GARDENS AND FOREST DEPARTMENTS,
STRAITS SETTLEMENTS.

AGRICULTURAL BULLETIN
OF THE
MALAY PENINSULA.

No. 7.] JUNE. [1897.

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AT THE
GOVERNMENT PRINTING OFFICE.

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RUBBER.

Except in the case of Ramie, no cultivation has been so long practically neglected, and all at once sprung into notice as that of rubber within the past few years. Though rubber was first found in South America in the second voyage of COLUMBUS, it was not recognized as of any value till Dr. PRIESTLY, in 1770, pointed out that it was useful for erasing pencil-marks, and it was sold in cubes of half an inch for three shillings. The rubber industry really commenced about the beginning of the present century, and in 1830, 464 cwts. were imported into Europe, since then there has been a rapid rise to 948,404 lbs., valued at over £51,000.

It has long been pointed out that rubber cultivation was well worthy of the notice of planters, but in no part of the world does any great interest seem to have been taken in it except in Ceylon, where, from 1873, when seeds were introduced from Kew till 1886, when the cultivation was abandoned, the planters were very enthusiastic about it. The plants then under cultivation were Ceara and Para rubber. In Assam also, the Indian Government protected and formed plantations of India rubber (*Ficus elastica*). But the greater part at least of the rubber of commerce has always been derived from wild trees or vines, and as these were largely worked out from careless cutting, the supply decreased in quantity and increased in price. Later the African rubbers came into notice, and the market became overstocked. Following on that, however, came an enormously increased demand for rubber, partly due to the great development of the bicycle trade, and the increasing use of rubber tyres for carriages. To meet this demand now, we have Africa only as a large source of supply, for it is stated that the South American supplies, from want of a policy of consideration of the trees producing rubber, has fallen to such an extent that they can only meet a small part of the demand.

The African supply, though without doubt very large, is at present derived from wild plants of *Landolphia*, a climber, and *Kickxia africana* and *Ficus Vogelii*, trees, and the large amount now produced must diminish as the forests are ransacked wherever accessible. Meanwhile there is but little doubt that the demand will increase yet more, and in the future the demand will have to be supplied from cultivated trees.

KINDS OF RUBBER.

The number of rubber-producing trees and shrubs throughout the world is very large, and they may be divided for economic purposes into trees and climbers. Of the latter, the chief are the Landolphias of Africa and Madagascar, and the Willughbeias, Melodinus, Leuconotis, and Urceolas known here as *Getah Gri-*

of the Malay Peninsula and islands. These climbers produce considerable quantities of the rubber of commerce, but are not at all satisfactory to cultivate. They grow, it is true, easily enough from seed or cuttings, but produce under cultivation thin, slender stems not at all easy to get the rubber out of, and even if they did attain the thickness of stem that they do in the jungle, which is about as thick as the leg, they would be difficult to work economically.

For cultivation purposes, it is, therefore, necessary to turn the attention to the trees, and of these the following are the kinds which have attracted most notice :—

India rubber,	*Ficus elastica*,	Assam to Perak.
Lagos rubber,	*Ficus Vogelii*,	West Africa.
,,	*Kickxia africana*,	,,
Jelutong,	*Dyera costulata*,	Malay Peninsula.
Pulei,	*Alstonia scholaris*.	
Ceara scrap rubber,	*Manihot Glaziovii*,	Brazil.
Para rubber,	*Hevea braziliensis*	,,
Central America,	*Castilloa elastica*.	
Mangabeira,	*Hancornia speciosa*,	Pernambuco.

Ficus elastica supplies a very fair rubber, but the tree seems to be of slow growth, and rather expensive to cultivate even in Assam. It does not grow at all well in Singapore, though it perhaps might do better in the hills of Perak and Selangor, but I should very much doubt its being at all suitable for cultivation by planters.

Ficus Vogelii and *Kickxia africana* are but little known as yet in cultivation. Seeds of the latter were received recently at the Gardens, but only a few germinated, and all soon perished.

Dyera costulata is a large tree common in our jungles. The rubber is abundant, but usually contains much water. It is considered of a low quality and seems chiefly to be used for adulterating other kinds. There is, however, a fairly large trade in it in Singapore.

Alstonia scholaris is also a common large tree, but the rubber is thought but little of and is seldom collected even in the Malay Peninsula.

Central American rubber, *Castilloa elastica*, the biggest of all the rubber trees, is a native of Panama, where it grows in damp wooded ravines, along the edges of streams. It grows very feebly here, and never looks healthy. It seems to thrive better in Southern India, but there is as much difficulty in extracting the rubber as there is in Ceara scrap.

Mangabeira, *Hancornia speciosa*, is a small birch-like tree, which grows on the dry sandy heaths in Pernambuco, where I have seen it. It is a poor class rubber, and is, I think, not worth cultivation, here at least. I doubt if it has ever been introduced into this country.

Para rubber, *Hevea braziliensis*, on the other hand, has the advantages of being exceedingly easily grown, and a very suitable

plant for wet low ground, for which we have no use except for sago or rice, and of which class of land there is a very considerable amount in the Peninsula. It also gives a quick return, at a very trivial cost, and requires no expensive machinery o elaborate cultivation, and finally holds, as it has always do the first rank in value among the rubbers.

It has been tried in Ceylon and India, but I can find but litt published as to its cultivation in the former country. It seemed, under Dr. TRIMENS' management, to have done almost if not quite as well in Ceylon as it does here, but, in spite of his recommendations, the planters seem to have condemned it with Ceara rubber, and abandoned it. In Tenasserim it seems to have done well, but I know nothing as to practical cultivation there on a large scale.

Manihot Glaziovii, Ceara scrap rubber, has attracted a great deal of attention in past years, and many trees were planted in Ceylon and elsewhere. The amount of rubber produced under cultivation was so small, and the profit so slight that the Ceylon planters destroyed their trees and abandoned the cultivation In the Peninsula, trees were planted in many places, and though isolated trees are to be found as fine as could be wished, the greater part utterly failed. The failure in Ceylon gave the whole of rubber cultivation a bad name, because planters, describing their want of success, did not say, in many cases, what rubber they had been growing, and sometimes confused the two plants.

The Ceara rubber is easily known by its silvery bark, like that of a birch, while Para rubber has a brown rough bark. There is a great difference also in habit, the former tree having a straight stem with leafy branches only at the top, giving it a flat umbrella-like appearance, the latter having a tendency to branch at about six or ten feet from the base, and forming a magnificent large crown of foliage. The habitat of Ceara rubber trees is one of the driest of the Brazilian provinces where the soil is sandy or gravelly or even rocky, where even tapioca requires to be watered, and there are occasionally years when no rain falls. In fact, the tree is a regular desert plant. What wonder then that it should not be successful in a wet climate like ours ?

PARA RUBBER.

Hevea braziliensis (*Euphorbiaceæ*), a very large tree inhabiting the swampy islands and banks of the river Amazon.—In suitable soil it grows very fast and attains the height of about sixty feet, with a diameter of about two feet through the stem.

The leaves are trifid, dull green above and whitish beneath. The flowers are produced in panicles on the ends of the branches. They are small and green, very sweetly scented, so that when a tree is in flower, it can be detected by the scent of the blossoms. The flowers seem only to be produced when

the tree has attained a considerable size, and usually before flowering the tree sheds a proportion of its leaves, sometimes becoming quite bare during the flowering season. The trees here flower somewhat irregularly. The fruit is produced some months later. It consists of a large three-lobed capsule about an inch and-a-half long containing a single large seed in each lobe. When ripe the capsule splits explosively, throwing the seeds thirty or forty yards from the tree.

This usually takes place in the hotter part of the day. The seed is about an inch long, rounded on the back and flattened in front, silvery marbled with brown in colour, much resembling a castor-oil bean on a large scale. They are very light and float readily in water. They germinate usually very soon after planting, and do not require to be filed or otherwise treated as Ceara rubber seed usually does, but do not retain their germinating powers very long, and should be planted soon after they are ripe.

Cultivation.—Para rubber can be raised from seed or cuttings. The former is the most to be preferred. The seed is planted in nurseries and lightly covered with soil, and when about six inches high can be planted out.

Cuttings are recommended for use in inundated spots where the seed might float away. They are taken from lateral twigs and planted in the mud so that their tops are above water, but they can also be grown in drier spots shaded at first from the sun.

They should be made from well grown wood, and not from the softer tops of the branches. It is sometimes stated that trees from cuttings do not last, and perish in a few years. Fallen trees, however, throw up strong stems, which eventually develop into healthy large trees, and, as it is stated that in South America trees are habitually grown from cuttings, there seems no reason why they should not be successful here.

The soil most suited for the plant is rich and very wet, such land as is commonly used for sago is very suitable, and wet rice-fields or any damp low-lying ground will do. The tree will grow on drier soil, but more slowly and in a less satisfactory manner. Where the ground is liable to shift from underground currents or streams cutting the soil away, the trees, owing to their having no tap root, are rather liable to fall, and though they continue to grow even when prostrate, they are much more difficult to tap. However, they are very easy to raise again wi h the aid of ropes, and can even when pretty large be propped up again, when they will continue to grow as before.

The trees can be planted about twelve feet apart or even closer. They grow very straight and do not spread much unless planted far apart, and the closer they are planted the straighter and taller they grow. When planted they require no further care than to keep down the brushwood and grass for the first year or two, after which they will draw up above

the weeds, and if planted close together will soon so shade the ground that but few weeds will appear beneath them. As they are rather sensitive to fire, care should be taken to keep down the lalang, if any should grow near the trees, to prevent risk of its taking fire.

In suitable soil the trees grow very fast. Trees planted from seed in the Botanic Gardens in 1888 have attained the height of about sixty feet and a diameter of from a foot to a foot and-a-half at the base. Some other trees, thirteen years old, planted about twenty feet apart have a diameter of about two feet, but are no taller. In these the stem has branched at about six feet from the ground which the closer planting of the others has prevented.

Trees on the outside of the wood which obtain more air and light are indisputably finer than those grown very close together, but it will probably be found better to grow the plants fairly close in order to obtain a taller and straighter stem which is easier to tap and to obtain a larger amount of stems on a given area.

I have not noticed any enemy, animal or vegetable, attacking the tree.

Collecting the rubber.—Trees can be tapped at the age of three years if they are well grown, but it probably would be better to wait till they are five years old, when they are stronger, and the wounds would heal more readily. It appears from the account of Mr. Cross, who went to Para to investigate the methods of collecting the rubber and the habit of the tree, that it was the custom of the collectors there to tap the trees in the early morning, but here it appears to be best to tap in the evening after four o'clock, as the milk is thicker and more free from water in the evening. I have noticed the same thing in other lactiferous trees, such as the Upas (*Antiaris*). It is preferable to tap in dry weather, not only on account of the greater amount of water in the milk in wet weather, but also because it is easier to prevent the rubber being spoilt by rain falling into the cups.

The tapping is best done in the following way. A number of oblique cuts are made in the bark converging to a central vertical cut, at the bottom of which a cup is placed. The rubber runs down the cuts into the central one which conducts it to the cup.

The cuts should be made through the bark, which is about a quarter of an inch thick, but so as not to injure the wood, and should not be made more than a half an inch wide. Their length, six or more inches, will depend on the thickness of the tree. These cuts may be re-opened a day or so later and more rubber will come out. It is best to make a small groove at first, cutting a thin slice off the edge of the wound each day till the groove is about half an inch wide. The wounds heal up in a few weeks if not too wide.

Any sharp knife can be used to cut the bark, but it will probably be necessary to supply the coolies with guarded knives which cannot be forced into the wood and so damage the tree. I have found a sharp chisel used with a hammer a good instrument for making the cuts.

The common method in Para seems to be to chop at the bark with a small axe with a blade an inch in length, and to put a cup under each incision. But this is a cumbrous and wasteful method and is not at all to be recommended. Another plan recommended by some is to make punctures in the tree and put cups to each puncture, but the method above described has the advantage of collecting all the rubber into one cup, instead of having a lot of cups on the tree, saving time and labour. In South America, cups of clay are prepared and stuck to the tree by means of lumps of wet clay, a very clumsy method, which also has this disadvantage, that the cups being quite open at the top, dirt and rain fall in and spoil the rubber. The best cups I have used are small cigarette tins with lids. These are nailed on to the base of the vertical cut with a small nail, hinge outermost. The lid is then pushed down so as to admit the rubber only. Any bits of stick, moss or dirt and rain will fall on the lid and not into the cup.

The cuts having been made and the cups fixed in the evening, the rubber continues for some time to run into the cup, and in the morning is found to have partially or quite set, and in a few hours a solid cake of pure white rubber can be taken out of the cup. Little or no rubber flows during the day.

There is usually a good deal of water which exudes from the rubber as it sets and after for a few days. This should be dried off in the sun, or the rubber can be pressed to get it out. The rubber shortly after it sets has a very foul smell, which soon goes off. In a few days the rubber becomes yellow, then dark grey. In Para it seems that the rubber does not set without being smoked in the smoke of burnt nuts. The milk is taken up on a batlet, and turned over and over in the smoke till it is dry, and then peeled off. This does not seem at all necessary here, unless it were necessary for improving the keeping power of the rubber. A sample cake of rubber prepared in the Botanic Gardens in 1893, on being cut across in 1897, was found to be perfectly sound and elastic and the interior even retained the white colour of the fresh rubber. This had been simply prepared in the above mentioned way without the addition of smoking or any other process.

Trees, if carefully cut, recover from their wounds very soon, and in a year or two can be cut again in the same place.

Amount of rubber produced by a tree.—The exact amount of rubber which can safely be drawn from a tree is not yet settled experimentally, but two pounds may be safely reckoned on for a year's tapping of a five or six years old tree if well grown, and it is probable that a larger quantity than this can be taken without harm. Of course much depends on the size of the tree, which

again depends on the soil and position in which it is grown. Further experiments are being made on this point.

A tree nine years old was tapped, April 20th. It was about forty feet tall and a foot through at the base. Cuts were made in it, the edges of which were sliced again every day for a week. The first cut yielded half a pound, and the whole result gave one pound fourteen ounces. Now (June 17), the wounds are partly callused over and the callus already contains rubber.

Price.—Para rubber seems always to command the highest price of any rubber in the market, fetching from half a crown to three and sevenpence a pound under ordinary circumstances. Samples sent from the trees in the Botanic Gardens to a well-known firm of rubber dealers were valued at the highest price then given for rubber. But, with the increased demand and failing supply, even higher prices may be obtained.

When one considers the little expense of planting, tapping and preparing the rubber, it seems clear that, though the amount given by each tree is not large, there should be a large profit made on the cultivation. One may safely say that the cultivation of rubber is at present in its infancy and may reckon that, as its study progresses, we shall obtain much larger results than these, which, I think, I have estimated at a considerably lower valuation than they will be found to bear.

RAMIE.

There is so much interest taken now in ramie that some notes on it may be acceptable to cultivators. The demand for the plant, which has been long neglected here, has been so great lately that it has been very difficult to provide an adequate supply, and ramie promises to be one of the most important cultures in the near future. Hitherto, the difficulty has been to extract the fibre in a satisfactory state, that is to say, clean and strong and economically. Numbers of machines and processes have been invented, and most of these have been but partial successes at most. Lately inventors have again turned their attention to the plant and with, it is alleged, perfect success. But while for some time the interest in the plant had died down, the fibre was still to be found in the market in considerable quantity, and has for a long time now been extensively used in making fabric, adulterating silk, rope-making, and in various ways. Most of this fibre has hitherto come from China, where it appears to be extensively grown, and where one variety is probably native.

There are two forms, or varieties, of ramie, viz., *Bœhmeria nivea*, Hook. & Arn., Ramie proper, or China grass, and the variety *tenacissima*, commonly known as Rhea grass.

The former is a shrub attaining sometimes the height of eight feet, but usually smaller. It has the appearance of a nettle, to which plant it is allied, belonging as it does to the same order, viz., *Urticaceæ*. The leaves are ovate and notched round the edge on fairly long leaf stalks, green above but white beneath. The flowers are very small and borne on long hanging racemes

rom the axils of the leaves. They resemble those of an English ıettle and are greenish white. The stems of the plant are woody, ıbout as thick as a pencil and when full grown are reddish brown ın colour.

The variety *tenacissima* is distinguished by its leaves being greener, sometimes quite green on the backs, and though there ıre forms of it in which the backs are whitish, they have not the onspicuous white colour of the real China grass. The home of his variety is not clearly known, but it occurs either wild or as ı escape from cultivation in Assam, Burma, Bengal and Su- ıtra, whence I have recently received plants. It is generally id that the white-leaved ramie grows in temperate or sub- mperate regions, and the green-leaved rhea in hot climates. he former has been grown successfully at Kew, out of doors, but he latter has failed. Both kinds are in cultivation in the Bota- ıic Gardens in Singapore, and both grow exceedingly readily, the hea, however, does seem to grow a little faster. At the same ime, as Indian rhea is stated to fetch always a lower price than China grass, and the latter grows quite rapidly enough for all ractical purposes here, it would be most desirable to grow ramie ı preference to rhea.

Cultivation.—The plant is always grown from cuttings, unless t is for any reason absolutely essential to use seed. But raising rom seed is easy enough though slow, although as the stems are r should be cut before the plant flowers in a plantation, it would e difficult to procure ripe seed. Almost any bit of the stem if ufficiently woody will grow, but it is best to make rooted cuttings rom the base of the plant. The stems under ground push out sto- ons in all directions which are in old clumps often tuberous, and portions of these speedily emit branches, when cut and planted. Cuttings should be shaded at first till they are well established.

Soil and climate.—Very nearly any soil will do for ramie, except very stiff clay, or very wet soil. Flooding quickly kills it. Partial shade suits it well, but it will grow exposed to full sun. t suffers somewhat from draught, but plants growing in the full un, in very poor soil in the Botanic Gardens not only survived he very hot and dry weather in the early part of the year, but grew steadily though slowly.

The climate of the Malay Peninsula is very well suited for amie, because of the constant rain and absence of a dry season. A constant change from very hot and dry to heavy rain not only loes not suit the plant but spoils the fibre, which grows irregu- arly unless there are no great variations of climate.

Manure.—The plant is certainly much improved by manuring, ood ash and cowdung seem to suit it best. These can be dug ato the ground when it is first prepared for planting and later gain when the plants having overcrowded themselves have to be lug up and separated.

Growth.—The rapidity with which the plants produce stems lepends mainly on the size of the clumps. Rooted cuttings, or

tubers throw up shoots much faster than stem-cuttings. The stems themselves grow very rapidly and attain a height under certain circumstances of about eight feet, but they are best cut when about four feet high. When fit to cut the bark should be brown and the stems quite firm. When over four feet tall the fibre appears to be inferior and to deteriorate with growth.

Enemies.—The only enemy I have seen is a small moth-caterpillar which rolls the leaf up and eats it. It does not appear to injure the plant much, unless it occurs in great quantities, but it spoils the appearance of the plant, and may weaken it by retarding the growth of the stem. It seems to be most abundant in damp grounds. The caterpillar is about an inch long, of a dirty green colour with a black head, and is sprinkled over with scanty hairs. It turns into a chrysalis in the rolled up leaf, and in a few days comes out into a small grey moth belonging to the group *Pyralidæ*. It is one inch wide across the wings, which are grey with yellowish and iridescent reflexions with obscure darker grey spots in three transverse wavy bands. The margins of the wings are fringed and grey. The antennæ are long and slender yellowish brown, the eyes black, the legs long with white coxæ the rest of the legs ocreous yellowish. The body is white below but coloured like the wings above.

The caterpillars can be removed by hand if they are found to be injurious or too abundant.

Extraction and treatment of the fibre.—A very large number of machines and processes for extracting the fibre of ramie have been invented, and fresh ones constantly under trial. Some recent inventions have been stated to be perfectly successful in every way, but not having seen them actually in work, it is impossible to give any opinion as to their value. The Faure machine seems to be the most popular one at the present time.

In one form of ramie grown in sandy loose soil in Penang it was found that the stems were soft and hollow instead of woody and solid, and that by beating them with wooden mallet on a board, the woody fibre could be broken up so as to be easily washed out. Not only was this a very simple process, but more fibre was obtained than by stripping the bark and washing it out as a considerable amount of fibre remained on the sticks after stripping, which could not be got off. Most ramie sticks are too hard for this treatment, and it remains to be seen whether this softer hollow stemmed form would not be more valuable to cultivate than the hard form. It may, however, be merely a form due to its cultivation in poor soil, in which case it would probably on treatment with manure, or planting on richer soil, develop into the stronger woody form.

Uses.—The fibre of ramie may be said the best fibre known for general purposes. In strength it is as strong, and in some trials has proved stronger, than Russian hemp. It presents an unusual resistance to the effects of moisture, and is finer than flax. A small admixture of it improves paper, but it is at pre-

sent too valuable and expensive for use in this way, though waste pits might be disposed of to the paper-manufacturers with profit.

The fibre has long been used for nets and cordage, as well as for sail-cloth, the sails of several of the well-known racing yachts being made of it. It is also used for lighter fabrics, such as silk scarves, dresses, umbrellas, table cloths, lace, etc. From the various uses to which it can be put, it will be readily understood that the demand is practically unlimited, but it is necessary that the fibre should be produced clean at moderate prices, that is to say, about £30 per ton. If this can be done, and there seems no reason why it should not, ramie should ere long be extensively cultivated and exported from this region.

The waste leaves of the plant form an excellent fodder for cattle, which are very fond of it. The Chinese also, by boiling them, prepare a black jelly, of which there is a considrable sale in Singapore and elsewhere.

NOTES ON SUGAR CULTIVATION.

The sugar-cane is cultivated largely in many parts of the Peninsula, for native consumption almost everywhere, and for the manufacture of sugar and rum in Province Wellesley and Perak, and though the sugar trade of the New World is now almost at a standstill, that of the Malay Peninsula seems to be still thoroughly remunerative. Its market is the Eastern region, viz., China and Japan, which are not affected by the beet sugar trade which has done so much to injure the trade of Europe. The depreciation of silver has also done much to assist the trade in this region. At the same time, n view of the collapse of the Western sugar trade, it is important to note any disease or pests attacking the sugar-cane which appear here, and to suggest any methods of eradicating them before they attain proportions too great to be easily dealt with.

Few cultivated plants have as extensive a literature as sugar. Its cultivation and manufacture have been written about most exhaustively, and there are plenty of well-known books on the subject, but till lately comparatively little has been written about its diseases and the insect pests to which it is liable.

As too often happens with crops, so long as the cultivator is making a reasonable profit on the estate, he is apt to overlook any diseases which may occur, but when the times are hard and the pests become an important factor in the depression, he endeavours, sometimes in vain, to defeat an enemy which has gained strength by his neglect.

It must be always remembered, especially in tropical countries, that plants do not naturally grow in such large quantities together as is necessary for cultivation, and that this aggregation of plants of one kind renders them far more liable to disease than if they were grown in a more isolated manner.

Sugar again is exceptionally grown in this way. The fields are necessarily of very large size on flat low ground usually with hardly a tree in sight which may give a resting place to the birds,

which materially aid in the destruction of injurious insects, or which may prevent the wind from sweeping across the fields and strewing them with spores of injurious fungi.

Another peculiarity of sugar cultivation is the great length of time for which the fields are kept continuously under the same crops. Rotation of crops of any kind is hardly known in this country. As a rule, any crop is continuously grown on the same soil till it absolutely fails to be remunerative, either from the ground getting quite exhausted, or from over-supply ceasing to bring a profit, and when it is considered that here we have no frosts to disintegrate the soil, and no winters to compulsorily rest it, few earthworms to turn it over, and no ploughs or deep digging machinery so that the ground gets barely any rest from incessant cropping, it seems wonderful in many cases that we get the crops that we do.

Constant cultivation on the same ground for a long period of years—as much as twenty in many cases—might certainly be stopped by throwing out a field at regular intervals, each field being thrown out after a definite period, say, six or seven years, and fallowed for a year. The objection to this is that a field when left is liable to become full of lalang grass or a creeping grass called *Panicum distachyum* which are both very difficult to eradicate. Beans, or pea-nuts, *Arachis hypogœa*—may be used as a catch crop, and if looked after should soon cover the ground so that these grasses would not come up, and would of course be dug in eventually to manure the soil. The loss of the crop for the year would probably be repaid by the superior out-turn of the sugar for the next few years, and there is sufficient demand for pea-nuts to make it worth while to collect the fruit of the plant.

Deep ploughing by machinery could easily be effected in the cane fields, which are almost invariably flat, and could be readily worked.

The planting of trees near the estates might well be encouraged. There would be no harm at least in planting roadside trees along the paths and roads throughout the estate, while fruit trees and other useful trees might well be planted in waste spots round the coolie-lines and the bungalows. As a rule, one seldom sees any useful birds except swallows and hawks in the sugar-estates, as there is really nowhere for them to roost still less nest in these open fields, and the smaller birds have but little chance of escape from the hawks if they do come. The amount of insect pests that some of the birds destroy is very large, and some encouragement might well be given them.

High class cultivation such as is practised in Europe and North America does not as yet exist in the tropics, though improvements are being steadily made in this direction, but the absence of farm machinery from the peninsula undoubtedly does strike those coming from lands where cultivation is carried on in a more elaborate style.

Yet another point is striking in sugar cultivation. It is one of the very few in which cultivation is carried on entirely as yet

from cuttings, though for the last few years a good deal of experiment has been made in raising sugar from seed with somewhat varied results. Here we have till lately not even attempted to raise cane from seed. Experiments, however, are now being made in this direction, an account of which will be published later.

It is true that some other plants have been in cultivation for many centuries which are propagated asexually only, and do not appear to have deteriorated in any way; as for instance the common red Hibiscus and Jerusalem artichokes. Still I cannot recall any other plant which has been so long and extensively planted on the same ground without any cross-breeding as the sugar-cane, and this practical inbreeding must weaken the strains. In these respects sugar certainly stands alone, and it remains to be seen whether planters can modify these peculiarities of cultivation without undergoing any even temporary diminution in out-turn.

Pests.

Among the enemies of the sugar-cane here the worst are the borer caterpillar, some beetles, rats and one or more kinds of fungus, and of these probably the most injurious in all the fields are the borer and the fungi.

The sugar-cane borer.—The borer is the caterpillar of a small moth known as *Chilo saccharalis*. It is small grub about an inch long when full grown, and white with black spots. The head is hard and red, the body rather slender, with scattered bristles. It attacks the cane by boring into it, and often destroys it by tunnelling through the terminal bud. Sometimes it burrows up the cane for a short way, comes out to the surface and tunnels in again. In this way it does less harm, but injures the cane not only by the actual boring but also by forming suitable entrances for the red smut fungus, which when once introduced seriously injures the whole cane. The caterpillar turns into a chrysalis in the cane and develops eventually into a small buff moth. This moth is about one inch across the wings, of a pale buff colour, the underwings a little paler, in the centre of the upper wings there is a distinct black spot. The body is fairly slender and fluffy, the legs long, the palpi prolonged into a beak. At rest the moth sits with the wings together forming a triangle in the usual method of the group commonly called snout moths. I found caterpillars in the sugar-canes in January and February, and took the moth at the same time at light and flying over grass at night. It probably has no particular season, but may be found in either state all through the year, as constantly happens with many of our insects. I could not find the moth at rest during the day, though I sought for it in piles of leaves, in the grass and among the sugar-cane. However, I have seen it flying before sundown in Singapore.

From careful examination, I am led to believe that the moth lays its eggs, which are deposited with a quantity of fluff round

them, between the leaf sheath of the cane and the cane itself. This being so, it would seem that the more carefully canes are trashed, *i.e.*, the dead leaves are pulled off, the less chance would there be of the moth's laying its eggs on the cane, and did it lay its eggs on the bare cane, they would be washed to the ground by the first shower. In confirmation of this, I would mention that in patches of cane grown for eating by natives, the chilo is comparatively rare, and these canes are much more carefully trashed than is usually done in a large sugar-estate.

In some plantations in the West Indies it has been found remunerative to send boys to cut out bored canes, and destroy the grub in that way, but this would be an expensive work on a large estate. The insect seems to be very widely distributed, probably travelling with sugar-cane as it is carried about from place to place by natives. It occurs in the West Indies, and is abundant in Province Wellesley and Singapore and probably elsewhere in the Peninsula.

The difficulty of dealing with the insect chiefly lies in the large areas of sugar under cultivation. To cut out bored canes might be practicable in some cases, but the best way of preventing the pest becoming unmanageable would be to pay greater attention to the trashing of the canes, and to destroy by burning as much as possible the dead or broken bits of canes and trashing in order to leave as few hiding places for the insect as possible.

The Sugar-weevil (*Sitophilus sculpturatus*, Schŏn).—In some canes I found the grubs and perfect insects of the weevil. They appeared only to occur in broken or injured canes, but there seems no reason to doubt that they would also attack healthy canes and might be productive of great mischief.

The grubs resemble those of most weevils, footless, cylindrical maggots, with a brown horny head. They were about a quarter of an inch in length. The beetle is little more than a quarter of an inch long, with a rather long curved beak. The head and beak are of a dark brown, the thorax is of the same colour and strongly pitted, there is a black line down the centre and one on each side. The wing-cases are dark blackish brown with four strong ridges on each. The under part of the body is grey, thickly dotted over with pits, and the legs are brown.

The Sugar Rhinoceros-Beetle (*Xylotrupes Gideon*).—This large beetle I found two or three times among the sugar-canes, and I was informed at Caledonia Estate, Province Wellesley, that it had been found inside a sugar-cane. It is about two inches long and of a dark brown colour. The head is armed with a strong horn a quarter of an inch long, which ends in a fork, the points of which are curved outwards and backwards. The thorax nearly two-thirds of an inch wide is rounded and in the centre projects into a short stout process, curved forwards. The wing-cases are broad, shield-shaped and blunt, each having a short boss near the tail end. The antennæ are clubbed as is usual in the section of beetles to which it belongs and the legs are long and powerful.

The animal makes a peculiar whistling or hissing sound when it is handled.

This beetle is an ally of the Rhinoceros-beetle (*Oryctes rhinoceros*) which is so injurious to coco-nut palms. The grub probably lives on decaying vegetable matter, either cowdung or rotten trashings and bits of cane, and if allowed to become numerous is quite capable of burrowing into canes or cutting them down.

*The brown Chafer** (*Lachnosternasp*).—Among the roots of a very sick clump of cane I found the grub and perfect insect of a medium sized brown chafer. The grub about an inch long had the usual appearance of cockchafer larvæ. It was white with a brown horny head, rather long fore legs and the body dilated at the tail. The beetle is less than an inch long with a small head, notched in front, short clubbed antennæ, a broad smooth thorax, oblong, smooth, finely dotted wing-cases with fine longitudinal lines, the legs long and hairy. The whole beetle is of a deep chocolate brown, perfectly smooth except the under parts which are covered with a soft down and the legs armed with hairs.

This chafer lies in the evening and comes to light. It is doubtless a root feeder and if abundant might do much damage, the grub eating the roots of the cane.

Mr. CURTIS sent me a number of the same beetle found attacking the roots of nutmegs in Penang, and I have seen it in Singapore.

The White Blight (*Coccus*).—Appears not unfrequently on canes between the sheath of the leaf and the cane, but only in cases where the plant was sickly. Constant trashing would prevent this insect from being very injurious, as it is soon washed off the bare stems by rain, and can only thrive where it is protected by the old leaf sheaths.

The Shot-borer (*Xyleborus perforans*).—A minute beetle which perforates the canes in every direction, riddling them, does not appear to have attacked the canes in the Straits Settlements. It has proved most destructive in the West Indies, and it is to be hoped that planters will watch for it and should it appear take steps to prevent its doing damage. It chiefly lives in old casks and such like half rotten wood, and its introduction in this way should be carefully avoided.

A small gnatlike bug (*Hemipteron*) was exceedingly abundant in the canes in Caledonia Estate, flying in clouds when the cane was being cut. It appeared to be quite harmless, perhaps deriving its nourishment from the leaves of the cane.

Rats seem to be most destructive in some fields, and the mongoose had been introduced to keep them down. The large hawks which were constantly to be seen flying over the fields in the evening, no doubt destroyed a good many, but when the cane is fully grown or nearly so, it is impossible for the hawks to catch them, as the canes protect them.

**Note.*—I am indebted to Mr. C. O. WATERHOUSE, of the Natural History Museum, for the identification of these beetles.

The Red Smut Fungus (*Trichosphœria sacchari*, Massee).—A good deal has been written about this deadly pest, chiefly in the Kew Bulletin, and Annals of Botany, VII, 515 (G. Massee), and also in Dutch papers by Went, &c.

The fungus is reported as very injurious in the West Indies and Java, and is also very plentiful in the Straits Settlements. The mycelium attacks the centre of the cane producing a conspicuous red colouring. At first the fibre bundles in the stem are coloured and appear as red streaks, then the surrounding tissue becomes red, and eventually the cane becomes thoroughly infected, and the centre becomes black and rotten. Not only does the cane in bad cases become quite spoiled, but even where the disease has not progressed far enough for this and the cane is only partly affected, the sugar is altered and there is a considerable loss. Eventually if left the fungus produces its fructification in the form of black raised dots on the rind of the cane, which when fully developed push out black sooty thread-like processes, consisting of the spores.

For some time it was thought that the fungus could only get an entrance into the cane through the boring made by the moth-borer (*Chilo*) or one of the other insects which burrow into it, but though it is very common to see an attack commencing in and round a burrow, experiments made at Kew showed that the fungus could attack the cane through the remains of dead leaf-bases and scars formed by broken branches and roots. In the great majority of cases I have seen the attack seemed to arise from the burrow of a borer.

As the fungus is at least very likely to attack canes when cut or wounded in any way, it is clear that trashing by the aid of a knife should on no account be permitted. Indeed on most estates this is strictly prohibited, but coolies will use a knife to save themselves trouble when they can and this should be carefully looked after.

The cuttings to be planted should be carefully looked over to see if all are sound and healthy. To plant infected cuttings not only spoils the crop, but may produce the infection of others. In many instances I have seen all the canes on a stool stunted and useless or thoroughly infected with disease. Very badly affected cuttings do not grow at all. Examination showed that the original cutting was quite eaten up with the fungus down to the very roots. I have also seen in some fields a large proportion of diseased cuttings put by for planting, none of which were fit for use. In cases where cuttings are taken from Chinese cultivators special care is required, as owing to the carelessness of Chinese planters, disease is, as a rule, much more prevalent than it is in fields under European management.

All diseased canes or parts of canes should be burnt or thrown into water, the former by preference. No pieces should be left on or near the fields. When left upon the ground as is often the case, the fungus very quickly develops spores which are drifted about over the field by the first puff of wind. Nowadays it is

customary in large estates to dip the cuttings before planting into a solution of carbolic acid in water in the proportion of one pint of carbolic acid to one hundred gallons of water (the Queensland solution). This is probably of considerable value in disinfecting the cuttings, but of course will not make cuttings thoroughly impregnated with the fungus healthy or fit to plant.

COFFEE DISEASES.

My attention has been called to two fungus diseases of the coffee which seem to do a considerable amount of damage. The first of these manifests itself first in a cracking of the bark on the branches, usually in the upper part, and descending from the twigs sooner or later makes its way to the base of the branch, which soon becomes black and dies. Careful examination shows at first small white specks scattered on the diseased portion, which seem to develop into leprous pink masses forming patches on the dying twigs. Examination with the microscope shows that these masses are the fruiting portion of a bark fungus pushed up through the cracked bark, and producing large number of minute spores. The fungus, Mr. MASSEE informs me, belongs to a new genus which he calls *Necator* (*i.e.*, the killer), the species being *N. discretus*. It is allied to the destructive *Nectrias* which are parasitic on many trees. It seems seldom, if ever, to destroy the whole coffee tree, but it certainly injures it considerably, and should be looked after.

All boughs affected should be cut off well below the already blackened part, and *rigorously burnt* to prevent the development and dispersal of the spores.

Another fungus disease attacks the base of the stem and roots, quickly causing the death of the tree. In this case it will be noticed that the chief symptom is the thickening of the bark on the larger roots and at the collar at the base of the tree. The bark becomes corky, and whitish and irregularly cracked, or scaly. A section under the microscope shews that the cambium layer, between the bark and the wood is black, and the mycelium of a fungus has crept through it and often has traversed a portion of the wood as well, marking its course by a black line. When the fungus has completely encircled the tree, it is of course quite killed. One of the remarkable points about this disease is that it occurs in patches in the coffee plantation, and does not seem to spread. All the trees in the patch may be killed, and young healthy trees planted there perish very soon. From this it appears clear that the fungus is in the ground, in the form of mycelium or as it is often called spawn. On a tree which had been destroyed by this fungus and then pulled up and thrown away I found a quantity of a species of Irpex, namely, *I. flavus*, fully developed at the base of the stem and at other points where traces of damage from the mycelium could be seen.

This fungus is a leathery white irregular mass of no great thickness firmly attached to the bark of the tree, covered on the

lower side with small sharp points of a canary yellow colou when fresh. This was I think the spore producing part of th fungus (*Hymenium*) and serves to identify the plant.

This fungus probably establishes itself in the ground from th fallen trees destroyed in clearing and left to decay. All coffe trees affected by it should be burnt, and lime should be dug plen- tifully into the ground where the coffee refuses to grow. I Europe where some of these fungi do much damage to trees, it i recommended to dig a trench a foot and-a-half deep round th affected spot and fill it with lime, to prevent the fungus fro spreading, and then treat the area with lime.

Another pest which has recently appeared among the coffee an insect identical with, or closely allied to, the "White Grub of Ceylon. This is the larva of one of the cockchafers, and is white caterpillar about two inches long and much resembling t grub of the coco-nut beetle, soft and dirty whitish in colour wi a large brown head and powerful black jaws. The legs are ve long. The body, especially the tail, is sprinkled with stiff hair and the end of the body is somewhat swollen as is usually th case in the grubs of Lamellicorn beetles, to which group th animal belongs. It is very active, digging its way through t soil with its powerful head and long legs. Mr. GREIG who se living grubs from Klang in Selangor writes : "It begins by eati all the side feeding roots and finishing by eating the tap roots.

The grub closely resembles that of the beetle called by HA DANE the big Patana cockchafer (All about Grub, R. C. HALDAN published by A. M. & J. FERGUSON, Colombo, 1881). Like mo of the larger cockchafers it appears that these animals li chiefly in grassy places, such as are known as Patana in Ceylo and apparently only attacks coffee secondarily, its natural foo being grass root. Guinea-grass is said to attract them. I digging in the Patana they were found at depths of from tw inches to two feet, the chrysalides being buried deeper. HA DANE states that the richer the soil in vegetable matter the mo liable it is to be attacked, and light friable soil generally escap from a bad attack, "Decaying timber seems to attract them. This may be so, but most coffee estates contain a great abundan of decaying timber and at present this is the first instance I ha heard of the appearance of cockchafers in the coffee estates her Perhaps the author is referring to one of the other beetles whi he classes as grub, some of which probably do feed on rotte wood, as well as roots. So destructive a pest as this cockchaf should be attacked without delay, or it will certainly spread other estates in the neighbourhood. It is especially agai this class of pests that barriers of forest between estates a parts of estates are exceedingly valuable both by stopping turning the beetles in their flight and preventing their flyi from estate to estate, and by encouraging birds and other inse eaters to take up their abode in the neighbourhood.

Among other animals HALDANE recommends highly the jung pig which he has seen grub a field of coffee most thorough

The wild pig is certainly highly destructive to tapioca and other tuberous-rooted plants, but I never heard of its injuring coffee trees, and doubt that it would dig them up. If it confines its attention to the grubs in the estate it might well be encouraged. Birds of course will destroy large numbers of these and other insects, and as the cockchafers, like most of the heavy beetles, fly in the evening, our nocturnal birds will be our strongest allies.

No planter, it is to be hoped, will shoot the night-jar (Burong Tukang Kayu) *Caprimulgus Macrurus*, or the Tiptibau (*Lyncornis*), nor any of the owls, the small kinds of which are great insect-eaters.

The common night-jar seems to be absent often from the wooded districts at least for a great part of the year. This is doubtless due to its habit of nesting among bracken which is often wanting in the wooded districts. In forest districts the Tiptibau takes its place, but I doubt that it is as valuable, as it flies much higher and feeds on insects which fly high which beetles as a rule do not do.

BIRDS ESPECIALLY USEFUL IN DESTROYING INSECTS.

It may be useful to call attention to the commoner birds which are of great value in destroying insects and which should be carefully protected by planters.

The value of insectivorous birds cannot be too highly rated. Indeed, were it not for them the hordes of caterpillars, beetles, termites, and grasshoppers would be quite unmanageable. This being so, the insectivorous birds about a plantation should not be shot or molested, and trees should be planted, where necessary, for them to roost and nest in and shade themselves from the great heat of the middle of the day. Where there are no trees large enough for them, as is often the case in coffee and sugar plantations, one sees but few birds, and I have seen in such estates the coffee trees quite eaten up by the caterpillars of various moths especially that of the very destructive bee-hawk.

The eagles and hawks, except in the case of sugar estates where they destroy rats and mice, are likely to do more harm than good by destroying the insectivorous birds, but an exception must be made in the useful little falconet (*Microhierax fringillarius*), a very small hawk no bigger than a black and white robin. It is black and white and may often be seen sitting on the topmost twig of a dead bough, darting off from time to time on its insect prey. It destroys grasshoppers, butterflies and moths.

Of owls there are several kinds, from the large fishing owl (*Ketupa javanensis*) to the little scops owls. The larger kinds eat mice and fruit bats. The smaller ones beetles and moths. The night-jars, or goat-suckers, "Tiptibau" and the "Burong Tukang Kayu," are very valuable assistants, destroying large quantities of evening flying moths and beetles. The swallows eat small insects of various kinds especially winged white-ants.

Bee-eaters, "Berik-Berik" (*Merops philippinensis*), beautiful green and blue birds with pointed tails and long beaks, are great enemies to white-ants, grasshoppers and other insects. They fly in small flocks sitting from time to time on the ends of bamboos or long boughs whence they dart on passing insects. When jungle is being burnt they will often flock round to seize the grasshoppers driven out by the smoke. The racket-tailed Drongo, "Chechawi," a black bird well known for the curious racket-shaped tail-feathers which it wears in the breeding season catches many insects, but as a rule does not go far from the woods except towards evening. The sun birds, often erroneously called humming birds (*Anthreptes* and *Arachnotheres*), usually feed on small insects and spiders, but I have seen one attacking one of the big brown crickets which are often so destructive to seedlings. The black and white robin or magpie robin (*Copsichus saularis*) destroys many insects and especially caterpillars. The white-headed bulbul, "Merebah" (*Pycnonotus analis*), is omnivorous, eating insects of all kinds, but also great quantities of small fruits, especially those of the cinnamon, of which they will very soon clear a tree. It may eat coffee-berries too, but of this I am not sure.

The myna (Tiong) *Eulabes* and the Java sparrow (which has been introduced into Singapore apparently under the impression that it would eat insects) are both exclusively fruit-eaters, as are the starlings, and so are rather injurious than useful. The shrikes, of which we have two or three kinds recognizable by their hooked beaks, are insect-eaters. The commonest is the small brown shrike (*Lanius cristatus*), which is not much bigger than a bulbul. It may often be seen sitting on telegraph wires or the tops of bushes looking out for its prey.

The woodpeckers always appear where there is dead timber standing. They destroy the grubs which live in the wood chiefly those of Longicorn beetles, and as some of these are injurious to the timber of the buildings, while some of the other wood borer injure living trees either as grubs or when developed in the perfect insect, the woodpeckers are to be encouraged. Quails though seed-eaters to a large extent also eat grasshoppers and other insects, and as they run about among the bushes or in the cane fields may clear off a great many insects concealed beneath the foliage. They do not eat berries so they are quite harmless in the coffee. Hornbills and pigeons being fruit-eaters, though the former eat also small animals such as lizards, and sometimes large insects, do more harm than good and may be excluded from the birds worthy of protection.—H. N. RIDLEY.

ON THE CULTIVATION OF POT PLANTS.

Although the cultivation of ornamental plants is of less importance to mankind than that of those used in food, medicine, or the arts, there is no branch of horticulture that appeals to a wider circle in all civilized communities, and it is not surprising

to find that in a climate like ours, and with the style of architecture adopted, no home is considered complete without plants of some sort in pots, both indoors and out.

For the present purpose, we may divide pot plants into two groups—those grown for their foliage, and those grown for their flowers. As a rule the former are much easier to grow than the latter and consequently in many gardens flowering plants are comparatively scarce. One important reason for this is that as a rule all pot plants are grown either under trees, on the verandah, or in a shed especially constructed for the purpose; but in each case the result is the same, an insufficiency of sun for most flowering plants. It may be taken as a general rule, to which there are, however, exceptions, that flowering plants require sun and foliage plant more or less shade.

To attain the highest possible point of cultivation, probably hardly any two kinds of plant require exactly the same treatment in every particular, but in this paper it is not intended to enter into the niceties of treatment required by individual plant, or even classes, but rather to give some information of an elementary nature for the benefit of those interested but whose experience is limited.

Let me say at starting that there is no more a royal road to success in plant growing than in anything else, and the main requirements are patience and perseverance. Any one who takes sufficient interest in the subject and the necessary trouble is pretty sure to succeed, not with every kind of plant attempted, but at least with a sufficient number to make gardening a real pleasure.

Preparation of Soil.

The composition and nature of the soil in which pot plants are grown is of great importance, and one over which we have more control than in the case of other important factors, such as rainfall and temperature, but the majority of amateur gardeners pay insufficient attention to it. Different kinds of plants require different soils and although we cannot obtain such things as good fibrous peat, turfy loam, silver sand, &c., as recommended in English gardening books, sufficiently good substitutes can be manufactured with a little trouble and forethought. Every one desirous of growing plants should always have on hand, more or less in accordance with the requirements of the garden, a supply of leaf-mould; the best soil obtainable in the neighbourhood, which we call loam; mortar-rubbish, and river sand.

The general practice in most gardens here is to carefully sweep up all leaves as they fall and as carefully burn them. A great mistake. All leaves collected should be thrown to a heap by themselves as far removed from the roots of trees as possible, or better still in a brick pit, and there left to decay, turning them over occasionally to hasten the process. It is ready for use when it will pass freely through a one-inch sieve and the manure should be in an equally decayed state. Fresh manure should never be

used, and the leaf-mould should be entirely of rotten leaves without any admixture of grass or other rubbish. Now with these materials a mixture can be made to suit almost any of the plants (except Orchids) found in ordinary collections. The proportions will require to be varied for different plants, but a good mixture which may be termed the "stock" heap, and which will do well enough for a great number of things without any variation, is about equal parts of the leaf-mould, loam, and manure, with a sprinkling of sand, unless the loam is naturally sandy, in which case it may be omitted altogether. On the other hand, if the loam is stiff or clayey add a liberal quantity of sand. Also if the loam is naturally rich reduce the quantity of manure. Mix these well together by turning the heap over several times and it is ready for use. A good plan and one I always practise myself is to keep a heap of this "stock" on hand ready for use and to use it without any addition for ordinary purposes, but adding to it in the case of delicate plants, or where experience has shown the addition to be beneficial, more leaf-mould, loam, sand, charcoal, &c. Further instructions on this point will be given when we come to deal with a few of the more important classes of decorative plants.

Pots and Potting.

Pots that have already been used once should be washed inside and out and dried, before being used again. If this is not done there is often a difficulty in turning the plant out when it becomes necessary to transfer it to a larger pot without disturbing the roots as they will be found to have stuck to the sides

A sufficient amount of drainage material should always be placed in the bottom of the pot to ensure the free escape of water. Pieces of broken pots are best, but broken bricks or tiles will do if these are not on hand. The largest pieces should be at the bottom and a concave piece directly over the whole to prevent its getting blocked up. Drainage is a most important matter, especially so in this country where the rains are at times exceptionally heavy and the native gardener without much judgment in the matter of watering.

The sizes of pots are reckoned in inches, the depth and breadth being approximately the same. A three-inch pot, which is about the smallest size ordinarily used, will require from half to three-quarters of an inch of drainage and a twelve-inch not less than two. In the case of delicate or valuable plants I should generally use more than this. On the top of the drainage material and before putting in any soil place a little rough peat, clean moss, or half decayed leaves, to prevent the finer soil getting down among the drainage and obstructing the free escape of water. Look carefully at the plant to be potted and choose a pot that is neither too big nor too small and in doing this be guided more by the roots than the leaves. Never put a plant with but few roots into a large pot as it is better to begin with a small one and transfer into a larger when that becomes moderately

full of roots. By this means a fresh supply of food is provided at a time when the plant is in a condition to make use of it. In transferring plants from smaller to larger pots an increase of about two inches at a time is generally sufficient. For instance a plant that has been growing in a four-inch pot can be put in a six-inch, and when that becomes full of roots into an eight-inch and so on. In the case of quick-growing hardy plants these measurements may be exceeded to save trouble in repotting so many times; but if the plant is one it is desired to cultivate as well as possible repot as often as necessary. The soil at time of using should be neither too wet nor too dry, that is to say, it should be neither too sticky nor powdery. The latter condition can always be prevented by sprinkling it with a fine rose watering pot before using, but it sometimes happens that one is obliged to use soil wetter than is desirable and whenever that is the case let the plant stand a few hours, after being potted, without watering; but if the soil is in a proper condition you can water immediately. In removing a plant from the pot in which it has been growing turn it upside down and knock it clean out without disturbing the roots. Place it in the centre of the newly prepared pot and fill the space between the ball and the side of the pot, pressing it gently but equally all round.

Watering.

The rainfall is not always what one could desire; sometimes it comes too heavy, and sometimes, when most wanted, not at all. In the latter case the deficiency has to be made good with the watering-can, and I should think there is no question so often asked as the one "How often should I water this plant?" It is a common saying among gardeners that the man who thoroughly understands the use of the watering-can has not much more to learn, and it is the want of this knowledge more than any other that makes the native *kebun* the vexation that he is. All plants even of the same kind, and standing side by side, do not require water in equal quantities or always at the same time, and no rule can be laid down as to how often any plant will require water. Much depends in the amount of root action going on, the state of the drainage, size of the pot, state of the weather, &c. Observe carefully and if the soil looks dry, water and water thoroughly until the water percolates through the bottom of the pot. Do not water again until the soil again shows signs of becoming dry. Avoid constantly giving a dribbling of water which moistens the surface only as the plant either wants water or it does not; if the former then give enough to moisten the whole mass of the soil. With a little practice it is easy to tell whether a plant is dry or not by simply tapping the pot gently on the outside with the knuckles or a bit of stick. If dry it gives out a hollow sound easily recognized after a little practice. Morning and evening are the best times to apply water, but in very hot dry weather it is sometimes necessary to water in the middle of the day, or at least while the sun is still high, and whenever this is the case the foliage should not be made wet.

Sowing Seeds.

Raising plant from seeds is interesting and in the majority of cases by no means difficult. Owing to the uncertainty of heavy rainfall at almost any time of the year it is advisable to raise all seeds of a delicate nature under some sort of covering, as a single heavy shower will often destroy them. Shallow boxes, pots or pans may be used for this purpose, but whichever is used proper provision should be made for drainage as already directed for potting plant.

For sowing seed the "stock" soil may be used, but it must be passed through a quarter-inch sieve, and a small portion for covering the seeds through a still finer sieve. Add more leaf-mould and a liberal proportion of sand to prevent the soil binding. Directly on top of the drainage place an inch or more, according to the depth of the pots or boxes being used, of the refuse obtained in passing the soil through the sieve and on the top of this the finer soil until the box or pot is full to within a quarter of an inch of the top. Make the surface as smooth as possible, water gently but liberally with a fine rose pot and let it stand for an hour c two before sowing the seeds. By watering thoroughly befor sowing the necessity of pouring much water on the seeds imme diately after planting is prevented. The ordinary watering-ca with a tin rose is ill adapted for seeds and a small one with a fin brass rose should be kept for this purpose. In sowing the seeds spread them evenly over the surface and cover with the finest soil mixed with one-fifth its bulk of sand.

As to the depth of covering to be placed on the top of the seeds that depends on the kind sown, but it may be taken as a safe rule that a covering equal to the diameter of the seed is sufficient. It will be seen from this that in the case of minute seeds, such as Begonias, Gloxinias, &c., the covering must be extremely ligl : and in such cases a mere sprinkling of the finest sand is also sufficient. With such fine seeds it is advisable to place a piece of glass over the pot to prevent the soil drying too rapidly, and instead of watering to stand the pot in a bucket of water for a few minutes if necessary. The water in the bucket must not be sufficient to slip over the top of the pot. The period required for seeds to germinate varies considerably. Some annuals germinate in two or three days, while one of our local palms the "Bertam" takes a year, and there are seeds which take much longer than that, but these are extreme cases.

After sowing, water carefully with a fine rose watering-can and place in a cool place protected from the rain, but as soon as the plants appear above ground, remove them to a more open spot, continuing to protect from heavy rainfall until they have acquired strength to stand it. One of the commonest things that happens to seedlings, especially things that germinate quickly, is what is termed "damping," that is, the young plants die off close to the ground and if not attended to immediately the whole lot is often lost. This is generally caused by over-watering,

ut sometimes by a superabundance of moisture in the air. t can sometimes be checked by removing carefully with a ointed stick all the diseased plants and sprinkling among the emainder a little charcoal or dry sand, at the same time les- ening the supply of water, or removing the pot to a drier posi- ion, but the safest thing to do as soon as it commences is to rick them off at once into another pot using the same soil as ad- ised for seeds.

Annuals.

Few plants grow so easily and quickly or make more show when in flowers than annuals, but much disappointment (and sometimes unnecessary expense) is experienced when unsuitable kinds of seeds are obtained as is often the case with beginners. None of the "collections" advertised by the seedsman either in India or England, and of which many residents here have had some experience, are quite what is wanted for this climate. They generally include Mignonette, Stocks, and a number of things that are useless here.

After having tried pretty well everything that is likely to succeed satisfactorily, I recommend the following as the easiest to grow, and the range of forms and colours is practically unlimited :—Balsams, Rose-flowered and Camellia-flowered ; Dianthus chinensis, in its various forms and colours, both single and double ; Coreopsis Drummondii, C. coronata, C. tinctoria ; Celosia, especially the feathered kinds ; Gaillardias, one of the best things possible for cutting ; Marigolds, French and African varieties ; Phlox Drummondii, in a great variety of colours and forms ; Sun-flowers, both the tall growing kind and the miniature ; Torenias, Zinnias, Petunias and Verbenas. The last two do not grow so easily as the others, except during the dry season when they do fairly well. All these may be grown either in pots or in beds, or both. Most of them may be had in flower during the whole year, but to keep up the standard, fresh seeds must be imported pretty often as they degenerate rapidly. Seeds keep very badly in this climate and should be sown as soon as possible after arrival unless, as should always be the case, they are in hermetically sealed tins when they should not be opened until required for sowing.

Although many may be sown at any time, November and December are the best months as they then come in flower during the months when there is least rain and consequently last much longer. The directions already given as regards preparation of soil, pot, sowing seeds, &c., are applicable generally to all these. The main point to be observed is to grow them in the full sun. From the hour they appear above ground plenty of sunlight is absolutely necessary. If kept in the shade for only a few days the plant becomes long and weak and practically spoilt.

There appears to be a pretty general idea among amateurs that plants belonging naturally to a colder climate should be placed under a tree or in some similar place because it is cooler, but

experience proves this to be wrong especially so in the case of annuals.

Cannas.

Among flowering plants suitable for either pots or beds there are few that grow so freely or flower so continuously as Cannas and no plant has been improved so rapidly under the hybridizer's hand. Every year brings out a new set an improvement in some one or more direction on their predecessors. A dwarf habit combined with large flowers are the two points that have been mainly aimed at and the result is marvellous. Until 1892 the only canna grown here was the one with small red flowers (Canna edulis), but in that year we introduced from England some of the best hybrids and have continued to add each year a few of the best new ones. Of the forty or fifty varieties introduced among the best are Koningen Charlotte, Madame Crozy, Comtesse d' Estol, Epi d'Or, Paul Bert, Mons. Corbin, Paul Liguist, Premises de Nice, Countess Elgin and George King. The two latter were raised in India and are equal to the best of those from Europe. Propagation is best effected by division of the roots as they cannot be relied on to come true from seeds. The main requirements for cultivation are plenty of manure, leaf-mould and water and the removal of the stems as soon as they have done flowering to make room for the young ones to come up in exactly the same manner as is done in bananas. As soon as the pots become crowded with roots divide them and plant afresh. They do best during the rainy season, when flowers are, as a rule, scarcer than at any other time, and are therefore invaluable. On Government Hill, where the temperature is lower than that of the plains, the colours become brighter but otherwise they do not do better in any way.

Bulbs, Tubers, &c.

Much of the difficulty, in fact in many cases the impossibility of growing some plants is the want of a winter or resting season but in the case of bulbous or tuberous roots, especially when grown in pots, this is not so great an obstacle, as the necessary rest can be obtained by withholding water and placing the pots in a position where they will not get the rain. Gloxinias, Achimines, Amaryllis, Hæmanthus, Arisæmas, Caladiums, Dahlias, &c., may all be treated in this manner. When they have completed their season's growth which is seen by the foliage beginning to get yellow and unsightly, place them where they do not get the rain, gradually reduce the amount of water and eventually stop it altogether. As soon as the foliage has quite died off, the root may be turned out, with all the soil knocked off, and stored in dry sand for three or four months. Examine them now and then to see whether they are beginning to grow, and if so it is best to pot them. In potting put a tablespoonful of dry sand directly under and around each bulb, which will prevent them from rotting, and do not water them for some days as the moisture in the soil and in the bulb is sufficient to give them a start.

As they grow and increase both in leaves and roots so increase the quantity of water. Although these kinds may all be treated the while same as resting they do not all require the same treatment when growing. Dahlias require the full sun, but Gloxinias require light shade and a dry position, otherwise the leaves damp off rapidly.

Caladiums.

Caladiums are fast coming into favour in Europe and the new hybrids are greatly in advance of the older varieties. For many years the improvement of these plants was left mainly to the French and Belgians, but during the last few years several English gardeners have taken them in hand and been working in the direction of a dwarfer and more compact habit. They are admirably adapted for cultivation in this climate and require no special attention.

More leaf-mould, sand and some broken charcoal added to the "stock" suits them well. Moderate shade only is necessary, the mistake generally made is to shade them too much, in which case the leaf-stalks become drawn and the plant looks untidy, besides never acquiring the same bright colour. Among the best of those recently introduced are Mrs. Harry Veitch, Count de Germany, Ibis Rose, Ladas, Tennyson, John Lang, Assungay, Chelsea Gem, Lillie Buck.

Begonias.

Hardly any plants are generally more grown here than Begonias and especially those with ornamental leaves of the Rex type; but many growers find difficulty in preventing them from rotting off. This is generally caused by over-watering, and sometimes by unsuitable soil. A rather light soil with plenty of leaf-mould and a fair proportion of sand and charcoal suit most of them. A moderately dry spot with protection from the heavy rain is the most suitable place to grow them. The flowering kinds will bear more rain and sun than the fine foliage kinds. Tuberous Begonias which make such a grand show in summer in England are of no use here. I have succeeded two or three times in flowering these, but the result is not equal to the trouble.

Roses.

Although Roses are generally grown in pots they do better planted out in beds. Only a limited number of kinds grow satisfactorily in this climate and even these become exhausted in a comparatively short time. Chinas and Teas are the kinds most suitable to grow and they continue to flower all the year. Hybrid perpetuals are not satisfactory. For pot cultivation three parts of good stiff loam to one part of old cow manure and a little bone manure added will be found to answer.

Stand the pot on bricks or some other hard bottom in a fully exposed position.

Orchids.

There are so many kinds of orchids differing entirely in their habits, manner and seasons of growth, that to attempt to gene-

ralize on their treatment is a matter of some difficulty, for what is suitable for one kind is quite unsuitable for another. There is one point, however, in which they all agree, and that is in requiring plenty of water when growing freely, and little or none when they are resting. As in the case of bulbous and tuberous rooted plants much can be done towards inducing rest at will by withholding water at the proper time, and by this means often forcing the plant to flower. Dendrobiums, especially the Burmese and Indian species, require a long period of drought to flower freely. Under natural conditions they do not get a drop of water for four or five months, except what they receive in the form of dew, and it is during this period that most of them flower. During the growing season they receive abundance of moisture, and these conditions it is necessary to imitate as nearly as possible when under cultivation. Those from Borneo, Java, Sumatra, Philippines and the Malayan Peninsula do not, as a rule, experience such a long drought, and many kinds from these regions can hardly be said to have any decided resting season, consequently they should never be reduced to such a state of extreme dryness. Only a comparatively limited number of Orchids can be grown successfully in this climate, and even these, with a few exceptions, are better grown in England than here. Our choice is naturally limited to such kinds as will stand a high temperatre largely charged with moisture and with very little variation all the year through ; consequently only a few of the South American species, and scarcely any of the Asiatic ones from mountain ranges, are quite satisfactory. The wondrous range of forms and colour, together with the long period during which the greater number of the flowers last is, however, sufficient inducement for any one having a garden to try their hand at Orchids. Among those with good showy flowers, I have found to succeed best in Penang, are Vanda Sanderiana, Vanda tricolor, Renanthera Lowii, Cypripedium Lowii, Dendrobium Dearii, D. superbum, D. thyrsiflorum, D. densiflorum, D. Dalhousianum, D. Veitchii, D. Pierardii, D. Farmerii, Cœlogyne asperata, C. pandurata, C. Cumingii, Peristeria elata, Oncidium ampliatum, Cattleya gigas, Saccolabium guttatum, S. giganteum, Aerides virens, Calanthe Veitchii, C. vestita and C. veratrifolia. This list might easily be extended to a hundred or more species that do satisfactorily, but for the beginner this is a sufficiently extensive selection.

Orchids may be grown either in pots, baskets, or on blocks of wood. As a matter of convenience we grow the greater number in pots made specially for the purpose with greater facilities for the escape of the water than in the ordinary pot, but baskets or blocks of partially charred wood do equally well, and for some kinds are even better. The advantages of pots are that they are more durable, and it is easier to see the condition they are in as regards moisture quicker than can be done in baskets when hung above the level of the eye. Whether grown in pots or baskets great attention must be paid to drainage. The pots should be

filled to not less than two-thirds of its depth with clean broken bricks and lumps of fresh charcoal, the larger pieces at the bottom and smaller ones towards the top. Much soil is seldom necessary, and for many none whatever, broken bricks and charcoal in big lumps being sufficient. Moss and peat, out of which all the fine stuff has been sifted, in equal parts with a sprinkling of sand, is a suitable mixture for many Orchids, but a large body of soil is at no time desirable. For hanging baskets there is nothing better than teakwood, but as it is not always obtainable we here use Chengal which is durable and answers the purpose very well. The proper time for re-potting is just when the plants are commencing to make new growths. In some cases shoots and roots commence simultaneously, but in others the young shoot has made considerable progress before there is any sign of new roots, their nourishment in the meantime being derived from the amount stored up in the previous year's growth. It is difficult to persuade orchid growers in England that there can be any special care or attention necessary to grow Orchids in the regions to which they naturally belong, but as a matter of practice I find it more difficult than to do the same thing in a glass-house in England. Given a knowledge of the natural conditions under which a plant grows there can be, with the exception of sunlight, more closely imitated under glass than in any garden in the tropics. Under glass the two essentials—heat and moisture—are entirely under control, and the suppression of the insect pests comparatively easy.

Palms.

From a decorative point of view no plants are more worthy of attention than palms; they are easy to grow and will stand better in rooms than almost any other plant, while as regards effectiveness there can be no two opinions. Their one fault, if fault it can be called, in the eyes of some is that they are, especially in the earlier stages, slow growers. When thoroughly established with plenty of roots the "stock" soil will do for pretty nearly all palms, but for young plants add more leaf-mould and a little sand. Although many, in fact most of them, will, if gradually accustomed to it, stand the full sun, they are much better growers in moderate shade as they have then a more graceful habit and a darker green colour. When the pots have become quite full of roots they require plenty of water, and if this is attended to quite large plants may be kept in moderate sized pots for many years. If allowed to get excessively dry they soon begin to turn yellow and lose their lower leaves. In addition to the numerous kinds that have been introduced from various countries the jungles in this part of the world are full of interesting species well worth growing in any garden. Some of the rotans in a young state before they begin to climb make very handsome pot plants, but in collecting these or any other palm bear in mind that palms unless quite small transplant very badly. Personally I prefer to get seeds, but as they take some time to germinate many growers have not the necessary patience for this.

Livistona chinensis, L. australis, L. rotundifolia, Thrinax elegans and Pritchardia pacifica are good kinds with fan-shaped leaves and Ptychosperma McArthurii, Cocos plumosa, Oreodoxa regia, Martinezia caryotæfolia and Chrysalidocarpus lutescens are species with a different and more erect habit and are worthy of a place in every garden.

Ferns.

Ferns thrive admirably in this climate and are largely grown, but in the majority of cases the number of kinds is limited. Maiden-hairs (Adiantum) are the favourite class, and of these A. tenerum, A. colpodes, A. trapezi forme and A. Farleyense are the kinds most generally grown. Our local Ferns do not receive the attention they deserve for there are many beautiful and interesting kinds wild in the jungle and by the road-sides. For the majority of Ferns a moist shady place is suitable, but for gold and silver Ferns (Gymnograms) and some of the Adiantums a dry and shady place with protection from heavy rains suit them best. Plenty of leaf-mould and a little old lime-rubbish suits nearly all Adiantums, many of which are found naturally growing on lime-stone rocks. Brick-dust and broken charcoal is also beneficial for many Ferns.

Dracænas.

Dracænas are very effective pot plants and not difficult to grow, but it is only now and then one sees them in perfection, that is, well coloured and with leaves close down to the pot. As a rule there is a foot or two of stem without any leaves. This is easily remedied in the following manner. Remove with a sharp knife a few of the lower leaves, if they are at all bad, and quite close up to the good ones remove a ring of bark about one-eighth of an inch broad right around the stem. Take a good handful of coco-nut fibre and tie it firmly around the stem about two inches below the ring so that by drawing up the ends you can form a cup, into which put a handful or two of light sandy soil or leaf-mould so that it comes in direct contact with the part from which the bark has been removed ; then tie it firmly so that it cannot slip down and keep it moist until the new roots show themselves pushing through the ball of fibre when it can be cut off close below the ball and planted in another pot. This process may be repeated over and over again as often as the plant loses its lower leaves. It will perhaps be said why take all this trouble when by simply cutting off the top and planting it the same end can be arrived at ? It is true that Dracænas grow easily from cutting, but if the top is cut off without being first rooted in the manner just described it will again lose several leaves before it is rooted and be only a little better than the original. This plant is subject to a root disease similar if not identical with one that affects sugar-cane and I find that the addition of a little lime to the soil is beneficial. There are numerous named varieties in cultivation here, all of them good and effective when well grown.

Aroids.

This very large Order, and exclusive of Caladiums which have already been mentioned, includes a great number of very ornamental garden plants with bold, effective, often variegated, leaves, and in few cases striking flowers, though as a rule the flowers are inconspicuous. . All the plants known locally as "kladi," and a good many others, belong to this Order. The most desirable genera for pot culture are Anthurium, Alocasia, Philodendron, Curmeria, Dieffenbachia, Phyllotænium, Aglaonema, and Arisæma, of which there are numerous species. Hardly any plants are more effective than Anthuriums, among which the best are A. Warocquenum, A. crystallinum, A. regale, A. Andreanum and A. Ferrierense. The first three are grown for their fine foliage and the others for their flowers, which are striking and last a long time in condition. Of Dieffenbachias there are many species, the best of which are D. Bausei, D. brasiliensis, D. eburnea and D. Jenmani. When these get tall and unsightly they should be "ringed" in the manner described for Dracænas. Arisæmas are mostly of botanical interest, but there is one, A. fimbriata, the Cobra-head worthy of a glance in any collection, and it is moreover a local plant. Aglaonema costatum is another local plant from Pulau Langkawi with mottled leaves and a pretty dwarf habit. Most of these Aroids have thick fleshy roots and require open free soil. Lumps of charcoal and chopped moss with plenty of leaf-mould suits them all. None of them require much sun, and when once fairly established they require plenty of water.

Plant Sheds.

A plant shed of some sort is to be found in most gardens of any size and although not absolutely necessary where there are trees or other suitable shady places for foliage plants, ferns, &c., is always, if properly managed, a pleasing addition. The cost of a suitable structure may be much or little according to the size and material used. Where expense is no particular object light T or angle iron is undoubtedly a much better material than wood, being neater and more durable, but so far as the cultivation of plants are concerned a few poles and chicks can be arranged so as to serve the purpose as well as the most expensive material. The two forms of sheds most general are the simple span roof and the octagonal and both are well adapted for the purpose. It is necessary whatever form the building may take, that some portion should be attapped in order that there may be a place in which to put such plants as will not stand heavy rain and this must be done with as little obstruction of light as possible and with the prevention of drip. This end is most easily obtained by attapping a width of two or three feet of the lower portion of the roof and covering the upper with chicks or split Nibong. Light and rain will thus be admitted from the centre, while the side beds will be protected from both rain and drip. Whenever practicable it should be quite close to the dwelling, and if possible

accessible directly from one of the principal rooms of the house. In the one or two cases in which this has been done the result has been most effective and the wonder is that the practice has not become more general.

Plant in Rooms.

Although some plants, especially palms, will continue to flourish for a long time indoors, it is advisable to change them pretty often, or if the circumstances do not admit of their being changed they should be put out at night and occasionally in a heavy shower to wash the dust off, and freshen them up. While in the rooms keep them in as light a place as possible for nothing weakens a plant so much as being kept in a dark place. See that they do not suffer from want of water, but at the same time do not over-water them. In the case of Orchids or other plants in flower do not wet the flowers as they will last much longer if kept dry.

General.

To carry out the few suggestions here offered, which only touch the fringe of the subject, no great expenditure of money is necessary, but in a country where everyone has to be his own head-gardener some little forethought and personal interest is absolutely necessary. As a rule there is no difficulty in obtaining manure, but it must be thought of and obtained long before it is actually required for use so that it may become thoroughly decayed. Leaf-mould is more difficult to get and takes a long time to make and a cart-load of fresh leaves amount to very little when decayed. Most of the principal roads in the Colony are planted with shade trees which though not truly deciduous shed large quantities of leaves during certain seasons which are swept up and burnt or carted away by Municipal coolies and would no doubt be given to any one in the neighbourhood who cared to collect them.

In addition to the few tools generally provided a fine rose can for watering seeds and a couple of rotan sieves are indispensable and also a brass syringe for watering Orchids on blocks and giving a general freshening overhead to the whole collection in very dry weather.

C. CURTIS.

Penang, 10*th September*, 1896.

A Select List of easily grown Plants suitable for cultivation in pots and baskets.

Name.	Native Country.	Remarks.
A.—Flowering Plants.		
Achimenes hybrids	South America ..	These require light shade and to be dried off after flowering.
Æschynanthus obconica ..	Perak ..	Flowers red ; specially adapted for hanging baskets.
,, Lobbiana ..	Malaya ..	
Anthurium Andreanum ..	Columbia ..	The majority of Anthuriums are grown for foliage ;
,, Ferrierense ..	Garden hybrid ..	these two have highly coloured spathes.
Arisæma fimbriata	Langkawi ..	Curious plant with a spathe resembling a cobra's hood.
Begonia	Various ..	Many shrubby Begonias do well, but none of the tuberous section.
Beloperone oblongata ..	Brazil ..	Flowers pink. Moderate shade.
Canna, Garden hybrids ..	South America ..	Colours various ; suitable for either pots or beds. Grow in full sun.
Clerodendron nutans ..	India ..	Flowers white. Full sun.
Costus igneus	South America ..	Flowers orange. Requires shade.
Crinum amabile	Sumatra ..	These and many other Crinums (commonly called
,, Kirkii	Zanzibar ..	Lilies) are well worth cultivating.
Chrysanthemum	Japan ..	Grow in full sun.
Crossandra infundibuliformis ..	India ..	Flowers reddish orange and last long in water.
,, undulæfolia ..	Do. ..	Grow in full sun.

A SELECT LIST OF EASILY GROWN PLANTS SUITABLE FOR CULTIVATION IN POTS AND BASKETS—*Continued.*

Name.	Native Country.	Remarks.
Eucharis grandiflora ..	New Grenada ..	E. grandiflora, E. amazonica ; commonly called Eucharis Lily and grown by everybody. The other two have white flowers, but differ somewhat in size and shape.
,, Lowii	Do. ..	
,, Sanderiana ..	Do. ..	
Eurycles amboinensis	Moluccas ..	A bulbous plant with large heads of white flowers ; requires plenty of sun.
Gesnera exoniensis	Garden hybrid ..	There are numerous others. All require to be grown in a place protected from heavy rain, but with plenty of sunlight.
,, refulgens	Do. ..	
Gloxinia	Do. ..	Same treatment as Gesnera.
Hedychium coronarium ..	East Indies ..	Flowers white, sweet scented.
Hæmanthus Kalbreyerii ..	Guinea ..	Large umbels of crimson flowers ; a very desirable plant.
Hippeastrum, hybrids ..	South America ..	Better known as Amaryllis ; colours various ; easy to grow.
Hoya imperialis	Malaya ..	Commonly called wax-flower. Suitable for hanging baskets.
,, multiflora	Do. ..	
Ipomea Horsfalliæ	West Indies ..	Lovely climbing plant with deep rich rose-coloured flowers.
Ixora macrothyrsa	South Sea Islands ..	There are a great many species and varieties of Ixora of many colours. They all require to be grown in sun.
,, sanguinea	Garden Variety ..	
Jasminum gracillimum ..	Borneo ..	Flowers white ; full sun.
,, Sambac	India ..	

Impatiens platypetala ..	South Sea Islands ..	Soft fleshy plants requiring a moderate share of sun and care in watering.
,, sultanii	Zanzibar ..	
Medinilla Curtisii	Sumatra ..	Ornamental flowering shrubs. Moderate shade.
,, magnifica	Philippines ..	
Mussænda frondosa ..	T. Asia ..	Woody shrubs. The coloured floral leaves or bracts are the attraction in this plant. Grow in full sun.
,, luteola	T. Africa ..	
Plumbago capensis	Cape of Good Hope	Flower pale blue. All require rather sandy soil and plenty of sun.
,, rosea	East Indies ..	Flower rose.
,, zeylanica	Do. ..	Flower white.
Poinsettia pulcherrima ..	Mexico ..	Large vermilion bracts. Sun.
Posoqueria multiflora ..	Brazil ..	Shrub; flowers white. Sun.
Ruellia rosea	Do. ..	Small, shrubby. Grow in sun.
Russelia juncea	Mexico ..	Graceful shrubby plants with red flowers. Plant in rather sandy soil.
,, rotundifolia ..	Do. ..	
Salvia splendens	Brazil ..	Flowers scarlet. Moderate shade.
Scutellaria Mociniana ..	Mexico ..	Flowers bright scarlet.
Solanum Wendlandii ..	Costa Rica ..	Flower lilac-blue. Climber.
Stephanotis floribunda ..	Madagascar ..	Grows best in full sun.

B.—Foliage Plants.

Acalypha Macafeeana ..	Fiji Islands ..	Shrubs with highly coloured leaves and equally useful for either pots or beds. Plenty of sun is necessary to bring out the colours.
,, macrophylla ..	Do. ..	
,, marginata ..	Do. ..	
,, musaica	Polynesia ..	
Aglaonema pictum	Borneo ..	Aroids with variegated leaves. Require moderate shade.
,, costatum ..	Langkawi ..	
,, commutatum ..	Philippines ..	

A SELECT LIST OF EASILY GROWN PLANTS SUITABLE FOR CULTIVATION IN POTS AND BASKETS—*Continued.*

Name.	Native Country.	Remarks.
Alocasia cucullata	India ..	Alocasias are of a bold and striking habit; the veins of the leaves in A. Lowii var. grandis are white, A. Sanderiana has the leaves deeply lobed. A light rather sandy soil and moderate shade suits them best.
,, Lowii grandis ..	Perak ..	
,, metallica	Borneo ..	
,, Sanderiana ..	Philippines ..	
,, Sedenii	Garden hybrid ..	
Anthurium crystallinum ..	Columbia ..	Anthuriums are among the most beautiful of ornamental leaved plants and free growers. There are a great number of kinds besides these mentioned worthy of a place in every collection. Open soil, plenty of water and moderate shade.
,, leuconeurum ..	Mexico ..	
,, macrolobum ..	Garden hybrid ..	
,, regale	Peru ..	
,, Warocqueanum ..	Columbia ..	
,, Veitchii ..	Do. ..	
Asparagus plumosus ..	South Africa ..	Better known as the Asparagus Fern. A very elegant plant.
Begonia gogoensis	Sumatra ..	The cultivated forms of B. Rex are innumerable and no class of plant is more largely grown here.
,, Rex varieties ..	Garden hybrid ..	
Bertolonia marmorata ..	Brazil, ..	Very pretty leaved plants, but they require to be grown in a glass case to get the proper colouring.
,, Madam Pynaert ..	Garden hybrid ..	
Caladium, hybrids	South America ..	See special note on these.
Calathia makoyana	S. America ..	Better known under the old name of Marantas. Besides the five mentioned there are many others almost equally good. All require a good deal of shade.
,, massangeana ..	Brazil ..	
,, Sanderiana ..	T. America ..	
,, Veitchii	Do. ..	
,, zebrina	Brazil ..	

Cissus discolor	Java ..	Climber with handsome variegated leaves. Grow in shade.
Codiæum variegatum ..	South Sea Islands..	Crotons are too well known to need any remarks.
Curculigo recurvata ..	Malaya ..	C. recurvata has green leaves; and the variety variegata silvery grey leaves. It is less common than the former.
,, variegata ..	Do. ..	
Curmeria picturata ..	Columbia ..	Dwarf Aroids (now included in the germs Homalomnea) with prettily variegated leaves.
,, Wallisii	Do. ..	
Cyanophyllum magnificum ..	Mexico ..	Leaves 1—2 ft. long, velvety green with white veins. Requires shade.
Cycas circinalis	East Indies ..	Palm-like plants with dark green leathery leaves, suitable for growing in dry dusty places.
,, Rumphii	Malaya ..	
Cyrtosperma Johnstonii ..	Solomon Isles ..	Often known as Alocasia Johnstonii.
Dieffenbachia Bauseii ..	Garden hybrid ..	Tall growing Aroids with handsomely variegated leaves. Plenty of leaf mould and rather dense shade. The juice of all these is poisonous and care should be taken handling them.
,, Bowmanii ..	Brazil ..	
,, brasiliensis ..	Do. ..	
,, Chelsonii ..	Columbia ..	
,, regina ..	South America ..	
Dracæna Goldieana ..	West Africa ..	Leaves marbled with dark green and silvery grey.
,, Sanderiana ..	Do. ..	Beautifully variegated plant.
,, (Cordyline) terminalis	South Sea Islands	This is supposed to be the parent of the numerous varieties of Dracæna cultivated here.
Fittonia Verschaffelti ..	Peru ..	Dwarf plant with prettily variegated leaves, specially adapted for rock-work shade.
,, argyroneura ..	Do. ..	
,, Pearcei	Do. ..	
Heliconia rubra	South America ..	Large, quick growing, highly ornamented foliage plants. Moderate shade and plenty of water.
,, aureo-striata ..	Do. ..	
,, metallica	Do. ..	

A SELECT LIST OF EASILY GROWN PLANTS SUITABLE FOR CULTIVATION IN POTS AND BASKETS—*Continued.*

Name.	Native Country.	Remarks.
Kæmpferia Gilbertii ..	Burma ..	Plants belonging to the Ginger family; suitable for rock work.
,, Parishii ..	Langkawi ..	
Leea amabilis	Borneo ..	A shrub; leaflets deep bronzy green with a white stripe down the centre. A very handsome plant. Shade.
Nepenthes albo-marginata ..	Penang ..	Pitcher plants. There are many others equally good and all are best adapted for hanging baskets. The pitcher is only a portion of the leaf.
,, phyllamphora ..	Do. ..	
,, Rafflesiana ..	Singapore ..	
,, sanguinea ..	Perak ..	
Nephthytis picturata ..	Congo ..	Aroid with variegated leaves.
Panax elegans	Queensland ..	Panax and Aralias are very nearly allied They are useful for growing in sunny places.
,, laciniatum	South Sea Islands ..	
Pandanus Veitchii	Java ..	Leaves bordered with broad bands of pure white.
Paullinia thalictrifolia ..	South America ..	Climber.
Peperomia marmorata ..	Brazil ..	Dwarf ornamental leaved plants, somewhat like Begonia, and requiring same treatment.
,, Saundersii ..	Do. ..	
Philodendron gloriosum ..	Columbia ..	Fine leaved plants in the way of Anthuriums, but generally climbing. Shade, moisture and an open soil.
,, Mamei ..	Ecuador ..	
,, Selloum ..	Brazil ..	
,, speciosum ..	Do. ..	
,, verrucosum ..	Ecuador ..	
Phrynium variegatum ..	Singapore ..	A variety of the Arrow-root, Maranta Arundinacea, beautifully variegated plants.

Phyllanthus nivosus ..	South Sea Islands	Pretty dwarf shrub. Sun.
Phyllotænium Lindenii ..	New Grenada ..	Ornamental Aroid. Shade.
Piper porphorphyllum ..	Malaya ..	Climbing Peppers with variegated leaves; both require shade.
,, rubro-venosa ..	Moluccas ..	
Pothos aurea	Solomon Isles ..	Strong growing plant suitable for a pillar or tree stump.
Schismatoglottis crispata ..	Borneo, ..	Dwarf Aroids with ornamental leaves; grow in shade.
,, longispatha ..	Do. ..	
Strobilanthes Dyerianus ..	Burma ..	Beautifully variegated leaves and a rapid grower.

C.—FERNS.

Adiantum æthiopicum ..	Africa ..	The genus Adiantum includes all the kinds commonly known as Maidenhair Ferns. All of them are beautiful for arranging with other plants in rooms, &c., and most of them for cutting to mix with flowers for table decoration, &c.
,, Bauseii	Garden variety ..	
,, colpodes ..	Peru ..	
,, concinnum ..	South America ..	
,, Flemingii ..	Garden variety ..	
,, Collisii	Do. ..	
,, cuneatum ..	Brazil ..	
,, Lawsonianum ..	Garden variety ..	
,, curvatum ..	South America ..	
,, cyclosorum ..	Ecuador ..	
,, decorum ..	Peru ..	
,, Farleyense ..	Barbadoes ..	A few kinds are found in most gardens, the most common being A. colpodes, A. tenerum and A. trapeziforme.
,, Fergusonii ..	Ceylon ..	
,, formosum ..	Australia ..	
,, gracillimum ..	Garden variety ..	
,, Lathomi ..	Do. ..	

A SELECT LIST OF EASILY GROWN PLANTS SUITABLE FOR CULTIVATION IN POTS AND BASKETS—*Continued.*

Name.	Native Country.	Remarks.
Adiantum macrophyllum ..	South America ..	A. cuneatium is known locally as the English Maidenhair (but it is not the true British Maidenhair) and A. formosum as the Australian Fern.
,, bipinnatum ..	Do. ..	
,, Pacotii	Garden variety ..	
,, peruvianum ..	Peru ..	
,, polyphyllum ..	Columbia ..	
,, Seemanii ..	C. America ..	
,, tenerum	Mexico ..	
,, tetraphyllum ..	T. America ..	
,, trapeziforme ..	West Indies ..	
,, Veitchianum ..	Peru ..	Light soil, plenty of water when growing freely. Protection from very heavy rain, and a light airy but not too sunny a position are the principal requirements for successful cultivation.
Aspidium triangulum ..	West Indies ..	
Asplenium Belangerii ..	Malay Peninsula ..	
,, cicutarium ..	T. America ..	
,, laserpitiifolium ..	Malaya ..	
,, longissimum ..	Penang, &c. ..	Very useful for hanging baskets.
,, macrophyllum ..	Do. ..	
,, nidus ..	Do. ..	Bird's-nest Fern.
Blechnum brasiliense ..	Brazil ..	Large bold Fern requiring shade and moisture.
Brainea insignis	Pulau Sembilan ..	Small growing tree Fern not known to occur in this region until recently; grows well.
Cyathea spinulosa	Penang ..	Large tree Fern; at low elevations.
Davallia affinis	Ceylon ..	These do well for hanging baskets.
,, elegans	Tropics ..	
,, fijiensis	Fiji ..	

Davallia pallida	Borneo ..	Better known as D. Mooreanus or the Sarawak Fern.
,, tenuifolia Veitchiana ..	Penang ..	Locally known as the Lace Fern.
Dicksonia Barometz ..	Do. ..	Handsome tree Fern.
Gymnogramme calomelanos ..	Tropics ..	Gold and silver Ferns, of which there are a great number of cultivated garden varieties, some of them beautifully crested. A dry airy situation with protection from heavy rain is necessary.
,, chrysophylla ..	Do. ..	
,, peruvianum ..	Peru ..	
,, schizophylla ..	Jamaica ..	
Lygodium dichotomum ..	Malaya ..	Climbing Ferns not often seen in gardens, but deserving of a place.
,, polystachyum ..	Do.	
Nephrolepis pluma	Madagascar ..	Large easily grown plant, useful for decorating rooms, &c.
,, rufescens tripinnatifida	Garden variety ..	
,, davallioides furcans ..	Do. ..	
Onychium auratum ..	Perak ..	A very handsome gold Fern found in the neighbourhood of Kuala Kangsa, Perak.
Platycerium æthiopicum ..	Guinea Coast ..	Stag's-horn Ferns. These succeed best fastened to a block of wood or the stump of a tree, but they can also be grown in hanging baskets if desired. Moderate shade.
,, biforme ..	Penang ..	
,, grande ..	Langkawi ..	
,, Hillii	Queensland ..	
Pteris argyrea	Malaya ..	A beautifully variegated form of P. quadriaurita.
,, cretica var. albo-lineata ..	Tropics ..	Useful decorative plants, requiring moderate shade.
,, palmata	T. America ..	
,, semi-pinnata	India ..	
D.—PALMS.		
Borassus flabelliformis ..	India ..	The Lontar.

A SELECT LIST OF EASILY GROWN PLANTS SUITABLE FOR CULTIVATION IN POTS AND BASKETS—*Continued.*

Name.	Native Country.	Remarks.
Calamus sps.	Malaya ..	"Rotan" suitable when young for pots.
Caryota mitis	Penang, &c. ..	These all grow to a considerable size but, as in the case of most other palms, can be kept in pots or tubs for years if watering is not neglected.
„ sobolifera	Malacca ..	
„ urens	India ..	
Chrysalidocarpus lutescens ..	Madagascar ..	A beautiful palm better known as Areca lutescens which is the old name.
Cocos plumosa	Brazil ..	Two very handsome palms. C. Weddeliana is somewhat slow growing and delicate.
„ Weddeliana	S. America ..	
Cyrtostachys lacca	Malaya ..	Red-stemmed palms, "Pinang Rajah" of Malays.
„ Rendah ..	Do. ..	
Diplothemium maritimum ..	Brazil ..	Distinct dwarf species.
Elæis guineensis	Guinea ..	Oil palm. Nice pot plant while young.
Geonoma gracilis	Brazil ..	Small growing graceful plant.
Hedyscepe canterburyana ..	Lord Howes Island	Leaves pinnate and thick.
Heterospathe elata	Moluccas	Elegant plant.
Howea Belmoriana	Lord Howes Island	Largely grown for decorative purposes in England.
Hyophorbe amaricaulis ..	Mauritius.	
Latania Commersonii ..	Do.	
Licuala acutifida	Penang ..	"Pinang Lawyer." Very slow.
„ grandis	Borneo ..	One of the handsome fan palms known.

Livistona altissima	Java.		
„ australis	E. Australia ..	}	Very ornamental palms with fan-shaped leaves, specially adopted for the decoration of rooms.
„ chinensis .. .	S. China ..	}	
„ Hoogendorpii ..	Java.		
„ olivæformis ..	Do.		
Martinezia caryotæfolia .	New Grenada ..		Underside of leaves covered with long black spines.
Maxmiliana Martiana ..	S. America ..		Good for pots when young.
Oncosperma tigillaria ..	Malaya ..		"Nibong" of Malays.
Oreodoxa oleracea	W. Indies ..		Cabbage Palm.
„ regia	Cuba.		
Phœnix rupicola	India ..		One of the prettiest of the Date Palms.
Pinanga maculata	Malaya ..	}	Local species worth collecting and growing.
„ malaiana ..	Penang, &c. ..	}	
Pritchardia pacifica ..	Pacific Islands ..		Requires plenty of shade.
Ptychosperma MacArthurii ..	New Guinea ..		Very free growing kind.
Rhaphis flabelliformis ..	S. China ..		Pretty dwarf kind.
Rhopalostylis Bauerii ..	Norfolk Island ..	}	Also known as Areca.
„ sapida	N. Zealand ..	}	
Sabal Adamsonii	North America ..		Dwarf Fan Palm.
„ Blackburniana ..	Bermudas ..		Fan or Thatch Palm.
Stevensonia grandifolia ..	Seychelles ..		Leaves large, very handsome.
Thrinax radiata	Trinidad ..		Very pretty plant.
Verschaffeltia splendida ..	Seychelles ..		Handsome large leaf kind.

A SELECT LIST OF EASILY GROWN PLANTS SUITABLE FOR CULTIVATION IN POTS AND BASKETS—*Continued.*

Name.	Native Country.	Remarks.
Wallichia caryotoides ..	India ..	Dwarf growing species.
,, disticha ..	Do. ..	Tall, habit resembling that of the Traveller's Palm.
F.—ORCHIDS.		
Ærides affine	India ..	Flowers delicate rose.
,, crispum	Do. ..	Flowers white suffused with purplish rose.
,, Fieldingii	Assam ..	The Fox-brush Ærides.
,, Lobbii	Burma ..	Flower white in the centre, tinted with rose outside.
,, odoratum	India ..	Flowers creamy white.
,, quinquevulnerum ..	Philippines ..	Flowers white, with reddish crimson blotches.
,, suavissimum ..	Malaya ..	Fowers white, tipped with deep lilac.
,, virens	Do. ..	Flowers white, tipped with rosy purple.
Angrecum eburneum ..	Madagascar ..	Flowers white. These grow well in Penang.
,, Sanderianum ..	Do. ..	
,, sesquipedale ..	Do. ..	
Arachnanthe Lowii ..	Borneo ..	Better known as Vanda Lowii.
,, moschifera ..	Java ..	Requires to be grown in full sun.
Bulbophyllum Beccarii ..	Borneo.	
Calanthe Regnieri	Siam ..	These generally flower about November, December. After flowering they should be kept dry for two or three months and be reported as soon as they show signs of making new growths.
,, rosea	Burma ..	
,, rubens	Langkawi ..	
,, Veitchii	Garden hybrid ..	
,, vestita	Mergui, &c. ..	
Cirrhopetalum Medusæ ..	Malaya ..	Flowers straw-coloured in dense heads. Very curious.

Cœlogyne asperata ..	Perak, Borneo ..	A free growing species with large cream coloured flowers.
,, pandurata ..	Do. ..	Flowers green and black, curious and distinct.
,, Parishii ..	Burma ..	Flowers brown and yellow.
Cypripedium Lowii ..	Borneo ..	Slipper Orchids, "Bunga Kasut" of Malays. There are a great number of species suitable for cultivation here.
,, niveum ..	Langkawi ..	
,, Stonii ..	Borneo ..	
Dendrobium aggregatum ..	Burma ..	Flowers yellow ; a small plant.
,, Dearii ..	Philippines ..	Flowers white ; very durable.
,, albo-sanguineum ..	Burma ..	Flowers white and crimson.
,, bigibbum ..	Do. ..	Flowers rosy-pink much like D. phalænopsis.
,, chrysotoxum ..	Do. ..	Pseudo-bulbs thick raceme 6—12 inches long. Flowers yellow.
,, cretaceum ..	Do. ..	Flowers chalky white.
,, crystallinum ..	Do. ..	Flowers white, tipped with rose or purple and lasting a long time.
,, Dalhousianum ..	Do. ..	Flowers buff with two large blotches of dark crimson on the lip. Free grower and certain to flower.
,, densiflorum ..	Do. ..	Flowers orange colour.
,, Farmerii ..	Do. ..	Flowers in pendulous racemes as in D. chrysotoxum and D. densiflorum, straw coloured, tinged with pink.
,, fimbriatum ..	Do. ..	Flowers orange, the lip bordered with a moss like [fringe.
,, formosum ..	Do. ..	Flowers large white with an orange throat.
,, macrophyllum ..	Java ..	Flowers greenish yellow. Also known as D. Veitchii.
,, moschatum ..	Burma ..	Creamy white flowers tinged with rose. A good grower.
,, Pierardii	Do. ..	Pseudo-bulbs pendulous. Grow in basket or on a block of wood.

A SELECT LIST OF EASILY GROWN PLANTS SUITABLE FOR CULTIVATION IN POTS AND BASKETS—*Concluded.*

Name.	Native Country.	Remarks.
Dendrobium phalænopsis ..	Solomon Isles ..	Very beautiful flowers in the way of D. bigibbum but larger.
,, suavissimum ..	Burma ..	Pseudo-bulbs similar to D. chrysotoxum. Flowers yellow with blotch of brownish purple on lip.
,, superviens ..	N. Australia ..	Flowers light purple or claret.
,, superbum ..	Philippines ..	Flowers pink tinged rose 3—4 inches across. Grow on a block.
,, thyrsiflorum ..	Burma ..	Flowers in large pendulous racemes. A good grower.
,, tortile ..	Mergui ..	Pale almost white flowers suffused with rose.
Grammatophyllum speciosum ..	Malaya ..	A large growing species and require to be grown in full sun.
,, multiflorum	Moluccas ..	Flowers green, brown and purple. Grow in a pot with peat and moss.
Habenaria carnea ..	Langkawi ..	Both these require resting, in the same way as Calanthos. When growing H. Susannæ requires full sun and plenty of water. The flowers of H. carnea last from six to seven weeks.
,, Susannæ ..	China, Timor ..	
Lycaste aromatica ..	Mexico.	
Oncidium ampliatum ..	C. America ..	All the Oncidiums are New World plants and the predominating colour is yellow. The four included in this list have done the best of the dozen or so species introduced and are much admired.
,, hæmatochilum ..	N. Grenada ..	
,, lanceanum ..	Demerara ..	
,, papilio	Trinidad ..	
Peristeria elata	Panama ..	Dove or Holy Ghost Flower; grows very easily in a pot.

Phajus albus	Burma ..	These two are commonly known as Thunias. They require to be rested after flowering and watering recommenced when the growths start.
,, Bensonii	Do. ..	
,, grandifolius	China, &c.	
Phalænopsis amabilis ..	Philippines ..	Phalænopsis being indigenous to this region it would seem reasonable to suppose that there is no difficulty in growing them, but that is not exactly the case. In some spots they do well, while in others only a short distance removed they fail entirely for no apparent reason.
,, esmeralda ..	Siam ..	
,, grandiflora ..	Borneo, Java ..	
,, Schilleriana ..	Philippines ..	
,, sumatrana ..	Sumatra, Perak ..	
,, violacea ..	Do. ..	
Platyclinis filiformis ..	Philippines.	
,, glumacea ..	Do. ..	Flowers white, sweet scented.
Renanthera coccinea ..	China ..	These require to be grown on a hardwood post or tree in the full blazing sun. It is useless trying to flower them in a shady place.
,, alba ..	Singapore ..	
,, matutina ..	Borneo ..	
Saccolabium Blumei ..	Malaya ..	May be all grown in pots, hanging baskets, or on blocks of wood in only moderate shade. All are pretty.
,, curvifolium ..	Burma, &c. ..	
,, Hendersonianum ..	Borneo ..	
,, giganteum ..	Burma ..	
Trichoglottis fasciata ..	Langkawi ..	Free flowering species.
Vanda insignis	Moluccas ..	There are many other Vandas that do well here, but these are the best. V. suavis and V. tricolor require rather more shade and water than the other two.
,, Sanderiana	Philippines ..	
,, suavis	Java ..	
,, tricolor	Do. ..	

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STRAITS SETTLEMENTS.

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VEGETABLES.

From a hygienic point of view, the use of vegetables in the Straits is generally very much neglected. Few persons ever cultivate any at all, but restrict themselves to a few imported kinds and a small number of native ones often very inferior in quality. Attempts have been made, both in Penang and Singapore, by supplying seed of suitable English kinds free of cost to some of the Chinese market gardeners, to induce them to cultivate these vegetables regularly, but without much success. This is partly due to the Chinese disinclination to take up anything new, and also to the fact that there are comparatively few customers who are prepared to pay a good price for good vegetables; and this not only deters the gardeners from cultivating newly-introduced vegetables, but prevents any material improvement in native kinds. Many native vegetables, partly wild as they are, are far superior to the original wild forms of the best European kind, but, as beyond a certain point, there has been no attempt to improve them by selection and competition, they are still very little altered from their original wild forms.

Of late years, however, the chocho has become quite common in Penang markets, and locally cultivated tomatoes, green peas and artichokes have appeared in the Singapore markets, but only very fitfully. A good many vegetables can be grown on the hills, which are utter failures on the plains, where several of the tuberous kinds, such as turnips, kohl rabi, beet and potatoes, run entirely to leaf and do not produce anything eatable at all. Mr. CURTIS, after several years' experience in growing vegetables on a small scale on Penang Hill at an altitude of 2,500 feet, and trying pretty well everything that had a probable chance of succeeding, came to the conclusion that the kinds which could be grown there with a reasonable amount of care and expense were artichokes, asparagus, beet, cabbage, carrots, celery, cucumbers, chocho, endive, kohl rabi, lettuce, leeks, tomatoes and turnips, with most of the pot herbs, such as mint and thyme. The ground on the top of Penang Hill is, however, limited, and the expenses of carriage of manure, etc., to the garden from the foot of the hill are very large, but it may be hoped that when this and other hills of the Peninsula are made more accessible, we may be able to increase considerably the cultivation and use of European vegetables.

In the plains, a certain unmber of the European vegetables can be grown with success, and there are also a large number of native vegetables, many of which, excellent when well cooked, are hardly known at all to Europeans, who seem quite content with imported potatoes and tomatoes, and native spinach, lablab beans, brinjals and okra, in fact with the cheapest and easiest things the cook can get. The importance of good and varied vegetables in a hot climate cannot be over-rated, and there is no

reason why there should not be a more varied display on the tables of private houses.

Choice of Site.

In choosing a site for a vegetable garden, an open sunny spot, well removed from the shade, drip and roots of trees, is indispensable. A rich well-drained soil is also desirable, but is not so important as the absence of trees, as these are matters that can, to a certain extent, be remedied by the application of manure and labour. An easterly aspect is also the one to be preferred when there is any choice in the matter, as is often the case, especially on the hills, where the bungalow is generally built on the crest.

Manure.

Farm-yard manure when obtainable is best for nearly all vegetables, and if well decayed can hardly be applied too freely. On the hills, unless cattle are kept, there is always a difficulty in obtaining enough, on account of the cost of transport, but on the plains this does not apply. Artificial manures such as guano, bone dust, and decayed prawns may be used to great advantage, either in a liquid form during dry weather, or worked in among the crops during showery weather.

Rotation of Crops.

Two successive crops of the same kind of vegetable should never be grown on the same ground. For instance, onions should be grown on ground that had been previously planted with peas or potatoes, and so on.

Season for Planting.

The most favourable season for planting is the months in which there is least rain, and this varies in localities no great distance apart. In Penang November to February are generally the driest months, and the principal sowing is made towards the end of November. Subsequent sowings are made up to the end of February, and a few things, such as carrots, leeks, lettuce, maize and cabbages, may be grown all the year round, if protection from heavy rain is given to the seeds and young plants during the earlier stages of their growth.

Sowing Seeds.

All small seeds, whether sown in boxes or beds, should be covered with a layer of rather light fine soil, varying in thickness according to the size of the seeds, in order that the young seedlings may readily find their way through it. In most cases they will also require, except during the most favourable weather, some protection during the first ten days or a fortnight from heavy rain. The covering of attaps, or whatever is used, must be movable so that it can be put on or taken off quickly, and on no account be kept on longer than is absolutely necessary. This is a most important point. If the seedlings are kept covered too

long, they become drawn and weak, and no after attention will render the crop of much value. Too much stress cannot be laid on the fact that in this climate, owing to the very heavy rainfall, special care is necessary with seedlings of most plants during the earlier stages of growth. In the case of quick-growing things like vegetables this only extends over a few days, but any one not prepared to take the necessary precaution during that short time, should only plant during the dry season, and even then there is always a chance of heavy rain.

As it is much easier to protect seeds sown in boxes than when sown in beds, we adopt this method for a good many things, but great care must be taken that the boxes are exposed to plenty of sunlight to prevent drawing Lettuce, beet, celery, cabbages and some others, do well raised this way, and transplanted in beds as soon as they are big enough to handle. Some other things, such as carrots for instance, cannot be transplanted with success, as they never make a good root afterwards.

Transplanting.

The beds having been previously prepared, transplanting should, if possible, be done in the evening, and unless the weather is dull, the young plants will require shading for an hour or two in the middle of the day for the first few days. If the weather is dry, attention must be paid to watering in the morning or evening, or both if necessary, but avoid watering in the middle of the day.

Insect-pests.

Insects of many kinds are very destructive to vegetables. I remember one instance, in which bed after bed of English beans and peas was utterly destroyed, as the plants were setting fruit, by small maggots of some fly, not unlike the destructive celery fly of England. I attempted to rear the insect to identify it, but failed, nor was I able to stay the destruction. The maggots bored up the stems from the base near the roots, and the plants quickly withered and died. I never saw another case of it, and suspected that the insect was accidently imported with the seed,

Blight (*Cocci*) often appears in wet spots, and should be destroyed by tobacco-water or tuba. The large brown crickets are very destructive to young plants, especially to seedlings just above the ground. I have known a whole bed of pumpkin seedlings mown down by the jaws of these animals in a single night. These animals are almost all nocturnal in their habits, concealing themselves in long grass or rubbish during the day. It is advisable, therefore, to keep the ground near the vegetable garden clear of thick grass and weeds, and to destroy all piles of rubbish, decaying sticks and leaves, and such like. The mole cricket, which burrows in the ground and bites through the roots of plants of all kinds is very harmful. It can usually be detected by the piercing whirring noise it makes as it sits in the mouth of its hole in the evening, and can be dug out. Tomatoes are apt to be destroyed by the common red milleped, which appears to bite

through the roots. They are also very liable to the well-known tomato disease, a fungus known as *Peronospora*. Caterpillars and small beetles, also often attack many vegetables, biting holes in the leaves, especially of the pumpkins and gourds.

Some species of ants are also very troublesome in carrying away the smaller seeds to their nests where they eat them.

For caterpillars and blight, the most easily obtained insecticide is tuba water, which is much used by the Chinese gardeners. The roots of the tuba plant (*Derris elliptica*) can be bought in the markets. They are pounded in water, till it becomes milky in appearance, and the decoction is sprinkled over the plants. It must be remembered that tuba is poisonous, and should not be applied to any vegetable for some days previous to its being required for the table. Tobacco water and soft soap, or phenyl dissolved in water till of the appearance of good milk, are probably the best insecticides for blight or aphides, the latter insects, however, are not very common here.

For a good portion of this paper, especially with the portions dealing with the European vegetables, I am indebted to Mr. CURTIS, who has for many years cultivated English vegetables on Penang Hill, at an altitude of 2,000 feet.

HERBS.

But few of the well-known English herbs are cultivated here, although it would be possible to grow many of them.

Parsley.—Is always in demand. It is readily grown from seed in boxes of earth, but as it never seems to produce seed here, it is necessary to import the seed for each cultivation, though it will last for some years if carefully treated. It is grown in boxes.

Rue.—Is often grown by the Chinese, usually in pots, as a curiosity or as a medicine. It is readily grown from cuttings, but seems to have almost died out as a seasoning herb in Europe, though formerly very popular.

Sweet Basil, "*Selasih*," *Ocymum basilicum*.—A small shrub with very sweetly scented leaves and white flowers, which is often cultivated by natives and used as medicine, for scenting clothes, etc. It grows very readily from seed, and forms a pretty, sweetly aromatic bush. Basil is a popular herb on the Continent as a seasoning herb, and there are a number of cultivated varieties grown in France.

Mint and *Thyme*.—Are easily raised from seed, and the former is often cultivated by the Chinese in Singapore. Thyme is less successful in the plains than on the hills.

Coleus aromaticus.—A fleshy, rather large-leaved, aromatic herb, with oval, green serrated leaves, readily cultivated from cuttings. The leaves are used for flavouring claret and other cups, and sometimes, instead of mint, for mint sauce.

SALAD HERBS.

A good number of these can readily be grown here, and as the importance of fresh green vegetables, especially in the tropics, is

great, it is very remarkable that so little attention has been paid to these.

Water-cress.—Is raised from cuttings and can be grown in boxes, or in damp spots near water. If grown in water it is apt to become coarse. It is of very rapid growth, and for this reason alone, should be one of the most common salad plants in the country. It is, however, very rarely seen now in European houses. Cuttings are planted in damp black soil, or small ditches may be dug in low-lying spots, and the cress planted along the sides. It requires no manure. As grown here, the leaves are often rather small, and though larger plants can be grown by increasing the water-supply, the flavour is apt to be too pungent and coarse.

It can be used either as a salad herb, or as a spinach by boiling, and makes an excellent dish in this way.

French Sorrel.—Has been cultivated successfully here, and very good samples have been exhibited at the local Flower Shows. It is a salad herb seldom used in England, but popular in France, where it is generally eaten boiled. It makes an excellent addition to a salad in small quantities.

Endive.—Is as easily grown as lettuce, and forms an important addition to salads. The seeds may be sown in beds or boxes of light soil, and afterwards transplanted at about nine inches apart. As soon as they are full grown, they should be tied up to make them crisp. Green curled and Batavian are the two best varieties.

Kohl Rabi, or *Knol Kohl.*—Comes between the cabbage and turnip, is a fairly good substitute for the latter, and grows much better. Good soil that has been well manured for a previous crop suits it best, and liquid manure twice a week during dry weather. Seeds may be sown either in beds or boxes, and the young plants transplanted when about two inches high, at about nine inches apart. In favourable weather they are fit for use in about ten or eleven weeks, and should be used before they get too old. The best varieties are the Green Vienna and Purple Vienna. It can only be grown successfully on the hills at a height of 1,000 feet and upwards.

Lettuce.—With a little care and attention, lettuce may be had in season all the year. To attain this, frequent sowings must be made, say every fortnight. It is useless sowing a great quantity of seed at one time for if the crop is not used up quickly it is wasted. Lettuces transplant well, and a pinch of seed sown in a box or large pot every fortnight or three weeks, and pricked out as soon as large enough to handle, at about eight or ten inches apart, will keep up a regular supply for any ordinary household. They are generally ready to plant out in the beds in about fourteen days, and for use in about seven or eight weeks. A light, rich, deep soil, and liquid manure twice a week if the weather is dry, is what they require. The Cos lettuces do not thrive so well as the cabbage, and of the latter there is none equal to Tom

Thumb. The Chinese in Singapore cultivate a common kind of lettuce very extensively, but their habit of using night-soil for manuring makes it, as well as all other ground vegetables which are eaten uncooked, somewhat dangerous to eat.

Mustard and *Cress*.—Can be grown by any one, whether they have a garden or not. There are several ways of doing it, but one of the simplest is to put two or three inches of moss, cocoanut fibre or anything that will hold moisture, in a shallow box and make it thoroughly wet. On the top of this lay smoothly a piece of clean flannel, and on this sow the seeds thickly. Do not allow the flannel to get dry, and in three or four days the mustard and cress will be ready for use.

Mustard is also grown by the Chinese for the leaves, which they eat cooked. Unlike most European vegetables, it will sometimes produce perfectly good seed here.

Dandelion (*Taraxacum*).—Is also a very excellent salad plant, either alone or mixed with others. It is grown from seed, and pricked out like lettuce. In Europe, several forms are cultivated and usually they are improved by blanching, and though it appears impossible to blanch it properly here, it is well worth cultivating.

Chicory.—Can be grown in the same way, and is an excellent addition to a salad. Like dandelion, it is much improved in Europe by blanching, but even unblanched it is excellent.

Lamb's Lettuce or *Corn Salad*.—Can also be grown here, but seems rather more delicate, and liable to injury by heavy rain.

Pegaga (*Hydrocotyle asiatica*).—A common weed with rounded leaves, growing on banks and in grass, and much sought by natives as a medicinal herb, may be added to salad. It has a somewhat peculiar flavour, which, however, is not unpleasant, and it is very wholesome as a digestive.

Celery.—Although celery cannot be grown white and crisp here, it is most useful for flavouring, and is well worth attention. Sow the seeds in boxes or pots, and when big enough, plant them in beds or trenches that have been previously heavily manured, at about nine inches apart, cow manure, bone dust, and burnt earth may be applied liberally and, during dry weather, liquid manure. When about a foot high, the earth should be drawn up round the stems and again later on, but care must be taken not to cover the heart of the plants. A little shade during the middle of the day is beneficial.

Celery can be readily grown in this way both in the hills and plains, and very good samples are often to be seen at our Flower Shows. It is generally used for flavouring soups.

Beet.—Can only be grown with success in the hills. It is rarely of any use if grown in the plains. It requires rather a rich, light soil, which has been well manured for a previous crop. The seeds should be sown in drills about nine inches apart, and, as soon as strong enough, the plants thinned out to about six inches apart

in the rows. They may also be sown in boxes and transplanted to beds when about an inch tall. In fact, this is the better plan when the rains are heavy. In England, the transplanting of beet is not generally recommended, but in this country it succeeds very well. An occasional watering with liquid, bone or fish manure during dry weather, hastens the crop, which is fit for use in from two-and-a-half to three months from the time of sowing. Egyptian, Turnip-rooted, Pragnell's Exhibition and Othello are the best varieties.

Radish.—English radishes are worth growing on account of the superiority of their flavour to that of the common Chinese kind, although they have a tendency to become woody very speedily. They grow much better in the hills than on the plains. "Frequent sowings of radish are necessary, as they remain only a short time in condition and require to be used up quickly. They require rather light, rich soil and, in dry weather, daily watering. When ten days or a fortnight old, a little guano or bone dust may be added to the water, or stirred in among the plants with a pointed stick, for the quicker they are grown the more crisp they will be. The seeds should be sown thinly, broadcast on beds previously prepared by digging and manuring, and covered with a little light soil. Turnip-radishes are better than the long kinds, and are ready for use in about a month from the time of sowing. Sow at intervals of about fourteen days from November to February," (C. C.)

Chinese radishes are easily grown from seed and are extensively planted in Singapore. They are white and oblong in shape, rather woody, and pungent and rather coarse in flavour. They can be eaten raw, but they are often cooked, when they somewhat resemble the turnip in flavour, though inferior to that vegetable.

Horse-radish tree "Morungei" (*Moringa pterygosperma*).—A small tree with finely-cut foliage and white flowers, followed by long, bean-like pods. The roots are used here in place of horse-radish, which in flavour they somewhat resemble, and the fruit is boiled and eaten either plain or curried, and is very popular with those who know it. The plant is raised from cuttings which are always taken from the woody branches about half-an-inch through and two or three feet tall. Smaller cuttings are rarely successful. It is usual to cover the upper cut end of the cutting with mud, which prevents decay. In good soil the plant grows rapidly and soon puts out roots large enough to use, but, as a rule, it takes much longer to fruit. To take the root without injuring the plant, the soil is cleared away by hand till a large enough root is found which is cut off, and the soil covered over again. Too many roots should not be taken from one plant.

Spinaches.

Spinach.—There are a number of plants which are, or could be used as spinach here, and by far the most popular is Kangkong

(*Ipomea aquatica*,) a semi-aquatic convolvulus with white flowers, said to be a native of Arabia. It is cultivated either in water or in damp spots such as are suited for water-cress, and is propagated from cuttings. Kangkong is a very rapid grower, and gives a larger return of green stuff per acre, than any other vegetable, and is one of the most wholesome of all. The Chinese cultivate it to a large extent.

Bayam.—A name given to several species of amaranthus used chiefly by natives as spinach. The best is said to be *Amaranthus spinosus*—Bayam Duri.

Bayam Kadong (*A. gangeticus*).—Is cultivated extensively by the Chinese, being raised from seed and planted in beds. When about a foot tall, it is pulled up and sold—a large bundle for a cent. It is then a large-leaved plant, very much suggesting spinach in form, but less compact. Boiled, it much resembles spinach in colour, and has a distinct spinach flavour, being less stringy and softer than Kangkong.

Basella rubra and *B. alba*.—The red and white Malabar nightshades are creeping plants with fleshy red, or green stems and heart-shaped leaves, used as a spinach. They are grown from cuttings or seeds, usually from the former here, and the leaves are the parts used as food. The red one is the more commonly cultivated here, and is an excellent vegetable, but hardly known to Europeans in Singapore, though it is an East Indian or Chinese plant and is well known in Southern Europe. It is so easily grown and so excellent, that it is worth more attention than is usually bestowed on it.

Chekop Manis (*Sauropus albicans*).—Is a small shrub, with green leaves blotched with white, which is very popular among natives as a spinach. The leaves when cooked are rather firm in texture and slightly acid, but make a fairly good spinach. It is grown readily from cuttings.

Cosmos caudatus.—A herbaceous plant with finely-cut leaves and a head of flowers, pink, and yellow. It is often cultivated for the eatable leaves by natives,and for its flowers by Europeans. The leaves have rather a strong flavour and are not likely to find favour with most Europeans.

Purslane (*Portulaca oleracea*).—This common weed is cultivated in Europe as a vegetable, and several varieties are known. It is a succulent, usually purplish herb with small yellow flowers and is very common in waste ground. It does not appear to be used here even by the natives, but it seems popular in Holland, as it is even preserved in tins. It can be raised from seed, and is cooked like spinach.

Ferns.—Several ferns are eaten by the natives and sometimes by Europeans. They are not cultivated, but the young fronds are collected and boiled like spinach. Among the most popular are *Anisogonium esculentum*, *Paku Benar*, *Paku Tanjong* (a very

common plant on the banks of streams), and the best of all, *Stenochlaena palustris*, "Lamiding" or "Miding" (a very abundant climbing fern), and *Ceratopteris thalictroides*—the water-fern—a finely cut fern growing in ditches and rice-fields.

Cabbage.

Cabbage requires deep rich well-trenched soil in a position free from the shade and roots of trees. Stable manure is best for this crop and should be well dug in. The seeds may be sown in beds or in boxes of light soil and covered lightly, and as soon as big enough to handle, transplanted in rows about eighteen inches apart. For some years we have been in the habit of growing cabbages from cuttings, with a better result than from seeds. The method adopted is this. After the cabbage has been cut, the the stump is allowed to stand, and in a few days commences to sprout. As soon as these sprouts are large enough, they are removed close to the stem with a sharp knife and planted in rows at the same ditance and in the same manner as plants from seeds, and shaded for a few days. These are grown all the year round, but the best season is from the beginning of December to the end of March. Savoy cabbages, cauliflowers and Brussels sprouts are of no use.

Beans and Peas.

Of the three kinds of beans grown in English gardens, *i.e.*, scarlet runners, broad beans and dwarf or French beans, only the latter is of any practical use here.

Scarlet runners indeed are stated to be always barren in the tropics, owing, it is said, to the absence of a suitable fertilizing insect.

French beans are only to be grown in the dry season, from November to February in Penang. The soil should be well dug over several times and liberally manured, the seeds planted in rows about eighteen inches apart and two or three inches deep. As soon as they are two or three inches high, a little fresh soil should be drawn lightly round the stems. Under favourable circumstances, they are fit for use in about two months. One important point is to gather them quite young. Native gardeners leave these, and, in fact, most vegetables, until they are past their best before gathering them. Canadian Wonder and Fulmer's Forcing are two of the best varieties.

Of native, that is to say, tropical beans, there are a good many kinds, several of which are very good, though without the flavour of French beans. The following kinds are best known here :—

Lablab, Egyptian Kidney-bean, *Dolichos Lab-lab*.—Kachang Karkaras. One of the commonest beans cultivated here. There are several varieties, the most distinct, however, being one with violet flowers and black seeds, and one with white flowers and white seeds. The plant is often very large, and the leaves have three very large and broad leaflets. It is easily raised from seed, and is best grown on a trellis or through bushes. The young

pods are eaten like French beans, and indeed usually take their place in the plains. They are more flavourless, however, though an excellent vegetable.

Kachang-prut-ayam (*Vigna Catiang*).—Is also very extensively cultivated. It has yellow flowers, and long cylindrical green pods over a foot long. It is readily grown, usually upon sticks, and generally fruits heavily. There are several forms, but the one grown here most commonly is one with very long pods. These are cut up in pieces and boiled like French beans. They do not possess much flavour, but are a very good substitute for the latter. It is stated that the ripe seeds are eaten in India, where, however, several other forms are cultivated.

Four-angled Bean (*Psophocarpus tetragonolobus*).—Kachang botor. An annual plant with large blue flowers and square pods about 8 inches long, with four large wings. It is frequently cultivated and can be grown on sticks, as it is not a very large plant. The young pods are cooked like French beans, and are excellent sweet vegetables.

Sword Bean (*Canavalia ensiformis*) Kachang parang.—A large plant with big sweet-scented white, or more commonly, pink flowers and very large curved pods over a foot long.

The young pods are cooked like other kinds but it is rather coarser than many species, and not often seen at the tables of Europeans.

The allied sea-shore bean (*C. lineata*)) with similar flowers and short thickpods, is commonly to be found creeping on sandy beaches along the coast. The young seeds are quite eatable and, if boiled and mashed, form a good though rather dry pease-porridge.

They are, however, not commonly eaten even by natives.

Peas should be sown in rows, the distance apart depending on the height of the variety grown. The dwarf varieties, which are the kinds most suited to this climate, may be planted at one foot between the rows. Earthing up should be attended to when the seedlings are a little above the ground, and again later on, when they have attained more strength. If the taller kinds are grown they must be supported by sticks. A good plan is to grow peas on land that has been heavily manured for a previous crop, but if that cannot be done, then the manure can be put in the bottom of the trench and a good covering of soil placed over it, so that the seeds do not come in direct contact with the manure. A rich soil containing lime is the best. Early varieties are fit for use in about six weeks from time of sowing, intermediate and later kinds from eight to ten weeks. Late kinds seldom do any good, and it is best to stick to early ones, such as American Wonder, and Laxtons No. 1 (C. C.)

Peas were formerly cultivated by the Chinese in Singapore, and European residents have also grown them with success. The Chinese kind is rather small and belongs to the dwarf section. In the plains, however, peas, though with pains they may be

made to fruit well, possess comparatively little flavour, and they are much more satisfactory when grown on the hills.

Gourds.

The Wax Gourd (*Benincasa cerifera*) Kundur.—There are two commonly cultivated varieties of this plant here, known as Kundur Java, and Kundur China. In the former, the fruit when ripe is hairy, in the latter it is smooth.

The Wax Gourd is a large climber with yellow flowers, as large as those of the vegetable marrow, and fruit which, though always hairy when young, becomes in the commoner form (Kundur China) quite smooth, greyish green and covered with a waxy bloom, whence the name Wax Gourd. The fruit is oblong and very large, about a foot and a-half long. It is grown from seed, and allowed to creep prostrate on the ground, or better still grown over a trellis. It is eaten boiled like other gourds, and the Chinese make a sweetmeat by boiling slices in sugar and crystalizing them.

The Vegetable Marrow (*Cucurbita pepo*).—Has, I believe, never been successfully grown here, but the pumpkin grows fairly well, although it is apt to fall before fully ripe in heavy rain. We have been most successful with Italian varieties.

The large gourd (*Cucurbita maxima*).—"Labu Merah" and the Labu Manis a variety of C. pepo are also cultivated to a certain extent, but many of the larger gourds are also imported from India, and they form an important article of food among the natives. They are used by Europeans in curries, or in soups, or plain boiled, being cut up into small pieces.

The worst enemies of the pumpkins and gourds are the crickets, which attack seedlings at night and devour them. I have seen a whole bed of seedlings mown down in one or two nights by a large brown cricket with light blue wings. Where these animals are numerous, it is advisable to protect the young plants with mosquito netting till they are big enough to climb, when the crickets do but little harm. A small beetle with a red head and thorax and blue elytra also attacks many of this group of plants, perforating the leaves with small round holes, but it does not appear to do much real harm.

Serpent Gourd (*Trichosanthes anguina*) Petola or Ketola Ular. —A climbing plant with rather small white flowers, with fimbriate edges and long cylindrical fruit, two feet or more in length and about two inches through, usually green marbled w th white.

It is raised from seed like other gourds, and grown on a trellis, and takes about two months to bear fruit. As the fruit ripens, it is usual to tie a small stone or other weight to it to keep it straight.

The serpent gourd makes an excellent vegetable boiled in milk It is softer and of a better flavour than an ordinary pumpkin, and resembles rather a vegetable marrow. It should be taken young, for if allowed to get ripe it is bitter.

Momordica charantia—Peria.—A climber with yellow flowers, and warted orange coloured fruit, very variable in size, the seeds covered with a sweet red pulp. Often cultivated by the Chinese who generally grow it upon sticks. The fruit varies from a few inches to about a foot in length.

It is eaten young, before it becomes red. The flavour is rather bitter, and it is not usually liked by Europeans, though very popular with natives.

Cucumbers.

The Chinese are very successful cucumber growers, and the market is generally well supplied. They grow them on sticks in much the same manner as scarlet runner beans are grown in England. Plenty of manure applied to the soil before planting, and liquid manure twice a week, are necessary, and the crop should be ready for use in nine or ten weeks. We have tried several kinds of high class cucumbers from England with only moderate success. Indian saved seeds give a much better result, as do several of the Italian strains.

Chocho.

Chocho (*Sechium edule*) is a climbing perennial plant of the cucumber family, one of the most productive as well as wholesome of vegetables. This has been in cultivation on Penang Hill many years, and is said to have been introduced by a Mr. Bain. It is best grown on a horizontal trellis, five or six feet from the ground, so that a person can get underneath to collect the fruit. The fruits are pear shaped, and should be gathered before they get too old. The root is said to be edible, but I never heard of its being used here.

Propagation is attained by leaving some fruits to ripen and then planting them whole, the pointed or stem end being inserted in the soil to about two-thirds of their depth. After they have sprouted a few inches, more soil must be placed around them or they may be transplanted to a greater depth in deep rich soil. The fruit is eaten boiled and much resembles the vegetable marrow in flavour. It is liable to the attacks of a small fly which destroys the fruit.

Bottle Gourd, *Lagenaria vulgaris*, "Labu Jantong," "Labu Ayer".—Is often cultivated and some varieties are used for food, especially a rather long pear shaped kind. It grows rapidly on trellises, and the young fruit is considered good in curries, or plain boiled.

The bottle shaped variety "Labu Kendi" which is cleaned out when ripe and used as a flask is not at least generally eaten, being grown for use as a bottle.

The Loophar, *Luffa ægyptiaca*, Petola Manis or Ketola Manis.—A climbing gourd with yellow flowers cultivated on sticks or trellis. The unripe fruit is eaten like other small gourds. The ripe fruit, cleaned of its pulp and split, is used for a bathing sponge in Europe.

L. acutangula, the Petola Sanding.—Differs from the last in having the long cylindrical fruit with ten angles on it, the Loophar having ten low ribs only or being quite smooth. It is grown and used in the same way.

Tomatoes.

This excellent vegetable sometimes grows and fruits so well that residents often wonder why everyone does not grow it. Almost every one interested in horticulture has tried the tomato, and usually at first has obtained splendid crops, but after one or two successful crops, the plants take to suddenly dying off, frequently just before the fruit is ripe. This is almost invariably due to the tomato fungus, which is, if not quite, identical with the potato rot (*Peronospora*). This disease is most common in wet weather, and is very difficult to avoid, and when once it has attacked the plants, they seem to wither up in a few hours. Some cultivators grow their plants in beds, while others prefer large pots or kerosine tins. The advantage of growing them in tins or pots is chiefly that they can be moved at will to a drier or shadier position, and also that they are less liable to the attacks of wireworms, millepeds and other animals which feed on the roots. The seeds are sown thinly in boxes and planted out in the tins or beds as soon as they are big enough. One or two plants are quite enough for a tin, in beds they should be planted about two feet apart. Ground that has been well manured for a previous crop, is better than that which has been newly manured, but a dressing of burnt earth may be dug in with advantage at the time of planting. The soil, however, should be made fairly rich in any case. As the plants grow, it is requisite to support them with stakes. A light trellis of split bamboo, to which the plants are carefully tied, is generally used for plants in tins or pots. Those in beds are usually simply tied to stakes. Mr. Curtis, however, says:—"An easy and satisfactory way of supporting is to put down strong stakes about three feet high at the four corners of the beds, and at intervals along the sides, to which are firmly tied horizontally others running the whole length and breadth, and thus completely surrounding the bed which should not be more than four feet wide. On the top of this, smaller sticks should be laid transversely at about six inches apart, and tied at each end, thus forming a horizontal trellis work." If the plants bear very heavily, it is often necessary to remove a number of the fruits when quite young, so as to allow the others to attain their full size. Though the tomato can be raised from locally saved seed, it generally deteriotates, and, usually at last the little wild cherry tomato alone is produced.

There are so many good tomatoes that it is difficult to say which is the best for our climate. The round smooth Trophy and Acme have, says Mr. Curtis, done as well as any. The large Reds and the yellow Plum have also been grown with complete success. Tomatoes have been cultivated in Singapore by the Chinese, but not to any extent, probably on account of the

disease, and as there is a great demand for them, a great many are imported into Singapore from China.

Asparagus.

Is not one of the most satisfactory vegetables grown here, and the best I have seen produced is much inferior in size to what one sees even in an ordinary garden in England, to say nothing of the gigantic specimens that are produced where the cultivation is made a speciality. Still, as it is such an excellent vegetable, and one that many attempt to grow, it is well worthy of some attention. Good drainage is absolutely necessary and plenty of manure. Stable manure and common salt are excellent. The beds should be raised twelve or eighteen inches, and the roots planted about nine inches apart. If raised from seeds it takes a long time to grow, so it is better to obtain roots if possible. (C. C.)

It seems clear that asparagus grows here best by the sea. In wet localities it is very unsatisfactory, the shoots being very slender. It has never, I believe, been grown very satisfactorily in Singapore, but in Penang and Province Wellesley, it has done much better, and I have heard of fairly good samples raised in Selangor.

Carrots.

Can be grown both in the hills and in the plains. They can be planted at almost any season, provided the seeds and young plants are protected fom very heavy rains during the first few weeks. Soil of a good depth, rather light, and a liberal supply of manure, unless the ground has been well manured for a previous crop, is what is required. The seeds may be sown broadcast on the beds or in drills about six inches apart. As soon as big enough, thin out to at least three inches from plant to plant. Do not attempt transplanting carrots as they are not worth the trouble. Bone dust or fish manure may be applied after the final thinning. Short Horn, Veitch's Perfection and James' Intermediate are three good varieties. Short Horn is the only one which is successful in the plains; it is fit for use in from nine to ten weeks. The long carrots are not at all suited for the plains. James' Intermediate is full grown in from ten to twelve weeks from sowing.

Turnips.

Can only be grown on the hills, and only early kinds such as will be fit for use in about six or eight weeks, are of any use there. Sow in drills about nine inches apart and cover lightly. As soon as big enough to handle, thin out to about six inches apart in the rows. In the plains they can only be grown for the leaves of the young plants (turnip tops), as they never form eatable roots.

Onions and Leeks.

Succeed best in rich soil. Farm-yard manure should be applied liberally, but it is best done for the previous crop, or at

any rate some time before the land is required for sowing. Deep digging and liberal manuring the former, two or three times at least, at intervals of a week or ten days, so that the ground may become pulverised by the action of the weather, is important. Before sowing, the ground should be made smooth, all stones and hard lumps removed and the surface made firm, with the back of a spade or some similar implement. The seeds may then be sown either broadcast or in drills, six inches apart, and covered lightly. The whole surface should then be again beaten over to make it firm. If the weather be dry, watering will be necessary, and when the young plants have attained considerable size, a little guano may be put in the water. Thinning must be attended to in time, and the plants pulled out may be transferred to other beds, but they will not do so well as those grown where originally sown, so leave the best, and remove the smallest and weakest. Onions and leeks require from four to five months to grow. White Spanish from Indian saved seed is the best that we have grown. (C. C.). The Chinese also grow a rather small round white onion in the vegetable gardens.

Shallots (*Bawang Merah*).—Are much cultivated by the Chinese market gardeners, and are a most useful vegetable. The bulb splits up into a number of cloves, from which it is propagated. The cloves are planted singly or one or two together, in rows and covered with soil, which has been previously manured; well-rotted farm-yard manure is said to suit it best, but the Chinese generally use nightsoil only.

The leaves, cut when quite young, are eaten as spring onions. But if the shallots themselves are required, they are not cut, but suffered to grow till they are full grown, and show signs of withering when the bulbs are dug up. Shallots are used for flavouring, or for a curry sambal, or may be pickled.

Leeks.

Are a very wholesome vegetable, easily grown in the hills, and remain a long time in fit condition for the table. Seeds may be sown at almost any time, but about the middle or end of November is the best. They transplant very well, and may be sown in beds or boxes, as may be most convenient. In order to have them large and white, the earth should be frequently drawn up around them as growth proceeds. London Flag and Musselburgh are the two best we have tried. (C. C.)

They cannot be grown successfully in the plains.

Artichokes.

Jerusalem artichokes are the rhizomes of *Helianthus tuberosus*. They are a very popular vegetable with Europeans, being used either as a flavouring or as a dish by themselves. Now and then the Chinese cultivate them, but easy as they are to grow here, they have been a good deal neglected, very few of the Europeans even cultivating them. The roots are planted in rows about two feet apart, and it is often well to shade the plants

when the leaf shoots first appear. When the plants have attained their full height and the leaves begin to turn yellow, the roots are ready for digging. The stems do not attain the height, at least in the plains, that they do in Europe, and they very often produce flowers, which is rare in England, but apparently do not set seed. Tubers for replanting should be kept for three or four months in a dry place, before planting them again. Of two varieties brought out from England, one red and the other white, the red variety gradually died out, the white one being apparently stronger and more productive. The tubers produced were rather smaller than those produced in England, and diminished still more in the third year.

Potatoes.

It is useless to try to grow these in the plains, as, even if the plant does grow, it produces no tubers. In the hills, however, they are more satisfactory, and very fair new potatoes can be grown on Penang Hill. A layer of farm-yard manure may be placed in the trenches below the sets, which should be planted about nine inches apart and eighteen inches between the rows. As they grow, they require to be earthed up to prevent the tubers getting too near the surface of the ground, and, at the same time, a little guano or bone dust may be worked in among the plants.

Early varieties are the best, but ordinary kinds obtainable in the market give fair results. If planted about the end of October they are ready for use in the middle of January.

Sweet Potatoes, Keledi.

Are the tubers of a convolvulus, *Ipomea batatas*. They are grown from tubers or portions of tubers planted in rows like potatoes. Sweet potatoes are one of the most extensively cultivated vegetables among the Chinese, and are very prolific. Two varieties are commonly grown, a red, and a white kind. Of these the former is generally considered the better, but the local sweet potato is rather an inferior class of vegetable, being inclined to be hard and woody. Probably they would be much improved by careful manuring, but the soil in Singapore seems to be too stiff and clayey for these vegetable to do well. The tubers are often attacked by a small slender weevil, the grub of which bores holes in them, and, when numerous, quite spoils them. It seems that the white variety is more liable to the attacks of this insect than the red one.

Colus tuberosus.

Is a small herb, with oval serrated bright green leaves, and blue flowers, often cultivated as an ornamental plant for carpet bedding, but also for its tubers, which resemble small potatoes about an inch or two inches long, with an aromatic flavour. The plant is grown from cuttings or tubers, and after about four months the tubers can be dug up. They are eaten either plain

boiled or put in soups like carrots. The plant is a native of Java, and, as a vegetable, very popular with the Javanese, but less known to Europeans. It is easily grown, and would be esteemed by Europeans if they were acquainted with it.

YAM-BEANS.

(*Pachyrrhizus tuberosus*) "Sengkuang" or Bengkuang.—A climbing bean with a tuberous root like a turnip, grown readily from seed. The root, which is said in some countries to attain a very large size is in the part eaten. It is very good raw, eaten as a radish and perhaps better cooked, as a turnip.

The beans are seldom eaten and only when quite young, as when ripe they contain a poisonous principle known as pachyrrhizin.

The plant is not very commonly cultivated.

Colocasia antiquorum, Schott, Keladi.—Is extensively cultivated by the Chinese in ditches; but though the shoots are often eaten by them the plant is chiefly grown to feed pigs, the leaves being given to them. Other plants cultivated for pig food in the same way are the Water Lettuce "Kiamban," *Pistia Stratiotes, L.*, and, occasionally, *Sagittaria sagittifolia, L.*

Alocasia macrorrhiza, Schott.—Is a much larger plant, often cultivated for ornament on account of its large leaves. It has a stout cylindrical stem which is eaten sliced and boiled. It is rather glutinous, but forms a substitute for potatoes when nothing better can be had.

Yams, Ubi.—Several kinds of yam are cultivated by the natives here, but they do not enter as much into the native food supply as they do in many other parts of the tropical world.

The method of growing them is as follows:—The upper part of the tuber is cut off and divided so that each portion has one or more buds on it. Then a trench is dug about eight inches or a foot deep, in which is strewed some burnt earth and a little manure, then a layer of dead leaves is laid on this, and the portions of yams placed about a foot apart, the buds uppermost, and the earth is then thrown in and the trench filled. In a few weeks the climbing stems of the yams appear, and require a trellis or some branched sticks to climb on. The tubers can be dug in about six months.

Yams can be eaten boiled or baked like potatoes. They are apt to be rather woody if too old, but good kinds when young are an excellent vegetable.

The cultivated yams here appear to be forms of *Dioscorea alata*, L. "Ubi Teropong" is a variety with *hastate acuminate* leaves and long white tubers. "Ubi Java" has *cordate acuminate* leaves and shorter and rounder white tubers. In "Ubi Kenduduk" the leaves are deeply *cordate ovate* and the tubers small, long and red. "Ubi Nasi" has very similar leaves, but the yam is purple, large and round and is probably *D. atropurpurea*, Roxb. In all these the stems are edged with four curled

wings, which are purple in the latter species, which is considered the best eating kind.

D. pentaphylla, L., with 3 or 5 foliolate leaves, wild in Johore, Pahang, etc., is used for food by the Sakais. *D. sativa*, L., which bears round brown warty bulbils in the axils of the leaves, is sometimes eaten by natives but is not considered good. It is common in waste ground, hedges, etc.

Brinjal.

Egg-plant (*Solanum Melongena*).—Much cultivated by the Chinese, and one of the commonest vegetables in use here. It is raised from seed readily, and pricked out in beds some distance apart, as it is a very wide spreading shrub.

The varieties most popular are the long purple, and white China, both long fruited kinds, but we have also here the round purple, and round white kinds. There are a considerable number of other cultivated varieties in Europe and America, including one from the latter country with fruits as large as melons.

Several other kinds of *Solanum* are cultivated by natives for their fruits, but they are generally of an unpleasant flavour, and not at all suited for Europeans.

Okra.

Hibiscus esculentus, Kachang Bendi or Kachang Lundi, Ladies' fingers.—Is a well known vegetable here. It is supposed to be a native of South America, and is a very handsome annual, attaining a height of about three feet, with large yellow flowers with a maroon eye. It is raised from seeds which can be sown directly in beds, or raised in boxes and pricked out when sufficiently tall. The unripe pods are eaten boiled or the young seeds served separately on toast. The pods are apt to be very mucilaginous especially if cut too young, but the amount of mucilage which exudes when the fruit is cooked seems rather to depend on the method of cooking. There are but few cultivated varieties, differing chiefly in the size and thickness of the pods.

Maize, Jagon.

It is strange that maize is not more generally grown for table use than it is. This is perhaps largely owing to the fact that few Europeans know that there are varieties, specially selected for eating, vastly superior to the field kinds. These varieties have mostly been produced in America, where there are more than a dozen named kinds cultivated.

No special care is required to grow this plant, but deep digging and plenty of manure are necessary. Seeds should be planted in rows three feet apart and about one foot between the plants. It is best to plant two seeds in each hole, and then pull out one plant if both germinate. Cattle manure, bone dust, fish manure and burnt earth are all good for this crop, and in dry weather, liquid manure twice a week.

Early kinds are fit for use in eight or nine weeks. The cobs are gathered before they are too old, boiled and served with pepper, salt and butter. Good eating kinds are Adams Early, Early Dwarf Sugar, Stowell's Evergreen and Large Missouri.

Another way of using maize is to germinate the ripe seed by laying it on a stone or cement floor, damping it with water and, covering it with a wet cloth. When the seed has germinated, the roots, etc., are broken off from the hard outer seed coat and boiled. This makes an excellent vegetable.

The chief enemies of maize here are a caterpillar which attacks the young fruit, and the maize fungus *Ustilago Maydis* which grows on the cobs, destroying them and covering them with a sooty mass. This disease, so destructive in other parts of the world, is, however, comparatively rare here.

Mushrooms.

Although the English mushroom (*Agaricus campestris*) is a native of the Malay Peninsula, occurring in Singapore, Penang and Pahang, no one seems to have been successful in cultivating it here. It appears very irregularly in old grass-plots, sometimes in some quantity, and is as good in flavour as the English one. The Malays consider it unfit to eat, although they eat several other species of *Agaricus*, one of which, a white kind, grows on rotten wood in the jungles. This is tasteless and tough when cooked, but it is very popular with them.

A yellow ball-shaped fungus, *Scleroderma aureum*, Massee, growing commonly on paths in woods, is also said to be eatable, and to resemble truffles in flavour. An allied species is said to be eaten in Germany.

THE POISONOUS PLANTS OF THE MALAY PENINSULA.

Plants possessing poisonous qualities have almost always a special value as drugs and are always worthy of careful investigation, not only on account of their medicinal value, but also from the fact that they are liable to be used for criminal purposes or to be the cause of accidents to human life.

The number of plants possessing poisonous properties in the Malay Peninsula is by no means large, and of those that are stated to be dangerous to life, but few have been at all carefully studied, either by analysis or experiment. Indeed, a vast amount of work in the analysis of our vegetable products remains to be done, when a suitable Laboratory is provided in which they can be properly investigated.

Criminal poisoning is by no means as common here among the Malays as people are led to suppose The variety of poisons used is quite small, and apparently the knowledge of their use is mainly derived from the Chinese. The poisonous plants of the forests are seldom used by the Malays, who do not seem to know how to prepare them. It would appear, however, that there are deadly drugs known to the natives which have not been identified, and to which we have at present no clue at all.

The Malays always distinguish between poisons which cause death (*Rachun*) and those which intoxicate or produce sickness (*Mabok*). The latter class includes a number of drugs which have really but little effect on the body.

Most of the vegetable poisons known to Malays are those which have been used as blood-poisons on the poisoned darts of the wild tribes, and of these, some contain well-known alkaloids or other principles, such as *Strychnos Tieute* which contains Brucine, and *Pangium edul* which contains Hydrocyanic Acid. Others again are not known to contain any poisonous principle, although they are commonly reported to be poisonous.

For convenience I treat of the plants used in dart-poison together, as far as they have been identified, and some of these are here identified for the first time The poisoned darts of the Malayan Peninsula and the islands have been known for many centuries, and a good deal has been written about them by travellers. The most important one Antiaris (*Ipoh* or *Upas*) has been made the subject of a number of papers, but even now our knowledge of the drug is far from complete and within the past year even, it has been stated that the Antiaris of the Malay Peninsula is innocuous which is very far from being the case.

The most complete accounts of the plants used in the dart-poisons of the Sakai tribes, are those of Vaughan-Stevens and Newbold. The former supplied me with pencil drawings and specimens of the plants used by the tribes with which he came in contact, and I have been able to identify most of them, and to confirm his statements as to their use by reference to other races

of Sakais. Newbold's account is less satisfactory, as he adds several doubtful ingredients to the arrow-poison, *e. g*, Arsenic, but most of his statements appear to agree with those of STEVENS, HORSFIELD and others.

I give a list of all vegetable poisons stated to be used by the Sakais or other wild tribes of the Peninsula in the manufacture of dart poison, in their natural order.

LIST OF PLANTS USED IN DART-POISON BY THE WILD TRIBES.

Plants.	Natural order.	Native Names.
Coscinium fenestratum, Colebr.	*(Menispermaceæ)*	Tole ; Koopur ; Kopah.
Pangium edule, Bl.	(*Bixineæ*)	Payung; Kapayung
Roucheria Griffithiana, Planch.	(*Lineæ*)	Bhoi (Sakai); Ipoh akar putih.
Miquelia caudata, King.	(*Olacineæ*)	S'lowung.
Lophopetalum pallidum, Laws.	(*Celastrineæ*)	Kroi, Krohi.
Derris elliptica, Benth.	(*Leguminosæ*)	Tuba.
Medinilla sp.	*(Melastomaceæ)*	Sendudu.
Aralidium pinnatifidum, Miq.	(*Araliaceæ*)	Balai, Malai, Tingal balai.
Coptosapelta flavescens, Korth.	(*Rubiaceæ*)	Prual.
Prismatomeris albidiflora, Thw.	,,	Mundess.
Strychnos Tieute, Bl.	(*Loganiaceæ*)	Blay hitam; (Sakai) Ipoh akar.
Str. sp. probably *S. Tieute* Bl.	,,	Akar lampong.
Str. pubescens, Clarke.	,,	Blay besar, Talun.
Str. Wallichii, Benth.	,,	Perghoo.
Tabernaemontana Malaccensis, Hook, fil.	(*Apocynaceæ*)	Perachit.
Piper stylosum, Miq.	(*Piperaceæ*)	Blay pendy.
Antiaris toxicaria, Bl.	(*Urticaceæ*)	Ipoh, Ches Tennent.
,,	,,	Tennik, Kennik.
Laportea crenulata, Forst.	,,	Rumpe (Sakai) ; Jelatang.
Cnesmone javanica, Bl.	*(Euphorbiaceæ)*	Jelatang Rusa.
Excœcaria Agallocha.	,,	
Gnetum edule Bl.	(*Gnetaceæ*)	Blay merah, Blay kechil.
Dioscorea doemona, Roxb.	(*Dioscoreaceæ*)	Gadung.
Amorphophallus Prainii, King.	(*Aroideæ*)	Likir, Lokie, Begung.
Epipremnum giganteum, Schott.	,,	Ringut.
Homalomena sp.	,,	Nampong.
Alocasia denudata, Engl.	,,	Berar kijang.
Daemonorops sp.	(*Palmæ*)	Rotan riong.
,, ,,	,,	Rotan butong.

Unidentified plants mentioned by VAUGHAN STEVENS, are Bal, Grow (chow) Choichoi, Lendow, Garsung.

IPOH, *Antiaris toxicaria*, Bl.

The best known poison of the East Indies is the Ipoh or Upas, as it is called in Java, the produce of *Antiaris toxicaria*, Bl. one of the *Urticaceæ*. It is mentioned in almost all of the earlier books of travel in the East Indies, and, as will be seen by the list of references to the drug, it possesses a considerable amount of literature. A great deal of the earlier accounts of it were very erroneous, notably the account by Foersch whose description was for a long time firmly credited, and some of whose blunders have only recently been completely exposed.

The tree is allied to the *Artocarpi* and *Ficus*, and as in these there is abundant milk or latex readily exuded from wounds in the bark, but whereas in these the latex contains nothing more harmless than Caoutchouc, in *Antiaris* there is a remarkable resin which, on being injected into the blood even in small quantities, produces a violent action usually speedily terminated by death.

This property is made use of by the Sakais of the Malay Peninsula, the Muong of Tonkin, the Bataks of Sumatra, and formerly by the Buginese of Macassar, and the Javanese. The latter used it with great success in war, as may be seen in the account of the taking of Malacca by Albuquerque.

Its use is now confined to the wilder tribes of the East who, not possessing fire-arms, poison the darts shot from the blow-pipes (*Sumpitan*) with which they kill monkeys and other small game. It appears never to be used for poisoning *krisses*, as is popularly supposed, and it is probable that it never was so used.

A few years ago I noticed that a large number of the experiments made with the poison, were made either with the darts used by Sakais or with a mixture of several ingredients made by them, and, naturally, the results were vitiated by this, and I made some experiments with the pure juice, in order to eliminate the action of the other poisons used in the preparation. At that time, too, specimens of the unmixed juice had been sent to Kew for analysis and experiment, and it was stated that the latex contained no poisonous properties. The fact is, however, that fresh extract, unless very carefully dried, putrefies in a few days, evolving sulphuretted hydrogen, so that the specimens sent to Kew had decomposed ere their arrival. I had intended to experiment further with the drug, but the large tree in the Botanic Gardens died, and the others were too young to afford sufficient latex.

As already mentioned the Sakais use a number of other extracts with the *Antiaris* for the dart-poison, including a preparation from the bark of at least one species of *Strychnos*. Of many of these, I received specimens and sketches from the late Professor Hr. Vaughan Stevens, who published an account of them in a German periodical.

The use of some of the same plants is mentioned by BLUME in his important paper in Rumphia, and these will be treated of later.

Mr. Wray, in a paper published in the Perak Government *Gazette* (Sept.11, 1891) states that Antiaris *Ipoh* and *Ipoh akar* (*Strychnos Tieute*) are rarely, if ever, mixed together and that the *Strychnos* is often used alone. This observation appears to be true in respect of the Perak wild tribes only. A Jakun in Malacca told me some years ago, that his tribe used the latex of the *Antiaris* and the extract of *Strychnos* together, but no other extracts. Some Selangor Sakais near the Batu caves told me they used several ingredients besides the *Strychnos*. Mr. SKEAT mentions the use of all the commoner ones among the Besisi tribe, and all other writers allege the same thing, viz., that the dart-poison is not merely *Antiaris* latex.

In my experiments, detailed later, I first, acting on the Jakun's statement, used the sap of the *Strychnos* alone, then later of *Antiaris* and also the two combined.

DESCRIPTION OF THE IPOH TREE.

Antiaris toxicaria, Bl. is a gigantic tree attaining a height of over a hundred feet and a diameter of four or more above the base where it throws out large buttresses. The bark is grey, about half an inch thick. Like nearly all of our largest trees, it drops the lower branches as it grows, so that a large specimen has a perfectly bare trunk for some sixty or eighty feet. The leaves vary very much in size and hairiness, they are generally oblong acuminate inæquilateral, from four to six inches long, and two or three inches broad, the leaf-stalk a quarter of an inch long the backs of the leaves as well as the buds are covered with yellow hairs, and the upper surface of the leaf is more or less hairy, especially in the case of young leaves, though older ones are often glabrous above. The male inflorescence is a small, fleshy green disc-shaped body on a short peduncle; and the flowers which are very small are imbedded in it. The female flowers are small, solitary, pear-shaped bodies with a pair of long, thread-like styles. The fruit is a globular succulent drupe about a third of an inch long, velvety and of a deep claret colour, and bears the remains of the styles. It contains a single, round seed.

Blume describes the fruit as of an elongate ellipsoid form and as big as a plum. Specimens, however, from near the caves at Kwala Lumper, in Selangor, were much smaller and quite globular.

ACTION OF THE POISON.

The following experiments, incomplete as they are, are, I think, worth recording :—

Experiment 1.—I obtained a small, brown, pariah bitch in complete health and at 11 a.m. injected into its back with a hypodermic syringe 10 mm. of the sap of *Strychnos Tieute*, a clear, tasteless liquid obtained by cutting the roots across and letting the sap drain into a vessel. There was no result. (I found afterwards

that the Sakais used a decoction of scrapings of the bark and not the sap. The sap, however, is said to contain a small amount of Brucine and sap obtained from the stem I have found to be intensely bitter).

At 5-10 p.m. I injected into the abdominal walls, 5 mms. of pure latex of the *Antiaris*, a very sticky liquid, difficult to inject as it clogged the syringe. The breathing of the dog became slightly more rapid and it became sleepy, but soon became lively again and nothing further happened. At the post mortem examination I found no discolouration at the point of injection, but the latex had been completely absorbed.

I cannot account for the failure of the poison to affect the dog, unless it was that the part selected was not very vascular and the drug was only slowly absorbed.

I then mixed the two liquids in equal parts, making a much more fluid drug easy to inject and injected 10 mm. into the lower part of the abdomen, the point of the syringe entering one of the mammary glands. Time 5-40.

5-43. Dog uneasy, yawned much, breathing heavy.
5-45. Breathing very hard and rapid.
5-47. Dog vomited, then breathing became easier.
5-48. Dog retched violently and became very restless. The tongue became blue.
5-50. Slight convulsions. Breathing nearly normal.
5-52. It lay down and got up again after a minute, and passed solid fæces.
5-54. It stood still with its head hanging down, groaned, and frothed at the mouth.
5-55. It lay half-down, bit at the straw and the chain, and seemed to be in much pain. The abdomen was moving rapidly, apparently convulsed. The dog was still sensible, and uttered cries.

It was then killed with a blow on the head, which unfortunately broke one of the large vessels in the head or neck, and caused a great flow of blood from the mouth. I immediately opened it.

At the point of injection, one vessel was heavily charged with venous blood, and the whole of the gland discoloured. The stomach was empty and, with the intestines, very pale and bloodless. The kidneys pale. The lungs quite empty of blood, as were the upper vessels. There was a little in the heart, which was not contracted.

I could not get any more dogs, so continued the experiments on toads (*Bufo melanostictus*.).

I first injected a small toad with the sap of the strychnos and poured some down its throat, but as this had no effect on it, I did not use any more in the rest of the experiments.

Experiment 2.—At 12-36 p.m. I injected 11 mm. of *Antiaris* latex ito the left thigh of a fairly large toad.

1-5. Great uneasiness. It lay flat on its belly, had slight convulsions, passed urine. The breathing became very hard. The legs very weak.

1-15. Pupils of eyes contracted much, but not yet permanently. It had a spasmodic contraction of the fore-legs. When turned on its back it could not recover itself.

1-20. It was quite unable to move. The pupils very much contracted. Eyes still sensitive to touch. Breathing very faint.

1-35. Laid it on its back. Voilent convulsions. Eyes no longer sensitive to touch. Spasms of pectoral and abdominal vessels. It was practically dead.

Post-mortem Examination.—Brain normal. Heart still beating, momentarily checked by convulsions. Lungs full of air. Vessels of abdomen and chest very full of blood. Stomach and intestines; vessels on the outer coat congested, inside not congested, stomach full of clear shiny liquid, colon full of the remains of grasshoppers, &c. Liver congested, gall bladder dark and full. (This appears to be always the case after an injection of *Ipoh.*) Kidneys full of blood.

B.—Another toad was injected with equal parts of *Strychnos* juice and *Antiaris* milk, at 12-47 p. m.

12-48. Breathing rapid, sides throb violently.

1-20. Passed urine and fæces.

1-25. Commenced to get weak.

The animal was then pithed and opened. The throat muscles were still active. The viscera on the whole were generally less congested than in the previous case, except the lungs which contained more blood. Application of the mixture to the now quiescent intestines and stomach produced violent peristaltic action (the application of water, and mechanical irritation having previously produced no result). Pure *Antiaris* latex applied produced instant and violent contraction of the intestine transversely. This contraction which lasted for some minutes was most violent in the colon.

C.—A similar toad injected at 1 p.m. with 5 mms. of the mixture.

1-2. Abdomen commenced to twitch. Beat of the heart became more violent.

1-5. Twitching of the abdomen increased in violence. Toad attempted to vomit once.

1-20. It commenced to lose the power of its limbs. Passed excreta.

1-25. Pupils contract. Breathing very faint.

1-55. Nearly dead. Eyes but little sensitive to touch.

2 p. m. Quite dead.

Post mortem examination.—Brain normal but with more liquid above it than usual. Lungs full of air. Heart black at the apex, outer wall congested, auricles full. Liver and spleen congested, as were the mesenteric and other abdominal vessels. Gall bladder full and black, much perivisceral fluid.

D.—Administered 5 mm. of the mixture by the mouth, to a toad. No effect.

E.—At 3-30 p.m. injected into a toad 5 mms. pure *Antiaris* latex, at 3-40 it was very weak, at 3-50 it had slight convulsions, at 4-0 it died. The action of unmixed *Antiaris* is much more rapid than the mixture.

F.—A toad was pithed and opened. *Antiaris* latex applied to the heart produced irregularity of beat, viz:—

32 beats in 25 seconds.
19 ,, in 14 ,,
20 ,, in 17 ,,
27 ,, in 25 ,,

The intestines, specially the colon, contract violently when the *Antiaris* latex is applied to it at the point of application.

G.—A toad was pithed and the thorax opened, and the heart beats recorded at 4 p.m.

At first there were ... ... 25 beats in 15 seconds.
Antiaris latex applied to heart... 20 ,, ,, ,,
A second application ... ... 21 ,, ,, ,,
3mms. injected under skin of thigh 24 increasing to 27 ,,
The sides began to twitch, and a second injection as before was given 26 beats in 15 seconds.

Convulsions set in. More *Antiaris* milk was applied to the heart, and the action became irregular(23 beats).

Irregularity of heart action increases, and the action is weaker (21 beats). Convulsions every two or three minutes.

Heart very irregular and feeble 20 beats.

At 4-20. The beats had fallen to 13½ in 15 seconds.

H.—Two toads were pithed and an opening made over the heart. In No. 1 the upper part of the heart was slightly cut by accident but not so as to inflict any real injury.

No. 1.	Heart beats in 15 seconds	16½
	Antiaris applied to base of heart	20
	After a few minutes fell to	18
	Pupils much contracted and nearly closed.	
	Injected 2 mm. into thigh	22
	Violent spasms	23

The heart beats now became more pronounced, and the animal became weaker and weaker till life was almost extinct. Electric shocks were adminstered which, did not affect the heart, but only the motor muscles.

No. 2. Normal heart beats ... ... 18½ in 15 seconds
At 8.54 p.m. injected 2 mm. *Antiaris* milk— ... 19 to 20

At 9 p.m. a very slight contraction of the pupil. The heart beats still normal.

9-3. Slight spasms of the abdomen. Beats ... 17
9-10. ,, ,, ,, ,, ... 9
9-25. ,, ,, ,, ,, ... 6

9-40. Administered several strong electric shocks. It discharged urine violently and shortly after died, probably from the shocks.

I.—A toad sound and unopened, had a normal beat of 23 in 15 seconds.

At 10-30, 2 mms. *Antiaris* was injected. Beats 21
10-37, ,, ,, ,, ,, 20
10-42. ,, ,, ,, ,, 18

J.—In order to see if the poison was destroyed by heat, some *Antiaris* latex was boiled in a test-tube. It emitted a smell of burnt india-rubber.

Injected three mms. into the thigh of a toad at 9-25. At 9-45, toad much affected. It does not move, but lies on its back, and does not attempt to recover itself. The pupils are contracted. There are no spasms, but a complete loss of motor power in the legs, the fore-legs first. It died at 10 a.m.

This experiment shows, I think, that boiling greatly increases the rapidity of the action. All writers state that the Sakais boil the decoction till it becomes thick before using it.

Newbold (Trans. Roy. Soc. 1837, p. 427) in describing the poison, gives an account of inoculating a pup with one of the arrows of the Aborigines, the effects of which closely resemble those in my experiment on the dog. It was struck in the right hip, the arrow penetrating only a quarter of an inch. Six minutes later "it demonstrated signs of uneasiness, yawned and moaned. In "10½ minutes it grew sick, vomited the contents of the stomach "and continued at intervals bringing up small quantities of a "white frothy liquid. In 16 minutes the muscles of the chest "and diaphragm were powerfully excited; slight convulsive "twitchings in the legs. In 20 minutes it fell on its side, foamed "much at the mouth, again got on its legs and struggled violent-"ly as if to get loose. In 23 minutes it was still foaming at the "mouth and had an involuntary alvine evacuation, then fell "down after painful retching" and continued this, becoming gradually weaker till, in 37 minutes, it died strongly convulsed.

The post-mortem examination showed a frothy saliva-like fluid in the stomach, the gall-bladder distended with bile, the intestines unusually pale. In the cavity of the thorax on each side were several drachms of serous fluid. In this experiment, as apparently in others by Newbold, the action of the poison was very slow, probably on account of the small amount of the drug injected, otherwise the action was quite similar.

One more experiment I made I will mention. A tadpole was put into a watch-glass of water, and a little of the *Antiaris* latex injected into the tail by a prick. Under the microscope, the blood-vesseles could be seen to become intensely congested, and the circulation in the tail gradually ceased, the capillaries of the tail becoming choked with corpuscles. It appear-to me that this was due to the contraction of the capillaries.

From these experiments, I gather the following as the results of the action of *Antiaris* latex on injection. The heart-beat at first rises in frequency, then immediately commences to fall till death. The intestines, especially the colon and stomach, contract rapidly and convulsively, and the contents of the latter, and often that of the former, are ejected. The pupils of the eyes contract. The blood is congested in the mesenteric vessels, the spleen and liver, and often in the outer walls of the stomach and intestines, but the inner coats are nearly bloodless. The brain and spinal cord do not seem ever to be affected. The loss of power of the limbs which sometimes occurs, does not appear due to paralysis; it only comes on towards the death of the animal, and seems to be due merely to the general collapse. Death is not due, in most instances at least, to the convulsions of the digestive tract, but apparently to some interference with the heart's action.

Horsfield, who wrote a paper on the poison and its effects, describes the symptoms and the post-mortem appearances in a very similar manner. He says that in animals killed by *Antiaris*, the aorta and venal canals were in every case found in an excessive degree of distention, the viscera in the vicinity of the source of circulation were uniformly filled to a præternatural degree with blood, which still retained a florid colour and was completely oxygenated. On puncturing the vessel, it bounded out with all the elasticity and spring of life. The vessels of the liver, stomach and intestines, and of the viscera of the abdomen in general, were also more than naturally distended, but not in the same degree as the breast. The stomach was always distended with air.

The records of the action of *Ipoh* upon man are very scanty, the use of the poison in war having been long given up, and the few observations on its effects made some centuries ago being naturally very inadequate.

At the siege of Malacca (Albuquerque, Hakluyt's voyages, vol. ii) it was remarked that all soldiers wounded with the darts died, except one man who was burned with a red-hot iron directly he was struck, "so that ultimately God spared his life."

Wray describes an accident with a dart in Perak thus.—

"While unloading and carrying the baggage over the rocks, a poisoned blowpipe dart fell out of a quiver and stuck in the upper part of one of the men's feet. It was at once pulled out, and a Semang squeezed the wound to get out as much blood as possible, then tied a tight ligature round his leg, and put lime-juice into the wounds. The man complained of great pain in the foot, cramps in the stomach, and vomited, but these symptoms soon passed off. The point only went into the foot about $\frac{1}{8}$ inch and the dart was instantly pulled out. The Semangs said that, had it gone deep into the fleshy part of the body, it would have caused death."

From this account, I think, it may be gathered that *Antiaris* has practically the same effect upon man that it has upon other mammals.

The supposed deadly effects of sleeping under the tree, and putting the latex on the skin, have been shown by VAUGHAN STEVENS to be mainly at least imaginary. He sat under the tree when the latex was exuding and slept for a whole night beneath it, and also covered his hand and arm with the latex, and held his head over the steam of the boiling liquid for an hour, without experiencing any ill effects.

He, like myself, has drunk the latex in small quantities without feeling any poisonous effect. Horsfield however states that taken into the stomach of a dog, the *Antiaris* produces nearly the same symptoms as it does when injected. Oppression of the head, twitchings, faintness, laborious respiration, violent contraction of the muscles (pectoral and abdominal), increased flowof saliva, vomiting, great restlessness, agony, etc.,for nearly two hours, but after evacuation of the stomach, the animal gradually recovered.

I have not been able to obtain this effect and have already mentioned that, on giving a toad a quantity internally, no effect was produced, though these animals are very sensitive to injected *Antiaris*.

REMEDIES.

Most of the Sakais say that there is no cure for a wound poisoned with Ipoh, they themselves having usually recourse to charms. But several methods of treatment were proposed or recommended in the early days of the opening up of the Malay Archipelago, when explorers were liable to be attacked by natives armed with blowpipes and darts, especially before the introduction of firearms, when the *sumpitan* was the common weapon of defence. Most of these proposed remedies need be mentioned only as curiosities. Actual cautery has already been mentioned as used at the siege of Malacca, but the method most in repute in the East Indies was to cause the patient to swallow his own excrement. The object of this was to produce violent vomiting. Rumphius, who with others recommends this, recommends also the use of *Crinum asiaticum*, the tubers of which are to be crushed, and some of the juice to be swallowed, and some placed on the wound. This plant, a common sea-shore plant with white lily-like flowers, was formerly included in the Pharmacopœia of India as an emetic. The same author urges the use also of sea-water, or a solution of chloride of sodium, on the ground that violent vomiting must be produced, or the patient has no chance. He advises, too, the use of water melons to extinguish the burning of the intestines. Kœmpfer recommends the use of *Ophiorrhiza Mungos* as an antidote to all poison. It is a herb which has long ceased to have any medicinal reputation at all. NEWBOLD mentions a plant called Lemmah-kapiting as used by the aborigines against the poison ; I have never met with any such name, and he gives no clue at all as to what the plant is like.

THE CHEMISTRY OF ANTIARIS

Has been studied by a considerable number of Analysts. Professor H. W. Bettink (Haaxmans Tijdschrift, 1889) found

three principles in the latex, viz., Antiarin, Œpaine (Upaine) and Toxicarine. Mr. Stockman (Pharm. Journ. 1893, p. 946) gives a note on Antiarin which he compares with Strophanthine and Urechitine. He found that while $\frac{1}{4500}$ grain of the former and $\frac{1}{2600}$ of the latter poisons were fatal to good-sized frogs, $\frac{1}{6400}$ grain of Antiarin was fatal within 24 hours, and that the smallest lethal dose caused stoppage of the heart in diastole, larger doses in systole. Antiarin is obtained by exhausting the latex with boiling alcohol and evaporating to dryness, and after the deposition of the Antiar-resin, treating the extract with water and evaporating to a syrup; the antiarin then takes the form of scales which are purified by recrystallization. (Watt's Dictionary of Chemistry.)

The latex preserves very badly, becoming putrid very soon unless properly prepared by boiling and drying. As all trace of poison disappears on the decomposition of the latex, samples of juice put up simply in bottles and sent to Europe have been found on arrival to be inert, so that it has been stated that the Antiaris of the Malay Peninsula is not poisonous.

Literature of Antiaris.

Valentine, Oud and New Oost Indien, III, p. 218.
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Coscinium fenestratum, Colebr. (*Menispermaceæ*).—Tole Koopur (Vaughan-Stevens), Kopah (Newbold), a stout climber with peltate leaves on long petioles, white or yellowish beneath,

with strongly raised ribs and reticulations. Flowers very small, green, in small heads arranged in a panicle. Fruit globular, tomentose, about ¾-inch through. The stem has the remarkable structure of other plants of the group and is yellow when cut. The taste is very bitter. The root is known in trade as false Calumbar root, and is said to have almost the same properties as the true Calumbar, being medicinally used for dyspepsia and fever, in India. It contains Berberine. The plant is a common jungle climber here.

According to Vaughan-Stevens, the sap from the stem and a decoction of the bark are added to the Ipoh-mixture, and Newbold also mentions its use by the Mentera tribe. There does not seem to be any really poisonous principle in the plant, and it is not easy to see why it should be mixed with the Ipoh.

MIQUELIA CORDATA, King (*Olacineæ*).—S'lowung, is a slender climber with curious, oval beaked flattened, red fruit, which, according to Vaughan Stevens is added to the Antiaris mixture. It is a rare plant, only met with in Perak, and nothing is known of its properties.

PANGIUM EDULE, Reinwt. (*Bixineæ*).—The Payung or Kapayung, a large tree with big ovate leaves, rather large axillary greenish-white flowers and oblong brown fruits a foot in length, containing a number of large seeds nearly two inches long, woody and grooved, enclosed in an oily pulp. The seeds produce an oil used by the Malays for lighting and cooking, and according to Vaughan Stevens, are also used in making dart poison by the Panghans. He states that they are cut small and boiled for four hours in as little water as possible, and the pressed out juice is added to the other poisons. In some of the islands of the Archipelago the seeds are boiled, the kernel taken out and pounded, and then macerated in water and used as a sauce, but this is apparently not commonly done, as, unless very carefully prepared, it produces diarrhœa. The pounded seeds are used in Pahang to attract fish. The bark, however, thrown into water, is stated to act as a piscicide, and the juice of the leaves is used for curing ulcers, and the kernels, chewed (care being taken not to swallow the juice), are used for killing vermin. (RUMPH, Herb. Amboinense). Blume, who in Rumphia (Vol. IV, 21), gives a good account and figure of the plant, states that it is used as an anthelmintic.

The poisonous principle has been shown by Greshoff (Nuttige Indische Planten) to be Hydrocyanic acid, a sufficiently deadly blood-poison.

The tree occurs abundantly in Selangor, Pahang, and Perak, and in most of the Eastern Archipelago.

The allied genus, *Hydnocarpus*, contains several poisonous species, *e.g.*, *H. venenata* Gaertn. of India, used to kill fish, and *H. heterophylla* of Java. A plant known as Sayang in Malacca appears to be a species of *Hydnocarpus*, and is stated there to be poisonous.

ROUCHERIA GRIFFITHIANA, Planch. (*Lineæ*).—A common woody climber known as Bhoi by the Sakais, and Akar Ipoh putih by the Malays, the bark of which is used by the Sakais for mixing with the antiaris. The stem attains a thickness of about 4 inches with a white bark (whence the name Ipoh putih). It possesses curious curved hooks by which it climbs on other bushes and trees. The leaves are small, lanceolate, dark green. The flowers numerous in axillary tufts are bright yellow. The fruits are small bright red drupes.

Nothing is known as to the properties of this plant but, as it is evidently reckoned to have poisonous properties by the Malays and Sakais, it will be well worth examining.

LOPHOPETALUM PALLIDUM, Laws (*Celastrineæ*). — Krohi, Kruoi (Besisi dialect, Skeat), Krabu (Malay), is a gigantic tree with lanceolate, rather stiff leaves, about two or three inches long, turning glaucous when dry, with about eleven pairs of main nerves. The fruit a large, oblong capsule, woody, breaking up into boat-shaped valves, outside black and shagreened, inside shining brown, length about four inches, the seed flat with a long, brown wing as long as the capsule.

This plant much resembles *L. Curtisii*, King, of Penang, but that has smaller and rounder leaves with fewer nerves, and I take it to be the little known *L. pallidum*, Laws.

The Kroi is mentioned by Vaughan Stevens as used by the Menteras in combination with Tuba, and I have specimens of the leaves and wood from him. I found it was known to the Sakais of Selangor, some whom I met near the Batu Caves, evidently setting much store by it. NEWBOLD (Malacca ii p. 399) talks of three preparations used by a tribe from Sungei Rhya—Ipoh Krohi, Ipoh Tennik or Kennik and Ipoh Mallaye, and says that the Ipoh Krohi is composed of Krohi (extracted from the Ipoh tree), Tuba, Kopah, red arsenic and lime juice, and Ipoh Tennik is made in the same way, omitting the Kopah. This is probably erroneous, as Tennik is simply a Sakai word for *Antiaris*, and Kroi is an entirely different tree.

The bark and outer part of the wood of the *Lophopetalum* are the parts used in the decoction. No examination of this tree has yet been made, but, as it is evidently considered a valuable addition to the Ipoh, it probably contains some poisonous principle. Another species of the same genus, *Lopho petalum toxicum*, Loher, has just been described in the Icones Buitenzorgenses (Vol. 1, p. 56, Fig. 16), of which the bark is used by the Negritos of the Philippines for poisoning their arrows.

ARALIDIUM PINNATIFIDUM Miq. (*Araliaccæ*).—Malai or Balai (Mallaye, Newbold), Tingal Balai, a shrub or small tree about twelve feet tall. The leaves are oblong and rounded at the apex or deeply lobed, being cut nearly to the mid-rib. They are usually about a foot long. The flowers are small and greenish white, in large terminal panicles. The fruit is an elliptic oblong drupe,

black in colour, and possessing an unpleasant soapy taste. It is about an inch long, and contains a single seed.

The plant is common in open woods and jungle borders all over the Peninsula as far north as Kedah.

This is mentioned by Newbold as forming part of the most potent of the three poisons described by him. It is used according to him with Tuba, Perachi (*Tabernæmontana malaccensis*), Kopah (*Coscinium fenestralum*) and the "Chey." Mr. Skeat sent me also a piece of the plant as used by the Besisi under the name Balai or Malai.

About its properties nothing is known, though the leaves are used by the natives in cases of rheumatism.

Strychnos Tieute, Bl.—This, the Ipoh Akar or Blay Hitam of the Sakais, is a strong woody creeper attaining the length of a hundred feet or less, and a diameter of three inches. The bark is smooth and black. The branches usually fairly stout, climbing by means of rather large woody hooks. Leaves, polished dark green, oblong acuminate, with the characteristic three parallel nerves as in other species, three inches long and about one and a half wide. The flowers are small and tubular, with four lobes to the corolla, greenish white; they are arranged in short axillary panicles about an inch long, in pairs. The fruit is a globular berry about two inches through, of a greenish grey colour. The rind about $\frac{1}{8}$ inch thick, is woody but brittle, and encloses a soft whitish pulp, in which are imbedded numerous oblong flattened seeds about half to one inch long, and half or more wide, brown with a silky coat. Every portion of the plant has an intensely bitter taste due, as has been shown by H. & G. Santesson (Archiv. de Pharmacie, 1893, 591) to Brucine. Intensely bitter as is the fruit and especially the pulp enclosing the seeds, both monkeys and civet cats eat it, the latter appearing especially fond of it.

The Ipoh Akar is abundant over the greater part of the Peninsula, occurring in Singapore, Malacca, Perak. It is also found Java.

The Sakias make a decoction of the scraped rind of the climber which they add to the Antiaris milk.

I have little doubt as to the correctness of the identification of this plant with Blume's *S. Tieute*, though he both describes and figures the fruit as red when ripe, which it never is here.

The Ipoh Aker (*sic*) and Aker Lampong, specimens of which were sent to Kew by Mr. Wray, are stated to be possibly *S. Maingayi*, Clarke, but this plant, at least the "var ? *furctuosa*," does not appear to be clearly distinguishable from *S. Ticute*, Bl., which is omitted from the Flora of British India, though our commonest species. The specimens were chemically examined by Mr. Stockman, who found that they produced effects like that of Digitalis and not at all like Strychnine (Pharmaceutical Journal 1893, p. 945). Santesson, in several experiments on frogs and mammals with the Ipoh Akar of Vaughan Stevens (*Str.*

Tieute, Bl.), obtained the characteristic convulsions of Brucine. Stockman's material was very limited, and it could not be exhaustively analysed, but if Wray's Ipoh Aker and Aker Lampong have an action on the heart like Digitalis, and not on the nervous system like Brucine, they must surely be different from *Strychnos Tieute*, and are probably not *Strychnos* at all.

Another climbing species with small hairy leaves about an inch long, and small yellow plum-like fruit, is used by the Sakais in the same way as *Str. Tieute*, but less frequently, under the name of Blay besar. It is perhaps *S. pubescens*, Clarke, but the specimens I have from Vaughan Stevens are insufficient to identify it.

He describes the plant as follows :—Leaves small, very minutely woolly, particularly on the upper surface, short tendrils, generally from the second leaflet from the central stem, but not on every twig. Main stem of vine 27 inches in circumference up to 200 feet long. About fifteen feet lies on the ground with numerous roots, four inches in circumference. The bark is greyish, dark green and reddish ; on scraping, reddish yellow ; wood soft and white. The stem divides into branches and re-divides as it goes up the tree. The foliage is only at the extremity of the branches and does not make a very large total.

"Perghoo" also mentioned by Stevens, resembles somewhat *Strychnos Wallichiana*, Benth., but I have only one or two leaves of it, and have never seen anything else like it in the jungles. Oompas pite described by the same author as used by the Menteras and other tribes where *Antiaris* and *Strychnos Tieute* are unprocurable, is also apparently a species of Strychnos, but the specimens are inadequate for identification. "Oompas," *i.e.*, Umpas, appears to be a variant of Upas, and "pite" may be intended for "putih" white. The plant is, however, not the Ipoh Akar putih (*Roucheria Griffithiana*) of the Malays. This plant is used by the Menteras in combination with Tuba. (*Derris elliptica*.)

The species of *Strychnos* are often troublesome to identify, as they flower as a rule very irregularly, and, owing to the height to which most species climb before flowering, are very difficult to collect. The foliage, too, is often very variable according to what part of the tree it is obtained from.

There are six species mentioned in the Flora of British India as natives of the Malay Peninsula, but I have met with several others apparently quite distinct from any of these, and from the Indian species.

Coptosapelta Flavescens, Korth. (*Rubiaceæ*).—Prual ; a climber with opposite broadly lanceolate leaves and axillary bunches of white flowers very sweetly-scented, according to Wray, the bark of the roots is used. It is said not to be so strong as Antiaris, but quite capable of killing by itself. The plant occurs in Malacca, Penang, Perak and Pahang. I know nothing of its properties.

Tabernæmontana malaccensis. Hook. fil. (*Apocynaceal*).—Perachit Prachek; a shrub usually of no great size with white flowers in corymbs and orange-coloured curved pods in pairs, containing seeds enclosed in a crimson aril; it is common in Singapore, Malacca and elsewhere. Perachit is mentioned as used in the manufacture of Ipoh poison by Newbold.

It is used by the Malays in native medicine, the leaves and sap for poulticing boils, and a decoction of the bark is also used for syphilis as is that of the allied *T. corymbosa*. The roots are said by them to be poisonous. Several others of the genus have poisonous properties as *T. dichotoma* of India, of which the seeds are said to be powerfully narcotic, producing delirium and other symptoms like Datura, while the bark and leaves are said to be purgative (Dictionary of the Economic Products of India) and *T. sphærocarpa*, Bl., of Java, which is stated to contain an alkaloid. (Lewin Die Pfeilgifte.)

Prismatomeris albidiflora, Thw. (*Rubiaceæ*) is used by the Menteras with the last mentioned plant under the name of Mundess. It is a shrub with white flowers, common in Singapore, Penang, and Sumatra. I do not know of its possessing any poisonous properties. The bark and roots are the part used.

Laportea crenulata, Gaud.—This shrub or small tree belonging to *Urticaceæ* is used with the Antiaris poison under the name of Rumpei according to Vaughan Stevens. The common Malay name for it is Jelatang. It is a soft wooded tree or shrub of no great size, with more or less oblong leaves, the petiole and part of the leaf armed with short stinging hairs. It is known in India as the Devil nettle or Fever nettle on account of its violent urticating powers. The flowers are produced in axillary panicles and are small and usually purplish.

It is by no means common in the Peninsula, but occurs in Selangor, Perak, Penang and Pulau Tioman. It is however very widely distributed, occurring in India and all over the Malay Archipelago. No medicinal properties are attributed to it, and it is probably only added to the poison mixture because it is irritating, and therefore in the native mind must be suitable for making poison. The form in the Malay Peninsula appears to be not so irritating as that of India and the Malay islands, but it has been stated that the hairs only sting at certain times.

Cnesmone Javanica, Miq. (*Euphorbiaceæ*).—Jelatang Rusa; is a climber of no great size which is to be found in thickets and waste spots. It has a slender stem covered with stinging hairs, oblong cuspidate leaves with a serrate edge and cordate base, covered with hairs and about six inches long and two inches in width; the leaf stalk is from half to one and a-half inches long. The inflorescence is a raceme about two inches long axillary, the upper flowers male the lower ones female. The flowers are small and green. The capsule is three lobed, about half an inch long and covered with strong spiny hairs. It occurs in Perak,

Pahang, Malacca, Penang, Kemaman and Kedah, as also in Java and other islands of the Archipelago.

Like *Laportea* it is very urticating, but not as virulent as that plant. No experiments have been made on the plant to show what the irritating poison in the hairs is, but like the *Laportea* it is probably added to the Ipoh poison, merely because it is known to be an irritating plant, though it is possible that it may increase the flow of blood to the wound, and aid to the absorption of the more deadly drugs.

EXCŒCARIA AGALLOCHA L. (*Euphorbiaceæ*).—Is a small or moderate sized tree with an intensely acrid milk. The leaves are glossy dark green, rather thick in texture and lanceolatein outline. The flowers are very small and borne in slender green catkins one or two inches in length, and are deliciously scented. The fruit is a small round capsule.

Dr. Lewin (*Die Pfeilgifte*) states that this plant is used in the composition of arrow poison. It is probably used only as an irritant to increase the rapidity of action.

The tree occurs on the banks of tidal rivers and sea-shores all through the East Indies from India to Australia.

DIOSCOREA DÆMONA, Roxb. (*Dioscoreaceæ*) Gadong.—This is one of the yams and possesses a tuber from which rises a tall glaucous somewhat thorny climbing stem. The leaves are trifoliate with large leaflets 3 to 8 or 9 inches long. The flowers very small and greenish white in spikes, unisexual, the spikes are panicled, and the panicle is often very long. The capsule is about two inches long, oblong three-angled and rather more woody than that of most species.

The tubers are ground and pounded up, and the juice squeezed out through a piece of cloth, and mixed with the Antiaris latex (Wray), or according to Vaughan Stevens they are cut up small and cooked for four hours in as little water as possible.

Mr. Wray found that the acid juice yielded a yellowish brown precipitate to a solution of iodine in iodide of potassium. The precipitate redissolved in sulphurous acid and evaporated yields long branching needle-like crystals which have an astringent taste like the juice and are possibly the poisonous principle. Schutte (Pharm. Zeit. fur Russ. XXXVI, 379) has examined the toxic alkaloid, Dioscorine, obtained from this plant and shows that on the animal organism it acts as a poison resembling picrotoxin. It is a paralysant of the nervous system but not a protoplasmic poison.

The Gadong is often to be seen growing near villages, but I have never seen it really wild. The Malays, as also the Sakais use the tubers for food, slicing them and washing them in running water for a long time to wash out the poisonous principle.

AMORPHOPHALLUS PRAINII, Hook. fil. (*Aroideæ*), Likir, Lokie, Begung.—The large tubers of this aroid are used in the same way as those of the Gadong. Like all of the genus the tuber throws up a single large leaf at a time. The leaf stalk attains often a

great size nearly two inches through at the base and tapering upwards, it is smooth and green mottled with white and brown, the leaf blade is much dissected, dark green in colour, and is of large size. The flower spike appears after the fall of the leaf and is enclosed in a large funnel-shaped primrose yellow spathe shorter than the spadix and recurved above when fully developed; the lower part of the tube inside is of a deep maroon colour. The male and female flowers are separated on the spadix which is terminated by a large primrose yellow cone-shaped process. The whole inflorescence is about a foot high.

The plant is common in Penang, Selangor, Perak, Sumatra and elsewhere. The juice of the tubers is, according to Wray, acid and causes irritation to the skin, but he was unable to find any alkaloid in the juice, and states that the use of it consists in causing local irritation which hinders wounded animals from escaping before the poison has had time to act. The Begung mentioned by Vaughan Stevens appears, from a sketch of his, to be the same species of *Amorphophallus*. He says that the tubers must be used fresh or they rot, and they are pounded up with other ingredients and boiled for half an hour. The tubers of this as well as other species are eaten after being sliced and washed as in the case of Gadong, but apparently not often as they are said to have an irritating effect. One species of *Amorphophallus* I saw being cultivated in Kelantan like potatoes for food and others are cultivated in India and Japan.

EPIPREMNUM GIGANTEUM, Scott, "Ringut."—A large climbing aroid with oblong leathery leaves one or two feet long. Common all over the Peninsula.

According to Vaughan Stevens the fruit is used for mixing with the Ipoh. He says, however, that when it is dry it contains a dust which, if it enters the eyes produces blindness, and the Sakais fearing this seldom gather it. As in the case of many Aroids the liquid contained in the spathe of the flowers, is very irritating to the skin, and it is perhaps the poisonous principle utilized or it may be the raphides which abound in the spadix which produces the irritation.

Vaughan Stevens mentions also the use of the sap of "Berar Kijang" (*Alocasia denudata*, Engl.) a common terrestial Aroid, used by the Menteras for mixing with the Ipoh, and Horsfield mentions also a plant called Nampong, probably some species of *Homalomena* as being used.

GNETUM EDULE, Bl. (*Gnetaceæ*).—A large woody climber with dark green lanceolate opposite leaves rather finely nerved, four inches long and one across. The fruit is two inches long and $\frac{3}{4}$ inch thick elliptical in outline and with a rather rough brown cerky exterior and is borne on very short spikes, only two or three on the spike. I have collected or received it from Singapore, Pahang and Kemaman, but it does not seem to be common. The large brown fruits make it a very distinct species, and it appears to be the plant figured by Rumphius (Herbarium Amboinense

V, plate 7). This is again described by Blume under the above name in Rumphia, but he adds to it the synonym of *Gn. scandens*. of Roxburgh, quite a different plant.

From Mr. Vaughan Stevens I have received leaves and a sketch of the plant which he describes as used by the Sakais under the names of "Blay Merah" "Blay Kechil" or among the Panghans "Kenne.t," The bark is used in the Antiaris mixture. No species of the genus are known to possess any poisonous properties.

Several plants are also mentioned as being added to the Ipoh poison which apparently have no poisonous principles at all, but are mere irritants and probably act by causing a flow of blood to the wound and increasing the absorption of the poison, such are *Piper stylosum*, Miq., Blay Pendy (Vaughn Stevens), a low-growing erect pepper about a foot tall. *Alpinia Galanga* and *Zingiber Cassumunaar*, Black pepper (Lada hitam) and leeks and onions are also mentioned by Horsfield, and Newbold mentions the use of Arsenic (warangan) and lime juice. The former of these must be considered very doubtful, as it would probably have no effect at all, and could hardly be obtained by a Sakai living in the woods.

Sedudu, mentioned by Vaughan Stevens, is apparently an undescribed species of *Medinilla*. It is an epiphytic shrub, with opposite leaves lanceolate, acuminate and denticulate, with short petioles. The flowers are axillary, two or three together, and the fruit is semi-transparent and white "like a white currant." The roots are used fresh, as their poisonous qualities disappear when dry, according to the Panghans. The sketch and leaves I have from VAUGHAN STEVENS are hardly adequate to identify the plant, but it differs in many points from any other species of the genus which I have met with. Some of the *Medinillas* are acid, and allied plants often astringent, but I know of none with poisonous qualities. The name Sedudu (or Senduduk) is commonly applied to many of the *Melastomaceæ*. Two species of Rattan (*Dæmonorops* sp.) Rotan Riong and Rotan Butong are also used, the sap from the cane being added to the decoction, according to STEVENS, who also mentions plants called Bal, Grow (or Chow) Choichoi, Lendow and Garsung. The sketches and leaves I have of some of these are insufficient for identification. Newbold also mentions the "Chey," but possibly this should be "Ches," a Besisi name for Antiaris (Skeat).

OTHER MALAY POISONS.

DERRIS ELLIPTICA, Benth. (*Leguminosæ*).—"Tuba," a low-climbing plant, often cultivated for use as a fish-poison. It is usually cultivated as a prostrate plant, the branches being allowed to straggle about on the ground. The roots are the parts used in catching fish, generally with the aid of lime, being pounded and mixed with the lime and water and thrown into river or arm of the sea. It is propagated by cuttings and grows fairly rapidly. The poison is said also by Newbold to be mixed with Antiaris for

the dart-poison by the Sakais, and it is also used in the same way by the Mentawei islanders (Lewin Pfeilgift, 131). Occasionally it is used criminally. A good account of the plant and its use was published by L. Wary, in the Pharmaceutical Journal (1892, p. 61). He extracted the poisonous resin to which he gave the name of Tubain, but this had already been experimented with by Greshoff* who had called it Derrid. A similar-poisonous resins occurs in many other Leguminous plants used for fish poisons and has been named timboine, nicouline and pachyrhizin, all of which Greshoff appears to consider the same principle in various conditions of purity. Pachyrhizin is obtained from the seeds of *Pachyrrhizus tuberosus*, the Yambean (Bengkunang or Sengkuang) commonly cultivated here for its edible tuberous root. There was recently a case of accidental poisoning, in Singapore, by the seeds of this plant.

One part of derrid in 350,000 parts of water according to Wray or one in five million parts of water according to Greshoff will kill fish in half an hour. The poison is according to Wray insoluble, and he states he has seen a fish eat a quantity without ill effects. However the decoction made by pounding the roots in water is not only rapidly fatal to fish when it comes in contact with the gills, but is speedily fatal to man when swallowed. The extract has long been used by the Chinese and other gardeners here as an insecticide, but of course it is unsafe to use it on vegetables eaten uncooked.

DATURA FASTUOSA (*Solanaceæ*), Kechubong.—A tall herb with large dentate leaves, and shown tubular flowers, white or more or less violet attaining a length of as much as seven inches but often smaller. The fruit is a globose thorny capsule about an inch through, dehiscing irregularly and containing a large number of flat seeds.

There are three varieties met with here; one with dark purple stems and single violet flowers the "Black Datura"; one with single white flowers and green stems, *var alba*, and one with double violet flowers. The plant is often cultivated and occurs as a common weed in many places, being indeed very difficult to eradicate. It grows rapidly and perishes after flowering. The plant is used by natives as an anodyne for sprains, rheumatism and boils, the leaves being applied to the injured part. In India it is smoked for asthma, and is a native remedy for hydrophobia. The native name here, Kechubong, is evidently a variant of Kechubu, an Arabic word given by Ainslie as a name for the plant.

Its action as a violent narcotic poison is well enough known, and it is stated that the black variety is the most poisonous. This variety is much the commonest here. Almost any part of the plant, flowers, leaves or seeds is used for poisoning.

D. Metel, L.—An allied species with pubescent leaves and stems and ten not five lobes to the corolla does not occur here, nor does *D. stramonium*, L. a smaller plant with white flowers.

* Nuttige Indische Planten, part iii, 100.

CERBERA ODOLLAM, Gaertn, Buta-buta, Babuta (*Apocynaceæ*).—This tree is very common in tidal swamps. It never attains a very large size and is sometimes rather a large shrub than a tree. The leaves are oblong and dark green. The flowers in corymbs are white with a pink or yellow ring in the throat tubular ending in a star-shaped limb. The fruit is large and fleshy, somewhat of the shape of a Mango, but less flattened, green, usually more or less tinted with red and containing a large stone covered outside with a strong network of fibre.

The whole plant is full of milk-like latex, which is stated by the Malays to produce blindness when dropped into the eyes, whence the native name Buta-buta (blind).

De Vrij isolated a crystalline substance from the plant known as cerberin. It is a violent heart poison acting like digitalin and allied to the poisons Tanghinine (from the Madagascar ordeal Bean *Tanghinia*) and Thevetine (from *Thevetia*). Cerbera appears to have been used as a poison intentionally either for crime or suicide in India, but I do not know of its use here. Malays have told me that to stop for some time under a tree of it makes them ill, but this may be imaginary on their part. However they generally avoid it when possible.

GLORIOSA SUPERBA, L. (*Liliaceæ*).—A climbing plant, with very ornamental red and yellow flowers with erect spirally twisted petals, often cultivated as an ornamental plant, and half wild on the sea-coast. This has long had a reputation for being poisonous, but of late it has been stated to be innocuous. A case of fatal irritant poisoning due to this plant occurred lately in Singapore. Two Chinamen, having collected and boiled a quantity of the rhizomes and eaten them, were seized with a severe illness, of which one died.

RENGAS POISONS.

The name Rengas is given by Malays to a number of trees belonging to the order *Anacardiaceæ* which exude, when wounded, a black varnish which produces a serious irritation of the skin. Among them are the following: *Melannorhea Maingayi*, Hook. fil., *M. Curtisii*, Oliver., *Melanochyla auriculata*, Hook. fil., *Gluta Benghas*, L., *Gl. elegans*, Kurz and *Mangifera Kemanga*, Bl.—Nearly all the Malayan *Anacardiaceæ*, contain a quantity of similar resin, but as a rule, the others are comparatively harmless. An account of the effects of Rengas poisoning has been published by Dr. Brown in the Journal of the Straits Asiatic Society, No. 24, p. 83. The resin when it touches the skin even in very small quantities produces inflammation followed by a pustular eruption and often much swelling of the part affected, sometimes ending in the formation of ulcers. Internally Dr, Brown states that it acts as a violent irritant causing vomiting and purging and is very dangerous. There is no doubt that some persons are more sensitive to the external action of this poison than others, but nearly all are more or less affected by it, and I have seen natives seriously injured by what must have been

very minute quantities of the milk. It is often stated that furniture made from the Rengas trees retain the property for a long time and affect the persons using it. Wood-cutters are the persons who naturally are most often injured by these trees, but they manage usually to avoid the action by rubbing themselves with coco-nut oil, which prevents the resin from touching the skin. Vaseline is the best application after injury from the resin. and Dr. Brown recommends the use also of bicarbonate of soda.

A very similar action on the skin is produced by *Caryota urens*, L. (*Palmæ*), a palm sometimes cultivated here and wild in some parts of the Peninsula. A boy who climbed on a tree suffered for some time from its action on the thighs, hands and arms.

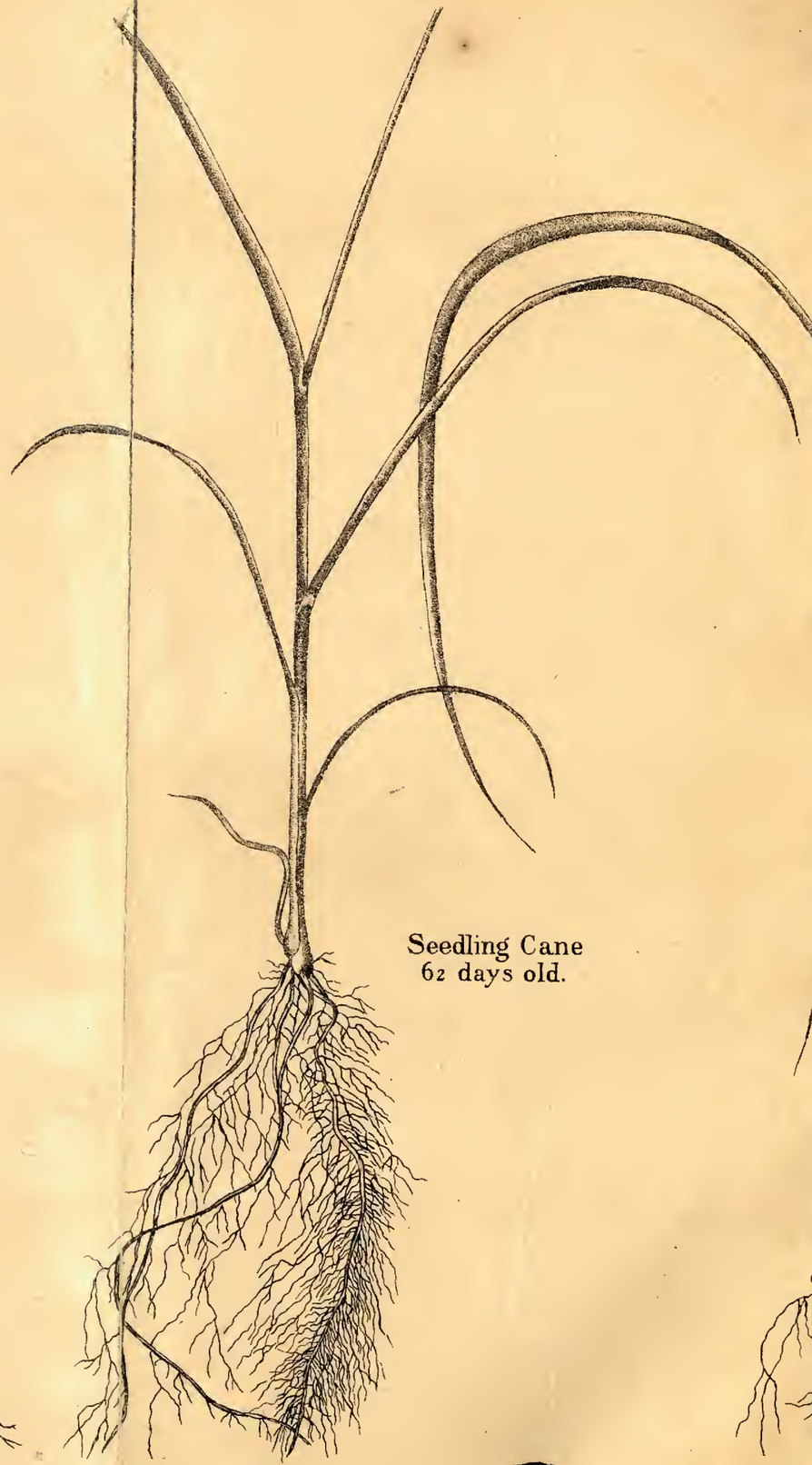
SUGAR-CANE FROM SEEDS IN THE STRAITS SETTLEMENTS.

Until about ten years ago it was supposed that the Sugar-cane had lost the power of producing fertile seeds, but that is now proved to be an error. During that period seedlings have been raised in Java, the West Indies, Mauritius, Kew, and probably elsewhere. It is said that canes were raised from seed by a gentleman in Barbadoes as far back as 1858, but little appears to be known of this, and the first successful attempt of which I have seen any authentic record is that of the late Dr. F. Soltwedel at the Experimental Station of Samarang, in Java. This was followed closely by Messrs. Harrison and Bovell's discovery at the Botanic Station, Dodds Reformatory, Barbadoes, of self-sown seedlings in the field, and also by their raising plants in the nursery. Opinions differ as to whether any great advantage will be gained by the use of seeds, but for my own part I cannot but think that seeing it opens up a much wider range of variations than had hitherto been possible, something of practical value will come of it if systematically followed up. At the beginning too much was expected all at once, and big prices were paid for seedlings, merely because they were seedlings, without waiting to see whether they showed any marked improvement on the parent or not.

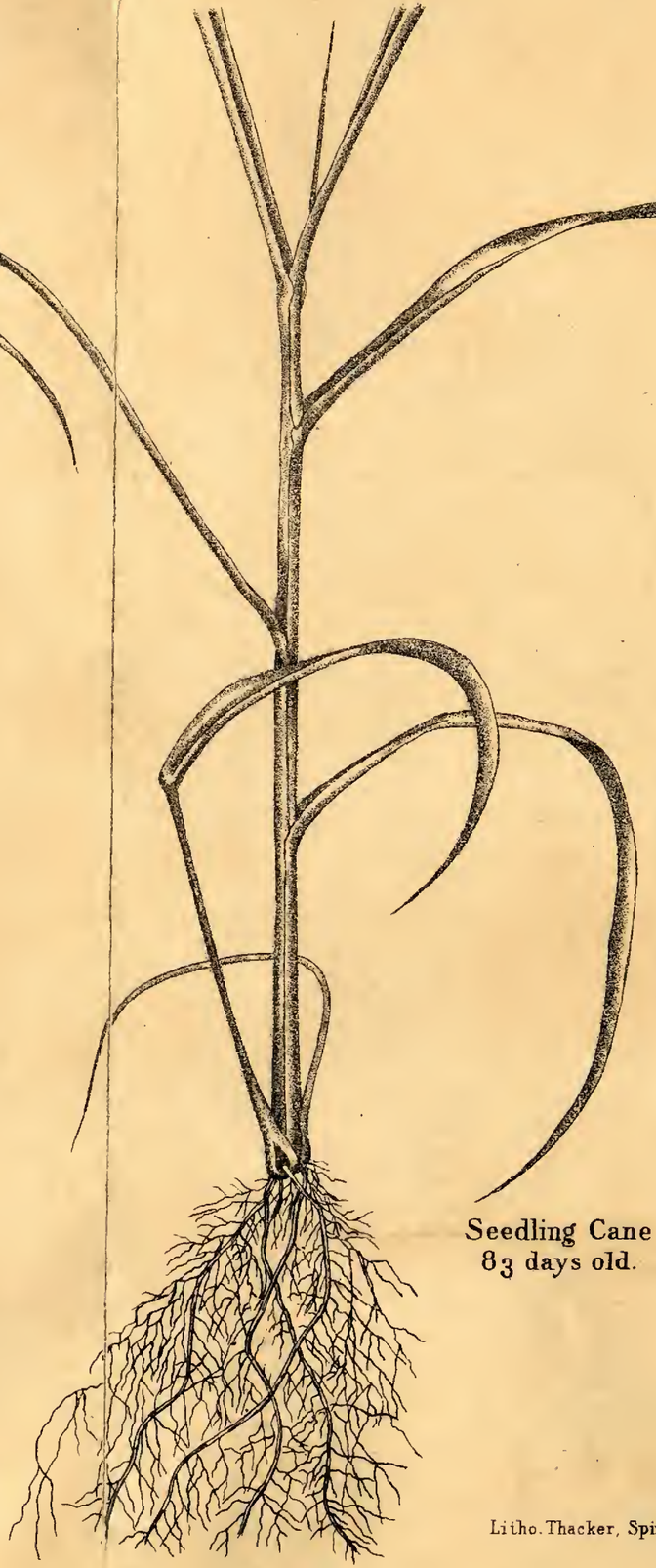
As in the case of other plants that have been brought to a high point of perfection by selection from seed, only a small proportion can be expected to be worth perpetuating, but by selecting these and seeding them again we may reasonably expect to attain the object in view. What this object is, is set forth in an article in the *Demerara Argosy*, for November 1st, 1890, and reprinted in the Kew Bulletin for January, 1891. In this the writer says:—"There are three possible ways in which we may look for improvement in the sugar-cane. We may obtain a variety that will give a larger weight of cane per acre, though it may contain no more sugar per ton of cane than the better kinds we possess now. Again, we may obtain a variety yielding a higher percentage of sugar though the weight of cane be not increased.

Seedling Cane
24 days old.

Seedling Cane
38 days old.



Seedling Cane
62 days old.



Seedling Cane
83 days old.

Litho. Thacker, Spink & Co., Calcutta.

Thirdly, we may obtain a cane containing both increased yield of cane and of sugar.'' There are also other points to be taken into consideration in which selection may be of advantage, such as, capability for a particular soil or altitude, which will at once occur to the practical planter.

After two or three unsuccessful attempts we succeeded in November, 1896, in obtaining from Mr. E. A. B. Brown of Prye Estate, Province Wellesley, a bundle of arrows of the Borneo cane containing good seeds from which were grown about three thousand plants. Owing to want of suitable ground in the nurseries of the Botanic Garden in which to grow on such a large number, the greater portion, when about a foot high, were handed over to Mr. Brown, who supplied the seeds, and to Mr. J. Turner, the manager of the Pinang Sugar Estates Company.

Unfortunately the weather set in dry soon after Mr. Brown had planted his, and there being no facilities for watering, the greater portion died. Mr. Turner informs me that his are doing well, but I have not seen them for some time. Of those kept to plant in the Botanic Garden Nursery, about six hundred in all, the first portion of three hundred were planted on the 15th February, that is, when just three months and ten days old. These made rapid progress, and in August two thousand one hundred canes were taken from this lot by Messrs. Brown and Turner for further trial on their estates. Each cane would at this stage give three or four cuttings.

Fifty stools, showing, as far as can at present be judged, the greatest promise and widest extent of variation, were allowed to stand for the purpose of obtaining seeds, but up to the present time, and they are now nearly a year old, and from ten to fourteen feet high, they show no signs of flowering. There is greater variation in this batch of seedlings than would be obtained from accidental ''sports,'' or bud variation, on an estate of several thousand acres in many years. The ''Borneo'' is a purple cane, but the seedlings are of various colours, a good number being green ones. There is scarcely one that is exactly typical ''Borneo,'' although in the matter of foliage all bear evidence of their parentage. The second batch of three hundred were not planted until about six weeks after the first, and were not potted off, so they are not so far advanced, but otherwise look just as well in every way. I am told by the planters that the difference as regards height, and general appearance, between the first lot planted and a field planted in the ordinary way from cuttings at the time these seeds were sown, would be in favour of the cuttings by about two months only. Considering what delicate little things they are in the earlier stages, as will be seen by the accompanying sketches made at different times, the rapidity of growth is remarkable.

The seeds were sown in light sandy soil on the 4th November, some in pots, and some on a bed protected from sun and rain. One portion of the soil was in each case sterilized by boiling to

make sure there were no grass seeds in it, but as cane seed germinates quickly there is no particular advantage to be gained by this. One portion was covered very lightly with a sprinkling of fine sand, and the others not at all. The advantage is slightly in favour of the former method, though it is not great. Each pot was covered with a piece of glass to prevent too rapid evaporation, and when the soil appeared to be getting dry the pot was plunged for a minute or two in a vessel with water up to the rim. No water was given overhead until the plants were a fortnight old.

Those sown in the bed were, however, watered with a fine rose pot from the first, as often as was necessary, and furnished a good number of plants, but not by any means in proportion to those sown in pots and covered with glass. The advantages are all in favour of the latter method. When a month old the young plants were pricked out in boxes four or five inches deep in a mixture of pure leaf-mould and sand in equal part and a sprinkling of bone dust added. This was passed through a quarter-inch sieve. At two months old three hundred plants were potted in five and seven-inch pots in a mixture similar to that used for the boxes, but with the addition of a little fine old cow manure.

If good seed is obtainable there appears to be no difficulty in raising any number of plants, but I think it should be sown as it is ripe. A second sowing from the same lot of seed from which these plants were raised, after an interval of fourteen days, and under exactly the same conditions, failed to produce a single plant. That this is not always the case is evident from the fact that canes were raised at Kew from seeds sent from Barbadoes. Those interested in this subject will find interesting papers in Kew Bulletins for December, 1888, October, 1889, January, 1891, and March, 1894.

C. CURTIS,

Penang.

SHADE TREES.

Suitable trees for shading roadsides and open spaces are not so easy to decide upon as would appear at first sight. They require several qualifications, in order to be satisfactory, and some which are adapted for one class of locality are quite unsuited for another. The trees selected should be at least fairly fast growers, but many trees of rapid growth must be condemned on account of their short life period, or the brittleness of their wood. This latter is of course very important, as during gales, boughs of brittle trees will be thrown down on carriages and passers by and cause accidents. In some trees the boughs die away even when large and remain attached to the tree in such a manner that they form a constant danger. This is especially the case with Fig trees, such as the Waringin. As a rule trees which produce few large boughs are safer than those which produce a

number of smaller ones. Most of our native trees are evergreen, that is to say, that they do not shed their leaves all at once. In deciduous trees like the Indian Almond, *Terminalia catappa*, the leaves are shed several times a year, altogether making a troublesome litter. Small-leaved trees are, as a rule, preferable to large-leaved ones, not only because of their producing less litter, but also because the large leaves, when falling, are apt to startle excitable horses.

Certain trees are objectionable, because they throw off the rain to the outer ends of the boughs, so that it all falls upon the road in one spot, usually causing much trouble and expense in upkeep. These trees generally possess small leaves ending in a long point, which hang downwards, either normally or at least during rain. The water falling on any part of the tree runs from leaf to leaf downwards and outwards till it reaches the terminal leaves of the boughs and then falls to the ground. These are known as centrifugal trees. The Waringin (*Ficus benjamina*)is one of this class. In centripetal trees such as *Elæocarpus ganitrus*, the rain pours down the boughs towards the trunk, where it runs down in a stream, so that a tree of this kind does not injure the road in this way at all.

Fruit trees again are unsuitable as a rule, because they tempt natives to climb them and break the boughs.

Attention must also be paid to the roots of trees. In the Fig trees and other such trees, the roots are very copious, and not very deep, and have a habit of ploughing through the road and breaking it up. They also get into drains and pipes, choking them, and pushing their way into crevices in brick-work; sooner or later separate the bricks and destroy the structure. Trees whose roots are shallow are also more liable to be blown down in a gale than trees which root deep and take a good hold on the soil.

A good shade tree should have a straight bare stem for at least twelve feet from the ground, and a good spreading head of strong branches. Proper pruning will improve almost any tree in these respects, and though it is usually neglected utterly by persons in charge of roadside trees, it well repays the little trouble entailed in attending to it. Trees with strict erect branches, like the Glam (*Melaleuca leucadendron*) are in some cases very suitable, but unless the road to be shaded is narrow they do not give enough shade to be of much use.

Treatment of Shade Trees.

It is not enough to merely put trees into the ground at stated distances and leave them to take care of themselves and grow or not as they like. They must be properly looked after and cleaned and pruned in a proper manner or they will entail a great deal of further work. The distance that trees should be planted from each other differs with different kinds. Usually about thirty feet apart is the best distance, but if it is desired to shade a road speedily, quick-growing trees may be planted alternately with

the permanent trees and cut out when the slower growing ones have grown tall enough to give the required shade.

The holes for the trees should be a foot and a half wide and of the same depth. The earth taken out should be mixed with cow-dung or other manure and replaced in the hole.

The trees should in most cases, at least near villages, be protected with bamboo or other guards to prevent injury by goats or cattle, which will otherwise destroy, or at least so hurt the tree, that it will never grow satisfactorily. It would indeed be preferable to prevent natives pasturing their animals along the roadsides altogether if possible.

As the tree grows the unnecessary boughs should be cut off. If it bifurcates low down it is best to cut off one of the shoots, and allow one only to grow. This should be done as young as possible, as it inflicts less injury upon the tree, and is also a less waste of wood, which would have gone into the main stem.

Pruning should be done with a sharp parang, and even in the case of large boughs with the saw. The ends of the boughs should be cut smooth. To break or hack a bough irregularly leaving a split irregular stump is most injurious as this end invariably dies, fungi and insects attack it, and the decay may penetrate from a single injury like this into the trunk and kill the tree. Which are the proper boughs to cut off can only be learnt by experience. Erect shoots parallel to the axis of the tree may always be removed except in the case of the few trees which have habitually erect or nearly erect trees, such as the Gelam tree.

Boughs which straggle too much, leaving the centre of the tree bare should be cut back so as to produce growth towards the centre. The object of all pruning should be rather to get a small number of large boughs than a great many small ones, as the tree is then of a better shape and produces less dead wood.

Some trees, like the *Poinciana*, have a tendency to throw out long straggling shoots which should be rigorously cut back. The Poinciana when at the height required may be heavily lopped, as it will then throw out shoots in such a way as to make a compact regular crown, and will flower far better than when left to grow anyhow.

If the tree throws out shoots from the base of the stem they should be cut off as soon as possible, as they only weaken the tree.

In cutting large boughs care must be taken to slope the cut end, so that water does not lodge there and set up decay, otherwise a hole may be formed which may penetrate into the main stem and break up the tree. This lodging of water and consequent destruction by decay is an additional reason for preventing trees from bifurcating low down. The Poinciana is peculiarly liable to destruction in this way. Earth, partly brought by insects, partly drifted into the fork, holds the rain which runs down the trunk, and a portion of the wood dies. Then fungi, termites and other insects continue the destruction till one of

the branches is broken off leaving a decay hole which soon destroys the whole tree.

Injury to the tree in the form of tears or hacks in the bark must be avoided as the wounded portion is very liable to be attacked by fungi which injure or kill the tree. Many of our native trees are protected against this injury by possessing a milky or resinous juice which flows out when the bark is cut or torn, covering the wound and preventing the lodging of spores of fungi.

Parasites and epiphytes.—These are highly injurious, and should be rigorously cleared off. The worst parasites are the mistletoes (*Loranthi*) which growing on the boughs send their roots downwards into the wood, and entirely destroying the bough which soon falls. It is of little use to tear the plant off, as it will usually grow again; the bough must be cut off below the parasite.

The epiphytic plants are those which merely grow on the bark and do not penetrate the bough itself. Many are really quite harmless as they do not cover the boughs but only grow sporadically on them. Orchids for instance rarely injure a bough even if in large numbers.

The worst of the epiphytes is the little creeping fern *Drymoglossum piloselloides*, which is excessively common. It is easily recognised by its round flat vegetative fronds and erect narrow spore-bearing ones. It will often quite cover a bough which will eventually die and fall. Another objectionable plant is *Dischidia nummularia*, a creeping plant with little rounded fleshy leaves very close together, which on being broken will be found to exude a milky liquid.

The climbing and more or less parasitic fig trees, are also usually very injurious. Seeds are deposited by birds or bats in cracks in the bark and grow eventually so large that the roots of the fig wrap round the tree, and at last kill it. In some cases the fig becomes a tree itself and so replaces the one it has destroyed. But several common kinds never become trees at all, remaining as shrubs or climbers and dying with the tree upon which they have grown. The most objectionable is the very common *Ficus subulata* with curious oval leaves with long points and small orange figs. Trees again are sometimes killed by a fig seed lodging in a fork of the main stem, the roots as it grows penetrating into the centre of the wood.

Trees ordinarily in use as Shade Trees.

Tembusu (*Fagraea fragrans*). — This is always raised from seed and grows very readily. It is a fairly fast grower, and of very handsome appearance. It generally attains a height of about sixty feet in suitable localities. The crown does not spread much, but it gives a good shade. It has a habit of branching low down, good specimens on a lawn feathering to the ground. It therefore requires pruning for roadside purposes so as to

make a tall bare stem. In pruning it should be cut with care so as not to leave bark wounds, as it is liable to attacks of fungi, especially a kind of Polyporus. I have also seen trees killed by a black slimy fungus, which destroyed the cambium layer, causing it to emit a very foul odour. The Tembusu prefers dry localities, and is not at all suited for wet spots. It is an evergreen, and the leaves remain on the tree a long time, so it produces but little litter, and being one of our hardest timbers the boughs are but rarely broken even by a gale, and it is very rarely blown down.

As an ornamental tree it is very suitable for lawns, for it is not only a very picturesque shape but its deep green compact foliage and masses of small yellow flowers followed by scarlet and orange berries makes it very attractive.

KRIAN, Jambu Ayer Laut, *Eugenia grandis*.—This is one of the commonest roadside trees, being easy to grow, and very rapid. It is grown from seed and attains a height of about forty feet. The leaves are rather large and make a good deal of litter, but are seldom shed in any great quantity so that it does not give any great amount of trouble. As a roadside tree it has been lately looked on with disfavour on account of its having a habit of dropping large boughs suddenly, and sometimes even large trees are blown over by gales. It is very liable to a disease which is apparently due to an obscure fungus. The bark cracks up usually near the base of the tree at first, and corky out-growths often appear beneath it. In many spots roots are emitted in short tufts. The disease creeps up the tree, the leaves fall off, and the tree dies. The disease most commonly occurs in damp spots, often all the trees along one road are more or less infected by it, though all do not die. I have never been able to find the fungus which apparently causes the disease. It is probable that this disease is the cause of the breaking off of boughs suddenly.

In a wild state, this tree as its second Malay name implies, inhabits the sea-coasts, growing in sandy spots, when it often attains a large size, and is apparently seldom attacked by the disease. For dry sandy spots it is an excellent roadside tree, growing rapidly, and affording a good shade, besides being very handsome from its bold dark green foliage and large terminal masses of white flowers. The wood is valued for boat building in many places.

ANGSANA, *Pterocarpus indicus*.—This is one of the finest of all shade trees. It will grow almost anywhere, but it especially suited for roads near the sea. It makes little litter and is strong and seldom breaks. Old trees attain a large size, and magnificent specimens may be seen in Malacca, Kuala Selangor and Penang. It is a deciduous tree shedding its leaves before flowering. It fruits readily and can be raised from seed, but it is usual to raise it from cuttings. These are made from old wood, about half an inch or more thick and about two feet long. As they break somewhat irregularly it is advisable to prune them to

the form desired early. Seeds may be planted in beds, and only lightly covered with soil, the beds being shaded till the plants are well up. Seedling trees are usually of a better shape than cuttings, but are much slower in growth at first.

SAMAN, Rain tree, *Enterolobium Saman*.—A rather soft wooded tree raised from seed or cuttings. It grows very fast and is fairly long-lived, but being of irregular habit and being inclined to throw up suckers from the base, and long straggling boughs from the crown, it generally requires pruning to get it into a good shape. It makes a good deal of litter and often drops dead branches, but this fault can be improved by pruning out of the smaller ones.

CANARY-NUT, *Canarium commune*.—This handsome tree so largely used in Java and other of the Eastern islands as a shade tree does not thrive here. It suffers much from a boring caterpillar which kills the branches which then fall off, and in Singapore at least it grows slowly and attains no great size. It probably requires a better soil.

THE TAMARIND, *Tamarindus indicus*.—Is a very suitable tree near the sea coast, though it grows rather slowly even there. Inland it seems rarely to grow well, it is raised from seed, and forms a very handsome tree; being hard wooded, it does not readily break up and its small leaflets do not produce much litter. The tamarind fruits but little here as a rule, but further north, *e.g.*, Province Wellesley it generally crops pretty well.

INDIAN ALMOND, Ketapang, *Terminalia catappa*.—Is often used as a shade tree, being a fast grower, and seldom broken by winds. The great objection to it is the litter that it makes with its large leaves especially when its period of rest comes on, when it sheds all the leaves at once.

SPATHODEA CAMPANULATA.—Is well enough known as an ornamental tree. It is very readily grown from cuttings, as it never fruits here. It gives but little shade but may be alternated with denser trees for the sake of ornament. Though soft wooded it does not give much trouble by breaking up, and is not a dangerous tree in this respect. It is however liable to be blown down in gales. The habit of throwing up shoots from the roots even at some distance from the tree is sometimes troublesome.

JACARANDA MIMOSÆFOLIA.—Is also a tree more suited as an ornamental tree than for shade. Its beautiful feathery foliage and showy violet flowers make it exceedingly attractive. It is raised from seed and grows fairly fast in most soils, but especially well in damp spots. It attains no great size and as a rule branches rather low down, and may very well be used for beautifying roads otherwise partially shaded.

POINCIANA REGIA, the Flamboyant.—Is frequently used as a roadside tree on account of the beauty of its flowers. Its great defect is that it is comparatively short-lived, usually breaking

up entirely in large pieces. The tree has a habit of rotting between the large branches, becoming partly hollow and then breaking up. It is however a rapid grower and is soon replaced. The tree is raised from seed and will stand a great deal of pruning which is often necessary to get it into a good shape.

STERCULIA ELATA.—A tree recently introduced from India, promises well as a roadside tree. It grows very fast and will stand lopping, and is moreover of good form. It is raised from seed and grows well almost anywhere so long as the soil is reasonably good.

PENAGA, *Calophyllum inopyyllum.*—Is a very handsome tree, easily raised from seed and growing fast, but owing to its habit of branching low down and forming but a short stem, it is not at all suited for a roadside tree. It also has the disadvantage of producing large quantities of hard, globular fruits which are most objectionable on the roads, being very likely to throw down horses. It is used, however, as a roadside tree in many places, especially in sandy spots near the sea where few other trees will grow well. It is but little liable to the attacks of parasites or epiphytes, and its wood is strong, so that it is seldom broken by wind.

There are a number of other species of *Calophyllum* here, but though they usually produce tall straight stems, they grow too slowly to be of use as roadside trees.

CASSIA FISTULA.—This magnificent tree called sometimes the Indian Laburnum, seems to grow best in the northern parts of the Peninsula, especially near the sea. The climate of Singapore does not seem to suit it at all, though there are a few fine trees to be seen there. It is more suitable as an ornamental tree from its beautiful masses of golden yellow flowers than as a shade tree, as it does not, as a rule, spread much. It is raised from seed and is a moderately fast grower.

C. NODOSA.—Is a handsome tree somewhat resembling the last with smaller leaflets and rosy flowers. It is a native of the Peninsula and in suitable places grows to a large size, with a spreading head of foliage. It is raised from seed and is a moderately fast grower.

C. JAVANICA.— Is a similar tree to the last with larger flowers borne on the ends of the branches, and not on the old wood as in the preceding species, and is altogether a more beautiful tree. It seems to grow more rapidly but not very tall. It is a native of Borneo and Java.

C. SIAMEA.—A smaller tree than the last three, with terminal trusses of golden yellow flowers, will grow readily almost anywhere. It is a very fast grower, but short-lived, and when it dies breaks up very quickly, so that though a very ornamental tree it is only suited for gardens and waste ground and not for the roadside.

SAGA, *Adenanthera pavonina* and *A. bicolor*.—Are fast growing trees suitable for alternating with slower growing ones, such as Angsana, and cutting out later. Among these, *A. bicolor* is the best, having much more compact habit, and its close small deep green leaves give it a very handsome appearance. *A pavonina* is of a much more straggling habit, and is not at all suitable for a permanent shade tree. It is much more liable to parasites and epiphytes than *A. bicolor*, however, itself possesses this defect in a large degree, and it is very liable to drop its branches. But for quickly shading ground, whether to improve the soil or shade other plants either are very satisfactory. The branches which fall are usually small and though objectionable on a road do no harm to coffee or other bushes beneath them. Their timber is soft and useless.

The two trees can be easily distinguished by their seeds which in *A. pavonina* are completely scarlet, in *A. bicolor* half black and half red.

ALBIZZIA MOLUCCANA.—Is a very well-known shade tree, growing very rapidly and attaining a great height. Its foliage is light and feathery so that it gives a very partial shade. It is not at all liable to parasites or epiphytes owing to its smooth to bark. The great defects it possesses are its liability to drop its large branches without any apparent reason, and the great distance to which its roots stretch. The roots are usually close to the surface, and throw up shoots at a considerable distance from the main stem. If the trees are planted too near the water-supply they taint the water especially during wet weather with a peculiar nauseous odour. The tree is generally raised from seed. It has long been in use as a shade tree for coffee.

WARINGIN, *Ficus benjamina*.—Some of the defects of this beautiful tree have already been alluded to. Its way of throwing the rain down from its pendulous branches upon one spot is most objectionable. Its boughs often fall, even large ones and more freqently smaller bits. Its roots run very far and penetrate into drains filling them up and disintegrating the brick work. It is also very liable to epiphytes, and to the attacks of a mistletoe (*Viscum*). Its rapid growth, easy handling, and beautiful form will, however, always make it popular. It can be raised from seed or cuttings. The seed is dispersed by birds and bats and young plants can be found in many spots, which are easily removed, and grow fast.

The PEEPUL, *Ficus religiousa*.—Is free from most of the defects of the Waringin, and if cut back constantly will form a beautiful tree especially suited for places near the sea. It seems to be long lived and is seldom injured by parasites or epiphytes nor does it spoil the roads by shedding the rain all in one spot like the Waringin. Its roots are however nearly as troublesome, and seedlings growing in brickwork where the seed is often deposited by birds soon breaks it up. It is a fast grower.

SENTOL, *Sandoricum indicum*, and Kechapi, *S. radiatum*.—Both very similar trees, are very suitable roadside trees. They grow fairly fast, straight and tall, are long-lived and seldom break, nor do they make much litter. They seem but little liable to parasites or epiphytes. They are well-known as fruit trees, though the fruit is poor, and not used by Europeans.

The Kechapi is distinguished easily from the Sentol by its downy leaves, which are, glabrous in the latter. Both are grown from seed.

MANGO, *Mangifera-indica*.—Needs only to be mentioned as a tree to be avoided as a shade tree. It is very liable to the attacks of a boring caterpillar and to other leaf-eating ones, so that it almost always looks shabby, and the boughs die and break off.

KURRIMIA PANICULATA is a very fine tree with large deep green leaves and possesses all the qualities suited for a roadside tree except that it is of very slow growth.

MIMUSOPS ELENGI, Poko Tanjong.—This tree grows very well along roadsides but it is rather a low tree, though bushy. It grows fast from seed and is a strong wooded tree, seldom attacked by parasites, and lasting long. Its deep green leaves and starry white sweet-scented flowers make it very attractive. It is better suited perhaps to shade narrow roads in gardens rather than main roads on account of its height.

CANANGA ODORATA, Kenanga.—Is a tall fast growing tree attaining a height of sixty feet, and usually possessing a clean straight stem. Though a somewhat soft-wooded tree it is not brittle and does not drop large branches, nor though its leaves are fairly large does it make much litter on the ground. It is especially suitable for damp ground, though it will readily grow almost anywhere. It is but little attacked by parasites nor owing to its smooth bark do epiphytic plants infest it. It has also the merit of having very sweet-scented flowers, which give a pleasing odour in the evening. It is readily raised from seed.

RU-TREE, *Casuarina equisetifolia*, Forst.—Though a popular tree is hardly suited for the roadside, being very liable to drop its branches and being very unsafe from this cause. It is raised from seed and is of rapid growth, but seldom grows really well except near the sea. In fact in the wild state it invariably grows along the seashore just above the beach and usually in a single line, never going further inland. It is seldom attacked by parasites or epiphytes, but the boughs often die away and fall in a gale.

PARA RUBBER NOTES.

Some planters seem to have experienced difficulty in germinating the seeds of the Para rubber satisfactorily. This appears to be due in some cases to their having planted them too deep

in the ground. In the natural state the seeds are shot out of the capsule when it explores so violently that they are often embedded fully half in the mud if sufficiently soft, and they then begin to germinate. It is therefore not natural to cover them deeply with soil. They should be placed on the ground the flat surface downwards and pressed into the mud for about half their depth, or a little more. If covered, this should be done very lightly so that the mice which often eat them may not easily find them. One planter reports that snails attack and devour the shoots as the seeds germinate. Snails are not, as a rule, very common in the Peninsula, but in localities where they are abundant the seedlings should be protected against them.

Seeds vary very much in size and colour, and naturally when it is possible to select, large and dark coloured seeds should be taken. The reason for the difference in size and colouring is not clear. Some trees produce pale unhealthy looking seed which, however, germinate well and seem to be quite sound. Possibly this may be due to the trees being young, as large and old trees generally seem to bear large and dark coloured seed.

In packing seed for sending to a distance it is found best to pack in fine soil, or leaf mould, the seeds being placed in layers with mould beneath. Rotten leaves, with a little sand is also a good packing material. Coco-nut fibre dust or charcoal or any dry dusty substance are inadvisable as the seed suffers more from dryness than from damp. Recently some seeds were sent in a wooden box filled with a coco-nut fibre dust and rotten leaves. At the end of the voyage, about a fortnight, these were found to be nearly all germinating but the plumule was hardly showing in any of them. At the same time some of the seed was sent in Wardian cases planted in the earth of the pots inside the cases. In these cases it was found that the seed had far outstripped the others in growth having stems from four to six inches long, and showing the great superiority of this method of packing. Indeed this would be the best method for shipping seed for considerable distances except that it is very expensive as only one layer could be put in a Wardian case.

There seems to be a great diversity of opinion as to the duration of the germinating power of the seeds. It has been stated that after two or three days a large proportion of the seed may be expected to be dead, while after ten days none will germinate. This is certainly an error. Seed has been successfully sent from South America *viâ* England, though usually with much loss, and seed has been sent from Ceylon merely in gunny bags without any packing whatever, almost every one of which germinated. The fine trees in the Botanic Gardens in Singapore were nearly all sent in this way. Of course loose packing in gunny bags is not at all to be recommended, as in hot weather they would suffer much if accidentally put in the sun on the voyage, but this shows that the germinating power is not so soon lost as is often supposed.

CUTTINGS.—Are very easily made from branches about as thick as the little finger or at least not thinner than an ordinary pencil. Any thicker or thinner than this usually fail. The American method mentioned by travellers of planting in water with only the tops appearing does not prove very successful, not only being inconvenient, but owing to the irregularity of our rainfall, the water sometimes overflows the tops of the plants and at others is insufficient. Cuttings are sometimes very slow in starting, but grow fast enough when well rooted. They seem to travel with great ease, if kept damp, and can be sent considerable distances if packed in damp grass, even before they are struck. I have met with but few plants which either as cuttings or seedlings have so much vitality as Para rubber.

We have not yet gauged the full capability of rubber producing of these trees. One planter, it is stated has recently taken not less than seven pounds of rubber, from a ten year old tree, nor does the tree appear at all to be injured by this drain.

A circular dealing with rubber cultivation in Ceylon, has recently been published by the Director of the Botanic Garden there. Among other information we learn from it that "while the tree will grow at Peradeniya (elevation 1,576 feet) it suffers much from cold and grows very much more slowly than in the low country." I do not know of any experiments which have been made in the Peninsula as to the altitude at which Para rubber will grow successfully, but in any case the hill lands we possess are not, as a rule, suitable in the matter of soil for this plant, and we fortunately possess a very large area of plain country which is very well adapted for it.

"The area of land in Ceylon suitable for profitable rubber cultivation is comparatively small, possibly not more than 10,000 acres." The trees, however, in suitable soil,in Ceylon, grow apparently as fast there as here. In the Heneratgoda garden were 45 trees, about 30 feet apart. They were eleven years old, and the girth taken about ft. 5·6 above the ground. The largest tree was ft. 7·5 round, the smallest two feet.

Some experiments were made as to yield of rubber which showed that trees of about 2 feet mean girth gave in six weeks' tapping lbs. 5·17 , while a tree nearly 12 years old and 50½ inch in girth gave an average of 1½ lb. per annum from its 12th to its 21st year, yielding 1 lb. 12¾ oz. at twelve years, and 3 lbs. 3 oz. in its 20th. This yield is really less than has been obtained in even younger trees in the Peninsula.

The circular is well worth reading by our rubber planters, who will, I think, agree that both the rapidity of growth of trees, yield of rubber, and probable return have been underestimated, at least for the Malay Peninsula.

LEMON GRASS OIL.

Lemon grass oil, distilled from the grass known as *Andropogon citratus*, was formerly one of the few peculiar Singapore products. Ceylon and Singapore held the market. Ceylon oil, however, says the *Chemist and Druggist*, has quite left the market, and little comes from Singapore. In January, there was a threatened famine of the oil in England, and prices would have risen very high had not unexpected supplies arrived from Cochin in Malabar. It is much to be regretted that an important manufacture like this should be lost to the Straits, and it is all the more remarkable since at the time that the product was commanding an unusually high price the Singapore supply was dwindling away. A few years ago Lemon grass oil was considered only fit for scenting the cheapest hair oils and soaps, and was priced at 1½*d*. to 1¾*d*. per oz., but it was discovered that it contains a larger proportion of citral (the odorous principal of oil of lemon) than any other oil, *viz*., 75 per cent., as against 7 per cent, in lemon oil, and it is now employed in the manufacture of Ionone or Artificial Violet. Lemon grass oil in 1896-1897 went up from 2½*d*. per oz. to 8*d*., and is now 10*d*. per oz. This high price has produced considerable adulteration, and it is pointed out that should lemon grass oil go say to 1-6 per oz. it would perhaps pay to make citral from geraniol, a body existing in oil of geranium and otto of roses. The export to London amounted to 3,000 cases, each case containing from 21 to 23 oz. so that the value of the export for the year taking an average was £1,443. There certainly seems room for more distillation of essential oils here. Citronella still holds a very fair price. Vetiver can easily be grown and should pay. Cajuputi, the common Gelam tree would need no cultivation, as Malacca could supply an unlimited quantity. Patchouli oil needs no recommendation, the dried leaves being now higher in price than usual, while Cananga, Ngai camphor (*Blumea balsamifera*), Basil and Champaca flowers would certainly be worth the attention of the distillers.

CITRONELLA OIL.

Since writing the above note on Lemon Grass Oil, an important paper on Citronella has appeared in the *Chemist and Druggist* of Nov. 12, 1898. Citronella oil is used almost wholly as a perfume for toilet soaps and the consumption is increasing every year. Ceylon exports this year 1,174,205 lbs. from an area of from 40 to 50 thousand acres. The grass grows on the hillsides and requires practically no attention until the harvests come round. There are two harvests—one in July and August, and the other in December to February. It is cut and bundled by women and taken to the distillery, a plan of which, very simple in structure, is given.

The still is worked by steam distillation, no water being added to the grass. An acre of grass produces in the summer time 36 to 44 oz., the winter harvest producing only one-fourth of this. The price in October for the oil was 11½*d.* per lb. in London. Mr. Fritzsche, of Messrs. Schimmel & Co., who supplies this report, states that the cost of production in Ceylon does not amount to more than 1 cent per oz., and Messrs. Schimmel mention that a Citronella oil of exceedingly fine quality is now distilled in the Straits Settlements but there is little of it and Java is also embarking on the enterprise.

COFFEA STENOPHYLLA.

In the proceedings of the Agri-Horticultural Society of Madras for July, 1897, p. 118, are some reports on this plant by three experimenters in different parts of Madras. All agree that their trees are quite healthy and free from leaf-disease. At Calicut and Wynaad the trees are reported to have done well in the matter of growth, but the crop produced is remarkably small. At Yercand, however, at an altitude of 4,300 feet, the growth has been remarkably slow, although the trees were very liberally manured. In Singapore one cannot find any fault with the rapidity of growth, and, judging from all observations, it would appear to be best suited for the low country. Its cropping, however, is decidedly poor. Unfortunately there is no suitable ground for Coffee of any kind in the Economic Gardens here, and it remains to be seen whether it will do better in richer soil, say in Selangor. The fruit too is very small, averaging a smaller size than Arabian. It is hoped to give it a thorough trial in the Native States, and should it be induced to crop sufficiently heavily, we should then be in possession of a plant resembling Arabian Coffee in the flavour of its seed, but possessing the advantages of freedom from disease and suitability for lowland cultivation.

COFFEE BLIGHT.

The following correspondence has been transmitted through the Secretary of State for the Colonies, and as it may be interesting to Coffee planters is printed here:—

GRENADA,

December 4, 1897.

SIR,—I have the honour to transmit an extract from a letter I received on the 25th ultimo from Mr. G. Whitfield of this Colony, on the subject of the injury done here to Liberian Coffee by a scale insect, some of which on diseased leaves I enclose for examination and report. I am collecting specimens of this insect in all its stages for identification.

2. Heretofore Liberian Coffee has been looked upon as proof against any blight or insect attack. In view of its wide culture

in every part of the world it would be indeed a sad awakening to find the contrary.

3. In 1875 some trees of Liberian Coffee in its home, Liberia, were affected by the *Hemileia vastatrix*. The effect was similar to what is described by Mr. Whitfield Smith. As regards the trees here no extensive injury was experienced nor have I heard since of any loss from the like cause.

4. May I invite reference on this important matter to the Director Royal [illegible]ens, Kew.

I have, &c.,
ALFRED MOLONEY,
Governor.

The Right Hon ble
JOSEPH CHAMBERLAIN, M. P.

EXTRACT FROM A LETTER FROM MR. G. WHITFIELD SMITH TO THE GOVERNOR, DATED 24TH NOVEMBER, 1897.

I also forward some diseased Liberian Coffee leaves. As Your Excellency will observe, these are attacked by a scale insect. When I first noticed it, some months ago, it was very scattered and seemed to do little harm, but of late it has spread rapidly, and now seriously affects the health of the trees. It occurs on plants growing in the open as well as on those under shade and the trees attacked gradually lose their branches.

Hitherto, Liberian Coffee has been considered proof against insect pests, and I thought your Excellency would like to know of this, especially as there is a chance of the disease becoming a serious evil if it finds a suitable object of attack in the Liberian Coffee.

ROYAL GARDENS, KEW,
January 12, 1898.

SIR,—I have the honour to acknowledge the receipt of your letter of December 30, 27379-97, enclosing copy of a despatch from the Governor of the Windward Islands with specimens of diseased leaves of Liberian Coffee.

2. On examination here it was found that these leaves exhibited no trace of "Coffee-leaf disease" (*Hemileia vastatrix*) or of any other fungus.

3. I observed that in the 3rd paragraph of his despatch Sir ALFRED MOLONEY makes the following statement:—"In 1875 some trees of Liberian Coffee in its home—Liberia—were affected by the *Hemileia vastatrix*. The effect was similar to what is described by Mr. Whitfield Smith," *i.e.*, apparently to that exhibited by the diseased leaves accompanying the despatch.

4. As the matter is of great importance, I may say at once that the effect is not in the least similar. The Coffee-leaf disease is a fungus which speedily destroys the tissues of the leaf and

causes it to fall prematurely. The Grenada Liberian Coffee on the other hand as Mr. Whitfield Smith correctly states, is "attacked by a scale insect." As a matter of fact two distinct kinds have been detected :—(1) The circular scale, *Aspidiotus articulatus* which is also found on the West Coast of Africa (Lagos); (2) the long narrow scale chiefly on the ribs of the leaves *Ischnaspia filiformis*, which is very common in the West Indies and is also found in England.

5. These scale insects, though no doubt serious, are not to be compared for a moment as a source of danger to Coffee cultivation to the Coffee-leaf disease. You are aware that the progress and distribution throughout the world of this scourge to Coffee cultivation has been watched by Kew with assiduous care. Originating about 1869, in Ceylon, it spread to the Malayan Archipelago in 1876, to Fiji in 1879, to Mauritius in 1881, to Natal in 1884 (Kew Bulletin, 1893, p. 362), and to German East Africa in 1894. But as I stated in my letter of December 16, 1896, it is not known to exist in the West Africa Colonies. Added to this, Liberian Coffee is found to be only moderately affected by it. I cannot but think, therefore, that all probability is opposed to the correctness of Sir Alfred Moloney's statement that the disease existed in Liberia in 1875, as Eastern Africa was not affected till nearly ten years later. I should be glad to know on what precise evidence Sir Alfred Moloney bases it. If true, it seals the fate of Coffee cultivation on the West Coast and seriously imperils that in the New World.

6. I enclose a memorandum of the most approved method of treatment for dealing with scale insects.

I am, &c.,

W. T. THISELTON DYER.

C. P. LUCAS, Esq.,

Colonial Office,

Downing Street, S. W.

Mixture for destroying Scale-Insects.

Heat milk nearly to boiling point and mix with double the quantity of kerosene; stir briskly until a thick creamy liquid is obtained.

Dilute with ten times the quantity of water. Spray or apply with a brush, keeping the mixture constantly stirred.

Sour milk is as efficient as fresh.

If milk cannot be obtained, or if the mixture is required in large quantity, a strong soap emulsion may be used in its place.

Note on the Correspondence.

One may safely say that there is no planter here with any experience in Coffee, who has not seen scale on Liberian Coffee, especially in neglected trees or on poor soil. As a rule, I think the blight does not do much harm, as the trees speedily get rid of it,

generally, if well manured and strengthened, though in a dying tree doubtless it hastens the death. Our experience here is that Liberian Coffee is very liable to insect attacks, as indeed almost every cultivated tree is, and a number of moth caterpillars, beetles, bugs, aphides and other insects have been described as attacking the plant.

Kerosene emulsion as recommended by the Director of Kew, is as convenient an insecticide as one can get, but I have found phenyl mixed with water peculiarly deadly to scale insects and especially cocci (white blight). It often happens that these *Hemiptera* are protected by a waxy coating which throws off any ordinary liquid before it has had time to penetrate to the animal's body. Phenyl acts on the waxy secretion and apparently dissolves it at once, and the unprotected animal dies. The phenyl, which is purchased in tins, is mixed with water and stirred till the liquid has the appearance of good milk.

GARDENS AND FOREST DEPARTMENTS,
STRAITS SETTLEMENTS.

AGRICULTURAL BULLETIN

OF THE

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No. 9.] MAY. [1900.

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THE NATIVE RUBBERS OF THE MALAY PENINSULA.

There are upwards of a hundred different plants belonging to several orders which have been recorded as producing rubber. Many of these, however, are really but little known commercially, and a considerable number have been practically condemned as commercially of no value, either from the inferiority of the product or from the small quantity produced.

This verdict will probably be reversed in some cases when we are more familiar with the best methods of extracting rubber, and of treating it. Hitherto rubber has been derived almost exclusively from the wild plants, lately it has come under the hands of the planter, and though, as a rule in cultivation of any product, one plant is found to be commercially the most suitable to cultivate in most places, still there are localities and conditions in which other plants may be preferable, or of value as accessory.

Although many works have been written lately upon the various kinds of rubbers commonly known, I observe that little or nothing has been recorded as to our local rubber vines and rubber trees, and there is much confusion about them. The wild rubber plants of the peninsula belong to the orders of *Urticaceæ* and *Apocynaceæ*. Of the former we have several species of *Ficus*, of which besides the well-known Getah Rambong, *Ficus elastica*, we have in our forests also *Ficus annulata* Bl. *F. altissima* Bl. and *F. obtusifolia* Roxb., all stated to produce rubber, but I have failed to get any from the first two. There are also the *Artocarpi*, *A. integrifolia*, the Jack, and *A. Kunstleri* King, Getah Terap. These latter undoubtedly contain a caoutchouc, but it does not set sufficiently well, by ordinary methods of treatment to be commercially valuable. It remains sticky and in some cases semi-liquid, and is chiefly used by the Malays as bird-lime for which it is very well adapted.

The order Apocynaceæ supplies the Rubber vines and the Rubber trees Dyera and Alstonia.

The rubber vines as rubber producers seem to have been very much confused, owing perhaps to the Malays using the same name for several distinct species, and also in some cases from writers guessing at the plants which produced a special rubber. The market names too are very much confused; such names, for instance, as Borneo rubber or Java rubber, have been very loosely used and the name Gutta Susu has been applied to Willughbeias and Urceolas impartially. The words Getah Grip or Grit, Gegrip, Gegrit and in Borneo Singarip, are applied to almost any rubber vine whether a *Willughbeia*, *Urceola* or *Parameria*, and may be taken as simply meaning rubber vine as opposed to a rubber tree. Serapit is another word applied to very various

rubbers. In the Peninsula it usually means *Parameria polyneura* or *P. glandulifera*, but it is also used for a *Hoya* which does not produce rubber. In Borneo it is applied to a species of *Willughbeia* or *Leuconotis*. The Borneo rubber vines are at present very little known. Burbidge collected and made drawings of them when in British North Borneo, and some account of these was published in the Kew Bulletin for 1880, of which work I have been unable to procure a copy. A considerable amount of rubber is exported from Borneo, and it would be very desirable to obtain specimens of the plants producing it.

Some of the recent works on caoutchouc state that the asclepiadaceous plants, *Calotropis procera* and *C. gigantea* supply part of the Borneo rubber. This I doubt very much, but if so, the amount supplied must be very small, as these plants are by no means abundant in this region, and thrive but indifferently, the climate being too wet for them. *Cynanchum ovalifolium* has also been stated to produce a local rubber, but this appears to have originated in a mistake. The climbing *Asclepiadaceæ* may certainly contain caoutchouc in their latex, but their stems are so slender and the amount that they produce comparatively so small that they would hardly be worth cultivating for this purpose.

Among the Apocynaceæ we have a number of rubber vines producing rubbers of considerable value and which have long been in use, besides two or three trees. The following is a list of the species :—

RUBBER VINES.

Flowers in short axillary cymes, fruit a berry often large.

Willughbeia firma, Bl. Flowers white, fruit globose, soft.
W. coriacea, Wall. ,, ,, oblong.
W. tenuiflora, Dyer. ,, ,, ovoid.
W. flavescens, Dyer. Flower yellowish, fruit globular.
Melodinus orientalis, Bl. Flowers white, fruit with a hard rind.
M. coriaceus, Oliv. ,, ,, ,,
Chilocarpus enervis, Hook. fil. Flowers orange, fruit splitting in two.
Leuconotis eugeniifolius, Wall. Flowers orange, fruit pear-shaped.
L. Griffithii, Hook. fil. Flowers orange.
L. Maingayi, Dyer. ,, ,,

Flowers in panicles, terminal or axillary. Fruit a capsule with plumed seeds :

Parameria glandulifera, Benth. Flowers pink.
P. polyneura, Hook. fil. Flowers pink or white.
Urceola elastica, Roxb. Flowers green very small.
U. lucida, Benth. ,, ,,
U. Malaccensis, Hook. fil. ,, ,,
U. Maingayi, Hook. fil. ,, ,,
U. brachysepala. Hook. fil. ,, ,,
U. torulosa, Hook. fil. ,, ,,

Trees :

Dyera laxiflora, Hook. fil. and *D. costulata*, Hook. fil. } Pods very large and woody, seeds flat with a thin wing.

Alstonia scholaris, Br. Pods slender, seeds plumed.

WILLUGHBEIA.

W. firma, Bl.—A large climber about 4 inches through. Bark thick black covered with brown warts, in section red. Branches black warted, tendrils long and slender on the ends of the branches. Leaves coriaceous, dark shining green, lanceolate, acute, 4 inches long by 1½ wide, petiole thick, nearly ½ inch long, nerves about 10 to 15 pairs. Flowers in short axillary cymes, about as long as the petiole on stout peduncles, white sweet-scented, pedicels very short and thick. Bracts ovate, lanceolate as long as the pedicel. Calyx ⅛ inch long, lobes 5, rounded ciliate on the edge. Corolla more than twice as long, tube dilated about the middle. Anthers 5, ovate acute, filaments very short, half-way down the tube adnate to the sides. Ovary globose style shorter than the calyx, stigma conic. Fruit rounded, oblong or globose, about 4 inches long and 4 inches through, dull green or orange coloured, seeds numerous, soft, oblong, flat, inch 1 long, ¼ inch wide, and rather more than ⅛ inch thick, with violet testa, cotyledons tinted violet.

Common in the Malay Peninsula from Singapore to Malacca, Penang and Perak, also Sumatra (Lampong) and Borneo.

Natives names, Getah grip, gegrip, grit, gegrit, or singarip putih besih and merah ; Cherit morai and Manungan pulau in Borneo.

This is perhaps the best of all the Getah grips, and is the most sought after. It grows readily from seed, though not very fast, having a habit of making long slender twiggy stems, especially if grown in the open. In forests it climbs to the tops of the highest trees, and the stem eventually becomes very thick. It is distinguished from *W. coriacea*, by the longer leaves with more nerves, longer peduncles and cyme, larger calyces.

The first account of the collecting of rubber from this plant is that of MURTON, who published it in the Kew Report of 1880, p. 46, which is long out of print and unprocurable, but extracts from it are printed in MORRIS' Cantor Lecture, p. 43. MURTON mentions two varieties. One he describes as having dark bark with lighter coloured warts, is the true plant. The other with light cork coloured bark is certainly something else, probably Leuconotis. His account of the collecting is as follows :—"The stem is ringed at intervals of 10 to 12 inches, and the milk allowed to run into vessels made of palm leaves, cocoanut shells, or anything available for the purpose ; it continues to flow for a time, but after flowing for ten minutes it becomes watery and thin, one plant will yield from 5 to 10 catties of the coagulated caoutchouc ; when raw, it has the appearance of sour milk, and to coagulate it the natives add salt or salt water. When freshly coagulated it is quite white, which gradually changes to a darker colour. It keeps white inside and, on cutting, produces

a foveated appearance, the cells containing water and salt, which have become enclosed during coagulation. In texture it is very soft, spongy and very wet."

It is commonly stated also that the natives use urine to set the rubber.

Another account of this plant has recently been published by Messrs. VIVIER and DEISS in the Bulletin Economique de l'Indo-Chine, No. 14, August 1899, which commences with a translation of MURTON's description of the plant and its two supposed varieties, without, however, any acknowledgment of the source of this information. The authors, after describing the method and difficulties of cutting down the liane and the ringing of the bark, collecting the latex in bamboos and coagulating with salt or boiling, state that a pound or a pound-and a-half is obtained from one liane, and proceed to give an estimate as to the returns which may be expected from a plantation in the following terms :—

"Le reproduction de cette liane est facile. Elle laisse loin derriére elle au point de vue de la vigueur et de la croissance toutes les autres sortes. Plantée dans un terrain defriché elle forme au bout d'un an une brousse epaisse. Les resultats de croissance de vigueur et de rendement rationnel du Willughbeia sembleraient demontrer qu'il est preferable d'en faire des plantations plutot que de chercher à acclimater des arbres étrangers qui demandent quinze ans et au de la avant de pouvoir donner leurs premiers resultats, toujours douteux dans de nouveaux habitats. Une plantation de 500 acres dans laquelle on planterait 100,000 Willughbeia reviendrait a la fin de la 2e annee, c'est a dire a l'epoque ou l'on pourrait l'exploiter a soixante-quinze mille francs environ. Le rendement doit estimé a 1 kilogramme par pied. Le prix de cette sorte de caoutchouc est de 6 francs 25 a 6 *fr.* 50 en Europe par kilogramme."

I am certainly quite unable to endorse the statements as to the rapidity of growth of Willughbeia. Raised either from seed or cutting, it takes a good deal more than one year to form a thick bush. Plants grown in the Botanic Gardens for about six or seven years have indeed made low bushes with very slender stems, while plants in their natural habitat in the jungle have at the end of one year thrown up single slender stems not a quarter of an inch through.

The return at the end of the second year is estimated at a kilogramme a plant ; *i.e.*, 2,204 lbs., yet a liane as collected by natives in the jungles of full size and probably 4 inches through and 50 or 60 feet long only gives 1 lb. to 1½ lbs. It would indeed be surprising if the plant itself at the end of the second year weighed a kilogramme. From my experience of it I should say the whole thing would not weigh a kilogramme, twigs, leaves and all. Further criticism on this paper is perhaps unnecessary except to point out that the authors give no details as to methods of cultivation, or extraction, of the rubber, and that the price of Willughbeia rubber is always lower than that of the Para rubber, and is generally quoted at about one and six pence a

pound, and it may be doubled that as much as *fr.* 6·25 per kilogramme would be obtained.

Plants of *Willughbeia firma* cultivated in the Botanic Gardens for a number of years, and either raised on trellises or allowed to spread along the ground, in full sun, form thick masses of rather slender twigs. The largest I notice in plants about 13 years old are ¾ inch thick. They are very leafy and dense, but do not develop into the stout lianes so often to be met with in forests. Twigs and leaves, however, are full of rubber, which exudes when the fresh twigs are cut. A few hours, however, after being cut, the twigs, if cut or broken, exude no more, unless they are heated at one end, when the latex begins to exude again with the sap, from the other. It may be possible to use this principle in dealing with *Willughbeia* grown in bush form in the open, or the plants might be cut and crushed with a machine which would press out the rubber, in such a manner that it could be economically collected. It would, however, be also worth while to plant the *Willughbeias* in the patches of forest usually preserved near estates, and allowing them to grow as they like, tap out the lianes when they attain a sufficient thickness to be conveniently tapped. In this way there would be hardly any expense connected with the cultivation except in the original planting and tapping. Any of the other rubber vines mentioned in this paper might be grown in the same way, but besides *W. firma* the best for this purpose would be *W. flavescens* and *W. coriacea*, *Leuconotis Griffithii* and *eugeniæfolius* and the *Urceolas*.

The *Landolphias* of Africa seem to me even more suited for this class of culture than our own rubber vines.

L. Heudelotii and *L.* sp. have made remarkably rapid growth in the open, and their stems under these circumstances attain a greater thickness than do the Willughbeias, but there seem to be some doubt as to the value of the latex of *L. Heudelotii*.

The following dimensions of the branches of various rubber vines cultivated in the Botanic Gardens may show the different values of the plants as regards growth. All are grown in the same class of soil, rather stiff inferior clay, and the measurements are from branches and not of the stumps, which are much thicker :—

Willughbeia firma about 13 years, ¾ inch diameter.
Leuconotis eugeniæfolia 13 ,, 3 inches ,,
Landolphia Heudelotii 4 ,, 2 ,, ,,
L. florida? 3 ,, 2 ,, ,,
Urceola brachysepala 10 ,, ¾ ,, ,,

W. c... Wall.—Stems stout, 4 inches through with thick warted black bark, dark red inside, tendrils, long, slender with few curved branches. Leaves very coriaceous elliptic obtuse, nearly lanceolate when young, deep green above, light green beneath (drying red), 3½ to 5 inches long, 2 to 3 inches wide or smaller, nerves obscure, hardly raised 7 to 8 pairs, petiole thick dark brown, ¼ inch long. Flowers crowded in very short axillary tufts, about 6 inches a tuft almost sessile, Calyx very small with short ovate lobes minutely ciliate, Corolla tube short dilated in

the middle pink, ¼ inch long, lobes linear oblong blunt white obscurely ciliate a little longer lobes. Stamens 5 adnate to the corolla tube in its widest part anthers ovate conic, obtuse, filament very short thickened and orange coloured at the back of the anther. Style short green, stigma conic. Fruit large oblong or pear-shaped, 4 inches long, dull green or orange when quite ripe.

Common in Forests, Singapore, Malacca, Penang and Perak. Natives names, Getah Gaharu, Getah Ujol, Jela Puchong Kapor.

One of the commonest species and very variable in size of the leaves, but easily recognized by their very thick stiff texture and few nerves. The rubber is of an inferior quality, however, and seems to be chiefly used for birdlime by the Malays, who also eat the fruit as they do of most species.

W. flavescens, Dyer.—Stem stout, 4 inches through, with rough black bark not warted as in *W. firma*, with broad distant rings elevated and knotty. Bark thick, light fawn colour in section, not red. Leaves dark shining green, elliptic to oblong, or nearly lanceolate, cuspidate with a blunt point, 3—4½ inches long, 1 inch to 1½ inch wide, nerves slender, about 20 pairs of primary ones, petiole thick, rugose half an inch long. Leaves often covered with small conical galls. Flowers in rather lax short panicles, few branched with a peduncle about ¼ inch long, pale yellow, pedicels ⅛ inch in length. Calyx lobes very short, ovate, rounded ciliate. Corolla ¼ inch long, tube swollen, lobes recurved, yellowish.

Fruit globular, about 2 inches long, orange yellow, seeds usually few. Dense Woods, Singapore, Malacca.

"Akar Sa'gran." The latex is somewhat slimy, and of inferior quality. Mr. MURTON, however, sent specimens of its rubber to Kew in 1880, of which Messrs. SILVER reported, "the quality is very fair, and it would be useful in our manufacture. The present value (1879) is about 1*s*. 3*d*. per lb. (Morris Cantor Lecture, p. 43.)"

W. tenuiflora, Dyer.—A stout climber with much of the habit of *W. firma*, with oblong cuspidate dark green leaves with about 25 pairs of straight parallel nerves, prominent on both sides when dry, texture rather coriaceous, not so stiff as *flavescens*. Flowers in short axillary panicles, compact. Calyx lobes rather larger than in most species rounded. Corolla ½ inch long, slender, lobes linear, oblong, longer than the tube, which is dilated at the base. Anthers narrow acuminate. Fruit very large, ovoid, 6 inches long and 4 inches through, light green, with comparatively few seeds. Seeds oblong, red inside.

"Getah Ujol." Woods in Singapore, Malacca, Selangor, Penang.

The latex from this plant is to be mixed with that of Getah grip, i.e. *W. firma*, in the proportion of one-third according to native statements. Mr. DERRY, however, sent a specimen from Malacca labelled "Getah grip" true. It is not a very common plant, but is easily known by the numerous close veins of the leaf, slender long flowers and very large fruits.

W. grandiflora, Dyer? Is a strong climber with rather narrow oblong cuspidate, thin textured leaves with about 30 nerves. Panicles rather lax, half an inch long. Flowers an inch long with broad lobes, the mouth of the tube is hairy, tube swollen at the base. The panicles and large calyx are pubescent.

"Akar Jitan." It occurs in Singapore, Malacca and the Dindings.

This is easily recognized by its very large showy flowers. The leaves resemble those of the last species. In the description of *W. grandiflora* in the Flora of British India the leaves are described as very thickly coriaceous and with only 4 to 7 pairs of nerves, which certainly does not agree with this species. If it is not *W. grandiflora*, Dyer, it must be undescribed.

Chilocarpus.—The species of this genus which is distinguished from *Willughbeia*, by its yellow or orange flowers and fruit splitting when ripe, containing numerous albuminous seeds, though very milky, climbers give, but a poor amount of caoutchouc. The stems are usually at least rather slender, with pale loose bark, their habit being altogether more like that of *Leuconotis* than *Willughbeia*.

Ch. enervis, Hook. fil., which has long been in cultivation in the Gardens, though flowering regularly, has never fruited, and all attempts to propagate it by cuttings or layers have failed. The stems are slender, about ½ inch through, covered with brown wrinkled bark, the leaves are thick and nerveless.

Melodinus—Includes three or four species or climbers with white flowers in axillary clusters, the fruit green or yellow globose, with a hard rind, the seeds numerous, wrinkled, enclosed in a good deal of pulp. *M. Orientalis*, Bl. the commonest, produces an inferior sticky caoutchouc mixed with the other Getah Gerips, but it does not seem to be a very common plant, occurring here only in Penang, though it is met with also in Java and Sumatra. Of our other species, *M. coriacea*, Oliv, a native of Penang, and *M. micrantha*, Hook. fil., a rare plant occurring in Singapore and Malacca, nothing is known as to their rubber-producing qualities.

Leuconotis.—This genus of five or six species is represented here by three kinds, all climbers (not erect shrubs as stated in the Flora of British India), small compared with the *Willughbeias*, but producing useful rubbers. The flowers are in close axillary panicles, orange coloured, the corolla tube is shorter in proportion to the size of the flowers than in *Willughbeia*, and the lobes are thicker and shorter. The fruits are comparatively small with few seeds.

L. Griffithii, Hook. fil.—Stem about 2 inches through. Bark light grey, rather rough. Leaves opposite lanceolate, acute or acuminate, rather thick, nerves about 7 pairs, dark green, 6 inches long and 3 inches wide, petiole 1½ to 2 inches long. Panicles axillary on stout peduncles an inch long, rather crowded. Flowers few. Bracts ovate. Calyx lobes lanceate blunt overlapping nearly as long as the tube. Corolla ½ inch long, tube thick, widest and square at the base, yellow lobes ovate

blunt, recurved orange. Stamens on very short filaments, another lanceolate acuminate acute enclosed in the tube and projecting as far as the mouth. Ovary conic with a stout style and a conic stigma. Disc crenulated. Fruits egg-shaped or pear-shaped, blunt at the apex, 2 inches long, 1½ inch wide in the widest part, yellow, on stout, thickened peduncles, pulp thick, seeds few, oblong rugose flat, olive green.

Usually to be found on borders of woods or open country climbing not high, about 20 or 30 feet as a rule, on trees or bushes, Singapore, Malacca.

This is known as Akar Getah Sundi, but is not to be confounded with Getah Sundik (*Payena Leerii*). The rubber is considered by Malays to be of good quality, and indeed approaches that of *Willughbeia firma*. The latex sets very speedily when drawn out, and leaves but a little liquid.

L. eugeniæfolius, Dec.—Stems dusky grey, about 3 inches through bark ⅛ inch thick rough, with narrow rings 3 inches apart. Leaves rather thinner than the last oblong lanceolate base rounded, apex acute, nearly 6 inches long and 2 wide, nerves 8 to 10 pairs uniting with a distinct intramarginal one, petiole ½ inch long or more, shoots midrib and petioles are covered with a thin rusty pubescence. Panicles axillary few flowered on a stout peduncle 1½ to 2 inches long. Bracts, linear lanceate, green, ⅛ inch long. Pedicels ½ inch. Calyx lobes cleft to the base, linear green, ¼ inch long. Corolla orange yellow, tube a little longer than the sepals, thick, cylindric, tapering upwards a little, lobes short, oblong, ovate, 5 anthers lanceate, acuminate on very short filaments. Ovary conic, style thick shorter than the filaments. Stigma conic, disc nearly entire. Fruit egg-shaped about 2 inches long, yellow.

Occurs in Malacca, Perak and Penang.

Native name—Getah Gaharu and said to produce the Getah known as Manungan bujok in Borneo (Burbidge).

Urceola elastica, Roxb.—Stems stout 3 or 4 inches through. Branches velvety. Leaves rather coriaceous, elliptic, with a broad base, apices acuminate, 6 inches long by 3 wide, glabrous and shining above, velvety beneath, nerves about 11 pairs, impressed above, prominent beneath. Petiole ½ inch, velvety. Panicles axillary and terminal with long peduncles hairy flowers, small green hairy tufted on the apices of the peduncles. Sepals five linear hairy. Corolla tube as long, urn-shaped, with five subacute erect lobes, all hairy. Stamens 5, meeting in a cone, filaments short, adnate to the base of the corolla. Anthers twice as long, arrow-shaped. Ovary short hairy, style cylindric, stigma cone-shaped. Pods in pairs, widely spreading, cylindric acuminate woody, 6 inches long over ¼ inch through, splitting along the upper margin. Seeds numerous, elliptic, acute, flat, ⅜ inch long, brown, silky, with a whorl of red tufts of hairs at the upper end, plumes an inch long, not stalked, white and silky.

Native names—Gegrip-gegrip tembaga, Getah susu, Gegrip merah (partly) Malacca rubber.

Occurs in thick woods in Penang, Malacca and Selangor, Perak and Sumatra.

This valuable rubber vine was first discovered in Penang by Dr. JAMES HOWISON, who published an account of experiments he made with the rubber of it in Asiatic Researches (Vol. V, p. 157) in 1798, under the name of the Elastic Gum vine of Prince of Wales' Island, and it was the first of the Malayan Rubber vines discovered. It was described somewhat later in the same publication by W. ROXBURGH, who however mistook the fruit of an Orchipeda for that of the Urceola. The species is easily known by its velvety leaves, all the other ones having the leaves quite glabrous on both sides. There seems to have been a good deal of confusion as to the product of this climber. COLLINS identified the Borneo Rubber known as Gutta Susu as the produce of *Urceola elastica*, but describes the fruit as that of a *Willughbeia*. A rubber vine shown to me in Sandakan as Getah Susu was certainly not an *Urceola*, but a *Willughbeia* or allied plant, possibly *W. Treacheri* (Kew Report, 1880), which is the name which has been given to the Rubber of North-West Borneo. The Rubbers described by BURBIDGE from Borneo (Journ. As. Soc. Straits Branch, p. 55) are all *Willughbeias* or *Leuconotis*. I have only seen one species of *Urceola* from Borneo, a plant allied to, if not identical, with *U. lucida*, nor has any other Bornean species been recorded so far as I know. It seems likely therefore that all the real Bornean rubber is derived from *Willughbeia* or *Leuconotis*.

It has been questioned whether HOWISON's Elastic Gum Vine was not *Willughbeia*. He did not obtain leaves or flowers, the description of the stem however, with "strong ash coloured bark, much cracked, which runs along the ground to a great length," does not correspond with that of any *Willughbeia*, all of which have black bark and which do not, as a rule, run far along the ground, before ascending, but agrees altogether with *Urceola elastica*, which is fairly abundant still in Penang.

U. lucida, Benth.—A woody climber. Leaves elliptic with a long point, base rounded, quite glabrous, somewhat coriaceous, nerves about 10 pairs, impressed above, raised beneath, 4½ inches long, 2 inches wide, perfectly glabrous, petiole ½ inch. Panicles axillary and terminal, often large with long slender branches pubescent. Flowers crowded at the end of the branches, very small, green. Calyx cup-shaped with five short lobes, pubescent, very short. Corolla short, lobes rounded, pubescent. Stamens 5 arrow-shaped with long spurs, apices blunt. Pistil conic. Pods in pairs, broad at the base, tapering to a point, woody, 4 inches long or less, about ½ inch through. Seeds few, obovate, pubescent, ⅔ inch long, with reddish tufts at the top, plume 1½ inch long.

Singapore, Malacca, Penang, Perak, also Rangoon. A very similar plant with larger flowers was collected in Borneo at Kuching by Dr. HAVILAND.

Native names—Akar Gegrip Nasi, Getah Grip Merah, Gegrip Besih, Akar Jala.

This can be identified by its short conic pods, very broad in proportion to their length, very unlike any other of our species. The plant, as I have usually seen it, is not a large one, but it probably can attain a greater size. *U. esculenta*, Benth. Tavoy and Pegu, is said by KURZ to be the same species.

The rubber is good, but the plants which I have seen wild, did not produce a very large amount of latex. It is mixed with other rubbers.

U. Malaccensis, Hook. fil.—A fair-sized climber, glabrous except the infloresence. Leaves rather stiffly, coriaceous, elliptic or ovate, lanceolate, acuminate, 6 to 7 pairs of nerves, prominent on both sides, 4 inches long, 1½ inch broad, petiole ½ inch long. Panicles terminal small compact, peduncles short pubescent. Flowers as large as in *U. elastica*. Calyx lobes oblong, lanceolate obtuse, pubescent, nearly as long as the corolla, which resembles that of *U. lucida*. Bracts persistent rather long, oblong, obtuse, pubescent. Capsules twin very long, cylindric, acuminate 6—7 inches long, ⅛ inch through.

Native names—Akar Sankang Buaya, Serapat jantan.

Singapore, Johore, Malacca.

The rubber is considered good and mixed with other rubbers.

U. Maingayi, Hook. fil.—Somewhat resembling *U. elastica*, but quite glabrous with stiff coriaceous leaves and long cylindrical slender acute capsules, occurs in Singapore and Malacca, but is not common. I have no information as to its rubber.

U. brachysepala, Hook, fil.—A fairly stout creeper. Leaves rather thin textured, elliptic acuminate, 3—4 inches long, 2 inches wide, glabrous, rather dull green, petioles ½ inch long. Panicles terminal usually rather large with stout peduncles pubescent. Flowers numerous green. Calyx pubescent, lobes 5, lanceolate. Corolla white, pubescent lobes, ovate, acute, pubescent. Stamens as in *U. lucida*.

Akar Gegrip Merah. A native of Singapore and Malacca.

The rubber is considered good by the Malays, who mix it with other grips. The latex is not very abundant and is rather slimy in cultivated plants.

U. torulosa, Hook. fil.—Leaves small, ovate. cuspidate, coriaceous, glabrous, 3 inches long and 1 wide, petiole ½ inch, nerves 5 or 6 pairs. Panicles small, terminal and axillary, about an inch across, short pubescent, bracts linear, oblong, obtuse. Flowers small pubescent. Calyx lobes linear pubescent. Capsules over a foot long, slender, dilated at intervals where the seeds are. Seed about 8, oblong with a red tuft at the tip and a plume 1 inch long.

Native names—Akar Serapat, Akar Sulo Hutan.

Forests in Singapore, Malacca.

Parameria polyneura, Hook. fil.—A stout climber 4 to 6 inches through, grooved and angled, with light coloured flaky bark. Leaves thin, lanceolate, acute, 3 to 4½ inches long, dark green,

petiole ¼ inch. Panicles lax, terminal, with a few wide spreading branches. Flowers small on pedicels ¼ inch long pubescent. Calyx 5, lobed lobes ovate, hairy, pink, ⅛ inch long. Corolla tube short and broad, nearly ¼ inch long, hairy within lobes, oblong a little longer and blunt, pink with white tips; a ridge runs round the corolla mouth. Stamens 5 short, filaments very short from base of corolla, anthers arrowshaped connivent. Pistil conic. Capsules twin long slender, cylindric, not distinctly torulose red, 15 inches long, ⅛ inch through. Seeds numerous, oblong, linear, blunt at both ends, terminated by a large sessile plume.

This is a beautiful plant when in flower, the flowers though small being produced in great abundance and of a beautiful rose pink. It is known as Akar Getah Grip Putih, Serapit and Sedang, and occurs in Singapore, Malacca and Perak.

The rubber is considered good.

TREES.

Dyera costulata, Hook. fil.—A very large tree attaining a height of 200 feet, with grey rough bark. Branches brown. Leaves in whorls of six, thinly coriaceous, oblong to oblong lanceolate, blunt at both ends, nerves about 15 pairs, 9 inches long by 6 wide, dark green above, paler beneath, petiole 1 inch. Panicles on peduncles 4 inches long, or less with few branches, axillary. Flowers small, ¼ inch long. Calyx short with blunt lobes. Corolla tube as short or shorter, lobes lanceolate, white. Stamens very short, filament very small, anthers conic brown. Style short conic. Fruit a pair of capsules deflexed, woody over a foot long, fusiform blunt, splitting along the upper edge where there is a thin broad margin. Seeds numerous, very thin flat, oblong with a broad wing on each side, 2 inches long and 1 wide.

"Jelutong"—Common over the whole Peninsula. This tree flowers after it has shed its leaves and when the young leaves are coming out. The leaves vary a good deal and are often smaller than described, and in young shoots, stumps, etc., very much larger. This variation in specimens is perhaps the cause of two species of Dyera being described in the Flora of British India, *viz.*, *D. costulata* and *D. laxiflora*. I have not recognized more than one species here, but the Malays do talk of two plants, Jelutong and Jelutong Pipit. This is the plant which produces the Jelutong rubber, in the Peninsula, and if *Alstonia costulata*, Miq., is the same plant (it is only very imperfectly described), it is also a native of Sumatra. MIQUEL gives the name Getah Labuai for it.

I have received another plant from British North Borneo at Labuk Bay under the name of Getah Jelutong from Mr. WADE. This, a branch with leaves only, has the leaves scattered not in whorls, they are rather thin textured, very long and narrow lanceolate, acuminate, 8 inches long, 2 inches wide, with a slender petiole an inch long. It is probably not a *Dyera* at all, but further material is required.

In Dr. HAVILAND's collection from Sarawak is a very distinct plant labelled "Jelutong." It has stout branches with the leaves crowded at the ends oblanceolate obtuse, tapering at the base, thickly coriaceous with about 25 pairs of nerves, straight and prominent, glaucous on the back with a stout petiole 1½ inch long, blade 6 inches long, 2½ wide. The panicle is small with a few branches on a peduncle 4 inches or less long. The flowers are small, and white, pedicels short and thick. Calyx lobes ovate. The corollas are all fallen in my specimen, but the style resembles that of *D. costulata*.

This is perhaps the plant mentioned under *Dyera costulata* in the Flora of British India as collected by BECCARI and others in Sarawak. It was collected at Kuching, December 25th, 1892 (No. 2170 HAVILAND), and is probably the source of some at least of the Jelutong rubber exported from Borneo to Singapore.

The Jelutong tree abounds in all parts in a very liquid white latex containing a good deal of caoutchouc. The latex pressed between the finger and thumb draws out into fine and fairly firm threads as do the better class rubbers. Allowed to dry in the ordinary manner it becomes hard and brittle, but for sale it is usually coagulated with the aid of kerosine, forming a mealy rubber of a white colour, and of but little value. I am informed that it is chiefly used for making mouldings of picture frames, and for adulterating other local rubbers.

As the tree is very abundant in the Peninsula and attains a very large size, it may be very well worth experimenting with, and owing to the liquidity of its latex will perhaps be a subject for the centrifugal machine. Till recently the tree has almost entirely been neglected both from the point of view of a rubber producer, and as a timber tree. Its wood is soft and white, and was formerly chiefly used for models and native clogs, lately, however, its use for planks for building and boxes has increased, and though it is not very durable it can be used for walls and partitions of houses.

A tree in the Botanic Gardens, about 80 feet tall and 2 feet through, was tapped for experiment. The bark was noticed to be very thick, fully half an inch. The latex flowed freely for a short time and then stopped. Two incisions of 6 inches long and ½ inch wide, one of 12 inches and two of 2 inches were made, on two successive days, and 1¾ oz. of tolerably dry rubber was obtained. The rubber was white and remained so, hardly elastic but easily moulded, insoluble, quite unacted on by ammonia and acetic acid, readily softened and made more elastic in boiling water. In this state a small piece drawn out to over 5 inches when released contracted slowly to about 1½. On drying it became very brittle.

Alstonia scholaris, R. Br.—"Pulai" produces an abundance of latex like that of Jelutong, which dries into a rather hard stiff sheet. It can hardly be used as rubber, and is very rarely collected even for adulteration. The tree is very abundant all over the Peninsula.

Ficus elastica, L. India rubber, Burmah, Rangoon rubber, Getah Rambong, Getah Karet (Java), Getah Achin (Sumatra).

This well known tree is abundant in Burmah, Assam and occurs in Java, Sumatra and also in Perak, on the limestone rocks near Ipoh. It has been cultivated in Assam and Sumatra for a considerable period, and is now in cultivation in the Malay Peninsula. It is raised from seed in Assam and elsewhere, but more usually propagated by cuttings. Mr. G. MANN, whose account (Kew Bulletin, April 1891, also Handbook of Commercial Products, Imperial Institute Series, No. 25, 1893), deals with the cultivation in Assam, states that young trees raised from cuttings are never so hardy as those raised from seed, and do not make equally good growth afterwards. I do not know of any attempt to raise the plant from seed in the Peninsula, cuttings being exclusively used here. Briefly the method of raising from seed is as follows :—.

The figs which are as big as peas are ripe in Assam between January and March. They are collected as they fall and dried in the sun, then broken up and sown in beds, boxes or pots on the surface of the soil. They require as much light from above as possible, side shade is an advantage. The drainage of the soil must be perfect, and it must be kept damp, not wet. Germination takes as much as three months. The seedlings very small at first require very careful treatment. Drip must be avoided, and the soil kept loose.

Colonel WALKER recommends as soil for the seed-beds the following :—Well dug soil one part, sand two, ashes one, old sifted stable manure one, all to be sifted through a wire gauze sieve. When the seedlings are 2 to 3 inches tall, they are transplanted to a nursery bed in lines 1 foot apart, and when 1 to 2 feet tall, they are very hardy and can be planted out. For cuttings perfectly ripe young branches should be used. They require a band of cocanut fibre or matting to be tied tight round the branches, which is left on till the roots are seen projecting through the mat. This takes about three weeks, the branches are then cut off below the roots. They usually grow with remarkable ease, but it sometimes happens in damp ground that a fungus attacks them, and they refuse to grow. In this case the infected ground should be abandoned, as it is useless to attempt to grow cuttings there.

When the cuttings are well rooted they can be at once transferred to the plantation, and as the trees become in time very bulky, they should be planted 40 to 60 feet apart. The tree grows rapidly and can be tapped in six or seven years after planting. The part tapped is the aërial roots. A large tree with well-developed crown and three or four stems is said to produce 210 to 245 lbs. rubber the first year of tapping, 140 lbs. the next, 52 to 70 lbs. the third, the fourth year nothing, but after two years' rest 80 lbs. may be obtained. Heavy tapping like this is, however, injurious to the tree, which becomes weak and dies. In Sumatra, a planter told me that India rubber gives about the same return as Hevea, for the same number of years.

The amount of rubber produced is, however, apparently apt to vary according to locality, for it is stated that in Assam the form which grows in the plains produces but little rubber, though much latex is produced, while that on the hills produces much rubber and little water.

How the plant will work out in different parts of the Peninsula we cannot judge at present. It undoubtedly grows very well in the low lands round Klang, in Selangor, in Perak and the Dindings and elsewhere. It grows very poorly in the stiff clays of Singapore, and here seems to be very liable to the attacks of fungi, especially of a leaf fungus which causes a fall of the leaves. It may be doubted that it will give the same return as Para rubber, but I saw an excellent sample obtained from some three-year old trees grown by a Chinaman in Malacca. The product is usually considered inferior, and the amount, as has been said, is remarkably variable. Next to Para rubber, however, Rambong is probably the best rubber to cultivate in the Straits. It is already being cultivated successfully in Sumatra, the produce being shipped to Penang in fairly large quantities. In 1897, 4,650 piculs were shipped from Penang, but this includes some wild Rambong from Perak, and probably also Sumatra.

INSECT PESTS.

There are few more annoying losses to a planter than those caused by some of the very numerous forms of insect life in the tropics, especially in cases where, as often happens, an, insect which, though known to be feeding on the plant under cultivation, inflicts for many years such trivial damage that it is quite neglected, till suddenly it appears in numbers so vast that before it can be checked, much damage has been done and no small expense has to be incurred before the estate can be saved. For this reason it is necessary to watch for insects on the crops very carefully, and to keep under observation any which inflict injury, however slight, lest they become from neglect really dangerous. In this region we are fortunately free from those insects, such as locusts, which invade a district in great flights, and in a few hours undo the labour of years, but we are not free from attacks made in force arising from neglected and dirty estates. Many troublesome invasions arise from abandoned patches of scrub and weeds allowed to grow near or in the estates, round the coolie lines and elsewhere. Grasshoppers and moth-caterpillars often haunt these patches for some years unnoticed and gradually commence to attack the estate itself. Sometimes again a pest destroys the stems or boughs of the trees, and the coolies cutting or breaking off the dead boughs still full of insects throw them on the ground, or leave the dead stumps on or near the estate, instead of burning them. The result naturally is that the insects continue to breed in the decaying wood, and a constant supply of the pest is kept on the estate. Much of the serious injury done by the coco-nut and nutmeg beetles in native estates is due to this neglect. If a tree is killed by any insect or by any fungus, it should be removed and destroyed without delay for fear of spreading the infection.

It not unfrequently has happened that an insect which normally feeds on some waste stuff such as dead wood, or decayed vegetable refuse, alters gradually its mode of life and commences to attack *living* plants, often inflicting considerable injury. Notable cases are those of the sugar shot-borer, *Xyleborus perforans*, well known for its habit of boring into wine casks and causing leakage, which, in the West Indies having probably been imported in a wine cask, attacked the growing canes and hopelessly destroyed some estates. The black coco-nut beetle again normally lives on cowdung and rotten wood, but now attacks and destroys palms, and *Xylotrupes gideon* the grub of which normally feeds on cowdung and decomposed vegetable matter, having found its way into the cane-fields commenced by feeding on the decaying portions of the sugarcane cuttings and has ended by attacking the living roots and destroying the plants. Some

insects seem to be almost omnivorous, but most attack only a certain plant and those most nearly allied to it, unless the food supply runs short when they fall upon the nearest plant that they can eat, as happened recently in Selangor when caterpillars, which had been feeding on castor oil plants grown near coffee, having devoured all the castor oil plants, fell upon the coffee bushes and commenced to eat them.

A pest sometimes after being easily kept within bounds for years, may, for no clear reason, suddenly on some year, become so abundant that it is quite uncontrollable, perhaps almost entirely disappearing on the following year, and not reappearing for a long period. The cause of this is not very clear, and it is usually attributed to variations in the weather, or the accidental absence of some enemy of the pest. During the time of the great plague of the Coffee-caterpillar in Selangor, 1898 and 1899, I noticed that several other kinds of caterpillars were extraordinarily abundant, notably that of the small yellow butterfly, *Terias*, which feeds on *Albizzia*. It is quite possible that in this case some abnormality in the weather proved either exceptionally suitable to these insects or exceptionally unsuitable to some particular enemy, but observations on these points are still required. The blights (Coccidæ) and aphides are very apt to be more virulent when the weather is damper than usual.

Plants that are sick or ill-nourished suffer more from insect pests than those in a healthy condition, and it is wonderful to note how manuring a tree will often cause the disappearance of blights which have resisted tuba water, tobacco or other insecticides. This shows that the miserable appearance of the tree was not due to the attacks of the blight, but that the blight persisted on the plant on account of its sickness. The same thing often happens even in caterpillar attacks, the trees which are sick have no recovering power and fail to throw out fresh leaves after the destruction of the old ones in time to save its life.

In some regions, trees which would otherwise thrive are practically kept out of cultivation by insect pests. The Mango in the south of the Peninsula is an example of this. It is attacked by so many insects that it really has no chance. The worst of these is a boring caterpillar which burrows up the branches, which soon die and fall off. It is interesting to note that the only trees not badly attacked here are those growing over water. It has long been known in Europe that ponds underneath trees often keep off insects, especially beetles and moths, which are perhaps afraid to cross, the water or if they do, fall in and are drowned.

Groups of Insects.

A short summary of the groups of insects may be of use in enabling a cultivator to judge whether an insect found on or near his plants belongs to an injurious group or not, as in many cases the enemy of the pest is mistaken for the enemy of the plant.

Lepidoptera.—Butterflies and moths are only injurious here in the caterpillar state. The caterpillars are soft bodied, often

hairy, and feed on leaves often by night, only concealing themselves by day, or bore into branches of trees, or not rarely attack fruit. The group of *Psychidæ* or "Bag worms" is known by the caterpillars inhabiting tubes or cases made of silk usually coated with bits of stick, bark, or leaves. They feed on leaves and are often very destructive. The *Limacodidæ* have woodlouse-shaped caterpillars (*Parasa lepida* is an example), often brightly coloured and armed with stinging hairs. They pupate in curious round leathery cocoons on the leaves. One of the worst groups as pests is that of the *Noctuidæ*, with hairless or nearly smooth fleshy caterpillars, leaf-feeders, often occurring in vast abundance, and feeding sometimes by night. The moths are thick bodied and often dull brown or grey. The *Sphingidæ*, or Hawk-moths with large perfectly smooth caterpillars always furnished with a horn on the tail, rarely occur in sufficient numbers to do damage, but the Coffee beehawk, as described below, shows that we cannot trust to any group of moths as being always harmless. Very destructive also are the *Tortrices*, or leaf-rollers, which roll or spin the leaves together, remaining in the rolled up portion. The Gutta Percha moth and Ramie moth belong to this group. It is a very difficult group to deal with, as the caterpillars here will not leave their retreats when the tree is shaken, as they do in England, and spraying with poisons has no effect on them, as the leaf protects them. Handpicking is the only chance with these animals. The *Tineæ*, which are usually very small moths, chiefly devote their attentions to stored produce. One very minute one attacks herbarium specimens and dried leaves of any kind. A grey moth about half an inch long (probably *Tinea granella*) I found destroying rice. The caterpillar, a dirty white grub spun the grains together, and devoured them, utterly destroying the rice; another attacks dried figs and other fruits, and the clothes moth, *Tinea tapetzella*, is well known to all.

Butterflies are less injurious to the planter on the whole. The worst we have here are the Banana butterfly, described below, the cocoanut butterfly *Amathusia phidippus*, *Papilio Erithonius*, which devours the leaves of the orange, and a few like *Cyaniris lavendulacea*, which eat the young leaves of Cycads, and other ornamental plants.

The *Hymenoptera*, Bees, Wasps, Sawflies and Ants, are four winged in the adults, the grubs being soft white, footless maggots usually requiring to be fed by the adults, except in the case of the Sawflies, the caterpillars of which closely resemble those of moths. They are a comparatively harmless group. The Sawfly grubs eat leaves, but are not often abundant. The only injurious one I have seen here feeds on rose leaves, and is described below. The carpenter-bees *Xylocopa*, make themselves a nuisance by tunnelling the beams and poles of buildings. The Gallflies, *Cynipidæ* may be injurious to foliage and twigs.

On the other hand, the bees and wasps do good service in fertilizing the flowers of many of our crops, while the Ichneumons destroy many caterpillars by laying their eggs in them, and the

Burrowing Sandwasps carry off caterpillars, crickets and other insects besides spiders to their nests to feed their young. The ants are on the whole useful to the planter, but do a certain amount of harm.

The *Diptera*, Flies, with one pair of wings only, are, as far as agriculture is concerned, almost harmless. A certain number produce galls on plants. One species is destructive to the Chocho fruit, the grub feeding on it, and on one occasion I found bed after bed of English peas and beans totally destroyed by the maggot of a fly which I was not able to rear. The flies, however, are important flower fertilizers, especially to trees with small green or white flowers, such as Rambutan, Pulassan, the Chesnuts, also the Durian, Urceola, and Nutmeg.

Coleoptera.—The Beetles are known easily by their having four wings, of which the upper pair are hard and opaque, often coloured and when at rest cover the lower transparent flying pair. They comprise the largest number of bad enemies of any group. The most destructive sections are the Weevils (*Curculionidæ*), the Chafers (*Lamellicornia*) and the very small borers (*Scolytidæ*). The Weevils are injurious only in the larval stage. The perfect insect is generally a very hard-coated animal and is always known by its long hard curved beak. The grub is thick, footless, white soft with a hard head and powerful jaws. It always lives in burrows in living plants or seeds. All are injurious, among the worst here are the Red palm weevil, *Rhynchophorus ferrugineus*, the Banana weevil, *Sphenophorus sordidus*, the small Rice weevil, *Sitophilus oryzæ*, and *Astychus*.

The Chafers (*Lamellicornia*) have broad thick bodies with blunt heads and are often armed with horns. The antennæ end in a dilated club consisting of a number of flat leaves. The grubs usually live in the ground or on rotten wood, or other vegetable refuse. They are white and fleshy with large brown heads and powerful jaws, the body curved and swollen at the end, so that they have always to lie on their sides. They have six small legs near the head. Sometimes it is the grub only which is injurious, by biting the roots of plants. Sometimes the beetle itself devours leaves or bores into the plant to suck the juice of it. The Black coco-nut beetle (*Oryctes rhinoceros*) is one of this group, as is *Xylotrupes Gideon*, of which the grub destroys the roots of the sugarcane, and the beetle bites into the cane itself. Some of the small chafers fly by night in enormous numbers and eat the leaves of cultivated trees voraciously, reducing them to rags.

The shot-borers *Scolytidæ*, are all very small, even minute-beetles cylindrical brown or black. They bore into dead or dying wood or live in living bark. The grubs are very minute, white fleshy insects. When numerous the attacked part of the tree looks as if a charge of small shot had been fired into it. The worst of them are the species of *Xyleborus*, and *Phlæosinus*, which destroy nutmeg trees and sugar canes. Some also destroy bamboos when cut, reducing them to powder, and attack also books, furniture, etc. Most of them normally feed on dead wood, but

they have a habit of leaving that to attack living wood, and estates in which rotten wood is allowed to lie about unnecessarily are very liable to attacks from this group of insects.

The *Longicorn* beetles with oblong or cylindrical bodies and long slender recurved antennæ, are all wood-borers. They are often of very large size, and are sometimes very troublesome. The grubs are long, cylindrical flattened insects without legs and live in burrows in timber, which are usually filled with the powder of remains of the wood they have eaten. I have not as yet met with any injurious to living trees here, but they are often very destructive to house timber.

The Leaf-beetles (*Chrysomelidæ*) rounded thick and curved, or oval and flat, often gaily coloured, and usually quite small, are generally found on leaves which they eat. I have seen but few on plants cultivated for use, but several are troublesome on our ornamental plants, orchids, aroids, etc.

The useful beetles belong to the carnivorous groups. *Carabidæ*, of which the tiger beetles which abound on sandy paths, flying briskly about for short distances at a time, are the commonest. They feed on other insects.

The other carnivorous group of importance is hat of the Lady-bird, *Coccinelidæ*, of which we have several species, which eat the plant lice and green flies (*aphides*) commonly known as blight. The beetles are red or yellow with black spots, the larvæ are oval or long soft-bodied insects which creep about on the leaves and devour the blight. One species is often to be seen on Coffee, when there is blight about. Of course these insects must be carefully protected.

The true bugs, *Hemiptera*, are known by the long-pointed beak generally carried when at rest in a groove or merely along the under surface of the thorax. Besides the true bugs large often gaily coloured animals with a very foul odour, the group includes the plant lice Coccidæ Aphides and Scale insects. The greater number are very injurious, sucking the juice of plants with their long beak, such are the rice-sapper, *Leptocorisa* and *Dysdercus*, but a few are carnivorous attacking caterpillars and other insects ; one of these is described below as destroying the beehawk caterpillars on the Coffee. The Cicadas, well known to all here from their noisy songs and commonly called here by the ridiculous name of tree-beetles, confining themselves to the forests, seldom injure the planter. A curious woody swelling very common on the boughs of Serayah trees (*Shorea leprosula*) is caused by the presence of the eggs of some species of Cicada, which appear to be deposited in the bark. This is very injurious to young trees. The larvæ however live in the ground after hatching and feed on tree roots.

The *Orthoptera* include a number of injurious insects in the form of grasshoppers, locusts, crickets, and mole-crickets. The first three groups devour leaves, and often cut down seedlings in the nursery beds, and as many work at night, only hiding in holes in the ground or under logs and rubbish during the day,

are very difficult to deal with. The mole-crickets live in burrows, where they devour the roots of various plants and are fearfully destructive when they get into nursery beds. They are recognized by their brown velvety bodies and mole-like digging paws. They can be caught at night sitting in the mouths of the burrows and making a piercing whistling.

Another destructive group is that of the walking sticks and leaf insects both leaf-eaters. Two or more stick insects are very destructive to orchids, Calatheas and Sansevieras. Resembling little pieces of wood or straws and usually concealig themselves during the day time among the roots of these plants, they devour the leaves and shoots at night. A very fine leaf-insect, exactly resembling the leaf of a mangosteen, was brought in lately from mangosteen trees which it fed on.

The well-known Mantis is carnivorous, feeding on other insects, and is therefore useful.

Like other groups, the *Neuroptera* can be divided into insectivorous and vegetivorous kinds. The dragon-flies are predaceous and live on small insects, and turn up often in great force, when the Termites (white ants) are swarming, clearing off many of these insects. The Termites belong to the same order, and are the only injurious insects of this order here.

The two remaining groups, Thysanura and Collembola, affect the planter but little. The Sugar fish, *Lepisma*, too common in houses, belonging to the first order, is a very troublesome little beast on account of the way it eats papers into holes. Napthaline will keep it away. The minute Collembola like very small lice, would hardly be worth mentioning as affecting planters at all, especially as there are comparatively few here, but considerable suspicion must attach to one species, a very minute white insect usually found under stones, *Lipura fimetaria*. Many years ago I found it in immense abundance on a fern in England, which was in a very sick state, and lately MR. STANDEN brought me from India, among other insects, a quantity of the same thing which had been found at the roots of seedling Cinchonas, which were evidently dying from root injury probably caused by these little animals.

The order *Myriapoda*, Centipedes and Millipedes, is allied to the insects and may be mentioned, as there are several of the millipedes which seem to be very destructive, notably a cylindrical red one often found in manure, sometimes in quantities. It attacks the roots of seedlings especially. The centipedes which are distinguished at sight from millipedes in having flat backs instead of rounded, and running very fast when disturbed (whereas a millipede moves slowly and sometimes curls up when touched feed on insects, and I have found a very large centipede killing the larva of a coco-nut beetle.

Destruction of insects.—In the case of an attack on a plantation by an insect pest, the first thing to do is to find out the life-history of the animal in order to know at what poin in its life it is most easily dealt with. Some insects are most easily and eco-

nomically destroyed when in the larval state, others when adult. In many cases handpicking is the most economical method in the end, especially in the case of leaf-feeding caterpillars when present in abundance, but poisonous substances can at times be used successfully. These are especially valuable in the case of Blights (*Coccidæ*), green fly, etc. The best are tuba-root, tobacco, phenyl, kerosine and soft soap and sulphide of potash. London purple and Paris green are extensively used as insecticides in some parts of the world, but I have not found the former at least very successful here. It is purple powder insoluble in water, but it is generally used mixed with water for convenience. On the grubs of the coco-nut beetle I found it had practically no effect either dry or in water, the grubs burrowing about in the powder quite unharmed, nor was it more successful in the case of the bee-hawk caterpillars, though the younger ones were killed by being wetted with a mixture of London purple and water, the larger ones soon recovered. It is however useful against termites either sprinkled in holes for posts, or painted on the wood work in the form of a mixture with kerosine. In this way it can be used against the house termite (*Calotermes domestica*). It must be remembered that, as London purple and Paris green, are preparations of arsenic, they must not be used on fruits or vegetables intended for food. Sulphide of potash in solution seems to be more deadly to caterpillars and is not at all injurious to plants, but rather acts as a manure. Tuba root (*Derris elliptica*) is pounded and soaked in water, making a soapy mixture, which is deadly to many insects, especially caterpillars and blights. Phenyl is useful for blights and especially those white Coccidæ which are protected by a coating of wax which throws off the insecticide liquid, but which is partly dissolved by Phenyl, which is then fatal to the insect. Phenyl is a tarry looking liquid which, when mixed with water, resembles milk. It should be stirred with water till it is of the colour of good milk, used thus it has no bad effect on even delicate leaves. For tobacco water, the ordinary Javanese tobacco can be used soaked in water. It can be improved by the addition of soft soap which causes it to adhere better to the leaves. Kerosine and soap is also a good mixture for blights.

These liquid insecticides can be sprinkled from watering cans or syringes, or a spraying machine of which many kinds have been invented, can be used. For a large area the latter is the most suitable. The great amount of rainfall militates against liquid insecticides as a heavy shower is apt to wash it away before it has taken full effect.

The best work on insecticides is Lodemans "Spraying of plants" (Rural Science Series).

Smoking the trees with sulphur or burning rubbish requires a good deal of care or the trees may be damaged. Small pots of sulphur on poles held near bushes will often clear off caterpillars and has been used successfully, it is said in Java, but fumes of sulphur, if prolonged, are apt to damage the foliage.

Traps consisting of a lamp over a tray of molasses or other sticky sweet substance catch a considerable number of crickets and beetles. The ordinary moth trap is useful for moths, and often catches beetles and crickets. The coco-nut butterfly enters it readily and may be taken in numbers. It is a cylindrical structure made of mosquito curtain stretched on two rings of rattan, about three feet tall, the top is conical and is best made of some opaque cloth. In the sides are small doors made, by which the insects enter. A bait of over-ripe plantains is hung in the middle of the trap or a lamp is fixed in the centre. The trap is hung up by the top in paths or open spaces, and the insects fly in by the doors and are unable to escape. I have known as many as thirty coco-nut butterflies taken in one of these traps in one evening.

Further information on injurious insects of the Peninsula is still wanted, and any persons who find insects injuring their plants would do well to send them for examination with such notes as they can make as to their habits, to the Director of the Botanic Gardens.

Lepidoptera.

Amathusia phidippus.—The Coco-nut butterfly is a large insect, the wings of which are brown above, and paler beneath, with light wavy bands running across both wings and two large eye-shaped spots on the lower wing. It is very common in coco-nut estates, hiding among the leaves by day and flying, only at sundown and just before sunrise. The caterpillar is 3 inches long, hairy, with a bifid tail. It eats the leaves of the coco-nut palms, reducing the leaflets to the mid rib, and when abundant, they give the trees a most miserable appearance. I have never heard of their destroying a tree completely however, but should they become really injurious, they might be caught in moth traps baited with bananas, into which they readily go

Papilio Erithonius.—The caterpillar of this is very destructive to orange, lime, and pumelo trees, chiefly however to young plants. It is a very striking insect of a dull bluish green with black markings, somewhat resembling a bird dropping, but especially remarkable for its protruding, when touched, two long red fleshy tentacles from its head. The chrysalis is attached to the plant by a thread as in most butterflies and is green. The butterfly is black with cream coloured spots, a bluish and black eye on the upper part of the hind wings and a red spot on the inner side at the lower part. Few orange seedlings escape being attacked by this caterpillar, and it is requisite in raising young plants to keep a look out for this insect which very soon defoliates a young plant and kills it.

Erionota thrax.—The banana skipper, a brown butterfly with 3-squared yellow spots on each wing and dull red eyes, body and wings dull brown. It is 4 inches across the wings. This very common insect is in the caterpillar state very injurious to bananas, and also attacks palms of various kinds. The eggs are

laid on the leaves or oftener on the stem of the banana. They are bun-shaped, white with pink stripes, radiating from the top downwards. The caterpillars when hatched are pale green with rather a large black head. When full grown they are about 3 inches long, sea-green with a large round black head, sprinkled over with hairs and covered with a white floury substance. They live in rolled up portions of the banana leaf, and by tearing and rolling up the leaf, destroy far more than they actually eat. The rolled up portion in which the grub lives is covered inside with the white floury substance which appears to act as a protection against rain water, which is apt to accumulate in the rolled up tube of the leaf. The substance being of a waxy nature prevents the water touching the animal's skin. It also acts to a certain extent as a protection against animal enemies, such as ants, which I have observed on attempting to bite the caterpillar and getting a mouthful of the waxy substance soon abandoned the attack. The caterpillar pupates in the rolled up leaf. The chrysalis is rather long for the size of the butterfly, and is also covered with the waxy secretion. This animal is so abundant that in most places it is difficult to find a banana which has not been attacked by it. It lives on all kinds of bananas including Manilla hemp (*Musa textilis*) and the wild Musas, also on coco-nuts and other palms. I have seen banana plants quite torn to pieces by this caterpillar, the leaves reduced to the mid rib and a row of rolls on each side, but as a rule unless very abundant the damage they do to the plant is trifling. It is however advisable to destroy them, which is easily done by handpicking. The butterfly usually flies in the evening and sometimes even comes into light.

In some places a very similar but larger skipper, *Gangara thyrsis*, attacks bananas in the same way, but as a rule it is a less common insect.

The Coffee-hawk Moth (*Cephonodes Hylas*).

The enormous amount of damage caused to the coffee in the past two years by the bee-hawk moth (*Cephonodes Hylas*), especially in Selangor, in the neighbourhood of Petaling, has caused so much alarm, that some account of the pest, its life-history and the means used to destroy it must be of interest to many persons residing in the East. In compiling this account of it, I have availed myself of the notes made by Mr. A. L. Butler of Selangor Museum, whose observations I publish *in extinso* and by Mr. J. Goodenough, Forest Inspector, and what information I could glean from planters in the district, during my visit to the infected estates in February, 1899. I also saw an outbreak of the same plague some years ago on the Chasseriau Coffee Estate in Singapore, where however, the damage was not so severe.

Description of the Moth.—The moth belongs to the group of the *Sphingidæ* (a group, as Mr. Butler points out, any members of which have very seldom been reported as causing any appreciable damage to crops of any kind), and it is closely allied to the English Bee-hawks characterized by their transparent wings. It

is of comparatively small size, being only 1½ inches in length from head to tail and nearly 3 inches across the wings. The head is rather broad, olive green in colour, the antennæ half an inch long narrowed at the base and dilated upwards, ending in a short slender point. The thorax and first three segments of the abdomen are covered with olive green fur, the fourth segment of the abdomen is nearly black with a thinner coating of green fur, the fifth chestnut red, the sixth yellow edged with black with a central red spot, the tail yellow, ending in a broad black brush like a fish tail in shape. Beneath the thorax and first abdominal segment are white, the next three segments red and black, the last ones white with a black centre. The legs white beneath and grey above, the terminal joints long black. The wings are quite transparent except for the broad upper margin and veins, which are black. It is diurnal in habit, darting about the Coffee bushes with great rapidity during the sunshine and disappearing during rain and when the sun goes down. While the coffee is in flower it can be seen hovering over the flowers and darting from one to another to suck the nectar, and probably fertilizes the flowers to some extent. It was noticed that when the Coffee flowers were fallen the moths usually disappeared and estates which happened to be without flowers when the moths were about were but little affected by the pest, but in estates not previously attacked as soon as the Coffee flowers were open the moths came in great numbers from other plantations. This group of moths being very powerful on the wing can fly very long distances with great ease, and are therefore often very widely distributed.

The eggs are deposited singly upon the leaves usually on the underside. The moth does not settle, it darts at the leaf and giving a sudden forward jerk of its tail places the egg on the leaf where it sticks. In some places where the coffee leaves had been so far destroyed that there was not a sufficient supply for the moths, they were seen to deposit their eggs on Lalang grass, or other herbage.

The *eggs* are small and globular of a semitransparent green colour with a rather hard shell; they are but loosely attached to the leaf and are easily rubbed off.

The *Caterpillars* when first hatched are green with a yellow head and a long black horn on the tail. As they developed they changed colour, and were very varied. Caterpillars of apparently the same ages being entirely different in colouring. The following variations in colour in the older and full-grown caterpillars were noted:—

A. Body green with a row of black dots on the sides above the spiracles and a white line running through the line of dots; neck covered with small yellow pustules.

B. Light green with a yellow stripe and black dots, horn green with black base.

C. Head green, neck with yellow pustules, body ground colour green with broad black dorsal band with fine black stripes on the side, legs and belly dusky with a white

lateral band and green and white regular triangular blotches over the spiracles; horn black.

D. Light green with a whitish band along the back, a pink side line and a green horn.

E. Head ochre yellow, body grey, spiracles yellow with a white line above them, legs black, hinder ones spotted with yellow, horn ochre at the base, black above.

When full-grown the caterpillar is about 3 inches long. It is very voracious, devouring the leaves, and when they fail attacking the unripe cherry, the bark, flowers and buds. Besides the Coffee bush, it feeds on the *Gardenia*, which appears to be its natural food in Ceylon. I noticed that round the cooly lines at the spot where the outbreak was stated to have commenced there were Gardenia bushes, and during the outbreak caterpillars were found on Gardenias in several places near Kuala Lumpur.

The insect is known to occur in India, Ceylon and Java, but I cannot find that in any of these places it has been found attacking the coffee.

Enemies.—The only enemy of this insect that I noticed was a large black bug, which was seen to attack not only the caterpillars but was able also to seize the moth as it was laying its eggs on the leaves.

The bug is about an inch long. The head very narrow, about $\frac{1}{4}$ inch in length with a long, rather stout, curved beak. The antennæ very slender over $\frac{1}{2}$ an inch long. The eyes large in proportion to the head. The thorax broad rhomboidal dull black, the abdomen nearly half an inch long, broad, with the sides turned up, so that the wings which are of a dull bronzy metallic yellow, in a depressed space between the raised margins. The legs are long and slender (see plate).

I have usually seen this bug flying about jungle paths, but at Petaling it had come from the forests and was flying about among the coffee bushes. It drives its long beak into the moth or caterpillar and sucks its juices. If handled it bites very sharply in the same way and its bite is very painful, being evidently poisonous. The insect was unfortunately not sufficiently abundant to cope with the immense abundance of the caterpillars but it certainly helped to destroy them.

Mr. Butler in his notes points out that both the Magpie robin and common bulbul attacked the caterpillars and destroyed some.

History of the attack.—The Manager of Petaling Estate stated that he first noticed the pest in the latter half of December, 1898, and put on all hands to destroy the caterpillars. It is probable however that the attack really commenced much earlier in the year. In the beginning of February, six weeks after the caterpillars had been noticed, they had spread over from half to two-thirds of the estate, and in many places could be seen rows of from 30 to 40 trees stripped of leaves, and with the berries gnawed. Mr. Aldworth, in a report to Government, counted at this time 204 caterpillars on an average tree, and estimated

that there were 90,000 to an acre, or about 22½ millions to the whole plantation.

Calculating the sexes to be equal, this would give at the estimated number of eighty eggs to a moth, the enormous amount of nine hundred millions of caterpillars on the estate at the next breeding season, within a period of four months from their first being noticed. The estate coolies being insufficient to keep down the pest, though destroying 300,000 caterpillars a day, the Selangor Government assisted by supplying additional labour and in a few months the plague was so reduced as to be manageable.

Beside handpicking, other means were tried to destroy the insects on a large scale. Butterfly nets were supplied to boys who caught the moths, and though a number were killed like this, the value of this work was reduced by the fact that the moths which were most readily caught were those that had finished laying their eggs, the more active ones fresh from the chrysalis escaping. Experiments were tried with London purple and sulphide of potassium, tuba root and smoking with sulphur, but none of these were of any practical result. London purple, which has been used to kill caterpillars in other parts of the world with so much success, has here proved useless, for what reason I cannot guess.

I have tried it on many kinds of caterpillars and find that it either acts so slowly that the caterpillars can easily free themselves from it, or does not kill them at all. Sulphide of Potash in solution is more rapidly fatal and with a proper syringing apparatus, might be utilized with good results in similar outbreaks, especially as besides being fatal to the insects it is beneficial also to the plant as a manure. Tobacco water, soap, tuba roots, quassia, etc., seemed to be fatal only to the very young caterpillars and not always to those. The moths being entirely day flyers cannot be attracted by light and an attempt to attract them with a powerful kerosine lamp ended in a catastrophe fatal to four persons.

Handpicking and shaking the trees so as to dislodge the caterpillars and eggs seemed the most effectual and economical method, but in cases like the present it should be begun on the appearance of the pest and kept up till all danger is over. The chrysalides should be collected f om their hiding places in rotten wood and dead leaves, etc., and where they can usually be found crowded together, as the caterpillars do not go far fro them bushes to pupate.

Notes on the Bee-Hawk Moth Caterpillars.

(*Cephonodes Hylas*). By A. L. Butler.

I visited Petaling Estate on January 31st. There were then millions of the caterpillars busy at their work of devastation, almost all were full-grown or of medium size, and I saw no eggs or very small young ones. Not a single moth was to be observed on the wing. The part of the estate worst attacked was on the

left of the railway line (facing Klang). The amount of damage done was extraordinary, a large acreage being almost completely stripped, as many as 50 for 60 consecutive trees often not having a single leaf left on them. On these trees the caterpillars were busily feeding on the rind of the green berries, to which they invariably turn when the leaf supply is exhausted. Whole branches of berries had suffered thus, looking very much as if the rind had been gnawed off by mice. Where any leaves remained the berries were practicaly untouched, and as long as any *green* berries remained the ripe ones were seldom attacked, though the caterpillars in some cases turned to these finally. At this date (Jany. 31st) thousands of chrysalides could be collected in a very short time, the debris of earth and dead leaves round the bases of the coffee trees, and every piece of rotten wood, etc., lying about being full of them. The caterpillars go through the transformation into chrysalides only just beneath the surface of the soil; sometimes on it, covered only by the deed leaves which collect round the stems of the trees. They are always found in a horizontal position, and by constantly wriggling from side to side in the loose top-soil usually make themselves a cavity a little larger than their bodies.

When approached or aware of danger, the caterpillars cease feeding, raise the fore part of the body with the head bent downwards in the usual Sphinx caterpillar style, and remain motionless while danger threatens. When touched they secrete from the mouth a drop or two of a greenish brown fluid, which on exposure to the air, immediately becomes a rich golden-brown very like iodine, staining the hands or clothes wherever it touches. Of small and medium sized caterpillars, I noticed that this fluid was usually of a bright grass-green for a second or so after secretion; in the larger ones it appeard to be of a greenish brown immediately it left the creature's mouth. Presumably this fluid has an extremely unpleasant taste, and is the caterpillar's only protection against insectivorous birds and animals.

The colouring of the caterpillar changes a great deal during its existence. and is not protected, beyond being green when the skin has been newly shed. In fact a protective coloration would be rendered useless by the very numbers of the larvæ, which, crowded together on the half stripped twigs of an attacked tree, are of course conspicuous.

I have seen the green pods of a kind of vetch at a distance closely resembling these caterpillars in shape and colour, the horn at the end of the pod corresponding to the horn on the caterpillar's tail did such pods occur on the food plant of the caterpillar, the purely accidental resemblance might be taken as an instance of mimicry.

On February 2nd I again visited Petaling Estate and brought away a large muslin cage full of caterpillars and chrysalides. No moths were visible on the wing. On the third, two moths hatched from my chrysalides; on the 4th, three and so on until the 9th, when all I had brought home were hatched. At the

same time an enormous batch of the perfect insects hatched out at Petaling, and for days the whole estate was humming with moths whirling and darting among the coffee trees in countless thousands, poising themselves over the fragrant blossoms or just pausing for an instant over a leaf to curve their bodies downwards and deposit an egg.

I fed my moths in captivity on plantain juice, which they sucked greedily.

At 1 P.M. on the 8th of February, I observed a pair of moths, four days old *in copula;* they were still paired at 5 P.M., but were separated when I looked at them again at 8 P.M. I isolated these two individuals for observation. Two days later, on the 10th the male died. The female after impregnation became very lively, whirling round and round the bottle most of the day. On the 13th this moth died, and on opening her I found 88 eggs apparently quite ready to be deposited. This number was about what I found in several gravid females dissected and is, I think, about the average usually laid.

Between the 5th and the 10th of the month a large number of the captive caterpillars turned into pupæ. These were all very noticeably smaller than the wild chrysalides, the difference in size being doubtless due to the fact that the caged larvæ were fed always on *plucked* and *withering* coffee leaves instead of growing foliage.

The time taken by moth's eggs to hatch, and the duration of the pupa stage are very variable and dependent on climatic conditions (pupæ are frequently 'forced' by English collectors), but as far as my observations go the different periods in the life history of the Bee-Hawk moth are approximately as follows :—

Egg stage : 5 days or a week.

Larvæ stage : 4 to 5 weeks.

Pupa stage : 10 days or a fortnight.

Imago stage: doubtless varies greatly. Females are probably impregnated within 3 or 4 days of hatching, lay their eggs about a week later, and die a few days afterwards. Males probably only live a few days, dying after fecundating a single female.

It is quite impossible to put an exact period to the different stages of an insect in the wild state, but the above data gathered from my specimens in captivity, are probably fairly near the mark as they come altogether to about two months, the interval of time occurred between the big hatches of the moth at Petaling.

The Bee-Hawk Moths seem to have practically no natural enemies, or rather no natural enemies sufficiently numerous to afford any check to their ravaging millions. Personally I have only seen two birds touch them, the Magpie Robin (Copsychus saularis) and the yellow-vented Bulbul (Pycnonotus analis); both of these feed on the small and half-grown caterpillars, but neither are gregarious species, or sufficiently plentiful to make any impression on the vast legions in which the caterpillar appears.

If the pest appeared in Ceylon I believe that good service would be done by the little white-eyed Tit (Zosterops Ceylonensis), a small greenish bird with a white ring round the eye. On up-country estates in Ceylon these little birds work their way about in the Coffee in large flocks, most carefully searching the leaves for spiders, insects' eggs and larvæ, aphides, etc.

I put four of the moths alive into a glass case with a big *Gecko Stentor*, but though they remained there for four days they were untouched, though cockroaches and grasshoppers also put into the cage during this time were immediately eaten.

Mason wasps and ichneumons are not sufficiently numerous to be of any use against such a plague of caterpillars. The former kill very few larvæ and of the 200 odd chrysalides which I hatched in captivity not one had been attacked by the latter.

Very heavy showers of rain at the time when the young caterpillars are hatching and in large quantities are apparently very destructive, washing the tiny larvæ off on to the ground in great numbers, when, unable to regain the foliage, they perish in the dust, or are destroyed by ants.

Probably warm sunny weather with occasional light showers is the most favourable to a batch of these pests. The heavy showers at the end of February did much to reduce their numbers and the recent drought has also proved very unfavourable to the insects, the pupæ dying underground from want of sufficient moisture.

It is extremely rare for any of the Hawk Moth caterpillars to appear in numbers sufficient to make them an appreciable agricultural pest. The only other case in which I am aware that this has happened was that of the large Sphinx Caterpillars which attacked the Cinchonas in Ceylon some years ago.—A.L.B.

NOTE.—A certain amount of damage has however been recorded as having been done by the caterp llars of the Death's Head Moth (*Acherontia Atropos*) to potatoes in Europe.—H. N. R.

PARASA LEPIDA, CRAM. (*Limacodidæ*).

From Negri Sembilan MR. ASHBY sends me some larvæ found feeding on coffee leaves. They are about half an inch long, wood-louse shaped, armed with four lines of processes furnished with semi-transparent stinging hairs. The caterpillar is pale blue with four of the tufts, two at each end black, and a black spot on the anal segment. They seem to be the larvæ of a species of *Parasa* near *P. lepida* and possibly the same insect. These caterpillars I have seen feeding on various trees and shrubs, and they are very destructive. Some of the catreprillars of this group sting badly and are very troublesome to get rid of by hand picking. *P. lepida*, Cram., is well known in Ceylon as a coffee pest, and also in Java, where the caterpillar is known as Ular seret, Ular sintang, and U. sengenet. It forms a round brown papery cocoon on the leaf, and appears as a green and brown moth, an inch across or more.

As more than one of these *Limacodidæ* have been proved very destructive to Coffee, planters will do well to cause their destruction if they appear even in small numbers.

Castor-oil Caterpillars.

From Kajang comes an account of a very destructive caterpillar which attacked first the castor-oil plants which had been planted among the coffee bushes and which having eaten all the leaves off the castor-oil fell upon the coffee for want of something else to eat. The caterpillars are about an inch and a half long, nearly smooth, with only a few scattered short hairs. The head is smooth and shining mahogany brown, the forelegs the same, the body dark blackish brown with lighter mottling over the back, there are two yellow dots on the back just beyond the last pair of forelegs, and from the same position runs on each side an orange ochre line along the spiracles. On examining some castor-oil plants in the Botanic Gardens, I find what is evidently the same animal, but it is of rather a lighter colour, with a more distinct mottled grey dorsal band with a dark central line, the dots on the back white and the side stripe pale laterite red. These caterpillars had eaten all the leaves off the castor-oil, and had attacked then some *Clerodendrons* (*C. fallax*), *Gynura Pseudochina* and other succulent weeds. These caterpillars pupated May 2 to 4, without making any cocoon. The chrysalises were nearly ¾ inch long. The moths hatched out May 15th. Upper-wings nearly an inch long, light reddish brown faintly marbled with a dark brown sigmoid mark in the centre, a wavy line along the edge, edge crenate dentate, a line of black dots within the margin. Under wings dark grey, edge yellowish crenulate. Head and thorax light reddish brown, a blackish grey spot at the base, body smoky grey, tail yellowish. Wings and body beneath pale reddish fawn, a row of black dots across the centre of the lower wings and one along the edge. It is apparently a species of Ophiusa near O. cuprea.

Turmeric Moth. *Dadessa evaxalis.*

The caterpillar of this moth inhabits the stems of several of the turmerics cultivated as spices. It is about ¾ of an inch long, smooth except for fine scattered hairs on back and sides, the head and first segment black, the body of a pale semi-transparent pinkish colour, with grey or black dots on warts down the back, and a row just above the spiracles on each side, a pink line above the spiracles the whole length of the body. It makes a burrow in the leafy stem and can be detected by the exudation of the excreta from holes in the stem and the withering of the leafy portion. The chrysalis is about an inch long and remains in the tunnel bored by the caterpillar. The moth is an inch across the wings entirely ochreous yellow above sprinkled all over with black spots an short streaks. The body is long and slender and the legs and antennæ are long and delicate. On the underside the upper wings and a bar across the thorax are sooty.

If troublesome all stems attacked should be cut and destroyed before the moth escapes.

THE WOLF MOTH. *Tinea granella.*

A bag of rice brought to the Garden was found to be infected with caterpillars to such an extent that it was quite useless, the small dirty white grubs lived in the rice grains, and spun them together with a web, nibbling them to dust. Having pupated the moth came out in a few days. It was about half an inch long entirely smoky grey. When at rest it rolls up its wings so as to appear quite cylendric and resembles a small piece of greystick. I suppose it to be the well-known Wolf moth, a regular godown pest in all warm places. It is said only to devour white rice, and the treatment recommended is to sprinkle the rice with salt. If it becomes abundant in the godown, the rooms should of course be cleaned out and thoroughly cleared of the pest.

THE PUMELO MOTH, *Nephopteryx sagittiferella*, Moore.

A very complete account of this pest was published by Mr. WRAY in the Journal of the Asiatic Society, Straits Branch, vol. XIX, p. 83, and it was described and named scientifically by Mr. MOORE in Indian Museum Notes, vol. 2. The eggs are laid on the fruit, and the caterpillars eat into the rind, burrowing eventually into the fruit and causing so much injury that the fruit falls before it is ripe. When full-grown the caterpillars descend to the earth where they pupate, and 12 days after escape as moths. The moth is brown with shading of silvery grey, and is about an inch across.

I have seen what I suppose to be this animal in pumeloes in various places, and it quite destroyed all the lemons on a tree in the Botanic Gardens in Singapore some years ago. The most practical way of dealing with this animal is to constantly destroy all fruit attacked by it so as to prevent the caterpillars developing into moths.

THE PADI BORER *Chilo. sp* near *Ch. oryzœellus*, Riley.

Is also described by WRAY as destroying the paddy in Perak. lc. p. 73. The egg is laid on or at the base of a leaf and the caterpillar tunnels the stalk and the midribs of the leaves and leafstalks. It pupates in the stalk or the leafstalk and hatches out into a pale ochraceous moth, nearly an inch across. It is very destructive, destroying whole acres of paddy. It is reckoned that there are six broods in the year. A parasitic larva, one of the Tachinid flies was found to destroy a quantity of them. Destruction of the straw and of selfsown rice by fire, after the harvest was recommended. Another species apparently of the same genus was also found attacking padi by Mr. WRAY but it was rarer.

The Sugar-cane *Chilo*, was described in Bulletin No. 7, p. 143. The habits of all these grass borers are much the same. The caterpillar tunnelling the stem coming out at intervals and

burrowing in again and pupating in the stalk. The moths remain quiescent during the day and fly about at sundown or later.

The Gutta percha moth.

The Gutta percha trees in Singapore are commonly attacked by a small Tortrix caterpillar which spins two leaves together and devours the epidermis and causes the death of the leaves and often of the shoots as it usually attacks the terminal leaves of the shoots and includes the bud in its nest. It is a slender caterpillar half an inch long, smooth with a dark brown shining head and a greyish black body with shining darker spots all down its back from which spring hairs. It draws the leaves together by the edge and covers the open ends with a wall of brown silk from which when it pupates it hangs by the tail. The chrysalis is dark brown an inch long with a curious knob projecting from between the eyes. I have failed to rear the moth.

To the same group of moths belongs the Ramie moth described on p. 139 of Bulletin No. 7.

The Atlas Moth, *Attacus atlas*.

Is well known in the moth state to every observer here, as it is very common and our largest moth. The caterpillar is nearly six inches long and very stout, entirely of a pale green colour covered with a white bloom except for a pinkish spot just above the last pair of hind legs. It is quite hairless but is covered with large thorn-like processes.

The animal will eat almost any kind of leaves, but appears to prefer those of the custard apples. I have also found it eating Stillingia sebifera, Trevesia eminens and even gambier leaves, being the only caterpillar which I have ever seen eating the latter. Though never appearing in very great abundance, it is a very destructive insect on account of its great voracity. It will strip a tree of its leaves in a surprisingly short time. The chrysalis enclosed in an egg-shaped bag of yellow silk is spun on the tree on which it has been feeding. The moth with its large curved wings red with markings of white and grey, with a large rhomboidal clear space on each, its fluffy red body and plumed antennæ, is conspicuous hanging on the branches of bushes, or flapping slowly through the air. The male is always smaller than the female, which is often over nine inches across the wings. It is not attacked by birds and even monkeys will not eat it, probably on account of its peculiar musky smell. It lays a large number of eggs, about 300, they are firmly gummed to the under surface of the leaves (Indian Museum Notes II. 72.)

It is curious that with the immunity from enemies which both caterpillar and moth seem to possess, that the insect is not more injurious than it is. Ichneumons, however, I believe, destroy a quantity of the caterpillars. It may be stated that the silk of the cocoon though in itself good is so glued together that it is

impossible to unwind it and it is usele s. Attempts have been made to use it however (Indian Museum Notes II. 72).

COLEOPTERA.

NUTMEG BEETLES, *Scolytidæ*.—The small beetles described in Bulletin No. 5, as causing so much damage to nutmeg trees in Penang and Province Wellesley, have been identified by Mr. BLANDFORD as comprising three species of Tomicidæ. Two of these are species of *Phlæosinus*, one of which is described as *P. cribratus*, BLANDFORD, and with them was *Xyleborus fornicatus*. This latter has been reported as very destructive to tea in Ceylon (Indian Museum Notes IV, p. 57, Pl. V). It attacks the stems, riddling them as if a charge of snipe shot had been fired at them. Mr. G. ALSTON is quoted as saying that strong vigorous trees in good soil seem to be very little affected but poor plants on ridges or poor soil seem naturally to feel the effect of it quickly, though in no case have I seen a tree killed by it. Other species of the same genus are well known insect pests, and in cases of any of the shot borers being found attacking trees, care should be taken to burn all dead wood and bark on the ground to prevent the animals breeding.

BATOCERA HECTOR, *Dej.* (*Longicornia*).—This is a very large plain light brown longicorn beetle about 3 inches in length with long antennæ and a thorn on each side of the thorax, I believe I am right in identifying it with a rather common insect which often comes to light in houses, where I suspect the larva has previously fed on the timber. The grub is about 4 inches long, stout and white. It is reported (Konigsberger Dierlijke Vijanden der Koffie culter in Java) as being very destructive to the shade trees, chiefly Dadup *Erythrina*, and less frequently to *Albizzia* and nutmegs.

Serica sp? near *S. pruinosa* (*Lamellicornia*).—From Tapa in Perak I have received some small brown chafers which Mr. BAILEY tells me have done a great deal of damage in devouring the leaves of Mango stem and Rambutan trees, quite defoliating them. These insects fly only at night, hiding probably in the ground during the day. The beetle is a quarter of an inch in length, entirely smooth, shining chestnut brown, the head is small, thorax rather short, elytra rounded dorsally almost completely covering the body and finely striate, the legs long and slender especially the hinder pair which project beyond the abdomen.

Two species of small chafers about a quarter of an inch long are very troublesome in gardens in devouring leaves of many shrubs such as Acalyphas and biting every leaf into holes.

These beetles attack the plants only at night when a visit to the shrubs with a lantern will show them to be swarming. They can be shaken off into a net or cloth but fly very briskly and many escape. One of them is entirely glossy black the other brown with faint mottlings. During the day these beetles probably hide in the ground and I have several times dug them up beneath the bushes they have been eating but only a few at a

time. Where the greater number vanish to during the day I am unable to discover. They are by no means universal in gardens, though widely distributed. On some gardens every bush is eaten by them, in others they are scanty or absent. Specimens sent to the British Museum were unknown to the entomologists there.

Other destructive lamellicorn beetles we have here are the black coco-nut beetle *Oryctes rhinoceros* described in the Journal of the Straits Branch of the Asia Society Vol. 20 and the big *Xylotrupes Gideon* L. found damaging sugar cane in Province Wellesley (Bulletin No. 7, 144) and stated to attack coco-nut in the same way as the black coco-nut beetle in India (Kew Bulletin March 1893) and *Lachnosterna* sp. the sugar chafer (Bulletin No. 7, p. 144).

Bamboos cut for building purposes, etc., are very apt to be destroyed by several species of very minute beetles which soon reduce them to powder This is however very easily prevented by soaking the bamboos as soon as cut in a pond or tank for a fortnight putting weights on them to keep them down. When taken out and put to dry they exhale a very unpleasant odour for some days but this soon goes off and the beetles will no longer attack them.

In the group of long-snouted beetles known as Weevils (*Curculionidæ*) we have several very troublesome insects. THE GRAIN WEEVIL *Sitophilus oryzæ*, a very small black narrow weevil always found in rice and other grain when stored in the godown is as abundant here as it is nearly all over the world. Many plans have been suggested for its destruction. Among other plans for its prevention it was the custom in Brazil to store the grain (Indian corn) in cement tanks and cover it with a thick layer of sand which seemed to prevent the animals getting at the corn from the ontside or escaping if they were already in.

ASTYCHUS CHRYSOCHLORIS Wied.—This green weevil was reported by Mr. WRAY, Perak Museum Notes II, 1, 1897, as doing great damage to the coffee on Gapis estate, and what I take to be the same thing was sent me some years ago as defoliating nutmegs. It was found also in Perak eating Dadup (*Erythrina*) Durian, Guava, Hibiscus, Limes, Pumelos, Orange, Mango, Bachang (*Mangifera foetida*), and the wild Bombax and some other plants. Mr. WRAY gives a full account of the life history of the beetle which is briefly that the egg is laid in the ground and the grub which apparently feeds on decayed vegetable matter till it grows to about ¾ inch long, forms a chamber in the earth, and pupates there about two inches below the surfa e, hatches out at night and feeds on the leaves; after about a month it breeds, the egg being laid over a month afterwards. As the beetle continues to eat the whole of the three months or more it exists, and does not leave a tree till it has eaten all the leaves it can, it is very destructive when abundant. It does not fly readily but can be shaken off the trees and was destroyed by hand-picking. The insect is easily known by its bright green colour covered

with golden scales easily rubbed off, and is about half an inch long. It is common in many other places besides Perak, but I do not remember to have met with it in Singapore. Mr. WRAY gives its name as perhaps *A. lateralis*, but from the figures of *A. lateralis* and *A. chrysochloris* in Indian Museum Notes, I take it to be *chrysochloris*.

THE BANANA WEEVIL, *Sphenophorus sordidus*, Schonh.—This is a very destructive insect and one not at all unlikely to be overlooked. The larva burrows in the stems of the plantains, often quite at the base, the stems cease to grow, become weak, the leaves turn yellow and the whole stem perishes. When the beetle is abundant the stems are attacked as fast as they push up, and eventually the whole plant dies away. On being split up the stems and leaf sheaths are found to be tunnelled vertically and transversely, grubs and pupæ are seen in the tunnels, white the full grown beetle is hiding beneath the sheaths, or often in the ground at the foot of the plant. When the plantation is thoroughly infested, which happens very quickly after the beetle makes its appearance, the pest seems almost impossible to eradicate. The only thing to be done is to cut the plantains down to the ground take out the stump, clean it thoroughly and replant it in a different plot of ground. All dead stems should be broken up and destroyed as the beetle will go on living in them till quite rotten. All plantain growers should look over their plants at times to see that the pest has not made its appearance, and when stems are seen to be unhealthy looking, cease their growth and fail to give fruit, the leaf sheaths should be stripped off when the beetle will probably be found. The beetle attacks all kinds of cultivated plantains, but the common Pisang Kelat though not absolutely proof against it is much more rarely attacked than other kinds, and I have seen this variety standing unhurt when all other kinds surrounding it have been destroyed. The Manila Hemp, *Musa textilis*, is also attacked by it, but to a less extent than the eating plantains such as Pisang Mas.

The beetle is half an inch long, rather flat, entirely black and shining. Its curved snout is $\frac{1}{8}$ inch long, the head very small, conic. The antennæ longer than the snout bent and clubbed at the ends. The thorax is rather narrow, oblong, conic, polished, black and dotted. The wing cases $\frac{1}{4}$ inch long and $\frac{3}{16}$ inch wide blunt and rather narrow grooved and ridged, shorter than the abdomen, the legs rather long with sharp spurs near the feet. It is sluggish in habit, and only creeping slowly about when disturbed. The grubs are about half an inch long, white with a red-brown head, of the typical weevil form, *viz.*, fleshy and curved, thickest in the middle and tapering at the tail, with powerful jaws and no legs. The pupa is enclosed in a cylindrical cocoon of fibres of the plantain. In fact both grub and pupa closely resemble those of the red coco-nut beetle, but on a much smaller scale. Together with the common black kind I found another kind *S. planipennis*, Schonh, which, however, is much rarer, in which the body, head and thorax were red with black markings.

The black one is abundant in Singapore and also I have seen it in Selangor.

To the same group of beetles (*Curculionidæ*) belong the red coconut beetle *Rhynchophorus ferrugineus* described in the Strait Asiatic Society No. 20. The West Indian palm weevil *R. palmarum* has been made the subject of a very valuable paper by W. F. BLANDFORD (Kew Bulletin, Feb.-Mar. 1893, p. 27-60) where there are many useful notes on dealing with these pestilential insects.

Recently a note was published in the *Ceylon Observer* and reprinted in the *Government Gazette*, as to the cleaning of a badly infested estate in Ceylon, and mention was made of the successful plan of cutting into infected trees and removing the larvæ of the red beetle, the wound being afterwards treated with tar. This has long been the practice in the Botanic Gardens and many valuable palms have been saved in this way. The plan adopted was to cut off the leaves one by one till the bud was exposed and the beetle grubs in the surrounding tissue destroyed. A cylindrical cap or bag was then placed over the top of the palm, to keep off the rain and removed when the next leaves began to push it up. No tar or other disinfectant was used. Of course care must be taken not to injure the growing point of the palm, but it is surprising how boldly one can cut into the bud without killing the tree. A fine *Oreodoxa regia* containing upwards of a dozen grubs was lately operated on and in a very few months showed no signs of the very severe operation it had undergone, The red beetle appears to be very partial to Sago palms, and breeds rapidly in the waste bits and the top and stump left by the sago cutter. Sago palm groves when being worked are apt to develop into an extensive breeding ground for these animals. They seem to do but little harm to the plant itself, though at times they do kill a few shoots. The tops and waste bits left in preparing Sago should be split up so that the beetles cannot breed therein. The most difficult thing however is to deal with the bases of the stems in the ground as they cannot be easily removed without injuriug the side shoots ; they should be scooped out as much as possible when, if water settles in the cavity, the beetles will not come.

HEMIPTERA.

THE RED COTTON BUG.—*Dysdercus cingulatus*, Fabr. is a very conspicuous and brilliant bug about half an inch long. The head thorax and upper part of the wings red, with the scutellum and a spot on each wing black, lower half of upper and lower wings, legs and antennæ black, body red with white rings. This insect which is very common, attacks cotton plants, piercing them with its beak and sucking the juices. It feeds also on other *Malbaceæ Hibiscus abel moschus*, and *Urena lobata*, and is said also to attack Bottle-gourds in India.

THE RICE SAPPER.—*Leptoc orisa acuta Thumb.* is mentioned by Wray, Perak Museum Notes II, p. 60, as occurring in Perak. I

have also seen what I take to be the same thing in Malacca. It is a greenish long-legged bug about an inch long, very variable in colouring. While it is in the young wingless state it sucks the juices of the stem causing it to wither. The adult settles on the rice and sucks out the juice of the seed itself. (India Museum Notes, Vol. I, p. 1). What I take to be this insect is very common here in long grass, and I find it always on plants of *Panicum plicatum*, grown in the Botanic Gardens. The male, however, is much darker than any forms described in the latter publication, the wings being quite dark brown, edged with green, the body green. It emits the usual horrible odour of the ordinary bugs.

Hymenoptera.

Rose sawfly.—*Hylotoma victorina*, Kirby. Very destructive, occurring in great quantities, devours the leaves. Caterpillars when full-grown ½ an inch long, smooth with a few scattered bristles especially on its head. Head round, shining greenish brown, body green with black spots on the back in about 7 longitudinal rows, 6 forelegs long, the others short, side flaps 4 with black spots. At rest it curls up its tail like most sawflies and when walking drags it behind as if injured. It forms a net work cocoon of fine silk ⅜ inch long in which the chrysalis remains about a week and then hatches out. The fly is ¼ inch long, the head and thorax shining blue black, abdomen yellow and shorter than the wings, which are black. The antennæ rather stout and as long as the thorax, cylindrical blunt black, the legs short black. It may be found sitting on the leaves of the rose bushes and being very sluggish is easily caught.

It is destroyed by hand-picking.

A species of leaf-cutter bee (*Megachile*) also sometimes attacks rose bushes, cutting semicircular pieces out of the leaves to make its nest with a tube-shaped structure concealed in the ground. The insect is not very common but sometimes occurs in sufficient abundance to quite spoil the appearance of the rose bushes.

The carpenter bees *Xylocopa* often do a good deal of damage to timber, especially rafters and poles by boring into them to make their nests. The most destructive is the large black one, *X. latipes*, but much injury is often caused by the smaller one *X. oestuans*, of which the female is black with a yellow thorax, and the male light brown. They should be knocked down and killed and their holes blocked if found doing much damage. All however do a good deal of useful work in fertilizing many plants especially those with large flowers, so that unless absolutely injurious are best left unharmed.

Ants.—One often hears from planters of trees being destroyed by ants, but it may be very much doubted as to whether in these cases the ants have anything at all directly to do with the death of the tree, but where from decay or other cause a hole or tunnel is produced in a tree, ants often utilize the perforation as a suitable position for a nest. This is commonly the case where

boring caterpillars have been. When the moth or beetle escapes and flies away, ants frequently occupy the boring, and might easily be accused of having produced it. We are fortunately free from the leaf cutting ants, which are so destructive in South America, and I have not as yet seen any species which devours foliage of any kind.

Some ants are undoubtedly friends to the planter while some are foes, others do both harm and good. The best known ant here, the Keringga, *Formica smaragdina*, which makes its nest by weaving together the leaves of the tree it inhabits, and which is so well known for its pugnacity and its sharp bite, must be classed with the latter. Its presence on a tree usually evidences the presence of one or other of the blights, (*Coccidæ*) and if that is destroyed the Keringga soon quits. I have, however, little doubt that it carries the coccidæ about and puts them on trees, for I have several times seen cocci, lying loose often on their backs in the nest, in a position not at all natural to them, they having evidently been brought from elsewhere and dumped down in the nest to serve as food supplies for the ants, who as is well known obtain from these insects a sweet exudation of which they are very fond. Again in the tunnels made by borers and later occupied by ants, it is not at all uncommon to find blight in a position which it is in the highest degree improbable that these insects should have got of themselves. It is needless to say that as the blight represents the milch cows of the Keringga the latter does not kill them but rather protects them. In this way this ant may be said to be injurious. Another objection to it is its ferocity as when it is abundant it makes the gathering of fruit or pruning almost impossible. It may also do a small amount of damage by bending the leaves together, and causing arrest of their growth or death.

It has, however, some good points in its favour, and the chief of these is its ferocity towards caterpillars. Only specially protected caterpillars can live on a tree infested with Keringgas, and it has been found sometimes advantageous not only to leave the ants' nests on a fruit tree, but to put fresh nests on the tree to induce the ants to destroy the caterpillars. When it is necessary to clear the trees of the ants the nests should be broken with sticks when the larvæ and eggs will fall to the ground and be lost or eaten by other animals, and this unless there is much blight generally gets rid of them. Another plan is to hang pieces of meat on a string from the branches, the ants will come to eat it and can be destroyed by dipping the meat into boiling water, or what is easier applying a damar torch to them. In this way myriads can be killed. The ordinary insecticides such as Paris Green may also be used, but it will be necessary to break the nests up first or the ants will retreat therein and escape the spray. Another very small black ant may often be seen traversing the paths in long rows, having previously thrown up a line of earth on either side of their track. Their nests are in the ground, and they go out to forage along the track for some days. These ants

capture and carry off to their nests all kinds of insects and other small animals. I have seen them carrying off millepeds, and small snails; and on one track I counted as many as ten snails at once being carried along in the space of about two yards, and this destruction was going on for several days at the same rate. They also destroy large insects by attacking and biting them to death.

A very similar if not identical species however destroys as well any small seeds which they come across, carrying them down their holes and biting portions off them, eventually throwing out again the relics of the destroyed seed. Any seed as big as rice or smaller is eaten in this way, and this is probably the reason, why it appears to be impossible to raise grass turf from seed successfully here. Any one who has tried this must be surprised at the way that however much grass seed is sown on properly prepared ground, little or none comes up, even if covered so as to prevent the grass-finches from eating it. Where small seeds such as Ramies or *Ficus elastica* or even larger seeds are sown in the nursery; the planter is very apt to lose a large proporton if th ere are many of these ants' nests in the neighbourhood.

These terrestrial ants may also do some damage by piling up mounds over young plants. They however do some amount of good to the soil, at least in some cases, by turning it over and breaking it up, but as a rule they are not abundant enough to be of much use in this way.

Orthoptera—The Coffee Locust.

Cyrtacanthacris nigrovaria, Walker.

The coffee locust (*Cyrtacanthacris nigrovaria*, Walker) is a very common and conspicuous insect occurring all over the Peninsula from Singapore as far North as Perak and Penang. It is about 3 inches in length with a large head and conspicuous eyes the antennæ slender ¾ inch long black, the thorax ½ an inch long, and both it and the head are light yellowish green with black spots on the sides above blackish grey with a broad yellow line running from the base of the antennæ down the back, the upper wings 2 inches long, are greenish brown, finely netted, and the upper edges are greenish yellow, so that when at rest the yellow band on the head and thorax continues along the edge of the closed wings; the lower wings are broad and transparent tinted and veined with brown, except the bases which are pink, and very conspicuous when the insect flies, the abdomen is dull greenish brown, shorter than the wings. The first two pairs of legs are short and blackish green. The hinder jumping pair very large and powerful, the thighs (femora) an inch long very thick at the base and tapering to the tibia greenish yellew, with two broad bands and the end black at the joint which is dilated somewhat are two yellow flanges, the tibia is an inch long black and armed on the back with a double row of yellowish thorns with black tips, the tarsus is short, a quarter of an inch long with

four small pads at the base, and a terminal one with a small claw on each side.

The female much resembles the male but may be known by its possessing an ovipositor.

The young locusts are apple green with yellow spots, rather soft bodied and wingless.

The young locusts live in low scrub and long grass and are not very conspicuous. They feed on leaves, but rarely do any damage to cultivated plants. The adult, which is a powerful and active insect, can often be seen in similar places, taking short flights when disturbed, but rarely going more than 20 yards at a time. Like the young it eats leaves, but seldom attacks coffee or tea with enough voracity to do harm. I have, however, detected it in the act of biting young Para Rubber plants, and it might in this way do much harm. It is very injurious, however, to many plants, from its habit of laying its eggs in slits cut with its ovipositor in twigs of various trees. The eggs, which are white cylindrical objects about $\frac{1}{8}$ of an inch long, are deposited in considerable numbers in short slits cut in the bark in a spiral manner, the locust going round the twig from the lower part upwards and laying the eggs as it goes. The twig very speedily dies, and falls off. The larvæ on hatching out usually leave the tree on which the eggs have been placed and betake themselves to the neighbouring grass and low scrub where they feed and develop. The coffee locust commonly attacks the coffee in this way, and I have also seen tea damaged by it, and from one estate in Selangor I received a collection of twigs also of guavas and other fruit trees and even fronds of ferns which had been destroyed in this way. Not long ago also I found an orchid in the gardens, in each one pseudobulb contained a double row of eggs of this or an allied species arranged in two rows in a long slit in the bulb. This however may have belonged to a different insect as the eggs were larger than usual and brown, and when they hatched out the young locusts were entirely green with long antennæ. They refused to feed and soon perished.

Though this locust must do a good deal of damage when abundant, it is usually neglected, even if pretty common on and about almost every coffee estate. A watch, however, should be kept on it to prevent its becoming too numerous, and it should be killed whenever seen. It is a clumsy flier and can only go short distances at a time, so that it can easily be knocked down with sticks by children and if too abundant the low scrub and lalang near the fields should be cut down and burnt to destroy the young ones which feed there.

Crickets.

Some specimens of a cricket which had been doing damage by biting off the tops of young rubber plants near Klang were sent me by Mr. Darby. They are like most of these animals nocturnal, remaining in holes during the day and coming out at night to

feed. These specimens apparently belong to the species, *Gryllus testaceus*.

The animal is about an inch long. The head is broad and rounded, with large eyes, the antennæ very short, $\frac{1}{4}$-inch long, the palpi as long. Thorax broad, abdomen thick, about $\frac{1}{4}$-inch across, wings $\frac{3}{4}$-inch long, dark brown with numerous cross nerves, the hind wings prolonged into long points. The legs semi-transparent brown, first two pairs comparatively short $\frac{3}{4}$-inch, hinder legs very long $1\frac{1}{2}$-inch, the first joint broad and stout, the second covered with strong thorns. The ovipositor is one inch long, slender, slightly curved, dilated at the tip. Two processes half an inch long project from the tail.

Few classes of insect pests are more difficult to deal with than crickets, living concealed all day in holes in the ground, they are difficult to find, and as they are often very voracious may do a great deal of harm in one night. It is however in the nursery beds that crickets are most destructive. They seldom ever do harm to trees which have grown two or three feet tall. If they are abundant in the field, it will be safer to defer planting out very young plants, and to wait till they are old enough to withstand the attacks of the crickets. Near the nurseries, rubbish and old logs in and under which these insects conceal themselves should be destroyed, and grass and bushes cut back. Flooding the ground so as to drown then out of their holes might be tried in serious cases, but as a rule keeping the ground clean of any rubbish will be sufficient to protect nursery beds.

Neuroptera.

Termites.—Termites or white ants as they are popularly called belong to the order *Neuroptera*, and have nothing to do with the true ants (*Hymenoptera*). They are exceedingly troublesome in many ways to the planter, and are often accused of destroying living plants directly by devouring the roots. Remarks on this action here have already been published in a previous bulletin, No. 2, p. 78. The question has been raised again lately in the Agricultural Ledger No. 18 of 1897, where a note from the Settlement Officer of Balaghat as to Mango saplings being attacked by white ants is printed. The Officer in question lost a number of saplings, and on investigation, found an apparently otherwise healthy tree with the roots eaten through in places "and a detachment of the voracious termites was actually pushing its way up the heart of the sapling eating its way through perfectly good juicy wood." Unfortunately no attempt seems to have been made to identify the species. The number of different species of termites is probably exceedingly large, and the group has been but little studied by any one except Dr. Haviland, whose paper (Journal, Linn. Soc. pp. 358 to 442) is the only one of any importance dealing with the Asiatic species. As might be expected the habits of the different kinds are very varied and whereas some kinds may and indeed do attack

healthy trees, others and far the greater number undoubtedly do not do so.

The only one I have met with here which is directly fatal to living trees is *Termes Gestroi*, WASMANN, a very curious species. It is a yellowish coloured termite with very powerful overlapping curved jaws with sharp points and it is also provided with an aperture in its head from which, when annoyed, it can exude a white milky liquid. It attacks trees by covering the trunk out side with a thick layer of mud from the base to about ten feet from the ground destroying the bark and burrowing into the wood through weak or dead spots and forming a nest of wood fibre inside. I have never seen a tree recover from the attacks of this animal although the mud has been repeatedly scraped off, the injured surfaces tarred or covered with other substances injurious to the insects. The workers contrive to cover the tree again and again with mud in a very short space of time, and the tree very soon dies. In a large bush of *Mimosa sepiaria*, which was attacked by this insect, or one closely allied to it, the whole tree was permeated by their tunnels, and even very small twigs when broken were found to have mud carried into them, and it was remarkable that though this was the case the tree outwardly appeared completely healthy, covered with leaves and bearing flowers and fruits. Specimens found destroying para rubber trees have been sent me lately from Selangor. It was perhaps a species allied to *T. Gestroi* that the Settlement Officer found attacking the Mango saplings. *T. Gestroi* however is by no means a common species, and seems rather to frequent woods than to appear in open ground, as the well known mound building species *T. Malayanus*, Hav. the best known species here does. This latter species is the one usually accused of destruction of various shrubs and trees, but I have never seen any signs of its ever biting living wood or roots. In cases in which roots of grass, orchids or trees traverse the nest they are walled out with a layer of mud and on carefully removing this the roots are seen to be quite uninjured. Any one who has examined a dry wood by night and noticed the immense abundance of termites running about everywhere beneath the leaves, would soon come to the conclusion that if they did attack living trees or shrubs the forests would be speedily destroyed, yet it is very rare to find a tree that one can suspect of being killed by them, as mentioned in a previous bulletin. *T. Malayanus* and other dead wood feeders can kill trees indirectly by removing dead portions and exposing living portion to the action of wet, and in other such ways, but this is really only hurrying on the death of a diseased tree. The very conspicuous black termite, *T. hospitalis*, which can often be seen marching in lines of extraordinary length, the workers bearing balls of nibbled bark or dead wood, the soldiers with their heads drawn out into sharp beaks, flanking the march, sometimes damages large trees by making their nests in the forks or between the roots, and indirectly producing decay of the tree. The nest which is quite exposed is easily cleared away and is not usually rebuilt.

In India, it is stated that *T. taprobanis*, Walk. an ally of *T. Malayanus* is very destructive, devouring stacks of corn, etc., and young unhealthy plants, and may be the white ant which destroys the sugar cane, burrowing into and destroying the sets as soon as planted eating "through the junction between the young plant and parent set so that the latter withers off. The remedy always applied is Castor-cake" which is applied powdered to the roots of the canes to the amount of between 1,500 lbs. and 2,000 lbs. per acre, chiefly as manure but it also keeps off white ants (Agricultural Ledger.)

I have found it sometimes very difficult to get rid of *T. Malayanus* especially where it has made its nest beneath a road, where it is very troublesome, forming cavities beneath which collapse suddenly when a horse passes over it. The nest may be dug out, and the queen destroyed by a fire made in the cavity and tar, etc., poured in, yet the nest is again and again reconstructed. Very often however they will go away if decaying animal matter, such as night-soil is poured into the ground where the nest is.

PARA RUBBER NOTES, II.

Mr. CURTIS, in the annual Report of the Penang Gardens for 1898, makes some remarks on his observations and experiments on the Para Rubber trees in the Penang Gardens, which are worth the attention of those interested in Rubber cultivation and as the annual Gardens reports seldom find their way into the hands of planters I reproduce the notes. He writes:—

"I have again tapped the best tree in the garden from which 1 lb. of rubber was taken during the rainy season of June, 1897. A sample of this was subsequently sent to Kew and submitted to Messrs. HECHT LEWIS and KHAN, for valuation, who reported it as "beautiful rubber, very well cured worth to-day (31.8.98 3-3 per lb." This had simply been dried in the sun and kept in the office for about a year. Being planted on dry gravelly soil this tree grows less rapidly here than those that are planted in moister and more suitable soil in Perak and elsewhere. At two-and- a-half feet from the ground it forks and the main stem measured at three feet from the ground in June, 1897, had a girth of thirty-six inches. Measured again in December, 1898, after an interval of 18 months, it had increased five inches in girth and the cuts had quite healed up. This tree is 13 years old. This time the tapping was commenced on the 16th November which is generally about the end of the heavy rains, but there is here no season which can be counted on as absolutely dry as in Burmah and India, and, in fact, rain fell frequently while the operation was carried on, which was spread over a period of thirty-four days. Oblique cuts leading to perpendicular channels were made in six places subsequently increased to seven, at the bases of which were fixed by means of a lump of clay and a nail small tins to receive the latex. An ordinary carpenter's

chisel was used for making and renewing the cuts. At the beginning the milk comes slowly and at no time continues running for long. With two exceptions the cuts were renewed between 7 and 8 A. M. and the tins brought in at 11 A. M. but the flow had ceased before that time. The two exceptions were when the operation was performed in the evening, but as there is always a danger of rain during the night and a very slight shower causes water to flow into the tins as nearly all the water trickling down the stem of the tree falls into the oblique cuts and is thence led directly into the tins the work is best done in this climate in the morning. Generally the latex had coagulated by the following morning, that is after standing about twenty hours but on two occasions only partially so. In these cases and also when rain water had got in the tins a pinch of powdered alum was added which caused perfect coagulation in a short time. If the addition of alum does not affect the value of the rubber it facilitates working operations in wet weather for a little water getting mixed with the latex does not matter provided the vessels do not overflow. All the rubber can be recovered by the addition of alum. On the morning the incisions were first made only $\frac{1}{4}$ oz. of wet rubber was obtained but by taking a thin shaving off the lower surface of the oblique cuts on fourteen subsequent occasions the following quantities were obtained at each operation, in ounces $\frac{3}{4}$, $1\frac{3}{4}$, $3\frac{1}{4}$, $3\frac{1}{2}$, $3\frac{1}{4}$, 6, 9 $6\frac{1}{2}$. $8\frac{1}{2}$, 6, $6\frac{1}{2}$, 10, $8\frac{1}{2}$, 8. Total 5 lbs. $1\frac{1}{2}$ ozs. of wet rubber which weighed when dry exactly 3lbs. As will be seen from this the last three tappings gave a better result than any previous three, the operations were only suspended as it was not advisable to make the cuts any wider. The time occupied in affixing the tins and renewing the cuts averaged half an hour on each occasion or $7\frac{1}{2}$ hours in all. It may therefore be taken that a man at say 30 cents a day could attend to at least fifteen trees a day, and that the cost of collecting it will not exceed 10 cents per lb.''

The alum, however, seemed to me to have an injurious effect on the rubber, making it soft and had better not be used.

Mr. Willis, in letters written to me, points out two errata in my quotations from his Bulletin, in the Gardens Bulletin No. 8, p. 230. The 45 trees at Heneratgoda were twenty-one, not eleven, years old, and the trees of 2 feet mean girth gave only 5.17 ounces not lbs. He also states that the popular idea that Para rubber cuttings die in a few years is a fallacy. He says ''Some of the best Para rubber trees here are from them and 12 to 15 years old. I fancy cuttings of *lateral* branches will not do so well. This is what one would have expected from evidence here, but certain persons have been constantly stating that in Ceylon trees from cuttings have always died in the fourth year. It is regrettable that would-be instructors in planting are not more careful in their facts. Undoubtedly Para rubber is not very easy to strike, but when well rooted the cuttings seem to be as good as any other plants. Recently it was noticed in the Botanic Gardens here that some sticks of Para Rubber about 4 feet tall and

an inch through which had been used as props to support other plants had thrown out shoots and begun to grow as readily as such cuttings of Angsana and Erythrinas do.

Abnormalities in *Para rubber trees*.—The capsule of the Hevea, like that of most Euphorbiacea contains three seeds and is three-lobed. One fine tree in the Botanic Gardens, however, produces a large proportion of four and even five-lobed fruits, containing four and five seeds respectively. A curious variation in the form of the leaf in young plants was seen at Pataling and elsewhere in Selangor. The lobes of the leaves instead of being oblanceolate were remarkably long, almost linear and narrow.

In big trees which have been cut or broken down it very often happens that the leaves produced on young shoots are of unusual size but generally of the ordinary shape.

Soils.

Recently Mr. Willis wrote to ask for samples of the soil in which the Para rubber trees were growing in the Botanic Gardens, with a view of having them analysed. He kindly sent me a copy of the analysis by Mr. Hughes. It is well known that in this soil the trees have grown remarkably well, and this analysis may help to determine the very best soil for this cultivation, so with his permission I append it. When compared with the ordinary clay soils of this part of the Peninsula it will be noted that there is a much larger percentage of organic matter containing nitrogen, and a corresponding diminution in silica and iron. The ground from which this sample was taken is low-lying and damp, water occurring about a foot below the surface. It was evidently originally swampy jungle, which being cleared was put under indigo till, in 1884, the land was taken over by Government, and the Rubber planted. It has never since it was under indigo been manured, but, a certain amount of manure, or salts derived from it may have been washed down from beds higher up on the hill. Earthworms are tolerably abundant where it is not too wet and termites are almost absent. With respect to the lime which is rather more abundant than in most of our soils, I note that the soil is so deficient, that the small spiral snails (*Stenogyra*), are reduced to nibbling the dead shells of a species of Helix in order to supply themselves with the necessary lime from their shells.

Analysis.

Composition in the air dried condition :—	
Water (lost @ 212° F.)	6.288
Organic matter and volatile combustible ..	27.541
Substance (containing nitrogen)—	
Oxides of Iron	3.198
Alumina	8.526
Lime	.272
Carried over ..	45,825

Brought forward	45.825
Magnesia	.028
Potash	.093
Soda	.147
Phosphoric acid	.181
Sulphuric acid	.034
Carbonic acid	traces.
Nitric acid	.001
Chlorine	.007
Silica soluble in alkali	12.049
Insoluble silicates and quartz containing coarse sand separated by washing	41.635
	100,000

(Signed) JOHN HUGHES, F. I. CH.,
Analytical Laboratory,
79, Mark Lane, London.

April 28th, 1899.

THE RESULTS OF the RESEARCHES OF MR. PARKIN and Mr. WILLIS, on the latex of Rubber-trees have now been published and will doubtless be read by every earnest planter. The paper contains a great deal of interesting information and many original observations and suggestions which are well worth considering. Great stress is laid on the preparation of rubber from the latex by centrifugalization and chemical processes. Separation of the rubber by centrifugalization was first experimented with by Mr. BIFFEN, in Mexico last year, and further experiments were carried out in Ceylon. Para rubber does not seem to work well with the machine, requiring a somewhat high rapidity to separate it, but the plan seems to be very successful with the latex of Castilloa and perhaps it might also be used with some of our more liquid native rubbers. It is stated that a company has been started in Mexico to produce commercial rubber by centrifugalization. "The advantage" say the authors "of this new process are obvious. The rubber can be obtained practically pure from the latex without the admixture of proteids, etc., hence no liability to decay. Since the Caoutchouc particles are obtained in a thick cream which can be spread out on a porous surface, it allows of the rubber being prepared quite dry in a short space of time."

Now in the Straits Para rubber sets solid almost directly after the latex is drawn off from the tree. To obviate this it is requisite to add a little ammonia and water to keep it liquid, it is then filtered twice, heated nearly to boiling point with some acetic acid and creosote, and then cold water is poured into it when the rubber collects in clots which are to be pressed out in thin sheets on a porous surface and dried off. It naturally occurs to one on reading this that though it is probable that a very superior article may be procured by this means the expense of pre-

paring it will be at least doubled, and that it may be doubted that the price of commercial rubber even of a better quality than has ever been turned out previously will rise in proportion. Undoubtedly the manufacturer should try to produce the best product he can make subject to the exigencies of expense but it must be remembered that ever since it has been used rubber prepared in the ordinary method without machinery or chemical processes has been used for every conceivable purpose, and that there will always be a demand for a comparatively cheap serviceable article. If the process as applied to Para rubber removed all the proteids from the latex it would easily be understood that it would make the rubber more durable but the authors explicitly state that it does not do so, the proteid remaining to a large extent in the rubber.

The proteid undoubtedly does putrefy and give off an evil odour during drying but this does not seem to affect the rubbers lasting qualities at all. Specimens have been kept here for years which although they originally had a foul smell and had even at times been mouldy on the surface, due to the wetness of our climate, yet at the end of the time are as good as the best home rubber in every way, that is to say as good as the manufacturer requires.

One suggestion to use creosote to prevent the growth of moulds in rubber, seems well worth trying. This would probably prevent the decay of the proteid, and any injury to the Caoutchouc which may be causd by this.

I have criticised the suggestions in this paper not to recommend the planter to turn out any cheap rubbish, but rather to prevent his being deterred from planting Para rubber by the idea that expensive machinery or an elaborate chemical process is necessary to turn out a good commercial product. Rubber is now at its highest price, and its uses increase every day, enormous quantities being used for a very large number of purposes. All this rubber is prepared in the ordiary manner without machinery or chemical process and is found quite suitable for these purposes.

Undoubtedly these processes may be most valuable for bringing into market, other very liquid rubbers which at present are valueless and it is certain that we shall be able to improve our Para rubber in many ways and turn out an article better than the rough jungle-gathered rubber which has been the chief material in the hand of the manufacturer, but the principle of preventing para rubber from setting naturally by adding ammonia and then resetting it by the addition of acetic acid does not seem to present any very clear advantages.

The paper also includes figures of a tin vessel proposed for collecting the latex in. It is a semi-cylindrical tin flattened on the side next the bark, above it is luted to the bark by some substance to prevent the latex escaping. There is no lid to prevent dirt or rain getting into the cap and the luting is inconvenient and clumsy. In fact the apparatus is by no means as good as the

cigarette tin suggested in Bulletin No. 7, which excludes every fragment of dirt and all rain even in a heavy storm, and by pushing a little mud between the side of the tin and the trunk so as to tilt up the bottom, or merely placing a leaf in the mouth of the cup, all the latex runs directly into the tin and none is lost.

KICKXIA AFRICANA.

A very important article on this little-known Rubber tree appears in "Planting Opinion" of April 8th, 1899, under the signature of "An occasional correspondent." The plant itself has been introduced into the Botanic Gardens in Singapore where it seems to grow steadily, though not with the surprising rapidity of an *Hevea*. *Kickxia* is by far the most important rubber plant of West Africa, though the rubber vines *Landolphia*, closely allied to our *Willughbeias*, and some species of *Ficus*, produce commercial rubber. It is a tree belonging to the order *Apocynaceæ*, and allied to *Mascarenhaisia*. The flowers are produced in the dry season, and at the same time the fruits developed from the previous years flowering are ripe, and splitting let free the plumed seeds, which drift away through the woods. As the correspondent observes the greater part of the seed is wasted by its not reaching the ground, and urges, reasonably enough, that the local Governments should encourage the gathering of the seed, and planting of it in suitable places. "The seeds, if carefully kept, preserve their vitality for a considerable time. It thrives best in a sandy clay with a sub-soil of clay, I have seen it flourishing in stiff clay but with feeders only partially buried. In quite a number of clearings in West Africa I have seen it growing luxuriantly as a sapling in loose friable sandy loam, although I must admit it had a tendency to be rather branchy, remediable, however, by judicious pruning. I should say the ideal soil for a plantation would be a loose sandy clay with more sand than clay and a sub-soil of clay. I know for a fact that the soil and climatic conditions are eminently favourable in the Straits Settlements."

The tree attains a height of 70 or even 80 feet, and in the forest it does not branch or bifurcate, but the author points out that in growing in the open it requires pruning, and if necessary can be stumped. He describes the method of tapping which does not differ from that in use for *Hevea*. But he points out that in the careless cutting by the aborigines, thousands of trees have died from exhaustion and deprivation of the chance of bark healing and recuperation by unreasonable tapping and unnecessary deep scorings through the bark into the wood of the tree rendering it an invitingly easy prey to a destructive grub with a predilection for the wood of the Kickxia and a prolific fecundity that is simply astounding. To preserve the tree against this damage he recommends an antiseptic plaster of one part of quick lime, two parts of wood ashes and five parts of clay.

Though at present we have seen no such damage to tapped Para-rubber trees, planters will remember that there is the risk

of attacks on the exposed wood of the cuts both by wood boring beetles and fungi. In tropical countries where wood-destroying insects and fungi are so abundant and develop so rapidly, there is always a risk to a tree when the wood is exposed, and one of the main uses of the rubbers, dammers, wood-oils and other such excretions is to prevent the intrusion of such enemies into accidental wounds, by sealing them up as soon as the wound is made. It would be easy however, when necessary to make and apply some such disinfectant as above suggested to protect the exposed wood till the bark has grown over the cut again.

"Kickxia when treated judiciously yields between $\frac{3}{4}$ and a pound of rubber for every year of its age, that is a tree 12 years old could be safely depended on to yield nine pounds of rubber. A pound of Kickxia rubber should realise at least 2*s*. 9*d*." This is a larger return than we expect from Hevea, although the rapidity of growth of the latter appears to be much greater than that of Kickxia. We have at present no details as to the rapidity of growth of the African plant, which I should judge from the behaviour of the few plants in the Botanic Gardens, is not what could be called a very slow grower.

Since writing the above further investigations into the various species of Kickxia has been published by P. PREUSS in the Notizblatt des Kgl. Bot. Gartens No. 19, July 1899; where it is shown that it is not *Kickxia Africana* but a new species *K. elastica* which supplies the Kickxia rubber. This plant has not yet been introduced.

INJURIOUS FUNGI.

A very troublesome fungus occurs on the leaves of clove trees which appears to have been overlooked. There appear on the leaves at first dark red spots on the under side which eventually attain a diameter of $\frac{1}{8}$ to $\frac{1}{4}$ inch, and can be seen on the upper surface as a dark blotch. Later the fructification appears on the under surface, it is white and remembles mildew at first sight. The leaves perish and fall, and as large numbers are affected the tree soon has a miserable half leafless appearance. At the same time the shoots become black and die, other shoots are produced but they too wither up, and eventually the tree becomes quite leafless and dies.

Some trees attacked by this fungus were treated with Bordeaux mixture, *viz*., Copper sulphate and lime in water. This was sprinkled on the trees by means of an ordinary garden syringe which however did not prove a very satisfactory instrument as it was difficult to spray satisfactorily the under sides of the leaves where the fungus was fruiting. The mixture did not injure the leaves in any way, and now, some months after, the trees appear more free from the fungus.

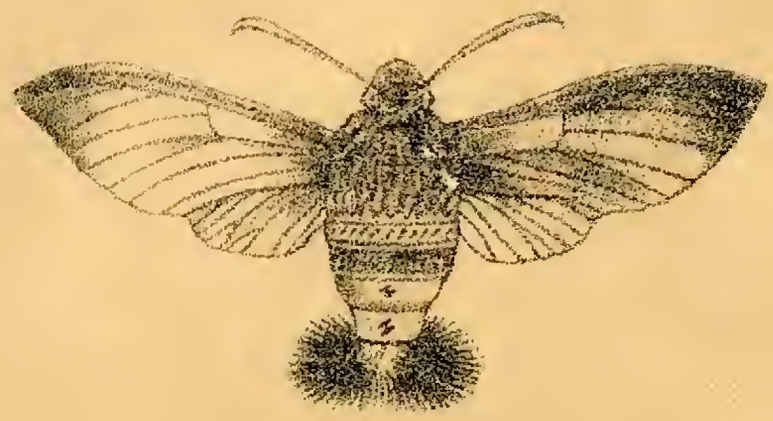
Rosellinia radiciperda, MASSEE.—This is a most destructive fungus which I recently found in a portion of the shrubbery in the Botanic Gardens. It was observed that all the plants of whatever kind growing beneath a large fig-tree, *Ficus dubia*,

were dying suddenly with just such an appearance as if some poisonous liquid had been thrown upon them. It was at first suspected that some weed-killer had accidently been thrown there, but the patch of dying plants increased to an area of about ten yards and the roots and base of the stem of the fig-tree became black, and some months after the attack commenced the fructification of the fungus was found on the roots of the fig-tree, now quite rotten, and on other shrubs and trees in the affected area. Hardly did one plant of any kind escape attack, trees, shrubs, ferns, rattans and other palms, dracaenas and aroids went down before this pest. The succulent Dieffenbachias alone seemed to defy it and even one of those was affected. The fungus attacked the roots first, and soon appeared as a black sooty substance on the stem at the base just above and below the ground, the leaves dropped, turned of a pale greenish colour, and the plant was dead. The fructification appears as round globose black pustules about as big as snipe-shot covered with warts and densely crowded together. To extirpate the pest the ground was first cleared of all dead or dying plants, rotten wood, sticks, etc., all the affected roots of the fig-tree were cut off, and all the infected material burnt, the ground was then dug over and lime liberally strewed about and dug in. Bordeaux mixture (Copper sulphate and lime in water) was liberally poured over the base of the fig-tree, and over the ground. The disease seemed to be checked at once, it spread no further, and some small trees which had been attacked but not killed recovered. The fig-tree put out new roots and seems none the worse.

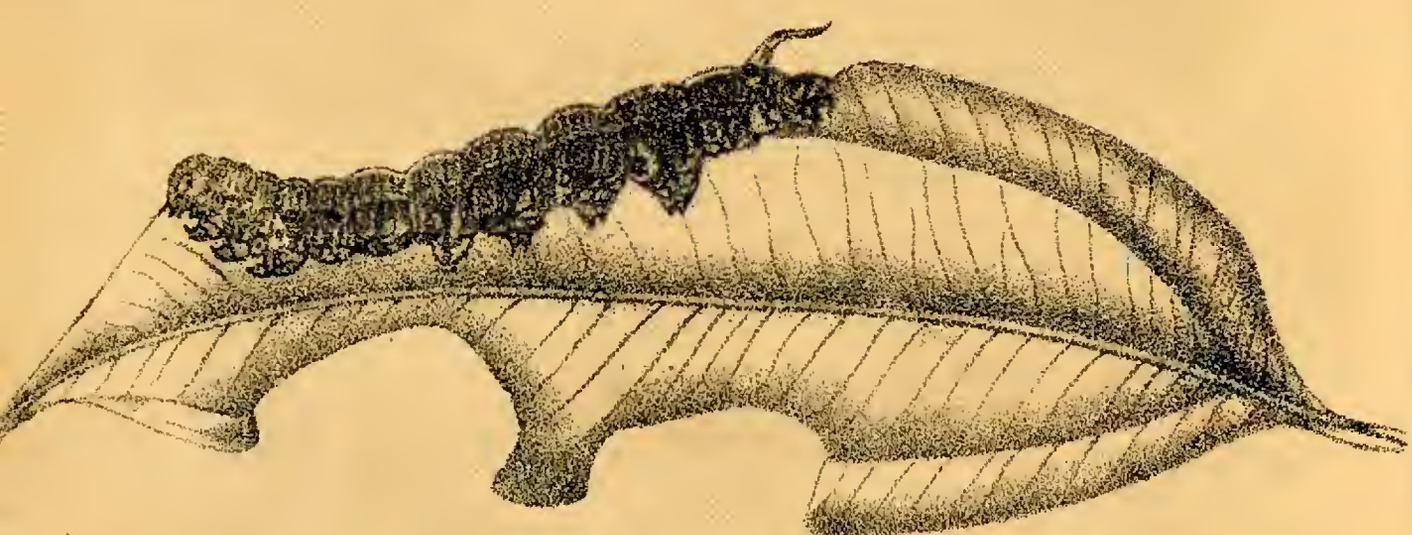
White Nutmegs.—In two valuable papers on the Nutmeg (De Noot Muskaat Cultur in de Minahassa, and De la Dehiscence du fruit du Muscadier, published at Buitenzorg) Mr. J. M. JANSE treats of the so-called white nutmeg disease, which he attributes to the attacks of a fungus forming the brown spots on the husk referred to in Bulletin No. 6, p. 105, and not to imperfect fertilization as I suggested. This fungus belongs to the *Melanconieæ Phragmosporæ* and he explains its action in this manner. The fungus causes the premature dehiscence of the fruit because it uses itself a part of the nutritive matters which ought to serve for the nourishment of the pericarp. The alimentation being defective, the valves cannot grow as fast as usual. The tension between the seed and husk increases more rapidly in the diseased fruit than in the sound one, and causes the splitting of the husk prematurely. This being so, planters will find it necessary to pay some attention to the spotting of the husk, and to destroy infected fruits as speedily as possible.

Termes Gestroi.

NOTE.—Since writing the paragraph on this destructive Termite, I have had a large tree six inches through attacked by this pest. The tree was a marking-nut, *Semecarpus Anacardium*. It was treated by syringing with Jeyes' fluid, without removing the crust of earth with which the termites had encrusted the



A



B

C

E

F

G

×2

D

×2

bark. This was done twice at intervals of about a fortnight, and the termites quite disappeared after the second syringing, and the tree has recovered and flowered well afterwards. This plan might also be tried in the case of rubber trees attacked, but it will be remembered that Jeye's fluid has a strong effect on leaves and tender plants, and care must be taken in its use.

Plate II.

A. Coffee Hawk moth (*Cephonodes Hylas*) natural size.
B. Caterpillar of the same.
C. Bug found destroying the caterpillars.
D. Banana Weevil, *Sphenophorus sordidus*, enlarged twice.
E. Larva, enlarged twice.
F. Pupa, ,,
G. Red Banana Weevil, *Sphenophorus planipennis*, enlarged twice.