidae.

Wasps often eat as much animal food as vegetable food, and therefore are less useful to flowers than the bees. The big *Vespa cincta*, Fabr., to which Mr. Ridley ascribes the pollination of *Grammatophyllum speciosum* (*Journal of the Straits Branch of the Royal Asiatic Society*, No. 44, 1905, p. 228) goes to flowers at times for honey, and at times to prey on bees. The writer has never seen it pollinating any orchids, but has seen it sucking honey upon the flowers of *Vitis* in Penang and of *Antigonon leptopus* in Malacca.

Other wasps have been seen upon the flowers of *Morinda citrifolia*, Linn., near Tampin, and *Scyphiphora hydrophyllacea*, Gaertn., at Port Swettenham, on *Baeckia frutescens*, Linn., at Penang, and on *Embelia dasythyrsa*, Miq., near Alor Gajah.

Butterflies and Moths.

Flowers particularly suited for fertilisation by butterflies have not come under observation to any great degree. Among the following, only *Ixora* and *Scyphiphora* are really suited.

Eugenia lineata, Duthie, many butterflies in Singapore.

Mussaenda erythrophylla, Sch., a Papilio, in Singapore.

Ixora macrothyrsa, B. & T., a Papilio, in Penang.

Veronia cinerea, Less., Lycaenids, in Singapore.

Roupellia grata, Wall., a Hesperid, in Penang.

Lantana Camara, Linn., two or three species of butterflies at Tanjong Malim.

Stachytarpheta jamaicenis, Schau., three butterflies in Penang and Malacca.

Asystasia coromandeliana, Nees, a Lycaenid, in Singapore.

Scyphiphora hydrophyllacea, Gaertn., a butterfly, at Port Swettenham.

Dracaena fragrans, Ker-Gawl., a Hesperid, in Singapore.

The observation of a Hesperid trapped in a flower of *Dipladenia Harrisii* recorded in this *Bulletin,* I, No. 10 p. 355, was made again upon April 4th 1917, the species of Hesperid being the same.

Flies such as Syrphids and Muscids are at times quite common on open flowers.

Sun-Birds.

Bird fertilisation is much less common in the topics of the Old World than in the tropics of the New. However there is one little sun-bird, which visits flowers in the Peninsula commonly, namely *Cyrtostomus pectoralis,* Horsf.

In the Botanic Gardens, Singapore it has been seen upon the following flowers:—

Hibiscus Rosa-sinensis, Linn., and its garden hybrids, commonly.

Saraca thaipingensis, Cantley.

Dipladenia Harrisii, Hook., taking advantage of holes made by squirrels in the swollen base of the corolla-tube.

Russelia juncea, Zucc.

Russelia sarmentosa, Jacq.

Clerodendron Thomsonae, Balf.

Dendrobium secundum, Wall.

Canna, garden hybrids.

Dictyosperma album, W. & D., possibly eating small insects.

Elsewhere it has been seen upon *Erythrina lithosperma,* Blume, (Batang Malaka, 30. i. 1916) and on *Stachytarpheta mutabilis* (Government Hill, Penang, 31. vii. 1917).

Bird-visits to the flowers of *Hibiscus* are well known, and they appear effectively to pollinate the flowers. Birds are recorded as visitors in Zanzibar, India and Java to them. *Russelia juncea* has been recorded as bird-visited in India, and *Canna* as bird-visited in South America and South Africa.

The common Malayan squirrel, sometimes goes to flowers that offer plenty of sweetness such as *Erythrina* or *Durio,* where the destruction done is out of all proportion to the good.

I. H. Burkill.

The

Gardens' Bulletin

STRAITS SETTLEMENTS

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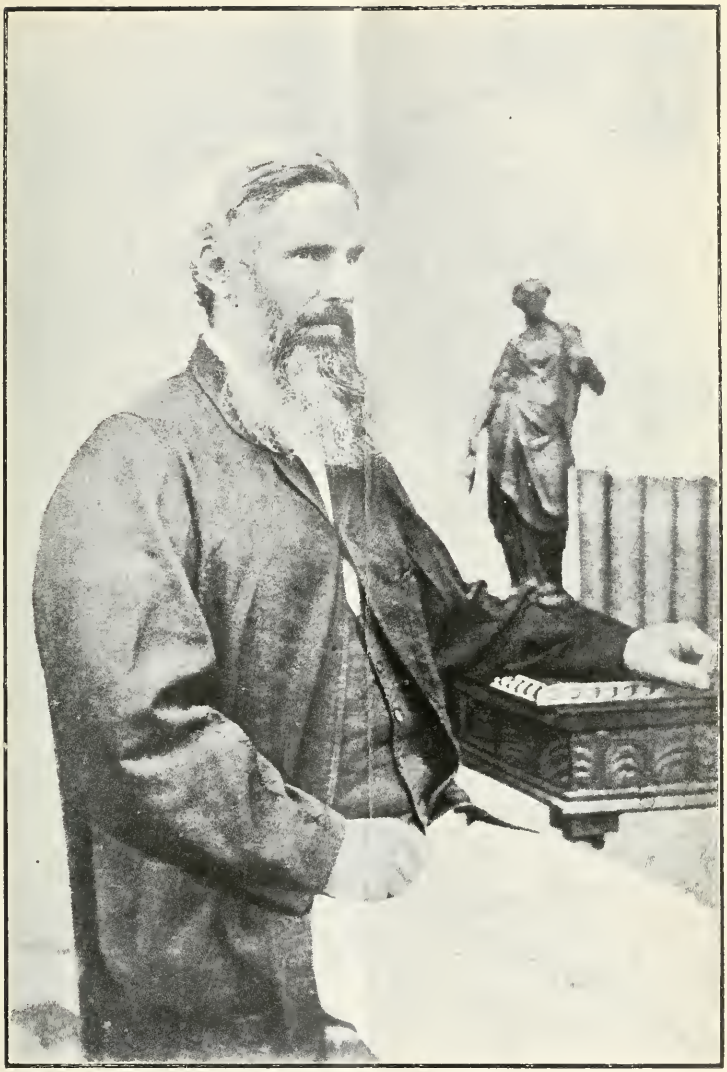

LAWRENCE NIVEN
Superintendent of the Botanic Gardens
Singapore, 1860-1875.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. II. Issued January, 31st 1920. No. 6.

Mr. Lawrence Niven.

Mr. Lawrence Niven commenced work at the Botanical Gardens almost as soon as they were opened by the "Singapore Agri-horticultural Society," which was formed in 1859. The Gardens were developed in 1861-62 and after successful shows in the former year, it is recorded that "The Society had obtained the part time services of Mr. Lawrence Niven as Superintendent." Mr. Niven was also superintendent of an adjoining nutmeg plantation, so that he could combine the two very well. He earned the thanks of the Committee for "his taste in laying out the Gardens," and Mr. Buckley records that he made the Gardens very attractive by large beds of pretty flowers. He is also mentioned with praise in the Gardens Guide published in 1889. The title of his office, which was more honorary than remunerative, was changed in 1874 to Manager, the Government then taking over the Gardens. Mr. Niven retained charge until the arrival of Mr. James Murton in 1875.

W. Makepeace.

A Guide to the Palm Collection in the Botanic Gardens, Singapore.

But two brief notes have so far been published on the fine collection of Palms growing in the Botanic Gardens, Singapore. The first in the "Agricultural Bulletin, S. and F. M. S." (Vol. III, p. 249) in 1904, the second in the same Journal (Vol. V, p. 6) in 1906, both presumably by Mr. Ridley. In the fourteen years since the last article was written many additions, and it is feared several losses, have to be recorded and accordingly it seemed desirable thoroughly to investigate the collection again.. The present paper is the outcome of this work.

In the first paper of Mr. Ridley, entitled "The Palm Collection of the Botanic Gardens, Singapore," the cultivation and pests of the palms has been rather fully treated, and a list of the palms

in cultivation in the Gardens is appended. In the second paper is a list of new palms introduced into the collection since the publication of the earlier paper.

The present paper is written with the object of drawing attention to the collection and in providing a guide and brief description for visitors to the Gardens, who are interested in Palms. It has been written in a semipopular style accordingly and botanical terminology, synonymy, and citations of other works are given as sparingly as possible. A short description of the collection is first given with a general comparison of the prominent features of the palms. This is followed by a list of the genera represented and a brief note on each species, sufficient to enable them to determined at sight.

Only those species whose identity has been established either from actual determination or from previous records as found on the labels have been mentioned. There are still several not yet named, many of them quite young, but until they produce flowers and fruit it is impossible to determine them accurately and they have accordingly been omitted.

The collection of palms is quite a representative one, including species from most tropical countries. No special arrangement, except in one or two instances, has been followed in planting and the result is by no means displeasing. A fairly large piece of ground near the Gardens Office, has been exclusively planted up with palms, and from the lower end of Maranta Avenue down to the Plant Nursery there extends what is known as the Palm Valley, and as the name implies, the valley has been reserved almost entirely for palm specimens. On the west side, several species have been quite successfully planted in clumps, notably—*Ptychosperma McArthuri*, Wendl., *Cyrtostachys Lakka*, Becc., *Martinezia caryotaefolia*, H. B. K., *Pinanga Kuhlii*, Bl., *Rhopaloblaste hexandra*, Scheff., *Oncosperma filamentosa*, Bl., *Heterospathe elata*, Scheff., *Oreodoxa regia*, H. B. K., *Stevensonia grandifolia*, Dune., *Verschaffeltia splendida*, Wendl., *Ptychoraphis augusta*, Becc.

Apart from these two special places, many specimens are scattered over the remainder of the Gardens. Small avenues have been planted in one or two places, as for example, the avenue of *Arenga saccharifera*, Labill., near the Tyersall Road entrance. There is also an avenue of *Sabal Palmetto*, Lodd., another not quite complete of *Rhopaloblaste hexandra*, Scheff., interplanted with *Phoenix rupicola*, Anders. This latter gives quite a pleasing effect, the tall *Rhopaloblaste hexandra* with its drooping leaflets, and the beautiful curved leaves of *Phoenix rupicola*, make a very pretty picture. Another avenue which must be mentioned, is of *Cyrtostachys Lakka*, Becc., the "Pinang Rajah," "Sealing Wax Palm," or "Red-stemmed Palm." This avenue contains fine specimens of this beautiful palm, so distinct from all others on account of what appears to be a red stem, but is actually the red sheathing bases of the leaves. The remaining plants have either

been planted in rows of single species, or more generally as isolated plants with a view to their developing into worthy representatives of their species. On the whole this latter ideal has been attained and a few very fine specimens might be mentioned such as, *Attalea Cohune*, Mart., near the lake, *Corypha Gebanga*, Bl., near the Herbarium, a young plant of *Latania Commersonii*, L., near the Office, and two very tall specimens of *Livistona altissima*, Zoll., on the Bandstand Hill, and many specimens of *Oncosperma filamentosa*, Bl. (Nibong) and *Elaeis guineensis*, Jacq. Altogether there are about 1085 specimens planted in the Gardens embracing upwards of 120 species and 60 genera.

A Comparison of General Characters.

The variation in growth of the palms allows them to be grouped under three heads:—

(1) Those which are soboliferous, that is whose stems grow in clumps such as *Caryota mitis*, Lour., *Cyrtostachys Lakka*, Becc., *Oncosperma filamentosa*, Bl.

(2) Those which are soboliferous but are not self-supporting, obtaining their support from surrounding trees. This section includes the many species of *Calamus*, *Korthalsia* and *Daemonorops*, and amongst which are many plants of considerable economic importance. Some grow to a great height, topping the highest of our jungle trees. Examples may be seen in the piece of virgin jungle preserved in the gardens, especially at the top end of Maranta Avenue.

(3) Those palms which are single-stemmed, bearing in some cases a magnificent crown of leaves as in *Corypha*, or in other cases a comparatively small one as in the tall *Livistonas*, and *Archontophoenix Alexandra*, Wendl.

A Description of Palms in General.

Root. Generally speaking palms have no tap-roots. After germination the primary root perishes and is replaced by adventitious roots springing from the base of the stem. In *Verschaffeltia splendida*, Wendl., roots are produced up to 2 or 3 ft., and even more above the surface of the ground. These grow downwards and finally become fixed in the soil giving the plant a firm footing. In others such as *Rhapis*, and *Pinanga*, suckers are produced which send up stems and leaves, soon forming fine clumps.

Stem. The height or length of the stem varies considerably and in some cases there is hardly any stem at all as in *Sabal acaulis*. In others however, they may be of any height or length, some specimens of *Calamus* being as much as 300 ft. Except for the last mentioned, no specimen in the Gardens exceeds 80 ft., this height being attained by two specimens of *Livistona altissima*, Zoll., on the Bandstand Hill. As a general rule single-stemmed palms attain to a greater height than soboliferous or several-stemmed palms. In diameter stems vary considerably, from 1-2 inches

in the slender *Calamus*, *Ptychosperma*, etc., to the very substantial looking trunks of *Oreodoxa*, *Metroxylon*, *Borassus*, and *Corypha*, which in some specimens are anything from 3-5 feet.

In *Oreodoxa regia*, H. B. K., the trunk is quite smooth, while in *Archontophoenix Alexandrae*, Wendl., it is ringed by the scars of the old leaves. Other species such as *Attalea Cohune*, Mart., and *Elaeis guineensis*, Jacq., retain the bases of the old leaves which gives them a rugged appearance. Ferns and orchids often obtain a footing in these leaf bases presenting a typically tropical effect. In *Caryota urens*, L., the sheathing bases remain round the stem after the leaves have fallen and are bound together with a dense mass of fibres. Yet other palms have spiny trunks as for example, *Oncosperma horrida*, Scheff., and *O. fasciculata*, Thw.

Very few of the palms have branched trunks. One species *Hyphaene indica*, Becc., is represented in the gardens, but the plants are quite small and are only about six months old.

The Rattans (*Calamus*, etc.,) are almost the only palms whose stems are not self-supporting.

Leaf. As new leaves are produced the old leaves generally die off and fall away. By this means in most cases a fine trunk is produced, surmounted by a magnificent crown of leaves. It is this crown of leaves which gives such a distinctive beauty to palms in general. They vary considerably in size, from the small-leaved *Rhapis flabelliformis*, L'Herit, to the gigantic leaved *Teysmannia altifrons*, Miq.

The variation in the shape of the leaf is considerable, but may be considered under two heads:—

(1) Palmate, in which the leaves are characteristically fan-shaped and

(2) Pinnate, in which the leaves are cut similar to a feather.

Examples of the first are *Livistona*, and *Thrinax*, of the latter *Ptychosperma*, *Cyrtostachys*, and *Oncosperma*.

Feather leaved palms have on the whole very much larger leaves than fan palms. The length of some of them being as much as 30 ft., and their width 8 ft. However, none quite so large are to be seen at present in the Gardens. The angle which the leaf makes with the stem varies according to the age of the leaf. At first when opening, a leaf is almost upright, but as it developes its weight bends it down and the falling away of the lower leaves causes it to hang lower until it in its turn dies and falls away. The leaves of fan palms as a rule form a larger angle with the stem than those of the feather palms. The reason being, that the weight is less evenly distributed, being placed at the end of the petiole, instead of almost the whole length of the leaf as in the latter.

Considerable variation is found in the leaflets. In the pinnate section their relative positions on the leaf-rachis give a distinctive appearance to many species. A few examples in both sections will emphasize this. In the palmate section, one finds in *Pritchardia*

In the Palm valley, Singapore.

grandis, Seem., that the whole of the leaflets seem to be joined up to form one deeply furrowed leaf, having a very strongly-toothed margin. Other species of the same genus *L. peltata*, Roxb., for example are divided almost to the base, producing furrowed leaflets which are very broad and strongly toothed at the apex, narrowing to the base, giving them almost a triangular shape. Good examples of fan-leaves are found in *Thrinax* and *Livistona* in which they are divided from $\frac{1}{4}$ to $\frac{1}{2}$ the length of the leaf. This is the general type of fan-palm.

In the pinnate section the angle which the leaflet forms with the leaf-rachis varies considerably. For instance in *Archontophoenix*, and *Cyrtostachys*, the leaflet is placed more or less at right angles to the rachis forming a fairly flat-leaf. On the other hand in *Rhopaloblaste* and *Oncosperma*, the angle is much greater giving a drooping appearance which is very attractive. The leaflets are generally arranged in two rows one each side the rachis, and as they are more or less opposite, they produce a flat leaf. This is the general arrangement for pinnate-leaved palms. A departure from this method is found in some species, as for instance in *Raphia Hookeri*, M. and W.. Here the leaflets appear to be arranged in four rows, two each side of the rachis. This is due to their being placed at different angles. The two bottom rows, one each side of the rachis, consist of alternate twos or threes placed at the usual angle, while the two upper rows, are the remaining leaflets placed at a very much more acute angle, thus giving the appearance of four rows, whereas in reality there are but two. This arrangement gives a very different appearance to this type of palm, and one fine specimen in the gardens makes a noble-looking plant. Another very distinctive form is that of *Caryota urens*, L. In this species the leaves are bipinnate or decompound, quite an unusual form in the palm-family. In fact this plant appears more like a gigantic tree-fern. One other genus should be mentioned, namely, *Martinezia* from America. In *M. caryotaefolia*, H. B. K., the leaflets, which are of peculiar shape, are placed at intervals in threes and fours on the rachis, the spaces between being clothed with very sharp spines.

The petioles of several species are armed with spines. When allied with spiny stems they form a very formidable barrier in the jungle. Mention has been made of the spiny leaf-rachis of *Martinezia*, this plant has also a very spiny stem. The same combination is found in *Oncosperma horrida*, Scheff., though the leaf-rachis of this species is not so spiny as that of *Martinezia*. Many palms have spines on the petiole only, such as *Livistona*, and *Elaeis*.

The stems and leaves of *Calamus*, and *Korthalsia*, are generally provided with numerous recurved spines, and the leaf rachis is often produced into a barbed, whip-like structure. These spines which are reflexed enable the plants to climb over the surrounding shrubs and to the tops of the highest trees.

The many different positions assumed by the leaves are often taken up to protect the plants from the effects of too intensive

sunlight and the violence of wind and rain. This arrangement adds very much in some cases to the beauty of the plant. *Phoenix rupicola*, Anders., affords an excellent example. The curve affected by the leaves of this plant renders it more beautiful than would be the case were the leaves straight.

Flowers. These are produced in large numbers on large and much-branched inflorescences. They are frequently embedded in the fleshy surface of the branches, and belong to a type of inflorescence known as a spadix. In almost all palms the inflorescences are axillary, only in one or two cases are they produced terminally, as in *Metroxylon*, and *Corypha*. Each inflorescence when in bud, is enclosed in a protective structure called a spathe. This is burst by the growing inflorescence and falls off at once, or sometimes remains to sheathe the stalk and lower branches. The flowers are very small and individually insignificant, but are produced in enormous quantities, thousands often being borne on one inflorescence. Collectively they often present a handsome appearance. They are sessile, and as a rule unisexual, the male and female occupying different parts of the same inflorescence. Very rarely hermaphrodite flowers are produced. In some cases female flowers are borne on the lower branches of the spadix with the male flowers densely packed on the upper. In others as for example in *Pinanga* the female flowers are placed between the male flowers and it is so arranged that two male flowers appear in succession and then the female, thereby making the spike unisexual for the time being. As palms are monocotyledonous plants the general arrangement of the flower is trimerous, that is 3 sepals, 3 petals, 6, or a multiple, stamens, and 3 carpels. In the male flowers the carpels are rudimentary and are called pistillodes and in the female flowers the stamens are rudimentary and are termed staminodes. Pollen is produced in great quantities and probably wind is one of the chief agents in pollination. Bees also play an important part in this matter. Also the writer has seen flower spikes literally swarming with a large type of ant and it seems probable that pollination might be carried out by them. The ovary generally consists of three carpels either quite free or completely united.

Fruit. The fruit is either a berry or a drupe. Two of the carpels may be abortive as in the Coconut, or if the carpels are free, a syncarp of one-seeded fruits results, or again if united, a single fruit with one, two or three seeds, according to the number of ovules which develop is the result. The fruits are on the whole small when compared with the size of the plant, that of the Coconut being one of the largest. This is, however, quite dwarfed by the huge fruit of the Double Coconut (*Lodoicea sechellarum*, Labill.), from the Seychelles.

Seeds. The seeds are of various shapes and sizes. They are round in the Coconut, owing to one ovule only as a rule having developed, whilst in the Date, (*Phoenix dactylifera*, L.), they are long and narrow. Where three seeds are produced two sides are often flattened.

CULTIVATION. A few notes on the general cultivation and propagation of palms in the tropics would it is thought be of use. This has been fully dealt with in "The Agricultural Bulletin S. and F. M. S.," Vol. III, page 250. The following extract is taken from that journal as the notes there given are equally applicable now.

"Although far the greater number of palms are natives of tropical regions a small number inhabit cooler, sub-tropical, or almost temperate regions. Such are *Chamaerops humilis* of Southern Europe, *Nannorhops Ritchieana* of Afghanistan, *Trachycarpus excelsus* of Japan, *Rhapis humilis* of Japan, *Kentia sapida* of New Zealand, and *Pseudophoenix Sargentii* of Florida.

"These cooler climate palms are much less easy to cultivate here and seldom thrive when planted out, although they may be kept as pot or tub plants for a long time.

"There are also a few desert palms, which are also difficult to grow on account of our heavy rainfall, such are *Hyphaenes*, the common date, (*Phoenix dactylifera*), which, however, can be made to grow but has never flowered with us. The Palmyra or Lontar palm (*Borassus*) introduced to India from Africa and thence to the Peninsula, thrives near the sea in sandy places, but seems difficult to grow far inland, and even in the drier parts of Singapore is not at all easy to grow satisfactorily. The Nipa palm so abundant in the tidal swamps does not grow well away from salt mud.

"Exclusive of these almost all the palms from different parts of the world which have been introduced into Singapore have done well and many have flowered and fruited successfully and are readily cultivated.

"SEEDS. Generally speaking palms are reproduced from seeds, in a few instances propagation by means of division or root cuttings is the method adopted. The principal genera from which root cuttings may be obtained are:—*Pinanga, Cyrtostachys, Oncosperma, Iriartea, Oenocarpus, Chamaedorea, Chrysalidocarpus, Wallichia, Arenga, Caryota, Nipa, Licuala, Rhapis, Calamus, Zalacca, Korthalsia, Raphia, Bactris, Desmoncus, Astrocaryum*, and *Sagus*. With these an underground creeping rhizome produces a new growth and it is best to cut or ring this rhizome behind the growth and when a tuft of roots has been formed the cutting may be removed. Root cuttings, however, seldom make nice shapely plants, the process is usually a slow one and the percentage of loss generally heavy, for these reasons when procurable seeds are always preferred.

"In collecting palm seeds it is essential that the seed should be perfectly ripe. This is generally easily determined by the hardness of the seed, that is to say of the albumen, and also by the colour and softness of the fruit, occasionally the albumen seems to be fairly hard before the fruit is ripe enough to germinate. The colour of the fruit is often a help, thus, in *Iguanura* the fruit is first white, then becomes red, and at last black, and when it has arrived at this colour only it is ripe enough for collecting.

"The fruits of palms may be fleshy, fibrous or even woody, and a few have a spiny spathe which has to be guarded against. Fleshy fruits soon ferment and the pulp is easily removed. Fibrous fruits may be macerated for a day or two when the outer covering can be split or peeled off. The Malayan "Kabong" is one of the worst to handle, the juice from the fruits being a skin poison. The Kitool (*Caryota urens*) is also a powerful irritant on the skin. Many palms germinate freely when left to themselves, under cultivation however it is best to remove the outer covering of the seed because of the decay of the pulp or fibrous covering and possible loss from fungus. The period of germination varies from 6 weeks with some to 3 or 4 years with others. Excepting, those palms requiring much space, Coconuts, Sago, it is best to plant seeds in pots or boxes, whichever is used the drainage should be deep and well covered with half decayed leaves to prevent the compost from blocking up the drainage. The compost to be used should be free from fungi and consist of burnt earth, well decayed leaf-mould, some sand, and a little powdered charcoal. Seeds may be planted fairly close, small seeds placed upright, large seeds on one side, or flat, and covered with one-half to one inch of the prepared compost which has been passed through a seive of a fine mesh. After planting the pots or boxes should be thoroughly watered (saturated) placed in a moderately damp situation and afterwards sufficiently sprinkled so as never to be over wet or too dry. Palm seeds when planted must be guarded from rats and mice, and white ants, the surface soil inspected, and excessive damp and fungus removed. The growth is often at first very slow (this is especially noticeable in rattans) but after a year or two the growth increases much more rapidly.

"Seedlings. With most of the best known palms seedlings may be described as fairly hardy and only ordinary attention is necessary to produce strong plants, most failures occur through excessive damp or watering, and the moisture remaining in the axils of the leaves, or because the surface soil is too damp in which case the seedling perishes. A few species of palms have been introduced to cultivation by seedlings collected in the jungle of which seeds have not been procurable. Owing to the different conditions under which such seedlings have germinated care must be taken to wrap the roots in mud immediately on lifting them and the seedlings dug up with a good ball of earth attached to them. The little plants must be kept very moist till they can be planted, and not allowed to get dry by exposure to the sun or they speedily perish. Some jungle palms stand transport fairly well, especially rattans and with some species it is the only way to get them.

"Re-potting. As soon as seedling palms have filled their pots with roots, the young plants should be transplanted or repotted into single pots and a strong compost used. Some loamy soil, well decayed cow manure and leaf-mould, some sand and burnt earth, all well mixed together and passed through a moderately coarse sieve. Let the drainage be sufficient and placed carefully. All loose

and old sour soil removed from the plants, the roots inspected if sound and free from pests, keep lightly syringed for a few days and water sparingly until the plants are established. Palms succeed best when potted or planted deeply, unlike flowering plants the lower roots of palms in thickening raise the plant, and the surface or adventitious roots grow upwards. In repotting or tubbing very strong plants of which the roots have become tightly bound together it is not necessary to disturb the ball or place new drainage underneath it, but a little additional drainage could be placed round the base, and though the plants may appear deeply tubbed at first the surface roots will soon appear on the top."

Selection of Species. The decorative value of palms is so great as to merit their being placed high in the list of decorative plants. The following hints are given with a view to assisting in selection and planting. Having obtained good strong plants, the question arises as to what should be done with them to obtain the best results. This is important as in the case of plants required for household decoration and around the bungalow, it is imperative that the species which make the best pot plants are chosen. In addition it is very necessary to know which species require shade and vice versa. This applies to garden planting generally.

Pot Plants. For this purpose the following species are generally considered best.—*Phoenix rupicola*, Anders., *Thrinax argentea*, Lodd., *Thrinax barbadensis*, Lodd., *Licuala peltata*, Roxb., *Pritchardia grandis*, Seem., *Livistona australis*, Mart., *Livistona chinensis*, Br., *Livistona altissima*, Zoll., *Calamus Lindeni*, Hort., *Caryota mitis*, Lour., *Arenga Engleri*, Becc., *Hyophorbe amaricaulis*, Mart., *Heterospathe elata*, Scheff., *Verschaffeltia splendida*, Wendl., *Ptychosperma McArthuri*, Wendl., *Ptychosperma Sanderiana*, Ridl., *Elaeis guineensis*, Jacq., *Cocos plumosa*, Lodd., *Martinezia caryotaefolia*, H. B. K., *Stevensonia grandifolia*, Dunc., *Rhopaloblaste hexandra*, Scheff., *Chrysalidocarpus lutescens*, Wendl.

Shade is necessary for *Pritchardia grandis*, Seem. and *Ptychosperma Sanderiana*, Ridl., a little shade is appreciated by the majority of the others.

All the above when they have grown too large for pots or tubs, can be planted out in situations which follow the lines already laid down as regards shade.

Specimen Plants. The following species are recommended for planting out in the grounds as specimen plants.—

(*a*) Several-stemmed species—*Chrysalidocarpus lutescens*, Wendl., *Rhapis flabelliformis*, L'Herit., *Caryota mitis*, Lour., *Arenga undulataefolia*, Becc., *Oncosperma filamentosa*, Bl., *Cyrtostachys Lakka*, Becc., *Ptychosperma McArthuri*, Wendl. The above do not require much shade. Some of these species are particularly useful for filling in gaps and where a clump is desirable. It may be mentioned in passing that though very effective *Cyrtostachys Lakka*, Becc., the Pinang Rajah, is a rather slow grower.

Pinanga Kuhlii, Bl., *Pinanga patula*, Bl., and *Ptychosperma Sanderiana*, Ridl., require shade.

(*b*) Single-stemmed species—*Acanthorhiza aculeata*, Wendl., *Livistona altissima*, Zoll., *L. australis*, Mart., *Latania Commersonii*, L., *Caryota urens*, L., *Elaeis guineensis*, Jacq., *Cocos plumosa*, Lodd., *Martinezia caryotaefolia*, H. B. K., *Phoenix rupicola*, Anders., *Dypsis madagascariensis*, Hort., *Oreodoxa regia*, H. B. K., *Actinorhytis calapparia*, Wendl., *Dictyosperma album*, W. and D., *Archontophoenix Alexandrae*, Wendl. None of these require much shade.

Avenue Plants. Many palms lend themselves for this kind of work and the following have proved very effective.—

Sabal palmetto, Lodd., *Caryota urens*, L., *Dypsis madagascariensis*, Hort., *Oreodoxa regia*, H. B. K., *Cocos plumosa*, Lodd., and *Arenga saccharifera*, Labill., all of which are sun rather than shade loving plants.

F. Flippance.

(*To be continued*).

THE FUNGUS FLORA OF HEVEA BRASILIENSIS.

A little while ago an enquiry was received asking what were the fungus diseases of *Hevea brasiliensis*. On consulting the literature on this subject it was ascertained that there was no recent complete enumeration of the diseases that have been found to attack this tree in Malaya. Such lists have been prepared for other countries, as for instance by Petch for the *Hevea* in Ceylon, but the diseases are not necessarily the same in different countries and it seemed desirable therefore to have a list for Malaya.

At the same time the present paper goes further than recording the diseases that have actually been proved and enumerates all fungi, both those that are known to be parasitic and those that are so far regarded as saprophytic, which have been found on Hevea locally.

The importance of having such a list is ably reasoned by Professor C. F. Baker in Vol. II, No. 4 of the "Gardens Bulletin," in his article "Hevea versus Fungi."

The records from which this compilation is made are the works and collections of H. N. Ridley, W. J. Gallagher, K. Bancroft, A. Sharples, W. N. C. Belgrave, R. M. Richards, and C. F. Baker.

It is considered that additions will have to be made to this list from time to time as further investigations produce new records.

Ridley in "The Agricultural Bulletin, Straits Settlements and Federated Malay States," Vol. X, 1911, page 141, quoting M. George Vernet gives on page 143 "a list of all pests recorded to the plant," and numerates 25 species of fungus, ending with the comment, "This may seem a formidable list but it is really small compared with the pests which attract most cultivated plants."

The same remark may equally well apply to the present list but it is to be hoped that the latter part of it may now be modified considerably. One might indeed at first wonder whether the *Hevea* tree would grow at all under the burden of such a number of uninvited guests, and so far no other kind of tree in Malaya has so many fungi observed on it. It must be remembered however that the chief reason so many fungi are here recorded is that so much individual attention has been paid to the *Hevea* by Malayan mycologists. There is no doubt that an equally large number of fungi would be found on any other tree grown under similar conditions and studied so assiduously and sympathetically by experts.

In the present list the fungi are grouped according to their respective habitats. It will be seen that all parts of the tree carry their quota and that all the great groups of fungi are represented.

ROOT AND COLLAR.

Fomes lignosus, Klotsch (*Polyporaceae*). An orange coloured bracket fungus, probably the best known of rubber diseases. Previously, this fungus was known as *F. semitostus*, Sacc, owing to a wrong determination in the first instance. The first specimens in Malay were collected by Ridley in 1896 and forwarded to Kew. Considerable work has been carried out in connection with it chiefly by Gallagher and Bancroft, and is published in the bulletin of the Department of Agriculture, Federated Malay States.

Fomes pseudoferreus, Wakefield (*Polyporaceae*). The "Wet Rot" of Hevea, previously described under *Poria hypolateritia*. Investigated by Belgrave in 1917-1919.

Helicobasidium, (?) *H. mompa*, Tanaka (*Thelephoraceae*). The specimens which were collected by Ridley in Selangor in 1901 were sterile, and could not be definitely determined. Massee considered them a species of *Helicobasidium* probably *H. mompa* which is very destructive to the mulberry in Japan. No further collections of this fungus have been recorded.

Hymenochaete noxia, Berk. (*Thelephoraceae*). A common brown root disease.

Irpex flavus, Klotsch. (*Hydnaceae*). A bright yellow woody fungus first collected on rubber by Ridley in 1897. Bancroft's investigations are published in the bulletins of the Department of Agriculture Federated Malay States. It is considered to be parastic.

Marasmius rotalis, B. et Br. (*Agricaceae*). Bancroft records the mycelium of this fungus as occuring at the base of trees, like "horse hair."

Poria hypolaterita, Berk. (*Polyporaceae*). Investigated by Belgrave and orginally determined as this species at Ceylon. Later a re-determination has referred the specimens to *Fomes psudoferreus*.

Ustulina zonata, Sacc. (*Sphaeriaceae*). A black crustaceous fungus which attacks the trees at their collar causing loss of foliage

and "die back." Investigated by Brooks and Sharples and recorded in the bulletins of the Agricultural Department, Federated Malay States.

Xylaria cynoglossa, Cooke (*Sphaeriaceae*). A small pale coloured tongue-shaped fungus recorded by Bancroft.

STEM AND BRANCHES.

Apiosporium atrum, Massee (*Perisporiaceae*). Found on dead branches. Bancroft does not consider it a parasite.

Asterina tenuissima, Petch, (*Perisporiaceae*). Petch considers that this mould lives on the sugary secretions of the nectaries at the base of the leaves.

Botryodiplodia theobromae, Pat. (*Sphaerioidaceae*). Reported by R. M. Richards as a cause of "Dieback."

Cephalosporium, sp. (*Mucedinaceae*). Recorded by Belgrave as one of the fungi present in "mouldy rot" on tapped surfaces. He also found it a parasite on *Hemilea vastatrix*.

Corticium calceum, Fries, (*Thelephoraceae*). A bark fungus determined by Massee in 1906.

Corticium javanicum, Zimm. (*Thelephoraceae*). A cause of "Pink Disease."

Corticium salmonicolor, B. et. Br. (*Thelephoraceae*). The cause of "Pink Disease." Described in detail by Brooks and Sharples in the bulletins of the Agricultural Department, Federated Malay States.

Cryptovalsa microspora, Sacc. (*Sphaeriaceae*). A new species found by C. F. Baker on rotting stems.

Cyphella hevea, Massee (*Thelephoraceae*). A cause of "Thread blight." Found on the bark by R. M. Richards.

Daldinia concentrica, Ces. et De Not. (*Sphaeriaceae*). A dark chocolate coloured bun shaped fungus forming hard globular masses, occurring commonly on dead wood.

Daldinia concentrica, Ces. var. *escholzii*, Ehrenb. (*Sphaeriaceae*). Found on a dead trunk.

Didymella oligospora, Sacc. (*Sphaeriaceae*). Recorded by C. F. Baker on dead branches.

Diplodia rapax, Massee (*Sphaerioidaceae*). Described by Ridley as a "pestilential black fungus" and named by Massee in 1909.

Diplodia, sp. (*Sphaerioidaceae*). The cause of "Die Back." It is considered to be a wound parasite, that is to say, it can only enter its host through a dead or wounded part. The fungus itself is scarcely visible to the naked eye, and is in the form of minute black dots on the dead shoots.

Eutypa caulivora, Massee, (*Sphaeriaceae*). This fungus forms numerous large black blotches on the trunk and is considered by Massee to be a parasite. Bancroft suggests it is a "wound parasite," and quotes Petch as stating that this fungus is the same as *Nummularia pithodes*.

Eutypa ludibunda, Sacc. var. *hevеana*, Sacc. (*Sphaeriaceae*). Recorded by C. F. Baker on dead limbs.

Gloeosporium alborubrum, Petch (*Melanconiaceae*). Reported on dead shoots.

Hirneola polytricha, Mont. (*Tremellaceae*). A thin dark coloured fleshy fungus occurring in clusters at the ends of dead branches or wounded parts.

Hypochnus, sp. (*Thelephoraceae*). A "thread blight" fungus.

Hypoxylon oodes, B. et. Br. (*Sphaeriaceae*). A black nodular incrusting fungus reported by Bancroft on dead branches.

Hysterium heveanum, Sacc. (*Hysteriaceae*). On dead limbs.

Lembosia glonioides, Sacc. (*Hysteriaceae*). On dead limbs.

Megalonectria pseudotricha, Speg. (*Hypocreaceae*). Bancroft describes this as a bright red minute fungus forming small round bodies the size of a pin's head. It occurs on dead bark and stems. Brooks states that *Stilbum cinnabarinum* is the conidial stage of this fungus.

Nectria diversispora, Petch (*Hypocreaceae*). A common small red fungus, saprophytic on dead bark and fruits.

Nectria sanguinea, Fries (*Hypocreaceae*). An orange red saprophytic fungus found on the bark.

Neotrotteria pulchella, Sacc. Found on the bark by C. F. Baker and described by Saccardo as a new species.

Nummularia pithodes, Petch (*Sphaeriaceae*). Reported by Brooks and Bancroft to be common on dead branches and roots. It is one of the causes of black lines in the wood. Its black fructification has the appearance of a piece of asphalt. Petch considers *Eutypa caulivora* Massee, to be the same thing.

Nummularia repandoides, Fuck. var. *singaporensis*, Sacc. (*Sphaeriaceae*). On dead limbs.

Oospora gilva, Berk. (*Mucedinaceae*). A pink powdery fungus recorded by Bancroft as occurring commonly on burnt rubber stems.

Peroneutypa heteracanthoides, Sacc. (*Sphaeriaceae*). Recorded by C. F. Baker on dead limbs.

Phyllosticta heveae, Linm. (*Sphaerioidaceae*). A disease affecting the youngest shoots and widely spread throughout the country. It is closely associated with the "die back" fungus, and Bancroft considers that in many cases of the "die back" disease the primary cause is this fungus.

Phyllosticta ramicola, Petch (*Sphaerioidaceae*). Recorded by Bancroft as a stem disease.

Phytophythora Faberi, Maub. and P. spp. (*Perenosporaceae*). Very common and destructive parasites credited with causing "Black Thread," "Stripe Canker," "Cambium Rot," and canker of the bark.

Pleonectria hevеana, Sacc. (*Hypocreaceae*). On rotting stems.

Polystictus sanguineus, Fries (*Polyporaceae*). The most brilliant coloured and one of the prettiest of Malayan bracket fungi. Its colour varies from a brilliant scarlet to dark blood red. It grows on all dead wood very commonly everywhere.

Schizophyllum commune, Fr. (*Agaricaceae*). A small mushroom with a lateral stipe growing in patches over dead wood. When wet it is a fleshy colour and expanded but when dry it turns white and the edges become involute. It is densely covered with hairs and is to be found on almost any dead wood.

Sphaeronema, sp. (*Sphaerioidaceae*). Reported by Belgrave to be the cause of "mouldy rot" on the tapped surfaces.

Stilbella hevеae, Limm. (*Stilbaceae*). A minute pin shaped fungus with a salmon coloured head and dark coloured stalk. Reported by Bancroft on dead bark.

Stilbum cinnabarinum, (Mont.) Lind. (*Stilbaceae*). On dead parts, reported by Brooks to be the conidial stage of *Megalonectria pseudotrichia*.

Thyridaria tarda, Bancroft (*Sphaeriaceae*). Considered by Bancroft as the perfect stage of the "Diplodia" fungus, the cause of "die back." Vincens of Saigon also does not think this should be separated from *Diplodia*.

Xylaria obovata, Berk. (*Sphaeriaceae*). On stumps.

Xylaria scopiformis, Mont. (*Sphaeriaceae*). Recorded by Ridley and Bancroft on dead wood.

Xylaria tuberiformis, Berk. (*Sphaeriaceae*). Occurring on stumps.

LEAVES.

Helminthosporium hevеae, Petch (*Dematiaceae*). Recorded by Ridley as attacking the young leaves and proving troublesome in nurseries.

Limacinia javanica, Sacc. (*Sphaeriaceae*). A sooty mould recorded by Bancroft as following on a scale, *Lecanium nigrum*. Such fungi live on the honey dew secreted by the insect and do not actually extract any food from the leaves, although their presence in masking the leaves is harmful in a young plant.

Pestalozzia Guepini, Desmaz (*Melanconiaceae*). This fungus first appears as small grey spots, more or less circular in shape. These spots enlarge and often coalesce and are bordered by a narrow black line. The fungus kills the chlorophyll and consequently causes the grey colour of the leaf. Recorded by Bancroft. This fungus is a very serious disease on tea.

Phyllosticta hevеae, Limm. (*Sphaerioidaceae*). Recorded by Bancroft as a leaf parasite.

Sphaerella hevеana, Sacc. (*Sphaeriaceae*). Recently collected on dead leaves by C. F. Baker, and considered a new species by Saccardo.

FRUIT.

Asterina tenuissima, Petch (*Perisporiaceae*). Recorded by Bancroft in 1913.

Nectria diversispora, Petch (*Hypocreaceae*). A small salmon coloured fungus on dead fruits.

PREPARED RUBBER.

Bacillus prodigiosus (*Bacteriaceae*). Reported by Bancroft as causing red spots on rubber crepe.

Chromosporium crustaceum, Sharp. (*Mucedinaceae*). Reported by Sharples as causing a black spotting in plantation crepe.

Eurotium candidum, Speg (*Perisporiaceae*). A common mould, reported by Bancroft. Sharples considers that the opaque spots on sheet might be attributed to this fungus.

Fusarium sp. (*Tuberculariaceae*). Stated by Sharples to cause a violet flush on sheet rubber. Previously Bancroft had stated this was due to *Bacillus violaceus*.

Monascus heterosporus, Schroeter (*Perisporiaceae*). Bancroft reports this fungus as causing a spotting on prepared rubber. Infection may take place from jungle wood both in the field or in the drying house.

Penicillium maculans, Sharp (*Mucedinaceae*). The cause of a yellow diffused flush on rubber. Investigated by Sharples.

Spondylocladium maculans, Bancroft (*Dematiaceae*). A cause of rubber spotting.

Trichoderma Koningi, Oud. et Konnig (*Mucedinaceae*). Considered by Sharples as the cause of blue black spot on crepe.

The above was already written when an article entitled "Disease Scares" appeared in "The India-Rubber Journal" of 15th November 1919 page 21. The situation is well summed up in the first two paragraphs as follows:—

"We do not think that anyone could visit any part of the East without being impressed with the havoc which diseases have wrought on rubber trees. Even if a visitor to the tropics does not see many rubber estates he is fairly educated on the subject by the Eastern Press. There is a possibility that many individuals who have visited the East for the first time may be led to take an exaggerated view of the danger from diseases, so far as rubber estates are concerned. We do not, as our readers know, wish to minimise the importance of the subject in relation to the future of Eastern plantations but we feel bound to say that in many cases the number of trees affected on particular estates seem to bear some ratio to the activity of the Press and the number of investigators who have reported on the properties.

"Some estates which have not allowed mycologists to visit them declare that they are free from disease. While such a condition may be possible we have very grave doubts as to whether any pro-

perty of considerable age is free from the various bark and root diseases so prevalent throughout the East. We believe that on most plantations there are plenty of affected specimens to be found if the staff is free to search for them. We have generally found that the keener the managers and assistants are the larger the number of cases reported in the usual monthly statement."

It is a matter for consideration as to whether the term "Scares" should be applied to the recording of these diseases which are obviously always with us but only occasionally reported, according to the opportunity the scientist has to investigate them or as they assume undue prominence. They may probably provide a "Scare" for the outside man who is nervous and over anxious about his investment but they should hardly be considered in that light by competent experienced managers for with the assistance of these same scientists who record these diseases, they should feel quite capable of dealing with them and holding them in check.

T. F. Chipp.

Tuba-Root (Derris elliptica).

As an Insecticide.

Readers of George Maxwell's "In Malay Forests" will recollect the graphic account of a fishing expedition where the Malays used the root of the Tuba-plant as fish poison.

Many plants exist in the Tropics, and notably in India, which can be put to the same purpose of killing fish, and Watts' Dictionary gives a fairly long list of them. Throughout the Malay Archipelago Tuba-root appears to be the poison most in use, and a very effective one it is in the hands of expert natives.

The interesting question arises whether the toxic properties of this root are also effectual for the destruction of insect life; for, if such were the case, its application to agriculture is naturally all indicated.

The Chinese appear to have solved the question to their satisfaction, for we know that they employ tuba extensively for the protection of their crops against injurious insects. In Sarawak, the Chinese pepper planters always have, or had (for the writer's visit dates far back) a few bushes of tuba growing alongside their vines.*

Beyond that knowledge, however, the enquiry suggests itself whether the macerated tuba-root, as used by the Chinese, acts as a stomach-poison to chewing insects, when taken with their food, as it does in the case of grasshoppers and beetles, or as a contact poison for insects which obtain their food by sucking as bugs and plant-lice generally do, or whether its toxicity is effective both as a contact and a stomach poison.

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* Tuba-root is now largely grown in Singapore.

The "Journal of Agricultural Research" of 15th August, 1919 published by the Secretary of Agriculture, Washington, has under the title "*Derris as an Insecticide*" an exhaustive article on the subject, and some of its tests and conclusions are given below.

But first, to prepare the ground, the writer may be permitted to give his own experience in the use of tuba-root in the course of his cultural work.

A believer in the orthodox standard sprays and emulsions found in text-books, the writer had only once casually tried tuba-root and that without any notable result. He gave it no further thought until, in the presence of the wholesale and persistent destruction of his bean-plots under the attacks of "*Agromyza phaseoli*" he was persuaded to give tuba a thorough and well controlled trial.

"*Agromyza phaseoli,*" a fly, deposits its eggs under the skin of the stem of the beans, a very few days after germination of the seeds; the larvae feed on the tender tissues of the stems just below the first pair of leaves: the skin a week or so after germination, turns from green to brown and on pressing with the fingers, it is found to be hollow: the leaves fade and drop, and on splitting open the little stem, the small yellow larvae are found imbedded in the destroyed tissue.

Every plot was attacked and such is the virulence of this pest that it is quite an exception for one plant in 20 to survive. Among the many remedies employed against the pest were the following:—

Steeping the seeds in a 5% solution of corrosive sublimate. Rubbing the young stems with lime and powdered sulphur. The application of tobacco dust. Rubbing the seeds in sifted earth sprinkled over with "neem-oil" and putting some of this earth in each hole at the time of sowing.

The last device, alone, proved, to some extent, effective—about 20% of the plants being saved.

A trial of tuba was then made on a field of 8 beds, 66 feet long, with 1056 seeds of Lima Bean (Small Siéva) on the 28th October 1919. Ten ounces of tuba-root were well pounded in a wooden mortar, the juice thoroughly expressed, and the fibre exhausted in 20 gallons of water.

Tuba-water was then applied to each young plant at the rate of a cigarette tin full to 4 plants, morning and evening. This was continued for 15 days, until the plants were sufficiently established to be past all danger, which is only present during the first stage of their existence, when the stem is quite tender.

Only 16 seeds failed to germinate and of the 1040 plants that came up, not one has since died. And to-day, the plot is showing the most vigorous growth, a living testimony to the potency of the tuba-root as a plant-insect killer.

A point worthy of notice is that the "*Agromyza*" fly is there still quite manifest, and every morning, it can be seen in numbers flitting round and about the plants which it still damages to some extent: the pest has not died, but it has been completely prevented from laying its eggs in the young stems. The saving of the leaves, which it perforates to a state of fine lace, is not, by any means, an easy matter, but failing tuba-root, it is hoped, by means of sulphur dustings in the early mornings, gradually to overcome it.

The Tuba-plant "*Derris elliptica:*" in Malay *Akar Tuba,* a leguminose, may be seen growing in the Economic Gardens, as a low bush, but it is a climbing plant with a short trunk and long trailing branches. The root system is extensive and among the bundles of "*akar tuba*" sold in Chinese shops, pieces of root 8 feet long are not uncommonly found. In digging for roots in the Economic Gardens, the longest, so far found, was 5 feet in length: this shortness may be due to the unsuitability of the soil in which it grows—a soil too sandy to retain moisture in hot dry weather. According to a Chinese informant, tuba should be planted not far from water, which attracts the roots, thus favouring early development, and more frequent cuttings.

It is to be noted that the trials related in the Journal of Agricultural Research were made with dried imported roots, which implies, judging from the effects recorded, that it loses none of its potency by keeping.

Long tables are given in the course of the article with details of tests of tuba root applied as a dry powder and as a spray mixture with and without soap.

The following extracts are taken from this paper. A test was made of the effects of tuba as a contact poison on *Aphids,* with a spray mixture of 1 pound of powder to 100 gallons of water with the following results:

Number of	Percentage of Aphids living on plants at the end of						
	1st day	2nd day	3rd day	5th day	6th day	7th day	8th day
Aphids treated							
182	52.2	24.7	10.4	4.4	2.2	0.5	0.5
150	25.3	22.6	7.3	2.0	2.0	0.0	0
209	19 1	11.0	9.0	8.1	5.7	3.3	2.8
172	33.7	20.3	23.2	19.7	19.7	18,6	12.7
Average	35.0	19.6	12 7	8.5	7.4	5.6	4.0
Aphids untreated 159	96	105.6	104.4	137.1	144.6	169.7	235.2

TEST WITH TUBA POWDER USED AS A DUST.

Number of	Precentage of Aphids living on the plants at the end of							
	1st day	2nd day	3rd day	4th day	6th day	10th day	13th day	15th day
Aphids treated								
96	43.7	36.4	31.2	16.6	3.1	0.0	0.0	0.0
157	38.4	21.0	6.3	2.5	.6	0.0	0.0	0.0
111	49.5	29.7	11.7	9.0	4.5	.9	.9	0.0
235	47.6	31.0	16.5	15.3	9.7	1.2	.4	0 0
	44.8	29.5	16.4	10.8	4.5	0.5	0.3	0.0
Aphids untraet-ed. 180	103.3	128.3	146.1	179.4	231.6	315.5	315.5	3155+

These tables (two out of many) are followed with the remark:

"Reference to the two tables shows that the percentage of un-"treated "Aphis" gradually increased from the first day of the "tests onward. The increase was due to the birth of new "Aphids on the untreated plants. Aphids were also born on the "treated plants from the time the insecticide was applied, until "the reproducing mothers had died. Since, practically, all the "Aphids on the treated plants were dead at the close of the tests, "the newly born young ones must have been killed by coming in "close proximity to the particles of powder still remaining on the "plants."

EFFICIENCY OF "TUBA" AS A STOMACH POISON AGAINST VARIOUS INSECTS.

Potato Beetle larvae. Tuba used in various strengths up to 1 pound of powder to 128 galls. of water was found very effective. Practically all larvae were killed within 48 hours. Applied as dust the tests were equally conclusive.

Tent Caterpillars. All mixtures varying in strength from one pound to 8 gallons of water to 1 pound to 200 gallons were found effective.

Apple--tree branches were thoroughly sprayed and, after the foliage had dried, 20 to 40 newly hatched larvae were placed on each branch. The caterpillars began to show signs of discomfort within 48 hours and were practically all dead in from 5 to 10 days. In no case, was any material amount of feeding observed. In a second series of tests the larvae were placed on the branches and

sprayed after they had begun to form their tents. Under these conditions, sprays containing one pound of powder to 50 gallons of water and 1 pound to 100 gallons, killed all the larvae within 24 hours. When 1 pound to 200 gallons and 1 pound to 400 gallons of water were used, all the larvae were not killed within 11 days, but the few which remained alive were very small and inactive.

Used as a dust, this material killed all the treated larvae within a week.

Oak-Worms. Two small oak trees, on which about 300 caterpillars (*Anisota Senatoria*) were feeding, were sprayed thoroughly with Tuba at the rate of 1 pound of powder to 25 gallons of water: soap was added at the rate of one pound to 50 gallons, and a knapsack-sprayer was used. Within 24 hours, the larvae became inactive and ceased to feed, and at the end of 6 days no living ones could be found. As a check on this test, powdered arsenate of lead was applied at the rate of 1 pound to 50 gallons of water, and almost identical results were obtained.

Hyphantria Cunea (caterpillars which weave a web inside which they work, devouring the foliage enclosed). The caterpillars about one third grown, were killed within a week by a spray of 1 pound of powder to 5 gallons of water. Mixtures ranging from 1 pound to 50 gallons to 1 pound to 200 gallons of water were not satisfactorily effective, since nearly all of the sprayed foliage was eaten and not all of the caterpillars were killed.

Datana larvae. Two apple-trees, on which large colonies of nearly full-grown apple datanas (*Datana ministra*) were feeding, were sprayed with Tuba at the rate of 1 pound to 50 gallons of water. Twenty-four hours later, one living larva was found on one tree, and two on the other tree. The ground under the trees was thickly sprinkled with dead larvae.

Cabbage Worms. Applied at the rate of 1 pound to 25 gallons of water all the larvae in two cage-tests were killed within 24 hours.

Methods were employed to trace the tuba-powder and spray mixtures in the bodies of insects and the results show that tuba powder dusted upon insects does not pass into the trachae, but a limited amount of it may lodge in the spiracles: in order that the vapours and exhalations from a spray be effective, it is necessary for the sprayed insects to carry some of the solution on their bodies, in order that the exhalation may pass into the spiracles in as undiluted a condition as possible. After being dusted the insects seem to swallow some of the power which later may act as a stomach poison. Soap solutions containing tuba extract pass freely into the spiracles and finally reach the various tissues, but probably the extract kills by first affecting the nerve-tissue. (The above physiological conclusions are based on microscopical examinations and chemical manipulations too long and too technical to be inserted in this paper).

CONCLUSIONS.

The preceding experiments, much abridged as they are here given, show that the toxic principle of the tuba-root kills insects by acting both as a contact and as a stomach poison. It kills some insects easily, and others with difficulty, but it usually acts slowly and seems to kill by motor paralysis.

The above tests were made under strict control at the Agricultural Boards Testing Laboratory of Vienna (Va). They put beyond dispute the efficacy of tuba-root as a plant-insect poison and give it a high place among agricultural insecticides.

E. MATHIEU.

The Angsana Tree.

Yet another avenue of the Angsana tree (*Pterocarpus indicus*) has succumbed to the "disease" that has already deprived this country of some of its finest avenues. It will be recalled by many how these avenues have disappeared one after the other, first the one on the sea front in Malacca, then about 1907 one hundred trees in Penang, followed by epidemics among these trees at Tapah, Kuala Kubu, Kuala Lumpor and Taiping. A short while ago the avenue along the sea front at Singapore was also swept away. At the end of May this year (1919) some trees at the end of an avenue at Tanglin Barracks, Singapore, began to show the well known symptoms. Four months afterwards the "disease" had advanced considerably along the Avenue, but not successively taking toll of every tree for occasionally one was omitted, but so many trees were affected that it was deemed necessary to cut the avenue down. A look-out was kept for fungi but there was no opportunity to make a detailed investigation of the tissues of the trees. The only fungus collected was one of the tropical varieties of *Polyporus* (*Ganoderma*) *lucidus*, sometimes a stipitate form and sometimes more unguiculate. This is interesting as the fungi formerly collected from these trees have been *Polystictus occidentalis*, Fr., *Polystictus floridanus*, Berk., *Schizophyllum commune*, Fr., and *Polystictus hirsutus*, Fr. So far no fungus has actually been observed in the tissue.

On the other hand it is understood that this tree is generally propagated by means of cuttings. Now there are some who hold that the reason of this tree dying off in the manner it does is a question of senile decay and not of disease. The theory put forward is that the age of the individual tree must be counted from the last time its stock was grown from a seed. It is quite likely this may be many generations and correspondingly a considerable number of years. It is also to be presumed that the avenues and groups of trees which die off at the same time, in the same localities, are planted from the same stock of cuttings and would therefore be approximately the same age. In view of this the following article taken from the Gardens Chronicle Vol. LXVI, No. 4111, page 190 is of interest.

"Mr. Benedict's interesting and valuable investigations on, the senile decay and loss of fruitfulness in plants contained material of special interest to fruit growers. Not the least interesting part of the paper is that in which he appeals to the opinion of that remarkable English horticulturist Thomas Andrew Knight, who, upwards of a century ago (1795) was occupied with this same problem of senility of plants. Knight in fact, came, as the result of his experiments with Apples and Pears, to the same conclusion as that reached by Mr. Benedict, and attributed to senility the gradual failure of different varieties of fruit trees. He found in his grafting experiments that the vigour of grafts was influenced by the age of the tree from which they were taken, and with the acumen of genius he appealed in support of his opinion to the common phenomena presented by certain woodland trees. He observes that certain of them, such as the Aspen, send up multitudes of root-suckers, and adds "were a tree capable of affording an internal succession of healthy plants from its roots, I think our woods must have been wholly over-run with those species of trees which propagate in this manner, as these scions from the roots always grow in the first three or four years with much greater rapidity than seedling plants.

"In another paper published in 1810 and entitled "On the Parts of Trees Primarily Impaired by Age." Knight makes the yet more remarkable comment:—"I am.....disposed to attribute the disease and debility of old age in trees to an inability to produce leaves which can efficiently execute their natural office. It is true that the leaves are naturally reproduced and therefore annually new, but there is, I conceive, a very essential difference between the new leaves of an old and of a young variety." This difference after over a hundred years, would seem to have been now demonstrated.

"It may be added that Mr. Benedict has extended his observations on the veining of young and old varieties, to fruits other than the vine and he found in the case of Apples, Pears, Plums and Peaches that increasing age is accompanied by the same concentration of small veins as occurs in the vine. Hence it would seem that it might be possible to ascertain approximately the age of a tree by an examination of one of its this year's leaves!

"Finally reference should be made to the interesting but purely speculative hypotheses of old age in plants which have been advanced. Of these hypotheses that of Metchnikoff deserves mention. It may be described as the "guilty organ" hypothesis, in that he ascribes old age to the failure of one organ of the body: in the human body the large intestine is the sinner; in annual plants Metchinkoff ascribes to the flower-head the guilt of producing toxins (poison) which destroy the vegetable parts.

"Another hypothesis ascribes senility to cell specialisation. On this an unspecialised cell is immortal, but a cell, the moment it becomes a specialist at certain kinds of work puts off immortality and becomes mortal; but against this view is the fact that a

differential plant cell may resume its powers of growth and division becoming once again embryonic and thereby resuming its immortality.

"Whatever be the final verdict on Mr. Benedict's discoveries we cannot but be grateful to him for getting away from words and appealing to facts. Nor will horticulturists be slow to accept the moral that it behoves us to go on producing new varieties by cross breeding, for whether or no all existing varieties are doomed sooner or later to old age, the fact remains that there is still room for improvement among all our cultivated varieties of fruits and plants generally."

It would be interesting to have authentic records of the behaviour of Angsana trees raised from seed.

T. F. Chipp.

Echinodia theobromae, Pat.

The following notes are in continuation of the article in the "Garden's Bulletin" Vol. II, No. 5, page 144. Further specimens of *Echinodia theobromae*, Pat. as described by Patouillard in the Bulletin de la Société Mycologique de France" Tome XXXIV, 2nd Fasc. have been obtained growing on small branches of a Quercus in the Botanic Gardens, Singapore. The smaller specimens agree entirely with the original description of Patouillard. In the larger specimens, which do not exceed 3 mm. in diameter, the older or generally middle portion of the specimens developes a typical polyporaceous tissue. The pores whose length is the same as the height of the plant, constitute the whole of the specimen except the thin crust of hyphae which is directly applied to the support, and the crust covering the outside edges of the specimens from which the stilboid fructifications arise. The transition from stilboid to porus formation is abrupt, the stilboid columns at the transition area quickly becoming the pore walls of the inner pore surface. The pore surface often presents a lenzitoid appearance. The diameter of the pores is small about 0.20 mm. No spores were found within the pores. (Singapore Field No. 5143).

T. F. Chipp.

Paddy in the Economic Gardens.

Two adjacent fields measuring together 4398 square feet, or say, one tenth of an acre were put under Paddy on the 20th July.

The land selected is almost an ideal one for the purpose, being a flat of light sandy loam overlying a clay subsoil, which, owing to the low configuration of the ground, drains itself very slowly. After grubbing up the roots, which were heaped and burnt, the land was thoroughly broken up and strewn with the ashes. A corner of the field, 12 feet by 12 (= 144 sq. feet)* was, after 3

* Note—In Cochin China the rule generally followed is to allow, for the nursery 2 hundredths of the acreage to be planted.

hoeings, reserved for a nursery, with a small ridge on all four sides to retain the water which was poured over it from a water-hole near-bye. One coolie was then put to tread the earth to a soft mud consistency, which was then levelled and smoothed. A quantity of 4 ounces of paddy, water-tested, which is equivalent to 75 pounds for one acre, was sown on the surface.

The paddy, so-called "hill paddy," used for seed, was unfortunately a very mixed lot containing many different varieties from the purple red "pulut rice" to various shades of brown and yellow, with black awns, or yellow awns, or no awns at all. One variety showed two well defined longitudinal brown stripes on a yellow husk. Some showed later a tall habit of growth with drooping ears, others grew shorter stems with ears almost erect.

As, however, there was no time to ascertain by selection the respective qualities of each individual variety, the seed was sown as it was received.

Transplanting began in the middle of August, when the seedlings were about 12 inches high. This was done after the nursery had been thoroughly watered, so that, the soil being wet and loose, the seedlings could be taken up with a ball of earth round their roots. The planting was done by women on lines one foot apart with ten inches' space on the lines, more or less regularly. Instructions were given to plant only one seedling per hole, and this, was adhered to as much as possible.

So far, the method applied had been that usually followed by natives in planting wet rice, under irrigation, except that the planting of wet rice is done when the fields are already under water, which was not the case here.

From the time of transplanting, the young plants were left to shift for themselves under the ordinary conditions which obtain for "hill" or "dry paddy," that is to say they received only the water from rains and no further labour was spent on them except a weeding before the flowering, and also that of scaring birds away, which was performed by a boy.

It may be here stated that the term "*dry paddy*" is open to misconception, for although hill paddy can be grown without irrigation, it, nevertheless, requires a considerable amount of rain at somewhat frequent intervals. Where such conditions do not prevail, where rains are not fairly dependable, the crop of so-called "*dry paddy*" has but poor prospects.

On the 10th December, about 4 months after transplanting, the cutting of the crop began at the ripest end of the field, the work henceforth was all done by Tamil women, who show quite a liking for it, and a marked expertness.

The harvesting was done by cutting the panicles with their stem down to the top leaf, the straw being left standing. Each woman having secured a handful of panicles tied it with the top leaf and laid the sheaf down to proceed further,

When the cutting was finished the sheaves were gathered and taken to a smooth piece of ground, where they were opened and exposed to the sun. At night the whole was taken up in mats and put under shelter.

Threshing began two days after by beating the ears with sticks, which causes the grain to drop to the ground. The small amount of broken straw which was on top was gathered by hand, leaving the paddy and chaff below. A first winnowing was done with the "neeru," a tray made of bamboo strips, to separate the grain from the finer pieces of broken straw, and a further winnowing was gone through to separate the light empty grains from the full grains, an operation requiring a great deftness of hand.

The crop taken off the 1/10 acre plot planted amounted to 16⅓ gantangs, which corresponds to a yield of 163 gantangs, weighing 937 lbs. per acre and is much below what might be expected from a trial made under such generally favourable conditions as described above.

But yet, from the first, the writer was under no illusion as to the possibilities of failure of this plot. It might give a satisfactory return—and it might not. An undrained swamp under a semi-aquatic vegetation of "Pandanus" and wild grasses, the land, until it was broken up, constituted an ideal breeding-ground for fungoid and insect pests, and it was a question whether after the thorough tillage (and thereby aëration) which it received, these pests would rally quick enough seriously to injure a crop new to it and a quick crop at that. Certain rotations, as it is well known, are devised on the immunity of certain crops to pests which attack other crops. If the paddy crop had matured, as some races do, in three months, it would have been a bumper crop but even at an early stage, when Mr. Richards, Entomologist to the F. M. S. Agricultural Department, saw it, the crop was already seriously attacked by a grub which he identified as "*Schoenobius bipunctifer*," a grub frequently found in stems of rice throughout India, and from that time, empty white ears were every day more and more conspicuous throughout the field. This borer belongs to the family of "Pyralidae" which, of all insect pests, is according to Lefroy's "*Indian Insect Life*" one of the most destructive to crops and stored products. The damage is done while in the larval state, it is hidden in the stem and its presence is only revealed when the ear of the paddy is actually dead, no grain being formed for want of the material which has gone to feed the grub.

Added to the toll taken by this pest, the depredations of birds seemed likely at one time to finish the crop. By dint of shouting and empty tin-beating, they were not allowed to have it all their own way, but many ears showed a heavy proportion of emptied husks. It is possible that the damage caused by birds is greater in small isolated spots surrounded, as was the case here, by trees and wild vegetation, where they find immediate shelter (to emerge

again a few minutes later) than on extensive paddy fields, where they have no shelter except by long flights. Be this as it may, they proved to be a most serious cause of loss in the present instance.

The above digression tends to emphasise one point, namely, the necessity of a clean field, especially in the case of so-called "dry" paddy. In the case of "wet" paddy, prolonged immersion under water tends to destroy or to check the breeding of noxious pests living in the ground; this is not the case with "*dry*" paddy which is only partially protected even by the most thorough cultivation. One may, it is true, come across very promising native paddy plots, raised without any cultivation to speak of, on virgin soil newly-cleared of its forest timber, but the case here is very different, for forest land is free from the pests which infest foul grassy plots where *Pyralidae* and *Noctuidae* breed freely.

Reverting to the crop taken from the paddy plot in the Economic Gardens, a test was made with 2 katties of the clean, threshed paddy, after five days' drying. It was made into "*Parboiled*" rice by first steeping the paddy some hours in water, then boiling it for 40 minutes when the husks began to crack, then drying it, and finally husking it with the ordinary mortar and pestle.

The result for 2 kattis (2 lbs., 10 ozs.) was:—

	lbs.	ozs.
Clean rice fit for the the table ..	1	12
Broken rice		1¼
Husk and small broken rice ..		9¼
Fine bran		½
	2	7

The balance being probably moisture.

The rice, raw, had a pleasant odour and, cooked, an agreeable flavour without the nauseating smell which generally accompanies parboiled rice bought from the shops; smell which is due, most probably, to the steeping of the paddy in water which is rendered foul by the repeated immersions which it is used for.

As already stated, the seed employed in this trial was very mixed and the crop obtained naturally reflected this heterogeneous character. Hence no conclusion can be drawn without further trials, after selection, as to the best variety among the different types harvested, the more so as their destinctive characters, the results possibly of crossings, may not be constant.

The writer is unaware whether investigations have been made in Malaya with a view to the improvement of the local races of rice. Mr. Pasqual's very able pamphlet "Paddy planting in Malaya" has just a few words on the subject. Yet, we read that the relative outturn of paddy per acre in Burma and Malaya is as 13 is to 8, other things being equal, by which is meant, we presume,

equal soil fertility, equal seasonal conditions, equal facilities of irrigation. Thus we may take it that, whereas the Malay wins 150 gantangs, (say), from one acre, the Burmese wins 243 gantangs i.e. 93 gantangs more, or just about enough to feed, under present conditions of shortage, two people for one year.

When we read this, we naturally seek an explanation in one of the two following reasons, or in both:—

No. 1 Faulty cultivation.
" 2 Poor seed.

The writer lays no claim to expert knowledge in the cultivation of rice, having had but a passing acquaintance with it, until a few months ago. Having, moreover, never been to Burmah, he is unable to compare the two modes of cultivation of the Burmese and the Malays, the only comparison he is able to make is with the little he has seen of it in Java, and in Cochin china, and judging by these standards, he cannot but be of opinion that the Malay paddy planter is the less efficient of the two. Perhaps it is due to the scarcity of buffaloes that the land is less thoroughly puddled, less plowed and rolled; to the scarcity of Kampong population, that the preparation of the land is so scanty, the maintenance of its fertility so little thought of, the embankments so inefficiently made. During a recent trip of the writer through the Malay States, as late as last November, Malays could be seen in the Krian District, still preparing their land for the planting of the paddy crop—that is, if such work as he saw can pass as preparing the land. This consisted in cutting the stubble and rank grasses with the "Tajak" and piling it in straight lines, in squares, actually to form the banks. That stubble which should have gone back to the soil for the sustenance of the crop, was made simply to serve as pathways through the fields. Such treatment of the land not only tends to starve it, but it must also foul it, as these piled up grasses will surely, bye and bye, serve as harbours for rats and vermins, and then what of the crops?

Regarding the amelioration of the seed, that is a matter in which the individual planter can do but little. He may, and does, in countries where husbandry is highly developed, like Japan, obtain by rough methods of selection, a certain degree of uniformity in his crops, but the establishing of improved strains of a permanent character is a work of slow processes, which Governments alone are competent to carry through.

Such work is now being eagerly pursued in regard to wheat in all wheat-growing countries and, now, following the methods of pedigree cultures from single seeds initiated by the Slavof Station in Sweeden, Japan, Java and India have also opened stations for the close study of the cultivation and improvement of rice. High yielding varieties have already been obtained and Buitenzorg was credited, a few years ago, with having raised on its trial fields a variety yielding 76 pickels of rice per bouw (2½ tons per acre).

As an illustration of the difficulties which confront the plant-breeder in the selection and improvement of rice, the crop now under review affords an instance. The paddy with awns was found after stripping it of its awns to be lighter than the awnless paddy, but, on the other hand, it was 12 to 15 days earlier in ripening, thus combining the very desirable quality of earlier maturity with the twofold drawback of lighter weight and of awns which are a decided disadvantage as, in the sifting with the "neeru," they have a way of sticking fast to the empty grains, thus hindering the proper sorting of the paddy.

Without aiming at such severe and necessarily slow methods, it should be possible for the paddy cultivator, if not always to improve, at least to maintain the quality of his crop, by a system of simple selections, which should commence in the field, by plucking separately a few, say a couple of hundred, of the best panicles, those that present the largest number of spikes with well formed and close-growing grains. If, as in the case here, the crop is a very mixed one, further classification is necessary by separating the samples under their most prominent character of external appearance, such as shape, colour of the glumes, colour of the awns, and absence of awns. If the ears taken off the field present a general appearance of uniformity, the grain should be picked off the upper third of the ears, and amongst those grains the heaviest and brightest coloured should be selected for seed for the future crop. There is not a doubt that the grains on the top part of the ear are the best and heaviest. The writer has made several comparative weighings of grains taken from the lower half of the panicles, and of grains from the top, and, for an equal number of grains, the difference of weight has always been in favour of the upper grains; in one case, 100 full grains of the upper part of the panicle weighed as much as 156 full grains of the lower part. This difference is observed in husked as well as in the unhusked grain. Having proceeded so far in his selection the cultivator may immerse his seed in water and throw out any grain which floats, thus eliminating all weaker and damaged seed: lastly, following the Japanese method, he can drop the seeds in salt solutions of varying strengths—thus securing, for sowing, the denser seeds which are generally found to germinate and ripen quicker.

Instead of sowing his seeds straight away in the nursery, they can be previously made to germinate under wet gunny bags, and sown after germination. Here again selection can take place to some extent.

In the writer's opinion the trend of selection should be, after weight of grain and early maturing grain, from the awned to awnless, and from dark-coloured rice to white, but of course, the cultivator knows best where his interest lies, and it is up to him to answer the demand of his market.

E. Mathieu.

Notes on Hevea confusa Hemsl.

In Vol. II No. 4 of the "Gardens Bulletin" a description was given of *Hevea confusa* which is considered to be an undesirable neighbour to *Hevea brasilensis*, although in general appearance it is not easy to tell them apart. In reference to the above article the following letter has been received from Prof. J. B. Harrison, C.M.G., Director of Agriculture, Demerara. It would appear that the plants at Singapore were raised from Prof. Harrison's seeds. "Your records will show you that about 1910-1911 I wrote to your gardens seeking information about the seeds of *Hevea confusa* sent there from here about 1898-1900. Will you kindly inform Mr. B. J. Eaton that his analytical results on the rubber fully confirm those obtained here about 1910-1911 during the large scale tappings of *H. confusa* trees in our forests. We showed the *confusa* rubber at the Rubber Exhibition of 1911. When the soft rubber is kept for a length of time it very slowly gains resiliency and finally resembles slightly tacky or very inferior rubber from *H. brasiliensis*. Towards the end of 1910 the *H. confusa* rubber was valued in the U. S. A. at approximately 66% of the then price of hard para rubber. Some hundreds of pounds were said to have been used in the factory tests. It was I believe, finally used as an ingredient in mixings for vulcanite.

"*H. confusa* has proved to be a most objectionable tree. Experience has shown that cross-fertilisation between *H. confusa* and *H. brasiliensis* readily takes place but, worst of all it appears in the Guianas to be the forestral host plant of the organism giving rise to the leaf-disease of Para rubber, which disease has practically put an end to the chances of successful Para rubber cultivation in French and British Guiana."

A small seedling has been planted in the Botanic Gardens near the Herbarium and far removed from any *Hevea brasiliensis*.

T. F. C.

A Pest of Lima Beans.

A beetle which has been very troublesome in eating the leaves of the Lima Bean plants was submitted to the Rev. G. Dexter Allen for determination. In his reply Mr. Dexter Allen says:—

"The insects you sent are Phytophagous beetles of the Section Eupoda and almost certainly belong to the Genus Cryptocephalus, the species is very probably un-named as yet. The genus has very numerous representatives in the Indo-Malayan Insect Fauna, and this is about the smallest species of the genus I have seen. These beetles generally feed on the leaves at night and are therefore difficult to exterminate. I have often collected Phytophagous beetles, never so small as these however, with some one carrying a hurricane lamp for me. Spraying the leaves is frequently useful, nicotine and arseniate of soda might be tried experimentally."

T. F. C.

On the Pollen of Carica Papaya.

The following notes on the flowers of the Papaya (Carica papaya) are compiled from the observations of some plants grown in the Economic Gardens, Singapore.

An examination of the pollen of different types of flowers showed a considerable difference in the germination of the pollen grains but unfortunately, owing to thefts of fruit the ultimate results of the work could not be observed.

Pollen from four different types of flowers was examined. 1. Flowers with ten stamens from dioecious plants. 2. Flowers with ten stamens from plants bearing both male and hermaphrodite flowers. 3. Flowers with five stamens from hermaphrodite plants. 4. Flowers with ten stamens from hermaphrodite plants. Flowers with the number of stamens varying between five and ten were omitted.

In all cases the pollen grains appeared to be identical. When dry the germ spore is not visible but when the grain has been soaked in water it swells up, becomes turgid, and the germ spore can be distinctly seen.

To ascertain if there was any difference in the time taken for the pollen from the four different types of flowers to germinate, pollen grains were cultivated in a sucrose gelatine medium in a hanging drop culture.

In the first experiment pollen from the first and second types of flowers mentioned above behaved practically the same, all the grains germinating and growing well. Similarly the pollen from the third and fourth types of flowers behaved almost identically but they both germinated several hours later than those of the first two types.

A second experiment was conducted using pollen from the first two types of flowers only, when it was found that pollen of the first type germinated half an hour before that of the second type.

The deductions to be drawn from these records so far as they effect pollination are not at present quite evident, and require further observations to be carried out.

G. B. Deshmukh.

Some Trials of Food-plants in the Economic Gardens, Singapore.

Ragi ("Eleusine Coracana")

In the *Singapore Free Press* of 23rd October, will be found a short account of this plot, of the method of cultivation followed, and an estimate of the yield of seed expected.

Briefly, this plot of 3980 square feet or say, one eleventh part of one acre, was stocked with 2675 seedlings transplanted on the 20th July from a nursery sown on the 29th June. The plot was divided into 18 beds, and the planting was all done on these raised beds at 12 by 12 inches.

An estimate made on October 5th put the expected crop at 20,000 panicles yielding 177 lbs. of clean dry seed.

The last gathering has now taken place and the result of the crop is shown by the following figures:

Dates of picking.	Number of panicles.	lbs.	ozs.
28th September	218	2	—
1st October	360	3	15
6th ,,	880	7	11
9th ,,	1030	8	8
12th ,,	not counted	4	2½
16th ,,	430	2	—
20th ,,	970	10	8½
26th ,,	4000	48	—
3rd November	10000	80	—
10th ,,	7000	17	—
Totals	24888	183	13

Thus the crop of one eleventh of one acre totalled 183 lbs. 13 ozs. of clean dry ragi ready for grinding, equivalent to 2000 lbs. or 300 gantangs per acre.

It is probable judging from the number of panicles collected, which is far in excess of the estimate previously made, that the crop would have been greater but for the depredations caused by birds. Although a boy was employed lustily beating a kerosine tin, it is feared that the toll taken on Sundays and holidays was somewhat considerable, as is shown by the short weight of the last picking of 10th November, which for 7000 panicles only gave 17 lbs. of clean seed—a great number of panicles being found empty of seed. The crop was sold at 7 cents per lb. realising $12.80 which is equivalent to a gross return of $140.80 per acre.

From the date of sowing the seed in the nursery on 29th June, to the last picking, the crop had occupied the ground for 4 months and 12 days .

The piece of land on which this trial was made is very low, rather wet and liable to floods, with a loose friable and deep soil, quite suitable to the cultivation of ragi if it could be properly drained. Fortunately no flood occurred to spoil the crop, and the weather was moreover propitious throughout, except just towards the end when excessive rains may possibly have delayed the ripening of the grain, affecting thereby the colour of the seed which lacked the brilliant orange tint of the previous lots.

Except the changkoling of the land and the making and raking of beds, the work, from the transplanting of the seedlings to the harvesting of the crop and the de-husking of the grains, was almost wholly performed by women, who seem to take to this work with the zest which attaches to the familiar tasks of farm life.

The gathered crop was treated in the following way. The panicles, cut close to the base of the spikelets, were brought in in baskets and put in heaps of ten, then in heaps of 100 to get an exact count of the crop. The whole day's gathering was then exposed to the sun on a concrete floor and after a few hours drying, the whole was trodden under with the feet, the right foot being now and again used in a twisting motion to tear the spikelets asunder. The result was a mixture of husks, of nerves of panicles, and of grain which was then taken up on trays, the ordinary "neerus" of the country—and there, after three circular motions and a final jerk upward, the seed, absolutely clean, was dropped in a basket in front, the remaining waste being thrown aside. This work requires great deftness of hand and tamil women excel at it.

E. MATHIEU.

(*To be continued.*)

Coconut Bud Rot.

The Philippine Journal of Science Vol: XIV, No. 1, January, 1919 contains a valuable addition to our knowledge of the disease known as "bud rot" which causes such severe losses of coconut trees throughout the tropics. Mr. Otto A. Reinking after giving a short history of the symptoms of the disease gives in detail his investigations both in the laboratory and the field. In his conclusions he states that the actual cause of the disease is a fungus *Phytophthora Faberi* Maubl. which in the majority of cases is quickly followed by bacteria which rapidly destroy the weakened tissues, causing the familiar rot.

As the fungus is the same that attacks coconut seedlings, cacao fruit, Hevea rubber seedlings, and papaya fruit, and as it is impossible to cure trees badly infected he gives the following instructions:—

1. Systematic inspection, condemning and burning of all diseased coconut trees.

2. All parts of diseased trees must be burned, otherwise the organism will live as a saprophyte on dead matter, and then spread to healthy trees.

3. Clean cultivation ought to be practised in all groves.

4. Under no circumstances should coconuts be interplanted with cacao or papayas.

5. If coconuts are planted near diseased Hevea rubber, precautions should be taken to avoid the spread of the disease.

6. Trees in new groves must be planted 10 meters apart each way. This spacing is one of the most satisfactory means of control against bud rot, and at the same time tends to give the highest production of nuts.

T. F. C.

Reviews of Local Publications.

From a perusal of the recent publications of the Scientific departments of the surrounding countries one is struck with a noticeable change in the type of article now appearing. Hitherto one has had the preliminary records and interim reports of the pioneer who tackled any subject that from time to time assumed economical importance. Now one sees on all sides attempts to sum up the information so far gathered and published piecemeal and the result is a series of comprehensive papers, one might almost say monographs, which are now appearing and which deal exhaustively so far as our knowledge up to date goes of whole subjects rather than isolated and unconnected items. It would seem that the first period of preliminary investigation of the poineer who was an all round scientific and technical man has closed and that in future the specialists who have been arriving in these parts in recent years will each conduct his investigations heneceforth in a much more restricted field but correspondingly probing into his subject all the more deeply.

In illustration of these comprehensive articles referred to the following are representative.

Plantes et produits filamenteux et textiles de l'Indochine. Crevost et Lemasie. Bulletin Economique de l'Indochine, 1919, No. 138. A brief description is given of each plant and the manner in which the fibre is obtained. The plants are arranged according to their Natural Orders. The article is illustrated by fifteen wood cuts which greatly facilitate the determination of the plants, and five photographs shewing plantations and the preparation of fibres.

Studies of Philippine Bananas. E. Q. y Arguelles. The Philippine Agricultural Review Vol. XII, No. 3. This is a comprehensive study of the varieties of bananas in cultivation in the Philippines. It is estimated that the College of Agricultural has over 600 varieties under culture and about one third of them have been definitely identified. A key is given which enables these varieties to be recognised, and is followed by descriptions of varieties of *Musa sapientum.* Thirty four plates are given at the conclusion of the article which enables one readily to distinguish the differences between the different kinds of flowers and fruits.

A biological and systematic study of Philippine Plant Galls. L. B. Uichanco. The Philippine Journal of Science Vol. XIV No. 5. This subject has been treated in a series of articles on Javanese, Sumatran and Celebes galls by W. and J. Docters Van Leenwen-Reijanvaan of Buitenzorg, but the present article on the Philippine galls is in English and therefore much more accessible to residents of Malay.

The galls and their causative insect agents are described in detail and the fifteen plates accompanying the article greatly assist in their identification.

Bamboos. To anyone interested in bamboos the handbook on this subject by Brown and Fischer issued as Bulletin No. 15 of the Philippine Bureau of Forestry is a most useful work. A key is given by which the species can be determined in the field from general observation and without entering into minute detail. General descriptions of the species are given, cultural notes and the results of observations of the plant grown in plantations. Thirty three photographic plates shewing the characteristics of the species individually and in plantations increases the value of the work.

Philippine Mangrove Swamps. W. H. Brown and A. F. Fischer. Bulletin No. 7 of the Bureau of Foestry of the Philippines is devoted to an account of Mangrove swamps. A list of species to be found in the swamps is given and a special key based on superficial characters which enables one to ascertain the name of anything down to a fern. Although primararily a study in the Philippines, Malay native names are included which greatly enhances its value to us in Malaya. A general description is given of each species and the cultivation of mangrove forests and their estimated yield of timber is recorded. Its economical uses are considered both as a firewood and as a tanbark and dye. A chapter is devoted to the uses and cultivation of the Nipa Palm. The whole booklet is lavishly illustrated by photographs and forms a valuable addition to the handbooks of special ecological formations of this part of the world.

Fruit Culture in Malaya. J. N. Milsum. The F. M. S. Department of Agriculture, Bulletin No. 29. This book bringing together our knowledge of local fruit trees and their cultivation has long been needed, and the want is supplied in the present publication. The author begins with a discussion of the past and present position of fruit cultivation and then suggests lines on which local fruits can be improved. General methods of cultivation are given and discussion on soil and diseases.

The article concludes with descriptions of fruit trees according to their general utility, and suitable localities. Twenty three excellent photographs of fruits and trees are included in the work.

Food Production in Malaya. F. G. Spring and J. N. Milsum. F. M. S. Department of Agriculture Bulletin No. 30. This is a companion volume to the preceeding and treats of the cultivation of food crops in general from all points of view.

T. F. C.

RAINFALL at the Director's house, Botanic Gardens, Singapore during the first half of the year 1919, in inches. Readings taken always at 8 a. m. and credited to the date in which the twenty-four hours begin.

Date.	Jan.	Feb.	March.	April.	May.	June.
1	trace.	.12	nil.	nil.	.04	.52
2	.09	nil.	.09	.14	nil.	.44
3	3.99	nil.	1.42	.60	.23	.99
4	.06	trace.	1.04	.06	trace.	.24
5	.17	nil	.22	.23	nil.	.02
6	.29	nil.	trace	nil	nil.	.02
7	.09	.13	trace	nil.	.35	trace.
8	.18	1 04	2.08	.18	.44	.49
9	05	.07	.09	.06	1.68	.01
10	.09	nil.	.40	.29	trace.	nil.
11	2.06	nil.	.02	1.15	.32	.02
12	1.46	nil.	trace.	1 03	.01	nil.
13	.29	.21	nil.	nil.	.01	.81
14	nil.	nil.	nil.	nil.	nil.	.01
15	nil.	.72	.02	.03	.02	.01
16	nil.	.27	.26	.02	nil.	nil.
17	.01	nil.	nil.	.02	.01	trace
18	.19	nil.	nil.	.12	.52	nil.
19	.03	.16	nil.	.55	1.09	nil.
20	1.21	.33	trace	.03	.03	trace.
21	.10	nil.	.20	.17	nil.	nil.
22	.01	.63	.02	.77	.15	nil.
23	.36	.59	trace.	.04	.50	trace.
24	.41	.02	.96	nil.	.15	.16
25	trace.	nil.	.26	nil.	1.24	nil.
26	1.16	.34	.04	1.47	.03	trace.
27	.74	.03	trace.	.33	.01	.54
28	.78	.08	1.26	nil.	1.13	.04
29	trace.	...	.96	trace.	.48	trace.
30	.67	...	nil.	.03	.02	.01
31	.83	...	.58	...	nil.	...
	15.32	4.74	9.92	7.32	8.47	4.33

RAINFALL at the Director's house, Botanic Gardens Singapore during the second half of the year 1919, in inches, Readings taken always at 8 a.m. and credited to the date in which the twenty-four hours begin.

Date.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.01	2.01	trace.	.02	.40	.01
2	nil.	.50	.13	.45	trace.	.26
3	nil.	.01	nil.	.35	.65	.29
4	nil.	nil.	.43	.45	.27	.03
5	.04	nil.	trace.	.60	.14	nil.
6	trace.	nil.	nil.	.20	trace.	nil.
7	.02	nil.	nil.	1.00	.10	1.20
8	.12	.04	nil.	.36	1.35	.67
9	2.20	nil.	nil.	1.35	.24	.26
10	.01	trace.	nil.	.11	trace.	nil.
11	.02	.36	.18	1.67	.25	.86
12	.01	trace.	.02	trace.	nil.	.28
13	.02	.05	trace.	nil.	.95	.19
14	.42	nil.	trace.	nil.	trace.	trace.
15	.02	nil.	.03	nil.	.47	.19
16	.01	2 38	nil.	nil.	trace.	.02
17	trace.	nil.	nil.	trace.	trace.	nil.
18	.15	trace.	nil.	nil.	.06	trace.
19	.38	.03	nil.	1.40	nil.	.30
20	.21	nil.	trace.	.01	.18	.33
21	2.05	.06	.05	.01	.77	trace.
22	.15	nil.	.86	.07	.06	1.63
23	2.07	.90	trace.	trace.	trace.	1.25
24	.21	nil.	.02	nil.	.05	.39
25	nil.	nil.	2.70	.20	.02	.15
26	nil.	nil.	.15	nil.	.43	.02
27	nil.	.08	nil.	.85	.01	.01
28	nil.	.05	.07	.04	nil.	.08
29	nil.	nil.	.09	trace.	.73	.18
30	nil.	nil.	.09	trace.	.62	.02
31	nil.	.15	...	1 80	.01	.13
	8.12	6.62	4.82	10.94	7.76	8.75

RAINFALL at the head of the Waterfall Gardens, Penang during the first half of the year 1919, in inches.

Reading taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of George Town, Penang.

Date.	Jan	Feb.	Mar.	Apr.	May.	June.
1	...	...	...	...	.25	...
2	...	...	...	.95	...	...
3	...	...	...	...	.42	1.30
4	.08	...	...	.66	1.85	.12
5	...	...	...	...	.19	...
6	.20	...	...	.85	...	...
7	.86	...	...	.25	...	...
8	.03	...	.09	.05	.05	...
9	...	...	.13	...	.30	...
10	.04	.53	...	...	1 84	...
11	...	...	...	.30	.03	...
12	...	...	...	1.75	.34	..
13	.24	...	...	...	...	.18
14	...	...	1.28	...	.26	...
15	...	.14	..	.03	.22	...
16	...	...	.06	.07	.03	...
17	...	...	...	.61	.25	..
18	...	1.16	...	.03	. .	...
19	.25	...	...	.17	...	...
20	.55	...	...	.32	.19	.33
21	...	...	...	.03	.17	.18
22	...	1.85	.31	...	...	...
23	...	...	.07	1.85	.62	...
24	.07	...	1.13	.55	.08	...
25	...	...	...	.03	...	...
26	.42	...	.83	...	.61	.37
27	...	...	.05	...	.88	1.20
28	.22	...	.03	.05	1.95	.27
29	...	...	1.77	...	.83	.12
30	...	...	.05	...	.09	...
31	...	...	1.05	1.78	...	...
	2.96	3.68	6.85	10.33	11.45	4.07

RAINFALL at the head of the Waterfall Gardens, Penang during the second half of the year 1919, in inches.

Reading taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of George Town, Penang.

Date.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	...	...	...	.88	.04	.03
2	.08	.50	.10	1.10	.22	.30
3	...	.42	...	1.05	.05	.15
4	...	...	...	...	...	...
5	.24	.77	.34	1.76	.24	.20
6	...	.23	.05	.63	...	.34
7	.85	.43	.09	.64	.63	...
8	.09	.06	...	1.88	.63	.24
9	...	.20	...	.80	.58	...
10	1.23	...	.85	.53	.17	...
11	.78	...	.31	1.53	.03	.10
12	...	...	1.15	.20	.29	...
13	.07	...	.54	.07	.03	.
14	...	.32	3.12	...	...	...
15	.12	.20	.10	.80	.79	1.33
16	.05	.56	.75	...	.03	.56
17	.55	...	...	...	...	.13
18	...	...	...	...	.30	...
19	...	...	.58	...	.12	.03
20	.03	.03	1.58	...	1.45	.56
21	.32	...	.03	...	.03	.15
22	.74	...	.15	...	.48	.07
23	...	...	.60	.24	...	...
24	.67	.29	.20	...	.53	...
25	.44	.10	.07	.17	.14	.12
26	...	.03	.32	.23	.03	1.69
27	...	.18	.14	.09	.07	...
28	...	.06	.03	1 07	.12	.57
29	...	.03	...	.35	1.15	.45
30	...	...	...	...	...	...
31	...	...	...	...	...	...
	6.26	4.41	11.10	14.02	8.15	7.02

SUMMARY OF RAINFALL FOR 1919.

	SINGAPORE.		PENANG.	
	No. of rainy days.	Longest spell without rain.	No. of rainy days.	Longest spell without rain.
January - - -	25	3	11	5
February -	15	3	4	9
March - -	18	3	13	7
April - - -	21	2	19	2
May - - -	22	2	22	2
June - - -	16	2	9	8
July - - -	19	7	15	6
August - - -	13	4	17	4
September - -	13	5	21	2
October - - .	19	4	19	7
November - -	21	1	24	1
December - -	24	2	18	3
Greatest amount in 24 hours ...	3.99 in		3.12	in.
,, ,, 48 ,, ..	4 08 in.		3.66	in.
,, ,, 72 ,, ...	4.27 in.		4.81	in.

The

Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. II Issued April 12th, 1920. No. 7

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THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. II. Issued April 12th, 1920. No. 7.

The Oil Palm (Elaeis guineensis,) in the East.

The thoughts of planters and capitalists have been turning for some time to *Elaeis guineensis,* the West African Oil-palm, as a new source of supply for oil, which as we see from the Market Reports is more and more in demand, at prices, which, high as they are, are not unlikely to soar much higher in future. An increased demand for seeds of *Elaeis* is an indication that the idea of establishing plantations of the palm is taking concrete shape in the minds of many, and this has induced the present writer, as far as his limited means of information allows him to visualise it, to work out for himself the problem of the future of *Elaeis* as a planting proposition on systematic lines.

With a view to establishing a nursery in the Economic Gardens, a look-out was kept for a bunch of fruit which had shown signs of approaching ripeness for some time. The tree, which bore it, is a well-grown palm measuring no more than 7 feet to the lowest row of branches, and with a girth, at one foot from the ground of 9 feet 10 inches, and 7 feet 2″ at five feet from the ground. These measurements include the protuberances due to stumps of decayed or cut leaves. No records are to be found of the date of its plantation, but a foreman-gardener who has been working for seven years in the gardens, remembers it as a seedling when he first came. This is the first head of fruit which the tree has yet produced and this fact allows us to compute its age as somewhere between 8 and 9 years, for the habit of *Elaeis guineensis* is at first, to bring forth male flowers only, the female flowers appearing a long time afterwards. Owing to the neglected state in which it had grown, all covered, as is the wont of *Elaeis guineensis* in similar conditions, with a heavy vegetation of ferns and other epiphytic plants, we may well allow a couple of year's delay in the appearance of the male flowers which one expects on a plantation, to come out in the fourth year, and also subsequently, in the appearance of the female flowers.

Neglect notwithstanding, the tree has, as already said, grown into a fine and vigorous specimen of its kind, with a profusion of leaves from 16 to 18 feet long, and an abundance of dead and

living male flowers, the dead forming by their decay, masses of a humus-like material which fills the cavities between the trunk and the bases of the leaves. These rich humus-pockets probably explain the tendency of foreign plants to seek sustenance on *Elaeis guineensis;* the strangest of all these being seedlings of *Elaeis* itself, of which the writer found two with well developed roots and plumules embedded in the leaf-base cavities.

It will be understood that this, being the first bunch collected off the tree, it cannot in any way be an indication of the fruiting capacity of the tree, no more than the first bunch plucked off a coconut tree can be considered as an indication of its future crop capacity.

The arrangement of the leaves round the trunk of the palm is in groups of three as shown in the diagram.

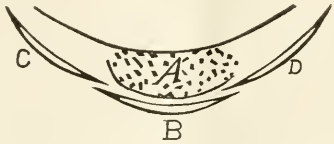


Diagram showing disposition of leaves and fruit bunch.

The bunch of fruit A is jammed between the trunk and the base of the leaf B, while the two leaves C and D also exert a pressure on the sides of the bunch. The pressure exercised by these three leaves against the bunch is very great, so much so that a large number of the fruit cannot develop beyond the embryonic stage and are absolutely wasted. Owing to this pressure, it is impossible to get at the bunches without first cutting the leaves as near as possible to their base. Now, the substance of the *Elaeis* leaf bases, is not, like that of coconut leaves, soft and yielding, it is woody and very tough, and it requires a sharp and heavy parang or a hatchet, or a chisel and mallet, to hack through it.

A point which also impresses itself very quickly on the coolie is the presence of spines at the lower end and on both sides of the stalks of the leaves (the midribs) : this makes it almost impossible for the hand of the coolie to get in touch with the bunch itself without getting hurt by the spines; and, lastly the fruit themselves are encased between spiny bracts, which put out of the question all possibility of picking them out individually by hand. It is thus seen that the fruit bunch is extremely well protected against human intrusion.

It was necessary to go into the above details to explain one of the difficulties, and not a mean one, that confronts the planter of *Elaeis*. For we may take it for granted that *Elaeis* will grow in these countries as well as in its African home, the superb specimens of the tree seen in Sumatra and in Malaya are a sure warrant of that. That it will yield as good returns and yields of oil may also be conceded. But to conclude from this, that the systematic plantation of *Elaeis* will be a "paying" proposition in Malaya or Sumatra is somewhat premature.

This is evidently not the view of a contributor to the "*Bulletin de l' Association des Planteurs de Caoutchouc*" of November 1919 who writes, page 91, "It is to be observed that the cultivation of the palm (*Elaeis*) is appreciably easier than that of *Hevea,* for the fruit is obtained by mere picking, and the question does not arise, as it does in the case of *Hevea,* whether the yield is premature or too heavy."

We think this writer attempts to prove too much. The word "cueillette" literally means "picking" and is applied to a gooseberry, an apple, or a papaya, but there is no picking the fruit of *Elaeis guineensis;* it is sheer hard whacking that does it and the following account is intended to prove it.

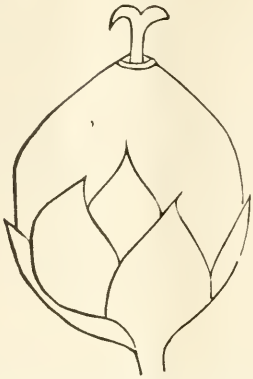
At 7.45 a.m. on the 10th of February, the present writer started work with one coolie to cut a bunch of fruit, at 8 feet from the ground on the previously described tree.

The spines on the branches had first to be pared with a parang, the man supporting himself, with his feet on the stumps of leaves which had been previously cut, his left hand holding on to a leaf above him, whilst the right hand was kept hacking with a parang at the leaf immediately below the bunch. At 8 o'clock exactly, the leaf fell, bringing down with it a lot of decayed matter, and at that moment, a great number of ants appeared, compelling the man to jump down. A ladder was sent for, and by 8.10 o'clock the man was able to resume his work by cutting the two leaves, one on the right, and the other on the left side of the bunch, and this took another seven minutes. Access to the bunch was now free, and after eight minutes more of hacking at the tough and thick peduncle, the bunch, severed at last from the tree, fell to the ground. It was then 8.25 o'clock, so that the actual time it took to bring the bunch down was from 7.45 to 8.25, *i.e.* (less 10 minutes of interruption) exactly half-an-hour.

At the store, the bunch was found to weigh 18 lbs., and with its 3 inches of peduncle, it measured 18 inches in length and it was about one foot in diameter. One side of it had only a few fully-developed fruit.

As far as the writer is aware, the only way to deal with the bunch is to lay it on its side and, with a sharp parang or an axe, to split it longitudinally in two halves, then laying each half on its flat side (the side just cut), to split it also in two. We thus have 4 quarters from which it is, comparatively, easy to dig out or pull out or wrench out by torsion, the fruit from the spiny bracts which hold them, a work which took 10 minutes to effect. The result was 206 fully-developed fruit, weighing altogether 7 lbs. In the bunch were also found a large number of misshapped and undeveloped fruit, the size and shape of a clove of garlic or even smaller, the result of incomplete fertilisation, or of compression in the bunch by the leaf at the axil of which the bunch is formed. Such fruit cannot be dealt with by any hand process which the writer can conceive. Whether they have any oil in them, and whether they can be dealt with mechanically, so as to pay costs by the extracted oil, he has no means of judging, but he is inclined

to think not. Thirty-five fruits more, of half normal size were dug-out of the bunch and, when stripped of the calyx-leaves and their peduncle cut off, were found to weigh altogether 4 ozs.



Size and shape of fruit of "Elaeis" with calyx leaves and dry stigma on top—Weight 17 grammes.

The largest of the 206 fruit is here represented in shape and size, but they were mostly of less symetrical shape, with depressions on one side and a more conical apex.

Their colour was bright orange at the base shading abruptly into deep purple and almost black at the apex.

So far the labour employed on these 7 lbs. 4 ozs. of fruit had taken 45 minutes, but it should be borne in mind that it was performed under the writer's own supervision and in his presence, without the loss of one minute, and, secondly that the tree was a very low one, the fruit being only 8 feet from the ground.

Further still, no time was put down for transport which is a larger question than appears at first sight. Dealing with coconuts, the crop of nuts can be hurled towards the transporting cart or wagon, by successive throws of 20 to 30 yards at a time, or more if the ground is a sloping one, and the job of loading is an easy one and quickly done, but with the hedgehog-like bunches of *Elaeis*, each bunch must be handled by hand, and gingerly at that, for they refuse to roll of their own accord, and the unloading at the store must proceed in the same way. Taken altogether, climbing up the tree, hacking through the leaves and the peduncle, getting down again, and carrying the bunches to the cart, the writer is of opinion that the coolie cannot, in a nine hours' day, visit more than 9 trees, and assuming a crop of two bunches per tree, his day's work is summed up by 18 bunches, which means that, at a daily wage of 75 cents, each bunch brought to the factory and split ready for treatment, will cost over 4 cents. Moreover, the work is so hard, so unpleasant that it is very doubtful if our ordinary class of coolie will stand it. It is pretty certain that coolies accustomed to the comparatively leisurely work of rubber or coconut estates will not look at it, and unless extra wages are paid it will be difficult to recruit the class of men required.

It is quite possible that in West Africa the natives, being expert climbers, give a greater output of work; yet Dudgeon tells us in "Agricultural and Forest Products of British West Africa" that it takes 8 minutes for a native to chop off a bunch.

The leaves are often, and should always be, cut long before the harvest, so as to favour the expansion of the bunch by reducing the compression exerted by the leaves. But what is more significant is "that the number of skilled palm-tree climbers is said to be decreasing in many districts and a very large proportion of the annual yield of fruit remains unharvested" (page 93). This does not say much for the attractions of *Elaeis* climbing as a profession.

The bunch which the writer is dealing with in this paper comes, as already stated, from a young tree and does not therefore, give quite a fair idea of the crop obtainable from the *Elaeis* palm, for as in the case of Coconut the full-bearing capacity of the tree is only reached when it has attained complete maturity. In his monograph, "The Oil Palm and its Varieties" J. H. J. Farquhar says, page 20:

"On the average, 5 bunches of fruit are produced per palm per annum; but it is common to find trees yielding many more. The average weight of a bunch is 31 lbs. made up of fruits 20 lb. and stalks, bracts, and calyx leaves which are worthless 11 lbs. The average number of fruit in a bunch is 1600 of which 600 or 38% are fully developed, 200 or 12% are imperfectly developed, and 800 or 50% are not developed."

The 20 lbs. of the fruit is made up as under (page 23)

the palm-oil extracted by native methods weighs	1.5 lbs.	20 lbs.
the kernels	4.0 lbs.	
the refuse, fibre and shells	14.5 lbs.	

5% of the weight of a whole bunch of palm-fruit may be considered oil, and at 5 bunches per tree this would mean 7½ lbs. of palm-oil yearly per tree.

One imperial gallon of cold palm-oil weighs 8½ lbs., accurately. The writer's own findings are:

One bunch ("maiden crop") weighs		18 lbs.
The bunch contained 206 fresh fruit perfectly developed weighing		7 lbs.
25 fruits, whole, after the calyx leaves and the peduncles had been cut off weighed	13.50 ozs.	
25 pericarps	5.75 ozs.	13.50 ozs.
25 fruits divested of their pericarps ..	7.75 ozs.	
25 pericarps gave of pericarp-oil (Palm-oil)	1.625 ozs.	

We need not attach any importance to the differences of weights of the bunches, as shown between the above two sets of figures: the bunch cut down in this case, being a "maiden" crop would be expected to weigh less than one cut from a mature tree: but when we come to compare the weights of the fruits and the

results in oil, the differences are wide. For instance, at the rate of 206 fruits to 7 lbs., it would require only 588 fruits to make up the 20 lbs. weight of 800 West African fruit (600 perfect and 200 imperfect). And the divergence in the outputs of oil is remarkable, but Farquhar's figure of 1.50 lbs. of oil to one bunch of fruit, applies to native methods.

As stated above, from the pericarps of 25 fruits the writer obtained 1.625 ozs. of oil. This was done in the following way. After freeing the fruit of their calyces and peduncles, the pericarps were sliced off with a sharp knife, cut up small, and passed through a special mincer which ground them to a fine paste. Boiling water was then poured, in small quantities, into the mincer, and the watery paste was allowed to escape by a tap at the bottom of the mincer into a pan which was put on the fire and boiled for 1½ hours, the mash being stirred the while, until the oil began to show itself on the edges, when it was dribbled from time to time into a cup. Boiling was continued, small quantities of water being added at times, until no more oil was seen to separate from the sediment which was put by until next morning when only a few drops of congealed oil had exuded. Perhaps a little more oil might have been obtained by pressing the sediment, but this was not done.

At first the oil is of a dark-brown orange colour, very clear, but the next day a very small quantity of sediment had formed at the bottom. In the early mornings it is congealed in the bottle and it takes the colour of anchovy sauce. The odour when fresh is pleasant, but eggs fried in it, came to the table with a deep orange film, suggestive of varnish or floor polish—and the flavour, to a palate accustomed to fresh coconut oil or gingelly-oil, was not quite pleasant. Yet, according to the "*Bulletin des Matières Grasses*" *No. 4, 1919, page 135*, palm-oil is one of the most advantageous materials for the manufacturing of margarine, when freed of its fatty acids.

The yield of 1.625 ozs. of pericarp-oil (palm-oil) from 25 fruits, means that, from 600 perfect fruits in an average bunch (we leave aside the 200 imperfect fruits), the resultant oil would be 2.43 lbs. per bunch, whereas the West African native, as shown above, obtains only 1.50 lbs. per bunch.

If we work out the above averages of outputs for an estate under systematic cultivation of *Elaeis guineensis* of say, one thousand acres, we should arrive at the following figures respectively:—

1,000 acres planted 27 × 27 feet = 50,000 trees.

50,000 trees giving 5 bunches each annually would give 250,000 bunches.

The "*Bulletin Economique et Financier du Journal d'Agriculture Tropicale*" of November, 1919 gives the following quotations.

Palm-oil Liverpool 10th November Congo £75 Lagos £83 per ton.

Palm Kernels London 10 November £38 to £38.10 per ton.

Therefore 250,000 bunches at 1.50 lbs. of oil = 375,000 lbs. Palm-oil at £80 per ton = £13,392.

250,000 bunches at 2.43 lbs. of oil = 607,500 lbs. Palm-oil at £80 per ton = £21,250.

Messrs. B. J. Eaton and F. G. Spring (Agricultural Bulletin F. M. S., Sept. and October, 1918) assuming a yield of 4,500 lbs. of fruit per acre, estimate the yield of palm-oil at 800 lbs. per acre; this would result in a yearly crop on 1,000 acres of 800,000 lbs. which, at £80 per ton, would give a gross return of £28,571. The discrepancies between the above figures show, if nothing else, the great need for further close investigations of the subject.

Palm Kernel Oil.

It may be useful to remind the reader that the above figures relate to *palm oil,* i.e. the oil extracted from the outside oily coat of the fruit. When this coat, or pericarp, has been taken off, there remains the nut, the Kernel of which has also a large oil content: this oil goes under the name of "palm-kernel oil."

The fruit of *Elaeis* is very much like the Coconut in structure, and the name "Klapa Kechil" given it by Javanese and Malays, is, botany apart, quite apt; for we have in both:

1st. The pericarp which instead of being of corky material, as in the Coconut, consists of a fleshy coat about ⅛ inch in thickness in which are embedded, as strands of steel in reinforced concrete, straight and almost parallel fibres which converge towards the apex of the fruit. This coat, or pericarp contains of oil (extracted by solvents) 32.86% of the weight of the pericarp (C. W. R. Ralston).

2nd. A shell of the same stone-like hardness as that found in the Coconut—but harder in the *Elaeis* fruit; thickness, ⅛ to ¼ inch.

3rd. A kernel of white "meat," filled with "water" in the Coconut, but full, *i.e.* without cavity, in the *Elaeis.* This "meat" has a bluish tint and is much harder than that of the Coconut.

It contains of oil (extracted by solvents) 43.96% of the weight of the kernel (C. W. R. Ralston).

The writer has found the weight of 25 kernels, divested of their shell, to be 2.12 ozs.

The writer has no personal acquaintance with this oil, nor, except from drawings, of the machinery in use for its extraction, but, as in the generality of cases, the extraction does not take place on the Estate itself the kernels being exported to Europe, it will be sufficient to take their market value, which in London is £38 per ton.

On the above basis of 25 nuts weighing 2.12 ozs. we should have from a 1,000 acre estate (250,000 bunches of 600 fruit) 357 tons of kernels at £38 per ton or £13,566.

Messrs. Eaton and Spring estimate a yield of ¼ ton of palm kernels per acre which is equivalent for 1,000 acres to 250 tons *i.e.* at £38 per ton, £9,400.

On this reckoning, taking only the figures relating to these countries, we have here two figures of the estimated gross revenue of a 1,000 acre Estate of *Elaeis* as under:—

	The writer's			*Messrs. Eaton and Spring*
Palm-oil	£21,250	..	..	£28,571
Kernels	£13,566	..	..	£ 9,400
Total Gross Revenue of 1,000 acres:	£34,816	..	..	£37,971

Conclusion and Suggestions.

We have in these Countries two products of the soil which have great attractions for capitalists, namely Rubber and Coconuts, both safe industries, both paying handsomely, both easy of performance without strain of labour.

In considering Coconut, in particular, planters are accustomed to think in terms of copra only, and at the present time, with the staple at $30 per picul and 10 piculs of it, more or less, per acre, produced at small cost, and with a minimum of labour, there is really not much wrong with the coconut industry, from the money making point of view. Yet planters might make more of it and benefit their land, by the return of the "poonac," if they turned their copra into oil, as they do in the Philippines, but as it is, the industry flourishes exceedingly.

Now there are not a few people who think that there is room also in these countries for the cultivation of *Elaeis guineensis.* Perhaps that is so, but that will only be in places where the population is dense, and the recruiting of labour, men and women, assured at all times; for labour will be an all important factor, more important perhaps than machinery. So far we have only mentioned the difficulties which beset the coolies at the work of the gathering of the fruit, but it is not only the hardness of the work one has to look to, when dealing with *Elaeis,* it is also the great number of hands required to do it.

Whereas, for instance, on a coconut Estate, four coolies doing nothing else, will suffice to bring down the crop of 200 acres in one month, the same number of men will barely suffice to bring down a crop of 30 acres of *Elaeis* in the same time.

The same conditions apply to the labour at the factory. Whereas the manipulation of copra is of the simplest, requiring practically no machinery, the fruit of *Elaeis* is about as intractable a staple as can be conceived, requiring most elaborate machinery for the mere depericarping of the fruit, before extraction of the oil.

To satisfy himself on this point and find out where the difficulty lies, the writer effected the depericarping of 25 fresh fruit.

With a very sharp knife, he worked continuously for 43½ minutes, slicing off the oily coating and the result was 5 ozs. of pericarp. It will be noticed that on a former occasion, when mak-

ing oil, the writer obtained 5¾ ounces of pericarp; this time, however, working against time, he probably did not scrape the nuts as carefully, and hence the loss of weight.

If we follow up this result, we find that a day of 9 hours should give an output of 62 ozs. or say, allowing for time wasted by the coolie 2½ lbs. of pericarp, yielding about 12 ozs. of palm-oil, worth about 6 pence. A daily task of 2½ lbs. of pericarp could not therefore be paid more than 4 pence, leaving 2 pence for cost of extraction of the oil freight and profit; plainly an impossibility, except where the very cheapest female and child labour can be drawn upon.

In this connection, a well known authority, Auguste Chevalier, (Bulletin des Matières Grasses de l' Institut Colonial de Marseille, No. 4, 1919) makes the following statement:

"A native of West Africa, working 300 days, produces yearly only 390 kilos of almonds, while another, treating the pericarps, obtains yearly 657 kilos of oil: the daily production of almonds not exceeding 1.300 kilos and that of oil 2.190 kilos."

2.190 kilos per day for two persons or say 1.100 kilos for one person, is more than treble what the writer himself obtained of oil; this is probably due to previous softening of the pericarps by fermenting in heaps, a native practice.

Taking as a daily task 1.100 kilos or 2 lbs. 7 ozs. of palm-oil per coolie per day, of a value (at £80 per ton) of 20 pence, it would perhaps be possible to pay a daily wage of 1/- sterling, leaving 8 pence for cost of extraction, oil containers, freight and profit. But the number of hands employed would be such as to render the operation impossible for an estate with a large production of fruit.

However, these figures may stand for the time being. Meanwhile the question naturally presents itself: what about machinery?

The writer is unacquainted with the various depericarping, depulping, grinding, and nut-cracking machines, which have for some time made their appearance on the market. Some of them, we are told, are made more to sell, than for anything else; others, having been working for some years, have proved their efficiency. But the writer has not seen any of them and his opinion would, at best, be only that of a layman: he must therefore borrow light from other, better informed sources.

Two such sources of information are now before him:

The Agricultural Bulletin F. M. S. for September and October, 1918, and the "Etude sur l'Exploitation industrielle du Palmier à huile," by Mr. Houard Director of Agriculture, Dahomey. The report is dated 1919.

On page 509 of the "Bulletin" reference is made to a German process installed in the Cameroons before the War. A summary description (to which the reader is referred for want of space) is given of the machinery and its mode of action.

Now if we dissect the process into its several changes from start to finish we shall find that the crop has to go through the following manipulations:

1° Cutting the bunches open to get at the fruit.
2° Removing the fruit from the divided bunch.
3° Transporting the fruit to the boiler.
4° Boiling the fruit for 1 hour.
5° Transfer of heated material, (by mechanical means presumably) to a number of mortars worked mechanically.
6° The stamping of fruit in the mortars.
7° The stamped-mass is steam-heated.
8° The nuts (for the sorting of which from the pericarp pulp some device must exist), are separated from the pericarps.
9° The transfer of the mass of pericarps to the hydraulic presses.
10° The extraction and reception of the oil from the presses.
11° The conveying of the oil to the sand filters.
12° The pumping into puncheons.
13° The disposal of the fibrous residue from the presses.
14° The separated nuts are transported to a barbecue or a drying-shed to dry.
15° The dried nuts are conveyed to the nut-cracking machines.
16° The nuts are cracked in a centrifugal cracker.
17° Kernels and broken shells fall in a tank below, filled with brine, in which the shells sink, and the floating kernels are collected.
18° The kernels, taken up from the brine, are put to dry.
19° The nuts are put in bags.

The total pre-war cost of such machinery is given as £3,500. The quantities treated 10 tons of fruit per day of 10 hours. The yield 16% of palm-oil 10% of kernels.

Accepting these data as exact, it would require to keep the mill at work for 300 working days of 9 hours to treat 2,700 tons of fruit. We base our calculations on a 9 hours day instead of 10 hours, as more in conformity with estates in Malaya.

If we reckon on a production of 5 bunches per tree per year, each bunch with 20 lbs. of fruit, and adopt the very generally accepted figure of 1½ lb. of palm-oil per bunch with 4 lbs. of kernels divested of shell, we shall come to a final result of:—

1 tree = 5 bunches = 100 lbs. of fruit = 7½ lbs. of palm-oil + 20 lbs. of kernels, and for one acre of 50 trees an annual return of 250 bunches = 5,000 lbs. of fruit = 375 lbs. of palm-oil + 1,000 lbs. of kernels. To produce 2,700 tons of fruit it will therefore require 1,200 acres of palms in bearing.

The whole production of 1,200 acres will be: 2,700 tons of fruit = (453,750 lbs.) 202 tons of oil + 536 tons of kernels.

202 tons of oil at £80 = £16,160
536 tons of kernels at £38 = £20,368 total £36,528.

It is perhaps a little bold, with such fragmentary information as we possess, to attempt to build an estimate of the total cost of an installation of this kind and of the expenditure incurred in running it. For that, it is necessary to visualise it as a whole, with its accessory and component parts and surroundings: but Mr. Houard's report (pages 198-199)) will supply us with several use-

ful figures, which, however, have had to be altered to Straits Currency and to estate conditions in Malaya, where salaries and wages are on a higher scale.

To begin with, the machinery, which is put at £3,500, pre-war cost, would now cost more than double and we can, without risk of surcharging put it down at £7,000 *i.e.* at $8.54 .. .. $59,780

Building of factory and engine house	12,000
Water Supply—pumps and reservoir (Water must be in abundance and constantly available)	1,500
Wagonets and rails for transport of fruit in the mill—also of fibrous and shell refuse	2,500
Drying sheds or barbecues	1,200
Store house	2,000
Tanks for brine with elevators	1,000
Spare pieces of machinery	2,000
Sand-filters and tanks to clarify the oil	2,000
Repair shop and tools	2,000
Offices	2,000
Manager's house	5,000
Chief Engineer's house	5,000
Clerks' and fitters' house	2,500
Coolie house	1,200
Total Cost of Installation	$101,680

Repairs and depreciation (20%) will amount to $20,336. We have now to work out the cost of running the mill on the assumption that 2,700 tons of fruit are treated per year.

Fortunately Mr. Houard's Report supplies us, under the heading *"Daily expenditure of a mill treating on an average 10 tons of fruits per day,"* with a full schedule of the labour and staff employed, which is given below unaltered, except for the wages which are brought to Malayan standards.

LABOUR:		*Yearly*
1 Receiving clerk paid daily	$2.00	$ 730
6 Coolies	.60	1,314
2 Men attending steriliser	.60	438
3 Men cooking the oil	.60	657
8 Men tending the presser	.70	2,044
2 Men tending the filters	.60	438
2 Men filling the casks	.60	438
4 Men tending the depulping machine	.60	876
4 Men tending the drying and the nut-cracking machines	.60	876
2 Engineers	3.00	2,190
2 Stokers	2.00	1,460
1 Fitter	4.00	1,460
1 Mason	2.00	730
1 Carpenter	3.00	1,095
Carried Forward ..		$14,746

Brought Forward ..		$14,746
2 Coopers	3.00	2,190
1 Black smith	3.00	1,095
1 Frappeur? (man who sounds the casks?) ..	.60	219
2 Bookkeeper	..	2,400
1 European manager	..	5,400
1 Chief Engineer	..	5,400
Fuel .. .. 50 francs per day		
Lubricant .. 3.		
Sundry .. 6.50		
——— = *f* 59.50 = $20 ..		7,300
Yearly Salaries Wages, etc. Total ..		$38,750

The mill requires a number of puncheons as oil containers, and of bags for the kernels.

Liverpool puncheons are 1 meter high and 1.30 meters at their broadest part; their weight 281 pounds; their content 205 Imperial gallons of oil, weighing about 1,590 lbs.

The puncheons are sent out from Europe, packed in pieces ready cut, with bands, bungs, and bottoms, and put up at the mill. Their cost at the mill was in pre-war days £1.19 made up as follows:

Manufacturer's sale price in Europe ..	£1.6.0
Freight	8.0
Landing at the Coast and transport ..	2.0
Cooperage (putting them together) ..	3.0
	£1 19.0

The present price would be, say double = £3.18.

As the mill has a nett production of 202 tons of oil to deal with, it will require 285 puncheons costing at £3.18 each, £1,111 converted at £8.54 = $9,488.

Kernels. Where loading facilities exist, the kernels are shipped in bulk—but where boats have to be used to the steamer, bags have to be used, which contain 1 hundredweight of kernels and would cost at present say $0.75 apiece. The output of the mill being 536 tons of kernels it would require:

10,720 bags costing	$8,040
Transport to the Coast and loading:	
285 puncheons oil at $4.00	$6,500
10,720 bags kernels at $0.50	
Insurance, freight, storage, Commission. Shortage *i.e.*	
50% on $83,213	$41,600

So far the yearly expenditure of the mill would be as under:

Depreciation repairs, etc.	$20,336
Wages and salaries	38,750
Puncheons and bags	17,528
Transport to Coast and loading ..	6,500
Insurance, freight, etc.	41,600
	$124,714

The produce sold in Europe, as shown above, would realise £36,528 or $311,950.

The 1,200 acre estate has therefore a credit balance of $187,236 to defray its expenses of cultivation, of harvesting, of transport to the mill, etc. *i.e.* $156 per acre.

The margin available for dividend will be a small one and might even be to the debit side of Profit and Loss Account.

The aim of this paper is not, as might be inferred, to make a case against the cultivation of *Elaeis*. The question is too large a one to be approached with prejudice, for there is little doubt that, placed under favourable conditions, the oil yield of *Elaeis* is so great that it puts the palm at the head of all oil-yielding plants of the world.

The question, in fact, is full of interest and it deserves to be probed in a much fuller way than is done in this paper.

The pioneers of Rubber planting were, for a long time, pulled this way and that, in their first steps in the, then, new industry. Some, on expert advice planted *Ficus elastica* others *Ceara*, and a good deal of money was sunk in putting these in the ground—and more money went in cutting them down afterwards. On the whole, however, the birth of the rubber was not a painful one, and the child has grown into a hefty boy. But blunders will cost more in the case of *Elaeis*: bad selection of land, wrong selection of seed, will kill it.

The writer has just received, and has now before him, photos taken in West Africa and, amongst them, are two bunches of *Elaeis* collected in the District of Lusango (Congo). One, standing on a table, must be, judging from the height of the man holding it, at least two feet high and nearly as broad,—a perfect mass of fruit, but its weight is not given. The second one is probably as big, but there being no standard to judge by, it cannot be estimated; its weight, however, is given as 62,750 kilos or 136 pounds!

Now, if the usual computations hold good in this case, that is, that the fruit weighs $\frac{2}{3}$ of the weight of the bunch, we have 88 lbs. of fruit, of which the oil-yield as obtained by machinery *i.e.* 16%, would amount to 14 lbs., and, as a conservative estimate would put the yearly crop of bunches at 5, we should have from one tree, 70 lbs. of oil and from one acre of 50 trees—3,500 lbs. of oil worth £125 in London. If besides, we reckon the weight of kernels at 20% of the weight of the fruit, we should get a crop of 88 lbs. for 5 bunches = 4,400 lbs. of kernels per acre worth £74. That is to say, the gross return of one acre would amount to £199.

There seems no reason why, under careful systematic cultivation, and under suitable conditions of soil and rainfall, which these countries afford, such bunches should not be obtained; then, of course, the whole aspect of *Elaeis* planting would change provided the labour is at hand.

Trees are not uncommonly seen in Malaya with 8 or 10 bunches; the writer has seen one in Sumatra with 12 bunches

which would all be ready for cutting within twelve months. But the question is governed also by the yield of oil and of kernels. As shown by the analyses made by the Imperial Institute, some varieties like the "Au Suk Ku" yield as much as 83% of pericarp and 48% of oil, while others, like the "Udin" show only 25% of pericarp and 16.5% of oil.

The following points also invite consideration, firstly the fact that *Elaeis* grows in pure natural stands on the West Coast of Africa and secondly, that there it is only fourteen days from the European markets.

The whole problem of the future of *Elaeis* is, in fact, bound up with:—

1°. Selection of suitable varieties yielding thick fleshy pericarps with heavy oil content and heavy kernels with preference for short-stemmed trees which greatly reduce the cost of cropping, (as is the case with the dwarf coconut) and for those which mature their fruit at well defined periods.

2°. Selection of land, preferably flat land, with water transport both within the estate and to the coast; irrigation where dry seasons are prolonged; ploughing between the rows of trees; heavy pruning of the lower leaves especially those that encircle the bunches; search for beetles; using the "poonac" for manure.

3°. Easing of the work of cropping, which certainly admits of much improvement. The adoption of light folding-ladders allowing the coolie to use both his hands; of powerful hand shears or tree-pruners to cut through the peduncle of the fruit.

4°. A judicious use of native methods of "depericarping," blended with mechanical devices of well authenticated efficiency.

5°. A settled population from which to draw labour.

E. Mathieu.

(*To be continued.*)

References.

"Le Palmier a huile" Paul Hubert.

"Bulletin des Matières Grasses de l'Institut Colonial de Marseille," 1919. Nos. 4 and 5.

"Agricultural Bulletin F. M.. S." September-October, 1918.

Dudgeon. "Agricultural and Forest Products of W. Africa."

J. H. J. Farquhar "The Oil Palm and its Varieties."

"Bulletin Commercial et Financier du Journal d'Agriculture Tropicale," November, 1919.

"Bulletin de l'Association des Planteurs de Caoutchouc," November, 1919.

A Host Index of Fungi of the Malay Peninsula ,I.

Although we are only at a beginning of our study of the cryptogamic flora of Malaya, it has been found that in collecting together the information already published in separate papers the material has been provided for a nucleus of a Host Index for this country. It has been considered advisable that this information should be published forthwith in index form and added to as further records are established, rather than delay publication for some years in order to obtain a more complete work.

In considering the form this work should take it has been deemed expedient to include all fungi recorded on a plant rather than only those that have hitherto been definitely determined as parasites. The advantage of such a list being in the first place that it is very difficult to establish definitely which are parasites and which are saprophytes, and secondly fungi determined as saprophytes now may in a little while be found to be parasites. In this matter the following list differs somewhat from the Host Indexes that have been issued for other countries.

Many well known diseases often regarded as quite common will not be found included as it often proves on investigation that such popular beliefs have not been actually recorded by the scientist.

The arrangement of the list is alphabetically under the host plants. A systematic arrangements of hosts was considered to limit the use of such a list as this to those few scientists who are familiar with systematic botany, and as it is hoped this list will prove useful to a larger circle the alphabetical arrangement has been adopted. For a similar reason the descriptions of the fungi have been given in popular language rather than scientific.

The material from which this list has been compiled is the works of H. N. Ridley, W. J. Gallagher, K. Bancroft, A. Sharples, W. N. C. Belgrave, R. M. Richards, and C. F. Baker published during the past few years in local bulletins and periodicals.

Afzelia retusa, Kurz. (*Leguminosae*) Merabau.

Bancroft records the leaves of 'Merabau' collected in Perak, attacked by a fungus he considered to be *Trabutia Stephaniae* (*Sphaeriaceae*).

Afzelia, sp. (*Leguminosae*) Merabau.

Fomes lignosus, (*Polyporaceae*) the well known disease of Para rubber, was recorded by Gallagher as spreading from 'Merabau.'

Agathis alba, Foxw. (*Coniferae.*)

Aecidium balansae, (*Uredinaceae*) was found on leaves of this species collected by Burkill on Penang Hill. It causes warty gall like protuberances on the upper surface of the leaves.

AGAVE RIGIDA, Mill. (*Amaryllideae.*)

Dead preduncles collected by C. F. Baker, at Singapore, were found to have a species of *Phoma*, which was described by Saccardo as a new species, *P. agaves*, (*Sphaerioidaceae*). It is a minute fungus causing little raised black spots where the frutification breaks through the epidermis of the host.

AGAVE, sp. (*Amaryllideae*).

A species of *Coryneum* (*Melanconiaceae*) is recorded by Burkill in Singapore and Johore as attacking the leaves and rendering them useless for the extraction of fibre. It first appears as white blotches which on spreading change to a deep brown colour and become sunken. When the leaf is dead it has a silvery look and the fungus appears externally breaking through the epidermis as small black pustules, which are often in more or less concentric rings.

ANDROPOGON NARDUS, Linn. V. CITRONELLA. (*Gramineae*).

A Rust, *Puccinia clavispora* (*Uredinaceae*) causing long reddish brown streaks on the leaves is recorded by C. F. Baker from specimens collected in the Singapore Gardens.

ARACHIS HYPOGAEA, Linn. (*Leguminosae*). Ground nut, Pea nut, or Monkey nut.

Bancroft records from Selangor a leaf spotting parasitic fungus, *Cercospora personata*, (*Dematiaceae*). The fungus appears as small, brown, orbicular spots 2-4 mm. or more in diameter. The spore bearing hyphae are short, brown, and densely tufted.

ARECA CATECHU, Linn. (*Palmaceae*). The Betel Nut.

C. F. Baker found a fungus on the dead leaves at Singapore. *Saccardo* described it as a new species *Exosporium* (*Bakerella*) *eximium* (*Tuberculariaceae*). The fungus appears as minute black tufts chiefly along the main veins of the leaves.

ARTOCARPUS INTEGRIFOLIA, Linn. (*Urticaceae*). The Jack Fruit.

A case of 'Pink Disease,' *Corticium salmonicolor*, (*Thelephoraceae*) is recorded in Malay by F. T. Brooks. Ridley in 1889 also collected specimens of *Hexagona polygramma* (*Polyporaceae*) from a dead Jack-tree at Jurong. This latter fungus is a thin, brown, circular, bracket shaped specimen with large regular hexagonal pores on the under surface. So far as is known the genus Hexagona is saprophytic.

ATTALEA COHUNE, Mart. (*Palmaceae*). The Cohune Nut Palm.

Gloeosporium palmigenum (*Melanconiaceae*) was found by C. F. Baker at Singapore on dead leaves of this palm. The fungus appears as minute spots, brown but ringed with a black edge.

BAMBUSA, sp. (*Gramineae*).

Specimens of *Polystictus occidentalis* (*Polyporaceae*) are recorded by Ridley as occuring on the outside of a bamboo clump. On cutting open a culm the mycelium of the fungus was found to be lining the inside in a thick, firm, leathery mass.

BOEHMERIA NIVEA, Gaudich. (*Urticaceae*). Ramie fibre.

Mentioned by Ridley as attacked by 'Pink Disease.' *Corticium salmonicolor* (*Thelephoraceae*).

BROWNEA GRANDICEPS, Jacq. (*Leguminosae*).

C. F. Baker records from the Singapore Gardens a fungus described by Saccardo as a new species *Microthyrium browneanum* (*Microthyriaceae*). This fungus appears on the leaves as minute black dots.

BRUGUIERA ERIOPETALA, W. et A. (*Rhizophoraceae*).

Two fungi are recorded from the leaves of this host by C. F. Baker from Ponggal, Singapore. *Helminthosporium subsimile* (*Dematiaceae*) and *Podosporium consors* (*Stilbaceae*).

CALAMUS, spp. (*Palmaceae*). The Rotan.

Only three fungi, found by Baker in the Singapore Gardens are recorded for this important section of Palms. On dead petioles and leaf rachises *Melanconium melanoxanthum* (*Melanconiaceae*), appearing as small white dots ringed with black. On dead stems *Coniosporium vacuolatum* (*Dematiaceae*) appearing as small black spots and splashes. *Hadrotrichum atromaculans* (*Dematiaceae*) also on dead stems causing black incrustations, and mixed with *Melanconium melanoxanthum*.

CALLOPHYLLUM FLORIBUNDUM, Hook. f. (*Guttiferae*).

Leptothyrella calophylli (*Leptostromataceae*) a black sooty fungus is recorded as a parasite on the living leaves, by Baker at Singapore Gardens.

CASSIA FISTULA, Linn. (*Leguminosae*). Purging Cassia.

Meliola aethiops (*Perisporiaceae*) a black cobwebby fungus found on living leaves in Singapore Gardens, by Baker.

CASSIA TORA, Linn. (*Leguminosae*).

A rust, *Aecidium torae* (*Uredinaceae*) was found by Burkill on a specimen growing at Tanjong Pagar, Singapore. It appears as little bright clusters of cup shaped frutifications on the leaves.

CASSIA, spp. (*Leguminosae*).

Other species of this genus are reported as being found with Pink Disease, *Corticium salmonicolor* (*Thelephoraceae*) by Brooks;

Peroneutypa heteracanthoides (*Sphaeriaceae*) appearing as minute black pustules on the wood, and *Hypoxylon microsporum* (*Sphaeriaceae*) which causes black charcoal-like eruptions on the bark. These latter two are recorded by Baker from Singapore.

CECROPIA PELTATA, Linn. (*Urticaceae*). The Sloth Tree.

Botryodiplodia cerebrina (*Sphaerioidaceae*) appearing as black eruptions on the bark was collected by Baker at Singapore.

CINNAMOMUM CAMPHORA, Nees. (*Laurineae*) Camphor.

One of the worst troubles affecting this plant is a "thread blight" which weaves a regular white cobweb over young specimens even up to 12 ft. high, and eventually smothers them. It was described by Bancroft in 1911 and was referred doubtfully to a species of *Corticium* or *Hypochnus*. No practical remedy has yet been suggested for removing it as it is difficult to treat young trees growing in the jungle.

Bancroft also reports *Hymenochaete noxia* (*Thelephoraceae*) as causing a root disease, and *Fomes lignosus;* and Brooks that Pink Disease has been found on this tree.

Quite recently specimens from Selangor that have presented the symptoms of 'die back' have been collected. A black *Sphaeriaceous* fructification was found on the bark, but the work on these specimens is not yet completed.

CINNAMONUM INERS, Bl. (*Laurineae*).

Baker reports that he found *Microxyphium tenellum* on dying leaves of this plant in the Singapore Gardens.

CITRUS ACIDA, Roxb. (*Rutaceae*). The Lime Tree.

Although one would expect several pests of this tree to have been collected, the only one recorded is that by Baker from Singapore, namely, *Cladosporium elegans*, var. *singaporense* (*Dematiaceae*) collected on dying leaves.

CITRUS MEDICA, Linn. (*Rutaceae*). The Citron.

Sphaerostilbe coccophila (*Hypocreaceae*) found by Bancroft is not really parasitic on the tree but on the scale insects which so frequently infest trees of this kind.

CITRUS, sp. (*Rutaceae*).

Brooks reports a case of Pink Disease on the "Lime," but the exact species is not indicated.

CLERODENDRON PENDULIFLORUM, Wall. (*Verbenaceae*).

Tetrachia singularis (*Tuberculariaceae*) is recorded by Baker as being found on living leaves at Singapore.

CLERODENDRON SERRATUM, Spreng. (*Verbenaceae*).

Baker collected *Podosporium penicillium* var. *clerodendri* (*Stilbaceae*) on the leaves of this species. This fungus appears as little white specks on the leaf surface.

CLITORIA CAJANIFOLIA, Benth. (*Leguminosae*).

This is another of the hosts of Pink Disease, recorded by Sharples.

COCOS NUCIFERA, Linn. (*Palmaceae*). The Coconut Palm.

The diseases and pests of this important palm are summarized by R. M. Richards in the Agricultural Bulletin Vol. V, p. 327. A complete list of the fungi found in Malaya so far are:—

Botryodiplodia, sp. (*Sphaerioidaceae*). A cause of die back of the leaves. Stated by Ridley to be a root disease cutting off the water supply, but Richards considers it to be a leaf parasite killing the leaf as it works downwards from the tip.

Bud rot. The most recent work on the fungi concerned in this disease is given in the Philippine Journal of Science Vol. XIV, No. 1, Jan. 1919.

Diplodia, sp. (*Sphaerioidaceae*). Reported by Bancroft on the roots but only secondary on dead parts.

Fomes pseudoferreus (*Polyporaceae*). Found by South on dead stumps and roots.

Fomes lucidus (*Polyporaceae*). Found by South on buried wood.

Fomes pseudoferreus (*Polyporaceae*). Found by South in buried trunks and previously described as *Poria hypolateritia.*

Helminthosporium sp. (*Dematiaceae*). Richards records on the leaves.

Hexagona variegata (*Polyporaceae*). Collected by Burkill from a dead trunk.

Hymenochaete noxia (*Thelephoraceae*). On buried trunks. Recorded by South.

Meliola palmarum (*Perisporiaceae*). A saprophytic sooty mould fungus covering the leaves, and probably due to the presence of scale insects. Its treatment is given by Bancroft in Agricultural Bulletin, F. M. S. Vol. 1, p. 110.

Metasphaeria Cocoes (*Sphaeriaceae*). A saprophytic fungus recorded by R. M. Richards on dead leaves.

Pestalozzia palmarum (*Melanconiaceae*). Described by Bancroft as a cause of a spotting of the leaves. These spots finally coalesce and appear like a large grey blister.

Poria hypolateritia (*Polyporaceae*). Described by South as being found in buried trunks. This fungus has since been redetermined as *Fomes pseudoferreus.*

Thielaviopsis sp. (*Dematiaceae*). Recorded originally by Bancroft in the tissues of the stem. Later Richards considers that *T. ethacetica* is the cause of "rusty and black patches (on the stem) from which a brown liquid oozes."

COFFEA, spp. (*Rubiaceae*). Coffee.

Unfortunately the many diseases recorded for this plant in Malay are generally mentioned as occurring only on "Coffee." In only one or two cases has the species or variety of Coffea been stated. Consequently it has only been possible to group the following under the generic name.

Ascospora sp. A stem disease of not very great importance.

Capnodium sp. (*Capnodiaceae*). A "sooty-mould" fungus described by Belgrave as being found in association with scale insects on the berries. It is considered harmless except so far as it cuts off the light from the fruit.

Cephalosporium sp. (*Moniliaceae*). Recorded by Belgrave as being parasitic on the spots caused by the leaf fungus *Hemileia*. It appears as a fine glistening white web on the mature spots.

Colleototrichum sp. (*Melanconiaceae*) found by Belgrave on stems. It causes black discoloured areas in which may be seen small knob like protuberances.

Coniothyrium coffeae (*Sphaerioidaceae*). One of the fungi found by Belgrave as being responsible for the large, brown, 'scorched' areas on leaves. The fungus seems able to attack healthy leaves.

Corticium salmonicolor (*Thelephoraceae*). Pink Disease. Recorded by Brooks.

Diplodia sp. (*Sphaerioidaceae*). Found by Belgrave on the stem and occurring as large hairy pustules.

Fusarium sp. (*Tuberculariaceae*). Collected on dead berries. Belgrave states that this fungus appears unable to infect healthy fruits.

Hemileia vastatrix (*Uredinaceae*). A rust. The most widely spread "leaf spot" disease. It first appears as small circular, yellowish, translucent spots, and is rapidly followed by the production on the underside of the leaves of the orange coloured powdery spores.

Hyalopus sp. (*Moniliaceae*). With *Cephalosporium* appearing as glistening patches on *Hemileia* spots.

Hymenochaete noxia (*Thelephoraceae*). Recorded by Bancroft as causing brown root disease.

Irpex flavus (*Hydnaceae*). Considered to cause a root disease. A bright yellow fungus covered with "teeth."

Necator discretus (*Tuberculariaceae*). Mentioned by Ridley as causing a considerable amount of damage to the stem. It appears as "small white specks which seem to develope into leprous pink masses forming patches on the dying twigs."

Pestalozzia coffeae (*Melanconiaceae*). Belgrave records this fungus on the fruits, appearing as little black dots on raised patches.

Phyllosticta coffeicola (*Sphaerioidaceae*). Another of the fungi responsible for the "scorched" appearance of the leaves. Little black pustules are seen on the large brown areas.

Stilbum sp. (*Stilbaceae*). A saprophytic fungus found by Belgrave on dead fruit.

CYRTOPHYLLUM FRAGRANS, D. C., (*Loganiaceae*) Tembusu.

Baker records two fungi on the leaves of this tree, as being found in Singapore. *Septoria cyrtophylli* (*Sphaerioidaceae*) forming light grey spot areas with concentric zones, and covered with black pustules, and *Helminthosporium spirotrichum* (*Sphaerioidaceae*) which forms dense masses of jet black mould chiefly on the under surface of the leaves.

DAEMONOROPS, sp. (*Palmiaceae*). Rotan.

Phyllosticta daemonoropsis (*Sphaerioidaceae*) is recorded by Baker from Singapore as being found on the leaves, and appears as brown scorched areas.

Rosellinia ambigens (*Sphaeriaceae*) was found on dead leaves, and occurs as lines of black dots.

DERRIS SINUATA, Thw. (*Leguminosae*).

Asterina trachycarpa (*Perisporiaceae*) a fungus occuring as groups of black dots on the surface of the leaves was collected by Baker in Singapore.

DIANTHUS CHINENSIS, Linn. (*Caryophyllaceae*). Pinks.

The dead calyces collected from specimens at Singapore by Baker were found to have on them *Phyllosticta dubia* (*Sphaerioidaceae*). All that appears of the fungus on the surface is minute black dots chiefly towards the ends of the calyx lobes.

DICTYOSPERMA ALBUM, W. and D. (*Palmaceae*).

Phyllosticta palmigena (*Sphaerioidaceae*) collected from dying leaves, by Baker at Singapore. It appears as white scorched areas surrounded by dark brown or black borders.

DIOSCOREA, sp. (*Dioscoreaceae*). The Yam.

Stilbum incarnatum (*Stilbaceae*). Collected on rotting roots by Baker at Singapore. In dried specimens the red colour of the young united spore stalks is long retained, and is characteristic of the groups of fructifications.

DURIO ZIBETHINUS, D .C. (*Malvaceae*). The Durian.

Brooks records an instance of Pink Disease, and Baker the occurrence of *Gloeosporium zibethinus* (*Melanconiaceae*) on the

leaves. In the dried material the leaves have 'scorched' spots or areas, spotted with black dots and surrounded by dark brown borders.

EUGENIA CARYOPHYLLATA, Thunb. (*Myrtaceae*). The Clove.

Irpex flavus, a yellow "toothed" fungus (*Hydnaceae*) is reported by Bancroft as causing a root disease. Ridley states that a red-spotting leaf fungus, probably a member of the *Peronosporaceae*, was responsible for abandoning the clove cultivation about 1860.

EUGENIA GRANDIS, Wt. (*Myrtaceae*). Jambu Ayer Laut.

Valsaria cinnamomi (*Sphaeriaceae*) on dead bark, collected by Baker at Singapore. The fructifications of the fungus appear as dark brown or black eruptions through fissures of the bark.

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(*To be continued*).

Some Trials of Food Plants in the Economic Gardens II.

Lima Beans (Phaseolus lunatus).

The Lima Beans, Small Siéva Pole, originally received from the firm of A. H. Dreer, Philadelphia, U. S. A., and which were reported upon at length in the Garden's Bulletin of 4th July 1919, have been kept under cultivation continually in the Economic Gardens since July 1918. It was shown, by the records of seed gathered up to, and inclusive of the fourth generation, that the crops had been well maintained and that the beans had not degenerated in weight, size or quality.

But the results since obtained do not confirm this; they in fact have disappointed the writer's expectations. It is not, however, yet time to ascribe the falling off in the subsequent crops to actual degeneration in the seed, for, in recent weighings taken in October 1919, it was found that the weight of the beans was well maintained, and the percentage of germinations on a plot of 1056 plants, sown on 28th October, the last of the season, was as high as 96 per cent. At the time of writing (22nd November) this plot shows the most vigorous and healthy growth, a fact which would exclude any tendency to degeneration.

To explain the discrepancy between this last statement and the disappointing results of the crop as a whole, it is necessary to refer to the locality where the trials were made. The area planted in Lima beans was a little over two acres consisting (all but a small part of 4000 square feet, or one eleventh of an acre) of a low strip of land skirting a hill, and made of drift soil, either washed from

Ragi, Eleusine Coracana.

the hill side, or brought by the floods which frequently occur. It is therefore of an alluvial character, of good depth and of a fine loamy texture, the very best medium one would think for a trial of this nature: actually however, it was not at all suitable.

To begin with, it had been for years under a rank, semi-aquatic vegetation of wild grasses and of Pandanus (Screw-pine), with a few stunted Rubber trees. The large sago-palms growing near-by, mark the land for what it really is namely an undrained, almost undrainable swamp: its structure, a peaty bottom overlaid with the rich silt brought by floods. Such is the land with the exception of the small plot of $\frac{1}{11}$ of an acre referred to above, a gentle slope at the foot hill, well above flood level. Here is no drift or alluvial soil but the ordinary coarse yellow sandy clay, characteristic of Singapore hill-sides. This small plot had been for some years under cultivation and sundry annual crops had been raised off it in 1917 by Professor Baker (see Gardens Bulletin July 4th 1918). Now, it is off this small plot of rather poor and thin material, that the crops of Lima beans were grown by the writer, the results of which were given in the Bulletin of 4th July 1919, and on it are still to be seen beds of Lima beans of healthy growth, with abundant crops on them. One bed, in particular, sown on 31st July 1918, shows at date of writing, quite a fair crop of young pods. What, then, is the explanation of the unsatisfactory return of the *ensemble* of the crop? How is it that the promising results previously obtained, as shown in Bulletin No. 4 of 1919, now fail?

In the writer's opinion, this failure is due to the host of diseases brought about by fungi and insect pests which are bound, in the natural course of things, sooner or later to attack and destroy plants grown under adverse conditions in an uncongenial soil. And here, for the sake of clearness, one may be permitted a slight digression. In some countries, Burmah for instance, we hear of the Lima bean being grown on alluvial deposits formed along the river banks, by the silt of periodical inundations, a condition resembling somewhat that under which the Economic Gardens are placed. But there is this difference between the case of periodical seasonal floods and the case of occasional floods which last only a few hours over undrained land. In the one case, the parasitic fauna and flora is killed by the prolonged sojourn of the waters on the land, moreover the steady withdrawal of the river water to a much lower level as the floods subside, allows of perfect drainage of the alluvial deposit left on the land. Thus a perfectly new soil is formed, perfect in nutritive elements for plant life, perfect in physical texture, and above all, a soil purged of fungoid and insect pests—a clean soil which, with a minimum of tillage, will bear such wonderful crops of tobacco and indigo as one sees, for instance, on the banks of the Mekong.

In the other case, new soil is brought on the land, carrying with it seeds of parasitic vegetation and spores of new fungi which find a congenial home in the rank vegetation, a vegetation which thrives all the more for a short immersion, and as the land drains

itself badly and slowly, the cleansing action of the withdrawal of the flood water is lost—result: a sloppy, acid land, infested with pests of every description—a foul land. That is precisely what this land is, which is now dealt with. A foul land, no matter how great its wealth of nutrient material, cannot be fit for intensive cultivation except after a period of repeated tillage and, even then, if the surrounding land is allowed to remain foul, the harvests will be precarious. It is said by people who know the country well, that it is very difficult to rear good dependable garden crops in the rich lowlands of the East Coast of Sumatra, because of the peristent attacks of pests; and this is explained by the fact that so much of the land, after the tobacco crops have been harvested, is allowed to revert to rank vegetation over which parasitic life runs riot.

This digression will serve to explain the failure of the Lima bean crop in the Economic Gardens to come up to expectations. The failure of a crop, however, does not necessarily imply the degeneration of the seed; but certain figures of weighings taken by the writer at different periods bear on this point and they are here given.

A. One handful of beans of the third generation put on one side of the scale numbered 55 beans: one handful of beans of the fourth generation put on the other side tilted the scale with 56 beans.

B. 100 seeds taken from a parcel of Lima bean seed received from the firm of A. H. Dreer, Philadelphia, on 19th June, 1919, were put on one side of the scale and it took 120 of our local selected seed, after one month's drying to tilt the scale. (The local seed were the offspring of seeds received from the same firm the year before).

C. One pound of beans picked on 23rd May 1919, and kept to dry for 8 days contained 916 beans, whereas,

D. one pound of beans picked on 20th October, (*i.e.* the following generation) and kept to dry for 12 days contained 1103 beans.

E. One pound of beans selected for sowing in October, contained, after one month drying, 910 beans.

As will be perceived, while some of these figures point to a decided falling-off of the beans in weight as shown in B and by comparing C and D, others, A, and a comparison between C and E do not point to the same conclusion.

In B, however, we have clear evidence, (several weighings were made with much the same results) that the local bean, after nearly twelve months cultivation in the Economic Gardens, has lost 20 per cent of its weight. Is that fact to be taken as a proof that the Lima Bean cannot establish itself in this country without degeneration? It must be remembered that the seeds sent out by the great seedsmen of Europe and America have been evolved by severe selection through successive generations under trained observers to produce a type of bean in this case suitable to a set of local conditions which may, or may not, be reproducible elsewhere,

Hill Paddy, Sown on 20th July, gathered on 10th December.

or only partially reproducible. The chances are that, in their ensemble, they are not reproducible, for the factors which enter into play are many, *e.g.* heat, moisture, constitution of the soil, pollinating insect life, and processes of cultivation are among the factors that work for divergences, and that affect the behaviour of the plant under altered conditions. There is, then, nothing surprising in the fact that the Lima bean, in its transfer from a temperate and relatively dry climate to a tropical and moist one, should suffer a decline from the parent seed. The question is whether, under successive generations of cultivation, the decline is continuous. If this were so, it would, of course, imply progressive degeneracy in the seed and the inadaptability of the Lima bean to our local conditions since reproduction of a seed true to type is the test of adaptability to surrounding conditions—of acclimatisation.

Now tests C and D seem to support the contention that the Lima bean does, in effect, lose in weight from one generation to the next. Here we have 2 lots of beans gathered off the same plot one belonging to one generation containing 916 beans to the pound —the second lot belonging to the following generation containing 1103 beans to the pound that is to say that the latter is 20% lighter than the first.

This may appear to clinch the matter and finally to settle the point of degeneration in the seed. But does it? The writer would be quite prepared to admit it, were it not for the adverse conditions under which the later crops have been reared—conditions which the above digression was meant to make clear.

As can be seen by visitors to the Economic Gardens, the cultivation of the various plots has been as thorough as it is possible to make it in this country and some of the standing crops, ragi, hill paddy, cholam (Sorghum vulgare), new to the land and, so far, immune or at least partly so, to the pests that infect the land, show quite adequate returns, birds notwithstanding. But in the sections where bean cultivation has been going on now for several months, the fight is all but hopeless, *Nematodes*, the *Agromyza* fly, *Bruchus rufimans*, also a black bug, round-bodied with shiny carapace, the name of which is not known to the writer, leaf fungi and root fungi have made a set-attack on these plots. Disinfection of seeds, sprayings with Bordeaux mixture and with insecticides, sulphur dustings, petroleum emulsion, neem oil emulsion, have been used without interruption, all with only very partial effect.

Referring again to the tests given above, the figures under A appear to negative the degeneration of the Lima bean from the third generation to the fourth generation: these weights were taken before the various above pests had taken such a hold of the land, but, unfortunately, it was found impossible to carry on these comparative tests with the later crops as the percentage of damaged beans was too great to make the tests of any use.

Test E was made from seeds obtained from the smaller plot previously referred to; but the test is inconclusive from the fact

that the seeds were selected for sowing, and were therefore plumper and, no doubt, heavier than average seeds would be.

As a conclusion to this paper, it may be stated:—

1st. That the Lima bean, Small Siéva, locally grown, shows a falling off in weight of 20 per cent. from the original parent seed received from Philadelphia.

2nd. That a falling-off in weight has taken place in the later crops, but that the adverse conditions under which the latter were grown, and probable loss of vitality from disease, make it unsafe to conclude that this falling-off would be continuous under normal conditions.

3rd. It may be pointed out that the Lima Bean is cultivated on a very extensive scale in the different countries surrounding us, and figures largely in their exports. Burmah has its Rangoon bean; Java its Java bean; Cochinchina its Haricot de Baria, the self—same "Small Siéva" which is under trial at the Economic Gardens, and all belonging to the species *lunatus*. In the face of this fact it will need very strong evidence to prove that it cannot be cultivated and acclimatised in this country, under normal conditions.

Roselle (Hibiscus Sabdariffa.)

The Roselle bush known also in the West Indies as "Jamaican" or "Red Sorrel," is a member of the Natural Order Malvaceae and is allied to the Bandikai or Lady's Fingers, and the Cotton plant. It was first planted in the Economic Gardens by Professor Baker who introduced it from the Philippines, and both the red, and the white "*Victor*" variety have been kept under cultivation there. Both plants develop into handsome bushes 5 to 6 feet in height with an abundance of almost horizontal branches spreading to a circumference of 4 to 5 feet in the lower part of the tree, which assumes a well defined pyramidal shape.

The so-called "*White*" Roselle is green in its wood, in its branches, and its leaves, but the calyces of the fruit are whitish green or straw coloured. The Red Roselle has a reddish bark and is quite distinguishable from the white type by the brilliant deep red colour of its calyces, which gives the jelly and jam made of it a very attractive red colour whereas the jelly made of the White Roselle takes the colour of amber.

This year, a consignment was received of seeds of the variety "*altissima*," new to the garden, and also of two distinct red and white types. Five beds were sown at the end of April, 1919, and on the 10th November, the first crop of fruit was plucked.

It is quite distinct in growth and habit from the Roselle of the "*Victor*" variety, the only one which had hitherto been cultivated in the Gardens. It is a much taller plant, attaining 10 to 12 feet in height, and the branches, instead of spreading horizontally as those of the "*Victor*" variety, grow at an acute angle to the stem, giving it a more slender appearance.

All its parts, even the calyces, are covered with short rough hair: the fruit, which is smaller than that of the "*Victor*" variety, is also rounder and the sepals, in the white type, are peculiarly streaked with faint lines of red spots. The fruit of the two varieties are here shown, side by side, in their natural size and shape.

Hibiscus Sabdariffa var: *Victor*
natural size
Colour—greenish white

Hibiscus Sabdariffa var: *Altissima*
natural size
White—spotted red

The "*altissima*" variety, although fairly prolific in fruiting, is less so than the "*Victor*" variety, and the smallness of its fruit, coupled with the more marked hairiness of the sepals make it a less desirable acquisition, for the purpose of making preserves, jams, jellies, or syrups.

Roselle has a long tap-root and it therefore requires a soil previously well dug to a depth of 10 inches. The writer, having planted it in varied kinds of soils, is of opinion that it thrives best in a fairly heavy clay soil, but being of rapid growth, it wants a soil well supplied with plant food. It is very grateful for a light application of well rotted cowdung. The land should be well drained, as the plant is somewhat subject, more particularly in low wet land, to the attacks of root-nematodes which dwarf it and render it unfruitful.

Roselle Jam or Jelly is well appreciated by all who know it, and, it is a great help to the housewife, in these times of costly and indifferent jams which figure in the market.

In making jam the sepals and calyces of the fruit alone are used, the seed-bag inside being cut-out and rejected. But the whole fruit can be used when making jelly, as in this case, the seed-bag is strained off.

The process for making jam is briefly as follows: Strip the calyces off and throw them in cold water to rinse them for 2 to 3 hours,—not longer—as, particularly in the case of red roselle, some of the pigment passes into the water and is so much loss in brilliancy of colour of the jam.

The calyces are then put in an earthenware pot or, if metal is used, it must be either a copper or enamelled pan. Boil in water sufficient to cover the fruit, for thirty minutes, more or less,

until the pulp is quite soft: add clean white sugar at the rate of ¾ pound to one pound of calyces: bring again to the boil for about 10 minutes, skimming meanwhile the scum that forms on top. The jam is then ready to put in bottles which must be previously heated; when cool, cover the mouth of the bottle with a round of paper previously moistened with white of egg, and applied to and overlapping the lips of the bottle.

This bottling is efficient if the jam is intended for home consumption in a relatively short time, but if it is intended to be kept, or if it is made for sale, then it is essential that the jam should be thoroughly sterilised. A very simple process of sterilisation was given in a leaflet of the "Board of Agriculture," (No. 250, May 1911) but thoroughly efficient processes, with quite simple implements, are to be found in many text-books which deal with the preservation of food-products. Also, if intended for long keeping, the proportion of sugar to fruit should be increased.

To make the jelly of Roselle, the same process is followed as given for jam; only, when the fruit has been sufficiently cooked to be quite tender, the whole is thrown on a fine sieve, and the calyces, after removal of the seed-bags, are mashed so as to extract the maximum of juice, which is collected below the sieve, and returned to the pot for a further boil, until it is found, on letting fall a few drops of the hot brew on a cool plate, that they jellify. The same proportion of sugar is used as for jam.

An excellent syrup can also be made of Roselle—and an equally excellent wine, somewhat of the nature of a very superior cider. This wine can be made without the addition of yeast and among the recipes given by sundry writers, the following taken from Quentin's "L' art de Conserver les fruits" is simple, and probably as efficient as any:—"In a barrel containing 15 gallons of water "dissolve 10 pounds of white sugar. Pour in the juice of 25 "pounds of calyces. Stirr well and leave to ferment for a couple "of days or until fermentation stops. Pour off the contents "through a filtering bag into another cask. If further fermenta-"tion occurs in the latter, the bung-hole should be covered with a "cloth only. If no fermentation takes place the bung may be "put in."

Wine made in this way is a still wine which improves on keeping.

A yet simpler method, by which the writer has himself obtained a strongly effervescing wine, is the following:—

Fill up a wooden cask or an earthenware jar with well-rinsed calyces after removal of the seed-bags. Press them well in to the brim and pour on top as much water as the cask or jar will take and let stand for 36 to 48 hours. Pour off the liquid over a filter-bag, put in clean white sugar, then bottle in strong champagne bottles, using well-fitting corks previously steeped in boiling water or in alcohol; secure them well with wire, lest the fermentation gases force them out.

The writer has seen in print some rather staggering accounts of the returns of Roselle cultivation. His own records are summed up in the following figures.

Roselle, Hibiscus sabdariffa var altissima also called Jamaica or Red Sorrel.

On a conservative basis, under average conditions, a crop of 120 fruit per bush may be looked forward to in 7 months.

6 whole fruit weigh one ounce; 9½ calyces (divested of seed-bags) weigh one ounce; 120 fruit, the crop off one bush, will therefore weigh 20 ounces.

There are 2,000 bushes in one acre planted 5 × 4 feet; the crop obtainable off one acre will therefore be 2,500 pounds of fruit.

In actual practice, the writer found that 8 pounds of fruit used in the making of jam, jelly, and syrup gave the following output:

2 bottles of Jelly—nett weight of jelly	= 26 ounces
1 quart bottle of Syrup—nett weight of syrup	= 33 ounces
4 large bottles of Jam—nett weight of jam	= 93 ounces

Estimating the value of the jelly at	$0.70
,, ,, of the syrup at	.60
,, ,, of the jam at	1.80
we arrive at a gross return of	$3.10

for 8 pounds of fruit.

From this figure must be deducted:

5 pounds of sugar at 25 cents ..	= $1.25
Bottles	= .60
Cost of cultivation, work and firewood	= .20
	$2.05

The nett profit on 8 lbs. of fruit would therefore be $1.05, and on 2,500 lbs., the produce of one acre, $328.

Excepting for the nematodes mentioned above, the Roselle plant, appears to be singularly free from disease; but it is the host of the Red Cotton bug, a red bug with white and black abdominal stripes, which is very common on several of the Malvaceae, and particularly on the Cotton plant. It propagates very quickly and, unless it is kept in check by frequent sprayings and sulphur dustings, it is difficult to get rid of. Fortunately it only feeds on the leaves, not on the fruit: but it soils the latter by its excreta. It is the *Disdercus singulatus.*

The leaves of the Roselle are also quite a good substitute for sorrel, and as such, form a valuable addition to a vegetable menu.

E. Mathieu.

(*To be continued.*)

A Guide to the Palm Collection in the Botanic Gardens II.

Pests.

Though not badly attacked as a whole by pests, palms have a number of enemies which have to be dealt with. In view of this fact it is felt that a few words concerning them, together with a few notes for guidance in dealing with them, would be helpful. These pests are practically all insects, being for the most part beetles and their larvae, the larvae of one or two butterflies, grasshoppers, scale, etc. The plants do not seem to suffer much from fungus diseases, in fact up to the present only two cases have come to the notice of the writer, these being on two species of *Cocos* which were attacked by a leaf fungus.

The following is an enumeration of the chief pests so far noted in the Botanic Gardens:—

Insects. (*a*) Beetles.

Rhyncophorus ferrugiens (Red Palm Beetle).
Rhyncophorus sp.
Oryctes Rhinoceros (Rhinoceros Beetle).
Various small beetles and weevils.

(*b*) Chafer.

Cetonica mandarinea.

(*c*) Butterflies.

Erionota Thrax, Larvae of.
Amathusia phidippus (Large Coconut Butterfly) Larvae of.

(*d*) Grasshoppers various.
(*e*) Coccids.
(*f*) Scale.
(*g*) Thrips.

Fungus. One leaf fungus not yet determined.

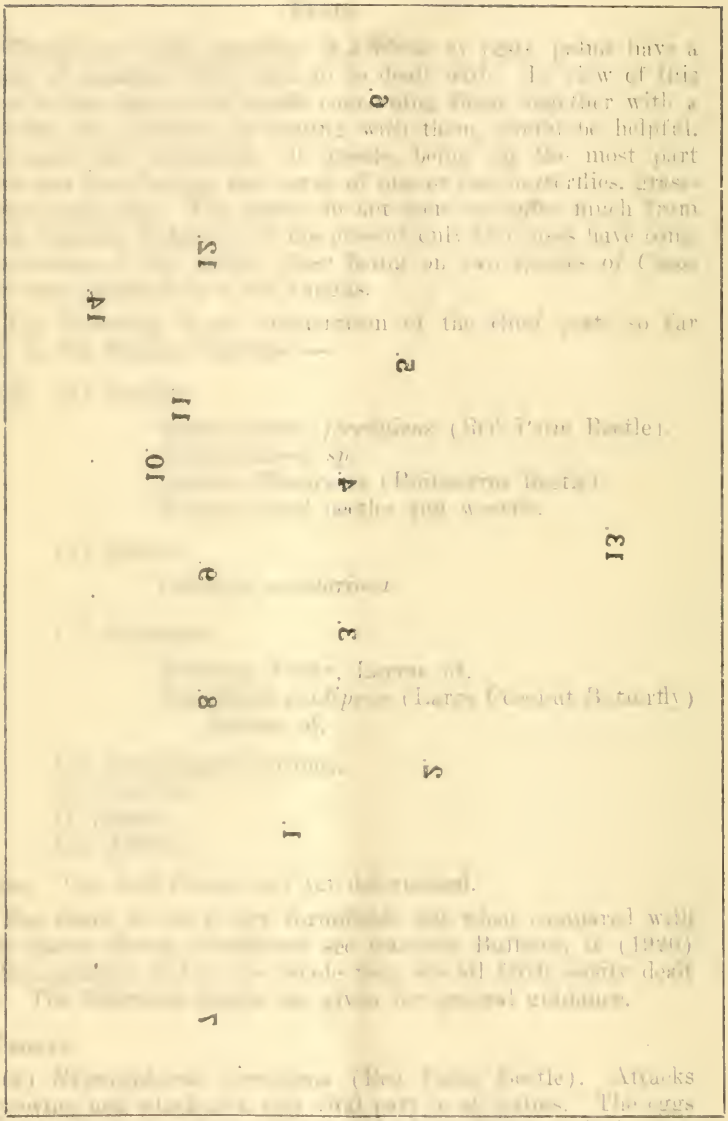
The above is not a very formidable list when compared with others plants *Herea brasiliensis* see Gardens Bulletin, ii (1920) 186 for example, and on the whole they are all fairly easily dealt with. The following details are given for general guidance.

1. *Insects.*

(*a*) *Rhyncophorus ferrugiens* (Red Palm Beetle). Attacks the growing bud which is a very vital part in all palms. The eggs are laid in the bud and when hatched the large fleshy grubs burrow into the soft tissue of the bud, often times proving fatal especially to the single-stemmed species. As a rule only large plants are attacked seldom those in pots or tubs. The beetle is 1½ to 2 inches long, black and has red markings.

1. Actinorhytis calapparia, Wendl.
2. Oncosperma filamentosum, Bl.
3. Elaeis guineensis, Jacq.
4. Oreodoxa regia, H. B. K.
5. Ptychoraphis angusta, Becc.,
6. Heterospathe elata, Scheff.,
7. Arenga saccharifera, Labill.,
8. Verschaffeltia splendida, Wendl.
9. Stevensonia grandifolia, Dunc.
10. Hyophorbe amaricaulis, Mart.
11. Hyophorbe Verschaffeltii, Wendl.
12. Ptychosperma McArthuri, Wendl.
13. Euterpe Jenmanii, Wright.
14. Chrysalidocarpus lutescens, Wendl.

A Guide to the Palm Collection in the Botanic Gardens II.



1. Aclinorhytis calapparia, Wendl.
2. Oncosperma filamentosum, Bl.
3. Elaeis guineensis, Jacq.
4. Oreodoxa regia, H. B. K.
5. Ptychorapbis angusta, Becc.
6. Heterospathe elata, Scheff.
7. Arenga saccharifera, Labill.
8. Verschaffeltia splendida, Wendl.
9. Stevensonia grandifolia, Duncan.
10. Hyophorbe amaricaulis, Mart.
11. Hyophorbe Verschaffeltii, Wendl.
12. Ptychosperma MacArthuri, Wendl.
13. Euterpe Jenmanii, Wright.
14. Chrysalidocarpus lutescens, Wendl.

In the Palm valley, Singapore.

Treatment. If stringent measures are taken the plant can often be saved provided the growing point has not been destroyed. The leaves should be removed and the young leaves cut right down exposing the growing point. The grubs should then be removed and the whole thing covered with a mat or gunny bag to protect it from rain until growth commences.

The genera attacked by the beetle are chiefly *Verschaffeltia, Stevensonia, Oncosperma, Cocos, Oreodoxa, Attalea* and *Livistona.*

In this connection of course it is best known as attacking *Cocos nucifera* (Coconut).

Rhyncophorus sp. This is a larger species than the preceding and attacks in the same manner especially *Oncosperma.* It should be dealt with in the manner recommended for *Rhyncophorus ferrugiens.*

Oryctes Rhinoceros (Rhinoceros Beetle). This beetle attacks differently from those mentioned above though the result is the same and it is the growing bud which suffers. In this case the beetle itself burrows into the stem of the palm near to the growing point, making a large hole quite ½″ in diameter. Once inside it begins feeding on the soft tissue and if not quickly dealt with the damage is fatal to single stemmed palms. The injury caused by the forcible entry into the trunk causes the plant to exude a considerable amount of liquid which takes the form of a very gummy substance. When this is present in any quantity it is a sure sign of the presence of these undesirable pests. When search is made for them they will generally be found inside the stem, but also occasionally, in the sheathing bases of the leaves.

Treatment. This pest is easy to deal with. The beetles should be speared with some sharp pointed object and when all have been removed a little salt should be sprinkled in the hole, this is a useful deterrent to other beetles seeking a suitable place to attack the palm. A sharp look out should be kept for this pest as it is very destructive. If treated soon enough the infected plant soon recovers.

A specimen of *Verschaffeltia splendida, Wendl.* in the Palm Valley demonstrates very effectively the manner in which this pest attacks. The hole in the trunk about five feet from the ground is quite easy to find. Whether this specimen has quite recovered it is difficult to say, but as the attack took place about five months ago, it seems likely that it was dealt with before the growing point had been injured. In any case it is under close examination and it is hoped that it is saved.

The larvae of this pest live in cowdung, decaying leaves and wood, and therefore piles of this should not be allowed to accumulate.

The genera attacked by this beetle are *Cocos* (particularly *Cocos nucifera, L.*, the Coconut) *Stevensonia, Verschaffeltia, Oncosperma,* and occasionally *Elaeis guineensis Jacq.* the African Oil Palm.

Various small Beetles. Under this heading are included various beetles and their larvae which attack the leaf-sheaths, causing the leaves to appear spotty when unfolded and the plant to appear sickly generally.

As a rule, they are in places which are inaccessible to insecticide in the usual way, and more stringent methods have to be adopted in dealing with them. All dead and badly affected sheaths should be removed and all beetles and larvae thus discovered must be destroyed. A good plan is to burn the sheaths straight away. Some reliable insecticide should then be dropped amongst the remaining leaves and allowed to penetrate wherever possible, this will effectually expel those remaining. Care should be taken in choosing the insecticide as it is sometimes necessary to put it in close proximity to tender parts of the plant. Soft soap, or tuba-root powder is suggested for this use.

(*b*) *Cetonica mandarinea.* The larvae of this chafer attack the roots of tub and pot plants. The signs by which they can be detected are a general sickliness in appearance of the attacked plant.

Treatment. The plant should be turned out of its pot or tub and all grubs destroyed. They are easily recognised by their dark, dirty looking bodies and hard brown heads. After this operation has been carried out the plant should be repotted in fresh soil and a clean pot or tub.

(*c*) *Amathusia phidippus* (Large Coconut Butterfly).- The larvae of this butterfly attack the leaflets usually of full grown plants, leaving only the midribs. The caterpillar is smooth, bright green with a broad head and two projecting spikes on its tail.

Treatment. The caterpillars should be picked off and destroyed. Afterwards the plants might be sprayed with tuba root insecticide to prevent more depredations.

Erionota Thrax. The larvae of this butterfly attack the leaves of some palms causing them to roll up, after which they proceed to devour them. The caterpillar is about two inches long, pale sea green in colour, covered with a mealy powder.

Treatment. Pick off by hand and burn, afterwards spraying with insecticide as in the preceding case.

(*d*) *Grasshoppers.* These are occasionally troublesome particularly to young plants. The best way of dealing with them is to catch them in a butterfly net or with a stick dipped in bird-lime.

(*e-f*) *Coccids and Scale.* Both of these pests are fairly abundant. They are particularly troublesome to young plants, though by no means confined to them, as often quite large plants are attacked.

Treatment. These must be dealt with by hand. The best way is to sponge them off the infected parts with a soft soap and paraffin solution.

(*g*) *Thrips.* These tiny insects are very troublesome quite spoiling the appearance of the new leaves, giving them a very blotchy appearance.

Treatment. They can be either sprayed or sponged with a soft soap and paraffin solution.

2. *Fungus.*

As previously stated the writer has only seen one case of fungus attack in the Gardens. Both of the plants attacked being members of the genus *Cocos* (*C. plumosa, Lodd.* and *C. flexuosa,* Mart.). They were attacked by a leaf fungus which caused the leaves to become brown and die off. The following measures were taken to deal with the disease.

Treatment. All the dead leaves, infected leaves and parts of leaves were removed and burnt. The plants were then sprayed with Bordeaux mixture. Up to the present the plants seem to have completely recovered and are already sending up new leaves.

Economic Uses.

The economic value of the palms is widely recognised and the palm family as a whole ranks very high in the list of families of economic value. Apart from the valuable industries of copra, rattans, oils, etc. there are many products which are of great local value and are extremely interesting. Some species seem to be invaluable and of these *Cocos nucifera, L.* is an outstanding example.

The following list, it is hoped, will serve to show how valuable palms are in the production of many articles in daily use, as well as in the important industries mentioned above.

The parts of the plant from which they are obtained are also indicated.

Stem and leaves.—Attaps, Fans, Umbrellas, Baskets, Hats, Mats, Brushes, Wax, Arrows, Spears, Fishing-rods, Sandals, Fancy Articles, Fibre, etc.

Bud.—Cabbage, used as a vegetable, to the detriment of the plant unfortunately.

Inflorescence.—Toddy, which is converted into Sugar, Spirit, Vinegar, etc.

Fruit.—Copra, Oil, Food, etc.

Further notes on this important subject will be given with the description of each species.

List of Genera represented in the Botanic Gardens.

The following list is arranged after the classification of Bentham and Hooker in the Genera Plantarum.

The countries from which they have been introduced are also indicated.

Arecineæ.

1. Areca, L. Trop. Asia; Malay Archipelago; East Indies.
2. Pinanga, Bl. India; Malay Archipelago; East Indies; Philippines.
3. Loxococcus, Wendl. and Drude. Ceylon.
4. Actinorhytis, Wendl. Malaya.
5. Archontophoenix, Wendl. and Drude. Australia.

6. Dictyosperma, Wendl. and Drude. Mauritius.
7. Ptychosperma, Labill. Australia; Polynesia.
8. Ptychococcus, Becc. New Guinea.
9. Coleospadix, Becc. New Guinea.
10. Rhopaloblaste, Scheff. Moluccas.
11. Cyrtostachys, Becc. Malay Peninsula.
12. Chrysalidocarpus, Wendl. Madagascar.
13. Oncosperma, Bl. Ceylon; Malaya.
14. Euterpe, Gaertn. West Indies.
15. Ptychoraphis, Becc. Singapore; Nicobar Islands.
16. Oreodoxa, Willd. West Indies; Trop. America.
17. Calyptrocalyx, Bl. Moluccas.
18. Malortiea, Wendl. Trop. America.
19. Heterospathe, Scheff. Amboina.
20. Iguanura, Bl. Malay Peninsula.
21. Stevensonia, Dunc. Seychelles.
22. Verschaffeltia, Wendl. Seychelles.
23. Dypsis, Noronh. Madagascar.
24. Chamædorea, Willd. Mexico.
25. Hyophorbe, Gaertn. Mauritius; Mascarene Islands.
26. Orania, Zippel. Malaya; Philippines; Moluccas.

CARYOTIDEÆ.

27. Wallichia, Roxb. India.
28. Didymosperma, Wendl. and Drude. Malay Peninsula; Java.
29. Arenga, Labill. Formosa; Malay Peninsula; Christmas Islands; Borneo; India.
30. Caryota, L. Trop. Asia; Malaya; Java; Philippines.

PHŒNICEÆ.

31. Phoenix, L. Africa; India; Ceylon; Siam; China.

CORYPHEÆ.

32. Corypha, L. India; Borneo.
33. Sabal, Adans. Southern United States America; West Indies; Trop. America.
34. Teysmannia, R. and Z. Malaya.
35. Acanthorhiza, Wendl. Central America.
36. Copernicia, Mart. Brazil.
37. Licuala, Thunb. India; Malaya; Polynesia; Moluccas.
38. Livistona, Br. Indo-Malayan region; China; Cochin-China; New Guinea; Philippines; Australia.
39. Pholidocarpus, Bl. Malaya.
40. Rhapis, L. China; Japan.
41. Thrinax, L. West Indies.
42. Cocothrinax, Sarg. West Indies.

LEPIDOCARYEÆ.

43. Dæmonorops, Bl. India; Malaya.
44. Calamus, L. India; Ceylon; Malaya; Philippines; East Indies.
45. Korthalsia, Bl. Malaya; Java.

46. Myrialepis, Becc. Malaya.
47. Zalacca, Reinw. Malaya; Java.
48. Metroxylon, Rottb. Malaya; Borneo.

COCOINEÆ.

49. Bactris, Jacq. Brazil; Colombia.
50. Desmoncus, Mart. Brazil.
51. Astrocaryum, Mey. Mexico; Trop. America; South America.
52. Martinezia, R. and P. Venezuela; West Indies.
53. Elæis, Jacq. Africa.
54. Cocos, L. Tropical and Sub-tropical America.
55. Maximiliana, Mart. Brazil.
56. Attalea, H. B. K. Brazil; Peru.
57. Pseudophoenix, Wendl. Florida.
58. Raphia, Beauv. Trop. Africa; Madagascar.

BORASSEÆ.

59. Borassus, L. India; Africa; Malayan Peninsula.
60. Lodoicea, Comm. Seychelles.
61. Latania, Comm. Mauritius.
62. Hyphæne, Gaertn. Africa.

A general description of the Palm family has already been given. It is now proposed to take the individual species separately.

PALMÆ.

Shrubs or trees, solitary or gregarious, armed or unarmed, rarely pubescent. *Stem* erect, scandent or decumbent, rarely branched above. *Leaves* alternate, plaited in bud, pinnatisect or palmate, rarely simple or bipinnate; petiole sheathing. *Flowers* 1 or 2 sexual, small, in panicles or spikes that are enclosed in one or more large sheathing bracts, generally termed spathes, usually 3-bracteate. *Perianth* inferior, segments 6 in two series, sepals and petals, usually all free, imbricate or valvate. *Stamens* 3 or 6 rarely more; anthers versatile. *Ovary* 1—3 celled or of 3 1-celled carpels; stigmas 3, usually sessile; ovules 1—2 in each carpel, adnate to the wall, base or top of the cell, anatropous. *Fruit* a 1—3 celled drupe or hard berry or of 1—3 carpels. *Seeds* erect or laterally attached, rarely pendulous; albumen horny or bony, solid or ruminate.

Genera about 140. Chiefly tropical.
Represented in the Gardens—about 60 genera.

No key to the genera has been inserted owing to its highly technical character. A key to enable visitors to distinguish specimens in the Gardens will be given later.

The descriptions have been kept as simple as possible, but to describe a species accurately without using a fair number of technical expressions is very difficult and would make them very long. Where practicable a key to species has been inserted, based on general characters as much as possible.

1. Areca, L.

Large or small palms either single or many stemmed, erect, ringed by scars of fallen leaves. *Leaves* pinnate. *Inflorescence* produced below the leaves, consisting of spathe and spadix, the former enclosing the latter. *Spadix* branches numerous, slender, terminal portions male, with a few female flowers at the base of each branch. *Male flowers* asymmetric, very small; sepals ovate, small; petals lanceolate often ribbed obliquely; stamens 3 to 6 in number; anthers attached by base. *Female flowers* much larger; sepals ovate, flat with a circular outline; petals slightly longer than sepals; stigmas 3, small; ovule, erect, basal. *Fruit* ovoid-oblong tapering towards each end; stigma terminal. *Seed* ovoid, truncate, that is as though cut off at the end; albumen ruminate.

Species 10, Indo-Malaya and Australia. Represented in Gardens 4.

The four species of *Areca* represented in the Gardens are, with the exception of *A. triandra, Roxb.*, very alike in general appearance. This renders it somewhat difficult to make a key without using much technical detail. However an attempt has been made to separate the species on leaf and fruit characters.

Single stemmed.

Leaflets about 30 pairs, placed fairly closely on the rhachis, fruit ovoid ..	1. *A. Catechu*
Leaflets about 20 pairs, placed fairly widely apart on rhachis, fruit spindle-shaped	2. *A. concinna*
Leaflets about 40 pairs, placed close together on rhachis, fruit obovate ..	3. *A. glandiformis*
Several stemmed	4. *A. triandra*

1. *Areca Catechu*, L. Sp. Pl. 1189. (Pinang or Betel Nut Palm.)

Stem.—Solitary, from 40 to 60 ft. in height when fully grown; diameter 8-12 inches, straight, cylindric, grey, of equal thickness throughout. *Crown* small in comparison with height. *Leaves* 4-6 ft. in length, spreading; leaflets many, 1-2 ft. long, linear, many veined, having 2 to 3 prominent ribs, lower leaflets acuminate, upper præmorse that is as though the end were bitten off, topmost leaflets short and broad. *Sheath*, long, smooth, green. *Spathe* simple, flattened, glabrous, produced below the leaves. *Spadix*, shortly peduncled, 12-18 in. long, branched at the base in a paniculate manner; branches filiform, bearing pendulous male spikes at their extremities. *Male flowers* small, disposed more or less in two rows; sepals 3, very small, and triangular; petals longer, oblong, rigid, marked with fine lines; stamens six. *Female flowers* 1-3 at the bases of the spadix branches or in their axils, larger than the male; sepals $\frac{1}{3}$ in. long, ovate, obtuse; petals longer than sepals. *Fruit* ovoid, orange or scarlet, 1-2 inches long. *Seed* $\frac{3}{4}$ inch in diameter, ovoid.

This palm is much cultivated throughout Trop. Asia, Malaya, etc. Its origin is not known as it is always found as a cultivated plant only.

The fruits are much used by the natives for chewing purposes and impart the red appearance to the lips and teeth when being masticated with betel leaves.

It has certain medicinal properties, and is chiefly used as an astringent and vermifuge. It is also used as a medicine in the treatment of worms in dogs.

There are also two specimens of a yellow form of *Areca Catechu, L.* This form is quite yellowish in appearance and produces yellow fruits. It can be seen in the Palm Valley in close proximity to the other species of *Areca.*

2. *Areca concinna,* Thw. Enum. 328 (1864).

Stem.—Solitary, from 8-12 ft. in height, 1-3 inches in diameter, cylindric, green. *Crown*—Larger than in *A. Catechu. Leaves* 3-3½ feet in length, spreading; leaflets 1½ to 2 feet in length, 2-3 inches broad, lanceolate, sickle shaped, acuminate, almost glabrous, lower simple, one ribbed, upper 2-3 ribbed, topmost pair of pinnae very broad, toothed at the margin. *Sheath* fairly long, up to 18 inches. *Spathe,* flattened. *Spadix* up to 1 foot in length, shortly peduncled, paniculately branched, branches filiform bearing male flowers in pendulous spikes at their extremities, female flowers borne in axils of branches or at their bases. *Male flowers*—arranged in two rows, small; sepals oblong, obtuse; petals nearly three times as long as sepals, obliquely ovate-lanceolate, acuminate, ribbed or striped; stamens 6. *Female flowers* very small; sepals form an unequally lobed cup of very tiny dimensions, petals, ovate oblong, obtuse. *Fruit* 1½ inches long, almost spindle shaped and bearing a protuberance in the centre, scarlet.

Habitat.—Ceylon.

The fruits of this *Areca* are also chewed with betel and are generally obtained from wild specimens. Only small specimens up to about 6 ft. in height are present in the Gardens collection.

3. *Areca glandiformis,* Lam. Encyl. 1. 241.

Stem.—Solitary, up to 40 ft. high, cylindric, annulate, diameter 4 to 6 inches. *Crown* medium. *Leaves* produced at top of stem, 4 to 6 or more feet in length, dark green; leaflets several, reduplicate, that is doubled back at the edges, sub-opposite, 1½ to 2 ft. in length, 1½ to 2 inches broad, linear lanceolate, acuminate, glabrous, green above, slightly glaucous below, nerves several, pale. *Spadix* produced below the leaves, monoecious, pendulous, peduncle about 4 inches long, several branches. *Male flowers* distichous, small; stamens 6. *Female flowers* larger than male; calyx lobes coriaceous, ovate, acute or acuminate, stigmas 3. *Fruit* longly-obovoid, glabrous, cuspidate, olive coloured at first, turning later to red.

Habitat.—Moluccas.

The specimens of this species present in the Gardens are to be found in the Palm Valley. No specimen is at present more than 20 ft. in height.

4. *Areca triandra,* Roxb. Hort. Beng. 68.

Stem.—Soboliferous, producing several strong stems, annulate, internodes fairly wide apart, green, up to 15 ft. in height, diameter 1-1½ inches. *Leaves* 3 to 4 ft. long, spreading, light green; leaflets 1½ to 2 feet long, 1 to 3 inches broad, linear lanceolate, acuminate, upper leaflets confluent producing a broad, præmorse pair of pinnae; nerves 2 or 3 in all but the top pair in which there are up to 7. *Spathe* 1 foot or more in length. *Spadix* shortly peduncled, up to 1 foot in length over all, branches many, paniculate. *Male flowers* small, disposed in two rows: sepals 3, small; petals larger than sepals; stamens 3. *Female flowers* 1-3 at base of branches of spadix or in the axils, larger than male; sepals shorter than petals, small. *Fruit* about the size of an olive, orange coloured eventually scarlet, upwards of 1 inch in length, ¼″ in diameter at middle, ellipsoid, tapering to base, truncate at apex, beaked.

Habitat.—India.

This plant is easily distinguished from the other species of *Areca* in the Gardens collection, on account of its soboliferous habit, the others all being single stemmed. Several specimens may be seen in the Palm Valley, it being quite an ornamental plant.

2. Pinanga, Blume.

Single or many stemmed palms, often producing good strong clumps, varying in height from 2 ft. in some species to 12 ft. or more in others, unarmed. *Stem* erect, annulate. *Leaves* pinnate with the upper leaflets confluent, more rarely entire; leaflets vary in length and breadth fairly considerably in different species. *Inflorescence* produced below the foliage. *Spathe* varying in size from 1 in. to over 1 ft., solitary. *Spadix* branched; flowers arranged distichously or spirally, one female between two males. *Male flowers* symmetric; sepals acute, keeled, not imbricate; petals ovate or lanceolate, valvate; stamens 6 or more; anthers erect, affixed by base. *Female flowers* much smaller, ovoid or globose, sepals and petals orbicular; ovary 1-celled, stigmas 3; ovule basal, erect. *Fruit* drupe, ovoid or elliptic. *Albumen* ruminate.

Species about 50. India, Malay Archipelago.
In the Gardens 7 species.

Dwarf palms—up to 4ft. in height.
- Leaves broad as long .. .. .. 1. *P. disticha*
- Leaves twice as long as broad .. .. 2. *P. subruminata*

Tall palms—up to 10 ft. in height.
- Stems ½ to 1½ inches in diameter.
  - Leaflets numerous .. .. .. 3. *P. malaiana*
  - Leaflets few.
    - Leaflets linear or linear lanceolate 4. *P. riparia*
    - Leaflets sigmoidly lanceolate .. 5. *P. patula*

Stems 2 to 2½ inches in diameter.

Leaflets 7 or 8 pairs	.. ..	6. *P. fruticans*
Leaflets 20 to 24 pairs	.. ..	7. *P. ternatensis*

1. *Pinanga disticha,* Bl. Rumphia. ii. p. 77 (Pinang Luggong).

Stems several, slender, up to 3 ft. in height, diameter ¼″, green. *Leaves* usually simple, divided into 2 lobes, or with a few broad acuminate leaflets, up to 1ft. in length, dark green mottled with yellowish-green patches, nerves prominent, numerous; petiole up to 4 inches in length, scurfy; sheathes short, up to 3 inches. *Spathe* oblong, beaked, about 1 inch in length. *Spadix* solitary, occasionally branched, 1 to 4 inches in length, deflexed, green, peduncle tomentose; flowers distichously arranged. *Male flowers* ⅛ in. long; sepals short, rounded; petals ovate, acuminate; stamens usually 15. *Female flowers* small; sepals orbicular; petals ovate, with sharp rigid point; pistil much longer than petals; stigma capitate. *Fruit* drupe ½ inch in length, ovoid, acute, red. *Seed* elliptic.

Habitat.—Malaya.

This pretty little palm makes a charming pot plant when well grown.

2. *Pinanga subruminata*, Becc. Males. iii. 174.

Stems short, erect, about 2 feet in height, diameter about ⅜ inch, annulate; internodes about 1 inch long. *Leaves* narrowly cuneate, forked, sometimes very deeply, apex truncate, toothed, light green, up to 12 inches in length, 3 to 4 inches wide; nerves numerous and strong; petioles about 2 inches long; sheaths about 2 inches long, ribbed. *Spathe* 3-angled, about 1½ inches in length, more or less oblong, having two horns about ¼ inch in length at the apex. *Spadix* solitary, deflexed, glabrous, up to 4 inches in length, thickening in fruit; flowers distichous or spiral, often opening and producing fruit inside the spathe. *Male flowers* ¼ inch long; sepals acuminate, deltoid; petals linear, narrow; stamens about 12. *Female flowers*, sepals round, spreading; petals erect, orbicular, larger than sepals; pistil conical. *Fruit,* drupe about ½ inch long, elliptic, beaked, red. *Seed* elliptic, subacute.

Habitat.—Malaya.

I have found only one plant of this species, in the Gardens.

3. *Pinanga malaiana,* Scheff. Natuurk. Tijdschr. Nid. Ind. xxxii, 175. (Pinang Dampong).

Stems several, slender, up to 12 ft. in height, diameter 1 inch, internodes about 3 inches long. *Leaves* pinnate, large, from 5 to 8 ft. in length, spreading; leaflets linear acuminate, about 15 inches in length, ½ to 1 inch broad, dark green, glaucous beneath, having 2 prominent nerves; petiole about 18 inches in length. *Spathe* about 10 inches in length, oblong. *Spadix* deflexed, stout, about 12 inches in length; branches 2—5, flattened, red in fruit; flowers arranged in two rows. *Male flowers* flat; sepals lanceolate;

petals much larger; stamens, filaments short. *Female flowers* sepals and petals very short; stigma in form of a disc (discoid). *Fruit,* drupe ¾ inch in length, narrowed at both ends, black when ripe. *Seed* olive-shaped with a truncate apex.
Habitat.—Malaya.

4. *Pinanga riparia,* Ridley, Journ. Roy. As. Soc. Straits Branch, xliv (1905) 201.

Stems several, distant, up to 12 ft. in height, ½ to 1½ inches in diameter, internodes 3-4 inches in length. *Leaves* about 3 ft. long, pinnate; rachis angled, scurfy; leaflets three or four pairs of lateral and one terminal bilobed one, lateral leaflets linear or linear lanceolate, acuminate, with 3 to 6 nerves, 3 to 9 inches in length, 1 to 2 inches broad, terminal leaflet broad, bilobed, many nerved, coarsely toothed. *Spadix* decurved, peduncle stout, about ¾ inch in length, branches 3 or 4, stout, 6 to 7 inches long; flowers distichous, close. *Female flowers* globose, about ⅛ inch in length; sepals and petals very short; stigma in form of a disc. *Fruit,* drupe ¾ inch in length, narrowed at both ends, black when ripe. *Seed* olive-shaped with a truncate apex.

Habitat.—Malaya.

5. *Pinanga patula,* Bl. Rumphia, ii, 86, t. 115.

Stems several, slender, up to 10 ft. in height, diameter ½ to 1 inch, internodes 2½ to 3 inches long. *Leaves* 2 to 3 ft. in length, pinnate; leaflets about 6 pairs, sigmoid, acuminate with a long point, narrowed at the base, terminal leaflet deeply divided, apex toothed, 7 inches in length, 2 to 2½ inches wide, dark green; nerves 3 to 7. *Spadix* 4-branched, deflexed, branches slender about 6 inches long, red in colour. *Male flowers* not seen. *Female flowers* small; sepals orbicular, margins crenulate and appear as though bitten; petals smaller and rounder. *Fruit* drupe, flesh colour, elliptic, ribbed, about ½ inch long. *Seed* elliptic, ruminate.

Habitat.—Malay Peninsula, Sumatra.

This species forms very effective clumps and in common with most *Pinangas* is always very clean stemmed.

6. *Pinanga fruticans,* Ridley, n. sp. MSS.

Stems several, close, light green, annulate, up to 10 ft. in height, diameter 2-2½ inches; internodes 2 to 2½ inches long. Leaves up to 5ft. long, light green; petiole 1 to 1½ ft. long, yellow, scurfy; sheath 1 to 1½ ft. long, very scurfy giving a brownish appearance; leaflets 7 or 8 pairs, 1½ to 2 ft. long, 4 to 5 inches wide, trapeziform acuminate, 5 to 7 nerved, upper 2 pairs of leaflets 9-nerved, very broad, strongly toothed præmorse. *Spathe* boat shaped, reddish, papery, caducous. *Spadix* red, 8 or 9 branched; peduncle ¾″ long, stout; branches up to 9 inches long; flowers distichous. *Male flowers* ¼″ in diameter; sepals ovate acuminate, flesh colour; stamens 12. *Female flowers* smaller than the male, orbicular; sepals ovate acute; stigmas 3. *Fruit* almost round, slightly narrowed at the base, ¼ inch long, at first light green, when ripe quite black.

Habitat.—Java.

Up till quite recently this plant was called *P. Kuhlii,* Bl., but Ridley has now made it a new species. There are several specimens of it in the Gardens. It spreads itself all over the place, and in a shady spot makes a very ornamental plant.

7. *Pinanga ternatensis,* Scheff. Ann. Jard. Buitenz. i (1876) 149.

Stems several, close, green, annulate; internodes 3-4 inches long. *Leaves* 6-8 ft. long, light green; petiole 1-1½ ft. long, yellow, scurfy; sheath 1½ ft. long, very scurfy giving a brownish appearance; leaflets 20-24 pairs, acuminate, 1½-2 ft. long, 1-1½ inches broad, generally 2 ribbed, upper pair of leaflets præmorse, 2 inches broad, strongly nerved, having 6 nerves, next five pairs of leaflets bifid or præmorse, 1″ broad. *Spathe* boat-shaped, brown, caducous. *Spadix* red, 12 branched; peduncle short, 1 inch long, stout; branches 9″ to 1 ft. long. *Male flowers* ¼″ in diameter; petals 3, ovate, acuminate; stamens 18, filaments much shorter than the anthers. *Female flowers* orbicular; sepals ovate, acute. *Fruit* ½ inch long, oblong, truncate at base and apex, at first yellow, when quite ripe black.

Habitat.—Ternate Islands.

This plant is very like *P. fruticans,* Ridley, in appearance, but it has considerably more leaflets, and a more branched spadix.

3. Loxococcus, Wendl. and Drude.

Trunk tall, erect, cylindric, annulate. *Leaves* pinnate; leaflets linear, obliquely truncate, margins of leaves folded back, surface plaited lengthwise. *Spathe* 2, boat shaped. *Spadix* monœcious, that is stamens and pistils in separate flowers on the same inflorescence, branched; flowers in threes, mostly in clusters of a female between two males, spirally arranged around the branches. *Male flowers,* sepals 3, orbicular, imbricate; petals 3, much larger, ovate, valvate; stamens 9-12, filaments very short, anthers subversatile; pistillode, minute, ovoid. *Female flowers* smaller than male, sub-globose, sepals orbicular, broadly imbricate, tips valvate, staminodes o; ovary 1-celled, stigmas 3, minute, ovule parietal. *Fruit* subglobose, beaked with a sharp rigid point, stigmas terminal, endosperm ruminate. Monotypic.

Species 1, Ceylon. Represented in Gardens 1.

1. *Loxococcus rupicola,* Wendl. and Drude in Linnœa, xxxix, 185.

Stem.—Solitary, erect, up to 40 ft. in height, 4-5 inches in diameter, swollen slightly at base, annulate. *Leaves* spreading 6-8 ft. in length, pinnate; petiole 1-1½ ft. in length, with green smooth base; leaflets 12-20 pairs, up to 2 ft. in length by about 2½ inches in breadth, spreading, somewhat recurved, linear, subglaucous beneath with scattered furfuraceous scales; sheath very short. *Spathe* about 1 ft. long, pale yellow, clothed with reddish scales. *Spadix* produced below the leaves, blood red in colour, about 1 ft. in length, triangular when fully developed; peduncle

short, branches spreading, glabrous; flowers spirally arranged, generally in scattered clusters of 3, males in pairs towards the upper part of the branches, females solitary between 2 males in lower part. *Male flowers* ½ inch in diameter; stamens 12, filaments equalling the anthers. *Female flowers* ovoid with appressed perianth segments. *Fruit* globosely ovoid, about 1 inch in length. *Seed* globose.

Habitat.—Ceylon.

This palm has not yet fruited in the gardens, though it has several times flowered. The plant which is in the Palm Valley is at present about 15 feet in height and is very attractive with its close growing crown of leaves and blood red flower spikes.

F. Flippance.

(*To be continued.*)

Polyembryony.

Two instances of what presumably are cases of polyembryony were recently noticed by Mr. G. B. Deshmukh on germinating seeds in the Economic Gardens.

In one case, that of *Citrus decumana*, L. the Pomelo, one seed bore five shoots each with its own diminutive cotyledon and rootlet. These shoots were separated and planted and have done well.

The other case was a seed of the Avocado Pear, *Persea gratissima, Gaertn.* which gave rise to six shoots and a common root. They were difficult to separate and have been allowed to grow as they arose.

The above seeds took longer to germinate than the normal seeds did, and the first shoots were somewhat weakly in their early stages.

Mr. Deshmukh also reports that at the same time adventitious buds were observed on the leaves of a cabbage.

T. F. C.

Relation of Soil Acidity to Plant Juice.

In Soil Science Vol. VII, No. 6. E. Trong and M. R. Meacham bring to a conclusion their paper on Soil Acidity in its bearing on the acidity of the Plant Juice. In view of the large amount of fruit planting at present contemplated in Malaya the following extract from the above quoted paper should prove of value in influencing planters in their selection of soil.

"There are considerable differences in the acidities of juices of different species of plants. The acidity of each species of plant, while it may vary to an extent easily measurable, is, however, usually limited to a rather narrow range. Undoubtedly for each species of

plant there is a certain acidity which is most favorable for the life processes of that species. Unquestionably in many cases soil acidity, by limiting the supply of lime available for plants, affects the acidity of the juice or protoplasm of these plants. The importance of a proper regulation of plant acidity in relation to vital plant processes should be noted.

"In the life processes of plants, acids are formed, some of which are probably simple by-products. Lime and other bases are needed to neutralise these acids. Plants high in protein are usually high in lime and other bases indicating the formation of acids in protein synthesis. If the supply of lime and other bases is inadequate, the acidity of the plant juice rises to a certain extent which is limited because the accumulation of acids probably decreases the rate of the processes which produce acids. A condition of self regulation thus probably exists and death due to over-acidity is prevented. Slow growth and a weakened condition however, result as is the case with plants of high lime requirement growing on acid soils.

"In plants there are many "buffer" substances which to a certain extent help to maintain a more uniform acidity and prevent rapid and excessive alterations, as would result especially from diurnal changes in plant processes. Bases are however usually needed in the formation of these "buffer" substances."

T. F. C

Red Ring Disease of Coconuts.

The following extracts are taken from a report read by Mr. W. Nowell, D. I. C., Mycologist, Imperial Department of Agriculture, Trinidad on Oct. 16, 1919, and published in the "Agricultural News" Vol. XVIII, No. 460. It is considered it may be of interest to local growers of coconuts.

"It may be remembered that during my last visit I had incidental opportunities of making observations on the so-called root disease of coconuts, and announced the invariable association of the disease in all cases examined, with a minute thread worm or nematode. The matter was not then sufficiently advanced for the issue of a report, and the investigation is still far from complete.

In the first place it must be stated that the connexion of the disease with the nematode worm has been abundantly confirmed. Not only is the worm present in close association with the first appearance of the disease in any organ of the plant, but infection experiments, with material to all appearances pure have resulted in complete and typical infestation of the inoculated trees with the reproduction of all the symptoms of the disease, the parallel controls remaining healthy. The proof cannot be considered absolute, but it comes nearer to certainty than is the case with very many plant diseases in which causation is regarded as established.

"The worm has been described as a new species, *Aphelenchus cocophila*, by Dr. N. A. Cobb, of the United States Department of Agriculture, who has prepared a paper on its characteristics for the forthcoming number of the West Indian Bulletin.

"It is now clear that the existence of the disease in the roots, though fairly general, is only secondary. Examples have been seen in which the roots were affected only in the slightest degree. The centre of infestation is the red zone in the stem, which is simply a vast breeding ground of the worm. From this it extends more or less along the roots, and, what is much more serious in immediate results, to the leaves. This includes not only the mature and semi-mature leaves which progressively fail in the familiar manner, but the very youngest rudimentary leaves, only a few inches long, in the centre of the bud. It appears to be this infestation of the leaves which brings about the death of the tree. In plantations where the trees are uniform in age, the disease typically appears first in widely and thinly scattered cases when the trees approach bearing age. This can occur equally on virgin forest soil or on old cultivated land. The worms may come from some unknown alternative host, not coconut, but the balance of probability seems at present to be with the conclusion that they are introduced with the seed nuts.

"From the centres of infection thus established, the disease extends to surrounding trees, and the resulting losses can be very serious. I have already seen or heard of several instances in which they approached 30 per cent.

"The process of natural infection, and the length of time required for development remain to be investigated. Three trees in Grenada inoculated in the stem 1 to 2 feet from the ground were fully infested and failing in sixty days. A tree inoculated in the stalk of a leaf had a rather general but not fully developed infestation in seventy-four days. A tree in which material was placed among the leaf bases without inoculation was fully infested in stem and leaves in seventy-four days, while a tree similarly treated in one leaf base had seventeen infested leaves at the end of the same period.

"It thus appears that infestation may take place among the leaves without previous injury and this can be conceived as quite possibly occurring from dry infected material blowing about or from worms gaining access to the leaf bases of young trees from the soil. There is a large amount of detail work remaining to be done with regard to the resistance of the worms to dryness and to chemical agents, to their distribution and longevity in the soil and other matters. This work is of an obvious kind, and, given the opportunity there is every prospect of approaching to a fairly complete knowledge of the disease within a reasonably short time.

"It is clear that the only hope of control lies in prevention and not cure and the bigger practical difficulty is going to be the disposition of the vast amount of infested material which the dying trees contain."

T. F. C.

The Poisoning of Birds by Cassia bicapsularis.

The Queensland Agricultural Journal Vol. XII, December, 1919 contains an account of the poisoning of birds by two species of the genus *Cassia* (*Leguminosae*). One of them *Cassia bicapsularis*, Linn., a native of tropical America is not unfrequently introduced into cultivation on account of its rather large masses of bright yellow flowers. Specimens of this plant in the Singapore Gardens' Herbarium were collected on the Race Course Road, Penang, and it is quite possible this species is growing in cultivation or as an escape in other localities.

Mr. White concludes his account with the remarks that "In the cases here quoted, there seems no doubt that the species of *Cassia* referred to could definately be blamed as the cause of the deaths of the birds in each; and it would further seem that the fairly numerous charges of stock poisoning made against various species of *Cassia* in Queensland may be more correct than previously imagined. This, however, is a matter that can only be ascertained by future investigations."

T. F. C.

A New Source of Plant Food.

Under the above somewhat misleading title an article in the "Journal of Heredity" Vol. X, No. 7 draws attention to plants which gather nitrogen and store it after the well known manner of the bacterial nodules of the *Leguminosae* plants. In the present case however the plants are members of the *Rubiaceae* and store the nitrogen in small nodules in the leaves instead of on the roots. The leaf nodules contain colonies of a non-motile, nitrogen bacterium, known as *Myco-bacterium rubiacearum*. The two plants quoted *Psychotria bacteriophila* and *Pavetta Zimmermanniana* are not recorded from Malaya but it is stated that probably other Rubiaceous plants have the same habits. The article continues. "These bacteria almost invariably inhabit the micropyle of the young seed, and, when the latter germinates, grow through certain stomata of the young leaves and into the intra-cellular spaces formed in the leaf-tissues around these stomata. Cavities are formed through the growth of the epidermal cells which later close entirely and make bacterial nodules which are deeply imbedded in the leaf tissues. A single leaf may have several dozen of these symbiotic bacterial nodules. Faber was able, by treating the seeds with hot water and a sublimate solution to kill the inhabiting myco-bacteria, and later, to infect part of the seedlings grown from these seeds with pure cultures of the bacterium. The artificially infected seedlings grown in soil free from combined nitrogen grew well and remained healthy for four months whereas those not so infected turned yellowish-white and died in three or four weeks. The plants from unsterilized seeds produced leaves bearing many more bacterial nodules than did those from sterilized seeds which were later artificially inoculated.

"In view of the fact that these Rubiaceous plants with nodule-bearing leaves occur in many parts of the tropics, and that in India the value of their leaves has long been recognized, and considering the importance of nitrogen-fixing legumes as soil enrichers, the suggestion of Faber that we may have in these trees and shrubs plants of positive agricultural value deserves the serious consideration of tropical planters. If they can be grown as subsidiary crops beneath plantations of rubber, cacao, coffee, or other important tropical cultures, and their leaves allowed to accumulate upon the ground to serve as a mulch and as nitrogenous fertilizer, they may have great value. They differ from the leguminous cover-crops in that they are perennial in habit, and will not need to be replanted every year. It might be possible to prune them severely every year and utilize the clippings as fertilizer. The subject is one which opens up a new field in connection with tropical agriculture, and one which offers remarkable possibilities."

As the Rubiaceae are well represented in this part of the world it will be of interest to ascertain if any local representatives are provided with these leaf nodules.

T. F. C.

Paper.

The sources from which paper pulp can be obtained are continually being discussed especially with a view to seeing what products of tropical forests or open country that are at present wasted can be turned to good account. The results of investigations on bamboos, grasses, etc. are given in Bulletin No. 16 of the Philippine Bureau of Forestry.

The following interesting account of the manufacture of paper pulp from "lalang" or "blady grass" (*Imperata arundinacea*, Cyr.) is taken from the Queensland Agricultural Journal, Vol. XII, November 1919. "It takes three tons of green blady grass to manufacture 1 ton of crude pulp, while it takes, at least, 7 to 8 tons of sugar-cane to make 1 ton of brown sugar. Delivered in the Southern Paper Mill, the pulp is worth, at least, £21 per ton a value equal to that of one ton of sugar. Under present conditions the cost of manufacturing the pulp is greater than that of making sugar, owing chiefly to the fact that chemicals are dear and the machinery and appliances have not been perfected; but Mr. Campbell can show not only how to make good use of local crude alkalis, but, also, how to bring the application of his method up to sugar mill standard, thus greatly decreasing the cost of manufacture. This would mean that a higher price should be paid for the grass—in fact, a price equal to that of sugar cane, say £2 per ton green—making 1 ton of hitherto useless blady grass (considered a pest and a curse by the cane-farmer) growing without cultivation, equal in value to 1 ton of the best cultivated sugar-cane.

"We (Queensland Agricultural Journal) shall be very pleased to hear that Mr. Campbell's experiments achieve such a result, as it would be of exceedingly great value to Australia generally; and would doubtless give rise to an extensive business in Papua, where there are large tracts of land on navigable rivers notably the Kemp Welsh River, covered with a luxuriant growth of this hitherto pest of the planters. And it must not be forgotten that native labour in New Guinea is cheap, plentiful and reliable."

There are no doubt many in Malaya who will also be interested to hear of further results in this direction.

T. F. C.

A Remedy for Bean-Fly.

In the last issue of the Garden's Bulletin page 205, mention was made of a beetle attacking the Lima Beans in the Economic Gardens. Other material was collected and forwarded to the Imperial Bureau of Entomology. In his reply the Director states:—"The fly is *Agromyza phaseoli, Coq.* a widely distributed pest of beans. The beetle belongs to the family Eumolpidae, the species being *Pagria flavopustulata, Baly.*

"With regard to the methods for dealing with bean-fly, the remedies of which I enclose particular have been adopted with success in Australia.

"The action of an appliance for destroying *Agromyza phaseoli* depends upon a habit which this fly has of making a rapid upward flight when disturbed. In its simplest form it consists of a sheet of window glass set in a light wooden frame, with a curtain of calico about 6 in. wide attached to three of its sides, and a pair of wooden handles on the upper side. The under side of the glass is lightly sprinkled with kerosene, which spreads into a thin film over the glass. The frame is then carried over the young bean plants with the open side in front, and about 9 or 10 in. from the ground, the rear part of the glass just clearing the young plants. The advancing sheet of glass passes over the flies before they rise, and as they do so directly upwards, they strike the glass, become saturated with kerosene and die instantly.

"A larger horse-drawn apparatus, constructed on a similar plan, is suitable for larger areas. After about nine days the flies are less destructive, and as they prefer young beans, a good trap may be prepared by sowing a row of beans in the near vicinity 9 or 10 days after the crop is planted.

"The rows of beans should be covered about four days after planting the seed with a light layer of sawdust, which should then be wetted with kerosene emulsion applied with a watering-can. When the plants are in the second leaf, a second dressing with this emulsion should be given. It should be made with 1 lb. ordinary soap dissolved in about 2 gals. of boiling water. When

dissolved, sufficient cold water should be added to make 4 gallons and three-quarter pint of kerosene should be well stirred in. The emulsion must be warm when used and must be kept well stirred.

"In every case it is advisable that the beans should be burned after the crops have been gathered."

T. F. C.

Castor Oil.

The question as to the market possibilities of Castor Oil production from locally grown crops is again the subject of much discussion. "Tropical Life" Vol. XV, No. 12 contains an article in which the problem is considered from a commercial point of view, and from which the following extract is taken. Methods of cultivation are also given. "Taking the American and English figures as a guide, we see then that the price in 1909 was somewhat about 4*s*., and in 1910 in the vicinity of 5*s*. 4*d*. per bushel.

"The cost of production can only be arrived at according to locality; it would be somewhat similar to the cost of producing an acre of maize except that the harvesting is much more expensive. This is accounted for by the fact that the pods do not ripen evenly and the crop has to be gone over several times in order to harvest it. An estimate for producing, harvesting, bagging, and marketing, a 20 bushel crop of castor beans, allowing 10*s*. per annum for rent would not be less than £5 per acre.

"From the above figures farmers will be able to draw their own conclusion as to whether this crop can be considered payable. Furthermore, it may be stated that castor oil plants cannot be grown continuously on the same land for any lengthy period, because the crop exhausts the soil rapidly; so much so that some authorities state that it should be grown only once in five or six years on the same land."

T. F. C.

The

Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. II Issued June 28th, 1920. No. 8.

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THE

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STRAITS SETTLEMENTS.

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The Oil Palm in the East. II.

In the paper which appeared under the above title in the April number of the Gardens' Bulletin, several points of interest to the prospective planter of the oil-palm were touched upon, which it is now proposed to treat more fully.

Selection of Land. Most of the thick palm-forest of West Equatorial Africa is found in broad open valleys with gentle undulations, where the soil and the rainfall favour the palm, and along the level plains from the coast to the high bush. It becomes scarcer in hilly regions and it is seldom seen, except in widely scattered patches, at altitudes of more than one thousand feet. The palm-forest stops where the evergreen equatorial forest begins. *Elaeïs* is essentially a tree of the lowlands and it is even found in situations which are intermittently submerged in periods of floods—but yet it does not thrive in swampy or badly drained places where water stagnates. Briefly it is at its best on well drained flats of deep rich soil with plenty of atmospheric and soil moisture, and it will be apparent, if we keep in view the general configuration of the Malay Peninsula, that its range of profitable cultivation is not a very wide one—at least not if we compare it with that of Rubber which accommodates itself to a wide range of soil conditions and to greatly varying altitudes—or with that of the Coconut which thrives right down to the sea-board in almost pure sand, or along the course of tidal rivers in salt-impregnated soil.

The selection of land for the planting of *Elaeïs* will therefore have to be carefully thought out, the planter keeping well in view not only the suitability of the soil, but the configuration of the land and its easy accessibility by water or by road; also the necessity of a thorough but economic network of communications between all parts of the estate and the factory. Some of the sugar estates of Province Wellesley, long since transformed into rubber estates, with their canalisations, would probably well fulfill, in respect of communications, both internal and external, the requirements of an *Elaeïs* estate; this, of course, apart from considerations of soil.

However, one thing is now certain, viz: that the *Elaeïs* does grow well under congenial conditions in Malaya, and that it produces crops as heavy as those recorded from West Africa; and, although there is no room in Malaya for the vast stretches of Palm-forests as seen in Africa, it is quite possible that fairly large tracts of land could be found, suitable for its cultivation. One expert who knows the Congo well, and who is also well acquainted with Malaya is emphatic in his opinion that certain parts of the Peninsula offer ideal conditions, in point of soil and climate, for *Elaeïs*.

Nurseries. Once a suitable location is found for an estate, the initial work of opening up will not present any special difficulty to a practical planter: it entails the usual programme of felling, clearing, draining, road tracing, &c., &c., but when we come to the establishment of nurseries, the difficult problem of an adequate supply of seeds will have to be faced. Seeds could perhaps be obtained from Sumatra, East Coast, where, according to the latest information, 6,500 acres, planted with 290,000 *Elaeïs*-palms were in full bearing on the 30th June, 1919, producing 700,000 kilos of oil during the first half-year of 1919. If *Elaeïs* has proved the success which these pioneers hoped for, they may not be too eager to part with their seeds, except at very high prices. Failing such a source of supply, seeds would have to be procured from West Africa—a proceeding not without risks, in view of the diversity of races of *Elaeïs*, and their varying oil-yielding qualities. Still, the thing has been done before, with success in the case of these Atjeh plantations, and it could, no doubt, be done again.

It may be said, if all has gone well with the selection of the land, and if the difficulty of the seed-supply has been overcome, that the planter has four years of easy time ahead of him in which to lay out his estate to the best advantage. He can safely leave his seedlings in the nurseries for full twelve months, before transplanting. The writer has had occasion to transplant trees at least two and a half years old, most of which, after three months, had resumed their normal rate of growth.

Catch Crops. Here then is an opening for the planter to put down catch crops of food stuffs such as maize, sweet potatoes, groundnut, to the extent of his labour facilities, or for putting down a subsidiary crop of coffee or perhaps of cocoa, which is said to succeed particularly well in West Africa with the oil-palm, owing to the large amount of moisture which is stored in the latter's root-pad, and in the felt coating round its trunk, and which comes in as a reserve in times of drought.

Moreover, it may be observed here that the *Elaeïs* does not form the same far-spreading matted rooting which characterises the coconut and renders it so uncongenial a neighbour to other plants.

At the base of the *Elaeïs* a pad of earth and roots forms, from which emerge successive generations of roots most of which do not live long, but their dead remains subsist and go to swell the

pad on which the tree stands. Those roots which live radiate in all directions to a distance from the tree. The writer has followed one, by digging with a fork, to a length of 32 feet from the base of the tree. Of a uniform thickness throughout of about one quarter of an inch, they run in an almost straight line through the earth, forming very few branches (only one short branch was observed in this case) and no hair-roots; but, at every three or four inches, single short feeders, from three to eight inches long, are seen emerging from the main-root and perpendicular to it; it requires a fairly strong pull to wrench these feeders out of the earth, and, in their *ensemble,* they must constitute a very powerful anchorage for the tree. The older portion of the main-roots, *i.e.* that portion nearest the tree, is woody and somewhat brittle, but it becomes soft and pliable in the newer parts; and under the brown epidermis which rubs off easily, it is found to be quite white and turgid. If the covering tube is slit longitudinally, continuous semi-transparent cord can be detached of the appearance and thickness of Chinese vermicelli: if squeezed, water oozes out of it. This shows that, given a free open soil with plenty of moisture in it, (which is the case for the tree under review) the *Elaeïs* can draw sustenance from a fairly wide area, and, under similar circumstances, wide-planting would be indicated. But, on the other hand, these main-roots are not numerous and they are easily interpenetrated by the roots of other trees, as was found in the present case, where two neighbouring trees, (one rubber, one coffee) were found sending their roots in all directions, above and below those of the *Elaeïs.* In another case, that of an *Elaeïs* over thirty feet high, growing in stiffish laterite soil, a root one inch thick, of a *champadak* tree (*Artocarpus polyphemia*), standing 20 feet away, was unearthed within five feet of the basal pad of the *Elaeïs.* Briefly, then, the root-system of the Elaeïs does not form a thick network, as the coconut does, and its interference with the neighbouring vegetation does not appear to be such as to inhibit the cultivation of plants foreign to it. Hence the interplanting of a subsidiary crop, (given proper spacing), which cannot be recommended, except at quite an early stage in the case of coconut, appears to the writer's mind, as a sensible and practicable proposition in the case of *Elaeïs.* The more so as during the period of waiting for the appearance of ripe bunches of fruit, the labour of upkeep will be reduced to keeping the weeds down (work which will be assisted by the subsidiary planting), to pruning off the lower leaves, and keeping the trunks clean. Moreover, as the *Elaeïs* grow older, their productiveness will decrease, whilst, the trees being taller, fruit bunches will cost more to collect. A subsidiary crop of coffee or cocoa may then prove a saving stand-bye.

The Crop. In or about the sixth year, or earlier, under favourable conditions, the first bunches of fruit may be expected and the serious work of the estate will then begin. Not that the harvesting will offer any great difficulties up to the ninth or tenth year, for the upward growth of the trees is slow up to that period, and if the

pruning of the leaves below the bunches has been attended to, the bunches will be easily accessible without climbing in most cases. But meanwhile two problems will have to be solved:

1. The transportation of the bunches to the mill, and, unless a clear grasp of the difficulties of the case has been taken at the inception of the estate, and its distribution planned accordingly, the labour involved will bear heavily on the concern.

2. The treatment of the fruit for extraction of the oil at the mill.

Touching the subject of oil-extracting machinery, the writer has already declared himself incompetent to pass an opinion on the relative merits of the appliances in use for treating the fruits of *Elaeïs* and what is written below must be taken only as the result of reflexions of a layman face to face with the elemental side of the problem as it presented itself in his own homely methods of extraction as previously described (Bulletin April 12th).

At the end of the latter Bulletin the writer expressed the view that the future of *Elaeïs* is bound up with, among other conditions:

"A judicious use of native methods of "depericarping" blended "with mechanical devices of well-authenticated efficiency."

An article of The Tropical Agriculturist of March 1920, affords an opportunity of amplifying that statement. The article is an extract of the Bulletin of the Imperial Institute, Vol. XVII, No. 2, which, itself, is a reproduction of a report of Mr. A. Bories, Inspector of Agriculture, French Equatorial Africa, published in the "*Bulletin des Matierès Grasses,*" No. 2, 1919. The gist of the report is given below, but as in the conversion of French weights into English, certain minor errors have crept into the account. Mr. Bories' figures are here reintroduced.

On a "palmery" at Louna (Gabon) consisting of 30,000 palms which had been looked after and kept clean during a previous period of three years, 4 men and 4 women were told off to gather a crop of *Elaeïs* and bring it to its ultimate result, viz: clean oil.

The first day was spent in collecting and transporting the bunches to the house. The result was 120 bunches weighing each about 10 kilos = 1200 kilos = 2640 lbs. equivalent to 1700 pounds of fruit. The bunches being of full ripeness the picking of the fruit out of the bunches was easily performed in the course of the afternoon.

The second day was spent in making the oil, an operation which took altogether about five hours, consisting in 1st cooking the fruit, 1 hour 30 minutes: 2nd pounding, 30 minutes; 3rd depulping, sorting out the stones and re-heating the pulp, 1 hour 30 minutes: 4th extraction of the oil, 1 hour.

Cooking the fruit was done successively in three iron pans, each of a capacity of 22 gallons, each receiving about 190 pounds of fruit, with about 4 gallons of water. The whole was covered with banana leaves. When, after 1½ hours cooking over a brisk fire the fruits were sufficiently softened, they were shovelled into a mortar.

Pounding the fruit and sorting out the stones. The usual form of wooden pestle was used. The pounded mass is then laid on iron plates where the women do the picking out of the stones, the fibrous pulp being put in wooden buckets, which were in this case barrels sawn in two.

Re-heating the pulp. The pulp now cooled is re-heated by means of stones heated to a very high temperature, which are dropped and stirred in the mass of pulp.

Extraction of the oil. The pulp is ladled into sacks made of rotan with a slit on their sides by which the pulp is introduced. At both ends of the sacks are loops through which a pole is passed and by turning these in opposite directions, the torsion produced on the sacks forces the oil out.

The next day the oil is boiled over a slow fire, which causes the water to evaporate, while the scum formed on the surface by impurities is skimmed off.

The yield of oil was equivalent to 12% of the weight of fruit, to which should be added the yield in Kernels (omitted in Mr. Bories' report) say at the rate of 20% of the weight of the fruit.

Thus we get as the output of two days' work of 4 men and 4 women,

1700 lbs. of fruit = 204 lbs. of palm oil.
plus 340 lbs. of kernels.

This put into Malayan figures at a price of (see Bulletin des Planteurs de Caoutchouc December 1919).

Florin 0.40 per kilo of oil in Sumatra.
0.20 „ of kernels do.

is equivalent to *f* 0.18 and *f* 0.09 per pound and we obtain as final result,

204 lbs. of oil @ 0.18 = *f* 36.72
340 „ kernels 0.09 = 30.60

f 67.32 = @ 1.15 = $58.50
Straits Currency.

Thus 16 days (8 people for two days) of coolie labour have produced a value of $58.50, or one coolie day, costing, say one dollar, has brought in $2.65 of nett revenue, less cost of cultivation.

This figure would do credit to a crack rubber estate; the more so as we are dealing with a process which, although constituting a great progress on the old native method of fermenting the fruit in heaps, is still very crude and capable of great improvement, (with consequent increased yield of oil), without the aid of any very complicated machinery.

But can we accept the above account of work as representing a normal and regular daily output of a coolie-day?

Here we have a very high official inspecting a crack palm-stand of 30,000 trees, kept up to the topmost state of cultivation obtain-

able in the country. It is highly probable that the manager in charge will choose for trees to operate upon, those which bear the heaviest crop of well-ripened bunches and will, besides, put in charge of the work, his most proficient labourers. The manager of a crack rubber estate, placed in similar circumstances, would, in all probability, select a first-rate tapper to tap a few chosen trees among his best "milkers" leaving aside those that have run dry through Brown Bast or other disease. Thus, in all good faith, startling results could be shown, but they would not be, in any way, representative of the normal yield of all the trees on the Estate.

Be this as it may, the process described above deserves to fix our attention for other reasons. Crude as it is, there is found in it a train of thought which inclines one to think that it was not born in the brain of the natives of West Africa without suggestion from the white man.

The most convenient way of separating the pulp from the stones, that which offers the line of least resistance to the native, is the fermentation process, which, if carried on long enough, causes thorough disintegration but causes also a considerable increase in the degree of acidity, which in oils so obtained, often amounts to 25 and even 30%, whereas the oils obtained by the above method are said to contain no more than 10 to 12% of free fatty acids. By carrying the process right through without interruption from the gathering of the bunch to the expression of the oil—by submitting the fruit at once to a steaming process in a small quantity of water, these natives suppress, or greatly check the formation of ferments—in fact their process is akin to a veritable sterilisation.

The same aim is furthered by using hot stones instead of water to increase the fluidity of the oil in the pulp, besides which the after operation of expelling, by evaporation, a great mass of water is dispensed with.

We can therefore trace, in the process, a set purpose of checking fermentation, which was probably initiated by Europeans in the beginning.

But, although the extracting process may be considered as satisfactory, so far as it goes, from the point of view of the degree of acidity, there is yet ample room for improvement in the man handling of the crop, by, as previously suggested, "a judicious blending of native methods with mechanical devices."

It may not be possible to attain the rapidity of action of the Trevor system, which, it is claimed by the inventor, can extract the oil within thirty minutes of the arrival of the fruit at the factory, but yet much time might be saved on the sequel of operations previously described.

For instance, it took 8 people one half-hour, *i.e.* 4 hours to pound the fruit in mortars, an operation which a hand-contrivance

in the nature of a disc coffee-pulper with a revolving rasping surface, could probably effect in much less time, and with less labour as the material would be worked by gravitation through hoppers.

Again, coils of heated steam in autoclave pans would advantageously take the place of hot stones to heat the pulp and would do it in half the time.

Lastly, a handscrew-press or a hydraulic press would be a sure improvement on the twisting of the rotan-bag.

It is therefore quite possible, even while following the lines of native methods, to reckon on an increased production of oil which would bring the output to a figure not very far behind the 16% which is the actual percentage claimed for modern mechanical appliances.

Conclusion. A question was hinted at, towards the end of our previous paper which was put to the writer, somewhat in the following way:

"Given the existence in West Africa of large stands of "*Elaeïs,* growing in its own native habitat and largely in the "bearing stage—exploitable at once at the cost of clearing the "undergrowth and cleaning the trees—would not capitalists, fol-"lowing the lines of least resistance, be more readily attracted to "such a proposition than to one entailing the heavy toil and "expense, and the long wait for results, implied by the opening up "of jungle land, in a country like Malaya, which has the further "disadvantage of greater distances from the home markets?"

The situation here presented, has, to some extent, a parallel in the "*Estradas*" of *Hevea* in its natural habitat on the Amazone, where the "*Seringuero*" collects the latex and coagulates it on the spot. We know, however, that this method of production cannot hold its own, either in the matter of economy or of quality and purity, against the product of cultivated rubber.

But would not the case be materially altered, if, instead of isolated trees or colonies of trees widely scattered in the forest, the *Hevea* trees were found in pure, unmixed stands over extensive tracts of forest, necessitating only the erection of a factory on the spot to transform the latex into clean, pure sheet, or crêpe rubber? In a word, viewing the *Elaeïs* as it presents itself in many parts of West Africa, in large pure stands of forest, is it not conceivably possible that it would be readily exploitable in an economic way by a factory on the spot?

Not knowing the country, the present writer is unable to view the question in all its bearings, yet certain points force themselves on the mind which tend to show that the process may not be so simple nor so inexpensive as appears at first sight.

To begin with, these extensive stands of *Elaeïs,* or the right to exploit them, belong, presumably, to somebody, to neighbouring villages or communities or to their chiefs, from whom they would

have to be acquired, and, in that case, we should soon see the "option" hunter appear on the scene and it is not usual with him to give anything for nothing.

In the second place, these stands, or "*Palmeries,*" (shall we call them?) would have to fulfill certain essential conditions, which are so varied that it seems impossible that they should be met in their entirety, in a state of nature.

A suitable spot must be found for the factory with abundance of water near by. The factory must be accessible by light railways or by canals (cattle draught cannot be used in West-Africa owing to the tse-tse-fly) to all parts of the estate, as the carriage of the bunches to the factory is inconceivable in any other way.

These railways or canals, to serve their purpose effectually, cannot be made to twist their way round about irregular lines of trees; they must be laid symmetrically and at short intervals, between well defined rows of trees—which can only exist on an estate conceived and developed on a systematic plan.

If, on the other hand, as was the case presented in our first paper in the Gardens' Bulletin for April, it is proposed to erect a plant to treat 9 tons of fruit daily, we shall have to acquire a far larger tract of "*palmeries*" than the 1200 acres which the scheme implies, for it is not possible to suppose that these natural stands, partly planted, and largely propagated from fallen seeds, will be, all over, in the same stage of growth. Some parts may be too young, some too old to pay for collection, others, growing in less favoured spots, will yield smaller bunches. The stand, in a word, will not offer that uniformity and stability of production which one can reckon with on a systematically planted estate. Hence, if the daily supply of 9 tons of fruit is to be kept up, and the factory is to be kept working full time, the cropping area will have to be largely in excess of the 1200 acres assumed to be sufficient to feed the factory. Hence, also, increase of means of communication, increase of railway mileage, of wagonets, and lastly increase of labour—labour, the stumbling-block of the cultivation of the oil-palm in West Africa and perhaps elsewhere. Further, if we suppose that the owner of the oil-factory relies for his supplies of fruit on deliveries from the neighbouring villages, by purchase of the fruit instead of employing his own labour, it is fairly certain that, contract or no contract, his supplies will be, to say the least, erratic; and it is well to note here, that under penalty of increasing the free-acid content of the oil the fruit must be treated fresh.

Another aspect of the question here presents itself. So far, very little of the oil exported from W. Africa is extracted mechanically; the whole of it, practically, is made by the natives themselves by their own methods it is a familiar industry in which women and children contribute their quota. But when it comes to mechanical treatment of the fresh fruit at the mill, the whole character of the industry is altered. The work is mainly plain coolie work, confined to climbing up the palms after the fashion

A Native of Congo climbing up an Elaeis.
After a photograph taken in the Lusango District (Congo).

shown in the accompanying woodcut; to chopping off the bunches, and carrying them whole to the factory. That is to say carrying also a mass of useless matter, 100 kilos of bunches containing only from 50 to 60 kilos of fruit, equivalent to a quantity of (16%) 8 to 9 kilos of oil and 12 kilos of kernels.

That the work is irksome, we have shown, that the climbers dislike it, is a known fact. We are therefore not surprised to read that climbers are getting more scarce every year, and that the gaps thus made in the available labour of the country cannot be filled by imported labour, for they cannot climb.

Turn which way we like, we find these two initial difficulties confronting us, viz: the climbing, and the collecting of the nuts, not to mention their transportation to the factory—and that in a greatly aggravated degree, in the case of the exploitation of the West African "*Palmeries*" owing to the uncared-for state of the trees—to their dispartly of growth and the absence of ways of communication with the factory. So great are these difficulties that writing from Porto-Novo in 1919, a correspondent of the *Bulletin des Matierès Grasses* No. 5, gives it as his opinion that only trees which can conveniently be reached with a ladder should be kept standing, all older trees which require climbing being cut down.

It would be an idle waste of the reader's time to labour further this question of "Wild versus Cultivated *Elaeïs*" and we should have left it untouched, had it not been put to us with some insistence.

The following words taken from the *Bulletin des Matierès Grasses* No. 4 throw more light on the subject than we could ever hope to do.

"For a long time, the possibility of the successful establish-
"ment of an industrial exploitation (of the oil-palm) in West
"Africa has simply been denied. Even now, the majority of the
"heads of the great Commercial Firms, and of their Agents are
"convinced that any undertaking of that description is doomed to
"assured failure, for the reason that the times have not yet come
"when it will be possible to find the necessary labour among the
"native population."

And the commentator, himself an advocate of *industrial exploitation* clinches the matter with the following remark:

"The success of the mills erected in Senegal for the decortic-
"ation of arachides (ground nut) demonstrates how erroneous that opinion is."

Seeing, that, of all oil-seeds, ground nut is about the easiest to cultivate, to transport and to decorticate—all things which the *Elaeïs* is not—this argument fails to convince.

The present paper was ready for the press when the writer received the "*Bulletin des Matierès Grasses* 1919, No. 6" with Mr. van Pelt's report of his mission of investigation in West Africa, which deals most fully with the question of the industrial exploitation of the Palm-forest as it stands. He sees no possible future in it and the reasons he gives are so cogent that they are unanswerable.

According to Mr. van Pelt, a careful valuation will show that, taking a block of palm-forest, not more than 25 trees to the hectare are immediately exploitable: that their output may be computed at 5 bunches weighing 10 kilos each, and yielding altogether 25 kilos of fruit per year *i.e.* for 25 trees, 625 kilos.

Here then, we have from the pen of a highly competent and unprejudiced observer an estimate of the capabilities of a palm-stand in its natural state given as 550 pounds of fruit to the acre per year, which, treated at the oil-mill, will give at the rate of (16 to 20%) say 18%—100 pounds of oil of a value (£80 per ton in London) of 71 shillings!

If we carry these figures to their logical end, we reach terms of pure impossibilities. For instance, to obtain 2700 tons of fruit, we shall require not 1200 acres which we found in our previous paper (April Bulletin) were necessary to keep a mill supplied with fruit for 300 working days at 9 tons per day; we shall require 11,000 acres, each acre containing 10 trees with 5 bunches that is to say 110,000 trees and 550,000 bunches. If, as Mr. van Pelt does, we estimate the capacity of a climber at 20 bunches a day *i.e.* 6,000 bunches a year, we shall require 100 climbers to do nothing else but chopping off the bunches apart from the collecting and transporting to the mill, which in itself, will require a very large number of hands.

As will be seen from the above digression Mr. van Pelt's cogent remarks completely confirm the present writer's views of the impossibility of an economic exploitation of the *natural* stands of oil-palms. If *Elaeïs* is destined to find a home in Malaya, as a cultivated product, it will have nothing to fear from its wild congener of West Africa—it will rather be the other way round, as the past history of Rubber shows.

Before finally closing these notes, the writer would call the attention of his readers to an interesting group of photographs of *Elaëis* grown in Sumatra, given by the Bulletin de l'Association des Planteur de Caoutchouc of Februay 1920. One tree, 4 years old showing a number of large bunches, hanging about 3 feet above ground, offers an object-lesson to the future planter of *Elaeïs*: the

branches below the bunches having been cut, the bunches instead of being compressed between the trunk and the leaves, hang outwardly, which allows them to expand and to receive on all sides the action of the sun, insuring thereby uniform ripening of the fruit—one of the problems of the cultivation of *Elaeïs*.

A remark in the previous paper, Gardens' Bulletin Vol. II, No. 7, p. 222 needs amending. An acre is put down as containing 50 trees planted 27 feet by 27 feet. *Elaeïs* should in no case be planted less than 30′ x 30′ which would give 48 trees to the acre. Its spread of leaves commands that span, and closer planting would be the surest means of encouraging growth upward, in response to the call of the sun, which all close-planted trees have to obey, at the expense of the proper expansion of their trunks. Above all things to be avoided in the *Elaeïs* are a long stem and a high crown.

After the above had been written the *Bulletin des Matierès Grasses* 1920 No. 1 came to hand with a very interesting notice written by Mr. Fauconnier, the well known planter of Rantau Ranjong (Selangor) with facts and figures which are of importance to the prospective planter of *Elaeïs* in Malaya.

His investigations show that: :

1. *Elaeïs* yields larger bunches in Malaya than in Africa, weights being recorded of 62 kilos.

2. The fruits of the Malayan *Elaeïs* are richer in oil, as much as 30% of Palm-oil being obtainable.

3. *Elaeïs* begins fruiting at 3 years and attains maturity at 5 years.

The yields obtained from 100 kilos of fruit bunches are 15 kilos of palm-oil, 12 to 15 kilos of kernels.

And the final conclusions are:

One acre planted with 40 trees = 6,000 kilos of bunches = 800 kilos of palm-oil plus 800 kilos palm-kernels.

Mr. Fauconnier's experience entitles these figures to our full acceptance. There only remains the question of the working costs and of the efficacity of present day machinery to obtain in practice, the output of oil as found to exist in the fruit of the Malayan *Elaeïs*.

REFERENCES:

Bulletin des Matierès Grasses de l'Institut Colonial de Marseille, 1919, Nos. 2-16.

Bulletin de l'Association des Planteurs de Caoutchouc, February, 1920.

Tropical Agriculturist, March, 1920.

E. MATHIEU.

A Host Index of Fungi of the Malay Peninsula. II.

HEPTAPLEURUM, sp. (Araliaceae).

In the Singapore Gardens, C. F. Baker, collected *Lembosia heptapleuri*, Sacc. sp. nov. (*Hysteriaceae*) on the leaves of this plant.

HEVEA BRASILIENSIS, Muell. (*Euphorbiaceae*). Para Rubber Tree.

A list of the fungi found on this tree was published in "The Garden's Bulletin." Vol. II, No. 6.

HIBISCUS ROSA-SINENSIS, L. (*Malvaceae*).

A. Sharples found that the fungus causing the "die-back," which often affects an ornamental Hibiscus hedge after it has been pruned, is due to a species of *Fusarium* (*Tuberculariaceae*). Spraying with Bordeaux mixture after pruning is recommended as a preventative.

HIBISCUS SABDARIFFA, L. Jamaica or Red Sorrel. The Rozelle.

C. F. Baker records two fungi on the dying stems of this plant. *Dothiorella rugulosa*, Sacc. sp. nov. (*Sphaerioidaceae*) causing black warty excrescenses to appear, and *Diplodia hibiscina*, C. and Ell. var. *subdariffae* Sacc. var. nov. (*Sphaerioidaceae*), which appears as minute black pimples.

HIBISCUS, spp.

Brooks records this as one of the many hosts on which he has found Pink Disease, *Corticium salmonicolor*.

ICHNANTHUS PALLENS, Munro. (*Gramineae*).

Recorded by Bancroft as having its inflorescence attacked by *Balansia asperata*, Massee. (*Hypocreaceae*).

Another species of the same genus was similarly attacked by *Balansia sessilis*, Massee.

IMPERATA ARUNDINACEA, Cyr. (*Gramineae*). Lalang grass.

A rust, *Uredo imperatae*, P. Magn. (*Uredinaceae*) is recorded by Bancroft as being found on this grass.

INDIGOFERA ARRECTA, Hochst. (*Leguminosae*) Otaheite Chestnut.

Three fungi are recorded by Baker on the rotting fruits of this plant in the Singapore Gardens. *Phoma inocarpi*, Sacc. sp. nov., *Diplodia inocarpi*, Sacc. sp. nov., and *Gloeosporium inocarpi* Sacc. sp. nov. (*Sphaerioidaceae*).

JUSTICIA GENDARUSSA, L. (*Acanthaceae*).

Brown discoloured areas on the leaves of this plant were found to be caused by a smut, *Ustilago Thwaitesii*, Berkl. (*Ustilaginaceae*), *Herb. Singapore*.

KOOMPASSIA MALACCENSIS, Maing. (*Leguminosae*).

Mentioned by Bancroft as a well known jungle host of *Fomes lignosus*.

KORTHALSIA GRANDIS, Ridl. (*Palmaceae*).

Baker records *Melanconium melanoxanthum* B. and Br. (*Melanconiaceae*) as being found on dead petioles and rachises at Singapore.

LANSIUM DOMESTICUM, Jack. (*Meliaceae*). Langsat.

Recorded by Brooks amongst the hosts of Pink Disease.

LASIA HETEROPHYLLA, Schott (*Aroideae*).

Baker records *Sphaerella lasiana*, Sacc. sp. nov. as occurring on the leaves of this plant. It causes grey brown circular blisters, the fungus fructifications appearing as black specks.

LICUALA, spp. (*Palmaceae*).

Several species of fungi were found on the leaves and rachises of these palms by Baker at Singapore. *Melanconium melanoxanthum* B. and Br. (*Melanconiaceae*), *Sepedonium dubium* Sacc. sp. nov. (*Moniliaceae*), *Coniosporium vacuolatum* Sacc. sp. nov. (*Dematiaceae*), and *Cercospora virens* Sacc. sp. nov. (*Dematiaceae*), all appear as small black excrescenses on the rachises. *Helminthosporium macrurum* Sacc. sp. nov. (*Dematiaceae*) appears as black dots on the leaves.

LIVISTONA COCHIN-CHINENSIS, Blume (*Palmaceae*). Serdang.

Mentioned by Bancroft as being one of the jungle hosts of *Fomes lignosus*. *Melanconium melanoxanthum* B. and Br. (*Melanconiaceae*) and *Winterina Bakeriana*, Sacc. sp. nov. (*Sphaeriaceae*) are recorded by Baker from Singapore as being found on the dead leaves and rachises.

LYCOPERSICUM ESCULENTUM, Mill. (*Solanaceae*). The Tomato.

In Bancroft's list of diseases published in 1911 he mentions as having found two fungi on locally grown tomato plants. *Bacillus solanacearum* (*Bacteriaceae*) which causes a wilting of the plants and a brown colouring of the stem occurs so badly in some parts as to render the successful growing of these plants almost impossible. A mildew, *Erysiphe Polygoni*, D. C. (*Erysiphaceae*) was also found on plants growing at Taiping.

MACARANGA GRIFITHIANA, Muell.-Arg. (*Euphorbiaceae*).

Ridley records a specimen of this tree which had been used for bridging as bearing *Eutypa caulivora*, Mass. (*Sphaeriaceae*). He considered it had attacked the plant after it had been cut down. It appears as black asphalt—like fructifications on the stem.

MALLOTUS sp. (*Euphorbiaceae*).

Specimens in the Singapore herbarium show leaves of this plant as being attacked by a species of *Sphaerella* (*Sphaeriaceaae*) and *Pestalozzia* (*Melanconiaceae*). Both fungi cause light brown circular spots on the leaves.

MANGIFERA INDICA, Linn. (*Anacardiaceae*). Mango.

Only three fungi have so far been definitely recorded on locally grown trees for this species. *Gloeosporium mangiferae* Noack, (*Melanconiceae*) which Bancroft describes as developing black spots on the fruit. These spots increase in size and run together until sometimes the whole surface is affected, the pulp becoming soft. Baker found two leaf fungi, one the common black leaf mildew, *Meliola mangiferae*, Earle, (*Perisporiaceae*) the other *Zimmermanniella trispora*, P. Henn. (*Dothideaceae*), occurring as raised black knobs on the leaves.

MANIHOT UTILISSIMA, Pohl. (*Euphorbiaceae*). Tapioca. Cassava.

Bancroft records *Cercospora Cearae*, Petch, (*Dematiaceae*) as causing leaf spots on this plant, and also a curious occurrence of *Fomes lignosus* on the tuberous roots, this latter fungus being admittedly a wood destroyer.

MUSA, sp. (*Scilamineae*). Banana.

The fact that only one fungus has been definitely recorded for this plant in Malaya, is without doubt, only due to the fact that it has so far not received much attention locally. *Gloeosporium musarum* Cke. and Massee (*Melanconiaceae*) is included in Bancroft's list, as occurring on the ripe fruits.

NEPHELIUM LAPPACEUM, Linn. (*Sapindaceae*). Rambutan.

A black mould, *Meliola nephelii*, Sacc. sp. nov. (*Perisporiaceae*) was collected on the leaves of this species by Baker, at Singapore. It is rather surprising that hitherto no other fungi have been recorded for this popular fruit.

ONCOSPERMA FILAMENTOSUM, Blume (*Palmaceae*). Nibong.

Bancroft quotes this as one of the jungle hosts of *Fomes lignosus*.

ORMOSIA SUMATRANA, (Leguminosae).

Baker collected specimens of *Lembosia hormosiana* Sacc. sp. nov. (*Hysteriaceae*) on the leaves of this plant.

ORYZA SATIVA, Linn. (*Gramineae*). Rice.

Only one fungus disease can so far be found definitely recorded for this important crop in Malaya. A smut, *Ustilago virens* Cke. (*Ustilaginaceae*) is mentioned by Bancroft as being parasitic on grains of rice in Perak.

PALAQUIUM OBLONGIFOLIUM, Burck. (*Sapotaceae*) Gutta percha. Taban.

Bancroft records *Laestadia palaquii,* Banc. (*Sphaeriaceae*) as causing a leaf spot disease of this plant, which in the seedling stage often proves fatal.

PANDANUS PENANGENSIS, Ridl. and

PANDANUS UTILIS, Bory. (*Pandanaceae*). Screw Pine.

On the leaves of both of the species Baker found *Lembosia pandani* Sheiss. (*Hysteriaceae*).

PASPALUM, sp. (*Gramineae*).

Ridley collected a specimen of this grass with its lateral branches distorted by *Hypocrella panici*, Mass. (*Hypocreaceae*).

PASPALUM, sp. (*Gramineae*).

Chaetostroma cladosporioides, Sacc. (*Tuberculariaceae*) was collected by Baker in Singapore on the dead fruits of this grass.

PINANGA, sp. (*Palmaceae*).

In a part of the Garden's Jungle at Singapore, that is being devastated by a fungus a species of *Rosellinia* (*Sphaeriaceae*) that was found on a dead stem of this palm seems chiefly responsible. The species cannot be determined at present, but is near *R. parasitica* E. and Ev.

PIPER, sp. (*Piperaceae*). Pepper.

The various species of pepper in local cultivation have not received much attention at the hands of the pathologists. Only two fungi are recorded for them. *Colleototrichum necator* Mass. (*Melanconiaceae*) was found by Ridley attacking the fruiting spikes and causing them to blacken and fall off. A species of *Diplodia* (*Sphaerioidaceae*) was at the same time observed growing on the roots.

PISCIDIA ERYTHRINA, Linn. (*Leguminosae*). Fish Poison Tree.

Baker records two fungi as growing on the dead limbs of this tree. *Dothiorella stratosa,* Sacc. (*Sphaerioidaceae*) causing black excrescences, and *Hymenula socia* Sacc. (*Tuberculariaceae*).

PLECTOCOMIA, sp. (*Palmaceae*).

Four fungi were found by Baker all appearing as black specks on the dead leaves and rachises of this Rotan.

Graphiola macrospora, Penz. and Sacc. *Melanconium melanoxanthum,* B. and Br. (*Melanconiaceae*) *Arthrobotryum socium,* Sacc. (*Stilbaceae*) and *Exosporium macrurum,* Sacc. (*Tuberculariaceae*).

POLYTRIAS PRAEMORSA, Hack.

A smut. *Ustilago polytriadis* Mass (*Ustilaginaceae*) is recorded on the ovaries of this plant.

PTEROCARPUS INDICUS, Willd. (*Leguminosae*).

Owing to the loss of so many famous avenues of this tree in the country it has received more attention than other ornamental trees. Consequently six fungi have so far been reported as having been found growing on it, although except the leaf fungi all were collected on dead stumps. It is possible however, that some may be responsible for hastening its death, the fungus fructifications only appearing at a later stage when the damage is done, and in this connection the shiny chocolate brown bracket fungus, sometimes appearing with a false stalk, *Ganodermus lucidus* (*Polyporaceae*) is more than suspected. Other Polyporaceous bracket fungi recorded are *Polystictus hirsutus* Fr., and *Polystictus floridanus,* Sacc. The small white tomentose fan shaped *Schizophyllum commune* Fr. (*Agaricaceae*) is commonly found on dead wood but doubtless as a saprophyte only. Leaf fungi recorded are *Dothidella pterocarpi,* Mass. (*Dothideaceae*) and *Helminthosporium oboratum,* Mass. (*Dematiaceae*).

RHODOMYRTUS TOMENTOSA, Wight, (*Myrtaceae*). Kamunting.

Two fungi are recorded by Baker for this shrub *Dimerium singaporense* Sacc. (*Perisporiaceae*) and *Podosporium penicillium* Speg. (*Stilbaceae*).

ROSA, sp. (*Rosaceae*) Rose.

Only one fungus *Sphaerostilbe cinnabarina,* Tul. (*Hypocreaceae*) is recorded for our cultivated roses. It causes the branches to blacken and die.

SACCHARIUM OFFICINARUM, Linn. (*Gramineae*). Sugar Cane.

The fact that only one fungus is recorded for the Sugar Cane can only be attributed to the fact, that the cane had ceased to be cultivated locally as a first class crop, before the study of diseases was seriously attempted here. A red smut fungus, *Trichosphoeria sacchari* Mass. (*Sphaeriaceae*) is the only record we have.

SARACA, sp. (*Leguminosae*).

Microthyrium browneanum, Sacc. (*Microthyriaceae*) was collected by Baker at Singapore on the leaves of this shrub.

SELOSIA SUMATRENSIS, (*Gramineae*).

Singapore material in the herbarium shows the fruits of this grass to be infected with a smut *Ustilago flavo-nigrescens,* B. and C. (*Ustilaginaceae*).

SHOREA, sp. (*Dipterocarpaceae*), Meranti.

Bancroft's list of jungle hosts of Pink Disease includes this tree.

SOLANUM TUBEROSUM, Linn. (*Solanaceae*). Potato.

The bacterial disease *Bacillus solanacearum* was found on potato plants at Taiping by Bancroft.

STERCULIA, sp. (*Sterculiaceae*).

Dimerosporium albomarginatum, Sacc. (*Perisporiaceae*) was found by Baker on the leaves of this tree.

STROBILANTHES, sp. (*Acanthaceae*).

Recorded by Ridley as a host for Pink Disease.

TABERNAEMONTANA, sp. (*Apocynaceae*).

A brown leaf spot disease *Cercospora tabernaemontana* Syd. (*Dematiaceae*) is found on specimens in the Singapore herbarium from Taiping.

TEPHROSIA HOOKERIANA, Wight and Arn. (*Leguminosae*).

Sharples records a patch of this plant growing under rubber as being badly attacked by Pink Disease, and providing a centre of infection for the rubber.

THEA SINENSIS, Linn. (*Ternstroemiaceae*). Tea.

The "copper blight" *Laestadia Theae*, Rac. (*Sphaeriaceae*) is the only fungus actually on record, although instances of the blister blight *Pestalozzia* sp. (*Melanconiaceae*) are undoubtedly common.

THEOBROMA CACAO, Linn. (*Sterculiaceae*). Cocoa.

Another example of a host of Pink Disease, recorded by Brooks.

TRISTANIA GRIFITHII, Kurz. (*Myrtaceae*).

Brown circular leaf spots on the leaves of this shrub recently collected were found by Wakefield to be caused by a new species *Sphaerella Tristaniae* Wakf. (*Sphaeriaceae*).

WORMIA SUFFRUTICOSA, Griff. (*Dilleniaceae*).

A black leaf mildew *Meliola malaccensis* Sacc. sp. nov. (*Perisporiaceae*) is recorded by Baker as having been found on the leaves of this shrub.

ZALACCA EDULIS, Bl. (*Palmaceae*). Buah Salak.

Micropeltis marginata, Mont. (*Microthyriaceae*) causing brown discoloured area on the leaves, and also *Melanconium melanoxanthum* B. and Br. (*Melanconiaceae*) were collected by Baker in Singapore.

ZALACCA WALLICHIANA, Mart. (*Palmaceae*). Kumbak.

Micropeltis marginata is also recorded by Baker for the leaves of this species.

ZEA MAYS, Linn. (*Gramineae*). Indian Corn.

The smut *Ustilago Maydis* (*Ustilaginaceae*) is the only record for this crop. It destroys the cobs turning them into a sooty mass.

ZINGIBER, sp. (*Scitamineae*). Ginger.

Hypocrella zinziberis, Mass. (*Hypocreaceae*) was found by Ridley on the petioles of this plant. The fungus has a bright orange coloured stroma.

The above brings to a conclusion the summary of fungus diseases of plants in Malaya as hitherto definitely recorded. The list is small and many of our best known farm and garden plants have but a small record against them. This no doubt is due to the fact that the main crops, such as rubber, have hitherto engaged the attention of the few pathologists that have worked out here. As this work increases more attention will be able to be given to other plants quite important in themselves but not ranking with the main crops of the country. When the next revision of this list takes places it is certain to be considerably increased. In the meantime additions will be published in this Bulletin from time to time as they occur.

———— T. F. CHIPP.

Castor Oil as A Crop.

The Castor-oil plant (*Ricinus communis*), seems so far, to have attracted little notice in Malaya, and yet, when looked into its cultivation appears to offer fairly good prospects for the small planter, while the industry of mechanical expression of the oil offers a promising opening for the establishment of up-to-date mills.

It brings prompt returns to the cultivator and its product, whether in seed, or oil, or cake is in increasing demand from home at steadily advancing prices.

According to the Chemist and Druggist 28th February, 1920, the prices quoted by the pressers in Hull were £114 per ton for pharmaceutical oil—£111 for first pressing—£109, for second pressing. For medicinal French oil, the price was 120/- per cwt. in cases.

The present price (1st May, 1920) of Castor-oil in Singapore, obligingly supplied by the Secretaries of the Chamber of Commerce is quoted at $50 per case of 74 to 75 catties packed in 4 tins, or 0.66 per catty.

The Blue Book states that 861927 gallons of lubricating oils were imported into the Straits Settlements in 1918, the value being $1,036,943.

We cannot apportion the amount for which Castor-oil enters in this aggregate, but we know that being a heavy-bodied oil and the most viscous of all fatty oils, it occupies a large place among lubricants for machinery, especially for the oiling of fast moving machines.

The writer has not at hand the figures relating to Medicinal Castor-oil, but here, also, we know that the figure must be a large one, and judging by the price of 85 cents, which the writer recently paid for a 10 ounce bottle of Morton's Castor-oil, we may imagine that, in passing from the seed to the bottle and finally to the consumer, the oil gathers unto itself many little rivulets of handsome profits.

The Castor-oil plant, of which there are small plots in the Economic Gardens, does extremely well in light alluvial loams, well supplied with organic matter. Sown in such soil from seed on 5th November, 1919, several trees are now, at time of writing, 1st May, 1920, showing well-formed fruiting spikes. One panicle, off one of these trees has already given 120 ripe seeds, and the rest of the seed will require picking in a very few days. These trees are from 4 to 5 feet in height.

Next to this plot is another one sown on the 10th of January, *i.e.* exactly 110 days old at the time of writing, of a smaller variety, whose plants are already, at a height of 3 feet, flowering heavily; one tree with five spikes in different stages of development.

In thin clayey soils and in sandy soils the growth of the plant is slow and its seed production is small. Yet, in India it is said to do well on red laterite soils at the foot of hills, provided they are not too stiff and they keep moisture well: but if they are poor in organic matter, they must receive an application of cowdung well incorporated with the land, previous to sowing.

The plant roots deeply and the ground requires a good digging at least 8 inches deep.

There are many cultivated varieties of *Ricinus communis* distinguished by various characteristics, such as the colouring of the stem which may be almost white, or of a glaucous bluish-green, or of a red colour with or without a white frost-like dusting on the stems and branches. There are also marked differences in the sizes and colours of the seeds, between one variety and another. Some, of a flattish shape, with dull-grey markings, $\frac{5}{8}$ inch in length were shown to the writer as coming from East Africa. Others, gathered from a tree growing wild in the Economic Gardens, not quite half an inch long, are oval in shape and rounded in contour: their colour is a bright reddish-brown with well marked yellowish veinings; while still others, also found growing wild locally, are just over $\frac{1}{4}$ inch in length, purple brown, with faint markings.

In Madras the seeds are classed under two main types:

1° The Coast and Warangal, which are small.

2° The Salems, which are large.

The Coast-seed of Cocanada is said to be the best for oil.

Some varieties are annual; others are grown as perennial crops. Mukerji mentions a small-seeded variety from the Deccan, which goes on bearing for 5 years in succession, and producing an oil of superior quality. (Handbook of Indian Agriculture).

The seeds of the small annual varieties are sown 3 feet apart, or better still, (if a subsidiary crop of ground-nut is interplant-

ed) at distances of two feet on rows four feet apart. Sowing one seed at each stake, three or four pounds of seeds would be sufficient for one acre; but it is as well to provide for failures by sowing two or three seeds four inches apart to each stake, and thinning out one month after germination, in which case seven pounds will suffice for one acre. This quantity will allow for selection of the best seeds, *i.e.* those showing the whitest and best developed "caruncle," or the fleshy out-growth near the hilum. The seeds in which, after steeping in water, this out-growth is found shrunken or discoloured, should be rejected.

Ricinus breeds true; cases of cross fertilisation being very rare.

The seeds of perennial varieties are usually sown at distances of 6 feet each way; but in the case of large, branching plants, wider spacing is perhaps advisable, as it is said that under a plentiful supply of air, the yield of seed is very largely increased, as much as 20 pounds of seed being recorded from vigorous plants under such conditions. Distances of 10 feet each way would probably meet the case, which would give 400 plants to the acre, necessitating less than two pounds of seeds. The writer has not had occasion, so far, to adopt such wide-planting, but the crops one occasionally sees on isolated trees, point to its reasonableness

The Castor-seedling bears transplantation badly; the seeds are therefore always planted straight away in the fields. But the writer found that, from a cause not yet ascertained (probably the presence of eel-worm in the soil) a proportion of as much as ten per cent of his plants died in the second month. Such infected soils should not be planted with *Ricinus;* but should the discovery be made too late, it is advisable to have a number of seedlings apart in bamboo baskets to fill the vacancies after creosoting the earth at the spot.

As previously stated, the ground must be brought to a fine state of tilth by a preliminary digging to a depth of 8 to 10 inches, followed by a harrowing or raking. The longer the land is allowed to lie broken and exposed to the air before sowing the better; as it gives a chance to the sun and the birds combined, to destroy the maggots and grubs, which, later on, in the shape of caterpillars, will, if the land remains foul, almost surely attack the plants, and, possibly, cause extensive damage by stripping them of their leaves. The writer has seen a handsome tree, 12 feet high, completely defoliated in a few days by a small black and red striped caterpillar. When the tree was shaken, myriads of the caterpillars fell to the ground. The Castor-seed caterpillar, *Dichocrocis punctiferalis,* which bores its way into the seeds is also a dangerous pest.

Although Castor-seeds preserve their germinative power a very long time if protected from damage by insects, immersion in water for a few hours is not a useless precaution as it softens them and facilitates germination. A preliminary short steeping in an insecticide solution such as a weak solution of copper sulphate, just strong enough to give the water a faint bluish tint, or in a maceration of tuba root, may also do much good.

Fresh seeds of healthy plants, selected with due care, need no such treatment: they germinate very readily, provided the soil is kept moist by rain or, in case of dry weather, by one or two waterings after sowing.

On a plot sown with quite fresh seeds on the 30th March last, all the plants showed their seminal leaves on the 6th of April and on the 10th April, the second pair of leaves was already out.

After germination, no more watering need be given, except in the case of actual drought. No further care is required except weeding, and keeping a good look-out for caterpillars which, if they are not kept down by hand-picking or by insecticide sprayings (kerosine and soap emulsion) are likely, as already stated, to cause great damage to the leaves, and, in the case of *Dichocrocis punctiferalis* to the young flowering spikes.

The Castor-plant can be cultivated with advantage with other annual crops. Of all such crops, the writer would give the preference to ground-nut, *Arachis hypogaea*, which, besides being in itself a very profitable crop, has the advantage of supplying to the soil some of the nitrogen which the Castor-oil plant, an exhausting plant, takes out of it.

The perennial Castor-oil plant often grows to a height of 15 feet, but such a height is a very great drawback and adds largely to the cost of harvesting, which may last for two months, in weekly pickings, as the crop ripens intermittently.

To check the growth in height, the trees should be topped at an early stage so as to maintain them at a height of 6 to 7 feet. This moreover induces the formation of lateral branches which, later on, will throw out flowering spikes.

It is generally admitted that the Castor-oil plant exhausts the soil, that it should not be cultivated twice in succession on the same ground and that a period of at least two years should be allowed between two crops. When annual varieties of *Ricinus* are cultivated, it is therefore necessary to devise a scheme of rotation embracing a series of quick-growing field crops to tide over the interval between one crop of the Castor-plant and the next.

Such a scheme should include crops adapted to similar physical conditions of soil, but belonging to different natural orders, so as to check any undue increase of insect-pests or the spreading of fungoid diseases.

Ricinus, Ground-nut, Gingelly, Sweet-potatoes offer such a rotation, which, moreover, has the advantage that the deep digging necessitated by the harvesting operations in the two cases of ground-nut and sweet-potatoes, exerts a beneficial effect on the mechanical condition of the soil, to the advantage of the following crop of *Ricinus*.

An interplanted crop of groundnut has already been suggested above. In this country, it is a four months crop, which accommodates itself well to the quality of soil suitable for the Castor-oil plant, and which under fair average conditions, especially if the land

has been limed, would give from 2,000 to 2,500 pounds of pods per acre. This is equivalent, at the ratio of 65% of their weight, in Kernels, to 1,300—1,625 pounds of shelled Kernels with an oil-content, from an ordinary country-mill, of 30% to 40% or say 35%, i.e. a final output of 450 to 560 pounds of oil per acre. In addition there is the very valuable oil-cake which can be used either as cattle food, or as manure, as it contains as much as 8% of nitrogen.

Although it is generally poor husbandry to grow the same crop twice successively in the same ground, the practice can be, and is largely, followed in India without harm, in the case of groundnut, provided the land receives between the two crops, a moderate dressing of lime and ashes. It is therefore quite feasible to obtain two crops in the course of one year, resulting in an output of 2,600 to 3,250 pounds of Kernels per acre or 900 to 1,120 pounds of oil and from 1,200 to 1,450 lbs. of cake, dry.

Followed by Gingelly (*Sesamum indicum*) which does exceedingly well after groundnut, a further crop of oil-seed would be obtained which could be treated for oil by the same extracting appliances as used for Castor-seed.

A last crop of sweet-potatoes could be put in, as in digging up the roots, a thorough breaking up and pulverizing of the soil takes place, which will make easy the preparation of the land for a new crop of *Ricinus*.

Manuring will be necessary at this stage. Manures are scarce and expensive—but in this case, they will cost nothing more than the cost of application; for the stock of groundnut and sesamum-cake will amply suffice for the requirements of the land in nitrogen; the deficiencies in potash and phosphoric acid (of which groundnut cake contains 1.2%) being made up by an addition of ashes from the stems of the Castor-tree itself and other refuse (shells and husks) and, if necessary, a modicum of bone meal. Nor must we lose sight of the Castor-pommace saved from the original crop, which is one of the best vegetable manures known—Castor-cake containing 5½ to 6% of nitrogen.

In February 1918 the price of the cake in London was £37 per ton, *i.e.* nearly 4 pence per pound. Considering that, by reason of its poisonous content, Castor-cake cannot be given to cattle for food, this price gives an idea of its high manurial value.

As a matter of fact, although the Castor-oil plant is considered to be an exhausting crop, it need not, under a careful system of husbandry, leave the land impoverished.

For, taking the plant as it stands, all of the plant food which has gone to form the roots, stems, leaves and seeds with their capsules and husks, can be restored to the land in the form of ashes, or better still, after passing through a chaff cutter or a root-cutter, in the form of a compost, so that nothing, except the oil, need leave the farm.

Now, Castor-oil, like other stable oils, contains only such elements *carbon, oxygen and hydrogen* as are drawn from the air, and by the sale of it, the land loses none of its fertilising agents.

Harvesting and Yield.

Having started planting in November, picking should begin about April for the earlier varieties and in May-June for the later ones. It is not a laborious operation and it can be done by women and children going over the fields once a week to pick the capsules when the calyces turn from green to brown and the yellow husks become visible. It may take over two months to finish the crop, but it often lasts less long if the weather, keeping hot and dry, hastens maturity. Harvesting is done by cutting the spikes, but where it is found that the capsules mature very unevenly on the spikes, a little hand picking of the capsules may be resorted to at first, to avoid loss of seeds, the spikes being cut later on when all the capsules present a more uniform degree of maturity. A less commendable method, but one which shortage of labour may excuse, is to let the capsules ripen and drop their seeds to the ground where they are gathered at leisure. This, of course, saves time, but it is admissible only where *Ricinus* is grown as a pure crop, and where the ground is clean and free from weeds. Where, *Ricinus* is grown with another oil-seed crop, especially groundnut the seed should be picked; the least admixture of Castor-seed with groundnuts would be fatal to the sale of the latter.

The capsules, collected in bags or baskets are brought to the store, and thrown in a heap on a clean concrete floor; a square enclosure is made to enclose the heap by putting up boards or iron sheets to a height of 3 feet—this to prevent the scattering of the seeds when the capsules open.

The heap which must be protected from the rain, is covered with gunny bags for 3 or 4 days and when, a beginning of fermentation having set in, the capsules have somewhat softened, the heap is opened, spread out and turned over in the sun. Most of the capsules will have shed their seeds in 5 to 6 days. Women are then put on to sort out by hand the broken pieces of shells which are taken to the compost heap or reserved for fuel. What capsules remain unopened are beaten with cudgels until all are disposed of. Small debris of shells remain mixed with the seeds after the bigger pieces have been removed, these are dealt with by means of the "*neeru*" a triangular tray, made of bamboo strips, with raised sides, or, if one is at hand, by passing the lot, seeds and debris, through a hand-winnowing machine.

The clean seeds, if they are to be made into oil on the farm, must be divested of their coats or husks. To this end, after two or three hours exposure to the sun to heat them, by which the husks are made more brittle, the seeds are passed between horizontal rolls set at a distance apart from each other, just sufficient to break the husks by slight pressure, without quashing the Kernels. The husks being very brittle crack easily, and with a very simple contrivance, to lead the seeds on to the rollers, a mangle such as used for the sheeting of rubber would do very well for this purpose. The husks, though cracked, may still adhere to the Kernels: a second passing between the rollers set a little closer will insure a further cracking,

and the seeds may then be put through the winnowing machine or shaken on the "*neeru.*" Some of the Kernels may still have small pieces of husk adhering to them but this is of no consequence in the further process of expressing the oil. It may be here mentioned that the husks impart neither colour nor taste to the oil, so that the quality of the oil is not affected by their presence with the seed.

As a matter of fact, present up-to-date oil-mills equipped with powerful presses, treat seeds in the husk without taking the trouble of husking them: but with presses of small power, such as would be used on small plantations, the husks would retain an undue proportion of oil in the cake: for this reason seeds must be husked in the latter case.

On the other hand, if it does not colour the oil, the presence of the husks in the cake gives it a dark colour, and, moreover, it detracts from its manurial value, in that the husks contain no nitrogen; the nitrogen percentage of the cake is thereby lessened, and its value correspondingly lowered.

Hand power Castor-seed decorticators are also made by makers of Oil machinery by which the outer husk is removed and the white Kernel turned out ready for the press but present prices put them beyond the reach of the small farmer.

Under fair average conditions a crop of 800 to 1,200 pounds of seeds with their husks can be obtained off one acre in a season.

According to Spon's "Industrial Arts" 1,400 lbs. of Calcutta Seeds gave 980 lbs. of Kernels from which the following quantities of oil were obtained:

1st Quality	324 lbs.	= 488 lbs. of oil.
2nd ,,	87½ ,,	
3rd ,,	76½ ,,	

That is to say that the Kernels divested of husks gave almost exactly half their weight of oil, *i.e.* 100 lb. of seeds gave 70 lb. of

Kernels which in their turn gave of oil	35 lbs.
,, ,, of cake	35 lbs.
the weight of the husks amounting to	30 lbs.
	100 lbs.

These figures vary according to the amount of pressure used: a powerful set of presses may give from 5% to 10% more oil than weaker ones and correspondingly less weight of cake.

Again some varieties yield more oil than others and lastly some also show a greater weight of shell than others.

The writer found 268 seeds weigh 1½ ounce and after husking them found:

268 kernels weigh	1	ounce
268 husks ,,	½	,,

These seeds were of a small variety in which the proportion of husk to kernel is likely to be higher than in the larger varieties.

The Bulletin of Imperial Institute 1911 gives a yield of oil of 55.41% of the weight of Kernels corresponding to 41.76% of the weight of the whole seeds containing:

kernels	75.37%
husks	24.63%

Oil Extraction.

The extraction of oil consists of three operations, namely:

1st. The grinding of the seed to a fine pulp in order to break the oil cells.

2nd. The heating of the ground seed to facilitate the flow of oil.

3rd. The pressing of the pulp, to force out the oil, leaving the cake as residue.

A fourth operation consists in submitting the meal to the action of a chemical solvent in which the oil is dissolved and from which it is separated afterwards, the final residue or cake containing only a very small percentage of oil. This process which is only practicable in specially equipped mills does not concern the planter.

Large modern mills, as already stated, treat the Castor-seed whole, with the husks on; but a hand power plant such as would be called for, to deal with the small crops contemplated in this paper, could not supply the pressure necessary for an adequate expression of the oil from seeds in their husks.

The small planter will therefore have either to sell his seeds to the oil-pressers, or to treat the seeds after husking them more or less completely. We have shown above how this part of the work can be done.

The husked seeds have thus to undergo the three operations of Grinding, Heating and Pressing.

Some makers of oil-mill machinery are now supplying hand-mills to meet the requirements of producers who do not use power.

The Firm of Rose, Downs and Thompson, Ltd. of Hull and Shanghai, supply such a mill catalogued as "*The Manual Oil-mill No. 359*" to crush 56 pounds of oil-seeds per hour, and worked by two men.

"The Mill consists of the following machinery: one set of Anglo-American Rolls 3′ high, 6 in. in diameter and 6 in. face, hand-driven with heavy fly-wheel; one wrought iron fire-heated pan or kettle, to be placed on a brick-foundation and worked by hand; one set of double hydraulic pumps, hand-driven, the large pump being arranged to give the first pressure rapidly, and the small pump to give the final or finishing pressure without a material increase of effort from the workman; one hydraulic press, to make five taper cakes 13″ x 6″ x 5″ fitted with corrugated metal plates bearing any desired brand; one 4 in. hydraulic gauge and pipes; a supply of woollen press bags, mending yarn and other needful sundries."

But even such a simple plant may be, in these times of extravagant prices, above the means of the Planter, and in this case he will have to fall back on such makeshifts as he may find at hand.

With ingenuity and the gift of contrivance, he will find that his case is not hopeless.

Grinding of the Seed. The Kernels of the Castor-seed are soft and do not require the elaborate process of shredding or pulverizing, in disintegrators which Copra, for instance, requires. They can be ground, by passing between the rollers of a strong mangle such as used for sheeting rubber, or by pounding in a wooden mortar made *ad hoc.*

Heating of the ground Kernels. The pulp is conveyed to a platform heated by means of a flue underneath. The heat should not be greater than what the hand can bear, or say 140° to 150° F. and such a flue as used on coffee estates to dry parchment would be suitable. Or it may be simply a barbecue in the open, dependent on the heat of the sun, provided a movable roof shelters it from rain and a flue underneath allows, in cases of insufficient sunshine, to supply the heat necessary (140-150° F) to penetrate the mass of meal and render the oil more fluid.

Pressing. A hand-power screw press will fulfill this purpose. Such screw-presses are made by makers of oil machinery, which are furnished with several steel plates and capable of dealing with 8 to 10 pounds of seed per charge, the meal of crushed seeds being enclosed, after heating on the flue, in woollen or canvas bags and inserted between the plates. On pressure being applied, the expressed oil flows down to a tray at the foot of the press, whence through a spout it falls into a suitable receptacle.

So far, then, the series of manipulations are as follows:

1. The crushed meal of seeds, on issuing from the rollers of the mangle, is laid on the heated table.

2. When sufficiently heated, the meal is taken up with a small hand-shovel in quantities sufficient to fill a square or oblong mould made of four small scantlings 4 to 5 inches high, without a bottom, and of the same size (inside measurement) as the steel plates mentioned above. Strips of canvas bagging—cloths of suitable size are disposed on the top of the hot table and the mould placed in the centre of these cloths, is filled with heated meal: the sides of the cloths are then folded round the meal following the contour of the mould, which is taken off and the slabs of meal are now wrapped up in the cloths. They are left on the hot table until the number of slabs, 5 or 6, is sufficient to fill the press for one pressing: they are then inserted in the press between the plates which, in the meantime have been kept immersed in a bucket of boiling water.

The pressure is now applied and a whitish oily fluid oozes out which is collected below and boiled with its volume of water, while all impurities, as they rise to the surface, are skimmed off with a

skimmer made of gauze. The mucilage and starch, contained in the meal are taken up by the water and the albumin, coagulated by the heat, forms a film below the oil between the oil and the water.

The oil is removed to another pan and boiled again with half its volume of water, until water vapour ceases to rise, when a small quantity of the oil put in a cup is found to be perfectly clear, transparent and colourless.

By this second boiling in a fresh supply of water, the oil is clarified and freed of acid matters.

The boiling may be done in a "dapur" such as used by the Chinese for the cooking of gambir or of pig-food; a 2 feet diameter pan will do for the purpose: its edges are let into the brick-wall of the oven, and the walls are continued, forming like a well to a height of 2 feet, thus giving a capacity, if we take into account the concavity of the pan, of about 6½ cubic feet or 40 gallons.

The boiling should be stopped as soon as the last drop of water has been expelled and no more bubbles appear.

Instead of a second boiling, the oil may be clarified by passing through charcoal in filtering bags, such as are used by distillers, or failing such, through a blanket.

The quantity of oil thus expressed would range from 30 to 35 per cent of the weight of the seeds with the husks on, leaving from 35 to 40 per cent of cake.

We may now bring our figures together and work out the produce of one acre of *Ricinus* interplanted with two successive crops of groundnut in one year.

An average crop of Castor-seed is computed to give from 800 to 1,200 pounds, or say, an average of 1,000 pounds of seeds which would result in 350 pounds of oil and 350 pounds of cake, yielding a gross revenue of:

$$\left.\begin{array}{l} 350 \text{ lbs. of oil @ } 45 = 157.50 \\ 350 \text{ lbs. of cake @ } 5 = \ \ 17.50 \end{array}\right\} = \$175.00$$

The produce of two crops of groundnuts was given above as between 2,600 and 3,250 lbs. or say, 2,900 pounds of shelled Kernels, a readily marketable product at the present rate of $25 per pikul; which will leave the planter a sufficient margin to cover not only all his costs of cultivation and of living but also the cost of manuring his fields for the following crop of his rotation, cost which need not be heavy for, it may be here noted, the leaves of *Arachis hypogaea* with the roots left after the nuts have been gathered, constitute, when dug under, a highly nitrogenous green-manure.

Given a land previously cleared, or under light blukar,—a land which could be made ready for cultivation at a cost say, of $20 per acre, the cost of a first Castor-oil crop (not including buildings and general farm equipment, ploughs and harrows, spraying apparatus or oil pressing appliances) would amount to about $100 per acre made up:—

by clearing, draining and cultivation	$50
Seed, planting, weeding, harvesting, insecticides	30
Oil extraction and tins	20

The 2 intercrops of groundnuts would cost per acre:

100 lbs. of seed (two sowings) at 25 cents	$25
two sowings	10
two harvestings and 2 shellings	25
Bagging and transport to market	25
Groundnuts, Cost of two crops ..	$85

The total aggregate cost of one crop of Castor-oil and two crops of groundnuts would therefore be $185.

The gross revenue of one acre of *Ricinus* has been already given as $175.

From the figures obligingly supplied us by the Manager of the Singapore Oil Mills the present prices of groundnut for which there is an excellent market, stand as follows:

Grade 1 unshelled $700 per koyan of 40 piculs.
" 2 " 650 " "
" 3 " 600 " "
Shelled nuts $25 per picul.
Oil cake 8.50 to 9 per picul.

The aggregate of the two crops of groundnut *i.e.* 2,900 lbs. (= 2,170 catties) of shelled nuts at 25 cents per catty would bring a gross revenue of	$542.50
Making a total gross revenue of one acre (including the Castor-oil revenue $175)	717.50
Less expenditure	185.00
Leaving a nett profit per acre of	$532.50

If, however, making allowance for the vagaries of seasons, for undue prevalence of pests, and also for the fact that the groundnut, in this case is an interplanted crop,—not a pure crop—we cut down the returns from that source by one fourth and bring the amount of the two crops to 1,6527.50 catties of shelled nuts, the revenue from

groundnuts would fall to (1627.50 x 25)	$406.85
which added to the Castor-oil crop	175.00
would give a gross return of	581.85
and after deduction of all expenses	185.00
would leave a nett profit per acre of	$396.85

Uses of Castor-oil.

The many uses to which castor-oil is put make it one of the most important raw materials of industry.

As is well known it is used in preference to other oils for dressing hides and skins, morocco leather, and generally all kinds of leather goods, belting, boots, harness, etc. as it makes leather soft and pliable.

It fulfills particularly well the functions of a first-class lubricant as being a heavy bodied oil and very viscous, it forms an effective film between moving parts of machinery and keeps them free from friction, and for that reason, it is used in preference to other oils, in concerns—estates and mines—where internal combustion engines are employed.

It is said that, mixed with a soda-lye, Castor-oil has the property of imparting transparency to the resulting soap and it is used for that purpose by soap-makers.

It enters into the composition of unguents and pomatums in perfumery in Europe as well as in India, where it is used as an ointment to keep the skin cool and open. In Italy, the well known "Olio di Ricini a l'Inglese" is, or was, in common use.

Among the less known uses to which Castor-oil is put is that of binding agent for certain insulating compounds which enter in the composition of "Enamel Wire" which is very largely employed for cables. The Western Electric Company of New York import for their own works alone 30,000 gallons of Castor-oil used, in great part, for that one purpose.

Castor-oil imparts fastness and lustre to the dyes used for cotton and woollen goods—and made under the name of Turkey-Red oil, after treatment in concentrated sulphuric acid. It is preferred by dyers as fixing agent for all alizarine colours.

Castor-oil is in great demand as lubricant for aeroplane-motors, owing to the fact that it is unaffected by a wide range of temperature.

Cases did occur during the war when, travelling at great altitudes, the oil congealed and failed to run into the bearings of the engine which would then get red hot, and fatal accidents were traced to this cause: but, it would appear from the "Chemist and Druggist" of 20th February, 1920, that means have since been found to prevent Castor-oil from congealing while retaining its lubricating properties.

From the same source, we also learn that casein combined with Castor-oil is now manufactured into flakes which mixed with water produce a perfect emulsion with the taste of milk.

The value of castor-cake as a fertiliser is very high, and a market exists for every pound of it produced.

Its medicinal properties are well known to all.

As a last resource, it can be used like other oil-seed cakes to generate gas for lighting or for driving machinery. This conversion of cake into gas is in practice in several towns of India, and Dudgeon gives us in 'Agricultural and Forest Products of West Africa" an instance of Cotton-seed cake being put to the same use in an oil-mill at Ibadan (South Nigeria) where it was found that 6 hundredweight of such cake is sufficient to generate gas to drive a 30 h.p. engine for 9½ hours.

Before closing this paper, the writer would emphasize the fact that Castor-oil is not a crop for extensive cultivation as a pure crop on a large scale. One of the reasons for this is that it produces normal crops only under such conditions as are quite congenial to it, and one such condition is *shade* during at least one part of the day not overhead shade, but side shade from large trees growing to the East or the West of the field.

A planter of very long experience, in a letter to the writer, says: "Castor-oil is a peculiar plant. I reared it in Africa. "Grown wild, it yields well; cultivated in plantations, it hardly "yields at all; moreover the oil is of irregular and inconstant "density."

The same is to some extent observable in the Economic Gardens for the plants growing in the full sun—their growth is backward, their flowering is poor—whilst the trees which receive, either in the morning or in the afternoon, the shade from large neighbouring trees are showing quite good crops.

E. Mathieu.

References:

Bulletin Imperial Institute 1911.
Tropical Agriculturist August 1914.
Mukerji, Handbook of Indian Agriculture.
The Book of the Madras Exhibition 1915-1916.
Laucks Commercial oils 1919.

Betel.

One of the first things noticed by the newcomer to the East is the red appearance of the lips and teeth of the natives together with their habit of chewing. He may also observe, particularly in country districts, that many of the natives carry a small tin or receptacle of some description about with them. A peep into this tin would bring to light various things but chief amongst them would be found some betel nut and betel leaves. These form the chief constituents of the mixture, known as "betel," which is chewed by many of the Eastern peoples. In towns the mixture may be seen ready made up for sale.

It is intended to give a brief outline of these two ingredients namely Betel Nut, the seeds of *Areca Catechu,* L., and Betel Leaf, the leaf of *Piper Betle,* L. The production of the former particularly, is essentially a native industry and is interesting on this account.

BETEL-NUT, ARECA CATECHU.

Betel Nut.

Areca Catechu, L., the Betel Nut Palm (see accompanying plate). General Description—

A palm which grows to a good height attaining in some cases 60 ft. Its stem is straight and cylindric, and ringed by the scars of fallen leaves. It is greyish in colour and is generally covered with lichens. The stem is very slender in comparison with its height but very strong nevertheless. The crown of leaves is rather small having a diameter of about 8 ft. The leaves are pinnate which places it in the feather-leaved section of Palms. They vary in length from 4 to 6 ft. and in the young state have a fairly straight leaf rhachis which forms an acute angle with the stem, but in older leaves the leaf-rhachis is curved. The colour of the foliage is yellowish green in plants grown in the sun and light green in plants growing in partial shade. The leaflets are more or less rigid giving the leaf a flat surface. Spathes are produced below the leaves and soon burst disclosing the much branched spadix which is pendulous and on the branches of which are produced the flowers. As the Palm is unisexual the female flowers are borne at the base of the branches while the male flowers are borne on spikes at the extremities of the branches and are arranged in two rows on the spike. In the plate facing p. 296 the two types of flowers can be easily distinguished the large unopened ones at the bases being the female and the tiny white crowded specks being the open male flowers. On the same plate will be seen a fine bunch of fruits which when they first appear are small and green. They very soon swell up and change colour becoming orange or orange scarlet when quite ripe and are from 1 to 2 inches in length when fully grown. The fruit consists of a fleshy pericarp surrounding the seed or betel nut. A fuller description of this palm will be found in the Gardens' Bulletin Vol. II, p. 252.

History.

Mention has been made of the "betel nut" for centuries, the earliest reference to it by a European being found in the writings of Marco Pole (1298 A.D.). Since that date the nut has been mentioned by many writers. Of its great antiquity there can be no doubt as mention of it has been found in manuscripts written in ancient Eastern languages. The nut has its place in the ceremonial and symbolic life of the people being offered as a polite indication of the termination of ceremonial visits. It is also symbolic of festivity and essential at the betrothal ceremony. It has held the same important position from earliest times.

Habitat.

The exact locality in which this plant first grew is unknown as it has been found for centuries, cultivated over almost the whole of tropical Asia. It prefers a moist atmosphere as is shown in India where it is found growing only in localities which are notably

moister than other parts of that country. It does not grow at a very high elevation and is seldom found above 3000 ft. In Malaya it naturally thrives owing to the humidity of the atmosphere and is generally met with growing in compounds and occasionally in plantations. Almost every native compound in Malaya has its few "betel nut" palms which often serve a double purpose, to supply nuts and also to serve as a support for the "betel leaf."

Preparation of Nuts.

Several varieties of the nut are met with in the market, the best class being those which have not undergone any preparation. These may be termed the natural or first class, and are simply dried in the sun before sending to the market. The artificial or second class includes all those varieties which have been prepared in some way before being placed on the market. The usual method of preparation is to boil the nuts either whole or cut into pieces. The latter operation is sometimes performed after boiling but not always. The value of the nuts largely depends on these factors and the natural class generally commands the highest prices in the market.

Areca Catechu or Kossa.

This is the only well known preparation extracted from the "betel nut." It is obtained in the following fashion. A quantity of scraped nuts are placed in water in a large copper pot; a handful of lime is added and the whole boiled for a time. The nuts are then removed and the same liquid is used for several subsequent boilings of nuts adding water when required. Eventually a thick red-brown substance is produced which is allowed to dry in the sun. This substance is Kossa and it is used to flavour and colour inferior nuts. So far as is known it has no particular value except for use in the above manner.

Uses.

The chief uses of the "betel nut" are—

(*a*) Masticatory.

(*b*) Medicinal.

(*a*) Masticatory.—As previously indicated the chief use of the "betel nut" is for chewing purposes. It is sometimes chewed by itself but generally a small piece is rolled up in a "betel leaf" together with a little lime, catechu or kossa, cardamoms and cloves. Prepared in this way it may be seen in most native towns particularly in Indian Bazaars and shops. It is supposed to stimulate digestion and is also claimed to prevent dysentery and generally to strengthen the stomach.

(*b*) Medicinal.—The young nut possesses astringent properties and is used in the treatment of bowel complaints and ulcers. If used in powdered form it is very effective in the treatment of dogs for worms. The natives put it to many uses and with very good results.

Fruit and Flower of Betel-nut Tree, Areca Catechu.

Cultivation.

Propagation is effected by means of seeds which are sown in a part of the plantation set aside as a nursery. Transplanting is carried out after about 2 years, the intervening time being used to prepare the ground and grow other crops. In this first transplanting the plants are placed 12 to 15 feet apart and are interplanted with shade plants, bananas often being used for this purpose. This set of plants fruit about the tenth or twelfth year. About this time the intervening shade plants are removed altogether and the second transplanting takes place, the plants of the first set now assuming the double role of production and shade. The second set do not fruit for about 20 years. There is no third transplanting except to fill in gaps caused by failures. It will thus be seen that the plants are eventually about 6 or 7 feet apart each way. Oftentimes other plants are used to fill in the gaps such as coconuts and fruit trees so that eventually the plantation takes on a rather jungle-like appearance. It may also be mentioned that some plantations are purposely planted up with plants other than the "betel nut." Very often too the "betel leaf" is interplanted with the palm and uses the palm stems as supports. The type of soil does not very much matter provided the atmospheric conditions are suitable and that plenty of manure is given to the plants. This latter has a considerable effect on the yield of nuts and in some places manuring takes place at least every two years. A moist soil is preferred though it is not essential so long as there is a good rainfall.

The most extensive cultivation is carried out in India where there are many plantations ranging in size from 1 acre to 100 acres. Methods of planting up vary considerably but all follow much the same lines. A certain amount of plantation work has been carried out in Malaya as will be gathered from statistics quoted later. Almost every native compound has its few palms to ensure a supply of nuts. Considerable quantities of nuts have been exported in past years but with the advent of rubber this industry has waned.

General Remarks.

The length of time which expires before a plantation bears fruit is rather surprising as generally speaking it takes from 20 to 30 years to bring all the trees into bearing. The average fruiting life of a plant is from 30 to 60 years bringing its age up to 50 to 90 years and even more occasionally. This marks the close of its productiveness and though it will live on many years after it is unproductive and of no use to the grower. It will be seen that this palm is long-lived and this may have influenced its survival in cultivation for so many centuries.

The following extracts have been taken from the Blue Book of the Straits Settlements and prove fairly conclusively that the acreage in the S. S. under "betel nut" is considerably less than it used to be.

Year	Colony.	Acreage.	Price per pikul.
1910	Singapore	290 acres	$3
	Penang N. E.	Mixed with fruit	$3 to $4
	,, S. W.	3000 acres	$2.20 to $4
	Prov. Wellesley	4997 ,,	$2 to $7
	Dindings	Mixed with fruit	$2 50 to $3.50
	Malacca	do	$2.50 to $4.00
1914	Singapore	In patches	$4
	Penang N. E.	Mixed with fruit	$3 to $4.50
	,, S. W.	1400	$3.50 to $4.50
	Prov. Wellesley	3579	$4 to $6
	Dindings	Mixed with fruit	$2 to $3.50
	Malacca	do	$2.50 to $4.00
1918	Singapore	In patches	
	Penang N. E.	Mixed with fruit	$4 to $6
	,, S. W.	1250	$6 to $12
	Prov. Wellesley	3102	$6 to $8
	Dindings	Mixed with fruit	$3 to $6
	Malacca	do about 141	$7

Presuming the acreage under "betel" "mixed with fruit" remains the same as it was 10 years ago, though it is unlikely, there is a large decrease in acreage in the settlements where acreage is definitely stated. Summarising the above we get—

Acreage in 1910—8287 acres.
,, ,, 1914—4979 ,, decrease 3308 acres.
,, ,, 1918—4352 ,, ,, 627 acres.
Giving a total decrease of 3935 acres in eight years.

A comparison of the prices shows an upward trend. The difference in price per picul in eight years is very marked.

Betel Leaf—(Piper Betle, L., see plate facing p. 298).

This plant is a pepper and belongs to the Natural Order *Piperaceae.*

General Description—

A perennial evergreen creeper or climber which grows to a considerable height given the necessary support. It has large heart-shaped leaves, which are thick and strongly 5 to 7-nerved. It produces spikes 4 to 6 inches in length of fleshy flowers which often cohere into a cylindrical mass.

Betel Leaf Pepper Cultivation, Piper Betel.

History.

The "betel leaf" plant is mentioned in very early European writings, also in the manuscripts of the ancients. As would be expected it is always mentioned in connection with "betel nut" and seems to have been cultivated for centuries for the purpose of chewing with the "nut."

Habitat.

It is considered indigenous to Ceylon, India and Malaya and is cultivated throughout tropical Asia for its leaves. Java is suggested as its original home. Like its companion the "betel nut" it requires a humid atmosphere and grows extremely well where such conditions are prevalent.

Uses.

Its recognised use is for chewing purposes and as an ingredient of "betel." The method of mixing it up with other materials has already been indicated. It is chewed in the green state and has a sharp pungent taste and is considered sustaining and particularly advantageous to a people whose food does not include flesh. Its tonic and carminative properties supplying the deficiency.

Cultivation.

Unlike its companion it requires considerable attention and the successful growing of it requires expert knowledge. As would be expected methods vary in different places both in propagation and general culture. The following broad principles may however be laid down for its successful culture.

Propagation is effected by means of cuttings and the method varies. The following two methods will suffice—

(1) Cuttings are taken from two year old plants and cut into lengths of 12 to 18 inches each with five or six joints; they are then planted burying two of the joints.

(2) Fully grown plants cut down close to the root, are stripped of their leaves and divided into three or four portions which are laid horizontally in trenches and covered with earth. They commence growth from each joint.

A fairly constant temperature is best, together with a uniform amount of moisture. The nursery should be if possible in a slightly elevated position to ensure good drainage. A good supply of water must be given as the plants need a moist soil. This latter should be rich in humus and manured at regular intervals. Top dressing is often resorted to, various kinds of manures being used. Shade must be given and for this purpose shade plants such as bananas or the "betel nut" palms must be utilised, otherwise artificial shade must be provided. It is a good plan to give the land a rest after a few years and then plant some other crop returning to "betel leaf" later.

In Malaya it is generally met with in "compounds" using as supports the stems of the palms, in other cases stakes are used, trellis work or anything which will allow them to climb. Attention is always paid to maintaining a sufficiency of shade overhead.

The cultivation of the two plants discussed above is essentially undertaken by natives and is without doubt a purely native industry. Unfortunately statistics are not available as to the export trade in "betel nut" but it is certain that with the large amount of native labour in the country and the decrease in acreage under "betel nut" the exports must be considerably less than in past years. There is no export trade carried on with "betel leaf."

F. FLIPPANCE.

Some Trials of Food Plants in the Economic Gardens III.

The Sword Bean.

(Canavalia ensiformis).

The Sword-beans seen in the accompanying plate were introduced into the Economic Gardens from Japan in February, 1919. Its cultivation has now been brought to the fifth generation and shows by its remarkably heavy crops its adaptability to our local conditions. A local sword-bean is frequently seen growing in Malaya, the difference between this and the Japanese being in the colour of the flowers, which is mauve in the Japanese plant, and white in the local one; and in the seeds, the local bean being bright ruby-red in colour, and the Japanese pale pink. A third white-seeded variety, the seeds of which were procured from Mr. W. Dunman of Grove Estate, is also grown in the Economic Gardens. It is a plant of very robust growth with large handsome mauve flowers and it fruits profusely: it is popularly known as "Owen's Bean" from the name of the popular Secretary of the S. C. C.

The plot, on which the plants were grown, is on the lower edge of a hillside, a piece of yellow stiffish clay, but self-draining by its position. It had been manured six months previously and had given a crop of Roselle. A liming, a good breaking-up with the changkol, and a finish-off with the rake made it a first-rate bed for the sword-bean, which thrives better in a fairly firm clay bottom than on a sandy one.

The seeds were planted three feet apart on rows 2 feet apart, being sown with the eye (hilum) down at a depth of 3 inches. Contiguous to this plot, another bed was planted with seeds of the local sword-beans.

In both cases, the growth was very rapid and 4 weeks after sowing a frame of supports had to be put up with transverse sticks overhead, to train the fast climbing vines, and support the mass of foliage.

Sword bean, Canavalia ensiformis.

The Japanese bean proved the earlier plant; it flowered and fruited two weeks before the local one did.

In about two and a half months from the time of sowing, the first picking of young hanging pods, when about 5 to 6 inches long, took place.

At that stage, they are tender, and can be eaten as a substitute for French beans, of which, however, they lack the flavour.

For that purpose, they should be sliced diagonally, boiled and then tossed for a few minutes in butter.

At a later period the pods become stringy, and later still they take a woody consistency, when they are useless.

The beans themselves are poisonous, unless they have been first divested of their skins, and the separated cotyledons have been heated over the fire previously to boiling them. But although the writer has eaten them after such treatment, the risk is too great to justify their use as a food, either for man or cattle.

The poisonous principle in the bean of *Canavalia ensiformis* is probably, judging by the odour of the freshly opened beans, the same as found by W. R. Dunlop (Tropical Agriculturist March 1916) in *Phaseolus lunatus*, viz: hydrocyanic or prussic arid.

The sword-bean is, as already stated, a very fast grower, which commends it as a restorative crop, in place of a bare fallow: to that end as soon as the first picking of the young pods has taken place, it can be dug into the soil, which it enriches with its stored nitrogen, while the copious leafage serves to aerate the soil and increase the supply of humus.

As a cover crop without staking, it has also much to recommend it, as its broad leaves spread rapidly over the ground and keep down the weeds very effectively.

If staked as previously described, it serves admirably as a screen for exotic plants which cannot be grown to their best under the sun in the open. Lettuces are amongst these. Under the strong sun the excessive evaporation saps the vigour of the plants —the leaves, instead of standing erect, close to the stem, droop away, while the stem itself bolts upward or trails limply on the ground. Strong rains on the other hand, often destroy the seedlings, or in the older stage, beat down the leaves and even tear them.

Under the diffuse light afforded by the foliage of the sword-bean (which has to be pruned when too thick) the excessive evaporation is reduced and the impact of the rain is broken. By using the sword-bean as a screen and rain-breaker, some quite fair samples (*i.e.* fair for our locality) can be grown even at sea-level.

E. Mathieu.

Staking Yams.

The Chinese who grow yams in the Malay Peninsula do not trouble to stake them. This fails to obtain the best yield and should be remedied.

Yams upon light porous soils in areas where the rainfall is relatively small may be left to trail their vines on the soil, for thereby the moisture in it is retained: but nowhere in the Malay Peninsula is the rainfall small enough to justify this: on the other hand the great room afforded for development by the use of stakes produces a greatly increased return. Experiments, demonstrating this increase, were performed twelve years ago in the island of St. Lucia, West Indies (Agricultural Bulletin, Barbados, VIII, April 3rd, 1909, p. 105). The results were as follows:—

Race of Yam	Return when not Staked	Return when Staked
"Lisbon"	3.2 tons per acre.	6.7 tons per acre.
"Bottle-neck Lisbon"	2.4 tons per acre.	4.3 tons per acre.

Since the above was written the following note has appeared in the Agricultural News, March 6th, 1920.

"A note in the Agricultural News February 8th, 1919, drew attention to an experiment conducted at the Botanic Station, Montserrat, in yam cultivation, as to whether it was profitable or not to provide stakes for the vines to run on. Mr. Robson, the Curator, came to the conclusion that the increased yield produced by the staked plants would more than pay for the increased cost involved.

"Mr. Robson has recently forwarded a note upon a similar trial carried out in 1919 with the results obtained therefrom, six rows of six different varieties of yam were planted on ordinary banks, to which pen manure had been supplied, 4 feet apart, the plants being three feet apart in the row. These rows were staked, and five rows unstaked were planted alongside as a control. The yams were planted on May 1st, 1919, and reaped on January 19, 1920. The results showed that in every case there was a large increase in yield from the staked rows as compared with the unstaked ones, amounting to more than 100 per cent. on the total yield, thus confirming the results obtained in 1918."

I. H. Burkill.

Some Factors in Plant Competition.

A preliminary account of the results of experiments conducted at the Rothamsted Experimental station to ascertain the relative importance of the different factors that come into play when one plant enters into competition with another is given in "The Annals of Applied Biology", Vol. VI, Nos. 2 and 3.

"Competition of one plant with another is a very complex, not a simple, phenomenon, and may be broadly analysed as follows:

(1) Competition for food from the soil.
(2) Competition for water.
(3) Competition for light.
(4) The possible harmful effect due to toxic excretions from the roots, if such occur.

"The first three factors lend themselves to direct experiment; the fourth is more difficult to demonstrate but the possibility of its existence must be reckoned with in estimating results."

A summary of the work which was carried out with mustard and barley provides the following:

"The mutual action of one plant on another when growing in juxtaposition, usually known as competition, is a very complex phenomenon.

"When the food supply is limited the dominant factor of competition is that of food and in particular the amount of available nitrogen. Other things being equal the total growth as measured by the dry matter produced is determined by the nitrogen supply, irrespective of the number of plants drawing on the resources.

"With limited food supply the efficiency index of dry weight production decreases with the number of plants as the working capacity of the plant is limited by the quantity of material available for building up the tissues.

"The decrease in light caused by overcrowding is a most potent factor in competition even when an abundance of food and water is presented to each individual plant."

T. F. C.

Effect of Lightning on Trees.

The question as to what extent groups of trees are effected by lightning and how far the damage extends after they have been struck is frequently discussed on estates where apprehension is often felt as to how wide a circle from the tree actually struck will be affected. The following extract taken from the Indian Forester Vol. XLVI, No. 3. contains interesting observations on this subject.

"Lightning-struck trees may be found surrounded by others which show no signs of having been struck at all, and trees standing only 4 ft. away from a tree may thus escape. On the other hand several trees standing close together are usually all more or less similarly affected. Of a number of records which I have of the maximum distance apart of any two trees struck in the same locality the four greatest distances are 50″, 36″, 35″ and 33″.

"Young chir advance growth and small woody shrubs have been found killed within a circle up to 18 feet radius round the base of a lightning-struck tree, but it is more frequent to find such shrubby growth apparently unaffected and I have no record of herbaceous growth showing any signs of damage at all. It is of course well known that the taller an object is the more likely it is to be struck, and it would therefore be unnatural to expect to find shrubby growth affected to the same extent as trees standing overhead.

"As a matter of fact I believe that only a very small percentage indeed of trees struck would die if other agencies did not combine to complete their destruction. Overmature tree with decreasing vitality might succumb but not healthy sound trees in full vigour. From general observations which are not, however, based on definite countings, I believe that under existing conditions about 50 per cent of trees struck (namely, so severely as to give clear

evidence) survive, and the death of the remaining 50 per cent is, I believe, mainly brought about by insect and perhaps also fungal attack.

"It will be seen that I should account for the subsequent death of lightning-struck trees in the main to insect and fungal attack following on local injury caused to the cambium and I can find nothing to confirm any theory which would attribute subsequent deaths to the belated but direct effects of the lightning."

T. F. C.

Castor Oil Plant Diseases.

The ever recurrent discussion as to the practicability of planting Castor Oil Plant as a first class crop in Malaya makes one keep a look out of enemies that the plant has encountered in other countries. The Tropical Agriculturist Vol. LIV, No. 3, contains the following quotation from the Journal of Mysore Agric. and Exp. Union Vol. I, No. 2,

"To the already considerable list of natural host plants of Bacterium Solanacearum (brown-rot of Solanaceae) must now be added the castor oil plant (Ricinus communis), which has been seriously attacked by the disease in various localities of Georgia and Florida,

"The Ricinus plants wilt in various stages of growth, and often at an early one. Dwarfing is usually the first sign of the disease in the seedling plants.

"Land on which any of the sommon Solanaceous plants have wilted should not be planted to Ricinus, unless it is known positively that the wilt was not of bacterial origin."

T. F. C.

Manuring of Rice.

The Agricultural Journal of Egypt, Vol. IX, contains an interesting note on the effect of nitrate of soda as a fertiliser for rice. Four plots manured with 85 kilos of nitrate of soda gave a return of 15010 rotls as compared with 12693 rotls from four untreated control plots.

T. F. C.

Vegetable Oil and Palm Products Industry,

The following notice appearing in Tropical Life March, 1920, may prove of interest to those contemplating planting the Oil Palm in Malaya.

It has been proposed that an Association be formed to advance and safeguard the Vegetable Oil Palm Products Industry.

"It is not to be carried on for the purposes of trade, but to safeguard and advance the interests of the trade generally in such manner as the members of the association shall think best. No details have been gone into at present, and whether the official headquarters will be in London, elsewhere in the U. K., or at some centre abroad has yet to be decided. We should, however, be glad to have our readers' opinion on this point. In any case London would be headquarters for the receipt, collection, and distribution of news, likely to be of interest to members who would, as time went on, decide what the nature of that news would be. It is suggested that at first the subscription be $10 American gold, or its equivalent in other currencies.

"The publishers and proprietors of Tropical Life are willing to include a supplement, especially devoted to the interests of the International Association, as and when desired, whether monthly or otherwise, and then, on terms to be agreed, copies will be sent to all members.

"We hope to hear from those, interested in vegetable oils, palm products, etc., whether the idea appeals to them and if so shall be glad if they will state in writing their willingness to become members and help the Association to be a benefit to the vegetable oil world generally, whether as producers, transporters manufacturers, distributors or consumers."

T. F. C.

Fruit Cultivation.

The steadily rising prices in the cost of locally grown fruit seem to be due not only to a demand from an ever increasing population but also to the common destruction of orchards either for substitution of rubber as a better paying crop, or where the orchards have been planted around towns, to make way for the still more pressing demand of land for building. These factors are contributing largely and rapidly to a shortage of locally grown fruits and high prices, and many are consequently turning their minds to plant sufficient fruit trees to provide a supply of fruit for themselves and their labour force. To those contemplating planting Citrus fruits two articles that have lately appeared should prove of interest. "The Possibilities of Citrus Culture in South India," in the Tropical Agriculturist, February 1920, considers the type of soil and the best varieties to plant. "Notes on Citrus Culture," in the Queensland Agricultural Journal, February 1920, treats of the management and working of Citrus orchards. Both articles are well worth perusing.

T. F. C.

Cola nitida at Singapore.

In the Gardens' Bulletin, Vol. II, No. 3, some data regarding the yield of trees of Cola nitida cultivated in the Economic Gardens, Singapore, were given. Mr. Mathieu recently had some of the trees manured, and one fruit just matured weighs 1 lb. and contains six fully developed seeds, it measures 6 in. in length and 10½ in. in circumference. This is a considerable advance on those hitherto recorded, and is to be attributed to the effects of manuring.

T. F. C.

Botanic Gardens.

The following extract from the "Agricultural News" February 7th, 1920, is reprinted from the Trinidad Guardian 1919, on the occasion of the centenary of the Royal Botanic Gardens, Trinidad, "The Trinidad Royal Botanic Gardens at St. Ann's Port-of-Spain have this year entered upon the second century of unbroken existence. There are very few Botanic Gardens in the British Dominions over seas which can boast of so long a life. Some were founded before these, it is true, but for one reason or another they were abandoned or allowed to fall into decay, to be revived in some cases at a later date when their value was once more appreciated. The Garden of St. Vincent is a noteworthy example, because it was the first of the British tropical gardens, and was drawn upon to start the Trinidad Garden. It was abandoned after some sixty years of activity, and was re-established after a resting period of about another sixty years. Jamaica founded the Bath Garden in 1774 eight years after the St. Vincent one: this was also subsequently abandoned, and restored to some extent. In the East the Garden at Penang in the Straits Settlements was started in 1800; but had a chequered history, being abandoned and restored more than once. The present Singapore Garden dates from 1878.

"Two Gardens which have already reached 100 years are Calcutta, founded in 1786, and Sydney, New South Wales, 1816. Peradeniya, Ceylon, the successor of earlier gardens in the low country will reach its century in 1921. Botanic Gardens are, however, not comparatively new developments. In Europe the old monastic institutions maintained gardens to provide pulses, vegetables, fruits, etc., and also medicinal plants.

"The Royal Botanic Gardens of Kew, to which the Colonies owe so much not only for the plants but also for the trained men it has distributed, arose as a Physic Garden. Fostered by George III and Sir Joseph Banks, Kew rapidly grew in importance as a centre of botanical activity."

The date 1878 given for our own Gardens at Singapore is the date the management was taken over by the Government. The original part of the present Gardens, the Bandstand Hill, was laid out under the Singapore Agri-Horticultural Society in 1862, the site having been acquired in 1859 when the Society was formed.

Previous to this a Botanic Garden had existed near Fort Canning, having been founded by Sir Stamford Raffles in 1822, but it was abandoned in 1829.

T. F. C.

Chrysil Rubber.

To the rubber-producing country of Malay the article appearing in the India Rubber World of January 1st, 1920 under such a title as "Three Hundred Million Pounds of Chrysil Rubber" may well draw attention. An ecological survey of the flora of Western North America provided 25 species of plants containing latex. In four of these the percentage of rubber was high enough to warrant the hope that the species may serve for the production of rubber on a commercial scale. Twenty five pounds of the product of *Chrysothamnus nauseosus*, termed Chrysil rubber, submitted for examination was stated to be "high grade and average quality, not as good as the best fine Para, but a great deal better than most Africans or low grade rubbers." The best samples carried only three per cent of rubber and most of them ran less than two per cent. The article continues, "It should be noted by the way that the *Chrysothamnus* is not a latex producing plant. The rubber is found in the individual cells of the shrub, as in guayule. Like guayule also it is found principally in the parenchymatous elements of the cortex. It may also be noted that rubber does not appear to be laid down during the first year of growth of a tissue, and, indeed, unless present in large amount, is not readily detected by the histological method in portions of the plant less than three or four years old.

"Shrubs of interest as possible rubber producers are usually of good size, measuring three to eight feet high and about as broad. The rubber is present for the most part in the inner bark of the stems, and those portions in average mature plants will weigh from five to fifteen pounds. An exceptionally large plant found near Lone Pine, California, weighed 60 pounds exclusive of the twigs, and shrubs weighing 20 to 40 pounds are not rare. This is partly because the plants reach the maximum size only under favorable conditions and partly because they are frequently burned or cut off near the base after which new stems shoot up only to be again destroyed before reaching maturity.

"Another shrub that is treated at length is the *Haplopappus*, which contains considerably more rubber than the *Chrysothamnus*, from 6 to 10 per cent. The product is, however, soft and resinous."

An extract is given showing that it is computed bushes that exist to give a yield of three million pounds of rubber.

T. F. C.

Vitamines.

In the planting of food crops and the preparation of a diet for the labour staff it is impressed on one that it is essential food containing vitamines be allowed. This is a comparatively new term in modern parlance and the following extracts may be of assistance to those concerned with these questions. The Chemist and Druggist February 14th 1920 in the course of an article states, "As is well known, the knowledge of the presence and importance of vitamines is comparatively new, and as yet nothing is known as to the chemical nature of vitamines. But of their importance in nutrition there is no doubt, although, strictly speaking, they are not nutritive in the same sense as proteins, fats, and carbohydrates. It has been established that the dietetic deficiencies which are the cause of beri-beri, scurvy, rickets, and pellagra are due to the absence or want of balance in the proportions of vitamines that should form part of the normal diet. The report deals with a large number of experiments that have been made of feeding animals on artificial diets with and without vitamines.

"The primary sources, however, are the green leaves of plants and the embryos of certain seeds."

The following is taken from Agricultural News, Feb. 21, 1920.

"In an interesting note in the Descriptive Catalogue of the British Scientific Products Exhibition, 1919, several important results of the (Lister) Institute's work are described.

"One of these is the manner in which scurvy was exterminated among the Indian troops in Mesopotamia during the war. At the beginning of the war those troops suffered very severely from scurvy. This disease is caused by the want in food of certain substances called vitamines. Vitamines occur only in the minutest quantities, but if they are wanting in human food a variety of diseases, according to which of the vitamines is deficient, result, with probably consequent death.

"In Mesopotamia, on account of the difficulty of transport, the Indian troops were at first fed principally on dried grains and pulses—good and concentrated foodstuffs, but wanting in one of the essential vitamines. The result was an epidemic of scurvy,

"The Government appealed to the Lister Institute for help, and this was at once forthcoming, as the discovey had been made by researches in the Institute that if a dry pea is allowed to germinate, large quantities of antiscorbutic vitamines are at once formed. All that was wanted was to damp the peas, and expose them to the warm Mesopotamia air for a few hours when they sprouted, and formed the necessary vitamines. This sprouting did not interfere in any way with the cooking of the peas, and, yet, when treated in this simple way, they became a perfectly wholesome food, and the scurvy disappeared."

T. F. C.

The Discovery of Rubber.

The history of the introduction of the potato and tobacco to Europe is known to every school boy but how many of the thousands interested in rubber know anything of its origin? The following extracts taken from the India Rubber World, March 1st, 1920, should prove very interesting to Malaya. "How India Rubber was made known to Europe by Charles Marie de La Condamine, of the Academy of Sciences, and later of the French Academy is told very entertainingly by AndréDubosc in his "*Histoire du Caoutchouc.*" La Condamine separated from a scientific expedition with which he was travelling to Ecuador and Peru, and made his way alone across the Andes to Quito. "He was a good botanist and he kept his eyes open, and on reaching Quito the first thing he did was to send to the Academy of Sciences "some rolls of a blackish, resinous material" which he had gathered in the forests, namely, caoutchouc. This was in 1736."....." La Condamine in writing home explained that this liquid flowed out of a tree, *Hevé,* after a single incision, milk-white and gradually hardening and blackening in the air. The natives made torches of it; they spread the liquid on cloth and used it as we use waxed cloth. Along the Amazon the Indians made boots of it which kept out the water; they put it around molds shaped like bottles, and when the gum had hardened they broke the mold, producing a light, unbreakable bottle that would hold any liquid. He set to work himself and made waterproof cloths, and also a splendid rubber case for his quadrant. He noted too, that the natives made small bottles of the rubber which they filled with hot water and used as syringes; they in consequence, called the tree, *seringueira.*

"By September, 1742, after he had made important discoveries in physics and mathematics, he decided that his work was done and that he would make his way down the Amazon to the French settlement at Cayenne, a journey of 2,000 miles in nearly unexplored regions. He made the journey alone, with only native attendants and reached Guiana in May, 1743. On his trip he had plenty of opportunities of examining the manner in which the rubber grew and the natives utilized the rubber. As France was at war with England he was obliged to wait two years at Cayenne before returning home, but he reached La Rochelle at last on March 7, 1745. He returned to his literary pursuits and told in the salons the story of his adventures and the wonderful qualities of the rubber which he had found, specimens of which he exhibited. Paris of the eighteen century, however, did not take the discovery any more seriously than it did the beginnings of modern science, and it was reserved to Hancock and Goodyear in the following century to break the way for the modern uses of rubber.

"In the five years following his return La Condamine wrote six big volumes, and, despite his social activities and his literary quarrels, kept up his interest in rubber. His friend Fresneau found the rubber tree in Guiana and wrote to him the description of the native method of gathering it, smoking it and using it. He and

the French chemists who examined the new substance reached conclusions that are startlingly similar in many points to those reached by modern rubber chemists. Fresneau, for instance, thought it was a kind of condensed resinous oil; the name now used is polyterpene. To prevent it from sticking he used Spanish white, ashes or dust.

"La Condamine induced other explorers to search for rubber and learned before he died in 1775 that it had been found in the Isle de France and in Madagascar. Nevertheless, the only practical commercial use found for the caoutchouc in that century was as an eraser of pencil marks, which led to Priestley's christening it by the name it has retained in English, "india rubber"."

T. F. C.

How to Destroy Large Jungle Trees.

In clearing the jungle from an estate it is often a great source of trouble and expense to get rid of the large jungle trees. Too often does one see their stumps and roots remaining, a ready centre of fungus infection to the rubber trees just when they are begining to bear at their best. The following note taken from the Indian Forester, May, 1920, may be of assistance to those about to clear jungle. Of course this method can only be employed whilst the tree is yet living.

"Where it is desired to destroy a tree without cutting it down, a hole is bored in the tree in a downward direction to the centre. For large trees an inch auger is used; for smaller ones ½ inch size is large enough. For large trees 1 oz. to 2 oz. of ordinary commercial saltpetre (nitrate of potash) is used, and for smaller ones ½ oz. to 1 oz. A plug is put into the hole to keep the rain from washing it out. The nitrate of potash is carried by the sap to the tips of the branches and the rootlets. If the tree is a large one, say, 2 feet or more in diameter, very little difference will be noticed in the foliage for 2 or 3 months, then the leaves begin to fall, and it assumes a bare wintry appearance. At the end of about 6 or 8 months a little brushwood is piled around the tree and lit; it will smoulder away to the remote ends of the roots, sometimes 30 feet away from the tree, leaving masses of valuable ash; the tree will fall, and when fallen it will continue to smoulder until every particle is converted into ash.—["A Hand-book of Forestry" by A. D. Webster.]"

T. F. C.

The

Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. II Issued January, 7th 1921. Nos 9, 10, and 11.

A List of the Fungi of the Malay Peninsula

Page 311

By T. F. CHIPP.

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THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. II. Issued January, 7th 1921. Nos 9, 10 and 11.

A LIST OF THE FUNGI OF THE MALAY PENINSULA.

I. *The object of this List.*

The Flowering Plants of Malaya have already received considerable attention, partly from the fact that they are easy to study and collect owing to their size, and partly that they early assumed importance from their economic value. The results of these investigations have been published from time to time, and a general view of the whole embodied in the "Materials for a Flora of the Malay Peninsula." "The Flora of the Malay Peninsula" itself, which will provide the standard work on systematic Phanerogams, is now in the press.

The remainder of the flora, consisting of the Ferns, Fern Allies, Mosses, Algae, Lichens and Fungi has not yet been considered in any co-ordinated work. With the investigation of this branch in view a special appointment was made to the Staff of the Botanic Gardens, Singapore, in 1914, but owing to the war the post was not taken up till 1919. Work was then immediately begun on the Fungi as they were considered to be of most economic importance. The original intention was to publish "Materials" from time to time, and not to bring out any general work until sufficient investigations had been carried out for the production of a standard publication. Owing to an unexpected change of staff, however, and the fact that an interval will elapse before the post can again be filled, it was felt that the work of the past eighteen months ought to be co-ordinated and put on record rather than a risk be run of its being lost and having to be done over again.

The present work is, therefore, a compilation only, and is a bringing-together of all the information to which access has been obtained relating to the Fungi and Fungus literature of the Malay Peninsula. Time alone has not permitted the extension of these investigations to the other Cryptogams.

In this enumeration no attempt has been made to discuss the merits of the various species to which collections have been assigned, nor has it been possible, owing to the work having been carried out

in Singapore, to check the earlier determinations or to determine a considerable amount of the material that is available in the Botanic Gardens' Herbarium. It is unavoidable, therefore, that many specific names are quoted separately that are now established synonyms, as the only resource in the present case was to enter each record, and leave amalgamations and reductions to a later work.

Owing to the difficulty of keeping herbarium specimens in the tropics the collections made before 1912 were sent to Kew, and only a small amount of named material was accumulated, therefore, for comparison at Singapore. Cryptogamic works of reference were also few as it was not possible or advisable to purchase the standard works on this subject which contain only the briefest and occasional references to the fungi of this country, and which are now at a very high price. As access to them is only possible in the large scientific libraries of Europe and America, the original intention was to delay any treatise on the whole of the Malayan Fungi until a visit to Europe should enable these shortcomings to be remedied.

II. *Our knowledge of Malayan Fungi.*

Until some few years ago our knowledge of tropical fungi was exceedingly small, and it was generally considered that the fleshy and more evanescent types were but poorly represented. This no doubt was due to the fact that collectors brought back to Europe only the harder and more durable kinds as they were unable to attempt to preserve the others. More recent researches show that these views were quite incorrect. Whilst the larger and harder fungi such as the Polyporaceae are everywhere in evidence it is soon seen that there is an immense variety of the more perishable kinds whose fructifications appear periodically and last but a few days. The only way these can be adequately recorded is by coloured sketches made from fresh material on the spot. An initial collection of such drawings has already been made at Singapore by De Alwis and Mrs. Burkill, and it is hoped that their publication will shortly be undertaken.

The following paragraphs give a general review of our present knowledge of the groups of Malayan fungi.

Work on the Myxomycetes is all recent. At the present moment Mr. A. R. Sanderson is preparing a monograph on the Malayan species and such as are cited in this work, therefore, are only those that are represented at Singapore. In view of Mr. Sanderson's extensive research it was felt better to leave the detailed account of them for his coming publication. The determinations were made by Miss Gulielma Lister to whom our thanks are due, and at Kew.

Our knowledge of the Phycomycetes is at present very small, entirely owing to lack of investigators in this branch. It is certain that these fungi are abundant and also that they are of considerable economic importance, as the work already done on Phytophthora, for instance, shows. At the present moment there is but very little completed work to be chronicled for this country.

The Ascomycetes have received rather more attention, but chiefly of recent years. Species of outstanding economic importance have been dealt with individually by different Malayan mycologists, but the largest additions to our collections are due to Professor C. F. Baker who served on the Staff of the Botanic Gardens, Singapore, in the year 1917.

The Basidiomycetes, except for the Agaricaceae form far and away the bulk of our collections. Our earliest records are specimens collected by Beccari between 1865 and 1879 apparently on his way to Sarawak, and by the Rev. Father Scortechini in 1885. Kunstler, a collector of Sir Geo. King of Calcutta, was also one of the earlier collectors, whilst a large number of all groups have been collected by Mr. Ridley. The largest local fungus of which we have a record, belongs to this section and is a specimen of Polyporus applanatus, with a diameter of 43 cm. and a thickness of 13 cm. To Mr. C. G. Lloyd our thanks are greatly due for his very kind assistance in determining the many specimens of the Basidiomycetes submitted to him.

The majority of our collections of Agaricaceae are due to Mr. H. N. Ridley and Mrs. Burkill. It is evident that they will prove to be as widely represented as any section of fungi when once the study of them can be carried out on the spot with fresh material.

Our records of the Fungi Imperfecti are again chiefly due to the collections of Prof. C. F. Baker. The study of this section, many of the species of which are of economic importance, has only been undertaken so far in individual cases, but with the provision of laboratories and scientific apparatus now being made investigations should go quickly ahead.

It is interesting to note the general habitats favoured by the various groups of fungi. The Myxomycetes appear as saprophytes generally on dead wood and similar matter. The Phycomycetes, so far as our scanty knowledge goes at present, are both parasitic and saprophytic, and provide the all-prevalent "mildews." The Ascomycetes are also both saprophytic and parasitic, and are responsible for a good deal of damage especially on trees and woody plants. The Rusts and Smuts so far appear but poorly represented, possibly owing to the absence of any large tracts of land in this country under cereal crops. The Basidiomycetes with the exception of the Agaricaceae and subsequent groups are nearly always to be found on a woody stratum, and although the fructifications appear most frequently on dead wood, it should by no means be taken that they are saprophytic. Indeed many of our worst diseases of the rubber plantations are due to this group. The Agaricaceae, Phallaceae, etc. are generally found on the ground. The Fungi Imperfecti, generally favour the same types of hosts as the Ascomycetes.

III. *The preservation of Fungi in the Tropics.*

A word may here be said on the preservation of herbarium specimens in the tropics as this has proved such a source of trouble in the past. It appears essential that when collecting fungi one

must be able to return to one's base every night. Specimens collected on one day's march cannot be preserved and carried on as in the case of flowering plants, with the exception of course of the hard woody kinds, as the characters must be worked out whilst they are fresh and the fructifications rarely last over twenty four hours. Fungi growing on leaves and of a similar nature can be put into an ordinary press, but for all others it was found advisable to collect them in baskets, wrapping each collection loosely in a sheet of paper and placing them on top of each other in the baskets.

On arrival at camp a certain number such as those of a leathery or fibrous nature may be sun dried, but the fleshy ones should be soaked in spirit for about five minutes. If they are fragile or it is essential to preserve their shape, and they are of a nature to allow this to be done, they may then be dried off in a press. Others such as thick or caespitose specimens should be dried off gradually in a hot air oven and preserved in boxes.

Before being put away all specimens must be poisoned, but the proportion of corrosive sublimate must not be such that it will form a deposit on the specimen and block the pores. In the herbarium cabinets balls of naphthalene should be placed on the shelves and in the boxes, and a little powdered naphthalene between the sheets.

Even with all these precautions it has been found necessary to go over all the specimens every two or three months and poison again where necessary.

In dealing with the Agaricaceae the experiment was tried of obtaining the spore cast on a glass slide, and so far this has proved very satisfactory. It enables the spores to be examined by reflected and transmitted light, and if the slides are kept in a slide cabinet they are handy for future reference and comparison. It is necessary, however, from time to time to examine them and when any growth of mycelium is observed to wash the slide over with alcohol.

IV. *The present work.*

The arrangement followed in the present compilation is that of Engler's "Die Pflanzenfamilien," except in the case of the Myxomycetes where Arthur Lister's arrangement has been adopted. Species are arranged alphabetically. The area dealt with includes the Straits Settlements, and the Federated and neighbouring Malay States.

The only works of reference cited in the text are those of Malayan publications which are available for local consultation. It was considered quite unnecessary to burden the work with complete lists of references by citations from European and world-wide standard works, the idea being to frame the pamphlet on the type of a local flora.

In the bibliography at the end the works quoted are those referring especially to Malayan Fungi. It is interesting to note that, apart from lists of determinations of collections such as those published by M. C. Cooke in Grevillea, there is, so far as can be

found, only one previous attempt to list Malayan Fungi. This was by Bancroft in 1913, where (in the Agric. Bull. F. M. S. i. p. 259) he gives a, "List of Fungi identified in the Federated Malay States, with notes on their occurrence." One hundred and five species are mentioned, including Cooke's list of determinations of the collections forwarded by Sir George King. Later in the same year Sharples published "Additions to the Mycologic Flora of Malaya," (Agric. Bull. F. M. S. ii. p. 83.), where he lists five more species. No attempt has been made to add up the number of species mentioned in the present work, as many synonyms are evident, and the early determinations need checking.

In the accompanying enumeration the specimens numbered above 4000 have been collected by the staff of the Botanic Gardens, Singapore since the special appointment, mentioned on p. 311, was taken up. Professor Baker's collections and those of other individuals can be ascertained from the collector's name given.

The work of the Mycologists of the Agricultural Department, F. M. S., and those independently engaged in this work in the country is evident from the copious quotations, throughout the accompanying pages. It is hoped that this present compilation will be of assistance to local mycologists engaged upon the biology of fungi that from time to time assume predominant economic importance, as well as to future workers on the systematic study of Malayan fungi.

Acknowledgement must be made of the copious notes made by Mr. Ridley during his long sojourn in Malay and which he has very kindly allowed to be incorporated in this work.

Thanks are due also to the Director of the Royal Botanic Gardens, Kew, and Miss Wakefield, for their welcome assistance in determining specimens and supplying information on many difficult points.

I am greatly indebted to Mr. I. H. Burkill, Director of the Botanic Gardens, Singapore, for the many facilities and assistance he has given me in the course of my investigations.

T. F. Chipp.

Abbreviations.

The following abbreviations have been used for citations in the body of the work:—

Agric. Bull. Mal. Penin.	Agricultural Bulletin of the Malay Peninsula.
Agric. Bull. S. and F. M. S.	Agricultural Bulletin of the Straits and Federated Malay States.
Gard. Bull. S. S.	The Gardens' Bulletin. Straits Settlements.
Agric. Bull. F. M. S.	The Agricultural Bulletin of the Federated Malay States.
Dep. Agric. F. M. S. Bull.	Department of Agriculture, Federated Malay States, Bulletin.
Journ. F. M. S. Museums	Journal of the Federated Malay States Museums.

MYXOMYCETES.

CERATIOMYXACEAE.

CERATIOMYXA FRUTICULOSA, Macbr.

VAR. FLEXUOSA, Lister.

Distr:—Singapore, Botanic Gardens, *Sappan,* 5105. Economic Gardens, *Chipp,* 4832, 5750.

Appearing as small white tufted patches on dead logs.

PHYSARACEAE.

PHYSARUM COMPRESSUM, Alb. and Schw.

Distr:—Singapore, Botanic Gardens, on a dead log, white when fresh drying grey, *M. Noor,* 5059.

PHYSARUM NUCLEATUM, Rex.

Distr:—Singapore, Tampinis Road, on a trunk of Cocos nucifera, *Burkill,* 269.

PHYSARUM NUTANS, Pers.

Distr:—Singapore, Economic Garden, January 1916, *Burkill,* A 48.

PHYSARUM VIRIDE, Pers.

Distr:—Singapore, Woodlands, on dead wood, *M. Noor,* 5376. Economic Garden, on a dead branch of Treculia africana, *A. Kadir,* 5793; on a dead branch of Hevea brasiliensis, *Chipp,* 5851.

TRICHAMPHORA PEZIZOIDES, Jungh.

Distr:—Singapore, Botanic Gardens, on a heap of brushwood, Oct. 1915, *Burkill.*

PHYSARELLA OBLONGA, Morg.

Distr:—Singapore, Botanic Gardens, on bark, *M. Noor,* 5132, 5133.

DIACHAEA ELEGANS, Fries.

Distr:—Singapore, Botanic Gardens, on dead stems of Acalypha, *Ridley.*

DIDYMIACEAE.

DIDYMIUM LEONINUM, Berk. and Br.

Distr:—Singapore, Botanic Gardens, on leaves, Nov. 1913, *Burkill.*

STEMONITACEAE.

STEMONITIS FUSCA, Roth.

Distr:—Singapore. Botanic Gardens, on a stump of Cyrtophyllum, July 1917, *Burkill;* on a dead log, *Burkill,* 5529. Economic Garden, on a stump of Hevea brasiliensis, Sept. 1915, *Burkill;* on a dead log, *Kiah,* 5730.

STEMONITIS HERBATICA, Peck.

Distr:—Singapore. Botanic Gardens, on a dead log, *Sappan,* 5139.

STEMONITIS SPLENDENS, Rost.

F. FENESTRATA.

Distr:—Singapore, Botanic Gardens, on a stump of Albizzia, Aug. 1914, *Burkill.*

COMATRICHA LONGA, Peck.

Distr:—Singapore. Botanic Gardens, on a dead log, *Sappan,* 5103.

COMATRICHA PULCHELLA, Rost.

Distr:—Singapore. Botanic Gardens, Nov. 1913, *Burkill.*

COMATRICHA TYPHOIDES, Rost.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor,* 5613. Singapore, Botanic Gardens, on a dead log, *M. Noor,* 5060.

HETERODERMACEAE.

CRIBRARIA SPLENDENS, Pers.

Distr:—Singapore, Woodlands, on dead wood, *Sappan,* 5413.

TUBULINACEAE.

TUBIFERA FERRUGINOSA, Gmeln.

Distr:—Singapore, Woodlands, on soil, *Sappan,* 5396.

TUBIFERA STIPITATA, Macbr.

Distr:—Singapore. Botanic Gardens, on dead wood, *Sappan,* 5108.

LYCOGALACEAE.

LYCOGALA EPIDENDRUM, Rost.

Distr:—Singapore. Woodlands, on dead wood, *Sappan,* 5412. Botanic Gardens, *Ridley,* 16.

LYCOGALA MINUTUM, Sacc. and Paol.

Distr:—Without precise locality, on fallen dead twigs, *Scortechini,* 511.

ARCYRIACEAE.

ARCYRIA DENUDATA, Sheldon.

Distr:—Singapore, Botanic Gardens, on moss, *Sappan,* 5141. Economic Garden, on a rotten stump of Hevea brasiliensis. Nov. 1916, *Burkill.*

ARCYRIA NUTANS, Grev.

Distr:—Singapore, Economic Garden, on a dead log, *Chipp,* 4842.

ARCYRIA OERSTEDTII, Rost.

Distr:—Singapore, Economic Garden, on a dead log, *Chipp,* 4850.

ARCYRIA PUNICEA, Pers.

Distr:—Singapore, Botanic Gardens, on dead wood, *Ridley.* Without precise locality, on dead branches, *Scortechini,* 154.

PHYCOMYCETES.

PERONOSPORACEAE.

PHYTOPHTHORA FABERI, Maub. Pratt. in Agric. Bull. F. M. S. v. 180. Chipp, in Gard. Bull. S. S. ii. 189.

Recorded as a bark disease of Hevea brasiliensis.

PHYTOPHTHORA sp. Richards, in Agric. Bull. F. M. S. v. 312.

Recorded as a cause of canker of Hevea brasiliensis.

ENTOMOPHORACEAE.

ENTOMOPHORA sp.

Distr:—Singapore, Botanic Gardens, on a Calliphora fly, Feb. 1917, *Burkill,* A47.

ASCOMYCETES.

MONASCACEAE.

MONASCUS HETEROSPORUS, Schr. Bancroft, in Agric. Bull. F. M. S. i. 259; and in Dep. Agric. F. M. S. Bull. Nos. 16 and 19. Chipp, in Gard. Bull. S. S. ii. 191.

Recorded as causing a spotting on prepared rubber.

GEOGLOSSACEAE.

GEOGLOSSUM HIRSUTUM, Cke.

Distr:—Singapore, Botanic Gardens, *Ridley*.

GEOGLOSSUM SPATHULATUM, Massee.

Distr:—Singapore, on the ground, *Ridley*.

PEZIZACEAE.

PEZIZA ALUTICOLOR, Berk.

Distr:—Without precise locality, on bark, *Scortechini* 116

PEZIZA CROCINA, Mont.

Distr:—Singapore, 1865, *Beccari*.

PEZIZA EPISPARTIA, Berk. and Br.

Recorded from a collection by *Burkill*.

PEZIZA MARTIALIS, Massee.

Distr:—Selangor, on the ground, *Ridley*, 48.

PEZIZA RADICULOSA, Berk. and Br.

Distr:—Perak, on the ground, *Ridley*, 12.

PEZIZA RUTILANS, Fries.

Distr:—Perak, *King's collector*.

PEZIZA TOMENTOSA, Massee.

Distr:—Selangor, on the ground, *Ridley*, 70.

PEZIZA TRICHOLOMA, Mont.

Distr:—Perak, *King's collector*, 2633. Selangor, on dead wood, *Ridley*, 36.

HELOTIACEAE.

COOKEINA TRICHOLOMA, O. Ktze. Sharples, in Agric. Bull. F. M. S. ii. 83.

Distr:—Pahang, West Bentong, on old wood and bark, *Sharples*.

TRICHOPEZIZA CHRYSOTRICHA, Sacc.

Distr:—Selangor, on rotten twigs, *Ridley*, 47.

MOLLISIACEAE.

MOLLISIA ALBOFLAVA, Massee.

Distr:—Selangor, on a dead branch, *Ridley*, 62.

MOLLISIA CINNABARINA, Massee.

Distr:—Selangor, on dead branches, *Ridley*, 95.

MOLLISIA ROSEA, Massee.

Distr.—Selangor, on dead branches, *Ridley*, 82.

CŒNANGIACEAE.

DERMATEA MYCOPHAGA, Massee.

Distr:—Singapore, Bukit Timah, *Ridley*, 158.

TRYBLIDIELLA RUFULA, Sacc.

Distr:—Singapore, Botanic Gardens, on dead branches, *Ridley*, 6.

STICTIDACEAE.

SCHIZOXYLON sp.

Distr:—Singapore, Botanic Gardens, on bamboo, *Sappan*, 5142.

PHACIDIACEAE.

PHACIDIUM AFFINIS, Sacc. and Paol.

Distr:—Without precise locality, on leaves, *Scortechini*, 22.

HYPODERMATACEAE.

GLONIELLA FUSISPORA, Sacc. and Paol.

Distr:—Without precise locality, on stems, *Scortechini*.

LOPHODERMIUM MACULARE, De Not.

Distr:—Without precise locality, on dead leaves of Elaeriospermum and Trigonostemon, *Scortechini*, 47, 48, 152.

HYSTERIACEAE.

LEMBOSIA GLONIOIDEA, Sacc. Baker, in Gard. Bull. S. S. ii. 111, and 119. Chipp, in Gard. Bull. S. S. ii. 189.

Distr:—Singapore, Botanic Gardens, on dead limbs of Hevea brasiliensis, *Baker*, 5278.

LEMBOSIA HEPTAPLEURI, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Singapore, Botanic Gardens, on Heptapleurum, *Baker*, 442.

LEMBOSIA HORMOSIANA, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp. in Gard. Bull. S. S. ii. 278.

Distr:—Singapore, Botanic Gardens, on Ormosia sumatrana, *Baker*, 443.

LEMBOSIA MACROSPORA, Sacc. and Paol.

Distr:—Without precise locality, on fallen leaves, *Scortechini*, 117.

LEMBOSIA PANDANI, Theiss. Baker, in Gard. Bull. S. S. ii. 118. Chipp. in Gard. Bull. S. S. ii. 278.

Distr:—Singapore, Botanic Gardens, on dying leaves of Pandanus spp. *Baker*, 444, 4977.

HYSTERIUM HEVEANUM, Sacc. Baker, in Gard. Bull. S. S. ii. 111, and 119. Chipp, in Gard. Bull. S. S. ii. 189.

Distr:—Singapore, Botanic Gardens, on dead limbs of Hevea brasiliensis, *Baker*, 440.

EUTUBERACEAE.

TUBER ECHINATUM, Sacc. and Paol.

Distr:—Without precise locality, in holes in the ground, *Scortechini*, 185.

ASPERGILLACEAE.

MELIOLA AETHIOPS, Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 233.

Distr:—Singapore, Botanic Gardens, on living leaves of Cassia fistula, *Baker*, 449.

MELIOLA AMPHITRICHA, Fries.

Distr:—Perak, *King's collector*, 2595. Without precise locality, on dead leaves and stems, *Scortechini*, 42.

MELIOLA KYDIAE, Sacc.

Distr:—Singapore, Botanic Gardens, on Garcinia kydia, *Baker*, 450.

MELIOLA MALACCENSIS, Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 281.

Distr:—Singapore, Botanic Gardens, on leaves of Wormia suffruticosa, *Baker*, 451.

MELIOLA MANGIFERAE, Earle. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 288.

Distr:—Singapore, on Mango, *Burkill*, 2827. Singapore, Botanic Gardens, on leaves of Mangifera indica, *Baker*, 452.

MELIOLA MANGOSTANAE, Sacc. Baker, in Gard. Bull. S. S. ii. 117.

Distr:—Singapore, Botanic Gardens, on leaves of Garcinia Mangostana, *Baker*, 453.

MELIOLA NEPHELII, Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 278.

Distr:—Singapore, Botanic Gardens, on leaves of Nephelium lappaceum, *Baker*, 454.

MELIOLA OCTOSPORA, Cke.

Distr:—Singapore, Botanic Gardens, forming sooty patches on leaves of Eugenia grandis, *Ridley*.

MELIOLA PALMARUM, Kunze and Fries. Bancroft, in Agric. Bull. F. M. S. i. 259. Chipp, in Gard. Bull. S. S. ii. 235.

A sooty mould on coconut leaves.

MELIOLA RETICULATA, Karst. and Roum.

Distr:—Singapore, Botanic Gardens, on leaves of Ficus urophylla, *Baker*, 455.

ERYSIBACEAE.

ERYSIPHE POLYGONI, D. C. Bancroft, in Agric. Bull. F. M. S. i. 112, 259. Chipp, in Gard. Bull. S. S. ii. 277.

Recorded as a mildew on tomatoes and cucumbers.

PERISPORIACEAE.

DIMEROSPORIUM ALBOMARGINATUM, Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 281.

Distr:—Singapore, Botanic Gardens, on dying leaves of Sterculia, *Baker*, 412.

ANTENNARIA PANNOSA, Berk.

Distr:—Without precise locality, on dead leaves, *Scortechini*, 55.

LIMACINIA JAVANICA, Sacc. Bancroft, in Agric. Bull. F. M. S. i. 27, 259. Chipp, in Gard. Bull. S. S. ii. 190.

Growing on a scale, Lecanium nigrum.

APIOSPORIUM ATRUM, Massee. Chipp, in Gard. Bull. S. S. ii. 188.

Distr:—Selangor, Kuala Lumpur, on dead branches of Hevea brasiliensis, *Bancroft*.

CAPNODIUM sp. Belgrave, in Agric. Bull. F. M. S. iv. 113. Chipp, in Gard. Bull. S. S. ii. 236.

Recorded in association with scale insects as a sooty mould on coffee berries.

MICROXYPHIUM TENELLUM, Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 234.

Distr:—Singapore, Botanic Gardens, on dying leaves of Cinnamomum iners, *Baker*, 468.

DIMERIUM SINGAPORENSE, Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 280.

Distr:—Singapore, Reservoir Woods, on dead leaves of Rhodomyrtus tomentosa, *Baker*, 411.

MICROTHYRIACEAE.

MICROTHYRIUM BROWNEANUM, Sacc. Baker, in Gard. Bull. S. S. ii. 118. Chipp, in Gard. Bull. S. S. ii. 233, and 280.

Distr:—Singapore, Botanic Gardens, on Brownea grandiceps, and Saraca sp., *Baker*, 465, 466.

MICROTHYRIUM GRAMMATOPHYLLI, Sacc. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Singapore, Botanic Gardens, on Grammatophyllum speciosum, *Baker*, 467.

ASTERINA TENUISSIMA, Petch. Bancroft, in Agric. Bull. F. M. S. i. 259. Chipp, in Gard. Bull. S S. ii. 188, 191.

On the green stems and fruit of Hevea brasiliensis. Said by Petch to live on the sugary secretions from the nectaries at the base of the leaves.

ASTERINA TRACHYCARPA, Syd. Baker, in Gard. Bull. S. S. ii. 118. Chipp, in Gard. Bull. S. S. ii. 237.

Distr:—Singapore, Botanic Gardens, on Derris sinuata, *Baker*, 401.

SEYNESIA MELANOSTICTA, Cke. and Massee.

Distr:—Malacca, Mt. Ophir, on living leaves of Alsodeia, *Hullett*.

MICROPELTIS APPLANATA, Mont.

VAR. GALEARIAE, Sacc. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Singapore, Changi, on Galearia affinis, *Baker*, 5893.

MICROPELTIS MARGINATA, Mont. Baker, in Gard. Bull. S. S. ii. 118. Chipp, in Gard. Bull. S. S. ii. 281.

Distr:—Singapore, Botanic Gardens, on Zalacca edulis, *Baker*, 5402, 5473; on Zalacca Wallichiana, *Baker*, 460.

MICROPELTIS TRIMERA, Sacc. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Singapore. Botanic Gardens, on dead leaves of Gustavia insignis, *Baker*, 461.

HYPOCREACEAE.

NECTRIA DIVERSISPORA, Petch. Bancroft, in Agric. Bull. F. M. S. i. 28, 260. Chipp, in Gard. Bull. S. S. ii. 189, 191.

Recorded on dead parts of Hevea brasiliensis.

NECTRIA SANGUINEA, Fries. Ridley, in Agric. Bull. S. and F. M. S. ix. 571. Chipp, in Gard. Bull. S. S. ii. 189.

Recorded on the bark of Hevea brasiliensis.

PLEONECTRIA HEVEANA, Sacc. Baker, in Gard. Bull. S. S. ii. 111, and 118. Chipp, in Gard. Bull. S. S. ii. 190.

Distr:—Singapore, Botanic Gardens, on a dead limb of Hevea brasiliensis, *Baker*, 5173.

SPHAEROSTILBE CINNABARINA, Tul. Ridley, in Agric. Bull. S. and F. M. S. v. 68. Chipp, in Gard. Bull. S. S. ii. 280.

Recorded on roses.

SPHAEROSTILBE COCCOPHILA, Tul. Bancroft, in Agric. Bull. F. M. S. i. 260. Chipp, in Gard. Bull. S. S. ii. 234.

Recorded as parasitic on a scale on Citrus medica.

SPHAEROSTILBE REPENS, Berk. and Br. Brooks, in Agric. Bull. F. M. S. iii. 40; and in Dep. Agric. F. M. S. Bull. No. 25.

Recorded as a root disease of Hevea brasiliensis.

MEGALONECTRIA PSEUDOTRICHA, Speg. Bancroft, in Agric. Bull. F. M. S. i. 28, 260. Brooks, in Agric. Bull. F. M. S. iii. 41. Chipp, in Gard. Bull. S. S. ii. 189.

Recorded on dead parts of Hevea brasiliensis trees and considered by Brooks to be the conidial stage of Stilbum cinnabarinum.

HYPOCRELLA DISCOIDEA, Sacc. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Singapore, Botanic Gardens, on living leaves of Schizocapsa plantaginea, *Baker*, 438.

HYPOCRELLA PANICI, Massee. Chipp, in Gard. Bull. S. S. ii. 279.

Distr:—Selangor, on a Panicum. *Ridley*, 88.

HYPOCRELLA SCUTATA, Cke.

Distr:—Dindings, on leaves, mentioned by *Ridley*. Singapore, Botanic Gardens, on leaves of Myristica fragrans, *Dr. Bancroft*.

HYPOCRELLA ZINGIBERIS, Massee. Chipp, in Gard. Bull. S. S. ii. 282.

Distr:—Dindings, on petioles of Zingiber, *Ridley*, 10.

HYPOCREA DISCELLA, Berk. and Br.

Distr:—Without precise locality, on branches, *Scortechini*, 118.

HYPOCREA JECORINA, Berk. and Br.

Distr—Singapore, Botanic Gardens, on dead stumps, *M. Noor*, 5058; *Sappan*, 5071. Economic Garden, on a dead log, *Chipp*, 4846.

HYPOCREA sp. aff. H. CITRINAE.

Distr:—Singapore, Botanic Gardens, on a dead twig, *M. Noor*, 5354.

CORDYCEPS INTERRUPTA, Massee.

Distr:—Singapore, *Ridley*.

CORDYCEPS LIGNICOLA, Massee.

Distr:—Selangor, on rotten wood, *Ridley*, 41.

CORDYCEPS RIDLEYI, Massee.

Distr:—Selangor, on an ant Formica gigas, *Ridley*, 89.

BALANSIA ASPERATA, Massee. Bancroft, in Agric. Bull. F. M. S. i. 260. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Johore, Mount Austin, on an inflorescence of Ichnanthus pallens, *Ridley*, 12508.

BALANSIA SESSILIS, Massee. Bancroft, in Agric. Bull. F. M. S. i. 260. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Johore, Kuala Tebing, on Centotheca lappacea, and Ichnanthus sp., *Ridley*, 10988.

CLAVICEPS spp.

Many specimens of this genus have been collected, but the species are not worked out.

DOTHIDEACEAE.

MONTAGNELLA BOTRYOSA, Sacc. and Paol.

Distr:—Without precise locality, on leaves, *Scortechini*, 59.

ROUSSOELLA NITIDULA, Sacc. and Paol.

Distr:—Without precise locality, on thick bamboo stems, *Scortechini*, **15.**

DOTHIDEA PHASELINA, Berk.

Distr:—Singapore, on bamboo culms, 1879, *Beccari*.

PHYLLACHORA CANARII, P. Henn.

Distr:—Penang, Government Hill, on leaves of Canarium sp., *Chipp*, 4697.

PHYLLACHORA FICI-MINAHASSAE, P. Henn.

Distr:—Penang, Government Hill, at 1100 feet, on leaves of Ficus sp., *Chipp*, 4689, 4690.

PHYLLACHORA LUCIDA, Sacc. and Paol.

Distr:—Without precise locality, on dying subcoriaceous leaves, *Scortechini*, 67.

DOTHIDELLA PTEROCARPI, Massee. Bancroft, in Agric. Bull. F. M. S. i. 151, 260. Chipp, in Gard. Bull. S. S. ii. 280.

Distr:—Selangor, Kuala Lumpur, on living leaves of Pterocarpus indicus, *Bancroft*.

ZIMMERMANIELLA TRISPORA, P. Henn. Baker, in Gard. Bull. S. S. ii. 118. Chipp, in Gard. Bull. S. S. ii. 288.

Distr:—Singapore, Botanic Gardens, on dead leaves of Mangifera indica, *Baker*, 500.

SORDARIACEAE.

SORDARIA BURKILLII, Massee.

Distr:—Singapore, Botanic Gardens, on cattle dung, *Burkill*.

SPHAERIACEAE.

TRICHOSPHAERIA SACCHARI, Massee. Ridley, in Agric. Bull. Mal. Penin. 1897, No. 7, p. 146. Chipp, in Gard. Bull. S. S. ii. 280.

On sugar cane, recorded by Ridley.

ROSELLINIA AMBIGENS, Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp. in Gard. Bull. S. S. ii. 237.

Distr:—Singapore, Botanic Gardens, on dead leaves of Daemonorops. *Baker*, 483.

ROSELLINIA BUNODES, Sacc.

Distr:—Singapore, Botanic Gardens, on Ficus dubia. *Ridley.*

This specimen was originally determined as R. echinata, by Massee.

ROSELLINIA ECHINATA, Massee.

Considered by Butler and Wakefield to be the same as R. bunodes.

ROSELLINIA HEMISPHAERICA, Sacc. and Paol.

Distr:—Perak, *King's collector.* Without precise locality, on decaying leaves of Dracaena. *Scortechini*, 2.

ROSELLINIA MAMMOIDEA, Sacc.

Distr:—Perak, *King's collector.* Without precise locality, on dead twigs. *Scortechini*, 3, 10.

ROSELLINIA PICACEA, Massee.

Distr:—Singapore, Botanic Gardens, on dead bark, *Ridley.*

ROSELLINIA RADICIPERDA, Massee. Ridley, in Agric. Bull. Mal. Penin. 1900, page 287.

Distr:—Singapore, Botanic Gardens, on jungle trees, *Ridley.*

ROSELLINIA sp. aff. R. PARASITICAE, E. and Ev. Chipp, in Gard. Bull. S. S. ii. 279.

Distr:—Singapore, Botanic Gardens, on a stem of Pinanga. *Chipp*, 4925.

ZIGNOELLA GARCINIAE, P. Henn. Belgrave, in Agric. Bull. F. M. S. ii. 229.

Recorded on Garcinia mangostana.

MELANOMMA TORNATUM, Sacc. and Paol.

Distr:—Without precise locality, on dead stems, *Scortechini*, 7.

CERATOSTOMATACEAE.

CERATOSTOMELLA COPROGENA, Massee.

Distr:—Singapore, Botanic Gardens, on cattle dung, *Burkill.*

CERATOSPHAERIA SUBICULOSA, Sacc. Baker, in Gard. Bull. S. S. ii. 117.

Distr:—Singapore, Botanic Gardens, on leaves of Fagraea auriculata, *Baker*, 5471.

OPHIOCERAS DIAPORTHOIDES, Sacc. and Paol.

Distr:—Without precise locality, on a thorny woody plant, *Scortechini*, 86.

CUCURBITARIACEAE.

CUCURBITARIA AGAVES.

Distr:—Penang, Waterfall Gardens, on dead leaves of Agave, *Burkill*, 4139. Johore, Kukob, on leaves of Agave sisalana, *Orerbeck*, A17; *Burkill*, A49.

NEOTROTTERIA PULCHELLA, Sacc. Baker, in Gard. Bull. S. S. ii. 111, and 117. Chipp, in Gard. Bull. S. S. ii. 189.

Distr:—Singapore, Botanic Gardens, on rotting limbs of Hevea brasiliensis, *Baker*, 5277.

AMPHISPHAERIACEAE.

TREMATOSPHAERIA CLYPEATA, Sacc. and Paol.

Distr:—Without precise locality, on dead branches, *Scortechini*, 17.

WINTERINA BAKERIANA, Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 277.

Distr:—Singapore, Botanic Gardens, on dead leaves of Livistona sinensis, *Baker*, 497.

MYCOSPHAERELLACEAE.

LAESTADIA CAMELLIAE, Berk.

Distr:—Johore, on leaves of Camellia thea, *King's collector*.

LAESTADIA PALAQUII, Bancroft, in Agric. Bull. S. and F. M. S. x. 108; and in Agric. Bull. F. M. S. i. 113, 260. Chipp, in Gard. Bull. S. S. ii. 279.

Distr:—Perak, parasitic on leaves of Palaquium oblongifolium, *Bancroft*.

LAESTADIA THEAE, Rac. Bancroft, in Agric. Bull. F. M. S. i. 113, and 260. Chipp, in Gard. Bull. S. S. ii. 281.

Distr:—Negri Sembilan, on leaves of tea, *Bancroft*.

SPHAERELLA ANALOGA, Sacc. and Paol.

Distr:—Perak, *King's collector.* Without precise locality, on dying leaves, *Scortechini,* 190.

SPHAERELLA CAMELLIAE, Cke. Bancroft, in Agric. Bull. F. M. S. i. 260.

Distr:—Johore, on leaves of Camellia thea, *King's collector.*

SPHAERELLA CYCLOGONA, Sacc. and Paol.

Distr:—Perak, *King's collector.* Without precise locality, on dying leaves, *Scortechini.*

SPHAERELLA HEVEANA, Sacc. Baker, in Gard. Bull. S. S. ii. 111 and 117. Chipp, in Gard. Bull. S. S. ii. 190.

Distr:—Singapore, Botanic Gardens, on dead leaves of Hevea brasiliensis, *Baker,* 488; Economic Garden, *Chipp,* 5764.

SPHAERELLA LASIANA, Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 277.

Distr:—Singapore, Botanic Gardens, on leaves of Lasia heterophylla, *Baker,* 489.

SPHAERELLA TRISTANIAE, Wakef. Chipp, in Gard. Bull. S. S. ii. 281.

Distr:—Penang, Moniot Road, on leaves of Tristania Griffithii, *Chipp,* 4694.

PLEOSPORACEAE.

PHYSALOSPORA IMMERSA, Massee.

Distr:—Singapore, Botanic Gardens, on cattle dung, *Burkill.*

DIDYMELLA OLIGOSPORA, Sacc. Baker, in Gard. Bull. S. S. ii. 111 and 117. Chipp, in Gard. Bull. S. S. ii. 188.

Distr:—Singapore, Botanic Gardens, on dead branches of Hevea brasiliensis, *Baker,* 410.

METASPHAERIA COCOES. Chipp, in Gard. Bull. S. S. ii. 235.

Distr:—Without precise locality, on dead leaves, *Richards.*

CLYPEOSPHAERIACEAE.

TRABUTIA STEPHANIAE. Bancroft, in Agric. Bull. F. M. S. i. 260. Chipp, in Gard. Bull. S. S. ii. 231.

Distr:—Perak, on leaves of Afzelia retusa, *Bancroft.*

VALSACEAE.

ANTHOSTOMA CAPNODES, Sacc.

Distr:—Perak, *King's collector*. Without precise locality, on branches, *Scortechini*, 65.

ANTHOSTOMA EUMORPHUM, Sacc. and Paol.

Distr:—Perak, *King's collector*. Without precise locality, on dead stems, *Scortechini*, 6.

ANTHOSTOMA PACHYDERMA, Sacc. and Paol.

Distr:—Without precise locality, on bark, *Scortechini*, 7.

VALSA ASSIMILIS, Ces.

Distr:—Penang, on bark, May 1865, *Beccari*.

VALSA SABALINA.

Distr:—Singapore, Botanic Gardens, on dead branchlets, *Ridley*, 140.

EUTYPA CAULIVORA, Massee. Ridley, in Agric. Bull. S. and F. M. S. ix. 217, 259, 460. Bancroft, in Agric. Bull. F. M. S. i. 259, 260; and in Dep. Agric. F. M. S. Bull. No. 25. Chipp, in Gard. Bull. S. S. ii. 188, and 277.

Recorded by Ridley and Bancroft on Hevea brasiliensis and jungle trees.

EUTYPA LUDIBUNDA, Sacc.

VAR. HEVEANA Sacc. Baker, in Gard. Bull. S. S. ii. 111, and 117. Chipp, in Gard. Bull. S. S. ii. 189.

Distr:—Singapore, Botanic Gardens, on dead limbs of Hevea brasiliensis, *Baker*, 417.

PERONEUTYPA HETERACANTHOIDES, Sacc. Baker, in Gard. Bull. S. S. ii. 111, and 117. Chipp, in Gard Bull. S. S. ii. 189, and 234.

Distr:—Singapore, Botanic Gardens, on dead limbs of Hevea brasiliensis and Cassia, *Baker*, 470, 471.

CRYPTOVALSA MICROSPORA, Sacc. Baker, in Gard. Bull. S. S. ii. 111, and 117. Chipp, in Gard. Bull. S. S. ii. 188.

Distr:—Singapore, Botanic Gardens, on rotting stems of Hevea brasiliensis, *Baker*, 409.

EUTYPELLA BAMBUSINA, Berl.

Distr:—Johore, Pagoh, Muar, on dead bamboo, *South*, 6073. Singapore, Government House Grounds, on bamboo twigs, *Burkill*, 2214.

THYRIDARIA TARDA, Bancroft. in Agric. Bull. F. M. S. i. 260; and in Dep. Agric. F. M. S. Bull. Nos. 14, 16, 18. Chipp, in Gard. Bull. S. S. ii. 190.

Recorded as a cause of "die back" on Hevea brasiliensis.

MELANCONIDACEAE.

VALSARIA CINNAMOMI, Sacc. Baker, in Gard. Bull. S.. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 238.

Distr:—Singapore, Botanic Gardens, on dead bark of Eugenia grandis, *Baker*, 496.

DIATRYPACEAE.

DIATRYPE EXCITANS, Cke.

Distr:—Selangor, on dead wood, *Ridley*, 44.

XYLARIACEAE.

NUMMULARIA PITHODES, Petch. Bancroft, in Agric. Bull. F. M. S. i. 260. Brooks, in Agric. Bull. F. M. S. iii. 106. Chipp, in Gard. Bull. S. S. ii. 189.

Common on dead branches and roots of Hevea brasiliensis. According to Petch this species is the same as Eutypa caulivora, Mass.

NUMMULARIA PUNCTULATA, Sacc.

Distr:—Singapore, Botanic Gardens, on a dead branch of Albizzia, *M. Noor*, 5664; on a dead twig, *Kiah*, 5736; Economic Garden, on a dead root of Hevea brasiliensis, *Chipp*, 5753.

var. INDICA, Sacc. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Singapore, Botanic Gardens, on dead limbs of Gluta benghas, *Baker*, 5371.

NUMMULARIA REPANDOIDES, Fuck.

var. SINGAPORENSIS, Sacc. Baker, in Gard. Bull. S. S. ii. 111, and 118. Chipp, in Gard. Bull. S. S. ii. 189.

Distr:—Singapore, Botanic Gardens, on dead limbs of Hevea brasiliensis, *Baker*, 469.

USTULINA ZONATA, Sacc. Brooks, in Agric. Bull. F. M. S. iii. 105. Sharples, in Agric. Bull. F. M. S. iv. 98; and in Dep. Agric. F. M. S. Bull. Nos. 22 and 25. Chipp, in Gard. Bull. S. S. ii. 187.

Distr:—Selangor, Kuala Lumpur, *Belgrave*, 4996; on dead Eucalyptus, *Chipp*, 5682. Johore, Pagoh, Muar, on a stump of Areca catechu, *South*, 6072. Singapore, Mandai Road, on a dead stump, *Chipp*, 5820. Botanic Gardens, on dead bamboo, *Sappan*, 5146; on a living tree of Canarium commune, *Chipp*, 6169.

Specimens 4996, and 5146 were determined by Lloyd as U. vulgaris.

HYPOXYLON APPROXIMANS, Ces.

Distr:—Singapore, 1879, *Beccari*.

HYPOXYLON CONCENTRICUM, Grev.

Distr:—Perak, *Kunstler*.

HYPOXYLON EFFUSUM, Nits. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Botanic Gardens, Singapore, on rotting bark, *Baker*, 5122. Without precise locality, on branches, *Scortechini*, 57, 183.

var. VIRIDARII, Sacc. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Singapore, Botanic Gardens, on rotting bark, *Baker*.

HYPOXYLON HAEMATITES, Lev.

Distr:—Singapore, Botanic Gardens, *Ridley*, 171.

HYPOXYLON MICROSPORUM, Ces. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 234.

Distr:—Singapore, Botanic Gardens, on dead bark of Cassia, *Baker*, 439.

HYPOXYLON OODES, Berk. and Br. Bancroft, in Agric. Bull. F. M. S. i. 260. Chipp, in Gard. Bull. S. S. ii. 189.

Distr:—Perak and Selangor, on dead branches of Hevea brasiliensis, *Bancroft*.

HYPOXYLON UDUM, Fries.

Distr:—Singapore, 1879, *Beccari*.

DALDINIA CONCENTRICA, Ces. and De Not. Bancroft, in Agric. Bull. F. M. S. i. 28, 260. Chipp, in Gard. Bull. S. S. ii. 188.

Distr:—Perak. *King's collector.* Singapore, Botanic Gardens, *Flippance,* 5647. Economic Garden, on dead wood, *Chipp,* 5464. This is the obovoid form known as D. luzonensis, Rehm.

Common everywhere on dead logs.

VAR. ESCHOLZII, Ehrenb. Baker, in Gard. Bull. S. S. ii. 111 and 118. Chipp, in Gard. Bull. S. S. ii. 188.

Distr:—Singapore, Botanic Gardens, on a dead trunk of Hevea brasiliensis, *Baker.*

DALDINIA VERNICOSA, Ces. and De Not.

Distr:—Penang, Waterfall Gardens, on dead wood, *Curtis,* 2213. Selangor, *Ridley,* 84. Singapore, Botanic Gardens, on logs, *Ridley,* 4.

KRETZSCHMARIA BOTRYTIS, Lloyd.

Distr:—Singapore, Economic Garden, on dead stem of Hevea brasiliensis, *Sappan,* 5433.

KRETZSCHMARIA HELISCUS, Massee.

Distr:—Singapore, Botanic Gardens, on dead bark, *Ridley,* 7.

KRETZCHMARIA SINGAPORENSIS, Sacc. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Singapore, Botanic Gardens, on rotting trunks. *Baker,* 5299.

XYLARIA ACICULA, Ces.

Distr:—Without precise locality, on thick leaves, *Scortechini,* 119.

XYLARIA ACICULARIS, Cke.

Distr:—Selangor, on rotten wood, *Ridley,* 63. Singapore, Botanic Gardens, *Ridley,* 53.

XYLARIA ALLANTOIDEA, Berk.

Distr:—Selangor, Port Swettenham, on dead mangrove below high tide mark, *Chipp,* 5640. Sungei Buloh, *Hashim,* 5011. Singapore, Woodlands, on dead wood, *M. Noor,* 5380. Botanic Gardens, *Ridley,* 4919; on an ant's nest, *M. Noor,* 5828.

XYLARIA BERKELEYI, Mont.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor*, 5591.

XYLARIA CYNOGLOSSA, Cke. Bancroft, in Agric. Bull. F. M. S. i. 28 and 260. Chipp, in Gard. Bull. S. S. ii. 188.

Recorded on a dead root of Hevea brasiliensis.

XYLARIA DIGITATA, Grev.

Distr:—Without precise locality, on branches, *Scortechini*, 66, 95.

XYLARIA EMERICI, Berk.

Distr:—Selangor, recorded by *Ridley*.

XYLARIA EUCEPHALA, Sacc. and Paol.

Distr:—Without precise locality, amongst moss on the branches of trees, *Scortechini*, 188.

XYLARIA EXALBATA, Berk. and Curt.

Distr:—Penang, Balik Pulau, *Ridley*, 164.

XYLARIA FIBULA, Massee.

Distr:—Singapore, Bukit Timah, on dead wood, *Ridley*, 159.

XYLARIA FURCATA, Fries.

Distr:—Penang, Waterfall Gardens, on a termites' nest, *M. Noor*, 5625. Singapore, Bukit Timah, on a jungle path, *Chipp*, 4926. Blakang Mati, on the seashore below high tide mark, *Chipp*, 5453.

XYLARIA GRACILIS, Kl.

Distr:—Selangor, Pahang Track, *Ridley*, 83.

XYLARIA GUEPINI, Ces.

Distr:—Without precise locality, on stems, *Scortechini*, 36.

XYLARIA HOLOBAPHA, Berk. Bancroft, in Agric. Bull. F. M. S. i. 260.

Distr:—Perak, Maxwell hill, at 2500 feet, *Bancroft*.

XYLARIA HYPOXYLON, Fries.

VAR. MUCRONATA, Berk.

Distr:—Singapore, Botanic Gardens, on dead wood, *Ridley*, 14; on dead roots of a Ficus, *E. M. Burkill*, 97.

Xylaria hypsipoda, Massee.

Distr:—Singapore, Bukit Mandai, gregarious on dead leaves, *Ridley*, 34.

Xylaria ianthovelutina, Mont.

Distr:—Perak, Larut, on rotten wood, *King's collector*, 2252.

Xylaria Kedahae, Lloyd.

Distr:—Kedah Peak, at 3000 feet, on the ground, *M. Noor*, 4982.

Xylaria nigripes, Kl.

Distr:—Singapore, Botanic Gardens, on the ground, *Sappan*, 5426. Without precise locality, on branches, *Scortechini*, 101.

Xylaria obovata, Berk. Baker, in Gard. Bull. S. S. ii. 111, and 118. Chipp, in Gard. Bull. S. S. ii. 190.

Distr:—Singapore, Botanic Gardens, on stumps of Hevea brasiliensis, *Baker*, 5376.

Xylaria oligostoma, Sacc. and Paol.

Distr:—Without precise locality, on logs, *Scortechini*, 28.

Xylaria plebeja, Ces.

Distr:—Without precise locality, on bark, *Scortechini*.

Xylaria polyclada, Fries.

Distr:—Without precise locality, on logs, *Scortechini*.

Xylaria polymorpha, Grev. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Singapore, Botanic Gardens, on dead logs, *Baker*, 5297; *E. M. Burkill*, 188. Economic Gardens, *A. Kadir*, 5415.

Xylaria rhopaloides, Kunze.

Distr:—Singapore, Botanic Gardens, *Ridley*, 127; on the stump of an Albizzia, *E. M. Burkill*, 185, 298.

Xylaria Ridleyi, Massee.

Distr:—Selangor, Pahang Track, *Ridley*, 80. Singapore, Botanic Gardens, *Ridley*, 15.

XYLARIA SCHWEINITZII, Berk.

Distr:—Selangor, Pahang Track, *Ridley*, 81. Singapore, Botanic Gardens, *Ridley*, 136.

XYLARIA SCOPIFORMIS, Mont. Bancroft, in Agric. Bull. F. M. S. i. 260. Chipp, in Gard. Bull. S. S. ii. 190.

Distr:—Perak, on dead wood, *Bancroft*. Singapore, Botanic Gardens, *Ridley*, 57.

VAR. HEVEANA, Sacc. Baker, in Gard. Bull. S. S. ii. 111, and 118.

Distr:—Singapore, Botanic Gardens, on a stump of Hevea brasiliensis, *Baker*, 5283.

XYLARIA TUBERIFORMIS, Berk. Baker, in Gard. Bull. S. S. ii. 111, and 118. Chipp, in Gard. Bull. S. S. ii. 190.

Distr:—Singapore, Botanic Gardens, on stumps of Hevea brasiliensis, *Baker*, 498.

XYLARIA VARIANS, Sacc. Baker, in Gard. Bull. S. S. ii. 118.

Distr:—Singapore, Botanic Gardens, on rotting trunks, *Baker*, 499.

PORONIA OEDIPUS, Mont. Bancroft, in Agric. Bull. F. M. S. i. 260.

Distr:—Perak, on dead wood, at 550 feet, *Bancroft*. Without precise locality, on elephant dung, *Scortechini*, 94.

PENZIGIA CRAINOIDES, Sacc. and Paol.

Distr:—Without precise locality, on stems, *Scortechini*, 50, 176.

PENZIGIA DEALBATA, Sacc. and Paol.

Distr:—Without precise locality, on stems, *Scortechini*, 135, 186.

BASIDIOMYCETES.

USTILAGINACEAE.

USTILAGO FLAVO-NIGRESCENS, Berk. and Curt. Chipp, in Gard. Bull. S. S. ii. 280.

Distr:—Singapore, Ulu Berik, on Scleria sumatrensis, *Burkill*

USTILAGO MAYDIS, D. C. Ridley, in Agric. Bull. Mal. Penin. 1898. p. 198. Chipp, in Gard. Bull. S. S. ii. 282.

Recorded on cobs of Zea Mays.

USTILAGO POLYTRIADIS, Massee. Chipp, in Gard. Bull. S. S. ii. 280.

Distr:—Malacca, in the ovaries of Polytrias praemorsa.

USTILAGO THWAITESII, Berk. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Singapore, Bajau, on leaves of Justicia Gendarussa, *Burkill.*

USTILAGO VIRENS, Cke. Chipp, in Gard. Bull. S. S. ii. 278.

Recorded by Bancroft as parasitic on grains of rice in Perak.

CEREBELLA PASPALI.

Distr:—Singapore, Kranji, 1891, *Ridley.*

GRAPHIOLA MACROSPORA, Penz. and Sacc. Baker, in Gard. Bull. S. S. ii. 117. Chipp, in Gard. Bull. S. S. ii. 79.

Distr:—Singapore, on dying petioles of Plectocomia, *Baker,* 429*a*.

PUCCINIACEAE.

HEMILEIA VASTATRIX, Berk. and Br. van Hall, in Agric. Bull. F. M. S. i. 251, 255. Bancroft, in Agric. Bull. F. M. S. i. 261. Belgrave, in Agric. Bull. F. M. S. iv. 111. Chipp, in Gard. Bull. S. S. ii. 236.

Distr:—Malacca, Jasin, on Coffea robusta, *Burkill,* 460.

Commonly reported as parasitic on coffee leaves.

PUCCINIA CLAVISPORA, Ell. and Barth. Baker, in Gard. Bull. S. S. ii. 116. Chipp, in Gard. Bull. S. S. ii. 232.

Distr:—Singapore, on Andropogon nardus v. citronella, *Baker,* 482.

AECIDIUM BALANSAE, Cor. Baker, in Gard. Bull. S. S. ii. 116. Chipp, in Gard. Bull. S. S. ii. 231.

Distr:—Penang, Government Hill, at 2500 feet, on Agathis alba, *Burkill,* 2574.

AECIDIUM CASSIAE, Bres. Baker, in Gard. Bull. S. S. ii. 116. Chipp, in Gard. Bull. S. S. ii. 233.

Distr:—Singapore, Tanjong Pagar, on Cassia tora, *Burkill,* 1285.

Considered at Kew to be A. Torae, P. Henn.

There are also many other collections which have not yet been determined specifically.

Uredo Dioscoreae, P. Henn.

Distr:—Singapore. Economic Garden, on leaves of Dioscorea bulbifera, *Burkill*.

Uredo Dioscoreae-alatae, Rac.

Recorded from Burkill's collection.

Uredo Imperatae, P. Magn. Bancroft, in Agric. Bull. F. M. S. i. 261. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Selangor, on Imperata arundinacea, *Bancroft*.

AURICULARIACEAE.

Auricularia Auriculae-judae (L.) Schroet.

Distr:—Singapore, on dead wood, *E. M. Burkill*, 191.

Common on all kinds of damp and rotting wood, throughout the country.

Auricularia brasiliensis, Fr.

Distr:—Johore, on pit shafts used in the Causeway Works, Johore Bahru, *Chipp*, 5831, 5898. Singapore, on dead wood, Woodlands, *Sappan* 5393. Botanic Gardens, *Chipp*, 5783. On dead stem of Hevea brasiliensis, Economic Gardens, *Kiah*, 5850.

The glabrous "Jew's Ear." Large specimens often measure 6 in. in diameter.

Auricularia indica, Massee.

Distr:—Singapore, Cluny Road, on a dead log, *E. M. Burkill*, 210.

The type specimen only is known so far.

Auricularia mesenterica, Fries.

Distr:—Singapore, Economic Gardens, growing on a species of Baccaurea, *Sappan*, 5430.

A European species now recorded for the first time from Malaya.

Auricularia polytricha, (Mont.) Sacc. Chipp, under Hirneola polytricha, in Gard. Bull. S. S. ii. 189.

Distr:—Without precise locality, appearing in clusters at the ends of dead branches or wounded parts, *Bancroft*.

This fungus is stated to be used in curries.

Auricularia porphyrea, (Fr.)

Distr:—Selangor, recorded by *Ridley*, 20.

AURICULARIA REFLEXA, Berk.

Distr:—Singapore, Botanic Gardens, on dead wood, *Sappan*, 5428.

TREMELLACEAE.

HETEROCHAETE TENUICULA, Pat.

Distr:—Singapore, Bukit Timah, on dead wood, *Chipp*, 5863.

TREMELLA PICEA, Massee.

Distr:—Selangor, on dead wood, recorded by *Ridley*, 27.

TREMELLODON AURANTIACUM, Massee.

Distr:—Selangor, on rotten wood, *Ridley*, 72.

DACRYOMYCETACEAE.

GUEPINIA BUCCINA, Sacc.

Distr:—Perak, *King's collector*. Without precise locality, on branches, *Scortechini*.

GUEPINIA COCHLEATA, Berk.

Distr:—Singapore, recorded by *Ridley*.

GUEPINIA FLABELLATA, Cke. Bancroft, in Agric. Bull. F. M. S. i. 261.

Distr:—Perak, Gopeng, on rotten logs, *Kunstler*, 646. Without precise locality, common on rotten logs, *Bancroft*.

GUEPINIA SPATHULARIA, Schw. Bancroft, in Agric. Bull. F. M. S. i. 261.

Distr:—Singapore, Botanic Gardens, on a dead branch of Ficus Benjamina, *E. M. Burkill*, 280. Economic Gardens, on a dead log, *Chipp*, 4843. Without precise locality, common on dead logs, *Bancroft*.

CALOCERA HOSTMANNI, Lev.

Distr:—Perak, *King's collector*. Without precise locality, *Scortechini*, 13.

CALOCERA STRICTA, Fries. Sharples, in Agric. Bull. F. M. S. ii. 84.

Distr:—Without precise locality, occurring very commonly on dead wood in newly opened rubber plantations, *Sharples*.

CALOCERA VISCOSA, Pers.

Distr:—Perak, *King's collector*. Without precise locality, on wood, *Scortechini*, 12.

THELEPHORACEAE.

CORTICIUM CALCEUM, Fries. Ridley, in Agric. Bull. S. and F. M. S. v. 69. Chipp, in Gard. Bull. S. S. ii. 188.

Distr:—Without precise locality, on the bark of Hevea brasiliensis. *Ridley.*

CORTICIUM INCARNATUM, Fries.

Distr:—Without precise locality, on dead wood, *Scortechini.*

CORTICIUM JAVANICUM, Zimm. Bancroft, in Agric. Bull. F. M. S. i. 28. Sharples, in Agric. Bull. F. M. S. iii. 203. Chipp, in Gard. Bull. S. S. ii. 188.

Commonly reported on trees throughout the country. Considered as one of the causes of "Pink Disease."

CORTICIUM LACTEUM, Fries.

Distr:—Perak. *King's collector.* Without precise locality, on wood and branches, *Scortechini*, 24.

CORTICIUM LAEVE, Fries.

Distr:—Perak. *King's collector.* Without precise locality, on decaying wood, *Scortechini*, 120.

CORTICIUM SALMONICOLOR, Berk. and Br. Bancroft, in Agric. Bull. F. M. S. i. 218, 261. Brooks, in Agric. Bull. F. M. S. ii. 238. Bancroft, in Dep. Agric. F. M. S. Bull. No. 18. Brooks and Sharples, in Dep. Agric. F. M. S. Bull. No. 21. Chipp, in Gard. Bull. S. S. ii. 188, 232, 233, 234, 235, 236, 237, 276, 277, 280, 281.

Commonly reported on trees throughout the country, and treated at some length by Brooks and Sharples, and by Bancroft in the bulletins of the Agricultural Department F. M. S. Considered as one of the causes of "Pink Disease."

STEREUM ANNOSUM, Berk. and Br.

Distr:—Perak. *King's collector.* Without precise locality, on wood, *Scortechini*, 97.

STEREUM ASTREA, Fries.

Distr:—Perak. *King's collector.*

STEREUM ATERRIMUM, Cke. Bancroft, in Agric. Bull. F. M. S. i. 261.

Distr:—Perak, Goping, on rotting wood in open dry ground, *Kunstler.* Singapore, Botanic Gardens, on dead wood, *Ridley*, 48. On a dead palm, *Sappan*, 5072.

STEREUM BICOLOR, Fries.

Distr:—Singapore, Economic Gardens, on a dead log, *Chipp*, 4844.

STEREUM BOLLEANUM, Mont.

Distr:—Singapore, Botanic Gardens, on the ground, *Sappan*, 5147.

STEREUM CAPERATUM, Berk.

Distr:—Perak, *King's collector*, 943.

STEREUM COCOA, Berk.

Distr:—Selangor, Kanching Forest Reserve, on dead wood, *Chipp*, 5506.

STEREUM CUNEIFORME, Lloyd.

Distr:—Singapore, Economic Gardens, on the damp earth among the roots of Hevea brasiliensis, *E. M. Burkill*, 189, 254, 288.

STEREUM ELEGANS, Fries.

Distr:—Perak, *King's collector*.

STEREUM INCISUM, Lloyd.

Distr:—Singapore, Botanic Gardens, on the ground, *M. Noor*, 5134.

STEREUM INVOLUTUM, Kl. Bancroft, in Agric. Bull. F. M. S. i. 261.

Distr:—Perak, *Kunstler*, 645. Singapore, Botanic Gardens, on dead wood, *Sappan*, 5149. Economic Garden, on a dead twig, *Sappan*, 5429.

STEREUM LATUM, Cke. and Massee.

Distr:—Perak, on dead bark. Singapore, Botanic Gardens, on dead wood, *Sappan*, 5111. This specimen is considered at Kew to be S. percome, B. and Br.

STEREUM LOBATUM, Kunze. Bancroft, in Agric. Bull. F. M. S. i. 261.

Distr:—Perak, *Kunstler*, 620. *King's collector*, 4864, 2056. Penang, Waterfall, on dead wood, *Curtis*, 2188, 2189, 2190, 2191. Selangor, *Ridley*, 124. Singapore, Chua Chu Kang, *Ridley*, 2. Botanic Gardens, *Ridley*, 68, 69, 116, 128, 129.

This species seems to be distributed throughout the country.

STEREUM MELLISII, Berk.

Distr:—Perak, *Kunstler,* 634.

STEREUM MONOCHROUM, Cke. and Massee.

Distr:—Perak, on dead wood.

STEREUM NITIDULUM, Berk.

Distr:—Selangor, *Ridley,* 79. Johore, Tebong Tinggi, *Ridley,* 10989. Singapore, Botanic Gardens, *Ridley,* 8.

STEREUM OSTREA, Fries.

Distr:—Without precise locality, on logs, *Scortechini,* 16 86, 113.

STEREUM PARTITUM, Berk. and Br.

Distr:—Singapore, Botanic Gardens, *Ridley,* 51.

STEREUM PERCOME, Berk. and Br.

Distr:—Singapore, Botanic Gardens, on dead wood, *Sappan,* 5111.

This specimen is regarded by Lloyd as being S. latum.

STEREUM PETALODES, Berk.

Distr:—Singapore, Botanic Gardens, *Ridley,* 58.

STEREUM RIMOSUM, Berk.

Distr:—Perak, Taiping Hill, *M. Haniff,* 2370.

STEREUM SPADICEUM, Fries.

Distr:—Perak, *King's collector,* 3604. Singapore, Botanic Gardens, *Ridley,* 29.

STEREUM SPECTABILE, Kl.

Distr:—Singapore, Botanic Gardens, on dead wood, *Sappan,* 5122.

STEREUM TENUISSIMUM, Berk.

Distr:—Perang, Waterfall Gardens, on dead wood, *M. Noor,* 5621. Selangor, Port Swettenham, on dead mangrove below high tide mark, *Chipp,* 5632.

STEREUM VELLEREUM, Berk.

Distr:—Selangor, Batu Caves, on dead wood, *Ridley.* Singapore, Botanic Gardens, *Ridley,* 5.

CLADODERRIS CARTILAGINEA, Massee.

Distr:—Singapore, Botanic Gardens, on decayed wood buried in the ground, *Ridley*, 47.

Lloyd considers this to be a Tremellaceous plant of unique structure.

CLADODERRIS DENDRITICA, Pers. Bancroft, in Agric. Bull. F. M. S. i. 261.

Distr:—Penang, Balik Pulau, *Ridley*. Perak, *King's collector*, 2166, 3133. Singapore, Botanic Gardens, *Ridley*; Napier Road, on dead wood, *Sappan*, 5369.

CLADODERRIS INFUNDIBULIFORMIS, Kl.

Distr:—Selangor, Smigei Buloh, on dead wood, *Hoshim*, 5009.

CLADODERRIS SPONGIOSA, Fries. Bancroft, in Agric. Bull. F. M. S. i. 261.

Distr:—Perak, *Kunstler*, 616.

CLADODERRIS THWAITESII, Berk.

Distr:—Singapore, Botanic Gardens, on bamboo shoots, *Ridley*, 38.

Considered by Lloyd to be a Tremellaceous plant of the same affinity as Ridley's specimen 47, determined by Massee as C. cartilaginea.

BECCARIELLA KINGIANA, Massee.

Distr:—Perak, Goping, on rotting logs in damp places, *King's collector*.

CRATERELLUS CORNUCOPIOIDES, Fries.

Distr:—Perak, *King's collector*. Selangor, Kuala Lumpur, *M. Noor*, 5582. Without precise locality, on logs, *Scortechini*, 99.

CRATERELLUS VERRUCOSA, Massee.

Distr:—Penang, on the ground at the foot of the hill, *Ridley*, 163.

CYPHELLA HEVEAE, Massee. Richards, in Agric. Bull. F. M. S. v. 368. Chipp, in Gard. Bull. S. S. ii. 188.

Distr:—Province Wellesley, on bark of Hevea brasiliensis, *Richards*.

HYMENOCHAETE CACAO, Berk.

Distr:—Perak, Maxwell's Hill, *Wray*, 13. Selangor, *Ridley*, 117. Kuala Lumpur, *Chipp*, 5696.

HYMENOCHAETE DEPALLENS, Berk. and Br.

Distr:—Singapore, *Beccari*.

HYMENOCHAETE NOXIA, Berk. Bancroft, in Agric. Bull. F. M. S. i. 219, and 261. South, in Agric. Bull. F. M. S. vi. 269. Chipp, in Gard. Bull. S. S. ii. 187.

Recorded by Bancroft for Perak, Selangor, Negri Sembilan, and Johore. One of the causes of "brown root disease" of rubber, coffee, camphor, etc.

HYMENOCHAETE PELLICULA, Berk. and Br.

Distr:—Perak, *King's collector*. Without precise locality, on branches of Eugeissona tristis, *Scortechini*, 40, 42.

HYMENOCHAETE PHACA, Berk.

Distr:—Penang, at the top of the hill, *Ridley*, 162. Selangor, Ginting Bidai, *Ridley*, 167. Kuala Lumpur, *Belgrave*, 4993.

HYMENOCHAETE STRIGOSA, Berk. and Br.

Distr:—Perak, *King's collector*. Without precise locality, on logs, *Scortechini*, 40, 180.

HYMENOCHAETE SUBPURPURASCENS, Berk.

Distr:—Perak, *King's collector*, 791.

HYMENOCHAETE TABACINA, Lev.

Distr:—Perak, *King's collector*. Without precise locality, on branches, *Scortechini*, 147 .

ASTEROSTROMA HAPALUM, Berk. and Br.

Distr:—Singapore, Botanic Gardens, on a dead vine, *Baker*, 5129.

ASTEROSTROMA INVESTIENS, Schw.

Distr:—Singapore, Blakang Mati, on branches of dead mangrove between low and high tide marks, *Chipp*, 5446.

HELICOBASIDIUM MOMPA, Tanaka. Ridley, in Agric. Bull. S. and F. M. S. i. 81. Chipp, in Gard. Bull. S. S. ii. 187.

Distr:—Selangor, *Ridley*. Doubtfully referred to this species by Massee.

RHIPIDONEMA LIGULATUM, Matt.

Distr:—Perak, *King's collector.* Singapore, on branches, *Scortechini,* 11.

CLAVARIACEAE.

PISTILLARIA FULGIDA, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on dead fruits of Nephelium glabrum, *Scortechini,* 37.

CLAVARIA BICOLOR, Massee.

Distr:—Penang, Gardens' Jungle, recorded by *Ridley.*

CLAVARIA CANDELABRA, Massee.

Distr:—Selangor, on rotten wood, *Ridley,* 37.

CLAVARIA FRAGILIS, Holmsk.

Distr:—Singapore, Botanic Gardens, common on the rockeries, *Ridley.*

CLAVARIA FUSIFORMIS, Sowerby.

Distr:—Pahang, Gunong Tahan, growing among moss, 3300 feet altitude, *Robinson and Wray,* 5346.

CLAVARIA ORNITHOPODA, Massee.

Distr:—Penang, on the ground, *Ridley.*

CLAVARIA RIDLEYI, Massee.

Distr:—Perak, on the ground at the base of trees, *Brown,* 19.

CLAVARIA RUFESCENS, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on wood, *Scortechini,* 21.

CLAVARIA STRICTA, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on old logs, *Scortechini,* 9.

CLAVARIA TRICHOCLADA, Sacc. and Paol.

Distr:—Perak, *King's collector.* Without precise locality, on logs, *Scortechini.*

CLAVARIA TRICHOTOMA, Lev.

Distr:—Perak, *King's collector.* Without precise locality, on logs, *Scortechini,* 14.

CLAVARIA THWAITESII, Berk. and Br.

Distr:—Singapore, *Beccari.*

PTERULA SIMPLEX, Sacc. and Paol.

Distr:—Perak, *King's collector.* Without precise locality, on bark from a fallen tree, *Scortechini*, 159.

PTERULA TROPICA, Mont.

Distr:—Perak, *King's collector.* Without precise locality, on dead logs, *Scortechini.*

LACHNOCLADIUM BRASILIENSE, Sacc. A. L. Smith, in Journ. F. M. S. Museum, ii. 142.

Distr:—Pahang, Gunong Tahan, on dead wood, 3300 feet altitude, *Robinson and Wray*, 5416.

LACHNOCLADIUM FURCELLATUM, Sacc. Bancroft, in Agric. Bull. F. M. S. i. 261.

Distr:—Perak, 300 feet altitude, on dead wood, *Bancroft.* Selangor, Batu Caves, on rotten wood, *Ridley*, 19.

LACHNOCLADIUM SEMIVESTITUM, Berk. and Curt.

Distr:—Perak, *King's collector*, 4036.

HYDNACEAE.

LOPHARIA MIRABILIS, Pat. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Selangor, Kuala Lumpur, on dead branches, *Chipp*, 5559, 5694. Singapore, Botanic Gardens, on dead branch of Hevea brasiliensis, *Baker*, 447; on dead wood, *Sappan* 5119. Labrador Villa, on dead wood, *Chipp*, 5910.

GRANDINIA sp.

Distr:—Singapore, Blakang Mati, on dead mangrove below high tide mark, *Chipp*, 5439.

ODONTIA sp.

Distr:—Singapore, Blakang Mati, *Chipp*, 5472.

Occurs on dead mangrove and coral between low and high tide marks, forming conspicuous red and yellow patches.

HYDNUM CESATI, Berk.

Distr:—Perak, *King's collector.*

HYDNUM CRINIGERUM, Massee.

Distr:—Selangor, on dead bark, *Ridley*, 107. Perak and Singapore, *Ridley*, 28.

HYDNUM DURIUSCULUM, Lloyd.

Distr:—Singapore, at the base of trees, Botanic Gardens, *E. M. Burkill*, 88; Economic Garden, *E. M. Burkill*, 345.

HYDNUM ELATUM, Massee.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 183. This specimen is considered by Lloyd to be H. ferreum.

HYDNUM FERREUM, Lloyd.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 183. This specimen was originally determined by Massee as H. elatum.

HYDNUM FLAVIDUM, Lloyd.

Distr:—Singapore, Botanic Gardens, on a dead tree, *M. Noor*, 5109.

Forming bright yellow superimposed brackets.

HYDNUM GLABRESCENS, Berk. and Rav.

Distr:—Singapore, *Beccari*.

HYDNUM LEPTODON, Mont.

Distr:—Perak, *King's collector*. Without precise locality, on branches, *Scortechini*.

HYDNUM MALIENSE, Lloyd.

Distr:—Singapore, Botanic Gardens, *Sappan*, 5478. Bukit Timah, on the ground, *M. Noor*, 5096.

When fresh it varies in colour from deep purple to shades of grey.

HYDNUM SCLERODONTIUM, Berk. and Mont.

Distr:—Selangor, Gua Batu, *Ridley*, 102. Port Swettenham, on dead wood, *M. Noor*, 4099. Kuala Lumpur, *M. Noor*, 5497. Singapore, Botanic Gardens, *Ridley*, 4916; on a dead branch of Ficus Benjamina, *E. M. Burkill*, 312; on a dead log, *Flippance*, 6198. Chua Chu Kang, *Ridley*, 46. Bukit Timah, *Ridley*, A. 7.

Commonly found on dry logs throughout the country. It is a matter for consideration as to whether this should be a species of Odontia, or as Lloyd suggests a colonial species of Pterula, or again, is it to be associated in the groups apparently contained by Echinodia ranging to some form like Polystictus aculeifer.

HYDNUM STEREOIDES, Cke.

Distr:—Perak, on logs, *King's collector,* 1660.

HYDNUM SUBTILE, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on branches, *Scortechini,* 182.

HYDNUM TAPEINUM, Massee.

Distr:—Selangor, on trunks, *Ridley,* 75.

CALODON RIDLEYI, Massee.

Distr:—Singapore, on the ground, *Ridley,* 72.

IRPEX FLAVUS, Kl. Ridley, in Agric. Bull. Mal. Penin. 1897, June, 147. Bancroft, in Agric. Bull. F. M. S. i. 30, 261. Baker, in Gard. Bull. S. S ii. 112. Chipp, in Gard. Bull. S. S. ii. 187, 236, 238.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor,* 5606. Selangor, Kuala Lumpur, on a trunk, *Hashim,* 5012. On an old coffee tree killed by it, *Ridley,* 19. Singapore, Jurong, *Lim Boon Keng,* 4804. Tanglin Barracks, on dead Pterocarpus indicus, *Chipp,* 5362. Botanic Gardens, on Eugenia grandis, *Baker,* 441; on fallen limbs, *Baker,* 5315; on dead Hevea brasiliensis, *Chipp,* 4827; on dead roots of Fibraurea, *Sappan,* 5358.

A bright yellow woody fungus, considered parasitic and a cause of disease at the collar and roots of trees.

POLYPORACEAE.

MERULIUS INSIGNIS, Wakef.

Now considered as a synonym of M. similis.

MERULIUS RUFUS, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on logs, *Scortechini,* 19.

MERULIUS SIMILIS, Berk.

Distr:—Botanic Gardens, on bamboo stools, *Sappan,* 5138; *Flippance,* 6061.

When fresh this fungus is a bright yellow and orange colour, and of a consistency like fresh rubber.

PORIA CALLOSA, Fries.

Distr:—Singapore, on dead twigs, Botanic Gardens, *Ridley,* 64, 4912; Economic Gardens, *Ridley,* A. 30; *E. M. Burkill,* 291.

PORIA CHAETOLOMA, Pat.

Distr:—Singapore, Botanic Gardens, on dead limbs of Cecropia peltata, *Baker,* 5409.

PORIA EPIMILTIUM, Berk.

Distr:—Selangor, Kuala Lumpur, on a dead branch, *M. Noor,* 5587.

Lloyd mentions as synonyms P. borbonica, Pat., and P. rufotincta, Ellis.

PORIA FERRUGINOSA, Fries.

Distr:—Singapore, Botanic Gardens, on dead twigs of Cyrtophyllum fragrans, *Baker,* 5486.

PORIA GLAUCESCENS, Petch.

Distr:—Singapore, Chua Chu Kang, *Ridley,* A. 29. Woodlands, *Lim Boon Keng,* 4936.

PORIA HYPOBRUNNEA, Petch.

Distr:—Perak, and Selangor, on Hevea brasiliensis, *Perry*

PORIA HYPOLATERITIA, Berk. Bancroft, in Agric. Bull. F. M. S. iv. 347. South, in Agric. Bull. F. M. S. vi. 269. Chipp, in Gard. Bull. S. S. ii. 187, 235.

Specimens originally referred to this species were later determined as Fomes pseudoferreus.

PORIA INTERRUPTA, Berk. and Br.

Distr:—Singapore, Tanglin Barracks, on dead Pterocarpus indicus, *Chipp,* 4678.

PORIA LEUCOPLACA, Berk.

Distr:—Perak, *King's collector.* Without precise locality, on branches, *Scortechini.*

PORIA MELLEA, Berk. and Br.

Distr:—Perak, *King's collector.* Without precise locality, on branches, *Scortechini,* 104.

PORIA RAVENALAE, Berk. and Br.

Distr:—Penang, Waterfall Gardens, on dead stems of Attalea Cohune, *Burkill,* 4147. Selangor, Kuala Lumpur, on a rachis of Eugeissona tristis, *Chipp,* 5688. Singapore, *Ridley,* 70.

PORIA VAPORARIA, Fries.

Distr:—Perak, *King's collector.*

PORIA VINCTA, Berk.

Distr:—Perak, Gunong Batu Patch, at 3400 feet on dead wood, *Wray,* 1216.

PORIA VULGARIS, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on branches, *Scortechini,* 67.

FOMES ANNOSUS, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on branches, *Scortechini,* 112.

FOMES APPLANATUS, Pers.

Distr:—Penang, Waterfall Gardens, on a dead tree, *M. Noor,* 5616. Selangor, Kuala Lumpur, *M. Noor,* 5494. Singapore, Payar Lebar, on dead Cocos nucifera, *E. M. Burkill,* 326. Bukit Timah, *Chipp,* 5884. Botanic Gardens, on a rotten stump, *Chipp,* 5890. Economic Garden, on a Casuarina stump, *E. M. Burkill,* 334; on Cinnamomum iners, *A. Kadir,* 5792.

The largest of the hard woody bracket fungi. Common throughout the country.

FOMES ARENOSUS, Cke.

Distr:—Perak, *King's collector.*

FOMES AUSTRALIS, Fries. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler,* 589, 590, 591, 592, 595, 606, 618. Penang, Waterfall Gardens, on stump of Albizzia Lebek, *Chipp,* 4985. Selangor, Kanching Forest Reserve, *Chipp,* 5508, 5590. Kuala Lumpur, on a Casuarina stump, *Chipp,* 5677. Singapore, Bukit Timah, on dead wood, *Chipp,* 5091, 5881, 5885. Botanic Gardens, *Ridley,* 2, 11. Without precise locality, on decaying trunks, *Scortechini,* 87.

Under this species are included the hard, heavy forms of this fungus as opposed to the lighter and more open F. applanatus.

FOMES CACAO, Pat.

Distr:—Singapore, Botanic Gardens, on rotten trunks, *Baker,* 5408.

FOMES CALIGINOSUS, Cke.

Distr:—Perak, *King's collector.*

FOMES CARYOPHYLLI, Rac.

Distr:—Singapore, Woodlands, on a dead tree, *M. Noor,* 5374. Botanic Gardens, on dead wood, *Sappan,* 5145.

FOMES CONCHATUS, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on stems, *Scortechini,* 17.

FOMES CORNU-BOVIS, Cke.

Distr:—Perak, mentioned by *Ridley.*

Lloyd considers this species to be the same as Fomes melanoporus.

FOMES CURREYI, Berk.

Distr:—Perak, on stems, *King's collector.*

Lloyd considers this species the same as Trametes strigata.

FOMES DIABOLICUS, Berk.

Distr:—Perak, *King's collector,* 1947.

FOMES FASTUOSUS, Lev.

Distr:—Selangor, Port Swettenham, on dead mangrove below high tide level, *Chipp,* 5644.

FOMES FLOCCOSUS, Bres.

Distr:—Singapore, Botanic Gardens, on a rotting log, *Baker,* 5311.

This specimen was determined by Patouillard as Trametes floccosa.

FOMES FULVUS, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on stems, *Scortechini,* 85.

FOMES GIBBOSUS, Nees.

Distr:—Selangor, Kanching Forest Reserve, *Chipp,* 5518. Singapore, Bukit Timah, on a dead log, *Chipp,* 5082. Woodlands, on dead wood, *M. Noor,* 5384, 5385.

There seems no reason to doubt that this species is an abnormal stipitate condition of the common Fomes applanatus, as suggested by Lloyd.

FOMES IGNARIUS, Fries.

Distr:—Perak, *King's collector*. Without precise locality on stems, *Scortechini*, 35.

FOMES INTROSTUPPEUS, Berk.

Distr:—Perak, *King's collector*.

FOMES KERMES, Berk.

Distr:—Perak, *King's collector*.

FOMES LAMAENSIS, Murr.

Distr:—Singapore, Woodlands, on a dead log, *M. Noor*, 5377.

FOMES LEUCOPHAEUS, Mont.

Distr:—Singapore, Woodlands, on dead wood, *Lim Boon Keng*, 4935, *Sappan*, 5403. Economic Garden, on dead stem of Nephelium lappaceum, *Kiah*, 5722.

FOMES LIGNOSUS, Kl.

The quotations for this species here given refer to F. lignosus, although owing to an early error in determination it was at first described as F. semitostus, Sacc., and the earlier references are under that name. Gallagher, in Agric. Bull. S. and F. M. S. vii. 518. Bancroft, in Agric. Bull. F. M. S. i. 25, 141, 220, 261; and in Dep. Agric. F. M. S. Bull. No. 13. Chipp, in Gard. Bull. S. S. ii. 187, 231, 234, 235, 277, 278.

Distr:—Selangor, Kanching Forest Reserve, on dead wood, *Chipp*, 5503. Kuala Lumpur, *M. Noor*, 5491, 5492. Johore, Kukub, on fallen trees, *E. M. Burkill*, 320. Singapore, Bukit Timah, *Ridley;* Botanic Gardens, on various trees, bamboo, etc., many collections.

The well known disease of Hevea brasiliensis and jungle trees.

FOMES MACER, Fries.

Distr:—Singapore, Botanic Gardens, on twigs, mentioned by *Ridley*.

FOMES MARGINATUS, Fries.

Distr:—Perak, *King's collector*.

FOMES MULTIPLICATUS, Mont.

Distr:—Selangor, Kuala Lumpur, *M. Noor*, 5493, 5585.

FOMES NIGRO-LACCATUS, Berk.

Distr:—Selangor, *Ridley*, 121. Pahang, *Barnes*. Johore, Pengerang, *Cassim*, A. 28. Singapore, Botanic Gardens, *Ridley*: on dead wood, *Kiah*, 5732. Economic Garden, on dead wood, *Kiah*, 5723.

FOMES OBLIQUUS, Fries.

Distr:—Perak, *King's collector*, Without precise locality, growing over branches, *Scortechini*.

FOMES PACHYPHLOEUS, Pat.

Distr:—Selangor, Kuala Lumpur, *M. Noor*, 5563.

FOMES PHAEOPLACUS, Pat.

Dist:—Singapore, Botanic Gardens, on a rotting log, *Baker*, 424.

FOMES POMACEUS, Pers.

Distr:—Penang, Waterfall Gardens, *M. Noor*, 5597.

FOMES PSEUDO-FERREUS, Wakf. Belgrave, in Dep. Agric. F. M. S. Bull. No. 28. Chipp, in Gard. Bull. S. S. ii. 187, 235.

A "wet rot" of Hevea brasiliensis, at first described as Poria hypolateritia.

FOMES RHYTIPHLAEUS, Mont.

Distr:—Perak, *King's collector*. Without precise locality, on stems, *Scortechini*, 88, 89.

FOME ROBUSTUS, Kars.

Distr:—Kedah, Gunong Jerai, *M. Noor*, 5202. Singapore, Woodlands, on dead wood, *M. Noor*, 5379.

FOMES SENEX, Nees.

Distr:—Perak, *King's collector*. Penang, *Curtis*, 2189. Johore, Johore Bharu, on dead wood, *M. Noor*, 5853. Singapore, Woodlands, on dead wood, *M. Noor*, 5386, 5837; Bukit Timah, on dead wood, *Chipp*, 5867.

FOMES SUBSTYGIUS, Berk.

Distr:—Perak, *King's collector*.

FOMES SUBTORNATUS, Murr.

Distr:—Singapore, Woodlands, on a dead log, *M. Noor*, 5389. Government House Grounds, on stem of living Albizzia moluccana, *Flippance*, 6153.

FOMES SULCATUS, Cke.

Distr:—Perak. *King's collector.* Without precise locality, on stems, *Scortechini.*

FOMES THWAITESII, Berk.

Distr:—Perak. *King's collector.*

GANODERMUS AMBOINENSIS, Fries. Bancroft, in Agric. Bull. F. M. S. i. 261.

Distr:—Singapore, *Beccari;* Chua Chu Kang, *Ridley,* 45. Lloyd considers this the same as G. dorsalis of the "lucidus" group.

VAR. COCHLEARIS, Nees. Without precise locality, on stems and branches, *Scortechini,* 46.

GANODERMUS COLOSSUS, Fries.

Distr:—Singapore, Botanic Gardens, on dead Ficus Benjamina, *Baker,* 425.

GANODERMUS DORSALIS.

Distr:—Singapore, Botanic Gardens, on a log, *E. M. Burkill,* 310.

GANODERMUS LACCATUS, Zoll.

Distr:—Singapore, Botanic Gardens, on a fallen trunk, *Baker,* 5131.

GANODERMUS LUCIDUS, Lev. South, in Agric. Bull. F. M. S. vi. 269. Chipp, in Gard. Bull. S. S. ii. 197, 280.

Distr:—Penang, *Curtis,* 20*a*. Perak, *Kunstler.* Selangor, Kuala Lumpur, *Chipp,* 5673. Singapore, Tanjong Katong, on a dead stem of Cocos nucifera, *E. M. Burkill,* 179: Watten, *Flippance,* 6011. Without precise locality, on branches, *Scortechini,* 76.

A common stipitate form also occurs:—

Distr:—Selangor, Kuala Lumpur, *M. Noor,* 5498. Singapore, Tanglin Barracks, on dead Pterocarpus indicus, *Chipp,* 4677, 4679, 5658.

GANODERMUS MANGIFERAE, Lev.

Distr:—Singapore, Bedok, on a dead tree Cocos nucifera, *Burkill,* 107.

GANODERMUS MASTOPORUS, Lev.

Distr:—Penang, Waterfall Gardens, *M. Noor,* 5601. Singapore, Botanic Gardens, on a rotting log, *Baker,* 5321.

GANODERMUS OCHROLACCATUS, Bres.

Distr:—Selangor, Port Swettenham, on dead mangrove, *Chipp*, 5642.

POLYPORUS ABRUPTUS, Berk.

Distr:—Perak, *King's collector*. Perak and Singapore, *Ridley*, 130. Singapore, Woodlands, on dead wood, *M. Noor*, 5392.

POLYPORUS ACERVATUS, Lloyd.

Distr:—Singapore, Woodlands, on dead wood, *M. Noor*, 5391. A cream coloured fungus, growing in superimposed brackets. Lloyd places it next to Polyporus grammocephalus.

POLYPORUS ADUSTUS, Fries.

Distr:—Singapore, Woodlands, on dead bark, *Suppan*, 5410.

POLYPORUS AFFINIS, Nees. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler*, 629.

POLYPORUS ALBELLUS, Massee.

Distr:—Selangor, *Ridley*, 24, 80.

POLYPORUS ALVEOLARIS, Fries.

Distr:—Perak, *King's collector*, 4863.

POLYPORUS ANEBUS, Berk.

Distr:—Singapore, Pasir Panjang, on a dead trunk, *Burkill*, 106. Botanic Gardens, on dead logs of Ficus Benjamina, *Burkill*, A. 3; *E. M. Burkill*, 170.

POLYPORUS ARATUS, Berk. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor*, 5612. Perak, *Kunstler*, 617.

POLYPORUS ARENOSUS, Cke. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, Gopeng, on logs lying on sandy ground, *Kunstler*, 631.

POLYPORUS ARCULARIUS, Fries.

Distr:—Selangor, on rotten wood, *Ridley*, 31.

POLYPORUS ATER, Lloyd.

Distr:—Singapore, Woodlands, on dead wood, *M. Noor,* 5383. Distinguished by its completely black colour.

POLYPORUS AUBERIANUS, Mont. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler,* 615, 643.

POLYPORUS BIOGILVUS, Lloyd.

Distr:—Singapore, Bukit Timah, on a dead log. *Chipp,* 5092. A small straw coloured, fan shaped fungus.

POLYPORUS BLANCHETIANUS, Mont.

Distr:—Perak, *King's collector.* Without precise locality, on branches. *Scortechini,* 146.

POLYPORUS BRUNNEO-PICTUS, Berk. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler,* 629.

Lloyd considers that the Malay specimens named as this species by Cooke, should be Polystictus brunneo-maculatus.

POLYPORUS CALIGINOSUS, Mont. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler,* 596.

POLYPORUS CARNEO-FULVUS, Berk.

Distr:—Penang, Waterfall Gardens, *M. Noor,* 5619. Lloyd considers this species to be but a colour form of Polyporous gilvus, Fries.

POLYPORUS CHRYSITES, Berk.

Distr:—Perak, *Kunstler,* 3837.

POLYPORUS CINERASCENS, Ces. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler,* 625.

POLYPORUS CINGULATUS, Berk. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler,* 597.

POLYPORUS COCHLEARIFORMIS, Cke.

Distr:—Perak, on logs. *King's collector,* 2821.

POLYPORUS CORNU-BOVIS, Cke. Bancroft, in Aric. Bull. F. M. S. i. 262.

Distr:—Perak, Goping, on rotten logs, *Kunstler*, 595.

POLYPORUS CYSTIDIOIDES, Lloyd.

Distr:—Singapore, Botanic Gardens, on bark, *Sappan*, 5357.

POLYPORUS DICHROUS, Fries.

Distr:—Singapore, Economic Garden, *Ridley*, A. 31. Botanic Gardens, on fallen limbs, *Baker*, 5130.

POLYPORUS DICTYOPUS, Mont.

Distr:—Malacca, Ayer Keroh, *Ridley*, 157.

POLYPORUS DIMORPHUS, Cke.

Distr:—Perak, *Kunstler*, 644.

POLYPORUS DURUS, Jungh.

Distr:—Kedah, Gunong Jerai, *M. Noor*, 5219. Selangor, Kanching Forest Reserve, on dead wood, *Chipp*, 5509, 5511. Singapore, on dead wood, Bukit Timah, *Chipp*, 5086. Botanic Gardens, *Chipp*, 4911; *Kiah*, 5733.

POLYPORUS EMERICI, Berk.

Distr:—Singapore, Botanic Gardens, on dying branches of Ficus Benjamina, *E. M. Burkill*, 332.

Considered by Lloyd to be a large-pored form of Polyporus grammocephalus.

POLYPORUS FLAVUS, Jungh.

Distr:—Singapore, Botanic Gardens, *Baker*, 5315.

POLYPORUS GILVUS, Fries.

Distr:—Perak, *King's collector*. Singapore, Dalvey Road, on stems of Nephelium lappaceum, *Kiah*, 5714. Tanglin Barracks, on branch of living Terminalia Catappa, *Chipp*, 4811. Blakang Mati, on dead mangrove below high tide mark, *Chipp*, 5473. Botanic Gardens, on a dead log, *M. Noor*, 5136; on a dead stem of Castanopsis, *Chipp*, 5891. Without precise locality, on branches, *Scortechini*.

This fungus often appears as brown sheets covering wounded portions of a living stem. It may prove to be a parasite.

POLYPORUS GRAMMOCEPHALUS, Berk. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Penang, *Beccari*. Perak, *King's collector*, 3836, 2989, 1107, 4134. Selangor, Kuala Lumpor, *Belgrave*, 4940. Singapore, Mandai Road, *Chipp*, 5826. Botanic Gardens, *Ridley*, 145, 146; *Sappan*, 5116, 5353, 5422; *Baker*. Economic Gardens, *Kiah*, 5725.

Common on dead logs.

Cooke also quotes the following records for *King's collector* in Perak:—

V. EMERICI, Berk. 739, 3441, 3442, 3444.
V. RUSSICEPS, Berk. 4257.
V. MACULATUS, Curt. 3343.

POLYPORUS HEMICAPNODES, Berk.

VAR. DIMORPHUS, Cke. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, Goping, on dead logs, *King's collector*, 665.

POLYPORUS HIRSUTUS, Pers. Bancroft, in Agric. Bull. F. M. S. i. 150, 220, 262. Baker, in Gard. Bull. S. S. ii. 112. Chipp, in Gard. Bull. S. S. ii. 197, 280.

Common on dead logs everywhere.

POLYPORUS HOOKERI, Berk.

Distr:—Singapore, Botanic Gardens, on a dead log, *M. Noor*, 5137.

POLYPORUS INCURVUS, Cke. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, Goping, *King's collector*, 610.

POLYPORUS INFLEXIBILIS, Berk.

Distr:—Perak, *Kunstler*, 627.

POLYPORUS INTROSTUPPEUS, Berk. and Cke. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, on jungle trees, *Kunstler*, 587.

POLYPORUS IOBAPHUS, Pat.

Distr:—Singapore, Botanic Gardens, on rotting logs, *Baker*, 472.

POLYPORUS KERMES, Berk. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler*, 601.

POLYPORUS LICHNOIDES, Mont.

Distr:—Singapore, Bukit Timah, on a dead log, *Chipp*, 5098.

POLYPORUS OCCIDENTALIS, Kl. Ridley, in Agric. Bull. S. and F. M. S. vii. 230. Fox, in Agric. Bull. S. and F. M. S. ix. 133. Bancroft, in Agric. Bull. F. M. S. i. 150, 220, 262. Chipp, in Gard. Bull. S. S. ii. 197. (under Polystictus) 233.

Common on dead wood throughout the country.

POLYPORUS OCHROLEUCUS, Berk.

Distr:—Perak, *King's collector*. Without precise locality, on stems, *Scortechini*.

POLYPORUS OSTREIFORMIS, Berk.

Distr:—Selangor, Port Swettenham, on dead mangrove below high tide mark, *Chipp*, 5639.

POLYPORUS PHAEODERMUS, Pat.

Distr:—Singapore, Botanic Gardens, on a rotting trunk, Baker, 5412.

POLYPORUS RAVENALAE, R. Br.

Distr:—Singapore, *Beccari*.

POLYPORUS RETRO-ATER, Lloyd.

Distr:—Selangor, Kanching Forest Reserve, on bark, *Chipp*, 5650.

POLYPORUS RHOMBIPORUS, Pat.

Distr:—Singapore, Botanic Gardens, on a stump, *Baker*, 480.

POLYPORUS RUBIDUS, Berk.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor*, 5593. Perak, *King's collector*. Selangor, Kuala Lumpor, on dead wood, *M. Noor*, 5558. Johore Bahru, *M. Noor*, 5856. Singapore, Woodlands, on dead wood, *M. Noor*, 5390; *Sappan*, 5408. Without precise locality, on stems, *Scortechini*, 156.

Easily recognised by its pale pink colour, though some forms approximate in colour to Fomes lignosus and have in the field at first been taken for that species.

POLYPORUS RUFO-FLAVUS, Berk. and Curt.

Distr:—Singapore, *Beccari*.

POLYPORUS RUGOSUS, Nees.

Very commonly distributed throughout the country, generally found growing on the ground, the base of the stipe attached to rootlets. The pore surface is pure white and forms a sharp contrast to the uniform black of the rest of the fungus. When the pore surface is bruised or scratched it quickly reddens. Lloyd considers that the reference of these Malayan specimens should rather be to P. Ramosii, Murr. owing to their thin and comparatively slender structure.

POLYPORUS RUGULOSUS, Jungh. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Singapore, Botanic Gardens, on rotting trunks, *Baker*, 5305.

POLYPORUS SCOPULOSUS, Berk.

Distr:—Singapore, Botanic Gardens, *E. M. Burkill*, 170; *Flippance*, 5646.

Sometimes shown as a species of Fomes or Trametes, and occasionally under the specific name of "rhizophorae."

POLYPORUS SCRUPOSUS, Fries.

Distr:—Perak, *King's collector*. Without precise locality, on stems, *Scortechini*, 63.

POLYPORUS SENEX, Berk. and Mont. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler*, 588, 594.

POLYPORUS SEPIA, Lloyd.

Distr:—Singapore, Ponggul, on a dead coconut tree, *Burkill*, 105. Botanic Gardens, *Ridley*, A. 24; on the stem of a living Albizzia, *E. M. Burkill*, 129; on logs of Ficus Benjamina, *E. M. Burkill*, 169.

POLYPORUS SPONGIA, Fries. Sharples, in Agric. Bull. F. M. S. ii. 84.

Distr:—Selangor, Kuala Lumpor, at the base of a dead stump, *Sharples*.

POLYPORUS SUBERIANUS, Mont.

Distr:—Perak, *King's collector*.

POLYPORUS SULFUREUS, Fries.

Distr:—Singapore, Botanic Gardens, *Baker*, 5194.

POLYPORUS THEOBROMAE, Lloyd .

Distr:—Singapore, Blakang Mati, on dead mangrove below high tide mark, *Chipp,* 5441.

Lloyd suggests that this may be another link in a series of development exampled by Echinodia, P. Theobromae, Hydnum sclerodontium, and Polystictus aculeifer.

POLYPORUS THWAITESII, Berk. and Br. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler,* 642.

POLYPORUS UNGULATUS, Bull.

Distr:—Penang, *Beccari.*

POLYPORUS VIBECINUS, Fries.

Distr:—Perak, *King's collector.* Without precise locality, on trunks and branches, *Scortechini,* 47.

POLYPORUS VULNERATUS, Lev.

Distr:—Singapore, Botanic Gardens, on a rotting log, *Baker,* 5320.

POLYPORUS WILLIAMSII, Merr. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Singapore, Botanic Gardens, on a stump of Hevea brasiliensis, *Baker,* 5423.

POLYPORUS ZONALIS, Berk.

Distr:—Selangor, Kuala Lumpor, *Belgrave,* 4992. Singapore, Botanic Gardens, on a jungle stump, *E. M. Burkill,* 184.

ECHINODIA THEOBROMAE, Pat. Burkill, in Gard. Bull. S. S. ii. 144. Chipp, in Gard. Bull. S. S. ii. 199.

Distr:—Kedah, Gunong Jerai, *M. Noor,* 5211. Singapore, Botanic Gardens, on a dead limb of Theobroma Cacao, *Baker,* 5410; on dead wood, *E. M. Burkill,* 314; on a dead branch of a Quercus, *Ahmat,* 5143; *Chipp,* 5735; *Burkill,* 6151.

See remarks under Hydnum sclerodontium.

POLYSTICTUS ACULEANS, Berk.

Distr:—Perak, *King's collector.* Singapore, *Chipp,* 4924. Without precise locality, on stems, *Scortechini,* 66.

In determining specimen 4924, which is the only one of the above he definitely assigns to this species, Lloyd remarks "Is it not strange, illustrating the sporadic occurrence of fungus species, that this plant which was found in Brazil sixty five years ago by Spruce was re-collected for the first time in Malay only in 1919?"

POYLSTICTUS ACULEIFER, Berk.

Distr:—Singapore, Botanic Gardens, on a dead log, *Sappan,* 5066.

See remarks under Hydnum sclerodontium. This is the first record for this species outside the American tropics.

POLYSTICTUS ALBOBADIUS, Lloyd.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor,* 5603.

POLYSTICTUS ALBOCERVINUS, Sacc.

Distr:—Selangor, *Ridley,* 119.

POLYSTICTUS ANOMALOSUS, Lloyd.

Distr:—Singapore, Botanic Gardens, *Ridley,* A. 26.

POLYSTICTUS BADIUS, (Berk).

Distr:—Selangor, Kanching Forest Reserve, on dead wbod, *Chipp,* 5512.

Lloyd suggests that this specimen might be considered as a "var. microporus," owing to its smaller pores.

POLYSTICTUS BASIPHAEUS, Sacc. and Paol.

Distr:—Without precise locality, on stems, *Scortechini.* 27.

POLYSTICTUS BICOLOR, Lloyd.

Distr:—Singapore, Botanic Gardens, on bark, *Sappan,* 5352.

POLYSTICTUS BRUNNEO-MACULATUS, Currey.

Distr:—Singapore, Economic Garden, on a dead log, *A. Kadir,* 5414.

POLYSTICTUS CAPERATUS, Berk.

Distr:—Singapore, Botanic Gardens, *Ridley,* 60: on dead wood, *Sappan,* 5126, 5423: *Kiah,* 5738.

POLYSTICTUS CERVINO-GILVUS, Jungh.

Distr:—Singapore, Blakang Mati, on dead mangrove below high tide mark, *Chipp*, 5435.

POLYSTICTUS CICHORACEUS, Berk.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor*, 5605. Perak, *King's collector*. Singapore, Botanic Gardens, on dead wood, *Sappan*, 5148. Without precise locality, on branches, *Scortechini*.

POLYSTICTUS CINNAMOMEUS, Fries.

Distr:—Singapore, Botanic Gardens, about the roots of Cyrtophyllum fragrans, *E. M. Burkill*, 270.

POLYSTICTUS CRENATUS, Berk.

Distr:—Singapore, on dead logs, Bukit Timah, *Chipp*, 5100; Botanic Gardens, *M. Noor*, 5130.

It is difficult to separate this species from P. pterygodes, Fr., and some authorities consider these two specimens should be placed under that species.

POLYSTICTUS CRISTATUS, Cke.

Distr:—Singapore, Woodlands, on dead wood, *M. Noor*, 5382.

POLYSTICTUS CUPROROSEUS, Berk.

Distr:—Perak, *King's collector*, 1867.

POLYSTICTUS DERMATODES.

Distr:—Singapore, Botanic Gardens, *Ridley*, 22. Originally determined as Hexagona pergamenea, but referred to above species on Lloyd's authority.

POLYSTICTUS DILATATUS, Berk.

Distr:—Perak, *Kunstler*, 2799.

POLYSTICTUS DISCIPES, Berk.

Distr:—Perak, *Kunstler*, 3913, 4135.

See also under Polystictus maliensis.

POLYSTICTUS ELONGATUS, Sacc.

Distr:—Perak, *King's collector*, 3665. Selangor, *Ridley*, 109. Singapore, Botanic Gardens, *Ridley*, 138.

POLYSTICTUS FEEI, Fries.

Distr:—Singapore, Botanic Gardens, *Ridley*, 144. Without precise locality, on decaying branches, *Scortechini*, 69.

POLYSTICTUS FLABELLIFORMIS, Fries. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Penang, *Beccari*. Perak, *Kunstler*, 637, 640. Perak and Singapore, *Ridley*, 65, 103, 112. Singapore, Kranji, on a dead stick, *Chipp*, 6003. Bukit Timah, on a dead branch, *Chipp*, 5877. Botanic Gardens, on a fallen branch, *E. M. Burkill*, 138; *Husein*, 5532; *Sappan*, 5421.

Commonly recorded throughout the country.

POLYSTICTUS FLORIDANUS, Sacc. Bancroft, in Agric. Bull. F. M. S. i. 150. Chipp, in Gard. Bull. S. S. ii. 197, 280.

Distr:—Selangor, *Ridley*, 114.

POLYSTICTUS GALLO-PAVONIS, Berk.

Distr:—Singapore, Botanic Gardens, on dead wood, *Sappan*, 5361.

POLYSTICTUS KURZIANUS, Cke.

Distr:—Singapore, Botanic Gardens, on a dead log of Ficus Benjamina, *E. M. Burkill*, 319.

POLYSTICTUS LATUS, Berk.

Distr:—Perak, *King's collector*, 740. Selangor, *Ridley*, 93. Singapore, *Ridley*, 23, 26.

POLYSTICTUS LILACINO-GILVUS, Sacc.

Distr:—Selangor, *Ridley*, 101, 108; Batu Caves, *Ridley*, 100.

POLYSTICTUS LUTESCENS, Pers.

Distr:—Perak, *King's collector*. Without precise locality, on decaying stems, *Scortechini*, 5, 111.

POLYSTICTUS LUTEUS, Bl. and Nees.

Distr:—Perak, *Kunstler*. Without precise locality, on stems and branches, *Scortechini*, 84.

POLYSTICTUS MALACCENSIS, Cke.

Distr:—Perak, *Kunstler*.

POLYSTICTUS MALIENSIS. Cke.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor*, 5622. Perak, on logs, *King's collector*, 5398. Singapore, Botanic Gardens, on a dead log, *M. Noor*. 5135. Economic Garden, *Chipp*, 4814.

Specimens 5135 and 5622 are considered at Kew to belong to the closely allied species P. discipes. Lloyd considers they might be named P. aratoides if that species can be considered to be distinct from P. maliensis.

POLYSTICTUS MEMBRANACEUS. Sacc.

Distr:—Selangor, *Ridley*, 92.

POLYSTICTUS MENZIESII. Cke.

Distr:—Singapore, *Ridley*, 37.

POLYSTICTUS MICROCYCLUS. Zipp.

Distr:—Perak, *Kunstler*, 910. Singapore, *Ridley*, 132.

POLYSTICTUS MOLLIUSCULUS. Berk.

Distr:—Singapore, Botanic Gardens, *Ridley*, 38.

POLYSTICTUS MUTABILIS. Berk. and Curt. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *King's collector*. Without precise locality, on branches, *Scortechini*.

POLYSTICTUS NILGHERRENSIS. Mont.

Distr:—Perak, *Kunstler*, 2001.

POLYSTICTUS OBOVATUS. Jungh.

Distr:—Singapore, Botanic Gardens, *Ridley*, 55. Determined by Massee as P. liemophorus, which is considered by Lloyd to be a dark form of this species.

POLYSTICTUS PALLIDUS. Berk.

Distr:—Selangor, Kuala Lumpor, *M. Noor*, 5561.

POLYSTICTUS PERENNIS. Fries.

Distr:—Perak, *Kunstler*.

POLYSTICTUS PERSOONII. Cke.

See under Trametes Persoonii.

POLYSTICTUS PTERYGODES, Fries.

See under Polystictus crenatus.

POLYSTICTUS RIDLEYI, Massee.

Distr:—Malacca, Ayer Keroh, *Ridley*, 149.

POLYSTICTUS RIGESCENS, Cke.

Distr:—Perak, on rotting logs, *King's collector*, 4818.

POLYSTICTUS SACER, Fries.

Distr:—Perak, *King's collector*, 911, 1822. Singapore, *Ridley*, 36.

POLYSTICTUS SANGUINEUS, Fries. Bancroft, in Agric. Bull. F. M. S. i. 262. Chipp, in Gard. Bull. S. S. ii. 190.

One of the commonest woody fungi, occurring everywhere on dead wood and easily noticeable from its bright scarlet colour.

POLYSTICTUS SECTOR, Fries.

Distr:—Singapore, Botanic Gardens, *Ridley*, 62.

VAR. CUBICOLA, Berk.

Distr:—Without precise locality, on branches, *Scortechini*, 150.

POLYSTICTUS SQUAMAEFORMIS, Berk.

Distr:—Perak, *King's collector*, 3682. Singapore, Botanic Gardens, *Ridley*, 61.

POLYSTICTUS STEREINUS, Berk. and Curt. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Penang, Maxwell Hill, at 3000 feet, on dead wood, *Curtis*, 20*c*.

POLYSTICTUS SUBMEMBRANACEUS, Berk. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler*, 613.

POLYSTICTUS SUBPELLUCIDUS, Sacc.

Distr:—Selangor, *Ridley*, 98.

POLYSTICTUS SUBSTYGIUS, Berk. and Br. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak, *Kunstler*, 633.

POLYSTICTUS TABACINUS, Mont.

Distr:—Perak, *King's collector*. Selangor, Kanching Forest Reserve, *Chipp*, 5516. Without precise locality, on dying stems, *Scortechini*, 39, 54, 90.

Lloyd considers that specimen 5516 might be referred to P. substygius.

POLYSTICTUS VERSICOLOR, Fr.

Distr:—Perak, *Kunstler*. Without precise locality on stems, *Scortechini*, 52, 111, 123, 178.

POLYSTICTUS VINOSUS, Berk.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor*, 5608. Perak, *King's collector*, 2143. Singapore, Botanic Gardens, *Ridley*, 26, 59.

POLYSTICTUS VIRGINEUS, Fries.

Ditsr:—Perak, *Kunstler*. Without precise locality, on dead branches, *Scortechini*, 128.

POLYSTICTUS XANTHOPUS, Fries. Bancroft, in Agric. Bull. F. M. S. i. 262.

One of the most widely distributed fungi, growing on dead wood.

POLYSTICTUS XERAMPELINUS, Sacc. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Singapore, Botanic Gardens, *Ridley*, 12.

TRAMETES BADIA, Berk.

Distr:—Singapore, Woodlands, on dead wood, *Sappan*, 5405. Botanic Gardens, *Baker*, 492.

Specimen 5405 is doubtfully referred to this species by Lloyd.

TRAMETES CINGULATA, Berk.

Distr:—Perak, *King's collector*, 3088.

TRAMETES CORRUGATA, Bres.

See under T. Persoonii.

TRAMETES CURREYI, Cke.

Distr:—Perak, *King's collector*.

TRAMETES FLOCCOSA, Bres.

Distr:—Singapore, Botanic Gardens, on rotting logs, *Baker*, 5311.

TRAMETES LACHNEA, Berk. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Singapore, on fallen limbs of Hevea brasiliensis, *Baker*.

TRAMETES LACTINIA, Berk.

Distr:—Singapore, Woodlands, on dead wood, *Sappan*, 5406. Botanic Gardens, on a fallen trunk, *Baker*, 5192.

TRAMETES LOBATA, Berk.

Distr:—Perak, *King's collector*, 4600, 5774.

TRAMETES MARCHIONICA, Lev.

Distr:—Singapore, Botanic Gardens, on a dead branch of a Ficus, *E. M. Burkill*, 105. *Chipp*, 5250.

TRAMETES MEYNII, Kl.

Distr:—Johore, Johore Bahru, on dead wood, *M. Noor*, 5859. Singapore, Economic Garden, on a dead Casuarina, *Sappan*, 5366.

Lloyd gives the following synonyms for this species, Polystictus obstinatus, Cke. and Trametes cornea, Pat.

TRAMETES MUELLERI, Berk.

Distr:—Selangor, Kuala Lumpor, on a Casuarina stump, *Chipp*, 5676. Singapore, Economic Garden, *Chipp*, 4838.

TRAMETES OCCIDENTALIS, Fries.

Distr:—Perak, *Kunstler*, 605, 614, 619.

TRAMETES PERSOONII, Mont. Baker, in Gard. Bull. S. S. ii. 112. One of the commonest fungi, to be found everywhere on dead logs.

TRAMETES PUNICEA, Fries.

Distr:—Perak, *King's collector*. Penang, on branches, *Scortechini*, 177.

TRAMETES RIGIDA, Berk. Bancroft, in Agric. Bull. F. M. S. i. 262. Distr:—Perak, *Kunstler*, 608.

TRAMETES SERICEA.

Distr:—Selangor, Kuala Lumpor, *Ridley*, 165.

TRAMETES SERPENS, Fries.

Very common everywhere on dead branches and twigs.

TRAMETES TRANSMUTANS, Lloyd.

Distr:—Singapore, Botanic Gardens, on dead wood, *Sappan*, 5364.

As Lloyd suggests, this is quite possibly a derivative of Lenzites repanda.

TRAMETES VERSATILIS, Berk.

Distr:—Perak, *King's collector*, 1239, 4607. Singapore, on dead wood, Woodlands, *M. Noor*, 5371. Napier Road, *Sappan*, 5370. Bukit Timah, *Chipp*, 5093, 5865, 5889.

DAEDALEA ANDAMANICA, Berk.

Distr:—Perak, on trunks, *King's collector*, 4161.

DAEDALEA FLAVIDA, Lev.

Distr:—Johore, Johore Bahru, Causeway Works, *Chipp*, 5857. Singapore, Woodlands, on dead wood, *M. Noor*, 5388. Economic Garden, on dead Casuarina, *Sappan*, 5365; on dead wood, *Flippance*, 5924.

Specimens of this affinity are most variable, and according to Lloyd may be placed under any one of seventeen different names, according to the form taken by the hymenium.

DAEDALEA INTERMEDIA, Berk.

Distr:—Singapore, Botanic Gardens, on dead timber, *Ridley*, 65.

DAEDALEA LENZITIFORMIS, Ces.

Distr:—Penang, *Beccari*. Perak, *King's collector*. Without precise locality, on stems, *Scortechini*, 15.

DAEDALEA RIDLEYI, Lloyd.

Distr:—Singapore, Bukit Timah, *Ridley*, 4920.

DAEDALEA SANGUINEA, Kl. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Penang, *Beccari*. Perak, *Kunstler*, 605.

DAEDALEA SUBCONGENER, Berk.

Distr:—Penang, *Curtis*, 2196.

LENZITES ALBIDA, Fries.

Distr:—Perak, *King's collector*.

LENZITES APPLANATA, Fries.

Distr:—Perak, *Kunstler*, 598, 599. Selangor, common on rotten trees, Gua Batu, *Ridley*, 87.

LENZITES BETULINA, Fries.

Distr:—Without precise locality, on branches, *Scortechini*, 121.

LENZITES DEPLANATA, Fries.

Distr:—Perak, *King's collector*, 4727.

LENZITES MALACCENSIS, Sacc. and Cub.

Distr:—Without precise locality, on stems, *Scortechini*, 140.

LENZITES PALISOTI, Fries.

Distr:—Singapore, Botanic Gardens, on dead wood, *Baker*, 5308; *Chipp*, 4817, 5843.

LENZITES PLATYPHYLLA, Cke. Bancroft, in Agric. Bull. F. M. S. i. 263.

Distr:—Perak, Goping, on rotting wood, *King's collector*, 607, 4512.

This name is considered at Kew as a synonym for L. malaccensis.

LENZITES PLATYPHYLLA, Lev.

Distr:—Selangor, on dead wood, *Ridley*, 26, 85, 91; Gua Batu, *Ridley*, 88. Singapore, Economic Garden, on a dead log, *Chipp*, 5417.

LENZITES REPANDA, Mont.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor*, 5607. Selangor, Kuala Lumpur, *M. Noor*, 5490. Singapore, Bukit Timah, *Chipp*, 5088. Botanic Gardens, *Sappan*, 5363; *Flippance*, 6173. Economic Garden, on a dead stem of Hevea brasiliensis, *Chipp*, 5749; *Flippance*, 5923.

Common on dead wood. Generally an ivory white colour but sometimes cream.

HEXAGONIA ALBIDA, Berk.

Distr:—Penang, Waterfall Gardens, on dead Albizzia, *M. Noor*, 5592. Singapore, on dead wood, Botanic Gardens, *Ridley*, A. 39, 153; *E. M. Burkill*, 271, 275, 297, 305. Napier Road, *Sappan*, 5368.

At Kew specimen 5368 was determined as H. macrotrema.

HEXAGONIA ANGULATA, Lloyd.

Distr:—Penang, Waterfall Gardens, on dead wood, *M. Noor*, 5604.

HEXAGONIA CERVINO-PLUMBEA, Jungh. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Singapore, Botanic Gardens, on limbs of Hevea brasiliensis, *Baker*, 435.

HEXAGONIA CUCULLATA, Mont.

Distr:—Singapore, Botanic Gardens, on the ground, *Sappan*, 5483.

HEXAGONIA DURISSIMA, Berk.

Distr:—Singapore, Botanic Gardens, *Ridley*, A. 25; on dead logs, *E. M. Burkill*, 93; *M. Noor*, 5110.

A black resinous heavy fungus with white pore mouths, and as hard as iron.

HEXAGONIA FLAVIDA, Lev.

Distr:—Singapore, Bukit Timah, on a dead log, *Chipp*, 5075.

Lloyd remarks that this is one of the many hymenial forms of Daedalea flavida.

HEXAGONIA POLYGRAMMA, Mont. Chipp, in Gard. Bull. S. S. ii. 232.

The specimen here referred to has since been determined as H. umbrosus. The species typically "polygramma" does not appear to have been collected in Malay so far.

HEXAGONIA PULCHELLA, Lev. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Singapore, on dead branches, Botanic Gardens, *Baker*, 436; *E. M. Burkill*, 104, 321.

HEXAGONIA SUBACULEATA, Ces.

Distr:—Johore, *Beccari*.

HEXAGONIA TENUIS, Hook. Bancroft, in Agric. Bull. F. M. S. i. 262. A. L. Smith, in Journ. F. M. S. Museums, ii. 142.

Distr:—Penang, *Curtis*, 2187, 2197. Perak, *King's collector*, 3342. Pahang, Gunong Tahan, at 3300 feet, on dead wood, *Wray and Robinson*. Singapore, Mandai Road, on dead branches, *Chipp*, 5804. Botanic Gardens, *Ridley*, 143; *M. Noor*, 5521. Economic Garden, *Ridley*, A. 20; *Kiah*, 5726.

HEXAGONIA THWAITESII, Berk. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Singapore, on dead limbs of Hevea brasiliensis, *Baker*.

HEXAGONIA TRICOLOR, Fries.

Distr:—Selangor, Kuala Lumpur, *M. Noor*, 5569.

According to Lloyd H. discopoda, Pat. is the same species.

HEXAGONIA UMBROSA, Lloyd.

Distr:—Pahang, Pekan, collector not stated. Selangor, Port Swettenham, on dead mangrove below high tide mark, *Chipp*, 5634. Singapore, Jurong, on an old tree of Artocarpus integrifolia, *Ridley*, A. 21. Blakang Mati, on dead mangrove below high tide mark, *Chipp*, 5460. Botanic Gardens, *Ridley*, 141; *Chipp*, 5784.

LASCHIA AGARICINA, Pat.

Distr:—Singapore, Botanic Gardens, on dead twigs, *E. M. Burkill*, 277, part.

LASCHIA CAESPITOSA, Berk.

Distr:—Selangor, on dead wood, *Ridley*, 12, 25, 32. Without precise locality, on stems, *Scortechini*.

LASCHIA CHIPPII, Lloyd.

Distr:—Penang, Waterfall Gardens, on dead palm stems, *Chipp*, 4698.

LASCHIA DELICATULA, Fries.

Distr:—Perak, *King's collector*. Without precise locality, on dead wood, *Scortechini*.

LASCHIA SIMILIS, Lloyd.

Distr:—Singapore, Bukit Timah, on a dead log, *Chipp*, 5084.

LASCHIA TREMELLOSA, Fries.

Distr:—Perak, *King's collector*.

FAVOLUS ALUTACEUS, Berk. and Mont.

Distr:—Perak, *King's collector*. Without precise locality, on branches, *Scortechini*.

FAVOLUS BOUCHEANUS, Kl.

Distr:—Singapore, *Ridley*, 161.

FAVOLUS BRASILIENSIS. Fries. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Upper Perak, on dead wood, *Bancroft*.

FAVOLUS FLACCIDUS. Fries.

Distr:—Perak. *King's collector*. Without precise locality, on dead logs. *Scortechini*, 53.

FAVOLUS MOLLUCCENSIS. Mont.

Distr:—Perak. *King's collector*. Singapore. Botanic Gardens, on dying branches of Ficus Benjamina. *E. M. Burkill*, 331. Without precise locality, on decaying logs, *Scortechini*. 117.

FAVOLUS PUXILLUS. Fries.

VAR. PALLIDIPES.

Distr:—Perak, *King's collector*. Without precise locality, on logs, *Scortechini*.

FAVOLUS RUFICEPS. Berk. and Br.

Distr:—Singapore. Botanic Gardens, on wood, *Ridley*.

FAVOLUS SCABER. Berk. and Br. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Perak. *Kunstler*. 639. Selangor, on dead wood, *Ridley*, 30.

VAR. FUSCA. Ces.

Distr:—Singapore. *Beccari*.

FAVOLUS SPATHULATUS. Jungh. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Singapore. Botanic Gardens, on dead limbs of Hevea brasiliensis, *Baker*, 5420. Economic Garden, on stem of Hevea brasiliensis, *Sappan*. 5431.

FAVOLUS TESSELLATUS. Mont.

Distr:—Perak. *King's collector*. 1192. Selangor, Kuala Lumpor. *Chipp*, 5700. Singapore, Bukit Timah, *Ridley*, A. 27. Botanic Gardens, on dead wood, *E. M. Burkill*, 278; *Sappan*. 5115.

CYCLOMYCES FUSCUS. Fries.

Distr:—Kedah, Gunong Jerai, *M. Noor*, 5203. Perak, *King's collector*, 4341. Penang, Waterfall Gardens, on dead wood. *M. Noor*. 5598. Malacca, Ayer Keroh. *Ridley*, 152.

CYCLOMYCES STEREOIDES, Sacc. and Paol.

Distr:—Perak, *King's collector.* Without precise locality, on branches, *Scortechini.*

BOLETUS ALBELLUS, Massee.

Distr:—Singapore, *Ridley,* 11. ser. 2.

BOLETUS ALTISSMUS, Massee.

Distr:—Singapore, *Ridley,* 9 ser. 2.

BOLETUS ALWISII, Massee.

Distr:—Singapore, *Ridley,* 42, 95 ser. 2.

BOLETUS AUREO-MYCETINUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker,* 4993.

BOLETUS BICOLOR, Massee.

Distr:—Singapore, *Ridley,* 56 ser. 2.

BOLETUS CRASPEDIUS, Massee.

Distr:—Singapore, Gardens' Jungle, on the ground, *E. M. Burkill,* 137.

BOLETUS CYANOPUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker,* 5006.

BOLETUS FLAVIPES, Massee.

Distr:—Singapore, *Ridley,* 25 ser. 2.

BOLETUS FLEXIPES, Massee.

Distr:—Singapore, *Ridley,* 97 ser. 2.

BOLETUS FUNERARIUS, Massee.

Distr:—Singapore, *Ridley,* 50 ser. 2.

BOLETUS ICTERINUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker,* 4991.

BOLETUS INDECORUS, Massee.

Distr:—Singapore, Gardens' Jungle, on tree roots, *E. M. Burkill,* 66, 147.

BOLETUS LONGIPES, Massee.

Distr:—Singapore, *Ridley,* 81 ser. 2.

BOLETUS MALACCENSIS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker,* 5004.

BOLETUS NANUS, Massee.

Distr:—Singapore, *Ridley,* 39 ser. 2.

BOLETUS NIGRICANS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker,* 4996.

BOLETUS PACHYCEPHALUS, Massee.

Distr:—Singapore, *Ridley,* 24 ser. 2.

BOLETUS PARVULUS, Massee.

Distr:—Singapore, *Ridley,* 56 bis. ser. 2.

BOLETUS PERNANUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Botanic Gardens, *E. M. Burkill,* 156; *Baker,* 5001; *Flippance,* 6179.

BOLETUS PHAEOCEPHALUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker,* 5050.

BOLETUS RETISPORUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker,* 403, 5000.

BOLETUS RIDLEYI, Massee.

Distr:—Singapore, Gardens' Jungle, on the ground, *Ridley,* 87 ser 2.

BOLETUS RUFO-AUREUS, Massee.

Distr:—Singapore, *Ridley,* 61 ser 2.

BOLETUS SCABER, Fries.

Distr:—Singapore, *Ridley,* 69.

BOLETUS SINGAPORENSIS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker,* 4992.

BOLETUS SPINIFER, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, solitary or tufted, among decaying leaves, *Baker*, 4994.

BOLETUS TRISTICULUS, Massee.

Distr:—Singapore, *Ridley*, 80 ser 2.

BOLETUS TRISTIS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker*, 404, 4995.

BOLETUS UMBILICATUS, Massee.

Distr:—Singapore, *Ridley*, 78 ser 2.

BOLETUS UMBRINELLUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker*, 405, 4997; *Sappan*, 5488.

BOLETUS UNICOLOR, Massee.

Distr:—Singapore, *Ridley*, 99 ser 2.

BOLETUS VELUTICEPS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker*, 4998.

BOLETUS VISCIDULUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker*, 4999.

BOLETOPSIS CORRUGATUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Botanic Gardens, *Baker*, 5003: on the ground, *Burkill*, 5786.

STROBILOMYCES PARADOX, Massee.

Distr:—Singapore, on the ground, gregarious, *Ridley*, 28 ser 2.

STROBILOMYCES PORPHYRIUS, Pat. and Baker, in Journ. R. As. Soc. Straits Branch, No. 78.

Distr:—Singapore, Gardens' Jungle, *Baker*, 5002.

AGARICACEAE.

BOLBITIUS LONGIPES, Massee.

Distr:—Selangor, on the ground, *Ridley*, 124.

COPRINUS COFFEICOLA, Massee.

Distr:—Selangor, on rotten coffee pulp, *Ridley*, 67.

COPRINUS EPHEMERUS, Fries.

Distr:—Singapore, on cow dung, *Ridley*, 32.

COPRINUS LEVIPES, Massee.

Distr:—Perak, on an old Areca stump, *Ridley*, 17.

COPRINUS NIVEUS, Fries.

Distr:—Singapore, Botanic Gardens, on horse dung, *E. M. Burkill*, 71.

COPRINUS PLICATILIS, Fries.

Distr:—Selangor, *Ridley*. Singapore, Botanic Gardens, on twigs, *E. M. Burkill*, 70.

GOMPHIDIUS ROSEUS, Massee.

Distr:—Singapore, on the ground, *Ridley*, 57, E.

PSATHYRELLA ALBIDA, Massee.

Distr:—Selangor, in dense clusters on rotten wood, *Ridley*, 55.

PSATHYRELLA DISSEMINATA, Pers.

Distr:—Perak, *King's collector*. Dindings, mentioned by *Ridley*. Without precise locality, at the base of trees, *Scortechini*, 42.

HYGROPHORUS CHLOROPHANUS, Fries.

Distr:—Singapore, Botanic Gardens, in the grass, *E. M. Burkill*, 260.

HYGROPHORUS CONICUS, Fries.

Distr:—Singapore, *Ridley*, 85.

HYGROPHORUS PUNICEUS, Fries.

Ridley records this as being very common in grassy spots and among leaves.

LACTARIUS BICOLOR, Massee.

Distr:—Singapore, Botanic Gardens, among leaves, *E. M. Burkill*, 73; *Burkill*, Dec. 1916.

LACTARIUS TRICOLOR, Massee.

Distr:—Singapore, on the ground, *Ridley*, 30 D.

RUSSULA AERUGINOSA, Massee.

Distr::—Singapore. Botanic Gardens, on the ground, *E. M. Burkill* 63; *Flippance*. 6040, 6170, 7006. Economic Garden. *Kiah*. 5745.

RUSSULA FRAGILIS, Fries.

Distr:—Singapore, on the ground, *E. M. Burkill*, 232.

SCHIZOPHYLLUM COMMUNE, Fries. Bancroft, in Agric. Bull. F. M. S. i. 28, 150, 263. Chipp. in Gard. Bull. S. S. ii. 190, 197, 280.

Probably the commonest of the larger fungi, growing everywhere on dead wood.

SCHIZOPHYLLUM FLABELLARE, Fries.

Distr:—Selangor, on rotten wood, *Ridley*, 90.

SCHIZOPHYLLUM MULTIFIDUM, Fries.

Distr:—Without precise locality, on stems, *Scortechini*, 52, 113.

XEROTUS CAFFRORUM, Kalch.

Distr:—Selangor, mentioned by *Ridley*.

XEROTUS LATERITIUS, Berk. and Curt.

Distr:—Perak, *King's collector*, 3983.

XEROTUS PAPYRACEUS, Berk.

Distr:—Penang, on bricks and wood, *Ridley*.

LENTINUS APPLANATUS, Fries. Bancroft, in Agric. Bull. F. M. S. i. 263.

Distr:—Perak, *King's collector*.

LENTINUS BECCARIANUS, Ces.

Distr:—Perak, *King's collector*, 3611, 3612.

LENTINUS BLEPHARODES, Berk. and Curt.

Distr:—Perak, *King's collector*, 2988. Selangor, on stumps, *Ridley*.

LENTINUS BREVIPES, Cke.

Distr:—Perak, on logs, *King's collector*, 4, 342.

LENTINUS CALVESCENS, Berk.

Distr:—Selangor, *Ridley*, 102.

LENTINUS CURREYANUS, Sacc.

Distr:—Selangor, Gua Batu, *Ridley*, 90.

LENTINUS DACTYLIOPHORUS, Lev. Bancroft, in Agric. Bull. F. M. S. i. 263.

Distr:—Perak, *Kunstler*, 611.
See remarks under L. exilis.

LENTINUS EXILIS, Kl. Bancroft, in Agric. Bull. F. M. S. i. 263.

Very common on dead wood everywhere. Extremely variable as to form, size, and texture. It would appear that L. Sajor-caju, and L. dactyliophorus, are identical.

LENTINUS INQUINANS, Berk.

Distr:—Perak, *King's collector*.

LENTINUS LECOMTEI, Fries.

Distr:—Selangor, Kuala Lumpor, on a Casuarina equisetifolia stump, *Chipp*, 5679. Singapore, on dead wood, Botanic Gardens, *Flippance*, 4921, 5944, 6172. Economic Garden, *Kiah*, 5848.

Some authorities regard these specimens as belonging to L. strigosus.

LENTINUS LEUCOCHROUS, Lev. Baker, in Gard. Bull. S. S. ii. 112.

Distr:—Singapore, on dead limbs of Hevea brasiliensis, *Baker*.

LENTINUS NICOBARENSIS, Rch.

Distr:—Without precise locality, on decaying wood, *Scortechini*.

LENTINUS PERGAMENUS, Lev.

Distr:—Perak, *King's collector*, 2183, 2184 .

LENTINUS SAJOR-CAJU, Fries.

Considered in this work as being the same as L. exilis, Kl. It is a matter for consideration as to which name should be kept up.

LENTINUS SERICEUS, Massee.

Distr:—Selangor, on rotten wood, *Ridley*, 33.

LENTINUS SIMILIS, Berk.

Distr:—Singapore, *Ridley*, 9.

LENTINUS STRIGOSUS, Fries.

The specimens quoted under L. Lecomtei are considered by some to belong to this species.

LENTINUS SUBNUDUS, Berk.

Distr:—Perak, *King's collector*, 3976. Singapore, Mandai Road, on dead wood, *Chipp*, 5825. Bukit Timah, *Chipp*, 5076, 5089. Reformatory Road in copious white tufts on a dying stem of a Durio zibethinus, *Chipp*, 6185.

LENTINUS TENER, Kl.

Distr:—Perak, *King's collector*, 3202, 4388.

LENTINUS TENUIPES, Sacc. and Paol.

Distr:—Perak, *King's collector*. Without precise locality, on dead wood, *Scortechini*, 10.

LENTINUS VELUTINUS, Fr.

Distr:—Perak, *King's collector*, 2295.

LENTINUS VILLOSUS, Fries.

Distr:—Selangor, *Ridley*, 77.

PANUS AUREO-FULVUS, Cke.

Distr:—Perak, on logs, *King's collector*, 1893.

PANUS FENDLERI, Berk.

Distr:—Perak, mentioned by *Ridley*.

MARASMIUS ANDROSACEUS, Fries.

Distr:—Perak, mentioned by *Ridley*. Without precise locality, on decaying leaves, *Scortechini*, 3.

MARASMIUS ARATUS, Massee.

Distr:—Singapore, Botanic Gardens, on dead leaves, *E. M. Burkill*, 113.

MARASMIUS EPOCHNOUS, Berk. and Curt.

Distr:—Selangor, on dead bark and wood, *Ridley*, 78.

MARASMIUS EXCENTRICUS, Massee.

Distr:—Perak, gregarious, on dead wood, *Ridley*, 18.

MARASMIUS GORDIPES, Sacc. and Paol.

Distr:—Perak, mentioned by *Ridley*. Without precise locality, on dead leaves, *Scortechini*, 11.

MARASMIUS LANATUS, Massee.

Distr:—Singapore, Botanic Gardens, on a dead leaf of Oncosperma, *E. M. Burkill*, 86.

MARASMIUS PAPYRACEUS, Massee.

Distr:—Singapore, Botanic Gardens, on a dead stick, *E. M. Burkill*, 121.

MARASMIUS POLYGRAMMUS, Mont.

Distr:—Without precise locality, on decaying leaves, *Scortechini*, 12.

MARASMIUS ROTALIS, Berk. and Br. Bancroft, in Agric. Bull. F. M. S. i. 263. Chipp. in Gard. Bull. S. S. ii. 187.

Distr:—Without precise locality, on thick decaying leaves, *Scortechini*, 13.

MARASMIUS ROTULA, Fries.

Distr:—Selangor, on dead branches, *Ridley*, 74.

MARASMIUS STENOPHYLLUS, Mont.

Distr:—Without precise locality, on branches, *Scortechini*, 541.

PSATHYRA CAMPANULATA, Massee.

Distr:—Selangor, on the ground, *Ridley*, 108.

PSATHYRA CYCLOSPORA, Massee.

Distr:—Perak, on rotten wood, *Ridley*, 7.

HYPHOLOMA ELATUM, Massee.

Distr:—Singapore, on the ground, *Ridley*, 83E.

HYPHOLOMA SUBLATERITIUM, Schaeff.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 127.

AGARICUS (PSALLIOTA) CAMPESTRIS, Linn. Ridley, in Agric. Bull. Mal. Penin. 1898, p. 198. Bancroft, in Agric. Bull. F. M. S. i. 263.

The common English "mushroom." Mentioned by Ridley as occurring in Penang, Pahang, and Singapore. Frequently found on tennis lawns. Apparently not eaten by the Malays.

AGARICUS (PSALLIOTA) TENUICEPS, Massee.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 267. Tyersall Grounds, *Burkill*, 6159.

STROPHARIA MINIMA, Massee.

Distr:—Singapore, Botanic Gardens, on horse dung, *E. M. Burkill*, 266.

STROPHARIA PERSONATA, Massee.

Distr:—Singapore, on the ground, *Ridley*, 55C.

STROPHARIA UMBONATA, Massee.

Distr:—Singapore, on the ground, *Ridley*, 36J. Botanic Gardens, on the ground, *Flippance*, 5946, 6178.

CREPIDOTUS RIDLEYI, Massee.

Distr:—Selangor, on a dead fern rachis, *Ridley*, 110.

GALERA FLEXIPES, Massee.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 111.

INOCYBE LONGIPES, Massee.

Distr:—Singapore, on the ground, *Ridley*, 73U.

INOCYBE UMBRINA, Massee.

Distr:—Singapore, Havelock Road, on a clay bank, *E. M. Burkill*, 250.

INOCYBE VIOLACEA, Massee.

Distr:—Perak, on lawns, *Ridley*, 2.

NAUCORIA PERINIANA, Sacc.

Distr:—Perak, *King's collector*.

NAUCORIA TRICHIALIS, Lev.

Distr:—Perak, *King's collector*.

FLAMMULA BELLA, Massee.

Distr:—Singapore, Botanic Gardens, on a jungle path, *E. M. Burkill*, 134.

FLAMMULA ELEGANTULA, Massee.

Distr:—Singapore, Payar Lebar, on a dead stem of Cocos nucifera, *E. M. Burkill*, 324.

FLAMMULA ORNATA, Massee.

Distr:—Selangor, on the ground, *Ridley*, 23.

PHOLIOTA HEPATICA, Massee.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 204.

CLAUDOPUS GRISEUS, Massee.

Distr:—Perak, on dead wood, *Ridley*, 11.

ECCILIA HYALODEPAS, Berk. and Br.

Distr:—Singapore, *Ridley*, 23.

LEPTONIA ALTISSSIMA, Massee.

Distr:—Singapore, Botanic Gardens, on the ground, *Ridley*, 4.

LEPTONIA BICOLOR, Massee.

Distr:—Singapore, Botanic Gardens, on the ground, *Ridley*.

LEPTONIA TRICOLOR, Massee.

Distr:—Penang, on the ground, *Ridley*.

ENTOLOMA BURKILLAE, Massee.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 152; *Burkill*, April 1916.

ENTOLOMA IODNEPHES, Berk. and Br.

Distr:—Singapore, *Ridley*, 19.

ENTOLOMA UMBONATUM, Massee.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 61.

CLITOPILUS CURTIPES, Massee.

Distr:—Singapore, on the ground, *Ridley*, 91.

CLITOPILUS FLAVIDUS, Massee.

Distr:—Singapore, on the ground, *Ridley*, 560.

VOLVARIA GEASTER, Berk. and Br.

Distr:—Singapore, *Ridley*, 23.

PLEUROTUS spp.

Several specimens of this genus have been collected but not worked out specifically, amongst them being the common luminous fungus.

OMPHALIA TENERA, Massee.

Distr:—Perak, on rotten wood, *Ridley*, 9.

MYCENA CRASSIPES, Massee.

Distr:—Selangor, on stumps, *Ridley*, 64.

MYCENA CUSPIDATA, Massee.

Distr:—Singapore, on the ground, *Ridley*, 25y.

MYCENA GIGANTOSPORA, Massee.

Distr:—Perak, on the ground, *Ridley*, 3. Dindings, mentioned by *Ridley*.

MYCENA PELLICULOSA, Fries.

Distr:—Perak, on rotten wood, *Ridley*, 13. Dindings, mentioned by *Ridley*.

MYCENA REPERTITIA, Massee.

Distr:—Perak, on rotting wood, *Ridley*, 21.

COLLYBIA ACUMINATA, Massee.

Distr:—Singapore, on the ground, *Ridley*, 22v.

COLLYBIA ALTISSIMA, Massee.

Distr:—Singapore, on the ground, *E. M. Burkill*, 112.

COLLYBIA ELATA, Massee.

Distr:—Singapore, on the ground, *E. M. Burkill*, 150; *Chipp*, 5841.

COLLYBIA RAPHANIPES, Berk.

Distr:—Perak, *King's collector*, 6006.

CLITOCYBE CARNOSA, Massee.

Distr:—Singapore, on the ground, *E. M. Burkill*, 82.

CLITOCYBE EGREGIA, Massee.

Distr:—Singapore, on the ground, *Ridley*, 89.

CLITOCYBE LACCATA, Scop.

Distr:—Perak, *King's collector*, 1590. Singapore, *Ridley*, 1, 37, 78.

TRICHOLOMA CHARISTERUM, Berk. and Br.

Distr:—Singapore, *Ridley*, 64.

TRICHOLOMA NUDUM, Bull.

Distr:—Singapore, *Ridley*, 86.

TRICHOLOMA THEIOCHROUM, Berk. and Br.

Distr:—Singapore, *Ridley*, 68.

SCHULZERIA PELLUCIDA, Massee.

Distr:—Singapore, Botanic Gardens, amongst fallen leaves, *E. M. Burkill*, 101.

ARMILLARIA SQUAMOSA, Massee.

Distr:—Singapore, on the ground, *Ridley*, 61, 1.

LEPIOTA ALBIDA, Massee.

Distr:—Singapore, Botanic Gardens, among the nests of black termites, *E. M. Burkill*, 219.

LEPIOTA CARNEO-RUBRA, Massee.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 136.

LEPIOTA CITRIOPHYLLA, Berk. and Br.

Distr:—Singapore, *Ridley*, 66.

LEPIOTA CONIOCEPHALA, Berk. and Br.

Distr:—Singapore, *Ridley*, 44.

LEPIOTA EUCONIATA, Berk. and Br.

Distr:—Singapore, *Ridley*, 41.

LEPIOTA FELINA, Pers.

Distr:—Singapore, *Ridley*, 33.

LEPIOTA FERRUGINOSA, Massee.

Distr:—Singapore, on the ground, *E. M. Burkill*, 214.

LEPIOTA HOLOSPILOTA, Berk. and Br.

Distr:—Singapore, *Ridley*, 20.

LEPIOTA INEBRIATA, Berk. and Br.

Distr:—Singapore, *Ridley*, 47.

LEPIOTA LICMOPHORA, Berk. and Br.

Distr:—Singapore, *Ridley*, 79.

LEPIOTA OCHRACEA, Massee.

Distr:—Singapore, on the ground, *E. M. Burkill*.

LEPIOTA PHYLACTARODES, Berk. and Br.

Distr:—Singapore, *Ridley*, 61.

LEPIOTA PROCERA, Scop. Bancroft, in Agric. Bull. F. M. S. i. 262.

Distr:—Selangor, on the ground, *Bancroft*.

LEPIOTA SEMIVESTITA, Massee.

Distr:—Singapore, on the ground, *E. M. Burkill*, 142, 143.

AMANITA VIRGINEA, Massee.

Distr:—Singapore, on the ground, *Ridley*, 1, 87. Botanic Gardens, on the ground, *E. M. Burkill*, 182; *Flippance*, 6059.

PHALLACEAE.

MUTINUS BAMBUSINUS, Zoll.

Distr:—Singapore, Botanic Gardens, among bamboos, *Ridley*.

PHALLUS DEMONUM, Rumph.

Distr:—Perak, *King's collector*, 3550, 4037.

DICTYOPHORA INDUSIATA, Fisch.

Distr:—Singapore, Pavar Lebar, *E. M. Burkill*, 181. Cluny Road, *E. M. Burkill*, 337.

Occurring generally as isolated specimens on the ground under trees.

DICTYOPHORA IRPICINA.

Distr:—Singapore, Botanic Gardens, *Ridley*.

DICTYOPHORA PHALLOIDEA, Desv. Bancroft, in Agric. Bull. F. M. S. i. 263.

Distr:—Singapore, Botanic Gardens, *Ridley*.

LYCOPERDACEAE.

LYCOPERDON LIGNICOLUM, Massee.

Distr:—Selangor, Kuala Lumpor, on dead bark, *Ridley*, 166.

LYCOPERDON RUBICULA, Berk. and Br.

Distr:—Singapore, *Ridley*, 52.

LYCOPERDON WRIGHTII, Berk.

Distr:—Singapore, Botanic Gardens, on the ground, *Sappan*, 5489.

CATASTOMA JUNGHUHNII, Schl. Ridley, in Journ. R. As. Soc. Straits Branch, No. 23, p. 75.

Distr:—Dindings, *Ridley*. Selangor, Bukit Etam, *Kelsall*. Petaling, *Ridley*. Singapore, Bukit Timah, *Ridley*.

CATASTOMA ORIRUBRUM, Cke.

Distr:—Perak, Larut, *King's collector*.

GEASTER JAVANICUS, Lev.

Distr:—Singapore, Botanic Gardens, on the ground, *Sappan*, 5127.

GEASTER MAURUS, Massee.

Distr:—Singapore, Botanic Gardens, 1891, *Ridley*; under cocoa trees, *E. M. Burkill*, 230; *Ridley*, 30.

GEASTER MIRABILIS, Mont.

Distr:—Singapore, Woodlands, on dead wood, *M. Noor*, 5378 Economic Gardens, on rotten wood, *E. M. Burkill*, 248.

GEASTER PAPYRACEUS, Berk. and Curt.

Distr:—Singapore, on wood, *Ridley*, 23, W.

NIDULARIACEAE.

CYATHUS SPHAEROSPORUS.

Distr:—Singapore, Botanic Gardens, on dead wood, *Sappan*, 5113; *Flippance*, 6184. Economic Gardens, *Kiah*, 5715.

Lloyd suggests this species may only be a large globose-spored form of C. pallidus.

CYATHUS STRIATUS, Hoffm. Sharples, in Agric. Bull. F. M. S. ii. 85.

Distr:—Without precise locality, on dead wood, *Sharples*.

SCLERODERMATACEAE.

SCLERODERMA AUREUM, Massee.

Distr:—Singapore, Botanic Gardens, *Ridley*, 32 vc.

SCLERODERMA FLAVIDUM, Ell.

Distr:—Penang, Government Hill Road, *Burkill*, 6074; Singapore, Botanic Gardens, on jungle soil, *Baker*, 5134; *Chipp*, 6017.

SCLERODERMA FLAVO-CROCATUM, Sacc. and De-Ton. Bancroft, in Agric. Bull. F. M. S. i. 263.

Distr:—Perak, *King's collector*. Singapore, Botanic Gardens, jungle, *Ridley*. Without precise locality, on the ground, *Scortechini*, 174.

SCLERODERMA LUTEUM, Lloyd.

Distr:—Singapore, Botanic Gardens, on the ground, *E. M. Burkill*, 268, 294; *Kiah*, 5903.

SCLERODERMA SINNAMARIENSE, Mont.

Distr:—Perak, *King's collector*. Without precise locality, on wood, *Scortechini*, 781.

SCLERODERMA VULGARE, Fries.

Distr:—Perak, *King's collector*, 4000.

CALOSTOMATACEAE.

MITREMYCES COCCINEUS, Berk.

Distr:—Perak, *King's collector*, 3838.

TULOSTOMATACEAE.

TULOSTOMA RIDLEYI, Massee.

Distr:—Perak, on the ground, *Ridley*, 8.

FUNGI IMPERFECTI.

SPHAERIOIDACEAE.

PHYLLOSTICTA COFFEICOLA, Del. Belgrave, in Agric. Bull. F. M. S. iv. 111. Chipp, in Gard. Bull. S. S. ii. 237.

Recorded as parasitic on coffee leaves.

PHYLLOSTICTA DAEMONOROPIS, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 237.

Distr:—Singapore, Botanic Gardens, on leaves of Daemonorops, *Baker*, 474.

PHILLOSTICTA DUBIA, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 237.

Distr:—Singapore, Botanic Gardens, on dead calyces of Dianthus sinensis, *Baker*, 475.

PHYLLOSTICTA FARADAYAE, Sacc. Baker, in Gard. Bull. S. S. ii. 119.

Distr:—Singapore, Botanic Gardens, on dying leaves of Faradaya papuana, *Baker*, 476.

PHYLLOSTICTA GUSTAVIAE, Sacc. Baker, in Gard. Bull. S. S. ii. 119.

Distr:—Singapore, Botanic Gardens, on dying leaves of Gustavia insignis, *Baker*, 5112.

PHYLLOSTICTA HEVEAE, Limm. Bancroft, in Agric. Bull. F. M. S. i. 263: and in Dep. Agric. F. M. S. Bull. No. 14, p. 22. Chipp, in Gard. Bull. S. S. ii. 189, 190.

Recorded as parasitic on leaves of Hevea brasiliensis.

PHYLLOSTICTA PALMIGENA, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 237.

Distr:—Singapore, Botanic Gardens, on dying leaves of Dictyosperma album, *Baker*, 477.

PHYLLOSTICTA RAMICOLA, Petch. Bancroft, in Agric. Bull. F. M. S. i. 25, 29, 263. Chipp, in Gard. Bull. S. S. ii. 189.

Recorded by Bancroft as a stem disease of Hevea brasiliensis.

PHOMA AGAVES, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 232.

Distr:—Singapore, Botanic Gardens, on dead peduncles of Agave rigida, *Baker*, 473.

PHOMA CAMELLIAE, Cke. Bancroft, in Agric. Bull. F. M. S. i. 263.

Distr:—Perak, *King's collector*. Johore, on leaves of Camillea theae, recorded by Cooke.

PHOMA INOCARPI, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Singapore, Botanic Gardens, on decaying fruits of Inocarpus edulis, *Baker*, 414c.

SPHAERONEMA sp. Belgrave, in Agric. Bull. F. M. S. vi. 7. Chipp, in Gard. Bull. S. S. ii. 190.

Distr:—Johore, Pagoh, Muah, on Hevea brasiliensis, causing "Mouldy Rot," *South*, 6071.

HAPLOSPORELLA SYCONOPHILA, Sacc. Baker, in Gard. Bull. S. S. ii. 119.

Distr:—Singapore, Botanic Gardens, on dead bark of Ficus elastica, *Baker*, 431.

DOTHIORELLA RUGULOSA, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Singapore, Botanic Gardens, on dead and dying stems of Hibiscus Sabdariffa, *Baker*, 415.

DOTHIORELLA STRATOSA, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 279.

Distr:—Singapore, Botanic Gardens, on dead limbs of Piscidia erythrina, *Baker*, 416a.

CONIOTHYRIUM COFFEAE. Belgrave, in Agric. Bull. F. M. S. iv. 111. Chipp, in Gard. Bull. S. S. ii. 236.

Described as parasitic on leaves of coffee.

DARLUCA FILUM, Br.

Distr:—Singapore, Botanic Gardens, on Andropogon Nardus v. citronella, *Baker*, 482b.

DIPLODIA HIBISCINA, C. and Ell.

VAR. SABDARIFFAE, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Singapore, Botanic Gardens, on dead stems of Hibiscus sabdariffa, *Baker*, 413.

DIPLODIA INOCARPI, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Singapore, Botanic Gardens, on rotting fruits of Inocarpus edulis, *Baker*, 414a.

DIPLODIA MARUMIAE, Sacc. and Paol.

Distr:—Without precise locality, on leaves of Marumia, *Scortechini*, 130.

DIPLODIA RAPAX, Massee. Ridley, in Agric. Bull. S. and F. M. S. viii, 290 and 571. Chipp, in Gard. Bull. S. S. ii. 188.

Recorded by Ridley on shoots of Hevea brasiliensis.

DIPLODIA spp. Bancroft, in Agric. Bull. S. and F. M. S. x. 321; and in Agric. Bull. F. M. S. i. 28, 111. Chipp, in Gard. Bull. S. S. ii. 188, 235, 236.

CHAETODIPLODIA sp. Belgrave, in Agric. Bull. F. M. S. iv. 111.

Described as parasitic on the stems of coffee.

BOTRYODIPLODIA CEREBRINA, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 234.

Distr:—Singapore, Botanic Gardens, on dead branches of Cecropia peltata, *Baker*, 406.

BOTRYODIPLODIA THEOBROMAE. Richards, in Agric. Bull. F. M. S. v. 308. Chipp, in Gard. Bull. S. S. ii. 188.

Recorded as a cause of "dieback" of Hevea brasiliensis.

BOTRYODIPLODIA sp. Ridley, in Agric. Bull. S. and F. M. S. ix. 178. Chipp, in Gard. Bull. S. S. ii. 235.

A cause of root disease.

HENDERSONIA sp. Belgrave, in Agric. Bull. F. M. S. iii. 229. On Garcinia Mangostana.

SEPTORIA CYRTOPHYLLI, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 237.

Distr:—Singapore, Botanic Gardens, on leaves of Cyrtophyllum fragrans, *Baker*, 485.

SEPTORIELLA BIFORMIS, Sacc. Baker, in Gard. Bull. S. S. ii. 119.

Distr:—Singapore, Botanic Gardens, on living leaves of Ficus alba, *Baker*, 486.

SEPTORIELLA CONFORMIS, Sacc. Baker, in Gard. Bull. S. S. ii. 119.

Distr:—Singapore, Botanic Gardens, on living leaves of Ficus sp., *Baker*, 487.

PHOMOPSIS sp.

Distr:—Penang, Government Hill, on leaves of Macaranga, *Chipp*, 4695.

NECTRIOIDACEAE.

ASCHERSONIA sp.

Distr:—Penang, Waterfall Gardens, on coccids on leaves of Eugenia, *Burkill*, 4133. Singapore, Economic Garden, on leaves of Myrica, *Flippance*, 4933.

LEPTOSTROMATACEAE.

LEPTOTHYRELLA CALOPHYLLI, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 233.

Distr:—Singapore, Botanic Gardens, on living leaves of Calophyllum floribundum, *Baker*, 445.

MELANCONIACEAE.

GLOEOSPORIUM ALBORUBRUM, Petch. Bancroft, in Agric. Bull. F. M. S. i. 263. Chipp, in Gard. Bull. S. S. ii. 189.

Recorded on dead shoots of Hevea brasiliensis.

GLOEOSPORIUM INOCARPI, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 276.

Distr:—Singapore, Botanic Gardens, on rotting fruits of Inocarpus edulis, *Baker*, 414b.

GLOEOSPORIUM MANGIFERAE, Noack. Bancroft, in Agric. Bull. F. M. S. i. 113, 263. Chipp, in Gard. Bull. S. S. ii. 278.

Parasitic on fruits of Mangifera indica.

GLOEOSPORIUM MUSARUM, Cke. and Massee. Bancroft, in Agric. Bull. F. M. S. i. 263. Chipp, in Gard. Bull. S. S. ii. 278.

Common on ripe fruits of Banana.

GLOEOSPORIUM PALMIGENUM, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 232.

Distr:—Singapore, Botanic Gardens, on dead leaves of Attalea Cohune, *Baker*, 427.

GLOESPORIUM ZIBETHINUM, Sacc. Baker, in Gard. Bull. S. S. ii. 119. Chipp, in Gard. Bull. S. S. ii. 237.

Distr:—Singapore, Botanic Gardens, on leaves of Durio zibethinus, *Baker*, 428.

COLLETOTRICHUM NECATOR, Massee. Ridley, in Agric. Bull. S. and F. M. S. x. 321. Chipp, in Gard. Bull. S. S. ii. 279.

Distr:—Singapore, on fruits of pepper, *Ridley*.

COLLETOTRICHUM THEAE, Massee. Bancroft, in Agric. Bull. F. M. S. i. 263.

Distr:—Negri Sembilan, parasitic on leaves of Thea, *Bancroft*.

COLLETOTRICHUM sp. Van Hall, in Agric. Bull. F. M. S. i. 255. Belgrave, in Agric. Bull. F. M. S. iv. 111. Chipp, in Gard. Bull. S. S. ii. 236.

Recorded as a disease of coffee.

MELANCONIUM MELANOXANTHUM, Berk. and Br. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 233, 277, 279, 281.

Distr:—Singapore, Botanic Gardens, on dead leaves and rachises, *Baker*, 448, 5382, 5414, 5426, 5440, 5442.

MELANCONIUM STICTOIDES, Sacc. and Paol.

Distr:—Without precise locality, on leaves, *Scortechini*, 148.

SEPTOGLOEUM ARACHIDIS, Rac. Brooks, in Agric. Bull. F. M. S. iii. 66.

Recorded as attacking leaves of Arachis hypogaea.

STILBOSPORA sp.

Distr:—Penang, Waterfall Gardens, on leaves of Licuala, *Burkill*, 4150.

CORYNEUM sp. Burkill, in Gard. Bull. S. S. i. 193. Chipp, in Gard. Bull. S. S. ii. 237.

Recorded as attacking leaves of Agave.

PESTALOZZIA COFFEAE, Belgrave, in Agric. Bull. F. M. S. iv. 113. Chipp, in Gard. Bull. S. S. ii. 237.

Recorded on coffee berries.

PESTALOZZIA FUNEREA, Desm.

Distr:—Singapore, Economic Garden, on leaves of Eugenia brasiliensis, *Mathieu*, 4923.

PESTALOZZIA GUEPINI, Desm. Bancroft, in Agric. Bull. F. M. S. i. 263; and in Dep. Agric. F. M. S. Bull. No. 14. Chipp, in Gard. Bull. S. S. ii. 190.

Recorded as a leaf disease of Hevea brasiliensis.

PESTALOZZIA LEUCODISCA, Penz. and Sacc. Bancroft, in Agric. Bull. F. M. S. i. 263.

Distr:—Selangor, on leaves of a jungle plant, *Bancroft*.

PESTALOZZIA PALMARUM, Cke. Bancroft, in Agric. Bull. F. M. S. i. 263; and in Dep. Agric. F. M. S. Bull. No. 14. Sharples, in Agric. Bull. F. M. S. iii. 381. Chipp, in Gard. Bull. S. S. ii. 235.

Recorded as a leaf disease of Cocos nucifera and Cinnamomum zeylanicum.

MUCEDINACEAE.

CHROMOSPORIUM CRUSTACEUM, Sharp. in Dep. Agric. F. M. S. Bull. No. 19, 12. Chipp, in Gard. Bull. S. S. ii. 191.

Recorded as causing a black spotting on prepared rubber.

OOSPORA GILVA, Berk. Bancroft, in Agric. Bull. F. M. S. i. 264. Chipp, in Gard. Bull. S. S. ii. 189.

Common on burnt wood.

MONILIA AURANTIACA, Pen. and Sacc.

Distr:—Singapore, Botanic Gardens, on a burnt log, *Chipp*, 4818.

CEPHALOSPORIUM sp. Belgrave, in Agric. Bull. F. M. S. iv. 111. vi. 7. Chipp, in Gard. Bull. S. S. ii. 188, and 236.

Recorded as parasitic on Hemileia Vastatrix, and as a cause of "mouldy rot" on Hevea brasiliensis.

TRICHODERMA KONINGII, Oud. Sharples, in Dep. Agric. F. M. S. Bull. No. 19, 12. Chipp, in Gard. Bull. S. S. ii. 191.

Distr:—Singapore, Botanic Gardens, on a burnt log, *Chipp*, 4819.

HYALOPUS sp. Belgrave, in Agric. Bull. F. M. S. iv. 111. Chipp, in Gard. Bull. S. S. ii. 236.

Recorded as parasitic on Hemileia Vastatrix.

STERIGMATOCYSTIS VITELLINA, Massee.

Distr:—Singapore, Bukit Timah, on fallen jungle fruits, *Ridley*.

STERIGMATOCYSTIS sp. Bancroft, in Dep. Agric. F. M. S. Bull. No. 16.

Recorded as occurring on rubber sheet.

PENICILLIUM GLAUCUM, Link. Bancroft, in Agric. Bull. F. M. S. i. 264.

A common "mildew."

PENICILLIUM MACULANS. Sharples, in Dep. Agric. F. M. S. Bull. No. 19, 8. Chipp, in Gard. Bull. S. S. ii. 191.

Recorded as causing a yellow flush on prepared rubber.

BOTRYTIS NECANS, Massee. Burkill, in Gard. Bull. S. S. i. 208.

Distr:—Singapore, Botanic Gardens, on larvae of Brachartona catoxantha, *Burkill.*

PHYSOSPORA sp.

Distr:—Penang, Residency Gardens, on living leaves of Kopsia fruticosa, *Burkill*, 6201.

SEPEDONIUM DUBIUM, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 277.

Distr:—Singapore, Botanic Gardens, on leaves of Licuala, *Baker,* 484.

MYCOGYNE sp. Bancroft, in Dep. Agric. F. M. S. Bull. No. 16.

DEMATIACEAE.

CONIOSPORIUM VACUOLATUM, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 233, and 277.

Distr:—Singapore, Botanic Gardens, on dead stems of Calamus and dead leaves of Licuala, *Baker,* 5444, 432b.

THIELAVIOPSIS ETHACETICA. Chipp, in Gard. Bull. S. S. ii. 236.

Recorded by Richards on Cocos nucifera stem.

THIELAVIOPSIS sp. Bancroft, in Agric. Bull. F. M. S. i. 111. Chipp, in Gard. Bull. S. S. ii. 236.

Recorded in connection with coconut bud rot.

MYXOTRICHUM COPROGENUM, Sacc.

Distr:—Without precise locality, *Scortechini,* 191.

TRICHOSPORIUM SELENIOIDES, Sacc. and Paol.

Distr:—Without precise locality, on stems, *Scortechini.*

HADROTRICHUM ATROMACULANS, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 233.

Distr:—Singapore, Botanic Gardens, on dead stems of Calamus, *Baker,* 430a.

CLADOSPORIUM ELEGANS, Penz.

VAR. SINGAPORENSE, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 234.

Distr:—Singapore, Botanic Gardens, on dying leaves of Citrus acida, *Baker*.

CLADOSPORIUM OCCULTUM, Ces.

Distr:—Penang, May 1865, *Beccari*.

HELMINTHOSPORIUM HEVEAE, Petch. Ridley, in Agric. Bull. S. and F. M. S. v. 68. Chipp, in Gard. Bull. S. S. ii. 190.

Recorded on leaves of Hevea brasiliensis.

HELMINTHOSPORIUM MACRURUM, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 277.

Distr:—Singapore, Botanic Gardens, on rotting rachises of Licuala, *Baker*, 432a.

HELMINTHOSPORIUM OBOVATUM, Massee. Bancroft, in Agric. Bull. F. M. S. i. 264. Chipp, in Gard. Bull. S. S. ii. 280.

Distr:—Selangor, Kuala Lumpor, on living leaves of Pterocarpus indicus, *Bancroft*.

HELMINTHOSPORIUM RAVENALII, Berk. and Curt.

Distr:—Selangor, Port Swettenham, *Burkill*, 4105.

HELMINTHOSPORIUM SPIROTRICHUM, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 237.

Distr:—Singapore, Botanic Gardens, on leaves of Cyrtophyllum fragrans, *Baker*, 432.

HELMINTHOSPORIUM SUBSIMILE, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 233.

Distr:—Singapore, Ponggul, on leaves of Bruguiera eriopetala, *Baker*, 434a.

SPONDYLOCLADIUM MACULANS, Banc. Bancroft, in Agric. Bull. F. M. S. i. 264; and in Dep. Agric. F. M. S. Bull. No. 16. Chipp, in Gard. Bull. S. S. ii. 191.

Recorded on prepared rubber.

CERCOSPORA BETICOLA, Sacc. Bancroft, in Agric. Bull. F. M. S. i. 113, and 264.

Distr:—Perak, Taiping, Maxwell Hill, parasitic on beet and spinach, *Bancroft*.

CERCOSPORA CEARAE, Petch. Bancroft, in Agric. Bull. F. M. S. i. 264. Chipp, in Gard. Bull. S. S. ii. 278.

Described as parasitic on leaves of Manihot and Tapioca.

CERCOSPORA COFFEAE. van Hall, in Agric. Bull. F. M. S. i. 255.

Recorded as a disease of Coffea robusta.

CERCOSPORA PERSONATA, Ellis. Bancroft, in Agric. Bull. F. M. S. i. 113, 264. Chipp, in Gard. Bull. S. S. ii. 232.

Distr:—Selangor, parasitic on leaves of Arachis hypogaea. *Bancroft.*

CERCOSPORA TABERNAEMONTANAE, Syd. Chipp, in Gard. Bull. S. S. ii. 281.

Distr:—Perak, Taiping Gardens, on living leaves of Tabernaemontana, *Chipp.* 4956. Doubtfully referred to this species by Butler.

CERCOSPORA UBI, Rac.

Distr:—Penang, Government Hill, on living leaves of Dioscorea glabra, *Chipp.* 4686.

CERCOSPORA VIRENS, Sacc. Baker, in Gard. Bull. ii. 120. Chipp, in Gard. Bull. S. S. ii. 277.

Distr:—Singapore, Botanic Gardens, on Licuala sp., *Baker,* 407.

STILBACEAE.

STILBELLA HEVEAE, Lim. Bancroft, in Agric. Bull. F. M. S. i. 28, 264. Chipp, in Gard. Bull. S. S. ii. 190.

Recorded on the dead bark of Hevea brasiliensis.

STILBUM CINNABARINUM. Brooks, in Agric. Bull. F. M. S. iii. 41. Chipp, in Gard. Bull. S. S. ii. 190.

Considered by Brooks to be the conidial stage of Megalonectria pseudotrichia.

STILBUM INCARNATUM, Walk.

VAR. DIOSCOREAE, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 237.

Distr:—Singapore, Botanic Gardens, on rotting roots of Dioscorea sp., *Baker,* 5417.

CORALLODENDRON AURANTIACUM, Massee.

Distr:—Singapore, Bukit Timah, forming bright orange yellow tufts on seeds of Willughbeia, *Ridley.*

ISARIA SPHINGUM, Schw.

Distr:—Singapore, parasitic on the Hawk moth, especially Sphinx convolvuli, *Ridley*.

PODOSPORIUM ACICULARE, Sacc. and Paol.

Distr:—Without precise locality, on dead stems, *Scortechini*, 58.

PODOSPORIUM CONSORS, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp. in Gard. Bull. S. S. ii. 233.

Distr:—Singapore, Ponggul, on living leaves of Bruguiera eriopetala, *Baker*, 434b.

PODOSPORIUM PENICILLIUM, Speg. Baker, in Gard. Bull. S. S. ii. 120. Chipp. in Gard. Bull. S. S. ii. 280.

Distr:—Singapore, Botanic Gardens, on leaves of Rhodomyrtus tomentosa, *Baker*, 478.

VAR. CLERODENDRI, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp. in Gard. Bull. S. S. ii. 235.

Distr:—Singapore, Botanic Gardens, on leaves of Clerodendron serratum, *Baker*, 479.

ARTHROBOTRYUM SOCIUM, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp. in Gard. Bull. S. S. ii. 279.

Distr:—Singapore, Botanic Gardens, on dead rachises of Plectocomia, *Baker*, 429b.

TUBERCULARIACEAE.

HYMENULA SOCIA, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp. in Gard. Bull. S. S. ii. 279.

Distr:—Singapore, Botanic Gardens, on dead limbs of Piscidia erythrina, *Baker*, 416b, 5126 bis.

TUBERCULARIA APIOSPORA, Dur. and Mont.

Distr:—Singapore, Botanic Gardens, on dead wood, *Ridley*.

NECATOR DECRETUS, Massee. Ridley, in Agric. Bull. S. and F. M. S. 1897, 147. Chipp. in Gard. Bull. S. S. ii. 236.

Distr:—Selangor, attacking coffee stems, *Ridley*.

FUSARIUM spp. Belgrave, in Agric. Bull. F. M. S. iv. 113. Sharples, in Agric. Bull. F. M. S. iv. 218; and in Dep. Agric. F. M. S. Bull. No. 19. Chipp. in Gard. Bull. S. S. ii. 191, 236, 276.

Recorded on dead coffee berries, as causing "die back" on Hibiscus Rosa-sinensis, and a violet flush on prepared rubber.

CHAETOSTROMA CLADOSPORIOIDES, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 279.

Distr:—Singapore, Botanic Gardens, on dead caryopses of Paspalum, *Baker*, 1932.

EXOSPORIUM EXIMIUM, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 232.

Distr:—Singapore, Botanic Gardens, on dead leaves of Areca Catechu, *Baker*, 418.

EXOSPORIUM MACRURUM, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 279.

Distr:—Singapore, Botanic Gardens, on dead leaves of Plectocomia, *Baker*, 419.

TETRACHIA SINGULARIS, Sacc. Baker, in Gard. Bull. S. S. ii. 120. Chipp, in Gard. Bull. S. S. ii. 234.

Distr:—Singapore, Botanic Gardens, on living leaves of Clerodendron penduliflorum and Ficus alba, *Baker*, 490, 491.

BIBLIOGRAPHY.

BAKER, C. F. — Hevea versus Fungi: in *Gard. Bull. S. S.* Vol. II. p. 109. Fungi from Singapore and also from Penang: in *Gard. Bull. S. S.* Vol. II. p. 116.

BANCROFT, K. — As cited in the text in:—*Agric. Bull. S. and F. M. S.; Agric. Bull. F. M. S.; Dep. Agric. F. M. S. Bull.*

BELGRAVE, W. N. C. — As cited in the text in:—*Agric. Bull. F. M. S.; Dep. Agric. F. M. S. Bull.*

BROOKS, F. T. — As cited in the text in:—*Agric. Bull. F. M. S.*

BROOKS, F. T. and A. SHARPLES. — As cited in the text in:—*Dep. Agric. F. M. S. Bull.*; Fungoid Diseases of Rubber Trees in Malaya: *Introductory Paper, Internationaal Rubbercongres, Batavia,* Sept. 1914.

BURKILL, I. H. — A Disease of Agaves: in *Gard. Bull. S. S.* Vol. I. p. 193.

CESATI, V. — Mycetum in itinere borneensi lectorum a cl. Od. Beccari: in extract from *Atti della Reale Accademia della Scienze e Matematiche di Napoli*, Vol. VIII. 1878.

CHIPP, T. F. — The Fungus Flora of Hevea brasiliensis: in *Gard. Bull. S. S.* Vol. II. p. 186.

The Angsana Tree: in *Gard. Bull. S. S.* Vol. II. p. 197.

Echinodia Theobromae, Pat.: in *Gard. Bull. S. S.* Vol. II. p. 199.

A Host Index of Fungi of the Malay Peninsula: in *Gard. Bull. S. S.* Vol. II. p. 231, and p. 276.

COOKE, M. C. — Enumeration of Polyporus: in *Journ. Linn. Soc.* 1878. p. 131. Under various headings in *Grevillea* at the following references:—VII. p. 14. XI. p. 85. XII. p. 70. XIII. pp. 1 and 32. XIV. pp. 12 and 43. XV. p. 21. XVIII. p. 34. XIX. p. 93. XX. pp. 33 and 92.

FOX, W. — Notes on the Angsana Tree Disease in Penang: in *Agric. Bull. S. and F. M. S.* Vol. IX. p. 133.

Fungi from Penang, from Mr. Fox: in *Agric. Bull. S. and F. M. S.* Vol. IX. p. 135.

GALLAGHER, W. J. — Root Disease of Hevea brasiliensis, the Para Rubber Tree: in *Dep. Agric. F. M. S. Bull.* No. 2.

A preliminary Note on a branch and stem Disease of Hevea brasiliensis: in *Dep. Agric. F. M. S. Bull.* No. 6.

A lecture on the Para Rubber Tree: in *Dep. Agric. F. M. S. Bull.* No. 10.

A Root Disease of Para Rubber Trees: in *Agric. Bull. S. and F. M. S.* Vol. VII. p. 515.

Annual Report of the Government Mycologist, Federated Malay States, for 1907: in *Agric. Bull. S. and F. M. S.* Vol. VII. p. 588.

VAN HALL, C. J. — Robusta and Some Allied Coffee Species: in *Agric. Bull. F. M. S.* Vol. I. pp. 251 and 255.

LLOYD, C. G. — Various references in *Mycological Notes.*

MASSEE, G. — Revision of the Genus Hemileia: in *Kew Bull.* 1906, p. 35.

Fungi Exotici: in *Kew Bull.* 1898, p. 118. 1899, pp. 168 and 175. 1901, p. 155. 1906, pp. 93 and 256. 1908, pp. 1, 6 and 218. 1909, p. 204. 1910, p. 251. 1911, p. 225. 1912, pp. 190 and 357. 1913, p. 104. 1914, pp. 75, 157 and 357.

PATOUILLARD, M. N. — Sur deux formes conidiennes de Poro-hydnés: in *Bull. de la Soc. Myc. de France,* Tom. XXXIV. 2e. Fasc., translated in *Gard. Bull. S. S.* II. p. 144.

PATOUILLARD, M. N. and C. F. BAKER. — Some Singapore Boletinae: in *Journ. R. As. Soc. Straits Branch*, No. 78, p. 67.

PRATT, H. C. — Preventive measures against Black Thread: in *Agric. Bull. F. M. S.* Vol. V. Nos. 5 and 6, p. 180.

RICHARDS, R. M. — As cited in the text in:—*Agric. Bull. F. M. S.*

RIDLEY, H. N. On the so-called Tiger's Milk—Susu Rimau —of the Malays: in *Journ. R. As. Soc. Straits Branch*, XXII. p. 311. Susu Rimau, further Note: in *Journ. R. As. Soc. Straits Branch*, XXXIV. p. 101.

As cited in the text in:—*Agric. Bull. Mal. Penin.*, and *Agric. Bull. S. and F. M. S.*

SACCARDO, P. A. Notae Mycologicae, ser. XXIV. Fungi Singaporenses Bakeriani: in *Bull. Orto Bot. Univ. Napoli*, VI. p. 39, 1918.

SACCARDO, P. A. and G. PAOLETTI. Mycetes Malacensis: extract from *Atti del R. Istit. Veneto di Scienze Lettere ed Arti*, Tomo VI. Ser. VI.

SANDERSON, A. R. and H. S. SUTCLIFFE. Sphaeronema sp. (Mouldy Rot of the Tapped Surface): in *Annals of Applied Biology*, Vol. VII. No. 1, p. 56.

SHARPLES, A. As cited in the text in:—*Agric. Bull. F. M. S.*: and *Dep. Agric. F. M. S. Bull.*

SOUTH, F. W. Buried Coconut Trunks, and Root Diseases of Rubber: in *Agric. Bull. F. M. S.* Vol. VI. p. 269.

SMITH, A. LORRAINE. On a collection of Plants made by H. C. Robinson and L. Wray, from Gunong Tahan, Pahang: in *Journ. F. M. S. Museums*, Vol. II. p. 142.

VINCENS, F. Maladie rose et chancre des branches sur Hevea brasiliensis, dus au Corticium salmonicolor, B. et Br.: in *Bull. Agric. l'Instit. Scient. de Saigon*, 1920, No. 11, p. 323.

WAKEFIELD, E. M. Fungi Exotici: in *Kew Bull.* 1918, p. 208.

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to Fungi of the Malay Peninsula and their hosts.

The

Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. II Issued August, 5th 1921. No. 12.

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THE

GARDENS' BULLETIN,

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Vol. 11 Issued August 5th, 1921 No. 12.

FORESTS AND THEIR RETENTION OF RAIN WATER.

Fifty years ago a forester named Surell, published a study of torrents in the High Alps (Etudes sur les torrents des Hautes-Alpes 1870), a book that ran to a second edition two years later under the editorship of another,—E. Cézanne. In this work the re-afforestation of bared slopes was advocated as a remedy against landslips and denudation resulting from streams in flood. The book led the way for reports, such as Demontzey's "Removal of torrents in France by re-afforestation" (L'extinction des torrents en France par le reboisement, 1894). Yet, though by the end of the last century the principle had been recognised that forests prevent this kind of destruction, many, some resenting forest regulations, failed to realise their true importance: and therefore in 1900 a demonstration of the influence of forests upon the running off of the rainfall was commenced in Switzerland by that country's Central institute for the study of Forestry. For the demonstration two comparable valleys near Berne were selected; one with forest throughout, the other two-thirds in pasture. Rain guages were installed; and guages put upon the streams that carry the water away. As no arrangements could be made for keeping records at temperatures below freezing point, winter-observations were impossible: but after 18 years of observation in each year from April 16th to November 30th, the results have been published by Dr. Arnold Engler under the title of *Untersuchungen ueber den Einfluss des Waldes auf den Stand der Gewasser.*

The fate of the rain which fell, it is concluded, was:—

	from the forest	from the open
to be run off through the streams ..	60 parts	60 parts
to be evaporated from off the surface of the vegetation	5 ,,	10 ,,
to be evaporated from off the surface of the soil	15 ,,	24 ,,
to be taken up by the roots of the vegetation and thence passed back to the air by transpiration	20 ,,	6 ,,
	100 parts	100 parts

Now the last process takes time and it is obvious that the water so used must be delayed in its circuit: but the chief interest is the rate at which the 60 per cent was run off in the streams. It was run off rapidly from the pasture but slowly from the forest: thus in the springs when the thaw came, the forest allowed the liberated water to escape much more slowly than the pasture: and through the summers when sudden downpours occurred, the stream from the pasture valley for a time would discharge per second twice to thrice as much water as the stream from the forested valley, for the same fall of rain. In times of protracted rain the discharge per second would be something up to twice as much, the difference growing less, the longer the downpour extended; this is as one would expect for every soil has a limit of saturation, beyond which it can retain no more.

It follows from the way in which the first valley parted slowly with the rain that its forest soil must be much more uniformly moist than the pasture soil: but the reason for this is not, as most think, because the forest covering prevents the sun from reaching the soil; but is in the circumstance that a forest soil is absolutely different from one more exposed: it possesses properties for instance which it keeps for a time after the forest is removed, which we refer to when we call it a "virgin soil;" and the most useful of all the properties of virgin soil from a forest is that of holding moisture against the dessicating effects of exposure to the sun.

Several factors assist in bringing this about.

There is more humus in a forest soil than in a pasture soil; and the decay of the humus opens it: there are more roots in a forest soil than in a pasture soil; and they open it: and almost certainly there is an entirely different soil fauna, which brings about enormous differences. Possibly other differences could be enumerated; but the result of all is that forest soil has a porosity lacking in exposed soils, cultivate them as we will.

That the differences observed in the running off of the rainfall from his afforested valley and from his deforested pasture valley are due to the nature of the soil Dr. Engler appears to have no doubt.

The water of the stream from the pasture valley carried more sediment than that from the afforested valley.

Had the Swiss Institute's experiments been a comparison of an afforested valley with a bared valley, how much greater would the contrasts have been; and how much more forcefully would the second stream have poured down in flood, carrying the soil with it.

These Swiss observations have considerable interest in Malaya.

The porosity of a forest soil is well illustrated in the Peninsula by the way in which the peat-lands of Kukob and other low-lying places shrink if exposed for the cultivation of rubber. The steady release of the rainfall by hill forest is pleasantly shown in the early rice crops that the narrow upper ends of the valleys give in Malacca. The consequence of the removal of forest has been obvious enough in the same neighbourhood where the Railway has had to alter its

culverts that were silted up. Perhaps there are no records which would show that the Malacca river is less constant than formerly, but it is more than probable that it is less constant as a consequence of the extensive clearing of the rolling ground about the Malacca-Negri Sembilan boundary.

Virgin forest soils are, in Malaya, most interesting. They can be destroyed in a few years; but it would seem that they can only be build up by several tens of years; perhaps it takes one hundred to restore them. At any rate the real forest trees appear to demand one hundred years§ of preparation before they are again at home. Belukar in all its stages is the evidence of soil unfit for them. What they need and the soil has not got when carrying belukar is probably porosity plus the right soil fauna; and of soil fauna here we are extremely ignorant.

I. H. Burkill.

SOME TESTS OF GARDEN VEGETABLES IN SINGAPORE—LETTUCES.

If reference be made to this Bulletin Vol. 2, No. 1, 1918, p. 9, a note will be found by Prof. C. F. Baker upon lettuces tried by him in the Economic Garden, Singapore. Since then, other lettuces have been tried, and the last of the experiments done, will be reported on here.

The seed came from three different firms, Messrs. Sutton and Sons, Reading, England; Messrs. Vilmorin, Paris; and Messrs. Dreer & Co. Philadelphia U. S. A. The lettuces of different origin could not be tried against each other, as it was impossible to sow them together, but those from each firm were grown side by side.

The method of cultivation was as follows:—

Soil and site. The soil selected for growing these was of two sorts (1) sandy loam; and (2) rich damp loam obtained from peat by constant cultivation, good drainage, and incorporation of lime. The soil was dug over twice, manured with cow manure at the same time, and then left exposed to the sun. After a week or so, beds 3 ft. broad and long according to the site, were made, and kept ready to receive the seedlings.

As for the sites, they were two: the first was above the zone of floods which have become somewhat frequent in the Economic Garden in the early part of the year; while the second was liable to flood. The first situation answered well while the weather was wet and in the dry spells with precautions, in giving water, keeping a fine dust mulch and giving shade in the middle of the day.

Germination and growth. Soon after the seeds were received they were sown in boxes in a soil with an addition of sand to run off extra water and to prevent damping off. The seeds usually

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§ Cf. in the Gardens' Bulletin II No. 5, pp. 145—157, an account of Secondary jungle thirty years old.

took 40-48 hrs. to come up; but if not sown promptly—in some cases, it was not possible to do so—they took longer even up to 5-7 days to germinate. The cause may be sought in weakened vitality which is lost exceedingly early in this hot moist climate.

When the seedlings were 2-2½ ins. high, that was in 7-9 days, they were transplanted into the beds in the afternoon or in cloudy days all the day long, in rows with 9″ between the rows and also 9″ between the seedlings.

A fortnight from transplanting, when the seedlings had taken, an emulsion of cowdung, (1 bucket of dung to 8 of water) was poured in between the rows. Fish manure and burnt earth were also used, but the first was found to be the most suitable, for it is in a more assimilable form. The growth was rapid after this and the salads were uprooted as follows.

Suttons'	after 41 days.
Dreer's	43 „
Vilmorin's	44 „

The weighments showed that the maximum weight was reached 10-15 days later; it gradually rose from ¾ oz. or 1½ oz. according to the type to 2-3 ozs. when the maximum growth was recorded.

Weather did not treat the different sowings equally, for there were constant changes in it from dry to wet, wet weather being unusually prevalent during the first quarter of the year of 1921. The lettuces in the damper situations grew very well in the dry spells; but in wet periods, those on the sandy loam did better. Artificial shade is essential in the seedling stage for 2-3 weeks in varying degree according to the weather to keep off heavy rains as well as midday intense heat; shade also prevents too much evaporation of water from the sandy loam; while in the case of damp soil, it keeps the air in contact with the plants humid.

Almost all strains succumbed to hard rains but least those which have long leaves—cos type—or behaving as cos. In wet periods, most of the lettuces lost much of their foliage.

Another noticeable feature of lettuces, is that, though warranted as Cabbage type, in this forcing climate, they did not behave as such. Many ran to stem; while a few only form loose and all less compact heads. Cos or behaving as cos, were early ones while the other type was later by a week or so.

The lettuces were distributed for opinion to many people, and the following were appreciated.

Suttons'. Ideal, Nonsuch, Early Paris, Golden Ball, and of these there was an unanimous opinion that Ideal and Nonsuch were the best.

Dreer's. Early curled Simpson, Black seeded Simpson, Mammoth salamander, Big Boston, Improved Hanson, Golden Queen, Wonderful.

Vilmorin's. Green Provence. Unfortunately Vilmorin's lettuces were sunk under flood water on 5/5/21 and therefore were not given full trial.

Sorghum Vulgare Millet, Sown on 21st August, gathered 4th December.

The lettuces by growth could be classed as (1) *heavy-type-salads*:—Ideal, Matchless, Iceberg, Mammoth Salamander, Black-seeded Simpson, Way-ahead, Mignonette, Golden Queen, Golden Ball, Algiers; or (2) *light weights*.—Early curled Simpson, Grand Rapids forcing, Trianon self-folding, Wonderful, Nonsuch, and White heart.

Of Suttons' the following showed themselves *early*:—Ideal, Matchless, Nonsuch, White heart, White Golden ball and Early Paris: —of Dreer's, Trianon self-folding, Mignonette, Big Boston, Early Curlèd Simpson, Mammoth Salamander, Iceberg, Black-seeded Simpson.

Of Dreer's the following showed themselves late: Golden Queen, Improved Hanson, Grand Rapids forcing, Way-ahead, Hitinger's Belmont, California cream butter.

The cost of cultivation is very low as under: and a man can manage one fifth of an acre with ease.

Cost of cultivation for one tenth acre	$40.57
Gross yield per one tenth acre	60.00
Total net income	19.43

G. B. Deshmukh.

AN EXPERIMENT WITH SORGHUM VULGARE, THE GREAT MILLET OR JUAR, FROM THE BOMBAY PRESIDENCY.

The accompanying plate shows (behind the men who stand in it) a plot measuring 25 feet long by 10 feet, planted with millet at 12 by 12 inches in all directions. The smaller plants in front of the men do not belong to the plot. This millet, which is in ear, is a race raised from seed kindly supplied by Dr. Harold H. Mann, Director of Agriculture, Bombay, as one of the best of the district of Khandesh, its exact origin being the town of Jalgaon in the Tapti Valley. The seed was one of two lots received together, the other being from Ahmednagar, Bombay Presidency.

The two lots were sown in contiguous plots on 21st August 1919, the sowing being done by hand in shallow channels traced along the ground at one foot apart.

Three weeks after, thinning out took place, the pick of the thinned-out seedlings being transplanted to a second plot near by. These operations were both done on the same day for the two lots; and the transplanted plots were also contiguous. It may therefore be said that both races were raised under absolutely identical conditions of soil, of weather and of cultivation. Both races suffered in the same degree from the attacks of the sugar cane borer (*Chilo simplex*) which was found in almost every stem and also from "aphids" and from bird-depredation. Yet the difference of growth and of yield between the two varieties was very remarkable.

A, the Ahmednagar Sorghum ran to leaf: it grew to stems from 8 to 14 feet high, with abundance of leaves but the panicles so small (from 2 to 4 inches in length only) as to be of no account at all, so that as a cereal crop it was valueless, although as a fodder crop, it would have a value.

B, the Jalgaon sorghum, as shown in the photo, varied in height from 4 to 7 or 8 feet, with a full heavy and rather close, but not compact head of grain,* and altogether the crop, as a cereal may be said to be a very profitable one, as the figures below will show.

A fact worthy of notice is that this plant, from a region of India where the rainfall is a light one, has succeeded under very diverse conditions of climate.

Another point which deserves notice is that the plots which were planted from thinnings throve better than the plots raised direct from seed—a fact which upsets the dictum that Sorghum does not stand transplanting well.

The result of this first cutting was:

Sown plot, 142 stems were cut weighing, with leaves 31 pounds: the 142 panicles collected weighed 8¾ pounds, after two days drying that is to say that each panicle weighed dry, 1 ounce. The final result was 5 lb. dry grain.

Transplanted plot, 223 stems were cut weighing with leaves 102 pounds; the 223 panicles collected weighed 23¾ pounds, afer two days drying, that is to say that each panicle weighed dry 1.70 ounce. The final result was 15 lb. 5.03 oz. dry grain.

As previously stated, the whole crop was attacked by the sugar cane borer, which creeps through the stem and feeds on its substance; the damage done, however, was confined to a small portion of the stem below the seeding head, and, in no case, were the panicles damaged by it: the pest which is very easily traced by the red excretions which exude from its tunnel, was easily dealt with by injecting sulphur by means of a rubber puff into the hole, or by introducing a thin wire through the hole; this either forces it out or kills it.

The panicles themselves were damaged to a small extent by aphids, and by a small weevil, which however gave way after repeated dustings with sulphur.

Birds were the most serious enemies to this crop, and it took all the shouting and tin-beating of a small boy on the watch to keep them off. A very effective device to scare the birds away, a device put up by the coolie himself, was found to be the following:—

* It is a rule in India that the Sorghums with very compact heads are grown in the wide plains where field joins on to field and there is no forest; while near forest such sorghums as may be grown are commonly those with open panicles. The Jalgaon Sorghum is of neither extreme; for with grains just touching, it combines fine pedicels under them. It has been thought that loose eared races are chosen by cultivators near forests because they are less subjected to bird depredation, but it may be said that they are also suited to a moister climate than the others.

The expanded skin of a flying-fox (after the body had been "scooped" out) was stretched to its full length of wing on a frame of bamboo, half rigid, half flexible, attached at both ends to the tips of the extended wings. The main bamboo, *i.e.* that which extends from tip to tip, is slightly bent, like a bow, so that, when taken hold of by the middle, and moved about, the wings, following the movement of the resilient bamboo, appear as if they were actually on the flight. The contrivance is attached at the top of a pole stuck in the middle of the field: a boy, in the distance, holds a string by which the pole is pulled: at the least tug, the bamboo bends and unbends, giving the skin a flying motion which scares the birds away—at least for a time.

Sorghum is one of the most important cereal crops of the world, its grain supplying a wholesome food which is largely consumed in all Asiatic countries. Estate coolies generally prefer it to "Ragi" (*Eleusine coracana*) over which it has the advantage that its grain can be cooked and eaten whole, whereas Ragi has to be ground into flour: it is also made into bread which is as nourishing as wheaten bread. It therefore commends itself particularly and strongly, at the time of rice and wheat shortage, to the attention of planters.

The returns of land under Sorghum cultivated as a pure crop, are variously given for India, as between 500 to 900 pounds of grain per acre (Watt's Dictionary, Mukerji, Macmillan). The seed in that country is generally drilled in rows 14 to 18 inches apart. The writer as already stated, had his seed sown in rows 12 inches apart, then thinned and transplanted at the same distances, viz: 12 inches by 12 inches.

Given a rich soil, the resulting crop appears to justify the practice of transplanting in this country and although it would be absurd to generalise from such small plots as are here in question, viz: 280 square feet, yet the amount of grain obtained was so much greater, (in the transplanted plot) than the averages given above for India, that it compels comment.

Reverting to the figures of yield previously stated, we found that 280 square feet of Jalgaon Sorghum planted 12 by 12 inches gave in one cutting, the following results:

Transplanted plot, 223 panicles weighing 23¾ pounds yielding 15 lb. 5.30 oz. of dry grain.

Sown plot, 142 panicles weighing 8¾ pounds yielding 5 lb. of dry grain.

The figures for the second cutting, which took place one week later on, by an unfortunate inadvertance, are not available. The panicles were, of course, much smaller, and the weight of grain obtained from them would have affected but slightly the final result. By neglecting them altogether, we shall strengthen our view that

Jalgaon Sorghum firstly may maintain its yielding capacity† under our local soil and climate conditions, secondly that transplanting increases the yield of grain.

Allowing for paths and computing one acre at 40,000 feet, we should come to the following figures:

Transplanted plot: 280 square feet 15 lbs. 5 ozs. of dry grain.

Sown plot: 280 square feet 5 lbs.

One acre—714 pounds dry grain.

In the light of the foregoing averages for India viz. 500 to 900 lb. per acre, the figure for the transplanted plot appears absolutely abnormal; but, then, so was the size and weight of the panicles. One, among the number, weighing 3¼ ounces was found after picking the seeds one by one, to give 2¼ ounces of seeds, the rachis weighing one ounce.

E. H. MATHIEU.

A NOTE UPON PLANTS GROWN FOR BLUE DYES IN THE NORTH OF THE MALAY PENINSULA.

Within the last few years a little information has reached the Botanic Gardens upon plants raised in the north of the Peninsula for the sake of the blue dye that they yield; and three have been submitted for determination being:—

Indigofera suffruticosa, Mill.
Strobilanthes flaccidifolius, Nees, and
Marsdenia tinctoria, R. Br.

The first two of the three were sent from the state of Kelantan by Mr. R. J. Farrer, the latter two of the three from Upper Perak by Captain H. Berkeley. All three are well known as dye-plants; but as a dyeing industry flickers only within the Peninsula, it is interesting to ask what influence may have brought them into cultivation here.

Indigo cultivation has a long and a very complicated history; and the above named species of *Indigofera* is one only of half a dozen grown in different parts of the world. Indigo, almost certainly imported, was used as a dye in ancient Egypt; for mummy clothes of 2300 B.C. have been found dyed with it. It was prepared in ancient India, and finds mention in the sanskrit writings of about the same period. It was an expensive import of Rome at the commencement of the Christian era, coming from India via Alexandria, and bearing the name "indicum" from its source. It is extremely probable that Ancient Egypt also got its indigo from India.

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† Misfortune attended an attempt to repeat this experiment; for rain fell heavily at harvest destroying the grain; and it is feared that the climate of Singapore in too unreliable for the crop; but in the north of the Peninsula if maturity be aimed at in February the chances of a return would appear good. I. H. BURKILL.

With the sacking of Rome the use of indigo became lost to Europe; but without doubt India still grew it: and it can be shown that the Arabs who brought paper making into Europe and the sugar-cane, brought a knowledge of indigo cultivation at least into Asia minor. Europe, as it had always done in chief part, meanwhile went on using woad for its blue dye; but after a time a little indigo (now of Arabian origin) filtered afresh along the Mediterranean to Italy. And later when Vasco da Gama in 1516 had opened the way to India, the portuguese east indiamen began to bring indian indigo to the great mart of Lisbon. After the Great Armada had been destroyed, and with the ascendency of the Dutch which followed, the cultivation of indigo in Malabar and the Malayan region was encouraged; for trade in it was very remunerative, as for instance, in 1631 when five dutch merchant vessels brought from Batavia into Amsterdam 285 tons of indigo then worth as much as five tons of gold.

From this period dates the eclipse of woad in Europe, but not its extinction: for woad is still used to induce the dyeing with indigo.

Indigo growing even invaded Europe: for a century and more back its cultivation was tried with success in various places, *e.g.* Malta, Sicily, Southern Italy and Spain; and with passable results even in Southern France (department of Vaucluse): but it is certainly not a plant that can be grown economically now that the value it had has dropped to one quarter.

At least three species of *Indigofera* contributed to the early supply; for, while Surat indigo was derived from the cultivation of *Indigofera articulata.*, Gouan, the cultivation of indigo in South India would seem to have been of *Indigofera tinctoria,* Linn.: and in the Malay region the Dutch met with *I. sumatrana,* Gaertn., and they interchanged the two latter; they brought *I. tinctoria* to Malaya; while they took *I. sumatrana* to India: and *I. sumatrana* proving the better, they adopted it in both places. They spread it through Malabar and Madras; and when under the rule of the East India Company indigo began to be produced in Bengal, *I. sumatrana* was the species brought into cultivation around Calcutta, whence its cultivation was taken north to Rajshahi and then west to Behar, it becoming the plant of the well known Behar indigo industry. From this beginning for three quarters of a century Bengal went on cultivating the one species. *I. sumatrana,* which the Dutch had brought into southern India so long before.

Europe, however did not draw anything like the whole of its requirements of the dye from the East; but tapped (1) the West Indies and southern of the United States, where at the end of the 17th century *I. tinctoria* was the indigo grown, and (2) Brazil where an American species *I. suffruticosa,* Mill. (I. Anil, Linn.) was brought into cultivation. From the New World the latter found its way into the Malay region, and as the Dutch believed it better than *I. sumatrana* they changed their crop in Java; at the

same time this American *I. suffruticosa* got a footing upon the south coasts of China along with *I. tinctoria,* became also a crop of the neighbourhood of Manila, and would seem to have been the indigo grown by Chinese a little later upon the out-kirts of Singapore. And therefore to this date with this, the East had put four species under contribution.

The Arabs when they started the cultivation of indigo in Arabia took for their crop *I. articulata*—the species which supplied Surat indigo; and they established it also in Egypt; but this particular species did not spread to the upper Nile, where *I. arrecta,* Hochst., was or became grown. It may be that the origin of indigo-growing in Africa came from the Arabs; and in any case it is exceedingly probable that ancient Egypt drew its indigo from India and not from the Soudan; but the cultivation of *I. arrecta* has become very wide in Africa; and about 1860 the Dutch got possession of it for Java where it displaced *I. suffruticosa,* but did not hold its ground for long as a second American species. *I. guatemalensis,* Moc. and Sessé, came into favour about 1870, only to be ousted, imperfectly however, by *I. arrecta* coming in again as a consequence of changed methods.

These alterations of the species in vogue in Java, did not in Malaya extend beyond the Dutch Indies: but in India the Behar industry slowly began to follow suite in adopting *I. arrecta* under the name of "Java-Natal indigo."

Singapore gave up indigo-production in the seventies: the Philippine islands lost their export in the nineties: but China remains growing over a limited area on its south-east coasts for its own internal consumption,probably both *I. tinctoria* and *I. suffruticosa.* The last named is the species of *Indigofera* cultivated in Kelantan.

The indigo dye manufactured for the Chinese local markets is sold in paste; and such was that from this species sent by Mr. Farrer.

It is not possible to see a future in the industry, especially as the batik workers in Java who consume a considerable quantity of indigo appear to find the artificial more to their liking: and moreover Kelantan is backward in growing a species now twice superseded in Java—growing it moreover when the war had curtailed the supplies of artificial indigo.

The enormous demand for a blue dye in China is met but in part by the use of indigo; and indigo cultivation seems only to have got a hold in the south-east of the country: elsewhere the blue dye comes from *Isatis indigotica,* Fortune, the Chinese woad, from *Strobilanthes flaccidifolius,* Nees (Ruellia indigotica, Fortune), from *Peristrophe tinctoria,* Nees, and from *Polygonum tinctorium,* Lour. The second of these is the second of the dyes from the north of the Malay Peninsula with which we are dealing.

Strobilanthes flaccidifolius has never found a place in cultivation outside southern China, Indo-china and the adjoining moun-

tainous parts of India; but within its area it has quite an importance. It is for instance said in southern China to be prefered to indigo, both in the vat, and because instead of being a biennial it persists over several years and can be cut repeatedly. It is probably unsuited to the open plains where indigo is grown in India; and no one has had occasion to try growing it upon a plantation scale.

Obviously the Kelantan and Perak cultivation of this species is to be regarded as the southern limit of the range of this interesting crop. It would not be new in those parts, but like the Kedah rice fields, probably established from at any rate the time several centuries back when settled governments ruled between the mouths of the Irrawaddy and the China sea.

The third dye plant, *Marsdenia tinctoria*, R. Br., would seem to show a very different history. Its natural distribution is from the eastern Himalaya and southern China to Borneo and Java; but there is no history of its cultivation in northern India and China. It was first described at the end of the 18th century by William Marsden, who found it in western Sumatra and sent specimens to England when Robert Brown named the genus *Marsdenia* after him. It was brought to notice in Calcutta, and Roxburgh "warmly recommended an extensive cultivation" of it, after trying it in the East India Company's garden. But despite quite a considerable interest taken in it, which interest is very evident from the correspondence printed in the Journal of the Agri-Horticultural Society of India, no cultivation was taken up.

In 1844 it was shown that the Karens; and sometimes the Burmese of Lower Burma grow it: but it is said that they did not consider it the equal of *Strobilanthes flaccidifolius*. It appears to have been grown at one time in Java. Elsewhere it does not appear to have been a crop; and in no place so much a crop as in western Sumatra. Its cultivation therefore belongs to this part of the world in a greater measure than that of indigo and of *Strobilanthes flaccidifolius*.

Mr. Farrer describes the preparation of dye from *Strobilanthes* as done thus: the twigs are cut, steeped in water to which lime is added, the water beaten when fermentation has set in, and the precipitated dye subsequently collected. No oil is used, as Fortune says is in the tea districts of China.

I. H. Burkill.

ANOTHER "WET ROT," AND PORIA HYPOBRUNNEA.

About eighteen months ago an old tree of *Spathodea campanulata* that had been blown over in the edge of the Gardens' Jungle within the Botanic Gardens, Singapore, was cut at three feet from the base, and the stump being left in the ground was allowed to coppice. Some dozen strong shoots shot up; but when about

eight feet high they suddenly ceased growing, shed their leaves and died. The base of these coppice shoots at the crown of the old stump was examined and the wood was found to be permeated by yellowish brown lines exactly as in a case of *Poria hypobrunnea*. Upon examination of the stump lower down, the wood of the collar and root laterals was found to be soft and friable. The outer layers of the wood were deeply stained a yellow brown; and under the bark the hyphae of a fungus had collected into a dense felt-like ferruginous mass forming a plate two feet or more in length and up to a foot in breadth. Adjacent was a more advanced stage where the bark had fallen and a fructification forming a plate 16 inches by 12 was exposed. On other parts of the collar the hyphae had spread over the outside of the bark forming stout reddish strands which frequently cohered into narrow plates of hyphae.

The above description and the effect on the wood tallies in a great deal with Petch's description of *Poria hypobrunnea* but the fructification is entirely different. The fructification is resupinate, corky, of a ferruginous brown surface and content, rather darker in the older specimen, 1 mm. thick. The pores are of medium size and irregular, and the contents reduced to a very thin stratum. The setae of the pores are stout, sharp-pointed, 15 to 20 micromillimetres long. Spores are pear-shaped, with a small hyaline mucro, white, darkly opaque, smooth, 6 by 4 micromillimetres.

From the general appearance of the fructification the fungus is related to *Fomes pomaceus*, but its spores cannot be called hyaline. Apart from this factor it agrees with the description and comparison of *Fomes pomaceus*.

On a recent visit to Mr. G. E. Perry, Mycologist to the Société internationale de Plantations et de Finance de Caoutchouc, a specimen of *Poria hypobrunnea* and its effect on rubber trees were seen. Owing to the remarkable similarity of the above fungus except in fructification, and of its effect upon the wood, specimens were shown to Mr. Perry, who in reply forwarded the following note upon *Poria hypobrunnea*.

"*Porea hypobrunnea in Malaya.* In the past there has been considerable confusion between two root diseases attacking *Hevea brasiliensis, Poria hypobrunnea*, Petch, and *Poria hypolateritia* (now known as *Fomes pseudoferreus*). They were at one time even considered one and the same disease, even though the descriptions published by the Ceylon and F. M. S. scientists were at variance. *Fomes pseudoferreus* has been quite prevalent in Malaya, some estates being badly infected. The old name, *Poria*, is still used by the planting community for this saturated spongy condition of the roots, hence the confusion.

Through the kindness of Mr. T. Petch, Government Botanist and Mycologist, Ceylon, specimens of *Poria hypobrunnea*, were sent to this Department for our museum collection of disease specimens. This *Poria hypobrunnea*, Petch, which heretofore was not definitely known to exist in Malaya has since been found both in Selangor and

Perak. An infected stump sent in to this Department for examination exhibited unmistakable characteristics of the root disease. Further examination of the spot from which the tree had been removed, shewed more advanced stages of the infection on the few remaining laterals. On a recent visit to an estate in Perak, the writer found a similarly infected tree, the roots showing the characteristic red mycelial strands and plates adpressed to the surface. In the writer's belief, these are among the first instances of the disease being found and identified in Malaya.

A very good description of this disease was published in the *Tropical Agriculturist,* Vol. LII, No. 1 by Mr. Petch. He states in part that the appearance of the diseased roots is very variable and in consequence its diagnosis is in many cases difficult. On young trees its identification is fairly easy. The tap root then usually bears external mycelium in a more or less young stage and in that condition it is unmistakable. The mycelium forms stout red strands on the exterior of the root which sometimes unite into a continuous red sheet. The strands are smooth and tough on the outside and vary in colour from bright red to brownish red according to age. Frequently, adhering to the root, are found very small stones and fine gravel, but not so encrusted as with Brown rot disease. The appearance of the diseased wood is also typical in the case of young trees. It is somewhat soft and friable and permeated with red sheets. These sheets often run in cylinders in the wood along lines of the annual rings. On older trees the indications are by no means so clear. The roots which have been longest diseased are generally soft and wet and on these there may be a net work of narrow white threads between the bark and the wood. The fructification may sometimes be found at the collar of the diseased tree, or along the underside of exposed lateral roots. It forms a flat plate closely applied to the surface of the root or stem. At first it is yellowish white: it then changes to reddish brown and finally to a dark slate colour. Its thickness is usually about one and a half millimeters and it may spread over an area of several inches.

There is no doubt that the disease spread originally from jungle stumps. Its recent appearance on rubber estates, about twelve years old, where it was not previously known, is probably to be attributed to the way in which the thinning out was done. It had been found to develop from the stumps of the felled *Hevea*, where the trees were cut down to ground level and the stumps left to decay, and is one of the most regular frequenters of rotting *Hevea* logs. The spread from tree to tree is usually by direct contact of the roots: however it has been demonstrated that the mycelium of this fungus can travel from the diseased roots for some little distance through the soil. With regard to the rate at which the disease progresses, the following may be noted:—*Hevea* was planted on newly cleared land in June 1913; the trees began to die in 1914: that is quite as rapid as any other root disease.

The treatment of *Poria hypobrunnea* follows the usual lines, but it is especially necessary that all *Hevea* logs should be removed as the fungus develops chiefly on them.

The recent appearance of this disease in Malaya should not be viewed with alarm, as in all probability it has been prevalent for some time, but until now has not been identified as *Poria hypobrunnea.*"

It would appear that the symptoms are caused by even more than the two fungi mentioned,* *Poria hypobrunnea* and *Fomes pseudoferreus*, although the present record is not from a Para rubber tree, but from another tree, exotic in Malaya, but not a native of the continent which has furnished the Para rubber tree to Malaya.

T. F. Chipp.

THE MELON FLY, BACTROCERA CUCURBITAE.

The melon fly, *Bactrocera cucurbitae,* found its way into the Hawaiian islands in 1895 and there did such serious damage, that Melon growing became impossible. To combat it, the Board of Agriculture and Forestry for Hawaii, sent their Entomologist Mr. David T. Fullaway, to the East in 1917 to seek for insects that prey upon the fly. In the course of his tour he visited Singapore, and soon located Bactrocera near the town in a Chinese vegetable garden; and by breeding out the insects he obtained three individuals of a parasite of the genus *Opius.* This was a first step on the road: but he got no more though he reared in captivity 6000 of the flies. Proceeding to Java he found the same *Opius* on the melon fly, and in slightly larger numbers: later on reaching India he got it again about Bangalore. This parasite, *Opius fletcheri,* he conveyed to the Hawaiian islands and turned loose in the neighbourhood of Honolulu. It has done its work to such an extent that in the "Hawaiian Forester and Agriculturist" for April 1920, Mr. Fullaway reports it to destroy 50% of the melon flies, and that "it is again possible to grow melons successfully."

It is very probable that the melon fly is the limiting factor to Melon cultivation in the Straits Settlements: and the occasional successes with melons that reward enterprising people are in that case chiefly due to the Melons being grown out of reach of the fly. Its connection with wild gourds has not been studied.

I. H. Burkill.

THE COHUNE NUT.

The recent fruiting of the Cohune palm, believed to be its first in the Malay Peninsula, calls for more than a bald record.

With this object in view the following notes have been prepared and give (1) a short description of the plant, (2) its native habitat (3) its uses, so far known, (4) the results of analysis of the

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**Cf.* Belgrave, A wet of rot Para Rubber Roots, in Department of Agriculture, F. M. S., Bulletin No. 28.

Nut and difficulties in oil extraction, (5) its possibilities. The plants mentioned above, as having fruited, are situated for the most part in the Botanic Gardens, Singapore; but two of a row of four plants in front of the Raffles Museum, Singapore, have also fruited. These plants are all about the same height and were probably raised from one particular batch of seeds, several consignments of which have been received and successfully raised at the Botanic Gardens, at various times. In view of this it can be safely assumed that all the plants now fruiting are of the same age. No record has been found to indicate the exact age of the trees, but as a result of careful enquiries it has been established beyond doubt, that they are from 25 to 30 years old. Care has been taken to avoid understating the age, in order that experiments from a commercial point of view, should not be attempted under a misapprehension as to the length of time which must elapse between the time of sowing the seed and the fruiting period.

Up to the latter of part of 1918, the plants of *Attalea Cohune* in the Botanic Gardens, Peradeniya, Ceylon had not produced fruits.

General Description of the Palm.

Attalea Cohune, Mart.—the Cohune Nut Palm. A magnificent feather-leaved palm which attains a height of about 40 feet. In the ordinary way the old leaves are cut off and the leaf bases remain on the stem giving it a very rugged appearance. These leaf bases afford a firm footing for ferns, etc., which when established are very ornamental and in the Botanic Garden the palms are so kept. When the leaf bases are thus allowed to remain the stem takes on quite a distinctive shape At the base it is from 1-2 feet through and gradually thickens upward until at the crown it becomes fully 4-6 feet through. The effect thus produced is certainly striking as the stem is three times thicker at the top than at the bottom. In a specimen from which the leaf bases have been removed the trunk is smooth and cylindrical, there being little difference in size the whole way up. The leaves are produced abundantly at the top of the trunk, are fully 20 feet in length and form a magnificent crown. The pinnae are placed close together on the rhachis and are held more or less rigidly at right angles to it, thus giving a flat surface to the leaf. The leaf becomes twisted at a short distance from the base with the result that the pinnae of the upper three quarters of it have their edges towards the light instead of their faces, as in the older leaves of the majority of the palms. Also, about two thirds of the way up, the rhachis makes another bend, producing a very gracefully curved upper part to the leaf. The inflorescences are produced in the axils of the leaves in fair quantity and are at first enclosed in large tough fibrous spathes from 5 to 6 feet long and ¼ inch in thickness. These latter are more or less boat shaped and extend at the apices into horn like structures about two inches in length. They soon split longitudinally on the upper surface and remain during the flowering and part of the fruiting period. Apparently they play

a dual role, at first that of enclosing the tender spadices and later when open protecting them from rain. The spadix is almost the same length as the spathe and bears numerous simple branches, arranged more or less spirally, the longest of which does not exceed 1 foot. The peduncle is about 2 inches thick, is somewhat flattened and the upper half only bears the flowering branches. The latter are more or less uniform in length and are quite thin. Flowers are produced in large quantities on the spadix and are yellowish in colour. Sometimes a spadix bears either all male or else all female flowers, in which case the spadix is dioecious: and sometimes a spadix produces separately both male and female flowers, in which case it is monoecious. Occasionally a few hermaphrodite flowers make their appearance. The male flowers are considerably smaller than the females and in monoecious spathes are borne on the upper parts of the spadix-branches while the female flowers are borne on the lower parts. The fruit is ovoid and large being about 2½ inches long and proportionately broad. A small projection occurs at the apex which originally bore the stigmas of the female flowers: the outer skin or pericarp is fibrous and woody, while the inner skin or endocarp is very hard and bony. These enclose the seed or nut which contains an oil of considerable value.

Habitat. The native habitat of this palm is in tropical America: in British Hoduras, it covers huge areas in the form of a natural stand. It is found in low lying parts and produces enormous quantities of fruits.

Uses. So far the palm has not been put to any extensive use. Beyond its local uses it does not yet rank in importance with its relatives the Coconut and Oil Palm. A note in the Annals of Botany XII p. 165, mentions the use of the Cohune Nut in the coagulation of rubber. By exposing a thin layer of Para or Ceara latex to the action of the smoke from the burning shells coagulation is immediately brought about. In this case the species mentioned is *Attalea excelsa*: but doubtless *Attalea Cohune* can serve the same purpose.

The following is an extract from the Gardeners' Chronicle (LXVIII. 1920, p. 211) and seems worthy of repetition for the peep behind the scenes and because it emphasises the important part which science played in the Great War.

"*Attalea Cohune*—the hard shell of the Cohune Nut of Honduras, the fruit of the Manaca Palm, was found when carbonised to give protection against poison gases in the war."

Results of an Analysis of the Nut and the Difficulties in Oil Extraction.

A careful analysis of the seeds has been made at the Imperial Institute and the results are recorded in the Bulletin of the Imperial Institute (1913). The conclusion arrived at is that as an oil palm *Attalea Cohune* is a very valuable plant. The analysis showed that "Cohune kernels" yield about the same per-

centage of fat as copra and rather more than palm kernels and it is considered that in the market, the oil should fetch about the same price as coconut oil and palm oil.

There are certain difficulties in dealing successfully with it, the chief of which are (1) the exceptionally hard nut which necessitates special crushing apparatus and (2) that experiments with mechanical crushing show that the kernels bruise very easily and during transit to any distance the oil in them becomes rancid. The latter is under further investigation and it is probable that the difficulties will be overcome successfully in the near future.

Possibilities. The possibility of the palm ever being of any economic value in this country seems improbable, owing to the length of time needed before the plant becomes sufficiently mature to produce fruits. When once this stage has been reached the yield seems fairly regular and no doubt on a large area sufficient fruits could be obtained to make it a paying concern. Until it can be made to produce fruits at an earlier age it is of no value in Malaya. It seems to be a subject for further investigation and if data could be obtained from British Honduras dealing with yield and age, the question could quickly be settled as to whether it would be worth while experimenting with a view to shortening the period needed for fructification or not worth while.

The note dealing with the use of Attalea nuts in the coagulation of rubber, points to two possibilities:—(1) the extraction of oil from the kernels and (2) the use of the hard shell for coagulating rubber, provided *Attalea Cohune* and *Hevea brasiliensis* could profitably be grown in close proximity. The latter point is open to criticism in that a certain amount of oil of an inferior quality can be extracted from the shells and with the mechanical problems solved no doubt this would be extracted and placed on the market. Which of these two procedures would be most profitable it is not possible to state and can only be determined by actual experiment. It may be mentioned in passing that as *Attalea Cohune* grows in low lying land, there would appear to be a use for the low-lying swampy portions of land often found on estates and which are put to no practical use. This however, all depends upon the question of shortening the period between the sowing of the seed and the fruiting stage, so far as Malaya is concerned.

F. Flippance.

THE BRAZIL-NUT TREE IN SINGAPORE.

In 1911 Mr. W. J. Young, discussed the Brazil nut in the Pomona College Journal of Economic Botany, 1, pp. 122-134, and came to conclusions which are questionable. It is convenient to introduce the subject in his own opening sentences. "The genus, *Bertholletia,* to which is assigned the Brazil-nut of commerce, was

established in 1808 by Humboldt and Bonpland, who placed in it a single species. *B. excelsa.* A translation of Bonpland's description of the fruit of this species follows.

Fruit a spherical compound nut of the size of a child's head and often larger, divided internally into four cells each of which encloses several nuts; covered on its exterior with a husk of green colour, smooth and shining.

Main nut very solid, rough and marked by the branching furrows on its outer surface, 6 lines (1 cm.) thick, divided internally into four cells by as many membranous dissepiments which become obliterated in part or entirely after the maturity of the fruit but of which there always remain traces.

The tree is described as 33 m. high (110 ft.) with a trunk 9 dm. (3 ft) in diameter. Leaves alternate, oblong, subcoriaceous, 1 dm. (4 in.) broad and 6 dm. (23½ in.) long, borne on short petioles. Type locality. Rio Orinoco.

On account of the great height of the trees these botanists were unable to obtain the blossoms although it is said that they offered in vain an ounce of gold for specimens. On this account they were uncertain as to the position which the genus *Bertholletia* should occupy in the vegetable kingdom."

In 1855, Berg, monographing the Brazilian Myrtaceae within which order the genus *Bertholletia* falls, gave a new description, which Miers (Trans. Linn. Society, London, Vol. XXX, 1873, pp. 161) was quick to see diverged from Bonpland's and Humboldt's. Thereon, he made two species, *B. excelsa,* Humb. and Bonpl. and *B. nobilis,* Miers, the latter being *B. excelsa,* Berg.

He followed the first authors and ascribed the origin of the Brazil-nut of commerce to *B. excelsa* rather than to *B. nobilis.*

But in 1911 Mr. W. J. Young (in the Botanical Gazette, lii. pp. 226-231, and in the Pomona College Journal of Economic Botany, pp. 122-127—I have only seen the latter), from an examination of consignments, at the United States ports, of fruits, declared Miers wrong and that *B. nobilis* is the origin of the Brazil-nut of commerce; he states:—

"Commercial samples of Brazil-nuts contain in larger or smaller numbers, opercula derived from the fruit and the presence of these in itself is evidence that the nuts were derived from *B. nobilis,* since as had been noted (earlier in his paper), the opercula fall from the mature pyxidia of *B. excelsa* and hence would not find their way into the sample of nuts from that source. On the other hand their presence in the nuts from *B. nobilis* is perfectly normal and what would be expected since in this species the opercula fall into the interior of the pyxidia and become mixed with the nuts. They vary in form from ovoidal bodies to cones of varying slope and all provided with a distinct apical point.

Every pyxidium of the Brazil-nut the writer has examined, has indicated that the fruit is that of *B. nobilis.* Their main

points of structure are well shown in the figures.....which illustrate pyxidia obtained from different sources. Comparisons of the photographs with Miers description of *B. nobilis* will leave no doubt of their identity. Most, if not all, of the pyxidia which the writer has examined were brought to this country by the importers of Brazil-nuts and represent the source of the nuts in which they deal."

In 1914, Dr. T. Petch, in the *Annals of the Royal Botanic Gardens, Peradeniya,* V. pp. 421-431, as a result of study of a living tree controverted Young's statements, concluding thus:—

"It is evident that the Peradeniya tree in many respects combines the characters of the two species. The foliage is that of *excelsa,* and the shape of the pyxidium is that of *excelsa,* though the opercular openings are those of *B. nobilis.*"

On the whole, though conclusions based on a single tree can scarcely be regarded as valid, it would appear that this Peradeniya tree affords strong ground for the suggestion that there is, after all only one species of *Bertholletia.*"

It is proposed here to give the results of an examination of the trees in the Economic Garden, Singapore, chiefly of the two older trees.

The Ceylon plant was introduced from Kew, in 1880: in 1881, Singapore received plants also from Kew: a common origin of the older trees is, therefore, possible. Observations on the two older Singapore trees are below. The third and younger tree would have a different origin.

In the Singapore trees the characters assigned as identification marks to Miers' two species are mixed and the proportion of characters said to belong to *B. nobilis* are to those said to belong to *B. excelsa* as 8 : 5.

From the examination of the fruits only, upon which Mr. Young has relied, our trees will fall into the species. *B. nobilis* and not into the species *B. excelsa*: but from other marks the conclusion holds that there is only one species.

SUMMARY OF THE CHARACTERS.

1.	Height: diameter ratio:: 36.4:1; 41.3:1; 42.5:1.	excelsa.
2.	Trunk bare up to about (1) 25 feet; (2) 30 feet; the third tree 10 feet	nobilis.
3.	Leaves dark green when old, young *rufescent*	nobilis and excelsa.
4.	Petiole is up to 28 mm. long	excelsa.
5.	Panicles 10.5 inches long, with 3-6 side branches horizontal and then becoming parallel	nobilis.
6.	Floral nodes 0.5 inch. apart	nobilis.

7.	(*a*) Pyxidium globose	nobilis.
	(*b*) Pyxidium elongated	excelsa.
	(diameter of the fruit according to the size of the fruit)	
8.	Cortex of the fruit rough, thick and much lenticellated	nobilis.
9.	Opercular opening small, widening considerably inwards; or with nearly straight walls narrowing slightly at the inner end ..	Mixed excelsa and nobilis.
10.	(*a*) Operculum conical with a sharp point: (*b*) Operculum cylindrical flattened at the top	Mixed excelsa and nobilis.
11.	Calyx tridentate	excelsa.
12.	Cortex of the fruit cracks but does not peel off if the fruit is handled	Mixed excelsa and nobilis.
13.	Operculum falls into the cavity of the fruit	nobilis.
14.	Cavity of the fruit unicellular on withering of the septa	nobilis.

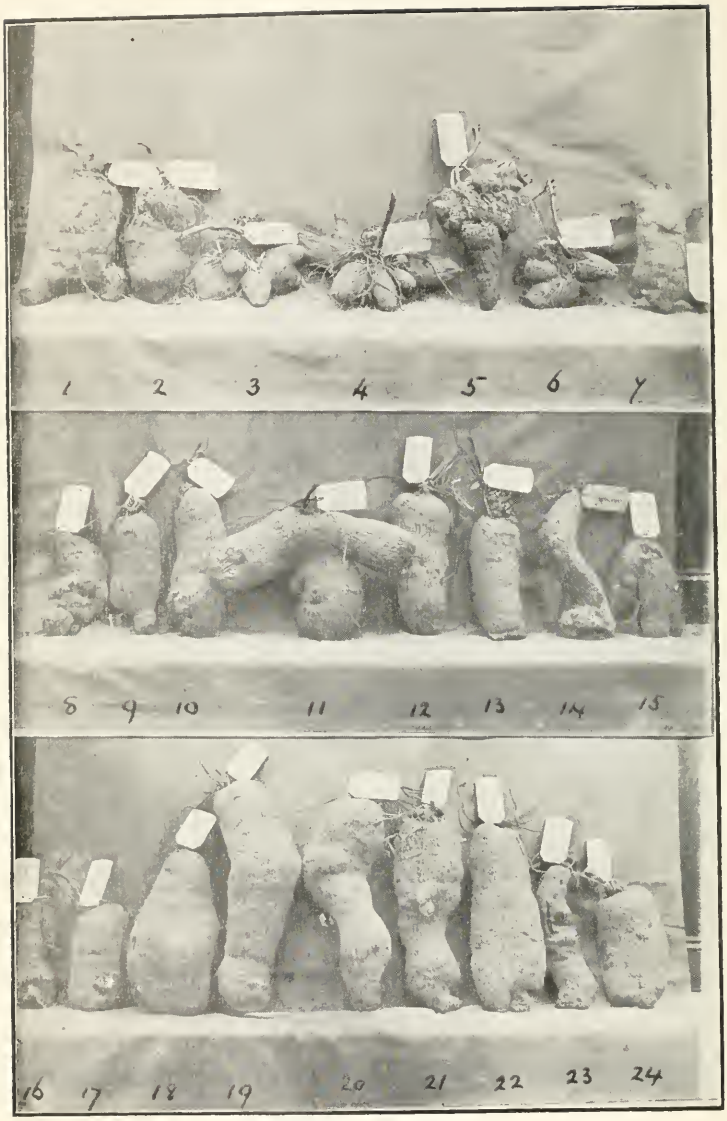
G. B. Deshmukh.

THE CORRECT BOTANIC NAMES FOR THE WHITE AND THE YELLOW GUINEA YAMS.

In the Gardens' Bulletin (this volume No. 3, 1918, pp. 87-91) short notes were given upon the above named two West African Dioscoreas, being important foods of many millions of Negroes. In it the identity of the second with *Dioscorea cayenensis* was stated; but no latin name was used for the first: and the purpose of returning to the subject here is to suggest that it is *D. rotundata*, Poiret (Encyclopédie méthodique, supplement, vol. III, 1813, p. 139). *D. rotundata* was described upon a specimen from the New World: but that Poiret could arrive at describing an African plant as West Indian is very easily understood.

The White Guinea Yam is grown in West Africa from Sierra Leone to Angola in great quantities. It is in the ground for eight months of the year, at the end of which period the dug tubers are stored in racks in the villages for consumption as long as they can be got to rest.

Having a wide area and great importance, it is raised in a considerable number of races, nineteen of which, grown in Nigeria, are figured here from photographs taken by Mr. J. Hutchinson of the Royal Botanic Gardens, Kew. Some of these races are earlier than others, and used for prolonging the season; some are more palatable; some heavier yielders, etc.: but of their qualities at present indications only are available.



NIGERIAN YAMS.

Plate XXVI.—Nigerian Yams.

1 OLOTUN IYAGBA (White Guinea Yam)

2 EFIAN (Yellow Guinea Yam)

3 EBA EDI (Dioscorea dumetorum)

4 OBUBIT IWA (Dioscorea dumetorum)

5 AKPANA (Dioscorea dumetorum)

6 NDISIME IWA (Yellow Guinea Yam)

7 SAJA (White Guinea Yam)

Upper Row.

8 AGOGO

9 AFIA OKO

10 OKPO UMAN

11 IHOBIA

12 OLOFERE

13 ALAOKO

14 OTUK OKPO

15 AGA

Middle Row, all the White Guinea Yam.

16 OKO

17 OKPURU

18 KANGE OJINLAJA

19 LAYINBO

20 AGAKE

21 IGUN

22 DODORO

23 NDIAHI

24 OLONKO

Lower Row, all the White Guinea Yam.

In the wetter regions of the Nigerian coast and adjacent parts, the Yellow Guinea Yam gets some of the importance of the White Guinea Yam; because as it grows through the whole year, never resting, it is peculiarly suited to those equitable parts, and the tubers can to a certain extent be dug as wanted. These tubers will not keep. It has not got the same great number of races that the White Guinea yam has.

Both the White and the Yellow Guinea yams were early taken to the New World, as also was the Indian *D. alata*,—whether for the first time independently of the slave trade, or in the course of that trade cannot now be ascertained: but this is well attested, that yams were shipped with the negroes as provisions for the voyage whether to Lisbon for proceeding thence to America or to America direct: and among the various names applied to them in the West Indies to this day are certain distinctly reminiscent of the custom, such as Negro Yam, Guinea Yam and Lisbon Yam. The proper application of these names would seem to be, Negro Yam to the White Guinea Yam, Guinea Yam to the Yellow Guinea Yam, and Lisbon Yam to certain races of *D. alata*, but there are inconsistencies in modern usage. The last named was probably in West Africa before it was in America, for Marcgraf writing in 1648 called it the Inhame de S. Thomé or Yam of St. Thomas' island, the said island being off the Gaboon coast.

Because of their keeping qualities, the White Guinea Yam and *D. alata* were better for provisioning ships than the Yellow Guinea yam; but the last had the advantage of being available almost through the year. The three kept a proportionate importance in the West Indies, and nothing could be more natural than that botanists should make acquaintance with them, though two are African, in America. Thus it happened that Lamarck in 1789 described the Yellow Guinea Yam from Guiana under the name of *Dioscorea cayenensis*, and Poiret in 1813 described from a West Indian specimen a *D. rotundata*, which as far as his inadequate material and incomplete description show, can be considered as the White Guinea Yam. The description not sufficing for a clear understanding, Grisebach in his *Flora of the British West Indies*, 1864, p. 587, set down the latter as a variety of the former, a place which it has occupied since, and in which Sir David Prain and the writer left it, when discussing in the *Kew Bulletin* 1919, p. 364, *Dioscorea sativa*. But subsequently the photographs here reproduced, of types of both names, as they exist in Desfontaines' herbarium,, were obtained, and in correspondence between Professor E. Chiovenda, who has charge of that Herbarium, Sir David Prain and the writer, the conclusions have been reached that Poiret had before him a branch of the White Guinea Yam when he drew up his description of *D. rotundata*, and that therefore, no older name existing, the White Guinea Yam is to be so called.

The identity of the Yellow Guinea Yam with *D. cayenensis*, Lamk., has been asserted already by Dr. August Chevalier in the *Bulletin de la Société botanique de France*, IX, 48, fig. 3 bis, where

The folded foliage of the White Guinea Yam.

The flatter foliage of the Yellow Guinea Yam.

DIOSCOREA ROTUNDATA, POIRET (*on the left*), and D. CAYENENSIS, LAMARCK (*on the right*),

is a picture of a type existing in Lamarck's own herbarium. Those who have access to that portrait will observe how closely it corresponds with the portrait here given.

Lastly as a contribution to the better understanding of the two species a third plate is added here showing the distinctive pose of their leaves.

I. H. Burkill.

HIBISCUS SABDARIFFA, VAR., ALTISSIMA.

In the Gardens' Bulletin opposite p. 244 of part 7 of this volume *Hibiscus Sabdariffa*, var., *altissima* was illustrated: and the remark was made on p. 243 that the fruits are too small and on account of their hairs little suited for making jams and jellies.

The variety is indeed a fibre plant and not a food plant, and as such should be experimented with in this country. At a recent date its fibre offered on the London market as Bimlipatam jute was worth £45 per ton.

Bimlipatam is a small port in the Madras presidency just south of the great Bengal jute area, where *Hibiscus cannabinus* is the local fibre plant and is grown plentifully in lines among other crops, retted and the fibre marketed. The fibre is slightly stronger than jute, but because the supply is used up along with jute gets the same price as the first marks of jute.

Hibiscus Sabdariffa being a species closely allied to *H. cannabinus*, it is not surprising to find in its tall variety *altissima* characters as to fibre which are common to both: and excellent fibre has been prepared in the Economic Garden, Singapore, by Mr. Mathieu, and valued in London, by the kindness of Professor W. R. Dunstan, at the figure above. The process used was retting.

I. H. Burkill.

ORCHID NOTES.

Bulbophyllum limbatum, Lindl.

In 1840 Lindley described as *Bulbophyllum limbatum* a small orchid which had been grown in Messrs. Loddiges' horticultural establishment at Hackney, near London. He recorded its origin as Singapore: and at the same place (*Botanical Register*, XXVI. 1840, Misc. p .74) he described several other orchids from Singapore to which the further record is added that they were "received from Mr. Cuming." These others are all well-known to grow wild in Singapore: but *B. limbatum* had not been seen again until last year.

Hugh Cuming was a great collector, who visited our coasts upon his way to and from the Philippine islands in 1835 and 1839. Although it is not expressly stated in the *Botanical Register*, it is

almost certain that it was he who took the *Bulbophyllum* to Britain; and as the other orchids are all species found locally in Singapore, the probability is that the Singapore forests and not the Singapore port, furnished it. The new locality at which it has been obtained is Kotah Tinggi in Johore, and the finder Mr. H. Leu Jeppesen, of the Mount Austin Estate.

Lindley's description, slightly modified, appears in Sir Joseph Hooker's *Flora of British India*, V. 1890, p. 763, and in Mr. H. N. Ridley's *Materials for a Flora of the Malay Peninsula, Monocotyledons*, I. 1908, p. 69. It is now possible to add to it.

The pseudobulbs were described from dried material by Sir Joseph Hooker as depressed subglobose: they are when fresh obturbinate. The leaf which has not been described is almost narrowly elliptic, being by but a little more rapidly narrowed below than above; it is 9 cm. long by 2 cm. wide, solitary, on a petiole 1 cm. long. The inflorescence may exceed the four inches of Lindley's description, and be 15 cm. long: upon it Mr. Jeppersen has seen as many as 12 flowers. The flowers give the impression of being of a dark claret colour: in detail they are thus. The centre within about the base of the column and of the petals is chrome yellow; this becomes paler outwards and tinged with lake on the sepals and petals under their purplish-chocolate margin. The dorsal sepal has three relatively wide purplish chocolate bands down it, which become somewhat interrupted towards its base; and the lateral sepals have five. Their margins are finely pubescent. The petals have one band running into the margin: they are half as long as the sepals. The lip is liver-coloured, paler below upon a triangular margined area with its base the hinge: this area has microscopic purple spots: there is a margined narrow groove on the upper surface extending nearly to the tip, with a chocolate border at the base. Seen from below the lip is elliptic-ovate; from the side it looks exactly like an ox-tongue in the same position: from above the groove makes it subcordate: it all but equals the sepals, and is distinctly mobile. The horns of the column project upon either side of the anther in the same plane as the column.

Eulophia macrostachya, Lindl.

Eulophia macrostachya, Lindl., is an addition to the Flora of the Malay Peninsula. Though an orchid of unusually wide distribution, it had remained unknown as occurring in the Peninsula until last year. It was found on a limestone hill near Sungei Siput, in Perak, and was brought into the Botanic Gardens in Singapore where it flowered in October.

In 1919 it was received in the Gardens from the Tambilan islands which are between Singapore and Borneo: and it is known to occur in Ceylon, up to 4,000 feet, in Travancore and in the Nilgiri hills, in Sumatra, Java, Ternate, Mindanao and Leyte. In 1889 a plant of it of unknown origin flowered in the Singapore Gardens.

Spathoglottis affinis, de Vriese.

Spathoglottis affinis, de Vr., is a second addition to the Flora of the Peninsula. This beautiful little terrestrial orchid, hitherto known only from the mountains of Salak and Tegal in Java, was found in 1919 by Mr. Mohamed Haniff on Kedah Peak, and has since flowered freely in the Waterfall Gardens, Penang.

The specimens were referred to Dr. J. J. Smith of Buitenzorg for confirmation of the name, and he writes that he regards it as correctly named *S. affinis,* but that the side lobes and the claw of the midlobe are much narrower than in the Javanese plant, and that the callus too is thinner.

Acanthephippium sylhetense, Lindl.

In the Gardens' Bulletin II, No. 2, 1918, p. 44, the genus *Acanthephippium* was added to the flora of the Malay Peninsula; since when a second species has been found south of the isthmus of Kra.—this one in the Siamese Malay States. The second species is *A. sylhetense,* Lindl., which was brought alive into the Waterfall Gardens, Penang, by Mr. Mahomed Haniff from Bukit Khaw Poh near Kasum.

The flowers of the plant from Siam are few, and just before opening they are 1½ inches long from the tip to the base of the bucket, with a maximum width of ⅝ of an inch. They are creamy white with yellowish lines where the sepals meet. They commence their opening, by splitting between the lateral sepals, and then give off a faint pleasant scent. The tip of the labellum can be seen in the opening. With further expansion the lateral sepals become obliquely revolute making with each other a wide V. The petals outgrow the dorsal sepal and stand forward beyond it slightly. The free parts of the sepals and petals are minutely dotted with a pink, which on the inside of the lateral sepals is somewhat collected into five bands, the lowest (nearest to the line of contact between the two sepals and so under the labellum) being very faint. The labellum has the inverted saddle shape so characteristic of the genus; the side lobes which make the side flaps being of a flattened axe-shape, the midlobe is tongue-shaped and curves downwards. It is of a clear buttercup yellow, and so is the part of the limb behind it, where are three crests, the lateral double toothed at the back. The rest of the inside of the flower is creamy white, except that it is suffused with yellow in the base of the bucket.

Lindley's description of *A. sylhetense* says that it is inodorous, gives the flowers a slightly greater size, and mentions no colour but white. But he himself later united Griffith's *A. ringiflorum* to his *A. sylhetense*; and Griffith says of *A. ringiflorum* that the white sepals and petals are spotted within with reddish purple, particularly towards their apices and that the linear concave stalk of the labellum is yellowish as also the mid lobe of the lip, which characters are found in the Siamese specimen. Griffith says that there are 5

crests on the labellum, 2 confluent; such a view is quite reconcilable with the one saying that there are 3 crests, the latter with two teeth at the back.

GASTRODIA MALAYANA, Ridl.

Gastrodia malayana,—an interesting leafless orchid has been found newly in Penang by Mr. Mohamed Haniff in a specimen 32 inches high. Such a height is far in excess of what it is known to reach in Singapore and neighbouring parts of the State of Johor.

I. H. BURKILL.

NOTES.

A POSSIBLE ANCIENT MIGRATION OF USEFUL PLANTS WESTWARD IN ASIA.

In a very interesting account of "The origin and ethnological significance of Indian boat designs" (*Memoirs Asiatic Soc. Bengal*, VII. 1920, p. 139-256) Mr. James Howell suggests that a boat-using community once occupied the coasts of Southern India which was of Negrito stock, and this was followed by a proto-Polynesian stock, and then by the Malaysian wave which reached Madagascar. Later the Dravidians came into Southern India and Ceylon from the Mediterranean by land, and completely absorbed the sea-going people whom they found already there.

These suggestions are worth remembering in connection with the migration of useful plants: the coconut for instance may have reached India by the agency of the second stock.

UNDER-SEA MEADOWS.

Professor W. A. Herdman's remarks in the Journal of the Linnean Society of London, Zoology, XXXIV, 1920, pp. 256-258, upon the great economic value of the seaweed meadows of the Irish Sea are most interesting. Firstly he touches upon the zone of the Brown Seaweeds, concluding "that a very large amount of organic food must be present" in it, and "it is not surprising that shoals of young fish are found feeding there." In the second place he turns to the green Grass Wrack (*Zostera marina*) which lives on muddy sand up to high water mark. The Zostera bed, says Professor Herdman, is an important source of food to fishes and invertebrate animals, "its waving forest, clothed with many other organisms, large and small, is one of the densest masses of living plant food.....in the sea, both directly from the food that it furnishes to the animals living in it, and indirectly from the enormous quantities of Diatoms which cover its decaying leaves."

In the seas of Malaya the brown seaweeds are unimportant: but not so the undersea meadows of the tropical Grass-wrack, *Enhalus*,

whose large loose meadows are the grazing grounds of the Duyong, and are frequented by we scarcely know what fish. In the study of them, the sea offers a wide and a most interesting field.

The size of a first class Botanic Garden.

Very interesting is the evidence taken by a Committee (the Joint Committee on the Library, Congress of the United States) on the proposal to establish in Washington a National Botanic Garden. The Committee meeting on May 21st, 1920, heard a number of eminent men, the second to give evidence having been Dr. N. L. Britton, Director in chief of the New York Botanic Garden:—

Senator Knox. "I would like to ask.....what would your judgment be as to an adequate area for a botanical garden such as the United States ought to maintain here at the Capital?"

Dr. Britton. "I should think you ought to have at the minimum four or five hundred acres. You ought to have that to develop an institution which would meet the necessities.

Senator Knox. What is the area of the New York Garden?

Dr. Britton. We have about 394 acres.

All the other witnesses supported the idea of obtaining an area of 400 acres: and as matters are reported it appears as if the proposal will go through.

The evidence ends with a review of the Gardens of the world, showing Germany to possess 36, Italy 23, France 20, Russia 16, the United Kingdom 14, Austria-Hungary 13, the United States 12, and so on; but the whole British Empire contains 65. The size of the Gardens and some account of them follows. The new Botanic Garden at Kirstenbosch, Cape Town is credited with 400 acres, Kew with 288, Calcutta with 272, and several with 200. From that they descend until with the purely University Gardens we arrive at some of very small size.

A Botanic Reserve—Mount Maquiling.

The Government of the Philippine Islands has set aside Mount Maquiling, in the island of Luzon as a national reserve: it is to be kept for the students of animal and plant life, for those who wish to study the Fauna and Flora. The mountain is 1144 metres high (3753 feet); and is covered with virgin forest through which a few paths have been cut. At its foot are the laboratories of the College of Agriculture of Los Banos, and it is intended that one use of the reserve shall be for the training of foresters.

RAINFALL.

at the Director's house, Botanic Gardens, Singapore, during the first half of the year 1920.

Readings taken always at 8 a.m. and credited to the date in which the twenty-four hours begin. Measurements in inches.

Date	January.	Feb.	March.	April.	May.	June.
1	3.65	0.43	...	...	0.10	Trace
2	1.65	...	...	Trace	...	...
3	3.82	...	0.61	...	0.14	...
4	0.18	...	0.16	...	0.21	...
5	0.08	...	0.14	..	0.20	...
6	0.02	0.03	2.02	Trace	0.01	...
7	Trace	0.02	0.05	...	...	...
8	0.40	0.15	...	0.72	...	0.96
9	Trace	0.01	...	Trace	...	0.07
10	...	...	...	...	1.03	0.02
11	0.60	...	...	Trace	0.72	1.27
12	0.65	...	Trace	Trace	...	...
13	...	...	..	...	0.72	...
14	Trace	Trace	...	0.34	0.86	...
15	...	...	8.85	0.15	0.02	0.40
16	...	1.65	Trace	...	Trace	0.02
17	...	...	Trace	Trace	...	0.03
18	...	...	1.12	0.34	...	0.05
19	2.34	...	Trace	0.35	...	0.03
20	Trace	0.15	0.84	0.07	...	0.03
21	0.17	0.50	0.05	...	...	...
22	Trace	0.03	0.23	Trace	0.11	...
23	...	1.59	0.35	0.05	0.41	...
24	...	Trace	...	Trace	1.31	0.46
25	...	1.02	0.23	0.09	...	0.28
26	0.10	Trace	0.63	...	Trace	...
27	...	1.26	0.05	0.09	...	...
28	0.40	0.42	0.08	Trace	...	...
29	...	0.02	...	...	Trace	...
30	...		...	1.48	0.20	...
31	0.39		...		0.07	
	14.36	7.23	7.42	0.68	5.48	3.62

RAINFALL.

at the Director's house, Botanic Gardens, Singapore, during the second half of the year 1920.

July.	August.	September.	October.	November.	December.
Trace	0.39	...	2.13	Trace	...
1.44	0.03	...	0.01	0.76	...
0.14	1.95	...	...	...	...
0.08	...	...	...	0.02	...
...	...	...	2.02	...	...
0.26	...	0.05	1.06	0.46	...
0.45	0.24	...	...	0.09	3.25
0.05	0.18	...	0.45	1.46	...
1.04	0.01	Trace	0.53	0.13	...
0 01	0.58	0.11	...	0.01	...
...	1.31	0.49	0.02	1.10	...
...	0.03	0.17	0.03	0.03	0.15
1.47	0.40	0.06	Trace	0.04	0.02
0.04	1.73	0.03	0 05	0 09	Trace
...	0.06	0.02	0.19	1.35	...
...	0.01	0.01	Trace	...	...
...	1.19	...	0.35	0.02	0.02
...	0.37	1.31	0.07	...	0.15
...	0.01	Trace	0.65	0.64	0.66
0.34	...	...	0.23	0.31	...
0.74	...	2.20	0.11	0.02	0.04
0.37	...	...	Trace	1.31	0.06
0.03	...	1.17	...	...	0.02
...	0.42	0.95	0.07	0.02	2.32
...	0.42	0.01	0.17	1.54	0.02
...	0.01	...	0.04	0.16	0.16
0 10	...	2.01	0.77	Trace	0.44
1.36	0.42	0.02	0.02	...	...
0.04	...	0.65	0.02	...	Trace
0.01	0.20	0.04	...	...	Trace
0.11	0.90		0.77		0.01
8.08	10.86	9.30	9.74	9.56	7.32

RAINFALL.

at the head of the Waterfall Gardens, Penang, during the first half of the year, 1914.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Measurements in inches.

Date.	January.	February	March.	April.	May.	June.
1	...	0.29	...	...	0.15	0.61
2	...	...	...	0.03	...	...
3	0.18	...	...	...	...	...
4	...	0 03	...	2.14	...	0.05
5	...	0 34	...	0.06	1.10	...
6	...	1.50	0.59	...	...	1.33
7	...	...	0.07	1.23	...	...
8	...	0.23	0 03	...	0.05	...
9	0.22	1.25	0.07	0.08	0.33	0.14
10	0.36	...	0.04	...	0.72	...
11	...	...	...	...	1.05	0.57
12	...	...	...	0.45	0 15	...
13	...	...	...	0.04	...	...
14	...	...	...	0.80	0.44	...
15	0.40	...	...	0.03	1.34	0.05
16	...	...	...	0.16	1.26	1.03
17	...	...	..	..	0 03	0.03
18	...	0.41	2.36	0.28	...	1.95
19	...	1.25	..	...	...	1.55
20	...	0.03	...	0.69	1.22	2.15
21	...	1.73	0.32	0.03	...	0.03
22	...	0.05	...	0.73	0.55	...
23	...	0.04	0.03	0.30	...	1.73
24	...	0.03	0.12	0.70	1.24	...
25	...	...	...	0.08	0.19	...
26	...	0.75	...	0.79	0.08	...
27	...	1.20	0.55	0.29	0.06	...
28	...	0.75	0.05	0.27	0.03	...
29	...	..	0.10	...	0.16	...
30	...		0.14	...	0.97	0.10
31	0.03		...	...	0.11	
	1.19	9.88	4.47	9.18	11 23	11.32

RAINFALL.

at the head of the Waterfall Gardens, Penang, during the second half of the year 1920

Date.	July.	August.	Sept.	October.	Nov.	Dec.
1	0·49	0.56	...	0.07	1.64	...
2	...	0.56	...	0.19	0.12	...
3	...	0.05	...	0.60	0.03	...
4	0.03	0.04	...	...	0.03	0.11
5	...	0.09	...	0.04	0.54	...
6	...	...	...	0.36	0.12	...
7	0.15	...	0.38	...	0.35	...
8	0 33	3.12	1.09	...	...	...
9	0.22	0.85	2.20	...	0.08	...
10	...	4.25	0.82	1.14	1.13	...
11	0.56	0.21	0 99	...	...	...
12	...	0.09	1.04	0.96	0.29	2.09
13	...	0 99	...	2.24	...	0.92
14	...	0.03	1.04	1.92	...	0.04
15	...	0.13	1.82	0.27	0.17	0.44
16	...	...	...	0.97	0 03	0.07
17	...	0.45	0.09	0.81	1 27	0.22
18	0.08	...	1.22	0.11	...	0.42
19	...	0.03	0.99	0.62	0.46	3.44
20	...	0.06	0.03	0.79	0.17	1.10
21	0 03	...	0.86	1.11	0.53	0.19
22	...	0.07	0 58	0.15	0.04	0.60
23	...	0.27	0.08	0.20	0 04	1.13
24	...	...	...	0.09	...	0.88
25	...	1.40	...	...	1 74	...
26	...	0.03	2.84	...	2 96	0.03
27	...	0.58	0.28	0.09	0.62	...
28	0.32	0.17	0.98	0.67	0.10	...
29	0.10	6 59	0.06	0.04	0 04	...
30	1.06	0.05	1.07	0.11	0.05	...
31	0.56	2.05		0.13		...
	3.93	22.72	18.46	13.68	12 55	11.68

SUMMARY OF RAINFALL, 1920.

	SINGAPORE.				PENANG.			
	No. of rainy days	Amount of rain in inches	in mm.	Longest Spell without rain	No. of rainy days	Amount of rain in inches	in mm.	Longest Spell without rain
January -	19	14.36	390	4 days.	5	1.19	30	15 days
February -	17	7.23	184	4	16	9.88	251	8
March -	19	7.42	188	4	13	4.47	114	7
April - -	19	3.68	93	3	20	9.18	233	2
May - -	18	5.46	139	5	21	11.23	285	3
June - -	13	3.62	92	6	14	11.32	288	6
July - -	20	8.08	205	5	12	3.93	100	6
August -	22	10.86	276	4	25	22.72	577	2
September	19	9.30	236	5	20	18.46	469	6
October -	25	9.74	247	2	24	13.88	353	3
November -	22	9.56	243	9	24	12.55	319	2
December -	17	7.32	186		15	11.68	297	7
Total ...	230	96.63	2454	...	209	130.31	3310	

Greatest amount in 24 hours	3.82 in. or 97 mm.	6.59 in. or 168 mm.
,, ,, 48 ,,	5.47 ,, 138 ,,	6.64 ,, 169 ,,
,, ,, 72 ,,	9.12 ,, 232 ,,	8.69 ,, 221 ,,

Excessively rainy periods, more than 5 00 having fallen in 72 hours (Jan.) -	1	3 June Aug. (2)
No. of days when condition persisted -	1	6
Periods of comparative drought, less than 0 02 having fallen in 120 hours Jan (2) Mch. April (2) June July (2) Sept. Dec. - - - - -	12	9 Jan. Feb. Mch. (2) June July (2) Sept. Dec.
No. of days when the condition occurred. - - - - - -	28	30

INDEX.

R

S

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U

V

W

X

Y

Z

Errata.

On the plate opposite p. 92 for 332 read 342.

p. 135 second footnote for 1253 read 1532,

p. 136 second delete the 30th line,

p. 141 last column, the asterisk is one line too high.

Departmental Notices.

A list of plants which can be purchased at the Botanic Gardens, in Singapore and in Penang, can be had upon application. The same list appears at intervals in the Government Gazette.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for every volume of twelve numbers, post free:—

Five dollars in the Straits and Federated Malay States.

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