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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE

EDITED BY

WILLIAM FAWCETT B.Sc., F.L.S.

Director of Public Gardens and Plantations.

Vol. IV.

LIBRARY
NEW YORK
BOTANICAL
GARDEN.

HOPE GARDENS, JAMAICA :

1906.

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JANUARY, 1906.

Part 1

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :

HOPE GARDENS.

1906.

JAMAICA.

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Part 1.

**HISTORICAL NOTES ON ECONOMIC PLANTS IN
JAMAICA.**

VI.—Tea (continued.)

An article on tea appeared in the Bulletin for June and July, 1903.

In order to bring the subject up to date the following paragraphs by Hon. H. E. Cox are reprinted from *Jamaica in 1905*.

“There are at present only two tea plantations in the western hemisphere; one at Summerville, South Carolina, U.S.A., and the other at Ramble in St. Ann, Jamaica.

“Varieties of the tea plant were introduced into Jamaica in 1868, and were planted in the public gardens on the Blue Mountains, some 4,900 feet above sea-level, where they grew well. Some twenty years later a plantation of about 13 acres was formed in the neighbourhood of the gardens at Cinchona, but the cultivation was discontinued, and although the bushes are still growing well, it has not yet been resumed. In 1896 the plantation at Ramble in St. Ann was commenced. Its progress at first was very slow, every step having to be tested by experiment. The soil being different to that at Cinchona, the rainfall less than at that place, and the elevation only 1,600 feet above sea-level, it was necessary to commence by trying whether the plant would grow under the altered conditions sufficiently well to make it worth while to incur the great initial expense of forming a plantation. This test was made with 250 plants and a packet of seed from the Cinchona gardens. The result being favourable, the cultivation was extended as plants or seed could be procured; but the quantity not being large, for several years only a small acreage could be planted. Of course, seed could have been imported, but it was decided not to do so for two reasons; firstly, that the tea grown might be homogeneous in character, and secondly, for fear of

importing certain enemies of the plant with the seed. Latterly the cultivation has expanded more rapidly, seed being obtained from the plants first put in; there are now from 80 to 90 acres with plants of various ages.

“After demonstrating that the plant would grow in St. Ann, it was necessary to experiment in manufacturing the tea from the leaf to judge whether its quality would justify a heavy expenditure on machinery for curing it. This test having been passed, machinery was procured and tea prepared for market, the first occasion being at the Thickets Show, in August, 1903. Since that time additional and improved machinery has been set up, and with the experience gained by practice in the manufacture, a good class of tea is being turned out.

“Tea is essentially a factory crop; it requires a large initial outlay for buildings and machinery; and there must be a considerable expenditure for keeping the ground clean while the plants are growing, about five years. In Jamaica this item constitutes a serious handicap on the planter, as compared with India, where the rate of wages is very much lower. For these reasons, tea cultivation requires a much longer period of waiting, before it can be remunerative, than some other cultivations, such as the banana; but on the other hand, it is not subject to any great risk from hurricanes, and it is a crop with many advantages for the settler who lives within reach of a factory. He can grow the plant in his provision ground without stopping his other cultivation, and when the plants are large enough he will have at the factory at all times a market for his leaf.”

The Gleaner Newspaper published an interview with Sir D. Morris, Commissioner for the Imperial Department of Agriculture, in the course of which reference was made to Mr. Cox's tea plantation, as follows:—

“Amongst the newer industries, I am glad to find that the Hon. H. E. Cox has extended his tea cultivation at Ramble, St. Ann, to 90 acres. This area is beautifully kept and the trees are in excellent health. The quality of the tea has greatly improved since my last visit to Jamaica, and when the new machinery which Mr. Cox has imported is in full working order, the tea of the coming season should all be of first-class quality. The tea is entirely made by machinery, and does not come in contact with the hands of the working people during the process of manufacture. This is the only tea cultivation in the West Indies and the prospects for the industry are very favourable.”

YAMS.

By W. HARRIS, F.L.S., Superintendent of Hope Gardens.

As far as I am able to gather the cultivated yams of Jamaica may all be referred to four species of *Dioscorea*, viz. :—

D. sativa, Linn., *D. alata*, Linn., *D. cayennensis*, Lam., and *D. trifida*, Linn., all climbing plants belonging to the order *Dioscoreacea*, and cultivated in the tropics.

It is exceedingly difficult to get good botanical specimens of these cultivated plants, but from enquiries made amongst cultivators, and by carefully comparing the information thus gained with the published descriptions of cultivated species of *Dioscorea*, I have arrived at the determinations here given. If ever the numerous recognised varieties are critically examined, it is possible that some of those now included *D. sativa*, and *D. alata* will be referred to other species.

DIOSCOREA SATIVA, Linn. "*Negro Yam.*"

Stem cylindrical, not winged, more or less prickly; leaves heart-shaped, roundish, gradually tapering into a sharp point.

Tuber large, of a dark colour externally, but the end white and bitter when boiled if not perfectly ripe. This yam is of a dirty white colour when cooked, and is soft, but is considered a good yam.

The Negro Yam is always cut before it is quite ripe, otherwise a very small "head" for planting would be obtained. It is a hardy yam and is the best kind for cold districts in the hills.

Varieties.—"*Man Yam.*" A larger yam and better flavoured than the "Negro." Tuber oblong, of nearly the same diameter throughout its length. This is allowed to ripen before being cut.

"*Lucea Yam.*" This is a longer yam than either the "Negro" or the "Man." In flavour it is considered superior to the "Negro" but inferior to the "Man." Tuber about the same thickness throughout its length. This yam is largely cultivated in the western parishes (Hanover, &c.), and is shipped in considerable quantities from the port of Lucea (hence its name) to Kingston, also to Cuba. It is a first-rate yam.

"*Mozella,*" or "*Bitter Yam.*" Very like the "Lucea," but of a purplish colour underneath the skin, and with a bitter taste when cooked, even when carefully cured.

The stems of this variety climb to a great height, reaching the top of the highest tree if they happen to get hold of the branches.

DIOSCOREA ALATA, Linn. "*White Yam.*"

India. Stems sharply angled, winged; leaves heart-shaped, roundish, or pointed, variable in size and shape, often very large. Tuber very large as a rule, white.

Varieties :—"*Guinea Yam.*" One of the largest white yams. Skin smooth; tuber soft when cooked, flavour good. Like the "Mozella Yam," the stems climb to a great height.

“*Moonshine Yam.*” Skin of a purple colour. A good white yam.

“*Snake Yam.*” Tubers club-shaped; growing to a length of 3 or 4 feet, and 8 or 9 inches in circumference. Not grown to any extent, being of poor quality.

“*Silver Yam.*” A dry, floury yam, one of the best of the white yams.

“*Bull-head Hard Yam.*” A rough coated, hairy yam, the shape of the tubers supposed to have some resemblance to a bull’s head. It is a hard yam when cooked, but of good flavour.

“*Two-sister’s Hard Yam.*” Somewhat similar to the “Bull-head.” Called “Two-sisters” because each “head” produces two tubers.

“*Bear-and-drop Hard-head.*” Produces a large number of small tubers which are joined together in a mass by fibrous roots. When handled, however, they drop asunder. The tubers are very watery when cooked, and this is altogether a useless sort, and not cultivated.

“*Bragging Tom Yam.*” Said to be the largest white yam grown. Tubers measuring 3 to 4 feet in length, and 18 inches in diameter, have been grown. It is very scarce, but was formerly cultivated with much care. Large pits were dug, filled with rotten manure, and covered with soil and the “heads” planted. In addition to being a very large yam, it is considered one of the best when carefully cultivated.

“*Pucka Yam.*” A large, round sort, and so soft that in cooking it must be steamed, not boiled. A good yam.

“*Bullet-tree Pucka Yam.*” A large, round yam like the “Pucka,” but the surface of the tuber is curiously pitted, the indentations being of a considerable size.

“*Flour Yam.*” A soft floury yam. One of the best.

“*Barbados Yam.*” A large yam, but clammy when cooked, and not considered a first-class kind. In some districts, however, it is of fair quality and is much liked.

DISCOREA CAYENNENSIS, Lam. “*Yellow Yam.*” “*Afou Yam.*”

Stems cylindrical, sparsely prickly below; leaves heart-shaped, roundish, pointed, 7 nerved, about $3\frac{1}{2}$ inches long by 3 inches broad, quite glabrous, papery in texture; flower spikes usually in pairs, produced from the axils of the leaf stalks. Tuber large, often branched, of a sulphur-yellow colour. If the tubers are allowed to become exposed during growth they are very bitter when cooked. Those grown in good open soils are fairly dry and mealy, but tubers grown in heavy, damp soils are clammy in texture when boiled, and anything but palatable. At best it is a heavy, coarse yam, but is grown extensively and is a general favourite amongst the working classes. It thrives best in hot districts, but it is a hardy yam and is not so readily affected by unfavourable climatic conditions as the more delicate white yams. It can be had at almost any time of the year, as tubers are cut

from the growing plants often twice, the hills are moulded up again and fresh tubers are produced. There do not appear to be any named varieties of this plant.

DIOSCOREA TRIFIDA Linn. "*Indian Yam.*" "*Yampce*" "*Cush-Cush.*" Stem angular, slightly winged; leaves 3-lobed; tuber cylindrical, about 6 inches long. Each plant produces several tubers.

This is quite the nicest of all yams for table. The tubers boiled or roasted, and eaten with good butter, are delicious. They have a "nutty" flavour not noticeable in other yams.

DIOSCOREA BULBIFERA, Linn. "*Acom Yam.*" "*Bulb-bearing Yam.*" East Indies. Naturalised in West Indies.

Stem sub-cylindrical; leaves heart-shaped, ovate, pointed; tuber somewhat globose.

This plant produces numbers of rather large bulbils on its stems; these are of a light brown colour, about 3 inches long, oval roundish, or flat on one side. They may be planted to propagate the plant. The tubers are rarely eaten, but a good starch is obtained from them.

CULTIVATION.

There is no crop so generally grown in the West Indies as that of yam of one kind or another. In Jamaica, yams may be seen from near the coast up to 4,000 feet altitude, and they seem to thrive everywhere.

Tubers grown in good open soils are naturally superior to those grown in damp, heavy clayey soils, but certain varieties are suited to the soils of certain districts, and as this is a crop on which the small cultivator largely depends for his food supply, he grows only those varieties that he knows from his own experience, and that of his neighbours, will produce good crops in the land that he cultivates.

The main crop of yams is planted from January to end of March, but planting is continued to July.

The "Negro" and "Indian" yams are planted first, and they take from five to seven months to produce edible tubers; the "Afou" or "yellow yam" is planted next, and it takes about seven months; the "White Yams" are planted last, and they take ten to twelve months to arrive at maturity. The length of time varies according to altitude and climate. In the mountains, from the time of planting to the time of lifting the ripe "heads" occupies twelve months.

The first tubers of "Negro Yam" and its varieties, and the "Afou" are cut during the growth of the plants, but the "White Yams" are allowed to finish their growth and ripen before being cut. When the tubers are all cut, the base of the vine, with the fibrous roots is carefully moulded up, and left undisturbed for a period of five or six months, or longer, during which time the "head" is formed. When the stems and leaves turn yellow and

begin to decay, the "head" is ripe. The *heads*, as a rule, are lifted, and kept perfectly dry till required for planting. Shoots are produced by these in the same way as produced by potatoes that are kept for seed. Generally, the *heads* are planted whole, but occasionally a *head* is composed of two or three small tubers, and these are separated and planted, two of these small *heads* being placed in a hill instead of one strong one.

Preparing the hills. The cultivator with his hoe digs the ground on an area of about four feet by three; he thoroughly pulverizes this and picks out all stones, roots, &c., and draws the soil into a mound. The hills are usually 6 feet apart, and when all are prepared, he proceeds to plant his "heads." With his hand he makes an opening in the centre of the hill or mound of earth, and carefully plants his "seed," generally one strong head to each hill. As soon as planting is finished, he puts a stout bamboo pole or stake firmly in the ground, one to each plant, as a support for the vines to twine on, and he slants these in one direction up the hill (yams are generally grown on the hill-sides in Jamaica). He carefully watches his plants, moulding the hills, and training the young vines in the way that they should grow.

When the tubers are fit for cutting they are used principally by the grower and his family, but any surplus stock is disposed of. His wife takes them to the nearest local market and either sells them, or barter them for plantains, "new sugar," or any other product not grown or prepared in her own district, or she carries them to Kingston market, and with the proceeds purchases such necessaries as she may require.

Catch crops are always grown between yam hills; these may be corn, peas, ochro, pumpkins, melons, cucumbers, or other quick growing crops.

A curious fact in connection with the twining habit of yams may be noted here. As far as I am aware, the stems of all the cultivated species, with one exception, twine to the right, that is from the west, by the south to the east. The exception is the Indian yam, or Cush-Cush, it twines to the left, that is from the west, by the north to the east.

NOTES ON IMPORTED AND NATIVE CORN.

By H. H. COUSINS, M.A., Agricultural Chemist.

Analyses of seven samples of imported American corn as sold in Jamaica have been made to ascertain the average composition of the imported article in comparison with well-cured native corn.

The average of the seven samples, which show little variation, indicates a content of 9.4 per cent. of albuminoids as against 12.4 in a fair sample of country corn based upon a content of 12 % moisture.

These figures clearly bring out the fact that our tropical corn is richer in flesh-producing material than the imported corn grown in the United States and is therefore superior as a food for horses.

These analyses are the work of Mr. E. J. Wortley, Assistant Chemist, and are a continuation of the analyses already published in this Bulletin, Vol. III. Oct., 1905, p. 214.

CORNS.

No.	Variety.	Where bought.	Details.						
			Moisture.	Ash.	Total Nitrogen.	Albuminoids N x 6.25.	Fat o/o.	Fibre o/o.	Albuminoids on basis 12 o/o moisture.
1.	Imported Corn	A McDougall	14.27	1.13	1.44	8.97	3.10	1.94	9.2
2.	"	Saml. James	14.37	1.19	1.47	9.18	3.21	1.79	9.4
3.	"	H. A. Lindo	14.25	1.20	1.44	8.97	3.51	1.80	9.2
4.	"	"	13.98	1.17	1.44	8.97	3.55	1.71	9.1
5.	"	Jas. Dunn	14.22	1.30	1.44	8.97	3.46	1.93	9.2
6.	"	Chas. Lennan	13.83	1.31	1.51	9.40	3.55	1.91	9.6
7.	"	Unknown	13.88	1.29	1.58	9.83	3.61	1.02	10.4
—	Average	Imported corn	14.11	1.23	1.47	9.18	3.43	1.87	9.4
8.	Country Corn	J. J. Hamilton	14.47	1.12	1.93	12.02	3.14	1.47	12.4

GINEP AS A STOCK FOOD.

By H. H. COUSINS, M.A., Agricultural Chemist.

My attention was called to the practical value of the fruit of ginep (*Melicocca bijuga*) for feeding sheep by Mr. Facey of Montego Bay—

Analyses have been made in the Laboratory with the following results :—

GINEP.

Skin 22·7

Seed 31·7

Pulp 45·6

	Ripe Fruit.					Dried at 100° C.					
	Moisture.	Ash.	Total Nitrogen. Albuminoids N x 6·25.	Fat o/o.	Fibre o/o.	Moisture.	Ash.	Total Nitrogen. Albuminoids N x 6·25.	Fat o/o.	Fibre o/o.	
Seed	54·71	1·22	84·5	22	53·5	0·09	2·69	1·85	11·56	1·17	11·21
Seed, skin & pulp	80·52	·53	32·1	·97	·25	2·1	2·67	1·64	10·11	1·28	10·77

The seed is fairly rich in albuminoids and may fairly be regarded as a concentrated food-stuff that should be valuable as an addition to grass and green fodder.

THE PALMYRA PALM.

Sir J. E. Tennant in his work on "Ceylon," speaks as follows of the Palmyra Palm (*Borassus flabelliformis*).

"The palmyra is an invaluable palm, and one of the most beautiful of the family. It grows in such profusion over the north of Ceylon, and especially in the peninsula of Jaffna, as to form extensive forests, whence its timber is exported for rafters to all parts of the island, as well as to the opposite coast of India, where, though the palmyra grows luxuriantly, its wood, from local causes, is too soft and perishable to be used for any purpose requiring strength and durability, qualities which, in the palmyra of Ceylon, are pre-eminent. To the inhabitants of the northern provinces this invaluable tree is of the same importance as the coco-nut palm is to the natives of the south. Its fruits yields them food and oil; its juice "palm wine" and sugar; its stem is the chief material of their builings; and its leaves, besides serving as roofs to their dwellings and fences to their farms, supply them with matting and baskets, with head-dresses and fans, and serve as a substitute for paper for their deeds and writings, and for the sacred books, which contain the traditions of their faith. It has been said with truth that a native of Jaffna, if he be contented

with ordinary doors and mud walls, may build an entire house (as he wants neither nails nor iron work), with walls, roof, and covering from the Palmyra palm. From this same tree he may draw his wine, make his oil, kindle his fire, carry his water, store his food, cook his repast, and sweeten it, if he pleases; in fact, he does so live from day to day dependent on his palmyra alone. Multitudes so live, and it may be safely asserted that this tree alone furnishes one-fourth the means of sustenance for the population of the northern provinces."

THE RUST MITE OF THE ORANGE.

The mite* which causes the rust of the orange, lives on all citrus plants. It is very small, only $\frac{1}{2000}$ of an inch in length. The eggs hatch in four or five days, and within seven to ten days the young mites undergo a moult. The period of moulting, or casting the skin, lasts two days, and eggs are probably laid in a few days after the moult.

The mites feed on the essential oil of the leaves and fruit, and move from one part of the plant to another as the conditions favour them.

EFFECTS OF ATTACK.

On the *leaves* each puncture of the mites causes a minute pimple, and if the mites are abundant, the leaf surface loses its gloss, and has a tarnished dusty appearance. The leaves do not drop off, but there is a loss of vitality, and the growth of the plant is to some extent checked.

If the *fruit* is severely attacked, it does not attain its full size. The skin shrinks and toughens, preserving the fruit from injury and decay, so that it carries better, keeps longer, and is superior in flavour to bright fruit.

REMEDIES.

In applying remedies, the life history must be remembered; and that while it is comparatively easy to kill the adult mites, it is very difficult to kill the eggs and the young mites while they are protected by the old skin during the moulting stage. Either the remedy must be sufficient to kill eggs and young as well as adults, or it must be repeated at intervals.

Whale Oil Soap.—Whale oil soap solution, made by dissolving one pound of the soap in ten gallons of water, is effectual in killing all the adults, and a large percentage of moulting mites and eggs. Applications should be made by a spray pump, and be repeated several times at intervals of a few days.

One pound to five gallons of water in still more effectual but while not injuring the leaves, may cause the blossoms to fall off if applied when the plant is in flower.

Sulphur.—Finely powdered flower of sulphur kills both adult and young mites, but does not affect the eggs. It may be dusted on the plant, or applied in water by spraying,—putting two or three ounces of sulphur to one gallon of water. If scale-insects

* H. G. Hubbard in Ann. Rep. U. S. Dept. of Agri. 1884, page 361.

are troublesome, the sulphur in the same proportions can be used with kerosene emulsion, so that both the mites and the scale-insects are attacked by each application.

REMEDY FOR CATERPILLARS ON COTTON, CASSAVA, &c.

Paris Green has been recommended in the Bulletin* as a dry application for the Cotton Worm, and it is believed that under all ordinary conditions the method recommended is the simplest, cheapest and most effective.

But where six or seven hundred acres of cotton are planted out in fields of from 100 to 300 acres as a new cultivation with large numbers of wild cotton plants growing all through the neighbourhood the opportunity for the cotton worm to increase and multiply is at once made use of, and when rain falls every afternoon, washing off the Paris Green, the resultant plague of cotton worms causes very extensive destruction, and a new remedy has to be found to deal with any such emergency.

It is believed that such remedy is arsenate of lead applied by means of a knapsack spray pump. It does not wash off easily, and does not injure young foliage as excess of Paris Green does.

It is useful for the destruction of any caterpillar or worm that injures by eating, e.g. the cassava caterpillar, and should be kept ready in stock for any emergency that may arise.

Prof. Fernald of Massachusetts Agricultural College recommends† the following recipe:—

Arsenate of Lead.

4 oz. arsenate of soda (50 % strength).

11 oz. acetate of lead.

150 gallons water.

“Put the arsenate of soda in 2 quarts of water in a wooden pail, and the acetate of lead in four quarts of water in another wooden pail. When both are dissolved, mix with the rest of the water. Warm water in the pails will hasten the process.”

The proportion of water may vary, the U.S. Dept. of Agriculture (Bull. 41, Div. Entom.) recommends less than half the water.

If fungus also attacks the leaf, as it did cotton in Vere lately, mix with Bordeaux mixture‡ as follows:—

“Prepare the arsenate of lead as above, but instead of adding the arsenate of soda and acetate of lead, when dissolved, to the water, mix the two together well, then add one-third of this to 50 gallons of Bordeaux mixture”.

Arsenate of lead is put on the market in a very convenient form under the name of Bowker's Disparene & Swift's Arsenate of Lead. The latter can be purchased in Kingston.

* Bulletin of the Department of Agriculture, Jamaica, II. July 1904, page 159; III. Sept. 1905, page 203.

† Bulletin No. 96. Hatch Experiment Station of the Massachusetts Agricultural College, May 1904.

‡ Bulletin of the Department of Agriculture, Jamaica, III. March 1905, page 51.

COCOA DISEASES. II.

In the December Bulletin (page 270) an account was given of a disease of Cocoa pods in which the darkening of the pod is accompanied by white mould on the outside.

Mr. Hart in a paper on "Some Fungi of the Cacao Tree*" states that in Trinidad "the disease was observed to be most prevalent in places where the atmosphere was humid and where the pods had been allowed to rot beneath the trees."

Mr. Albert Howard, formerly the expert in fungoid diseases to the Imperial Department of Agriculture, recommends,† besides the remedies mentioned last month, "Reduction of shade. Where cacao is grown under shade as in Trinidad, and where this disease is prevalent, it would be advisable to diminish the number of shade trees and to prune the cacao trees as much as possible, so as to considerably reduce the humidity of the atmosphere. In this way conditions could be adjusted so as to be unfavourable to the development and spread of the fungus while not interfering with the growth of the cacao tree."

Another disease has been noticed as occurring in Jamaica, that known as the "brown rot" disease of the pod.‡ This was determined here, and confirmed by reference to the Commissioner of the Imperial Department of Agriculture. It is described in the paper by Mr. Howard as follows—

"When cacao pods are attacked by this disease, a circular brown patch makes its appearance which gradually extends all over the pod and causes complete destruction of the rind and its contents. The time taken in the destruction of a pod varies somewhat according to its ripeness, but usually falls between six and ten days from the appearance of a diseased spot visible to the naked eye. This appearance must not be confused with the rusty or "mahogany" pods which result from "thrips" when the whole of the outside of the pods takes on a rusty colour but when the rind is not diseased.** The definite brown patches in question generally commence either at the insertion of the stalk or at the free end of the pod, but they may occur at other points, especially where the rind has been injured or where the pod comes in contact with a branch. These diseased pods are particularly numerous near the "breaking-grounds" where the beans are extracted by the pickers. If one of these attacked pods is carefully examined it will be found that the brown area is rotten and that the decay extends to and spreads round the shell of the pod to a much greater distance than would be supposed from a surface examination. The disease soon spreads to the "beans" which are speedily attacked and destroyed by a greyish fungus mycelium which grows

* W. Indian Bulletin Vol. I, pp. 422-7 with plate,

† W. Indian Bulletin Vol. II, p. 198.

‡ *Diplodia cacaoicola*.

** The rusty colour of the pods attacked by "thrips" is caused by the formation of a cork layer, below the epidermis, which cuts off all the cells above it. These cut off cells consequently dry up and turn brown. The cork layer is really a new epidermis layer formed on account of the numerous perforations made in the original epidermal cells by the "thrips."

with enormous rapidity in the mucilage surrounding the seeds, and eventually dries up the whole contents of the fruit, and gives to it a curious sour smell.

“When the diseased patch on the rind is about the size of a penny piece, small circular mounds, about the size of a pin’s head, can be seen about the centre of the brown area on the rind from which a greyish white powdery dust is expelled which turns black in a short time. This dust is composed of elliptical dark brown one-septate spores. The small mounds into which the surface of the pod is raised are found to be due to the fructifications of a fungus in which the above spores are formed which rupture the epidermis and liberate the spores through a small circular opening.

Remedial Measures.

“It is obvious when we consider the character of this disease that no steps can be taken, with any hope of success, to arrest the spread of the fungus when once it has gained access to a pod—in other words, there is no ‘cure’ for the disease. Preventive measures alone are possible, and these must be directed towards the destruction of everything in the plantations which harbours the fungus with a view of preventing further infection by means of spores. The following treatment is suggested for dealing with the disease.

“1. As a general rule care should be taken not to allow the pods to get too ripe, as the fungus seems most liable to attack pods in this condition. Again, ripe pods, showing small brown discoloured areas, should be picked at once so as to save the beans if possible.

“2. All husks or shells left after the beans have been extracted, should be buried as soon as possible under the trees, and, if the buried heaps are large, lime should be added to hasten decay and prevent local souring of the soil. There are two obvious reasons why this expense in burying pods should be incurred. First, there is the advantage to the soil in supplying humus, and secondly, the fungus is deprived of a substratum on which it thrives and produces countless millions of spores which may infect living pods. The “breaking-grounds” should be moved from time to time so as to give as many trees as possible the benefit of this manuring. Recently, while making a tour through the island of Grenada, I was very forcibly impressed by the general absence of this disease in plantations where the pods were systematically buried, and also by its presence on estates and small holdings where this practice had not yet been adopted. Indications are not wanting, however, that cacao planters are realising the importance of this step, both from the point of view of the enrichment of the soil and the prevention of disease.

“3. All badly diseased pods on the trees where the fungus has reached the beans, and all old husks on the ground which have turned black and become covered with the sooty spores of the fungus, should either be buried away from the cacao trees or else burnt.

“4. All dead cacao trees, old prunings and branches should be periodically collected and burnt, and the ashes which are rich in potash, spread under the trees. This proceeding is necessary because the fungus lives on dead cacao wood and will thus be able to infect healthy pods.”

VALUE OF MULCHING, II.

The value of mulching has been recognised in Jamaica for some years, and in the December Bulletin an account was given of exact experiments that had been carried out in Dominica under the general superintendence of Hon. Dr. F. Watts, showing that mulching cocoa with leaves and grass during a period of three years gave a greater increase in crop than various manures.

The report of the Annual General Meeting of the United Planters' Association of Southern India held last August, has just been received, and it is instructive to note that the coffee planters there appear to think they may have been using too much artificial manure during the past 20 years, and that they are just beginning to recognise the value of mulching.

The following are extracts from the very interesting report of the meeting :—

MR. A. F. MARTIN :—Dr. Lehmann has told us that the general practice in several countries is that the amount of manure to be put on a field is calculated by first of all determining how much of the soil constituents the crop has removed from the ground ; but in coffee we have not only to consider what amount has been removed by the crop, but we have to consider the general health of the tree. I would like to know if it would not be necessary to give other manures and a greater quantity than has actually been removed by the crop ?

DR. LEHMANN :—In other countries, as a general principle, the manure is added in proportion to the soil constituents removed by the crop. It is absolutely impossible, however, to keep a book account of that kind. But as a general principle, it has been recommended by certain German chemists, and the results they have obtained are certainly satisfactory. In regard to the coffee tree, there is absolutely nothing to show that the coffee tree will differ from other crops. The coffee tree will yield in proportion to its vigour. It cannot yield a crop if it is not in a vigorous condition ; unless it is injured to such an extent as to put forth a special effort to reproduce its species before it dies, as, for example, in a badly bored tree. But these are abnormal conditions. Under normal conditions, a coffee tree will produce an amount of crop to a certain extent proportionate to the vigour and health of the tree. Perhaps you may have a number of examples which appear to contradict this, for the principle is only generally applicable. If we return to the soil the same amount of plant

food we have removed from it, the amount of plant food will remain stationary. Mr. Hughes in his attempt to arrive at a similar basis for Ceylon has taken into account the leaves that drop off and the pulp and everything else. All these are returned to the soil. Therefore they do not require to enter into the calculation. But I do not recommend a reduction in manures. I only recommend, and that most emphatically, the necessity for experimenting with manures. I do not wish to lay before you any facts and figures for reducing your bill in manuring. I only wish to enlist your sympathies in the matter of experimenting, and in order to do so I have pointed out that there may be a *possibility* of reducing such a very important matter as the manure account. In order to convince you that there may be a possibility of reducing that expenditure, I have quoted facts and figures which have led me to think that there is such a possibility. I don't want to interfere with the present manuring problem. We are not in a position to do so, but we are in a position to realise that we must have information on the matter, that our present system of manuring is not necessarily accurate or the best or the right thing to do.

MR. HARRIS:—I should like to mention in connection with what Dr. Lehmann said about the matter of experimental plots, that what he stated is perfectly correct and that the average for the past 4 years show that the manured plots have yielded the smallest crops. But it is rather interesting to notice that during the last year of the experiment the no-manured plots show a decided tendency to decrease; which rather points to the fact that they might have fed on manure previously received.

DR. LEHMANN:—That is just what I have been wishing to impress upon the meeting. Probably we have over-manured the plots in the past. If we had done so, we must know it; because, of the manure that we put into the soil, although a certain proportion of it remains there, a certain proportion is lost. The experiments which I have made in regard to the after effects of poonac on Ragi have conclusively indicated that there is very little manurial effect of poonacs left in the soil after one year. Our principal manures have been bone and poonac. Bone contains a certain amount of nitrogen. Its principal constituent is phosphoric acid. If we take as a basis the experience of other countries, we may say that phosphoric acid will remain in the soil; but the nitrogen, which is the most expensive constituent, will undoubtedly be lost sooner or later. If we have applied manures which have given nitrogen for four years, then we have been applying very much, too much of it. The nitrogen that is applied in the poonacs will certainly not last longer than four years.

MR. DANVERS:—The nitrogen in bone, will it not last longer?

DR. LEHMANN:—I might say that in the experiments I have just told you about there was apparently no after effect either from the

poonac or the bone. As regards the availability of bone meal Dr. Kellner's experiments conducted in Japan are probably the most valuable to us. He found that bone meal was, under the conditions which existed in his experiments, much more available than the results of Wagner, Maerker and other German investigators indicated. Kellner found bone meal about as available as Basic Slag, and in that case the after effect is of course relatively small for if the principal part of the fertilizer is used the first year there is not much left of it for the second and third years. What I saw on Mr. Sprott's estate seems to indicate that Kellner's results obtained in Japan are more likely to apply to India than Wagner's experiments made in Germany. Mr. Sprott had put out what appeared to me very coarse bone meal to one of his fields about 10 months before I visited his estate. This bone meal was left on the surface and only covered by the leaves which gradually dropped from the shade trees and coffee bushes. All we could find of this bone meal was a splinter a little over an inch long and a little less than half an inch thick, and this crumbled to powder when rubbed between the fingers. You will agree with me, I am sure, that this indicates that under the conditions existing on Mr. Sprott's estate, bone meal decomposes very quickly. Possibly the reason for this is that the bone meal is surrounded by decomposing organic matter, and that the carbonic acid produced helps to dissolve the bone.

MR. DANVERS:—I think the solubility of Mr. Sprott's bone manure is largely due to the nature of the plots to which it was applied. I am still digging up bones in my estate that were put out 9 or 10 or even 25 years or more years ago.

I would like to ask Dr. Lehmann whether he has had any opportunity of ascertaining if there is any difference in quality, judged by analyses, between coffee from these manured and unmanured experimental plots; whether there has been any deterioration in the unmanured coffee or improvement in the manured?

DR. LEHMANN:—I have not had an opportunity of determining the specific gravity of the coffee from these plots. I shall do so, with Mr. Harris and Mr. Denne's permission, in future. But as there has been no difference in the average quantity of coffee produced apparently manures have had no effect on these plots; and I do not know whether it will be reasonable to expect that manures had an effect on the quality if they had no effect on the quantity. In regard to the matter of bone manure, I am very much interested in what Mr. Danvers has told us. It seems to confirm the idea I have given you just now in regard to the reason why Mr. Sprott's results are different from those obtained in Europe. In the experiments made in Europe with bones in pot-cultures, the soil in the pots is comparatively poor in organic matter. Although Mr. C. Danver's estate soil contains more organic matter than is used in pot culture it does not contain as much organic matter as there is, or was, on the surface of Mr. Sprott's estates. I may here mention another idea I have; that is, that the organic matter on the surface

soil is one of the most essential things we have to consider in the matter of coffee growing. We hear of the deterioration of coffee, and have several indications that that deterioration is due to a diminution of the organic matter in the soil. I think it behoves us to be most careful in regard to this organic matter. In these tropical climates organic matter decomposes very very quickly. There are indications, I believe, that coffee is able to assimilate directly organic matter which is on the surface. As a rule, plant roots are not able to do so. Organic matter in the soil acts only on the mechanical condition of the soil with crops like wheat, barley and oats. But in the case of coffee we are dealing with a plant about which we know very little, and the fact that there is a great cluster of very thick white rootlets going through organic matter on Mr. Sprott's estate seems to me to indicate that probably or possibly, coffee roots may be surrounded with that network of mycelium, which Dr. Butler has found to exist on the roots of tea plants. I cannot speak with any degree of certainty about it. But it appears to me, that the thickness of the white-tipped coffee roots that I have seen is larger than is generally the case; and from the fact that these roots are found in such large numbers on the surface and from the fact that they are of such large diameter I conclude that there is a possibility that these roots are able to make use directly of the organic matter which is on the surface, and that they do not only make use of this organic matter but may very possibly require it; and to my mind, at any rate, there is a very hopeful indication that coffee may be improved in quality in the future. I may mention here, too, that all the mulching experiments which have been carried out in Mysore have, so far as I know, been very successful indeed. I remember one patch of very poor coffee on a heavy clay soil, in an otherwise nice piece of coffee, which I advised the manager to mulch heavily. The next year when I saw that patch, I could not distinguish it from the surrounding coffee. I think Mr. Harris will bear me out that on his estate the mulching that has been done has been effective. The effect of a mulch is two-fold; it supplies organic matter to the surface when it decomposes and it prevents the nasty disagreeable caking on the soil which is so deleterious to coffee.

MR. SPROTT :—I should be obliged if Dr. Lehmann could tell us what manure had been put to these experimental plots previous to their being taken up for experiments, and also if he could tell us the amount of manure which he put to the manured portions of it. I do not know if Mr. Harris could tell us that. I ask him because I have been very much of Dr. Lehman's opinion, after having had very many conversations with him on the subject. I think we have been very much over-manuring and have wasted a great deal. I am trying now putting smaller doses of manure, for I think there is a possibility of our having over-manured. I am watching very carefully whether coffee deteriorates in any way by lessening the manure. So far, I can only say it has not; and I think that spreading our manure in smaller quantities over an area will bring in beneficial results. I can also strongly bear out what Dr. Lehmann

said about mulching. I have tried it on several bare patches of ground. It has done far more good than a heavy dose of manure.

MR. DANVERS:—I have some patches to which manuring year after year has done no good; but mulching has done good to them.

The Honble. MR. HODGSON:—I have been very much interested in what Dr. Lehmann has told us today. Whenever he comes to our Session, he has a great deal to say to us of very great value. Very important is the problem to us of the possibility of reducing the cost of manure. I believe that Dr. Lehmann is on the right track in this matter, for I have noticed for some years past that a great many estates have necessarily been obliged to reduce the cost of manuring as a matter of economy. The price of coffee having gone down, they simply have no money for heavy manuring, and curiously enough, concurrently with the reduction in the quantity of manure applied, there has been in many cases an increase even in the crop returns. That is a remarkable thing. It rather bears out what Mr. Harris and Mr. Sprott have told us about the two plots of unmanured lands yielding larger crop averages. But then there are two accounts to be considered in working out profits, the Revenue and the Capital account, and both these have to be kept in view. Along with the Revenue account the condition of the estate, whether it has deteriorated or not, must be taken into consideration in working out profits.

If this were not done, it would be quite possible to show a good profit in the Revenue account which in reality has been taken out of Capital, that is to say by sweating the trees, and this might even be kept up for two or three years. It is therefore very necessary, as Dr. Lehmann always impresses upon us, to be very careful as to our facts in drawing conclusions from experiments.

MR. DANVERS:—I think what you say bears out what Dr. Lehmann recommends, viz., the carrying out of these experiments for a long series of years. In four years the yield of crops may not have reduced but the estate may have deteriorated.

DR. LEHMANN:—The reason why I am very cautious in the matter of even hinting at the fact that the manure might possibly be reduced, is, that I know from bitter experience how difficult it is for an estate that has run down to pick up again. It is frightful expenditure and trouble to get an estate into a good bearing condition. If it has once been allowed to run down, it is very difficult for it to pick up again.

MR. HARRIS:—Mr. Sprott asked me if I could supply him with certain information regarding my plots. I should be delighted to do so. But it is difficult to go back in memory to ten years. If he is interested in the matter I will try and have the information collected for him from my records. As regards the plots there are ten different plots; with the exception of the two unmanured plots, the rest of them are all manured, and have been manured for the last four years, with different mixtures. The object of the experiments is

to determine which is the most satisfactory manner in which we could apply phosphoric acid.

DR. LEHMANN:—I think there are two objects; one to find out in what particular constituents the soil was lacking, because if we apply nitrogenous manure to a soil which is already rich in nitrogen but poor in potash, nitrogenous manure will give us no result. But if we apply potash, it will give good results in such land; so that the whole plan of experiments was to find out first of all in what particular constituents that soil was lacking, whether potash or phosphoric acid, nitrogen or lime. In addition to that Mr. Harris' plot was particularly deficient in phosphoric acid, and he had been recommended to apply phosphoric acid over and over again. It had been previously manured with basic slag. It was desired to find out whether bone or superphosphates would give better results. That was applied on this estate, because Mr. Harris' estate is not particularly rich in iron. On some estates there was, to my mind, a suspicion that superphosphates would not act properly, because it would be transformed into phosphate of iron, which is, according to recognised dogmas of agricultural chemists, valueless. However, it was in their experiments in connection with soil to find out whether it was rich in organic matter, they found that phosphate of iron is valuable. It is a notion that phosphate of iron is valueless because it is insoluble. Whether such is the case we do not know. We have to fight shy of these notions and suggestions and suppositions. We must experiment and try to find out what really is the truth.

MR. DANVERS:—I suppose it will be difficult to find any estate in India which has not been manured for 20 years.

DR. LEHMANN:—I saw an estate 20 years old. It was in a magnificent condition, had an exceptionally rich soil, and was in a favoured locality. An estate like that will do very well to experiment with very small doses of manure

MR. HARRIS:—May I ask Mr. Sprott to what extent he has reduced the application of manure, roughly speaking?

MR. SPROTT:—Speaking from memory, we used to put out as much as 7 to 8 cwts. of bone and poonac. I have put out 5 cwts. bones and poonac or fish in one portion of the estate every year for some eight years, and it has steadily improved, previous to that the chief manure I used was cattle and fish manure. Fish manure I have put as much as 7 to 10 cwts. per acre. The manure I have put out for the last 20 years has all been on the surface. I have put out this year in February 1 cwt. refined saltpetre to some portions of the estate without anything else at present. I am now going to back it up with 3 cwt. of fish manure or bones and poonac, thus making 4 cwts. for the year; on other portions I have put 2 cwt. of crude saltpetre, and it will get 3 cwt. bones and poonac or fish later.

DR. LEHMANN:—In good poonac we already apply all the phosphoric acid that is removed. If there is a mistake—I don't

know that there is a mistake—in manuring, it is that we have been putting out too much bone. There is five times the amount of potash removed that there is of phosphoric acid, and we have applied no potash. We have applied bone and poonac. Bone contains 23 per cent. of phosphoric acid. In 2 cwt. of bone we have 20 times as much phosphoric acid as we really require. It is a very large amount of phosphoric acid that has been applied to the estate in proportion to the potash and nitrogen. Potash has been particularly disregarded in former years, and now they may apply very much potash.

THE TALIPOT PALM.

The famous Talipot Palm (*Corypha umbraculifera*) is a native of Ceylon and the Malabar Coast. In Ceylon it is rather common in the moist region up to 2,000 feet altitude.

It has an erect, straight, cylindrical trunk 30 to over 80 feet high. The measurements of a specimen that flowered at Peradeniya, Ceylon, were as follows:—Height of stem 84 feet, of flower panicle 21 feet, total 105 feet; girth at 3 feet from the ground round the persistent bases of the leaves 13 ft. 9 inches, at 21 feet from the ground 8 feet 3 inches; age about 40 years. The tree dies after once flowering and fruiting.

The trunk is surmounted by a crown of gigantic fan-like leaves. These leaves have prickly stalks 5 to 10 feet long, and when fully expanded form a nearly complete circle of 8 to 16 feet in diameter, and composed of 80 to 100 radiating segments, joined together and plaited like a fan till near the extremity, where they separate and form a fringe of double points.

The leaves are made into fans, mats, and umbrellas, and are used for writing on. They are also largely employed for thatching. “The leaf being dried is very strong and limber, and most wonderfully made for man’s convenience to carry along with them; for though this leaf be thus broad (enough to cover 15 or 20 men) when it is open, it will fold close like a lady’s fan, and then it is no bigger than a man’s arm; it is wonderfully light.” (Knox.)

A bread is made of the pounded soft interior of the trunk. The seeds have the hardness of ivory, and are known as Bazarbatú nuts; they are used as beads in Ceylon, and largely in the manufacture of buttons in Europe. The young fruit pounded is used for stupefying fish.

Visitors to the old Botanic Garden at Bath a few years ago will remember the fine specimen that existed there. It fruited in 1902, and then died.

A supply of seeds was obtained and plants raised from these may now be had from Hope Gardens.

The Talipot is not suited for small gardens, but where space can be spared for it on a lawn it will grow into a noble tree.

THE FUTURE OF RUBBER.

(From a Special Correspondent in "Madras Mail, 11th October.")

We may be certain that present prices are enabling the American Rubber gatherers to exploit very out-of-the-way districts, involving heavy transport charges; and yet the increase in output is not serious, the rise in exchange no doubt taking away much of the benefit from the enhanced price. So that it looks likely that, if Brazilian exchange is maintained at its present level, a comparatively moderate drop in prices would render it unprofitable to work much of the country that is now being tapped, in which case a really serious drop would be deferred for an uncertain number of years. Supposing, however, that the continual planting up of Rubber in the East finally brings this about, and there is a struggle ending in the survival of the fittest, the only possible result can be the knocking out of wild rubbers and the transference of the industry into the hands of the planter, who could, if necessary control output.

This is looking far ahead indeed, but both in cinchona and tea the maintenance of some control over output is recognised, and as the rubber supply will eventually be chiefly in British hands, the possibility of such a control, if ever required is evident. It is useless at present, to attempt careful estimates of rubber production. In Ceylon, apparently all tea land under some 2,000 ft., and much other land, is going into rubber, but what will it do and what the yield will be is another question. Mr. Burgess holds the view that the Straits must eventually excel Ceylon in production on account of the fine land that is being opened in the former country. But against this is the great accessibility of all the Ceylon districts, and transport is a very important point after leaving the sea. No doubt the more sanguine estimates of yield will not be realized, and I hear that the large trees at Peradeniya, which Mr. Wright expected would give some 12lb. of rubber each per annum under the latest method of tapping, have stopped their flow of latex to a great extent. I am satisfied with the, to me, unavoidable conclusion that a good class of rubber, under suitable conditions, will yield large profits for many years to come.

MR. BURGESS' VIEW.

Mr. Burgess, the Straits expert, states that Eastern plantation rubber is found not to be as resilient or of such recuperative power as the wild product (Amazon Para). This is hardly surprising, seeing that, practically, Eastern rubber is all from young trees, whilst the American is from picked forest giants! The same reason may, perhaps, partly account for the fact that some Eastern rubber at any rate has shown signs of not keeping after a couple of years, though Mr. Burgess is inclined to think that the acetic acid or formalin used for coagulation has produced this effect. This is a matter for the chemist and experience to decide; I certainly have samples of rubber, taken in India four years ago,

which are practically as sound as they were at first and no coagulant was used.

WHICH IS THE BEST SPECIES TO GROW ?

Para is first and the rest nowhere with most planters, especially in Ceylon. The *Castilloa* at Peradeniya are not imposing trees for their age, and Mr. Wright's experience of this variety does not seem very favourable. The trees milk fairly well, but are apt to die within the year. Another keen planter, with *Castilloa* growing at 1,000 feet found it almost impossible to get the latex to coagulate. In S. India, however, these difficulties do not occur. It takes a very large amount of ill-treatment to even affect the health of a *Castilloa* at 3,500 feet and the latex coagulates without special difficulty. Generally speaking the *Castilloa* prefers a drier climate than that which Para revels in, and also does better at a fair distance above sea-level. Ceara is being tried here and there, planters being encouraged by the copious flow of milk from the old trees which survive from plantings of twenty years ago and more. These certainly produce excellent rubber nearly if not quite equal to Para in appearance when carefully prepared, and the tree grows on very poor soil and at a considerable elevation. It also does not demand a heavy rainfall, though like all rubbers it thrives best with a good allowance of moisture. *Ficus elastica* is certainly not a tree to plant amongst coffee or near anything valuable, if one may judge from the Peradeniya trees. These completely occupy a large area with their roots, and are now showing signs of decay. As, however, I understand they are getting on for 50 years old, there would be time to extract a fortune out of them if they contained it; some quicker-yielding trees, however, are preferable. *Funtumia* trees grow well in S. India at 3,000 feet or so; at Peradeniya it is found that they are so eaten by caterpillars that nothing can be done with them. I would certainly give the award, as a general thing, to Para. It is as far as I have seen, decidedly the hardiest of all. It resists ill treatment wonderfully and is practically unaffected, as far as I can see, by excess of rain or severe drought; whilst it is a useful shade for coffee for a good term of years. In South India I have given measurements of growth at 3,500 feet and I may mention that I have plants 6 feet high from seed planted at stake, amongst coffee, in 1904. Taking the opinion that "it does not pay to tap trees at over 3,000 feet," what does this mean? We must remember that the nature of the forest tapping, where trees are scattered and where, we are told, trees of 2 feet girth would not be noticed as worth tapping and only the widely scattered giants, giving 5lb. or more rubber, are selected. At over 3,000 feet these giants would be comparatively rare and take much finding, but plantation conditions would make all the difference. At 3,500 feet the trees on a plantation would be at just the same distance apart as at 1,000 feet or 2,000 feet. They would perhaps require another year to make equal growth, but this would not prevent their paying handsomely.

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The usual monthly meeting of the Board of Agriculture was held on Tuesday 12th December, present : Hon. H. Clarence Bourne, Colonial Secretary, Chairman, the Director of Public Gardens, the Island Chemist, the Superintending Inspector of Schools, His Grace the Archbishop, Mr. G. D. Murray and the Secretary.

The following letters from the Colonial Secretary were submitted :—

1. re W. I. Agricultural Conference intimating that the proposal for holding the Agricultural Conference in Jamaica next year had been definitely abandoned owing to insuperable difficulties in transport.
2. Sending copy of letter from Imperial Institute re Cotton Cultivation and asking the Board to comply with the request made that the Imperial Institute should be kept informed of the progress of cotton cultivation in the Colonies and that reports or special information should be regularly forwarded. Also asking that the Board might consider it desirable to send additions to the standard collection of cotton referred to.

This was directed to be circulated.

3. Asking whether the Board of Agriculture could arrange for the syllabus in connection with the proposal to confer the Jamaica Scholarship on Agricultural Students.

With reference to the last letter, His Grace the Archbishop said that a Committee of the Schools Commission consisting of the Chief Justice and Mr. Capper had considered the various matters involved and had made a report, a precis of which he read. He suggested that the matter might wait over a month until this report had been considered and adopted by the Commission at its first meeting and sent to the Governor.

After discussion it was accordingly resolved to hold over consideration of the matter until next meeting.

(The Chairman here left the meeting as he had to attend a meeting of the Privy Council and he asked the Director of Public Gardens to take the Chair.)

The Secretary submitted letters on the subject of Jamaica Tobacco and Mr. Chalmers' experiment in blending with Virginia Tobacco for use in the Navy, which were directed to be circulated.

The Secretary read letter from Mr. Robert Thomson suggesting that a report he had made on agriculture in the parish of Manchester with special reference to packing of oranges might be published in the Bulletin of the Department of Agriculture.

It was pointed out that this report had been made to Mr. Haggart and published in the newspapers, but had not been sent either to

the Board of Agriculture or to the Agricultural Society as it ought to have been.

The Secretary was directed to reply to Mr. Thomson and say that if the report was sent to the Board, it would consider whether it should be published.

The Secretary submitted a letter from the Rev. J. F. Gartshore, Secretary Hanover Agricultural Society, thanking the Board for the services of Mr. Cradwick.

This was directed to be circulated.

The Secretary submitted two letters from the Honourable J. V. Calder acknowledging receipt of the copy of Mr. Olivier's minute re the Locked Still matter, with memo by the chairman to whom it had been submitted.

These were directed to be circulated.

The following reports by the Chemist were submitted :—

1. Application of A. A. Forbes to give his son a second year's course as an agricultural student without a scholarship and without fees. This was allowed on the recommendation of Dr. Cousins.
2. Application from C. A. Liddell for admission as an agricultural student on the usual terms. This was approved.

The following reports of the Director of Public Gardens were submitted :—

1. Hope Experiment Station.
2. Reports from Mr. Cradwick and letter re drainage experiment.

These were directed to be circulated.

A report from the Secretary re Cotton Gins and Baler was submitted and directed to be circulated.

The following papers in circulation since last meeting not yet submitted to the Board, were now submitted, as follows :—

Letters from the Colonial Secretary forwarding letter from Hon. T. H. Sharp asking for the appointment of an Entomologist in Jamaica, with comments by members of the Board.

His Grace the Archbishop moved "That the Board of Agriculture is satisfied of the fact that the successful development of various industries in Jamaica will largely depend upon the advice and guidance of a competent Entomologist and therefore earnestly recommend the Government to make provision for the appointment of such an officer at the earliest possible opportunity."

Mr. Capper seconded and this was unanimously agreed to.

The Secretary was instructed to forward the resolution to the Colonial Secretary as the unanimous opinion of the Board.

Memorandum on the Standardization of Jamaica Rum, with comments by the Board.

After discussion it was agreed that the most judicious course would be first to have a meeting of representative sugar planters to talk over the matter. The papers were referred back to Dr. Cousins to make further suggestions as to communicating with sugar planters.

The following papers which had been circulated were submitted for final consideration :—

Chemist's Reports :—

1. Research in Tropical Medicine by Capt. Wanhill, R.A.M.C.
2. Training of Distillers at the Laboratory.
3. Distribution of Cane Tops.

Reports Director of Public Gardens :—

1. Experiment Station.
2. Mr. Cradwick.

Letters re Jamaica Tobacco from 1. Sir D. Morris, 2. Mr. F. V. Chalmers, 3. The Imperial Institute, with members' comments on the last, which were read.

The Director of Public Gardens read a paragraph which had appeared in the Jamaica "Daily Telegraph", reporting on the sailors' opinion in the Navy of tobacco issued to them for trial; they objected to the pipe tobacco but were well pleased with the cigarette tobacco.

Papers re Mr. Nolan and Jamaica Rum, with the Chemist's comments on same urging a standard of 200 parts of Ether.

This standard was approved of.

[Issued 10th January, 1906.]

Printed at the Govt. Printing Office, Kingston, Jam.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

FEBRUARY, 1906.

Part 2

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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P R I C E—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :

HOPE GARDENS.

1906.

JAMAICA.

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Part 2.

SOME BANANA SOILS OF ST. MARY AND
UPPER ST CATHERINE.

By H. H. COUSINS, M.A., Government Chemist.

At the suggestion of the writer, the Board of Agriculture arranged that Mr. Cradwick should take a number of soil samples from typical cultivations of the smaller planters in St. Mary for partial Analysis in the Laboratory, so that advice might be given as to the need of drainage, humus, or lime in each case; our previous Analyses and experiments having indicated that the banana soils of St. Mary are not in present need of commercial fertilizers, but require special attention to drainage and humus and in some cases lime, it appeared desirable that a good number of typical soils should be examined to this end.

Mr. Cradwick made a special visit to St. Mary* and early in 1905 sent in 51 examples of soil to the Laboratory, with observations as to the conditions he noticed in each case.

Unfortunately several of the samples were labelled with perishable labels and only 39 samples were capable of being identified.

These have been examined as to

A. Mechanical condition.

B. Percentage of Lime as Carbonate.

C. Percentage of Humus, soluble in Ammonia, and the results are here given. Mr. Cradwick's original observations being quoted in each case.

* Mr. Cradwick's Report will be found in *Bulletin* Oct. 1905, page 220. *Editor, Bulletin.*

MAR 21 1906

A.—RIO MAGNO—ST. CATHERINE:

["Soil from the bank near River, Bananas poor, cocoa very poor."]

No. 1—*Surface Soil.*

Sample lost.

No. 2—*Subsoil.*

Lime as carbonate	...	Abundance
Humus	...	1.28
Mechanical condition	...	Clay, loam

Observations.

From a previous sample examined in the Laboratory from the same source, it was found that this soil was variable, some patches being very good soil for bananas and others below par in humus and general fertility.

The soil does not lack lime.

No. 3—*Surface soil.*

["Near Immortelle nursery, between house and river, poor bananas, cocoa worse".]

Lime as carbonate	...	Abundance
Humus	...	2.23
Mechanical condition	...	Clay, loam

Observations.

This soil does not lack lime and the humus is fairly good.

The soil is inclined to be heavy and *drainage* is probably the factor required to ensure a good and vigorous growth of bananas and cocoa.

The subsoil sample was lost, but there are indications, that the subsoil here is impervious and that deep drains would be necessary to enable the cocoa roots to penetrate and develop.

No. 5—*Surface soil.*

["From corner near cow-pen, good bananas and good cocoa."]

Lime as carbonate	...	1.25
Humus	...	4.16
Mechanical condition	...	Stiff clay

Observations.

The humus in this case is very high and despite the stiff nature of the soil, the results of the cultivation are reported as satisfactory.

If well drained, this soil should be of very high fertility.

There is abundance of lime and an unusual amount of humus.

HAMPSTEAD—ST. MARY.

No. 7—*Surface soil.* (Missing).No. 8—*Subsoil of No. 7,*

["Just inside gate—a spot where nothing has thriven, the proprietor says it is improving from the application of banana trash."]

Lime as carbonate	...	Abundance
Humus	...	0.36
Mechanical condition	...	Clayey marl

Observations.

This soil is almost devoid of humus and one that would absorb an enormous amount of vegetable matter without greatly improving its nature.

It is doubtful whether soils of this type can be profitably cultivated for bananas.

No. 9—*Surface soil.*

["Near by cotton tree—everything thrives here, but I think more drainage would improve the bearing of cocoa.

Bananas very fine and very large cocoa pods on some trees grown from seedlings from Hope Gardens."]

Lime as carbonate	...	Abundance
Humus	...	4.4
Mechanical condition—Stiff soil, inclined to clay		

Observations.

This soil is very rich in humus and contains an abundance of lime.

Mr. Cradwick's suggestion as to deeper drainage can be confidently supported.

This soil is worth handling on intensive lines of cultivation and has a large reserve of banana-producing power to draw upon.

The contrast between this soil and the previous one is very striking.

No. 11—*Surface soil.*

["From spot where bananas give good bunches but do not finish up well. Cocoa does not grow in spite of being near a big guango."]

Lime as carbonate	...	Abundance
Humus	...	3.37
Mechanical condition ... Heavy clay		

No. 12—*Subsoil of above.*

["This land wants more drainage."]

Observations.

This soil only needs deep drainage to produce excellent results.

The humus is well up to standard. In my opinion this soil would repay the cost of deeper drainage and intensive cultivation.

No. 13—*Surface soil.*

["One of the spots I suggested as no use wrestling with, better plant some good trees and grass on it."]

Lime as carbonate	...	Very high
Humus	...	4.4
Mechanical condition ... Clayey loam		

Observations.

This soil is so rich in humus that if adequate drainage is practicable, it should grow good fruit.

A trial should be given of this before abandoning the land to grass.

No. 15.—*Surface soil.*

["Spot where the Laboratory has been experimenting with manures."]

["Very poor and 'shotty,' has improved with manure but still looks pretty bad. The bananas look spotty and thriftless, do not bear, and have a lot of little round galls or warts on them.

The manure has grown about the finest Spanish needle I have ever seen."]

Lime as carbonate	...	Excessive
Humus	...	0.95
Mechanical composition		Clay marl

Observations.

This soil is quite unsuited for bananas by nature, and in my opinion will not repay the heavy applications of vegetable refuse and manure that would be required to enable it to produce good fruit.

No. 17.—*Surface soil.*

["'Pasture Piece,' a field of young cocoa, about 3 years old, most of which are growing nicely. The land has some drains, but they are not systematic, and I recommend, in order to make a success of this field, that contour drains at intervals of not more than 24 feet should be put in."]

Lime as carbonate		Abundance
Humus	...	4.25
Mechanical condition	—Stiff clay with similar subsoil.	

Observations.

A first class soil, but demanding deep drainage. Unless this is attended to the cocoa will probably fail after a few years.

HIGHGATE, ST. MARY.

No. 21.—*Surface soil.*

["'John's Piece,' where cocoa is growing well. More drainage would improve the bearing. Fine bananas were growing on this land, but shelter trees would be useful both for bananas and cocoa."]

Lime as carbonate	...	1.25
Humus	...	2.57
Mechanical condition	—Stiff—inclined to clay, with similar subsoil.	

Observations.

Drainage is clearly essential. The humus is good, but might be higher to advantage. The soil does not lack lime.

No. 23.—*Surface Soil.*

["Bananas and cocoa, 2 years old, nearly all look poorly. This sample is not taken from the worst spots, which I have advised to be thrown up and planted in trees and grass to provide manure for the better land from which the sample was taken."]

Lime as carbonate	...	1.0
Humus	...	3.2
Mechanical condition—Stiff clay with similar subsoil.		

Observations.

With drainage this soil should grow good bananas. The humus in this sample is higher than in the previous one reported upon (No. 21).

ORACABESSA A. ST. MARY.

No. 25.—*Surface soil.*

["Very mixed cultivation of good bananas, cocoa, coffee and coco-nuts. Bananas are very fair as ratoons, but late, and the proprietor says are late every year. Well-drained land, but not forked since the prize-holding contest of three years ago."]

Lime as carbonate	...	2.75
Humus	...	2.84
Mechanical condition—Stiff, inclined to clay.		

Observations.

This land is in good heart, but would give better results with more tillage. This land should be forked thoroughly and a supply of green manure secured, so as to maintain the standard of humus.

No. 27.—*Surface soil.*

["From heavy flat, near house, bananas grow well here, but are also late. I have suggested that bananas on this land should be replanted oftener and particular attention be paid to drainage. Trash, which is very easy to obtain, should be applied as heavily as possible, and the land receive a dressing of lime."]

Lime as carbonate	...	2.25
Humus	...	3.39
Mechanical condition—Stiff, inclined to clay.		

Observations.

The analysis shows that this soil contains abundance of lime.

The addition recommended by Mr. Cradwick might prove of advantage in making the soil more friable, but it would tend to a somewhat rapid loss of humus.

Drainage and tillage are obviously the chief requirements.

The present standard of humus is quite good for an average banana soil.

ORACABESSA, B.

No. 29.—*Surface soil.*

["Bananas planted July, 1904. Drained and in good health, but in many spots the bananas are coming on very slowly."]

Lime as carbonate	...	1.25
Humus	...	3.39
Mechanical condition—Stiff soil, with very stiff clay subsoil.		

Observations.

The indications are that more drainage would remedy the defect noted by Mr. Cradwick.

The lime and humus are quite satisfactory.

HIGHGATE B.

No. 31.—*Surface soil.*

Lime as carbonate	...	2.5
Humus	...	3.0
Mechanical condition—Stiff clay.		

No. 33.—*Surface Soil.*

Lime as carbonate	...	1.0
Humus	...	2.32
Mechanical condition—Medium clay.		

Observations.

No. 31 is a good soil for bananas if well drained.

No. 32 is somewhat deficient in humus.

There is no deficiency of lime. Drainage is the chief factor to be considered in the cultivation of these soils.

No. 35.—*Surface Soil.*

["A fair sample of many 'gall spots' which appear in the midst of very good land, fruit is both small and late.

A manure that would increase the size of bunches and bring in the fruit earlier is much needed"].

Lime as carbonate	...	3.0
Humus	...	1.84
Mechanical condition—Light soil of medium texture.		

Observations.

The humus in this soil is below par, and it is very doubtful whether any manure other than farmyard manure would do much good.

Galls are often a temptation to the use of extravagant manuring that the crop cannot pay for and in many cases are best left alone.

PORT MARIA.

No. 37.—*Surface soil.*

["From cocoa walk near house. I have suggested as a first step, systematic drainage, forking right through the land, manuring with trash or any kind of manure available, together with Lime and the replanting of the bananas.

The cocoa here was badly damaged by the hurricane."]

Lime as carbonate	...	1.62%
Humus	...	2.86%
Mechanical condition—Very stiff clay with impervious sub-soil.		

Observations.

All Mr. Cradwick's proposals, with the exception of the use of lime, are fully supported from the Laboratory observations.

This is a very heavy soil and would be benefited by deep drainage and tillage and the humus could be increased to advantage.

PORT MARIA—B.

No. 39 40.—*Surface and Sub-soil.*

["From a spot where bananas practically go to nothing, it is drained very irregularly to a depth not exceeding 18 inches."]

Lime as carbonate	...	Considerable.
Humus	...	3.07%
Mechanical Condition—Stiff clay with light coloured clay marl, sub-soil.		

Observations.

This soil cannot be expected to grow good fruit without a really deep and efficient system of drainage.

Considering the amount of chalk in the soil, the Humus must be considered good.

This is a type of soil on which bananas grow with difficulty and if all the land were similar to this, it would be expensive to work and the results probably disappointing.

RIVERSDALE.

No. 41 & 42.—*Surface and Sub-soil.*

["From Banana Walk, Eastern slope—Bananas four years old, good stems but damaged by winds.

Land wants draining and cultivating only."]

Lime as carbonate	...	0.61
Humus	...	1.55
Mechanical condition—Red soil, stiff clayey loam, with similar sub-soil.		

Observations.

This soil is deficient in Humus and a heavy covering of refuse manure should prove beneficial.

Drainage is obviously necessary. The soil is capable of great improvement.

No. 43 & 44.—*Surface soil and Sub-soil.*

["From flat near house; Bananas not so good. Land wants draining and manuring."]

Lime as carbonate	..	Nil.
Humus	...	0.89
Mechanical condition—Clay loam, with similar sub-soil		

Observations.

This soil is entirely deficient in chalk, and should be treated with half a ton of lime each year. The humus is so low, that bananas cannot be expected to grow.

Heroic measures are required to improve this serious deficiency.

Drainage is also imperative. As compared with the previous soil, this presents far greater difficulties in converting it into good banana land.

HIGHGATE C.

No. 47.—*Surface soil.*

["From Orange River field about the centre where cocoa trees look well."]

Lime as carbonate	...	1.87
Humus	...	5.09
Mechanical condition—Stiff clay soil.		

Observations.

A soil with a splendid standard of Humus and containing abundance of chalk. Retentive and demanding drainage.

No. 48.—*Surface soil.*

["Higher up the same field where the cocoa looks middling"].

Lime as carbonate	...	1.87
Humus	...	3.11
Mechanical condition—Stiff loam.		

Observation.

This soil only has $\frac{2}{5}$ as much humus as the previous sample and this would account for the trees not doing quite so well.

No. 49.—*Surface soil.*

["Top of the same field, cocoa trees poor, much exposed to wind or rain.

There the trees require a good wind-brake to protect them.

I would suggest as an experiment that the proprietor should drain a small section of this land to an extent that might even seem extravagant"].

Lime as carbonate	...	1.75 $\frac{0}{100}$
Humus	...	2.56 $\frac{0}{100}$
Mechanical condition—Stiff clay.		

Observations.

A comparison of the three last soils will illustrate how in the tropics, the upper area of hills in cultivation get washed and poor in Humus, while a progressive enrichment is found in the lower levels. All these soils indicate the desirability of drainage.

They do not need lime. The humus of the upper portion is so much less in amount than that of the lower, that it is not surprising that the cocoa should be poor, apart from the exposure to wind which Mr. Cradwick has pointed out. Any drainage works would have to be carried out at a carefully adjusted gradient and the washings carefully replaced on the soil. Every effort should be directed towards reducing loss of fertility in the upper area.

CONCLUSIONS.

These soils indicate that the original idea upon which the work was based is sound, viz :—

That in most cases the needs of the banana soils in St. Mary and the neighbouring districts are not chemical fertilizers, but rather—

- (i) Drainage
- (ii) Humus
and in some cases
- (iii) Lime.

Mr. Cradwick is to be congratulated upon the way in which his advice has been generally supported by the conclusions derived from the subsequent examination of the soils in the Laboratory, as is here evident and it is hoped that this work may be extended in the future so that a large number of the smaller cultivators may be advised as to the practical treatment of the soils on their holdings.

HOPE GARDENS.

The cultivated area at the Hope Gardens contains not only an ornamental garden but also an Experiment and Teaching Station.

The first beginning of an Experiment Station at Hope was in 1874 under Mr. Robert Thomson. The Government came into possession of 200 acres of land there in 1873, and determined to transfer the new varieties of Sugar Cane, received from the Botanic Gardens of Mauritius and Martinique and planted in the small garden at Castleton, to the ample area at Hope. Nearly 18 acres were put under Cane in 1874, and 5 more in 1875, and during the same year 10 acres were planted in Teak. A small nursery was also formed. In 1885, Sir D. Morris, at that time Director, proposed that the land round the nursery should be made into a public park at a cost of £5,000, though he thought a Botanic Garden could not be carried on without a system of reservoirs for the storage of water. However, Governor Sir Henry Norman decided that, as there were no conveniences at that time for people travelling cheaply from Kingston, there should be no outlay except gradually in forming a Garden.

In 1897 the Government transferred the present Director with Office and Herbarium from Cinchona to Hope, with the intention of making it the central botanical establishment of the island. Since that time the Garden has gradually been formed and extended.*

The following plants are grown for experimental purposes, and also for use in teaching agricultural principles, and the best methods of dealing with these tropical crops :—Sugar Cane, Cocoa, Coffee, Tobacco, Banana, Rubber, Nutmeg, Citrus, Grape Vine, Pine Apple, Cassava, Sweet Potatoes, &c.

Practical instruction is given in the Garden to apprentices, to boys from the Industrial School, to Students at Training Colleges, to Elementary School Teachers in their vacation, to Agricultural Students, and to Planters themselves.

There are about 8 acres under Sugar Cane of several varieties which are being tested by the Agricultural Chemist and distributed to Planters. Seedlings are grown from seed and are tested as they mature.

Forastero and Criollo Cocoa are grown, and experiments are being made as to the effect of shade trees, and as to the difference in growth, and yield of crop, when planted close and at wider distances apart.

Coffee of several kinds may be seen :—Arabian or common Coffee, Liberian, Abbeokuta, Highland Coffee of Sierra Leone (*stenophylla*), Maragogipe, Golden Drop, &c.

Tobacco is under cultivation, and the leaf is cured in the tobacco house close by. The apprentices are instructed in all the details of cultivation, and the technique of curing the leaf for cigar tobacco. A quarter of an acre of Sumatra seed tobacco is grown under the shade of cheese cloth. This tobacco yields a very high-class leaf for the outside wrapper of cigars.

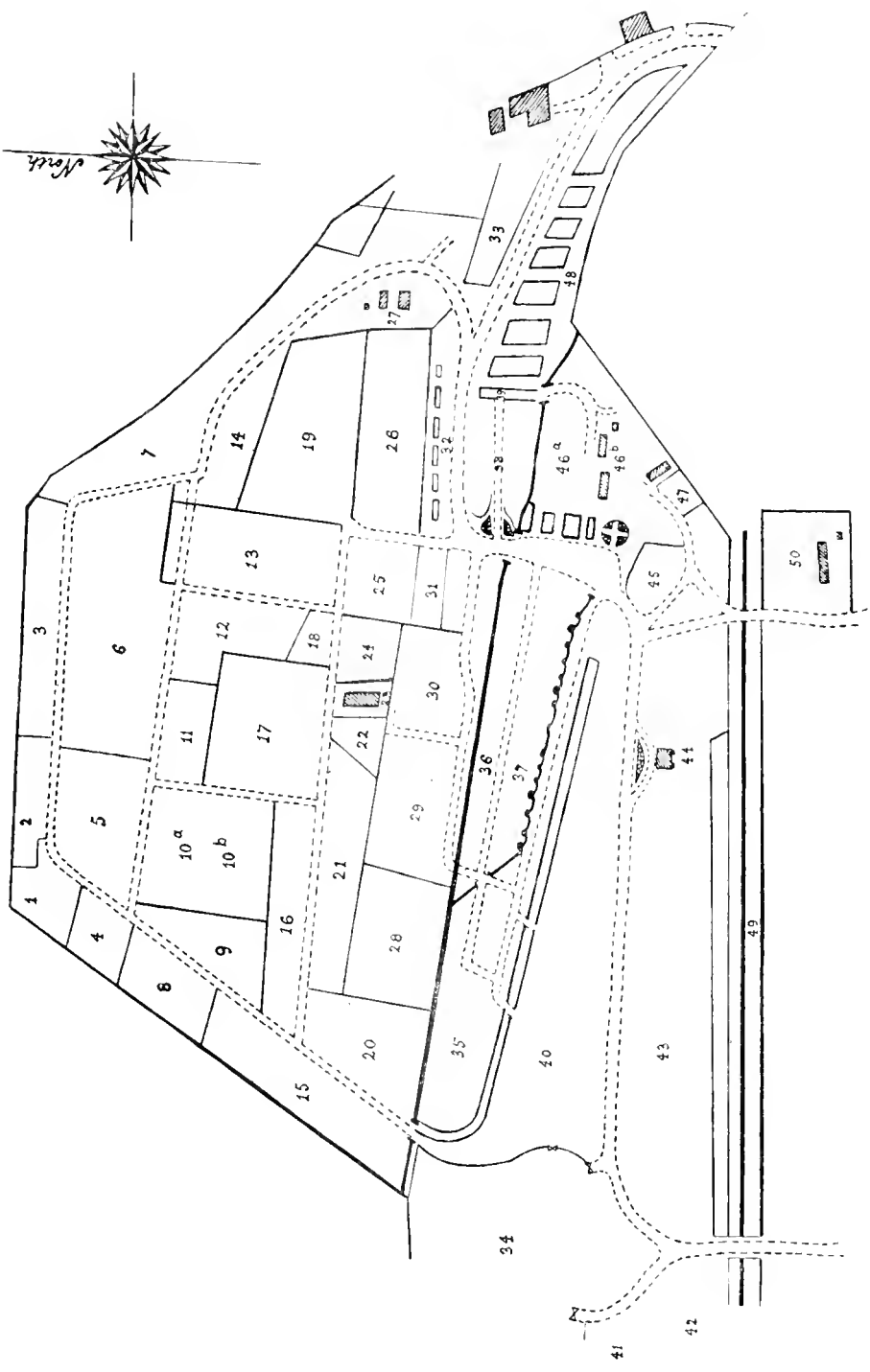
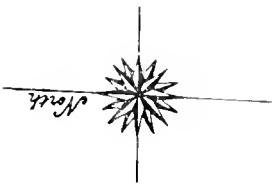
A collection has been established of twenty-three varieties of Banana from various parts of the world, chiefly obtained through the kindness of the Director of Kew Gardens and the Commissioner of the Imperial Department of Agriculture.

Budded Citrus plants have been planted out for comparison, both of varieties that have proved successful in Florida and California, and also of native seedling trees. Attempts are being made to get a variety of Orange which will bear fruit when the highest prices are obtained in English and American markets.

Pine Apples of several varieties are grown, and experiments are being made in cross-fertilising different varieties, with the object, for instance, of getting a pine with the flavour of the Ripley, the fine appearance of the Smooth Cayenne, and the good carrying qualities of the Red Spanish.

Rubber plants of various kinds are grown :—Para, Castilloa, Ceara, Lagos silk rubber, Landolphia, &c.

* See Guide to Hope Gardens by Walter Jekyll. Published by Messrs. Aston Gardner & Co., Kingston. Price, One Shilling.



There are 28 varieties of Cassava collected from different parts of Jamaica, 10 from Porto Rico, and 30 from Colombia. These 68 varieties are being tested as to weight of tubers per acre, and percentage of starch. The starch is said to be better for laundries and for dressing Manchester goods than that produced by any other plant. It is claimed also that Cassava yields more starch per acre than any other plant.

Similar tests, besides value as food, are also carried out with reference to Sweet Potatoes,—27 varieties from Jamaica, 12 from Barbados, and 9 from the U. S. Dept. of Agriculture, Washington, D. C.

Results of tests of plants are published from time to time in the Bulletin and Annual Reports.

A plan of the cultivated portions of the Government grounds is given, so that visitors may readily find any particular kind of economic plant grown there for experimental or teaching purposes.

The following is an Index to the numbers on the plan :—

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| 2. Cassava. | 28. Canes. |
| 3. Pine Apples. | 29. Bananas. |
| 4. Yam Beans. | 30. Navel Oranges and Sweet Potatoes |
| 5. Tobacco and Cassava | 31. Khus-khus Grass. |
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| 7. Bananas and Mangoes. | 33. Crotons, &c. |
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| 10a. Tobacco. | 36 & 37. Vanilla, Cocoa, &c. |
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| 12. Plantation of Cananga and Para Rubber. | 40. Lawn |
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| 15. Ippi-appa. | 43. Lawn with Date Palms. |
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| 18. Cassava. | 46a. Nursery. |
| 19. Canes (Seedling). | 46b. Plant Houses. |
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| 24. Cassava. | |
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| 26. Seedling Canes. | |

GRAPE FRUIT AND SHADDOCKS.

The following popular notes on varieties of grape fruit and shaddocks, by Sir Daniel Morris, K.C.M.G., D.Sc., D.C.L., appeared in *Garden and Forest*, an American horticultural journal published at New York, April 22, 1896. Recently applications for information in regard to the respective merits of grape fruits and shaddocks were received from the Board of Agriculture in the Bahamas and other sources, and with the view of placing the facts on record in an accessible form, they were reprinted in the pages of the *West Indian Bulletin** and are now reproduced here:—

During my recent visit to New York I was much interested to notice the considerable demand that existed there for grape fruit,† from the West Indies. It appears to be very strongly recommended by the medical faculty for its refreshing and tonic properties, and, in consequence, the use of it has become an important feature in the diet in American cities. The fruit I saw in New York called grape fruit consisted of various sorts and qualities, and there is little doubt that much confusion exists as to what is really grape fruit as distinct from the allied citrus fruits passing under such names as Pumelow‡, Shaddock, Forbidden fruit, Paradise fruit and others. The chief characteristics of all these fruits, distinguishing them from the different varieties of the orange, are associated with the size and colour. They are all, or nearly all, larger than the largest orange, and they are uniformly of a pale-yellow colour. In texture the rind may be smooth or even polished. It is seldom rough, nearly always firm and not very thick. The pulp is pale yellow or greenish-white, sometimes pink or crimson. The vesicles of the pulp (juice bags) are more distinct than in the orange; very juicy, somewhat sweetish with a distinct, but agreeable, bitter flavour. The pith surrounding the segments possesses more of the bitter than the pulp, but is less agreeable, and on that account is never eaten. In shape these fruits vary a good deal. Some are quite globular, others somewhat flattened at the top and tapering below, forming a pear-shaped body. Even in the globular fruits the top is more or less flattened. There are none, I believe, pointed at both ends.

Having indicated the general characters of this class of citrus fruits, I may venture on a brief sketch of their origin and history. It is agreed by all authorities that these fruits are quite distinct from the other groups of the orange family, such as the true oranges and the citrons. They have, therefore, been kept apart and ranged under the Giant Citrus, *Citrus decumana*. In this species the tree is 12 to 18 feet high, with a flat crown and spreading branches, usually with no spines. The leaves are elliptic-rounded at both ends, emarginate (that is, with a notch at the apex) and crenulate (having the edge marked with small depressions);

* From West Indian Bulletin VI., 1905, page 284.

† It is so called because the fruits grow in clusters like a bunch of grapes.

‡ It is invariably spelled Pomelo in the United States.

the under side of the leaf is softly hairy, with the wings broad, crenulated as in the leaves, and bordered with fine hairs. The flowers are in clusters of from three to nine, large, white, and fragrant. The fruit is either globose or pear-shaped, forming many seedling varieties without distinct names. This is supposed to be a native of the islands of the Pacific, whence it had been brought to southern China, Japan, and India. It was introduced to the West Indies, according to Macfayden, from China by Captain Shaddock, whose name has since been given to it. The term shaddock may be correctly applied to any of the larger members of the giant citrus, and is equivalent to the French pomelmouse, which is another form of the Dutch pomplemoes. The word pomelow, so widely used in India and Ceylon, is supposed to be a contraction of 'pomum melo,' the melon apple. The largest "pumelows" in India are said to reach '2 feet in circumference and weigh 10 to 20 lb.' The best sort, according to Bonavia, is 'the thin-skinned, red pumelow of the Bombay market.' This is of a globose shape, juicy, and 'of the colour of raw beef internally.' There are, however, numerous grades in size, some being almost as small as oranges. In India the varieties do not appear to have recognised names. Elsewhere the smaller fruits have been variously called Paradise apples, Forbidden fruit, and Grape fruit.

As regards the proper classification of the West Indian varieties, I cannot do better than record that put forth by Dr. James Macfayden, the learned author of the *Flora of Jamaica*, which, however, he never lived to carry into more than one volume and part of another. Referring to the large-fruited sorts, he states: 'There are two varieties of shaddock. In the variety *a. maliformis*, the fruit is globose, with the pulp of a pale-pink colour, approaching to a very light yellow. In the variety *b. pyriformis* the fruit is more or less pear-shaped, and the pulp is of crimson colour, more or less intense. The second of these varieties is the more esteemed, being sweet and juicy and having only in a slight and palatable degree the acidity which abounds in the first. . . I may remark that I have always found the pear-shaped variety good, whereas it is seldom the case with the round-shaped fruit. There cannot be a doubt but that, if budding, as is done in China, were more generally practised, instead of trusting to propagation by seed, the fruit would be much improved.'

The smaller pumelows or shaddocks are ranged by Macfayden under a distinct species, which he calls *Citrus paradisi*. The tree is described as 30 feet high, of handsome appearance, with sub-erect branches and sharp at the apex. The leaves are oval, rounded, and smooth on both sides. The flowers have linear petals and the stamens are twenty-five in number. The differences between this and *C. decumana* appear to consist in the more erect habit of the plant, in the rounded (not emarginate) leaves, and in the linear-rounded (not oblong-obtuse) petals. With regard to the fruit he remarks: 'There are also two varieties of this species: var. *a. pyriformis*, Barbados Grape fruit; var. *b. maliformis*, For-

bidden fruit. The pear-shaped variety, as the shaddock, possesses most of the sweet principle, and is, on the whole a preferable fruit.' This classification was made by Macfayden nearly sixty years ago, therefore long before these fruits were so widely distributed as now in other parts of tropical America. He was so accurate and skilful an observer that, as far as the new world fruits are concerned, we cannot very well improve upon it. It is doubtful whether the small-fruited sorts he places under *C. paradisi* really deserve specific rank, but that point does not affect the main question with which we started, namely—what are the differences, if any, existing between the shaddock and the grape fruit? In summing up the results of the investigation, we may say that all the larger-fruited sorts may be called indifferently either pumelows or shaddocks. These are merely the eastern and western names for the same thing, and are perfectly interchangeable. No distinction appears ever to have been made between them. There are two well-marked varieties, one being globose, with the flesh of a pale-pink colour, and the other pear-shaped, usually with a deep-pink or crimson pulp. As regards the small fruited sorts, these, according to Macfayden may be either globose, when they are called forbidden fruit, or pear-shaped, when grape fruit is the older name. The name forbidden fruit (from a fancied connexion with the Garden of Eden) is tolerably old in the West Indies. Tussac, in the *Flores des Antilles*, published in 1824, gives a good figure of the typical shaddock, which he translates into the French *Chadec*. In Vol. III, pp. 73-74, he states: 'J'ai eu occasion d'observer a la Jamaïque, dans le jardin botanique d'Éast, une espèce de Chadec dont les fruits, qui n'excedent pas en grosseur une belle orange sont disposés en grappes: les Anglais de la Jamaïque donnent à ce fruit le nom de "Forbidden-fruit," fruit défendu, ou smaller shaddock.' Later on he refers to the same fruit in the following words: 'C'est une assiette de dessert très distinguée et fort saine' (p. 74). In the case of the forbidden fruit and grape fruit they are exactly reversed. As usually happens, when a name has become familiar in commerce, it is eventually applied in a much wider sense than the original one. Thus, the term grape fruit has become so general that any moderately large fruit provided the skin is pale-yellow, thin and smooth, and the pulp of a delicate flavour, is designated by it. The fruit commonly called grape-fruit in New York is really the forbidden fruit of the West Indies. The true grape fruit is pear-shaped, and according to Macfayden, when obtainable at its best, is preferable to the forbidden fruit. The fruit shipped from the Bahamas as grape fruit is usually round with a polished yellow skin of a silky texture and very heavy. This is probably one of the best of its class, and quite equal to Macfadyen's pear-shaped variety. Next comes some excellent fruit from Jamaica, no doubt that already referred to by Tussac under the name of forbidden fruit, a smaller shaddock. According to the New York estimation, this would be almost a typical grape fruit, supplying 'une assiette de dessert très distinguée et fort saine.'

Further information on the pumelow was contributed by Sir Daniel Morris to the *Gardeners' Chronicle*, 1896. Vol. II., p. 616, as follows :—

I have been asked more than once lately whether there is no fruit, yet unknown to most English palates, which might be introduced into this country, and form a pleasant article of food. As there seems to be some general interest in the subject, your readers may, perhaps, like to hear of some fruits which have come under my notice.

The pumelow of India, one of the giant members of the orange tribe, is well known to people who have lived in the East. Some very large specimens have been known to attain a circumference of more than two feet, and to weigh from 15 to 20lbs. Generally pumelows are not held in high esteem in India and Ceylon, except by those who have lived long there, and know how to select the best sort by their size and colour. The best Bombay pumelows are said to be exceptionally good. They have a pink pulp of a juicy character, sweet in flavour, with a slight but agreeable bitter taste. The first pumelows were brought to the West Indies by Captain Shaddock about 150 years ago. Since that time the fruit has always been known in that part of the world as the shaddock, in compliment to the person who introduced it. Owing to circumstances of soil and climate, and to the raising of plants almost exclusively by seed, many varieties have sprung up that have become recognized by distinct names. Of the larger fruits, the pumelow or shaddock proper, there are two well marked forms; the first is the apple-shaped shaddock, usually with a whitish or a pale pink pulp, the other is a pear-shaped fruit, with a pink, and sometimes a deep crimson pulp. Both these are large fruits, weighing from 3 to 6 lbs. in weight; they have the characteristic pale yellow skin, and inside there is a white pithy layer more or less thick; then comes the pulp with the vesicles or juice bags very prominent—indeed the latter are so distinct that they can be easily separated the one from the other. The bitter flavour is very marked in the inferior sorts, in some instances it becomes quite acrid. The best sorts have a sweetish flavour and only a slight taste of bitter, of the smaller fruits, to which Macfadyen has given the name of Paradise fruits, there are in the West Indies two well marked forms. The apple shaped fruits are known as forbidden fruit, while the pear shaped sorts are known as Barbados grape fruit. Both these are very attractive looking fruits; they have a pale yellow skin usually very thin, are soft and silky to the touch, while the pulp is sweet and refreshing. The slightly bitter flavour is regarded as giving them tonic properties of great value in dyspepsia and allied ailments.

During the last fifteen years the paradise fruits, or more correctly grape fruit, have been in great demand in the United States. They have been very strongly recommended by the medical faculty, and in consequence their use has become an important feature in the diet of a large number of the American people.

The consumption of them has increased by leaps and bounds, and every year for the past few years it has more than doubled. A few days ago (says *Garden and Forest*) 2 barrels of small-sized grape fruit realized the extraordinary price of £5 each in New York; and 7 barrels of similar fruit were sold in Philadelphia for £5 10s. each. Such fruit would retail at more than \$1.00 a piece. This is probably the highest price ever paid for specimens of the orange tribe. It shows very clearly how keen is the demand for grape fruit, and what importance is attached to it as a refreshing and healthful adjunct to the food supply of the United States. At one time there was a better market for grape fruit—or, rather forbidden fruit, as it was called—in the United Kingdom than in America, but the tables are now turned. America especially since the destructive frosts in Florida, has now absorbed almost the whole supply from the West Indies. Sooner or later, however, English people will realise the special merits of the grape fruit and a demand will arise for it, to the possible advantage of those West India Islands which are in a position to supply it. It would be well, therefore, for the people in that part of the world to establish small orchards of grape fruit trees of the best quality, and to be prepared to ship the fruit in such condition that they may get the best price for it. This would be one way of alleviating, to some extent, the depression under which they are now suffering, owing to the unremunerative character of the sugar industry.

The following, containing further notes on grape fruits and shaddocks, was contributed by Sir Daniel Morris to *Chambers' Journal* of January 30, 1897.

Under the title of 'paradise fruits,' Dr. Macfadyen, many years ago, described some interesting members of the orange family. Their origin was not clearly traced, but there was little doubt that they had been produced by seed variation in the West Indies. Their nearest relations were the common shaddocks or pumelows (*Citrus decumana*). These are well known as the largest of the citrus fruits; some fine specimens have weighed as much as 20lbs., and measured 2 feet in circumference. According to Alphonse de Candolle, 'shaddocks and pumelows are probably natives of the islands east of the Malay Archipelago.' They were found in a wild state by Seemann and others in the Fiji Islands and the Friendly Islands, so there is little doubt of their Polynesian origin. They are now distributed in most tropical countries, but, except in a few localities, they are not so highly esteemed, for instance, as the best oranges. Usually the skin is thick and pithy, and the pulp bitter, and there is little or no demand for them in commerce. The paradise fruits, on the other hand, are in great demand, and they are regarded as the most refreshing and wholesome of any of the citrus family. Recently in New York, some of the latter were retailed at almost fabulous prices, and the demand increases every year. The paradise fruits, while they fall specifically under *Citrus decumana*, or the giant Citrus, have many points of merit, not the least of which, is the keen preference shown for them by

the people of the United States. They are quite distinct from the true oranges, citrons, and other groups of the orange family.

The typical fruits of *Citrus decumana* are those known in India as pumelows (a contraction of *pomum melo*, the melon apple) called by the French Pompelmouse or Pamplemouse, and by the Spanish and Dutch Pompelmoos. As these fruits were first introduced to the West Indies by Captain Shaddock, in that part of the world they have always borne his name. Pumelows and shaddocks are only the old and new world names for the same fruit. Sometimes it is stated that the largest fruits are called shaddocks and the next in size pumelows. There is no authority for this distinction. In this place, I shall quote pumelows and shaddocks indifferently as convenient popular names for all the largest fruits of the typical *Citrus decumana*. A preference may unconsciously be given to the use of the word shaddock, but only because it is the most familiar name in the West Indies. As regards the varieties of these fruits existing in different parts of the world, they are for the most part distinguished by the locality where they are grown rather than by any character they may possess. For instance, in India the best pumelow, according to Bonavia, is the thin-skinned, red pumelow of Bombay. This is a perfectly globose fruit, very juicy, and with the pulp of a rosy-red colour. The botanical characters of *Citrus decumana* are perhaps more marked than in any other species. The tree is larger, and both the young shoots and under side of the leaves are covered more or less with soft down. No other species of citrus has the latter characteristic. The tree may be as high as 20 feet, with a flat crown and many spreading branches. Usually there are no spines. The leaves are distinctly rounded at both ends, with a notch at the apex; the edges are uneven or wavy, owing to the presence of a number of small depressions; the stalk or petiole is furnished with two broad wings, also wavy, and bordered with fine hairs. The flowers are somewhat like those of the orange, but larger, and are both white and fragrant; they are usually in clusters of three to nine. The fruit is spherical or pear-shaped, very large, sometimes even as large as a man's head, and very heavy. The juice is always slightly acid, while the rind in the common sorts is remarkably thick, with a bitter inner membrane. The vesicles containing the juice are very prominent, and arranged transversely; in the orange they are hardly discernible.

Pumelows or shaddocks differ from other citrus fruits in size; they are invariably larger than the largest orange and, in addition, are compact and very heavy. In colour, they are pale-yellow, almost like lemons, but they differ from the lemon in having usually a smoother skin. The flesh is pale-yellow or greenish-white; in some sorts there is a tendency to pink or crimson, as in the so-called 'blood-oranges.' The pink-fleshed shaddocks, if otherwise acceptable, are more esteemed than the white-fleshed. They are said to be sweeter and more juicy, and have only in a slight and palatable degree the peculiar flavour of the ordinary

shaddocks. Macfayden, sixty years ago, stated that he always found the pear-shaped shaddocks better than the spherical sorts. His experience is not invariably endorsed at the present time. Some of the spherical fruits are of a very delicate flavour, and, as already mentioned, the best of the Indian sorts are not only spherical, but have also a pink flesh.

So far, I have described the fruits of the typical *Citrus decumana* only. When we come to the smaller fruits, we find that both in the tree yielding them, as well as in the fruits themselves, there are certain distinguishing features which show they are rightly separated by Macfadyen, although we cannot go so far as he has done in assigning the plant producing them specific rank. Macfadyen grouped the smaller fruits under *Citrus paradisi*, thus expressing his appreciation of them by designating them the fruits of Paradise. He distinguished two varieties, to which he gave the names of forbidden fruits and the Barbados grape fruit. He described the tree as of handsome appearance, about 30ft. in height, with branches sub-erect and sharp at the apex. It will be noticed that in the shaddock the tree was 20 feet high, with a flat crown and spreading branches. The leaves are oval, rounded, and smooth on both sides. The flowers have linear instead of oblong petals, and the stamens are twenty-five to twenty-six in number instead of thirty to thirty-five. The fruits, as in the shaddocks, are either spherical or pear shaped. To the pear shaped fruits were assigned the name of grape fruit, because they usually grow in clusters; while the spherical fruits were called forbidden fruit from a fancied connexion with the Garden of Eden. This classification was made by Macfadyen nearly sixty years ago therefore long before these fruits were so widely distributed, as now, in various parts of tropical America. The forbidden fruit was known to Tussac in 1824, who called it 'Fruit Défendu, or smaller shaddock.' Later he refers to the same fruit in the following words: 'C'est une assiette de desert très distinguée et fort saine.' With the exception of the shape, forbidden fruits and grape fruits are very much alike, but they are both superior to any shaddock or pumelow—the fruits of *Citrus decumana*—while the smaller and more delicate fruits bear the distinctive name of paradise fruits. Of these the grape fruit is the one now so highly esteemed in the United States. The *Penny Cyclopadia* had adopted a similar classification even in 1837. It is stated: 'When these fruits arrive at their greatest size, they are called pompelloes or pomelmousses; when at the smallest, they form the forbidden fruit of the English markets. Another small variety, with the fruit growing in clusters, is what the West Indians call grape fruit.'

The grape fruit is not a shaddock nor a pumelow. It is quite a distinct fruit, and possesses exceptional merits; at its best, it differs from the shaddock as much as a fine apple from a common crab.

We may be sure that such keen-witted men as the fruit merchants of New York would not give high prices for grape fruit unless it were in great demand and thoroughly appreciated by people able to pay for a choice and delicate article. It is estimated that there were received in the United States last year grape fruit of the value of about £20,000. The demand for it is quite of recent date, but it is increasing so rapidly that in a few years the grape fruit will be one of the most valuable of the citrus fruits in the New World.

There are doubtless, many inferior sorts of grape fruit. In fact in the West Indies the plants have been allowed to run almost wild. No care has been taken to select the best varieties, or to bud and graft them, so as to keep them uniformly at a high standard. *Garden and Forest*, the leading horticultural journal in America, very wisely advises that, wherever the fruit is grown, it should be borne in mind that the highest success will only come with the use of the best varieties. There is no need to grow the thick-skinned and bitter sorts, and those with a dry, cottony pulp, while there are varieties both of the apple-shaped and pear-shaped fruits with a silky skin, full of juice and of a most delightful flavour, with just enough bitter to give it piquancy and suggest its valuable tonic qualities,

Mr. C. B. Hewitt gives the following account of the grape fruit:— At one time it was not thought much of in Florida, being only eaten by the old Floridians as a spring tonic, to drive away malaria. As soon as its great medicinal qualities were recognized, the doctors began to recommend it for indigestion, and also as an appetizer. The majority of people who eat this fruit do not like it at first, and many have not tried to like it, on account of the bitterness of the pithy membrane dividing the pulp. The correct way to eat this interesting fruit is to remove carefully this lining and to eat only the pulp. Some people prefer to cut the fruit open through the middle, take away the seeds, and then sprinkle a little sugar over the cut surface, and work it in with a spoon. Then let it stand for a little time, or overnight and eat before meals.' 'There is nothing,' continues this writer, 'in the fruit line yet discovered that possesses the medicinal qualities of the grape fruit. The demand for it will increase from year to year, and take up all the fruit that will be grown for the next twenty years. As many as 6,000 fruits are said to have been gathered from a single tree. This was an exceptionally fine specimen. It was described as 49 feet in height and 30 feet across its widest branches. It was thirty-four years old.' There are many varieties of grape fruit, some seedless, or with an occasional seed only.

The grape fruit is in such great demand in America chiefly because it has been so highly recommended by the medical faculty for its valuable dietetic and tonic qualities. It is also very refreshing, and is regarded as a specific for dyspepsia. The Americans are large fruit-eaters, and seldom begin or end a meal with-

out fruit of some kind. To supply them with bananas alone, there arrived from the West Indies during the year 1895, 185 cargoes of this fruit, comprising nearly 17,000,000 bunches, of the value of over £5,000,000 sterling. Jamaica furnished the larger share of this immense shipment of tropical fruit; and that island is becoming quite prosperous in spite of the great depression that has overtaken all the sugar-producing countries in that part of the world. Hitherto, Florida has supplied a good deal of the grape fruit for the American market, but since the disastrous effects of the 'freeze' of last year, the Florida plantations have been almost destroyed. Much English capital invested in fruit growing in that state has been lost, and many of our young countrymen settled there have suffered a severe reverse of fortune. Even where the groves are not quite destroyed, it will take years of toil and expenditure to bring them back to their former condition. For some time, at least, the chief supplies of grape fruit must therefore be drawn from the West Indies. The people in that part of the world would do well to establish trees of the best varieties, and take advantage of the opportunity to participate in what promises to be a steady and remunerative industry.

THE BREAD-FRUIT TREE.

Stephen Fuller, the writer of the following letter (one of the last he wrote in his official capacity), was agent for Jamaica in London for no less than thirty years—from 1765 to May 1795, when he was succeeded by Robert Sewell.

He belonged to a well-known Jamaica family founded by Colonel Thomas Fuller, a soldier of fortune, who, coming out under Venables in 1655, became a member of the Council. Other members of the family sat in the House of Assembly during the eighteenth century.

The Council and the Assembly at that period considered it desirable that, their agent should have a seat in the House of Commons, and when Sewell succeeded Fuller they raised the salary from £500 to £1,000 with that end in view.

Fuller represented Jamaica in the House of Commons during the early part of the struggle which led to the abolition of the Slave Trade, and was an out and out supporter of the planters' views, publishing various Reports on the subject by direction of the Assembly.

The bread-fruit trees referred to had been brought to Jamaica, from Otaheite, by Admiral Bligh, in 1791; for which Bligh received a vote of one thousand guineas from the House of Assembly of Jamaica, and the gold medal of the Society of Arts of London. The letter appears in the manuscript letter-book of the Agent of Jamaica for 1794-1801, in the Library of the Institute of Jamaica.

London, 31st March, 1795.

HONBLE. GENTLEMEN :

It is with singular pleasure I have heard that there are many of the breadfruit trees, now in fruit, and many more in blossom in our island. As we owe the blessing of this introduction entirely to the King, I am sure you will think as I do that he has a peculiar right to the primitives, the fruits first produced from those trees. I know nothing that would give his Majesty greater pleasure, and if it was accompanied with a proper compliment from the Legislative body, it would make the present still more acceptable.

The manner I would wish it to be sent in, if you think proper, is this, to send ten or twelve in number of the fruit, in a large jarr, covered with strong rum, well corked, bound with leather and pitch and resin melted upon the cork. And I would wish it to be directed to the Chairman of the Custom House, with a letter to him by the same ship (tho' I will signify to him that he may expect such a present), setting forth the reason of sending it to him, in order that it may not be overhauled by the searchers, who will be sure to do it some injury or other: and if you will give orders for it to be delivered to me, I will take care to get a capital flint glass vase for it, properly inscribed and to put some proof spirits instead of the rum and present it myself. His Majesty knows me, and has been pleased to express great satisfaction at the method I took two or three years ago to enrich his garden at Kew with a great number of Jamaica plants more than had been introduced there in twenty years before. I will consult Sir Joseph Banks upon it, and we will endeavour to make it an agreeable present, equally honourable to the maker and the receiver. I have been many years in pursuit of this object, even since Captain Cooke's returned from his first voyage to Otaheite; old Beeston Long and myself being the two first persons that subscribed our names to a paper drawn by myself promising a reward to the first person that should bring the Breadfruit tree to the Island of Jamaica; but all our endeavours proved abortive, till His Majesty most nobly undertook it, strenuously persevered in it after one failure, and at last accomplished it. His Majesty is a true friend to the colonies. I am of opinion we owe more to him than is generally known in regard to the defeat of the absurd attempt of abolishing the slave trade, which I think we shall hear no more of, even in the H. of Commons after the next general election. Till then, you will. I hope to live to see a considerable increase of negroes in our Island, and every one of them with two or three breadfruit trees in his own garden. They will then see who are their friends.

I have the honour to be, Honble. Gentlemen,
Your most obliged and obedient servant,

STEPHEN FULLER.

The Honble.

The Committee of Correspondence.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House, on Tuesday, 16th January, 1906, at 11.15 a.m. Present:—Hon. H. Clarence Bourne, Colonial Secretary, Chairman; the Director of Public Gardens, the Superintending Inspector of Schools, the Island Chemist, His Grace the Archbishop, Messrs. C. E. deMercado, J. W. Middleton, G. D. Murray and the Secretary.

The Secretary submitted the following letters from the Colonial Secretary's Office:—

1. *Contagious Diseases Animals Bill*.—Re Contagious Diseases Animals Bill, stating that it was not proposed to introduce the proposed bill at the next session of the Legislative Council.

The Secretary read a minute saying that when he was attending a meeting of the local Agricultural Society at Appleton, one small penkeeper said that he had lost 10 cows and one bull in two weeks and that the carcasses had been allowed to lie and rot. He suggested that a description of a few of the most contagious diseases among animals might be published throughout the island, that it might be made compulsory to report to the police the outbreak of any such diseases and the burning of carcasses ought also to be made compulsory.

(The Chairman here left the meeting to attend a meeting of the Privy Council and the Director of Public Gardens was asked to take the Chair.)

After discussion Mr. Middleton moved that members of the Board should meet members of the Board of Management of the Agricultural Society at the latter's meeting the next day and discuss the whole matter of legislation regarding contagious diseases among animals so as to get something practical settled as soon as possible.

This was agreed to.

2. *Coco-nut Disease*.—Letter from Mr. G. P. Dewar, Harmony Hall, Duncans, asking if the Government could not introduce some law to make it compulsory for the owners of diseased coco-nut trees to cut them down and burn them, as the disease was prevalent in Hanover where he was in charge of a valuable property, and seemed to be gradually spreading without anything being done to prevent it.

The Secretary was instructed to reply first that the matter had been referred to the Director of Public Gardens, who had replied that the same bud-rot disease had been dealt with in the Bulletin, in which was stated the result of experiments laid down by him and carried out by Mr. Cradwick, that the disease could be prevented by spraying with Bordeaux mixture; and secondly that the Board would arrange for Mr. Cradwick to give a demonstration at Lucea. On the suggestion of the Archbishop it was resolved

that the Director of Public Gardens should publish a leaflet embodying what was known concerning this disease.

3. *Sweetstuff Factory*.—Letter from Mr. Edward Redsue, British Colombia, suggesting that a big sweetstuff factory should be started in Jamaica for the production of Jamaica Rum Lime Tablets and other Rum flavoured Sweetmeats.

The Secretary was instructed to ask the authority of the Governor to have this letter published in the newspapers for the information of all whom it might concern.

4. *Jamaica Scholarship*.—Letter from Schools Commission *re* Jamaica Scholarship. Mr. Cousins' memo *re* proposed alteration in Jamaica Scholarship with criticisms of the Superintending Inspector of Schools and the Archbishop were also read.

After discussion the Archbishop moved that—

“In the opinion of the Board of Agriculture it is undesirable to allocate the Jamaica Scholarship every third year for agriculture, that a more efficient stimulus of general agricultural education might be effected on the following lines as indicated more fully in the correspondence, each of the Scholarships to be available annually :—

1. The restriction of the Jamaica Scholarship to as low a point as is consistent with making it really available for the purposes of various classes of students.

2. The appropriation of the remainder of the available money for an Agricultural Scholarship tenable for two or three years at an Agricultural College abroad to be awarded upon the Diploma Examination of the Board of Agriculture.” This was unanimously agreed to.

School Chart.—His Grace the Archbishop brought forward a matter which had been discussed at the Board before and which had been in hand for nearly two years. This was a list of “Agricultural Dont's” prepared by Mr. E. J. Wortley in conjunction with Messrs. Hicks and MacFarlane, to form a chart to be hung up in schools and be repeated over twice a week by scholars. The Secretary was instructed to get copies of this typed and sent to each member of the Board who were asked to make any suggestions.

Mr. S. Olivier.—A letter of acknowledgement from Mr. Sydney Olivier *re* the Locked Still matter was directed to be circulated.

Cotton.—A letter from Mr. G. Musgrove, Jackson, Mississippi, in reply to the Secretary's letter sending him a sample of cotton was submitted and directed to be circulated.

Reports.—The following reports from the Chemist were submitted :

1. Agricultural Scholarships Examination.
2. Report work of Agricultural Students for Michaelmas Term.
3. Report on Banana Soils of St. Mary.
4. Progress Report Distillers Experiments.

5. Appointment of two assistants, Sugar Department.
These were directed to be circulated.

The Director of Public Gardens submitted Reports as follows :—

1. Experiment Station.
2. Instructors.
3. Letter from India re varieties of bananas.

These were directed to be circulated.

The following papers which had been circulated, but not yet submitted to the Board, were submitted :—

1. Memo re proposed alteration in Jamaica Scholarship.
2. Report of Committee appointed to investigate the Cotton Caterpillar Pest in Jamaica. It was resolved to publish this report in the form of a special 'Bulletin.'
3. Publications on 'Bud-rot Disease of Coco-nut Palms' and forwarding diseased plants and insect pests, both sent by the Imperial Department of Agriculture, Barbados.

[Issued 17th February, 1906.]

Printed at the Govt. Printing Office, Kingston, Jam.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

MARCH, 1906.

Part 3.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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P R I C E—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :

HOPE GARDENS.

1906.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

LIBRARY
NEW YORK
BOTANICAL
GARDEN

Vol. IV.

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Part 3.

CULTIVATION AND MARKETING OF CITRUS
FRUITS.

BY H. Q. LEVY.

*An Address delivered at the Annual Meeting of Elementary School
Teachers for Agricultural Instruction, January, 1906.*

The subject set down against my name on the Syllabus, is "The Cultivation and Marketing of Citrus Fruits." Some may well ask why it is that I persistently advocate the cultivation of Citrus fruit year after year when we cannot dispose of those we already have growing wild about the different parts of the Island. My answer would be, as I have often repeated, because by cultivating standard varieties we would have a ready-made market for all the fruit we could grow; secondly, we would have a more even grade of fruit that would better stand shipment, and thirdly, by having the trees in grove form we could handle them quicker and more carefully than by the present system. I advise, time and again, the planting of the improved varieties of oranges and grape fruit as I firmly believe that there will always be a market for them if shipped in a proper manner and given every chance of their arriving at their destination in a good condition; on the other hand, I have always said that at no distant day we will have no sale for our wild oranges except when the foreign markets are bare of supplies. Now this is a subject well worth considering, for it means bread and butter to many of us. Are we going to waste time until we are elbowed out of the market altogether? or are we going to set about planting improved varieties and so gradually capture a portion of the market that is ready waiting for us? Do not be discouraged by the number of failures that have taken place in the past, for if you enquire into each one you will be sure to find that in every case the parties were doomed to failure from the very commencement. Citrus culture needs careful study and a special

APR 14 1906

knowledge of the requirements of the tree to ensure its success, so that at the outset when men who knew nothing of the cultivation or principles to be followed, launched out by planting 30 or 40 acres of oranges and grape fruit, were simply tempting Providence.

Now it is not my intention or desire that any of you should go away from this Lecture Hall believing that by taking up citrus culture you are going to make your immediate fortunes, or that even if you follow my instructions implicitly there will be no failure; these things I cannot promise, but this I will say, that it is my firm belief that all those who embark in citrus culture on a small scale at first, and follow out my instructions will in the years to come find they have in their small groves quite as profitable an investment as any other product they may grow, and one that is especially suited to the man of small means.

For all practical purposes, in dealing with citrus plants this afternoon, although there are endless varieties, we need only take into consideration for commercial purpose, two of the species, the "Sweet Orange" and the Pomelo, or as we call it in Jamaica, "Grape Fruit," and as the cultivation and treatment of both are similar, I will treat them under one head, which will both save time and prevent any undue confusion in your minds.

In the first place I would particularly warn you against the great mistake most people have made in starting on too large a scale, a quarter of an acre you will find will be quite large enough an area for a start, extending your cultivation as you gain experience and your means allow. A universal mistake that nine-tenths of the men in Jamaica make, whether in Commerce or Agriculture, is, taking on more than they can manage. Always bear this in mind, that whereas the right amount of money spent on just sufficient cultivation, may bring you in a handsome profit, the same amount spent on twice the acreage or undertaking, is sure to land you in serious losses and make you disgusted with that special industry.

In starting a citrus grove the first thing to be considered is suitable land, and this is a great point if you desire to meet with success. In every case a gentle slope will be found to give much better results than very level land, heavy clays should be avoided, a soil of limestone formation such as the red soils of St. Ann and Manchester, do admirably for oranges and grape fruit, and you might say constitute the natural home of the orange in Jamaica. The ideal location for a grove will be found on soils that are interspersed with limestone rock, but yet having plenty of deep soil around them; it will not be so easy to cultivate but will be found in the long run to give better results. A rich sandy loam is also good, but you will find that this description of soil, being found nearer the sea coast, is accompanied by a very dry and hot atmosphere, the fruit takes longer to mature and the colour will not be so good when it ripens.

Having chosen the spot for your grove you must set about propagating plants to stock it. For this purpose I would advise your

starting a small nursery, as it is better to grow your own plants than purchase them from other parties, it will be found cheaper, more interesting, and when the planting time arrives, you may cull out all the bad ones, only planting those with good fibrous roots and well-developed stocks.

I will not go into the method of forming a nursery, as I understand that is part of the course which you are now undergoing in the section of field work. But I must tell you this, under any circumstances use only grape fruit stock for budding on, and at all times use budded trees in preference to seedlings for your groves, and you are sure to get the same quality and kind of fruit as the description from which you took your bud-wood. But if you grow seedlings and allow them to become permanent trees you are sure to get the majority of them bearing very indifferent fruit, and of uncertain shipping qualities. Grape fruit is an exception to this rule, so long as you procure your seeds from trees that are far removed from any other variety of citrus plants, but even then the fruits from which you take the seeds, although looking fine and a desirable sort, may have been hybridized by some inferior one in that particular section.

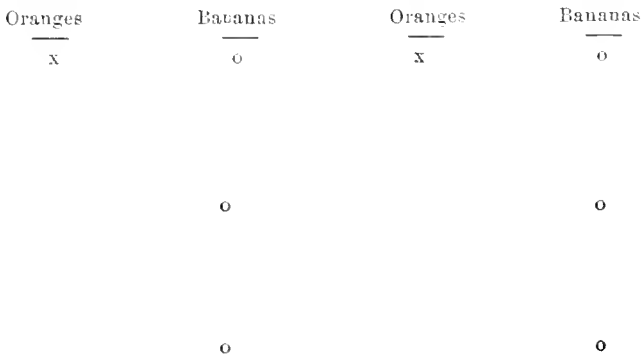
Having started your nursery, the plants doing well, and near ready to be transplanted, that is, when they have reached a height of about two or three feet, it is best to turn your attention to the land chosen for your grove. It should be cleaned and lined out,—for oranges 20–25 feet apart, and for grape fruit 25–30 feet, the rows running parallel and square to each other; at each stake dig a hole 2 feet in diameter and about the same depth, say one month before planting; leave it open until just the day before so that the sun may get a fair play on the soil in the bottom of the hole. In filling in a hole put the top soil at the bottom and fill in with the surrounding top soil scraped from around the hole, using the earth from the bottom of the hole to replace any such soil taken away from the adjacent land. The tree should be planted on a hill somewhat resembling that used for planting yams but not quite so high and somewhat more rounded over the top, this will enable your plant to be placed about 6 inches higher than the surrounding soil. In taking up the plants from the nursery be careful to preserve every small root, do not take up more than you can plant immediately and never expose, even for a moment, the roots to the direct rays of the sun or to high winds; the ends of the longer roots should be cut back a few inches, also the tap root, the head of the plant must have its share of trimming and all the leaves cut away three-quarter of their area, as by so doing you equalize to a certain extent the shock to the plant that you have caused by disturbing the roots. Arriving with your plant at the side of the hill, use your hand to make a hole in the centre of it, large enough to take in all the roots when laid out in their original position: stand the plant upright, then put in some earth and firm it well around the tap root, leaving no air spaces, as this would be sure

to cause the death of the plant or stunt its growth: pour in some water and put in more earth, firming it again, continue putting earth and water alternately until the soil is level with the highest root; that highest root should now be about 6 inches higher than the surrounding soil. As the earth settles, so will the tree, until it takes up a permanent position with the top root just exposed to the air. Citrus plants should never be planted deep, better to have them six inches too high than half an inch too deep; defective planting has been the cause of more failures than all others put together, as by planting too deep you will find it make no growth and be a fitting subject to all the diseases to which the citrus family is subject, and these are many, especially when planted under unfavourable conditions. It will be well to spread some dry grass or trash of any kind all over the hill until you are certain that the trees have taken root, say in about four weeks, as by so doing you conserve the moisture in the soil; if no rain, you must water at least once a week until the first growth after planting has fairly ripened, this stage is reached when the new leaves turn to a dark green.

As it would be very expensive to keep the land clean for a number of years where only citrus plants are cultivated it is advisable to establish catch crops which would give some revenue and at the same time not injure the trees in your grove. Fortunately there are many such crops that may be grown without detriment, such as bananas, cocoes, yams, cassava, corn or peas. Try to avoid planting sweet potatoes in any citrus grove, except you plant only two rows down the centres and keep the vines from spreading too near to the trees, the same applies to pumpkins.

I will now demonstrate to you the distances apart it would be best to plant the plants I have named so as to give you a maximum yield and a minimum amount of damage to your citrus cultivation.

(1) Banana as catch crop until orange trees are 2 or 3 years old, orange trees 20 ft. apart, bananas in the middle of the rows at a distance of 8 ft. from one another:—



Always keep your land clean and as soon as your trees start to bear, remove all catch crops from the land except peas which you may continue to grow for some time as this being a nitrogeous crop rather adds to the fertility of the soil than otherwise.

I should not pass this stage without giving you some advice as to the varieties of oranges and grape fruit to plant. In the citrus family we have a large number of species, and these are again divided up into endless varieties. For instance take the sweet orange. Of the cultivated varieties we have under the class called Navel :— Petersfield, Washington, Australian, Thomson's Improved, &c., and under ordinary or seeded varieties, St. Michael, Valencia, Ruby, Homosassa, Parson Brown, Majorca, Jaffa, Pineapple, Tardif, Rivers, Blood, &c., and a host of others too numerous to mention ; then it is almost the same with grape fruit ; the imported varieties include the following :—Marsh seedless, Triumph, Pernambuco, Royal, Walters, Duncan, &c., and in Jamaica there are almost as many varieties as there are trees in the island. But for our purpose we can bring the oranges down to two or three varieties that are worth while cultivating. I would advise your propagating in preference to all others the Petersfield Navel as being the most vigorous grower and heaviest cropper of them all ; the Washington and Thomson's Improved Navel are also very good ; all Navels are classed as seedless varieties. Of the seeded sorts you cannot get a better than the Pineapple, for although it contains a very large number of seeds it is a very strong grower and cropper, and is seldom attacked by disease of any kind, and having a very tough skin, is one of the best shippers I know of. Of grape fruit I should advise your planting some selected Jamaica variety as the foreign sorts are not to be compared with them either for flavour or texture. I have tried all the oranges and grape fruit quoted, therefore I speak from actual experience.

The citrus tree requires very little pruning except in the time of its first growth after planting when all suckers below a height of two feet from the ground should be removed with a sharp knife and covered with some paint, after that just prune up the limbs that have a tendency to droop towards the ground, and any dry branches ; more than this would not be necessary.

With manuring we have to be very careful, as the citrus are very particular. Stable manure of any kind should never be used except very old and well rotted, the same applies to that obtained from the pig. Sheep manure is different, it can be used at once. Ashes are good at all times. Remember all manures must be applied in advance of the roots so that it may be thoroughly incorporated with the soil before the roots reach it, in which case it will be of benefit to the tree, otherwise applied it will bring on endless diseases of the root.

This brings us to the stage when I must say something as to the diseases of the citrus. All are more or less caused from bad management, such as planting too deep first and foremost, the appli-

cation directly to the roots of rank manures, bad cultivation, and a disease that I call "Greedy Choke Puppy" i.e., planting catch crops right up to the trees, allowing pumpkin and bean vines to grow all over them.

I will first deal with a disease known as "Foot Rot." It is first observed by a yellowish gum exuding from the roots or the trunk adjacent to them and when the bark is peeled off the wood immediately under it will be found to be of a brownish colour in the first stages, and later quite dead. This disease, if handled at once can easily be cured; first remove the soil from around the root for about 18 inches, cutting away all diseased bark and wood and applying white-wash, with a little coal tar added, to the cut surfaces and allowing the hole to remain open until filled up by the natural washing of the rains.

"Die Back" as its name denotes, is a dying back of new growths and smaller branches. This is due to the application of highly nitrogeneous manures and also wet soil; if these causes are removed and some dry wood ashes applied to the root system the trees will soon recover.

"Scale Insects" are more prevalent in densely shaded groves and poorly fed trees. They exist under the most favourable conditions and if not checked will eventually kill the tree. For these pests soft soap emulsion is a good remedy, but it has to be repeated until you have eradicated the pests, and ever after keep a watchful eye for the return, dosing them as soon as they make an appearance.

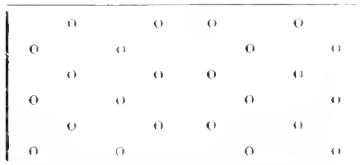
What I have told you will be quite enough to give a fair start and if you follow out my instructions as regards planting and growing the catch crops I have mentioned, you will find at the end of about four years you will have a nice grove that will be capable of helping out your income and which has cost you almost nothing as far as ready money is concerned

I hope I have not wearied you with this long string of details, but they are all quite necessary to entail success and must be carefully followed.

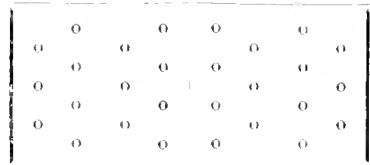
Now there is the other part of my discourse which I will treat as briefly as possible, and that is the marketing of citrus fruits. The present system I think is an impossible one, and is bound to bring ruin sooner or later to all concerned in it. I am sorry to have to say it, but our ordinary labourer is far too careless an individual to be trusted to pick and handle oranges and grape fruit all over a property as is now done. To get good work you must personally supervise the picking, and this is not possible where you have to employ dozens of hands scattered over a large area. In a grove it is different as the trees are blocked together and you can take row by row; then the trees being of lower growth, most of the fruits can be picked directly from the ground or from short ladders, put in small canvas bags hung from the shoulder and these

when filled emptied into the field boxes, which in turn can be carted to the packing house instead of the fruit being bulked in a cart as is done at present. Citrus fruits should at all times be handled as carefully as eggs; in picking, if an orange should drop on the ground destroy it at once, do not let that orange get in your pack as it will be sure to rot and contaminate others. If possible clip the oranges directly from the trees as by doing this the buds immediately behind the oranges, which will form the growth for the succeeding crop, are not destroyed as is done when a part of the stem is picked from the tree along with the fruit. After picking, oranges should be placed in thin layers in the packing house, remaining thus for at least four days before packing and grape fruit at least a week; by that time the skins have become tough and all bruises are easily recognised. All fruits bearing these marks should be discarded. The fruit is now ready for packing operations. First all fruit should be divided into three classes, brights or fully ripe and clean, secondly, fully ripe but discoloured or russet, and thirdly, greenish fruit; then each of these grades must be sized and packed separately. Now wrap in tissue paper, if possible bearing the packer's Trade Mark, then pack in Standard size boxes, each box holding according to the size of orange or grape fruit the following number of fruit. The standard packs for oranges are 96, 112, 126, 150, 176, 200, 216, 225, 250; smaller oranges than these are generally classed as unmarketable. Grape fruit are packed in the following sizes.

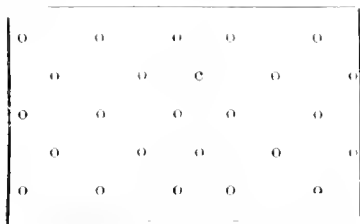
The method of placing oranges in the box to get them to hold the exact quantity is illustrated by the following diagrams* :--



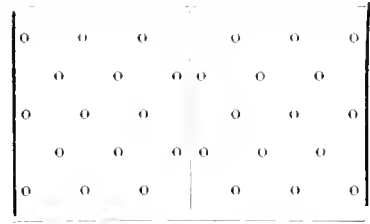
1 Packing 96 to the box: four layers, alternating, as in A and B.



2 Packing 112 to the box: four layers, alternating, as in A and B.

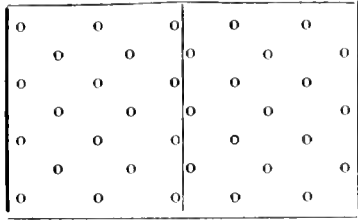


3--Packing 126 to the box: first, third and fifth layer as in A, and second and fourth layer as in B.

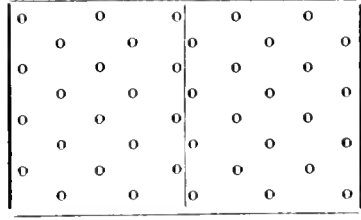


4--Packing 150 to the box: five layers, alternating, as in A and B.

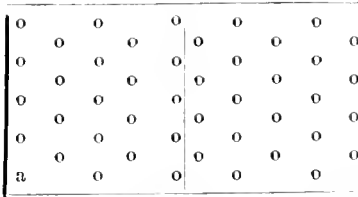
* See Bulletin of the Botanical Department, December, 1895, page 283.



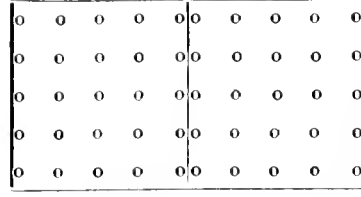
5—Packing 176 to the box; first, third and fifth layers as in A, and second and fourth layers as in B.



6—Packing 200 to the box; five layers, alternating, as in A and B.



7—Packing 225 to the box; five layers, alternating, as in A and B.



8—Packing 250 to the box; five uniform layers.

Always remember that neatness counts for much in putting up oranges. After packing slightly above the edges of the box, this is as it should be, in putting on the cover use gentle pressure distributed as even as possible over the whole surface to get the fruit to settle down; then nail on the cover with three straps, which should go completely around the box; neatly stencil your mark and despatch. All this of course refers to the packing of boxes. With barrels it is different. The oranges should be allowed to remain in the house as before, and as it is unnecessary to size as with boxes, this operation is saved. Neither is it advisable to wrap in tissue paper; ordinary straw paper being the kind adopted. It is not generally known that it requires an expert to properly pack a barrel of oranges, but nevertheless such is the case, and this is how it should be done. First search the barrel well for any nails that may be protruding inside through carelessness of the cooper, then start by packing oranges around the outer edge of the bottom of the barrel, using a slightly smaller size of orange for the first row round than you intend to put in the middle part; this will compensate for the inside lining. Turn all the whorls of the paper up for about four layers and see that as far as possible each layer after the first one contains the same size oranges, as the object should be to get each layer exactly level before starting another one. Never use your thumb to push an orange in place; you are sure to injure it, but use all your fingers to give a gentle pressure sideways to each orange; when you come to the centre, if space allows, put in three oranges at once and use the palm of your hand to gently firm the three down into their place and so act as a wedge against all the others; continue each row like this until you come to the last, which should just come level with the top of the barrel. Place the heading on top of the oranges and give the

barrel a slight but sharp rocking motion to and from you, pressing the top down with your elbows in the meantime; on uncovering you will find that the fruit has settled down just to the chine of the barrel; after heading up, stencil and despatch.

With these details I must bring my lecture to a close, but before doing so, let me seriously impress on all of you, the desirability, in fact the absolute necessity, of the better handling of our fruit. An orange or grape fruit is not an India rubber ball, but a fragile fruit, which if properly handled can be kept for months so long as it is well ventilated, but if bruised at all will be decayed and unfit for anything after a few days, and in some instances, after a few hours. Your obligations are not over when you have nailed the heading down; they continue until the fruit reaches the consumer and he finds it the article you represent it to be. You call the shopkeeper a dishonest and unscrupulous man who sells you an article that is not up to that standard he represents it to be; well the same name applies to the packer who gets an order for good marketable fruit, but instead puts up half rotten and unmarketable stuff or handles the fruit carelessly and so jeopardises its keeping qualities. Also remember that you are not only injuring your own name by pursuing this dishonourable course, but that of your country and its products in the markets abroad, and that if some reformation is not immediately started these same markets will be forever closed to all of us.

TOBACCO OF JAMAICA :— VI.*



32 S.S. 371

Colonial Secretary's Office, 30th January 1906.

SIR,

I am directed to transmit herewith, to be laid before the Jamaica Agricultural Society, for their information and for publication should the Board of Management so desire, a copy of a despatch from the Secretary of State for the Colonies, enclosing copy of correspondence in regard to Mr. F. V. Chalmers' experiment of blending Jamaica with Virginia tobacco for use in the Navy.

I have the honour to be,

Sir,

Your obedient Servant,

T. L. ROXBURGH, Asst. Col. Sec.

371

Downing Street, 30th October, 1905.

Governor Sir J. A. Swettenham, K.C.M.G., &c., &c., &c.

SIR,

With reference to my despatch No. 347 of the 6th inst., and to previous correspondence, I have the honour to transmit to you for your information, the accompanying copy of a letter from Mr. F. V. Chalmers relative to the supply from Jamaica and other British

* Continued from *Bulletin of the Department of Agriculture* Dec. 1905 page 271.

Colonies of the tobacco required for His Majesty's Naval service, together with copies of correspondence with the Admiralty on the subject.

I have, etc.,
(Sgd.) ALFRED LYTTTELTON,

13 Devonshire Square, Bishopsgate, E.C.,
20th September, 1905.

C. P. Lucas, Esq., C.B., Colonial Office.

SIR,

I have the honour to report to you the result of my interview with you some time since, upon the introduction of Sir Alfred Jones. I have been twice to the West Indies, Jamaica, and have also reported upon growths from Barbados and St. Kitts to the Imperial Commissioner of Agriculture. At the request of the Lords of the Admiralty, I blended and manufactured 8,657 tins of tobacco by way of experiment for the Navy, and I am pleased to tell you that the production is second to none. Should this meet with the approval of the seamen, it will give a great impetus to the West Indian Tobacco Industry, and I see no reason in future, if proper care and advice are given, why the whole of the tobacco for the Navy should not be composed of tobacco grown in one or other of the Colonies, entirely eliminating foreign growth. Such being the case, Colonial tobacco would vie with American or any other growth. In other kinds of tobacco, I have advised Jamaica to experiment and the results are most gratifying, and I have reported that in my opinion, with some small modifications the productions should compete with Havana and Sumatra, and I am told the increase in acreage this year is to be very considerable, but this experiment will have to be watched most carefully and continuously or there will sure to be delay, if not relapse.

I am, etc.,
(Sgd.) F. V. CHALMERS.

33923-1905

Downing Street, 26th September, 1905.

The Secretary to the Admiralty,

SIR,

With reference to your letter of the 15th of December last, (V. 8192) relative to Mr. F. V. Chalmers' suggestion for the supply from British Colonies of the tobacco required by His Majesty's Naval service, I am directed by Mr. Secretary Lyttelton to acquaint you, for the information of the Lords Commissioners of the Admiralty, that he understands that 8,657 tins of West Indian tobacco have been supplied by Mr. Chalmers for the Navy, by way of experiment, and I am to state that Mr. Lyttelton would be glad to be informed of the result of this experiment.

I am,
(Sgd.) C. P. LUCAS.

Admiralty, S.W., 21st October, 1905.

The Under Secretary of State
for the Colonies, Downing Street,
SIR,

I am commanded by my Lords Commissioners of the Admiralty to acknowledge the receipt of Mr. Lucas' letter of the 26th ultimo, No. 33923/1905, on the subject of the supply from British Colonies of the Tobacco required for H. M. Naval service.

2. In reply, I am to acquaint you for the information of the Secretary of State for the Colonies, that with the assistance of Mr. Chalmers, the Admiralty obtained a supply (1,508 lb.) of Leaf Tobacco from Jamaica, but, as it transpired that this tobacco by itself was not suitable for pipe smoking and that there is not at the present time any Colonial grown Tobacco suitable for blending with it, arrangements were made for it to be blended and manufactured with a quantity of Virginia grown Tobacco, the proportion being 1,508 lb. Jamaican to 5,075 lb. Virginian. This preparation is now undergoing trial in the Fleet and my Lords will be happy to communicate the general results of the experiment in due course.

3. As, however, more than 75 per cent. of the blend now under trial is of American origin, it is evident that this test does not go very far in the direction of substituting Colonial for Foreign grown Tobacco, and it is doubtful whether such a step is practicable at the present time. It is true that My Lords are informed that much attention is being given to the cultivation of Tobacco in Victoria and Rhodesia, and that it is hoped eventually to produce there a type possessing the same qualities as that now grown in Virginia, and therefore suitable for blending with West Indian Tobacco. But planting in these Colonies seems to be, as yet in the experimental stage, whilst, so far as their Lordships are aware, supplies even of Jamaica Tobacco, are not at present procurable in the open market in any quantity.

4. In the event, therefore, of the present trial proving successful, it must still be a matter for careful consideration whether any reliance can be placed upon obtaining regular and sufficient supplies of Colonial grown Tobacco at a reasonable price, and it would be very helpful to their Lordships in dealing with this question if they can be given fuller information with regard to the position and prospects of the Tobacco planting industry in the Colonies generally, and also as to whether the Secretary of State is preparing to take any special action in regard to the promotion of Tobacco cultivation which will be likely to assist the Admiralty in obtaining adequate supply from Colonial sources.

I am, etc.,
(Sgd.) GEO. H. HOSTE, Pi. Sec.

B

The following paragraphs are taken from a letter of a correspondent in Africa, who has had considerable experience in growing Sumatra tobacco in Sumatra. His notes will be of great

interest to those who are engaged in the cultivation of this tobacco in Jamaica :—

Many thanks for Bulletin of July, 1905, which I have read with interest. I have further received your letter of the 12th October and in reply to your query *re* fermentation.

A light coloured leaf in Sumatra tobacco by no means implies want of fermentation. Most of the cigar manufacturers are under the impression that fermentation darkens the leaf, which it does of heavy tobacco, but a certain proportion of Deli leaf is very light coloured (L. sorting mark) and sells at the highest price for the American's in the Amsterdam market.

My experience is that a cigar manufacturer of course knows whether a leaf suits him or what its faults are, but when they try to find a reason or suggest a remedy for these faults, they are at sea, because they have no experience as growers.

Twenty* tons is a good weight of Sumatra leaf to ferment; less would probably be insufficiently fermented, therefore this tobacco is not a poor man's business.

With regard to your Bulletin, which is of great interest to me, you may like to have the following notes, but having no experience of your climate or soil, of course they must be considered merely in the light of Sumatra and African experience, and for this reason may not be of great value.

Topping—I see you did not top apparently, but let the plants flower. If I remember aright, this was done also in the Connecticut Valley; it was also tried in Deli about 1897, but abandoned in favour of the old plan of topping, as it was found the leaf by not topping was too papery to work, also the lengths were poor.

Age of plant when harvested—The quicker the growth the finer the leaf of course. In Deli, 100 to 110 days, from date of sowing to harvesting, is the rule.

Curing—Yours is the first attempt I have seen to grapple with the problem of too rapid curing in the Bam; a state of affairs which seems to prevail everywhere I have tried Sumatra tobacco, except in the very moist atmosphere of Sumatra itself.

Here we ran three streams in furrows through the C. Bams day and night while the tobacco was curing, also watered the floor heavily, with however but little effect; the dry bulb of Psychrometer still showed 10° and 12° difference to the wet one, consequently the leaf cured blotchy.

I should like to try the method of hanging the cloth round Bam but should think it expensive. I note you partly sweated the leaf on floor before hanging to turn it yellow. Perhaps in your climate this may do well, but in Deli we were specially warned against this, as "green sweat" is said to give the leaf an acrid flavour, impossible to eradicate by fermentation.

* A press of half a ton of Havana tobacco ferments well, and if part of this, say 90 lbs., be Sumatra, the latter is fermented. *Editor.*

Fermentation—Your tobacco would appear to have followed the lines of the American Sumatra leaf in the Washington bulletins which perhaps suits that leaf, but it is quite different to a Deli ferment.

For instance, you ran it up on first bulking to 125 F. 52 C. I should have turned it at 40 once or twice, and then brought it gradually up to 52 or higher, but of course all depends on how the tobacco looks when turned.

Too rapid fermentation makes the leaf first tender then weak, and an excessive rise in temperature may burn it altogether. Too slow and you dry it out, so it's like fly fishing, cast too fine or too coarse and you lose your fish.

It would seem the climate of Jamaica is very suitable for the growth of a nice cigar leaf, and I trust that your experiments will induce growers to take it up.

Our shade unfortunately was blown right away in a storm, so I have no shade tobacco in Bam. The plants were about 3 feet high, growing fast and gave every promise of being a fine leaf, so I was sorry.

Perhaps later you would feel inclined to exchange samples of our fermented leaf. I am just beginning fermentation now and will be finished about March.

I find a good plan is to get a few bundles of Sumatra leaf to keep by one as a standard.

A NEW NAME FOR A JAMAICAN FERN.*

By WILLIAM R. MAXON.

In the first fascicle of Christensen's Index Filicum (1905), *Acrostichum lomarioides*, Jenman, a middle American species, is reduced to *A. aureum*, L., supposed to be dispersed generally throughout the tropics. In first proposing *lomarioides*, Jenman suggested that *A. aureum* might prove an aggregate of several more or less closely related species; and arguing from analogous cases we judge this to be likely. But at present we are concerned only with *lomarioides*, described at length by Jenman; this and *aureum* he held to be as distinct as "any two closely allied species in any genus." Several recent writers have not held to this opinion; but from field observation and the collection of adequate material we are quite convinced that the two are, as Jenman has said, absolutely distinct, and we shall try to prove this conclusively in a later paper.

Jenman's use of *lomarioides* for an American plant is, however, invalidated by the earlier application of the same name to an East Indian species, by Bory. In its stead we propose, with the same type:

Acrostichum excelsum nom. nov.

Chrysodium lomarioides, Jenman, *Timehri* 4: 314. 1885.

Acrostichum lomarioides, Jenman, *Bull. Bot. Dept. Jamaica*. II. 5: 154, 1898.

Not Bory, *Belang. Voy. Bot.* 2: 21. pl. 2. 1833.

* Proc. of The Biological Society of Washington. Vol. XVIII. Oct. 17. 190

The type of Jenman's species is from British Guiana, but the plant occurs also in Jamaica, Porto Rico, Florida, Mexico and Guatemala.

SELECTION OF SEED : COCO-NUTS.

The coprah produced by 1,000 Ceylon ordinary nuts is about twice as much as that obtained from Seychelles nuts. This result has been obtained in the same soil, under the influence of the same climate, and is entirely due to selection. It is to be hoped that the discussion raised on the subject by the planters after their having seen the nuts introduced from Ceylon may prove the beginning of a careful selection of nuts for planting in Seychelles. Many of them have already informed me that they have found on their estates a few of their trees producing nuts similar to those of Ceylon and that they intend keeping them for propagation. It is probable that the trees which produce very small nuts have less requirements than those which produce bigger nuts, and that varieties which produce big nuts normally will bear smaller nuts if they are starved out. But when one thinks of the very trifling amount of plant food which is removed from the soil by coconut cultivation, there seems to be no difficulty in supplying the elements which are required to a greater extent by the big-nut varieties. The planter must choose between having small nuts without trouble and having double the crop by using proper methods and selection.—*Annual Colonial Report, 1904, Seychelles.*

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The usual monthly meeting of the Board of Agriculture was held on Tuesday, 13th February, at Headquarter House. Present: the Director of Public Gardens, the Island Chemist, His Grace the Archbishop, Messrs. C. A. T. Fursdon, C. E. deMercado, J. W. Middleton, and the Secretary.

The Secretary read an apology for absence from the Chairman, Hon. H. C. Bourne, intimating that there was a meeting of the Privy Council which he had to attend at the same hour, and asking that Mr. Fawcett might take the chair.

The Secretary read minutes of previous meeting which were confirmed.

The Archbishop asked leave to bring up a matter he had mentioned at last meeting, viz.: the question of a Jamaica Agent in London to protect and facilitate their commercial interests. The same matter had been discussed some years before by the Merchants' Exchange and such an appointment had been approved of, the only objection being lack of money. Mr. Middleton in support of the proposal, moved that a Committee be appointed.

The Chairman asked the Archbishop and Mr. Middleton to form this Committee, and make a report to the Board on the subject.

As the day and hour of the meeting of the Board so often clashed with the meeting of the Privy Council, it was resolved to alter the day to the Monday of the same week in the month, at the same hour.

The Secretary read the following letters from the Colonial Secretary's Office :

1. Authorising publication of Mr. Edward Redsue's letter re Sweetmeat Factory.

In connection with this the Secretary said that sweetmeats were now being made at the Barossa Creamery and the person doing so had promised to experiment in the direction mentioned, namely rum and lime juice tablets.

2. Sending copy of report of the Second International Congress of Master Cotton Spinners & Manufacturers Association.

This was directed to be circulated.

3. Reports from Mr. Nolan giving results of his work in the United Kingdom.

With regard to the matter of the use of steam coils in Jamaica pot-stills especially referred to the Board, the Secretary stated that to save time he had sent the papers to the Chemist for his opinion which he now presented. This was read together with a list of the estates using steam coils.

It was resolved to advise the Government "that it was the opinion of the Board that the contention that steam heat is injurious cannot be maintained and that the erroneous impression arises from a confusion of pot-stills heated with steam coils, and continuous stills in which the liquor is brought into direct contact with the live steam."

The Secretary was directed to forward this resolution to the Government together with a copy of the Chemist's minute and list of estates using steam coils and results of their crops, for the information of Mr. Nolan.

4. Letter from the Imperial Commissioner of Agriculture for the West Indies sending copy letter to him from Mr. F. V. Chalmers advising satisfactory results of a blend of Jamaica Tobacco in that issued to the Navy.

The Secretary submitted Draft Contagious Diseases Animals Bill as revised by a joint committee of the Board and the Agricultural Society and said the draft had been submitted to the members of the Committee and Penkeepers for further revision or suggestions.

The Secretary submitted letter from Mr. E. A. dePass, London, to the Chemist giving opinions re the commercial aspects of High Ether Rum on the Continent.

This was directed to be circulated.

The following reports from the Chemist were submitted :

1. re Award of Scholarships reporting that of seven candidates who had competed for three scholarships, only one candidate, Mr. L. L. Carrington, attained a standard of over half marks and recommending that he be awarded a Scholarship and the other two be held in abeyance.

This was agreed to.

2. Asking authority to publish the results of the Sugar Experiment Station work for 1905 in the form of a special report, which was granted.
3. Asking authority for the purchase of a steam-heated pan from Mr. Lazarus, Kingston, at a price not to exceed £15 to be charged to "Alterations" and New Plant for Estates Distilleries on the estimates of the Sugar Experiment Station.

This was granted.

The following reports from the Director of Public Gardens were submitted :—

1. Report Hope Experiment Station.
2. " Instructors.

These were directed to be circulated.

The Secretary reported that Mr. Sharp advised safe receipt of the Steam Gin and that it had been erected in the Ginnery at Eltham and was in good working order; also safe receipt of the Baler from the railway workshop, also found in good order. Owing to the heavy loss on cotton by his Company through caterpillars, Mr. Sharp said he would be unable to make an offer for these at present.

The Secretary stated that although he had written several times to Mr. Levy of Brown's Town to return the Hand Gin which he had not been able to get in working order, it had not yet been sent back. One Cotton Gin was in the hands of the Black River Agricultural Society and one with Mr. Shore at Little River, and one retained in the office.

The Secretary submitted a small book by Mr. E. J. Wortley entitled "Agricultural Practices and Morals" and which embodied a list of the "Agricultural Don'ts" prepared for the Board for use in Schools. The Board's approval of the Book was asked.

This was directed to be circulated.

The following papers which had been circulated, but had not yet been before the Board were now submitted :—

1. Notes on School Gardens together with notes by Mr. Cradwick and comments by members of the Board.

All these were directed to be returned to Mr. Williams.

2. Itinerary of Mr. Hirst, Instructor in St. Catherine.

The following papers which had been circulated were submitted for final consideration :—

1. Agricultural Scholarships' Examination.
2. Report: Work of Agricultural Students for Michaelmas Term.
3. Report on Banana Soils in St. Mary.
4. Progress Report Distillers Experiments.
5. Appointment of two assistants, Sugar Department.
6. Report Hope Experiment Station.
7. Report Mr. Cradwick.
8. Letter from India re Bananas.
9. Lettter from Mr. Sydney Olivier re Locked Still.

SEASONS AND PRICES FOR FRUITS, VEGETABLES, AND OTHER ECONOMIC
PRODUCTS IN KINGSTON, JAMAICA.

Compiled by Wm. Harris, F.L.S., Superintendent of Hope Gardens.

As there is a good deal of misapprehension with regard to the seasons for the various crops grown in Jamaica, and the duration of the season for each crop, the compiler visited the principal market in Kingston once a week for twelve months for the purpose of noting the various products offered for sale, and the prices charged to consumers. These prices are at least one-third, and frequently three or four times higher than the prices paid by the retail dealers to the growers of the commodities enumerated. The prices noted for economic products such as ginger, anatta, &c., were those paid by a large exporting firm to the producers.

It will be readily understood that the seasons vary somewhat according to prevailing weather conditions, and the prices also vary according to supply and demand.

Approximate Seasons for, and prices in Kingston, of fruits, vegetables and other products

Common name.	Botanical name.	Seasons and prices in Kingston Market.
<i>Fruits.</i>		
Banana	Musa sapientum	Throughout the year—1½d. to 3d. per dozen fingers.
Blackberry	Rubus jamaicensis	June to November—4d. to 9d. per quart.
Bilberry	Vaccinium meridionale	Summer months—4d. to 6d. per quart.
Cashew fruits	Anacardium occidentale	May to August—3d. to 4d. per dozen.
Cashew nuts	Anacardium occidentale	May to September—1½d. to 3d. per quart.
Coco-nuts—dry	Cocos nucifera	Throughout the year—9d. to 1s. per dozen.
Coco-nuts—green	Cocos nucifera	Throughout the year—1s. to 1s. 6d. per dozen.
Cherimoya	Anona Cherimolia	October to February—1d. to 3d. each.
Custard Apple	Anona reticulata	Plentiful November to middle of February; scarce during remainder of the year—1s. per dozen.
Ginep	Melicocca bijuga	August and September—¼d. to 1½d. per bunch.
Granadilla	Passiflora macrocarpa	Throughout the year, but most plentiful during the winter months—3d. to 6d. each.
Grape Fruit	Citrus decumana	Scarce April to August—10s. to 12s. per 100; fair supply August to November—8s. to 10s. per 100; plentiful November to end of March—5s. to 10s. per 100.
Grapes—black	Vitis vinifera var.	Scarce and poor January to March—1s. 6d. per lb., none middle March to end of May; June to end of year fair supply—1s. to 1s. 3d. per lb.
Grapes—white	Vitis vinifera var.	None in the early part of the year; scarce and poor April and May—2s. per lb., June to end of year fair supply—1s. 6d. to 2s. per lb.

Common name.	Botanical name.	Seasons and prices in Kingston Market.
Lime	Citrus medica, var. acida	Scarce and green April to August—fairly plentiful end of August to December; plentiful December to March—1s. per 100.
Mango, Numerous varieties	Mangifera indica	The regular season for this fruit begins in April and prices for No. 11 and other favourite varieties are then 3d. per dozen. The fruit is very plentiful from middle of June to end of August, and prices drop to ¾d. per dozen. From October to May the fruit is occasionally seen in the market, and the price is ½d. to 1d. each, according to variety and quality.
Melon	Cucurbita Melo	Winter and spring months—4½d. to 9d. each.
Melon Cantaloup	Cucumis Melo	Plentiful during the spring, autumn and winter months—6d. to 9d. each.
Melon—Musk	Cucurbita moschata	Plentiful during winter and spring months; scarce and poor March to end of August—6d. to 9d. each.
Melon—Water	Citrullus vulgaris	Throughout the year, but most plentiful during the autumn and winter months—9d. each.
Naseberry	Achras Sapota	Plentiful April to middle of June—3d. per dozen; scarce middle of June to July. 4½d. to 6d. per dozen; none July to October then fairly plentiful to April—4½d. to 6d. per dozen.
Orange—Sweet	Citrus Aurantium	Scarce June to end of August—3s. to 4s. per 100; fairly plentiful September to November—3s. to 4s. per 100; plentiful November, to end of May—2s. to 3s. per 100.
Orange—Tangierine	Citrus nobilis	Scarce during June; none July and August; fair supply September to November; plentiful November to end of May—6d. per dozen.
Papaw	Carica Papaya	Throughout the year—1d. to 2d. each.
Pine-apple Bull-head	Ananas sativa, var.	Rather scarce September to March—5d. and 6d. each; fair supply March to May—4½d. to 6d. each plentiful May to end of August—2d. to 6d. each.
Pine-apple Ripley	Ananas sativa, var.	Same seasons as previous—3d. to 6d. each when plentiful; 6d. to 1s. each when scarce.
Pine-apple Sugar-loaf	Ananas sativa, var.	Same seasons and prices as for Bull-head.
Pindar-nut Shaddock	Arachis hypogæa Citrus decumana	Throughout the year—1½d—2d. per quart. Plentiful November to June, and to be had all through the year—6d. each.
Sour Sop	Anona muricata	Plentiful December to June—1d. to 2d. each; scarce in July—3d. each; none August and September; scarce in October and November—3d. each.

Common name.	Botanical name.	Seasons and prices in Kingston Market.
Star-apple	<i>Chrysophyllum</i> <i>Cainito</i>	Scarce during February—1s. per dozen; plentiful March to beginning of June—3d. to 9d. per dozen; scarce during latter part of June—1s. per dozen; none from early part of July to February.
Sweet Cup	<i>Passiflora mali-</i> <i>formis</i>	Throughout the year—1½d. to 3d. per dozen.
Sweet Sop	<i>Anona squamosa</i>	None from February to early part of June; fairly plentiful middle of June, and plentiful July to September; then a fair supply to end of January—3d. to 9d. per dozen.
<i>Vegetables.</i>		
Akee	<i>Blighia sapida</i>	Plentiful July to October—¾d. per dozen; November to end of June not plentiful—1½d. to 2d. per dozen.
Avocado, or Alligator Pear	<i>Persea gratissima</i>	Season begins early part of July, and pears are plentiful to end of September—¼d. to 1½d. each; scarce from October to end of April—1d. to 2d. each; none during May and June.
Beans—French	<i>Phaseolus</i> <i>vulgaris</i>	Throughout the year, but most plentiful during the autumn and winter months—2d. per lb. when plentiful, to 6d. per lb. when scarce.
Beans—Lima, or Sugar	<i>Phaseolus</i> <i>lunatus</i>	Throughout the year—4½d. to 6d. per quart.
Beetroot	<i>Beta vulgaris</i>	Throughout the year, but most plentiful and best during winter and spring months—9d. to 1s. per dozen.
Breadfruit	<i>Artocarpus incisa</i>	Throughout the year; most plentiful December to March—1d. to 2d. each.
Cabbage—native grown	<i>Brassica oleracea</i>	Throughout the year; best during winter and spring months—4½d. to 9d. each, according to size.
Calalu or Spinach	<i>Amarantus viridis</i> <i>A. gangeticus</i> <i>A. spinosus</i>	Throughout the year; very plentiful during and after the rainy seasons—1d. to 1½d. per bunch.
Calalu, Jockatoo (See also Indian Kale)	<i>Phytolacca</i> <i>octandra</i>	Throughout the year—1d. to 1½d. per bunch.
Carrot	<i>Daucus Carota</i>	Throughout the year; best during winter and spring months—1½d. to 3d. per bunch.
Chocho— <i>White</i> and <i>Green</i>	<i>Seschium edule</i>	Throughout the year, most plentiful November to end of February—3d. to 6d. per dozen when plentiful, 6d. to 1s. per dozen when scarce.
Cocoas	<i>Xanthosoma</i> <i>sagittaeifolium</i>	Throughout the year, most plentiful November to March—6d. to 9d. per dozen tubers.
Corn, Indian or Maize— <i>Green</i> <i>Corn</i>	<i>Zea Mays</i>	June to August, and October to December—6d. to 9d. per dozen cobs

Common name.	Botanical name.	Seasons and prices in Kingston Market.
Corn, Indian, or Maize—Sweet Corn, or Sugar Corn	Zea Mays	June to August, and October to December— 6d. to 9d. per dozen cobs.
Cucumber	Cucumis sativus	Throughout the year, small but plentiful— 6d. to 1s. per dozen.
Garden Egg	Solanum Melongena	Throughout the year 9d. to 1s. 6d. per dozen
Gourd, Bottle, or Sweet	Lagenaria vul- garis	Throughout the year, but most plentiful during the cool months of the year—3d. to 6d. each.
Indian Kale, Calalu, or Spinach	Xanthosoma atrovirens	Throughout the year—1s. to 1s. 6d. per dozen bunches.
Lettuce	Lactuca sativa	Throughout the year—6d. to 1s. 6d. per dozen heads.
Ochra	Hibiscus esculentus	Throughout the year—2d. to 6d. per lb.
Parsley	Carum Petro- selinum	Throughout the year—1d. to 1½d. per bunch.
Pea—English, or Green	Pisum sativum	During the winter and spring months, not plentiful—3d. to 6d. per dish
Pea—Black-eye	Vigna Catjang	Throughout the year, but most plentiful April to June, and October to December— 3d. to 6d. per quart.
Pea—Gungo, Congo, or Pigeon—dry	Cajanus indicus	Throughout the year—3d. to 6d. per quart.
Pea—Gungo, Congo, or Pigeon—green	Cajanus indicus	Throughout the year—2½d. and 3d. per quart.
Pea—Red Kidney Bean, Haricot Bean	Phaseolus vulgaris	Throughout the year, but most plentiful March to June, and November to Decem- ber—4½d. to 6d. per quart.
Plantain	Musa sapientum, var. paradisiaca	Throughout the year—½d. to 1d. each finger.
Potato—Irish	Solanum tuber- osum	During the winter and spring months—1½ to 2d. per lb.
Potato—Sweet	Ipomoea Batatas	Throughout the year—½d. to ¾d. per lb., or 4s. to 5s. per 100 lbs.
Pumpkin	Cucurbita Pepo	Throughout the year—4½d. to 6d. each.
Scallion	Allium fistulosum	Throughout the year, but most plentiful during the cool months—1½d. to 3d. per bunch, according to size.
Spinach (See Calalu, and Indian Kale)		
Tomato	Lycopersicum esculentum	From February to July, plentiful and good —3d. to 4½d. per lb. ; from July to Febru- ary, fair supply medium quality—4½d to 6d. per lb.
Turnip	Brassica Rapa	Throughout the year, but plentiful and good during the winter and spring months—1½d to 3d. per bunch.

Common name.	Botanical name.	Seasons and prices in Kingston Market.
Water Cress	<i>Nasturtium officinale</i>	Throughout the year—1d. to 1½d. per bunch.
Yam—Negro, Lucea, &c.	<i>Dioscorea sativa</i>	June to December—7s. to 10s. per cwt.
Yam, White, Guinea, Barbados, &c.	<i>Dioscorea alata</i>	January to May—10s. to 12s. per cwt.
Yam—Yellow or Afou	<i>Dioscorea cayennensis</i> var. <i>rotunda</i>	January to June, and August to end of year—8s. to 10s. per cwt.
Yampee, or Indian Yam	<i>Dioscorea trifida</i>	Throughout the year, but most plentiful during the autumn, winter and spring months—6d. to 2s. per dozen according to size.

ECONOMIC PRODUCTS.

Common name.	Botanical name.	Seasons and prices paid by Merchants to Growers.
Anatta	<i>Bixa Orellana</i>	25s. to 30s. per 100 lbs. Crop from Dec. to end of May.
Bitterwood	<i>Picraena excelsa</i>	30s. to 34s. per ton of 20 cwts., 6s. per ton extra for free on board. From April to October there was no demand and no trade.
Cocoa	* <i>Theobroma Cacao</i>	32s. to 34s. per 100 lbs. in January with a gradual rise to 44s. per 100 lbs. in March when the spring crop closed; 40s. to 41s. per 100 lbs. for middle year crop—Middle of May to end of July; 40s. to 44s. per 100 lbs. for autumn crop, starting in September and lasting to end of year.
Coffee (Fancy)	* <i>Coffea arabica</i>	36s. per 100 lbs. in January to May, and 34s. to 40s. in June when crop finished. No business July to middle of October, when new crop started at 36s. per 100 lbs. dropping to 34s. in November and December.
Coffee (Fine)	<i>Coffea arabica</i>	33s. per 100 lbs. in January to June when crop finished. No business July to middle of September, when new crop started in Manchester at 30s. per 100 lbs. This price was maintained to middle of October when all crops started and the price advanced to 32s. dropping to 30s. again in middle of November and remaining at that figure to end of year.

* All the produce of Estates is sent direct to London or Liverpool. Cocoa gets 52s. Blue Mountain Coffee realises as high as 130s.

Common name.	Botanical name.	Seasons and prices paid by Merchants to Growers.
Coffee (Ordinary)	<i>Coffea arabica</i>	28s. to 30s. per 100 lbs. in January to end of crop in June; no business to beginning of September when new crop started in Manchester at 20s. per 100 lbs., this price was advanced to 22s. during September and remained at that figure to middle of October when all crops came in and the price rose to 23s. and 24s. at the beginning of November; in the middle of November the price dropped to 22s. at which figure it remained to the end of the year.
Coffee (Good Ordinary)	<i>Coffea arabica</i>	30s. per 100 lbs. at beginning of January to end of crop in June. This grade of coffee continued to appear after the end of the crop in June to the opening of the new crop in Manchester at the end of August when the price dropped to 23s. per 100 lbs.; this price was maintained to beginning of November when it rose to 26s. and remained at this figure to the end of the year.
Coffee (Parchment)	<i>Coffea arabica</i>	20s. per cwt. (112 lbs.) at beginning of January rising to 21s. by middle of the month, and 24s. by end of the month. During February to end of March the price remained steady at 15s. per cwt., it then rose to 16s. and remained at that figure to middle of May when it went up to 24s. per cwt. From middle of August to middle of Oct. none was offered, then all crops came in and the price started at 20s. per cwt. and remained at that figure to end of the year.
Divi-divi	<i>Cesalpinia coriaria</i>	5s. 3d. per cwt. for large quantities, sellers finding their own bags; 4s. 6d. per cwt. for small quantities—January to June. In December the prices paid were £5 per ton for large quantities and £4 10s. per ton for small quantities.
Fustic (roots)	<i>Chlorophora tinctoria</i>	From January to middle of April 35s. per ton (20 cwts.) and 6s. extra for free on board; during May and early part of June 39s. per ton; June to beginning of August 43s.; August and September 48s.; October to end of November 40s. and during December 36s. per ton.
Fustic (trunks)	<i>Chlorophora tinctoria</i>	From January to middle of April 48s. per ton of 20 cwts., and 6s. extra for free on board; May to early part of June 52s.; from middle of June to end of September, 56s.; from beginning of October to end of November 48s. and during December 44s. per ton.

Common name.	Botanical name.	Seasons and prices paid by Merchants to Growers
Ginger	Zingiber officinale	January 25s. to 28s. per 100lbs.; in February 26s. to 28s.; from February to end of April, 28s.; May, 32s. to 34s.; June, 36s.; crop all reaped; July, 32s.; August, 35s. per 100lbs. No trade after early part of August to middle of December when crop started at 24s. per 100lbs.
Kola-nuts	Cola vera	Crop starts in March. No trade before June when 12s. 6d. per 100lbs. was paid for fresh nuts. This price advanced to 15s. per 100 lbs. by middle of June and dropped to 8s. in July for cured nuts. It remained at 8s. to end of crop. The trees give 2 crops—Mar. to June, and Aug. to Nov.
Logwood (roots)	Haematoxylon campechianum	From January to June 34s. per ton of 20 cwts., and 6s. extra for free on board. From middle of June to end of year 50s. per ton. For local consumption at Chemical Works the price paid is equal to shipping rates free on board.
Logwood (trunks)	Haematoxylon campechianum	48s. per ton (20 cwts.) at wharf, 6s. extra for free on board, Jan. to middle of April; 52s. May and June; 50s. to end of year.
Orange, Sweet	Citrus Aurantium	10s. to 11s. per 1,000 January and February; 12s. 6d.—13s. March; 14s. April; 15s., May; 16s. to 18s., June—Crop over; 20s. July and August. New crop started in August with a demand for Canada; 18s. in beginning of September, dropping to 15s. by end of the month; 12s. 6d. to 12s. in October; and 12s. 6d. and 13s. during November and December.
Pimento	Pimenta officinalis	16s. to 18s. per 100 lbs. January to March; 18s. 6d. to 20s. March to beginning of May when the Southside crop comes in and lasts to about end of June; July 18s. full crop in August, 18s. 6d.; September 18s. 6d. dropping to 14s. 6d. at end of month; October 13s. 6d. to 16s. 6d.; November 15s. 6d.; December 15s.
Pimento sticks and clubs	Pimenta officinalis	Sticks, $\frac{3}{4}$ inch to $1\frac{1}{2}$ inch, diameter, 8s. to 10s. per 100. Clubs, 3 inches to 6 inches, diameter, 4s. to 8s. per dozen. Both in good demand.
Pine-apple (Bull head)	Ananas sativa var.	January to early part of March, 3s. per doz.; 4s. in April; 2s. to 3s. per doz. from April to August. No trade from end of August.
Pine-apple (Ripleys)	Ananas sativa var.	During March, 4s. to 7s. per dozen; April, to end of June, 6s. per dozen, July, 5s. per dozen, August, 4s. per dozen.
Sarsaparilla	Smilax papyracea	4d. to 4½d. per lb. from January to end of August. The real crop time is from January to end of June.

[Issued 22nd March, 1906.]

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

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GARDEN

Vol. IV.

APRIL, 1906.

Part 4.

CASSAVA TRIALS III.

FINAL RESULTS OF TEST OF 23 VARIETIES.

By H. H. COUSINS, M.A., Oxon., F.C.S., Island Chemist.

The results obtained in this series of trials at the Hope Experiment Station of Cassavas at 12 and 15 months' growth have been given in this Bulletin (1905 pp. 152-155 and 218-219) and the final results of the tonnage and starch yield per acre after 21 months' growth have now been obtained.

Tables are given showing the results of the final yield, the comparative yields of tubers and of starch at 12, 15 and 21 months' growth, and finally of the increased yield of tubers and of starch by prolonging growth from 12-15 months and 15 to 21 months respectively.

Best varieties for harvesting at 12 months.

'White Top' proved the best variety in these experiments with a yield of 10.5 tons tubers containing 7,902lbs. starch per acre. Next came 'Long Leaf Blue Bud' with 9.0 tons tubers followed by 'Blue Top' with 8½ tons per acre. 'Smalling' was fourth, closely followed by 'Rodney' and 'Luana Sweet.'

Best varieties for harvesting at 15 months.

'White Top' fell off after 12 months' growth and is clearly a variety that does not improve by a longer period of growth than a year. At 15 months, 'Long Leaf Blue Bud' proved to be the most prolific variety, yielding 15.4 tons of tubers with 4,955lbs. starch per acre. 'Smalling,' 'Mullings' and 'Luana Bitter' followed in the order named.

Best varieties at 21 months.

'Blue Top' is the champion cassava of this series having given us 21.9 tons of tubers and over 7 tons of starch per acre (15,818 lbs). This result would have been considered fabulous previous to this careful series of field trials, and it is claimed that we have now proved that cassava can be grown without irrigation in the plain of Liguanea in Jamaica to give a yield of starch greater than has ever been recorded before of any starch-producing plant.

It is true that this crop has taken the plant practically two years to produce, but when we remember the cheapness of land

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and the low cost of cultivation involved in the prolonged period of growth, it is abundantly clear that the cost of increasing the starch yield from $3\frac{1}{2}$ to 7 tons per acre is out of all proportion to the value of the increased product.

It would appear therefore, that the most economic production of starch would be attained by the cultivation of such a variety as 'Blue Top' upon a biennial basis.

For quick returns 'White Top' would be the better variety and in starting a starch factory it would be advisable to grow half the cassava area as an annual and half as a biennial crop.

The variety 'Black Stick' has steadily improved during the second year of growth and now holds second place in starch production with the record percentage of 38.2 per cent. of starch in the tubers and an indicated yield of nearly 7 tons starch per acre. 'Smalling,' although giving a bigger tonnage of tubers than 'Black Stick' stands decidedly below that variety in starch yield. "Mullings" comes fourth with a little less than 6 tons starch per acre, while 'Long Leaf Blue Bud' that led at 15 months has not since gained at all in yield of tubers and shows only a very small increase in starch per acre as the result of the further 6 months' growth.

Clearly, this is a variety that is at its best at 15 months, and one that it would not pay to grow as a 21 months cassava in competition with the other varieties.

Percentage of starch in the tubers.—At 12 months' 'Luana Sweet' had the highest content of starch (35.2 per cent.), at 15 months, 'Long Leaf Blue Bud' heads the list with 37.4 per cent., while at 12 months' growth this variety is very slightly inferior to 'Black Stick,' which leads with 38.2 per cent. of starch in the tubers.

The recorded maximum starch content for a Jamaican Cassava is 39.1 per cent. for the variety 'White Smooth Bitter' grown by the Hon. T. H. Sharp at Inverness in Clarendon in 1903.

This variety as grown at Hope only attained a content of 35.5 per cent. of starch.

These experiments emphasize the fact that Cassava varieties are so variable in their yield under different conditions of soil and locality that it is most desirable to carry out careful tests of a selected series before the best varieties for any given place and purpose can be correctly ascertained.

Not only is there a great variation in the yield of tubers, but also of starch content and period of growth.

Conclusions.

1. Under conditions obtaining at Hope and without irrigation a yield of $10\frac{1}{2}$ tons tubers at 12 months, of $15\frac{1}{2}$ tons at 15 months and of nearly 22 tons tubers per acre at 21 months has been recorded.

2. The indicated yield of starch per acre has risen from $3\frac{1}{2}$ tons at 12 months to $5\frac{1}{2}$ tons at 15 months, and $7\frac{1}{4}$ tons starch at 21 months' growth.

3. This yield has been obtained at a cost of about £5 per acre and it is abundantly clear that we can produce enormous crops of

Comparative yields at different stages.

No.	Variety.	Tons per acre.			Lbs. Starch per acre.		
		12 m'nths	15 m'nths	21 m'nths	12 m'nths	15 m'nths	21 m'nths
1	Blue Top	8.25	14.2	21.9	5,636	9,733	15,818
2	Black Stick	6.5	6.5	18.0	4,878	5,197	15,433
3	Smalling	7.5	11.1	19.3	5,494	8,553	13,883
4	Mullings	5.75	11.1	18.0	4,160	8,180	13,277
5	Long Leaf Blue Bud	9.0	15.4	15.4	6,552	12,857	13,187
6	Duff House	5.5	10.6	15.4	4,107	7,598	12,632
7	Prize or Silver Stick	3.5	5.1	12.9	2,634	4,044	10,666
8	White Smooth Bitter	3.25	9.4	12.9	2,460	7,435	9,920
9	White Stick	3.25	3.9	11.6	2,522	3,127	9,742
10	Brown Stick	3.25	11.6	11.6	2,384	7,405	8,927
11	Black Bunch of Keys	3.25	6.5	11.6	2,388	4,586	8,894
12	White Top	10.5	11.0	11.6	7,902	7,638	8,753
13	Silver Stick	3.5	6.5	10.3	2,744	4,600	8,574
14	Bobby Hanson	6.25	8.4	10.3	4,777	6,134	8,197
15	Black Bitter Long Leaf Blue Bud	6.00	6.9	9.0	4,462	5,193	7,567
16	White Bunch of Keys	5.25	6.5	9.0	4,069	4,906	7,466
17	Cotton Tree	...	...	9.0	...	...	7,221
18	Luana Sweet	6.75	8.1	9.0	5,322	6,540	7,102
19	New Green	5.25	6.5	11.6	3,192	3,086	6,895
20	Rodney	7.5	9.7	10.3	5,337	6,931	6,547
21	Luana Bitter	4.25	9.4	9.6	3,975	7,686	6,425
22	Mass Jack	4.25	5.1	...	3,091	3,243	...
23	Yellow Belly	3.5	3.2	...	2,321	1,921	...

INCREASE.

No.	Variety.	Tons tubers per a. lbs. starch per acre			
		12-15 months.	15-21 months.	12-15 months.	15-21 months.
1	Blue Top	6.0	7.7	4,097	6,085
2	Black Stick	...	11.5	319	10,236
3	Smalling	3.6	8.2	3,059	5,330
4	Mullings	5.3	6.9	4,020	5,097
5	Long Leaf Blue Bud	6.4	...	4,955	330
6	Duff House	5.1	4.8	3,491	5,034
7	Prize or Silver Stick	1.6	7.8	1,410	6,632
8	White Smooth Bitter	6.1	3.5	4,975	2,485
9	White Stick	0.6	7.7	605	6,615
10	Brown Stick	8.3	...	5,021	1,522
11	Black Bunch of Keys	3.2	5.1	2,198	4,308
12	White Top	0.5	0.6	264	1,115
13	Silver Stick	3.0	3.8	1,856	3,974
14	Bobby Hanson	2.1	1.9	1,357	2,063
15	Black Bitter Long Leaf Blue Bud	0.9	2.1	731	2,374
16	White Bunch of Keys	1.2	2.5	837	2,560
17	Cotton Tree	...	...	...	...
18	Luana Sweet	0.3	0.9	1,218	562
19	New Green	1.2	5.1	106	3,809
20	Rodney	2.2	0.6	1,594	384
21	Luana Bitter	5.1	0.2	4,611	1,261
22	Mass Jack	0.8	...	152	...
23	Yellow Belly	0.3	...	400	...
		Loss }		Loss }	

COTTON DISEASE.

From Commissioner, Imperial Department of Agriculture, to Director of Public Gardens.

Imperial Department of Agriculture for the West Indies,
Barbados, January 23, 1906.

My dear Fawcett,

I am in receipt of your letter of the 8th instant advising the sending of some bolls from Mr. DeMercado's cotton in Vere apparently attacked by anthracnose.

I enclose for your information a report prepared by Mr. Stockdale on the samples sent.

With kind wishes,

Very sincerely yours,

(Sgd.) D. MORRIS.

Imperial Commissioner,

The four cotton bolls forwarded by Mr. Fawcett from Mr. De Mercado's estate in Vere are small and ill-shaped. Two of these show the characteristic spots of anthracnose, from which spores of *Colletotrichum gossypii* are given off. These spores appear to be of a greater diameter than those described by Mr. Lewton-Brain (W. I. B., Vol. V., p. 191) as *Colletotrichum gossypii* var. *barbadense*, and I should be pleased if Mr. Fawcett could obtain further specimens, so that this difference might be looked into more fully.

The spots of anthracnose on these two bolls were over-grown with *Fusarium* which is probably saprophytic (West Indian Bulletin, Vol. V., p. 178). The other two bolls show no signs of anthracnose, but appear to have been dried up through some purely physiological causes and have subsequently become covered with *Fusarium*. I have seen many such examples in Barbados this year, more frequently immediately after changes of weather when the plant does not seem able to support or properly feed a large number of bolls.

Suggested Remedial Measures—The fungus that causes the Anthracnose spreads by means of spores which are disseminated by wind and insects and is capable of growth on all parts of the plant. If the area is badly attacked it would be advisable to destroy all diseased plants and parts of plants and not to set cotton in the infected area for a few years.

If a young crop of cotton is badly infected, spraying with Bordeaux mixture would probably prevent the germination of spores and so prevent further infection of bolls. This must not be done if any of the bolls are matured, as the solution of copper salts would seriously discolour the lint and therefore reduce its value. If the crop of cotton is advanced and the disease is doing serious damage, experiments with dry fungicides might be conducted, say

with a mixture of sulphur and lime (the lime being in excess of the sulphur).

This mixture can easily be made and can readily be applied. The slowly-evolved gases, are readily soluble in water, forming a solution which should be strong enough to kill the spores and germinal tubes, but too weak to injure the leaves of the plant. I have been unable to obtain any information respecting any experiments that have been carried on either in America or the West Indies with a view to obtaining a treatment for the prevention of anthracnose of cotton, and therefore this makes it all the more important that experiments should be started even on a small scale, to obtain such information.

Another point in the treatment of this disease is very important—this is the sterilization of cotton seed before planting. Spores are held attached to the seed coat and these possibly produce the disease in the cotyledons of seedlings. Further information on the sterilization of cotton seed will be forthcoming before next planting season as experiments are now in hand dealing with this subject.

F. A. STOCKDALE, Mycologist.

LOGWOOD : DISEASE AND CULTIVATION.

In the fall of the year 1902 the Director of Public Gardens went on special leave to the States. He was fortunate enough to interest Dr. Britton, Director of the New York Botanical Garden, in Jamaica, and on his return Dr. Britton allowed Prof. Earle to accompany him to study generally the plant diseases of the Island. Prof. Earle made a report which was published in the Jamaica Bulletin for February, 1903. One of the diseases investigated was the Logwood Root Rot, and the following is Prof. Earle's statement about it. Recently letters have appeared in the "Gleaner" from Dr. Bucher and Mr. J. W. Edwards on the subject, and it has been thought well to call the attention of planters again to the subject.

I. BY PROF. EARLE.

On some estates, especially toward the western end of the island, logwood trees are dying in considerable numbers.

The diseased trees usually occur in groups, the infection spreading slowly but in constantly widening circle. An examination of dying trees shows the roots to be badly rotted. Their surface tissues are invaded by a white fungus mycelium that is usually more abundantly developed in the region between the bark and the wood. The disease seems to attack first the small rootlets, gradually spreading to the larger roots and the crown when the tree dies. In many cases seeming healthy trees near the border of infested areas were found to have the roots on the side next the dying trees badly diseased, while on the other side they were still perfectly healthy. The fungus seems to be the mycelium of some of the Hymenomycetes. Numerous species of Polyporaceae

and Thelophoraceae were taken on logwood stumps and logs, but in no case could their connection with this root rot be satisfactorily proven. Whatever the nature of the fungus, leaving stumps of trees that have died from this disease in the neighbourhood of living trees is clearly dangerous. Dying trees should be dug and the roots burned as soon as the disease can be detected. Where it is confined to certain small definite areas as is often the case, it would be advisable to dig a trench three feet deep just outside of the diseased area in order to prevent its spread underground to the roots of healthy trees. On a few of the estates examined the disease was so widely scattered that this method of treatment would not be practicable. Here it would seem best to clear the infested tract entirely of logwood, marketing such as was sufficiently mature, and allowing the land to grow up in pimento and limes, or reserving it for pasturage or cultivation. It should be mentioned in this connection that pimento trees are said to die from a similar root rot in some parts of the island. If this should prove to be identical with the logwood root rot, pimento would not be available as an alternative crop.

This root rot seems to spread slowly. One old logwood chipper assured me that trees had been dying for thirty-five years on a spot that he pointed out. This area does not now include over three or four acres. This would indicate that by vigorous measures it could be controlled. The disease was found on various kinds of soils and under moisture conditions varying from dry rocky hill sides to the margin of swamps. In some cases the diseased areas were on spots where the soil was rich and deep and the moisture and drainage condition perfect. It was not observed on the heavy clay lands towards the eastern end of the island but whether this was due to the absence of infection or to the character of the soil could not be determined.

II. BY DR. E. BUCHER.

In driving through Westmoreland one cannot but notice that the logwood blight investigated some time ago by Prof. Earle of the New York Botanical Garden* is rapidly spreading. Too many pastures look as if the logwood trees, young and old, had been singed by fire from the top downwards. Prof. Earle pronounced the blight to be a contagious root disease. If not attended to, it will do serious damage to the logwood industry in that part of the island.

Logwood growers will do well to remember the disastrous experience of European wine growers with phylloxera. That insect pest appeared to be harmless enough at first, until it spread so fast that it was hopeless to cope with it. The best vineyards of France were laid bare. Those who had thought themselves to be the wealthiest cultivators suddenly found themselves to be almost

* Now Director of the Agricultural Experiment Station, Cuba. *Editor.*

beggars. Utter ruin was only averted by making a fresh start, pulling out every vine stock and replanting the vineyards with the hardier American plant.

A logwood grower who sees the disease appear on his property owes it not only to himself but also to his neighbours to eradicate the disease as it appears and prevent its spread. If any one doubts that this can be done successfully let him pay a visit to that model logwood property, Old Hope. There he will look in vain for a dead logwood tree. Mr. J. W. Edwards, the attorney, will perhaps be good enough to tell us by what means he has managed to keep Old Hope free from the disease. We will be thankful to him if he will give us the information.

III. By J. W. EDWARDS.

With reference to Dr. Bucher's letter, I am bound to admit that the remarks about the logwood generally in Westmoreland are only too correct.

I took Prof. Earle, when he was in the country three years ago, to Old Hope.

The Professor went to considerable trouble to inspect the trees at different positions on the property that showed signs of the disease and after most minute investigation he pronounced it a root disease that was highly contagious.

Acting on his advice I have from that time cut down and burnt wherever practicable, any trees showing the slightest trace of the disease, with satisfactory results.

As Dr. Bucher who is such an eminent authority on logwood, thinks that Old Hope is in a fair state of cultivation, it may interest logwood growers to show the system that has been pursued at this property.

The growth of young saplings is encouraged every year with the view of having rotation crops.

Saplings are grown thickly in order to induce the growth of long straight trunks, but after a time the useless ones are thinned out to give light and air to the most promising ones.

On no account are any saplings allowed to be trimmed of the prickles which are evidently given them by nature to protect them from stock, and when the trunks are sufficiently strong to resist pressure from animals in rubbing against them, the prickles disappear naturally, the trunks then presenting a nice clean smooth bark.

If after the trunks are naturally cleaned off, it is thought that too many limbs are thrown out some of the lower ones should be cut off with an *upward cut* to prevent soakage by water.

The shippers are never allowed to rest their wood against other trees, in order to preserve the bark from injury by chafing.

Another matter that receives attention is the killing of duck ants' nests, which are so frequently seen on trees; this is done by arsenic sweetened with molasses, or sugar.

EARLY ORANGES.

24th January, 1906.

The Governor directs* the publication, for general information, of the following letter from the Director of Public Gardens and Plantations, containing suggestions for promoting the earlier ripening of oranges.

By command,

H. CLARENCE BOURNE,

Colonial Secretary.

Department of Public Gardens and Plantations.

Hope Gardens, Kingston, P.O.,

12th January, 1906.

SIR,

I have the honour to acknowledge your letter No. 11002/13504, dated 14th ultimo with reference to the controversy on the shipment of unripe oranges, and asking me to consider whether it is feasible to cause oranges to ripen earlier.

2. There are two classes of oranges exported viz. : the fruit of seedling trees, and that of budded trees, of which the number exported of the former is enormously in excess of the latter. The problem therefore refers chiefly to the fruit of seedling trees.

3. Budding trees from early varieties can to some extent and after a considerable time, bring in early fruit : these trees will also be affected by any solution of the general problem.

4. To the peasantry, who own the vast majority of the trees, I would offer the following suggestions. Early fruit is encouraged by :—

- (1) removal of all fruit late in October or early in November,
- (2) removal at the same time from the trees of all dead wood, lichens, moss, and other growths,—this of course should be also done throughout the year.
- (3) opening up the main roots for a foot or 18 inches from the stem, and removing the soil from them.
- (4) application of lime on surface of ground from stem as far as branches extend,—all the above work to be finished during November.
- (5) forking up the soil in December for a breadth of a foot all around the tree just outside the extremities of the root-system, and application of woodashes, bones and a little well-rotted pen manure to it, or the equivalent in commercial fertilisers.
- (6) maintaining a mulch of grass, &c., from January until the fruit is full and then removing it.

* Jamaica Gazette, 25th January, 1906.

- (7) irrigating, whenever possible, by using waste water, &c., during the same months that the mulch is used.
- (8) thinning out the fruit by one half when they are about the size of marbles.

5. I believe that these cultural operations would have a decided effect in bringing in earlier fruit, and would be well worth the expense.

I have, etc.,

W. FAWCETT, Director.

The Hon. The Colonial Secretary.

The following letter on the same subject is reprinted from the "Gleaner" of the 12th February.

The Director of Public Gardens and Plantations to the Editor of the "Gleaner."

Hope Gardens, 9th February, 1906.

SIR,

Mr. T. H. Sharp's letter on producing early fruit in the orange is interesting and suggestive.

His statement that "the trees have two energies: the energy of reproduction and the energy of growth" is correct, and the theory and its practical applications have been treated at some length in the *Bulletin* for February, 1904, in which it is shown that "a decrease in nutrition during the period of growth favours the development of the reproductive parts while abridging the vegetative parts."

The consideration of this fact in the economy of plant life was not omitted in the letter to the Colonial Secretary, but the method suggested is that used by nature herself, checking or preventing nutrition, rather than injuring and half-killing the tree, as Mr. Sharp proposes, by "smashing the outer bark as well as the cambium" of the trunk near the ground by blows from a mallet.

Under natural conditions plants undergo a decrease of nutrition from various causes: two of these causes,—drought, and in some plants, the fall of the leaf, e.g., in our "common cedar," are readily recognized by every one as natural checks to growth.

The fall of the leaf prevents the chemical union of the mineral constituents taken up by the roots with the carbon extracted from the carbonic acid of the air,—which chemical change takes place in the leaf, forming the food of the living organism.

The check by drought to the absorption of food materials by the roots is much more serious, if it is thorough, and if it lasts long enough.

In treating the orange we cannot cut off its leaves, but we can interfere with the action of its roots. We cannot prevent rain falling, but we can do something to prevent absorption by the roots, and so imitate drought.

The removal of the soil from the roots was suggested for 12 to 18 inches from the stem ; if that is not sufficient to stop growth. I would remove the soil to a greater extent, but then comes in the question of expense and whether it would pay to do so.

Forking round the extremities of the root system was also suggested ; this should be done in such a way that the roots would be carefully cut back, so limiting root action.

These two methods of checking nutrition are not only effective for that purpose, but they conduce to greater vigour.

Opening up the main portion of the roots near the stem aerates and dries the soil all round, checks any tendency to foot-rot, and prevents attacks there by grubs. Shortening back the roots leads later on to extensive branching and development of the roots, especially as the ground has been loosened in the direction of growth.

I am, etc.,

W. FAWCETT.

Dr. Tillman has kindly contributed the following account of the methods adopted in his Orange Grove, which is a model for cultivators.

Dr. Tillman to the Director of Public Gardens.

Camden Grove, Race Course, P.O. Jamaica,
10th March, 1906.

Dear Sir,

In reply to yours of the 28th December, I beg to enclose herewith, a c sales of fruit sold in December ; and you will see that the prices range from 8' to 9' per box. It cost 6' to place a box of oranges on the market, including everything—capital paying prices for that time of year.

During August I got 15' to 16' ; September, 14' and 14'3 ; October, 11' to 12' , and November, 10' to 11'/. You must pardon my not answering before, as I had to wait for the last a/c sales, and they did not come to me until end of last month.

Re my efforts to obtain early fruit : Immediately after the October seasons will permit, I pick off all fruit, say early in November, and start ploughing with two pony ploughs, up and down each side of the intervals, between the trees ; making three cuts on each side, about three inches deep—the first cut being made directly under the extreme end of the outside of the lateral branches.

The same cuts are made by the other plough, the other way of the interval, so that the fine terminals of the surface roots are sliced through on each of the four sides of the trees that is pruned. The whole interval is not ploughed or close ploughed, for the reason that I would not be able to do the whole 32 acres quickly enough.

As soon as each interval has had three cuts made both sides, all over the cultivation, then the ploughs are allowed to plough

thoroughly the whole field. The ploughing is so done that each cut of the plough throws the earth towards the tree, so as to protect the cut ends of the roots with the fine dirt thrown by the next cut. The ploughs have new socks every six days to ensure clean and deep cutting when the above work is being done (ordinarily only every fourteen days are they changed).

The trees are in the meantime gone over with a gang of women under two headmen; all infested leaves that are bad are cut off with the scissors, and those with scale insect scrubbed by hand with small pieces of bagging dipped in warm soap or kerosene emulsion—branches also scrubbed.

All the inner branches and twigs that prevent light and air from going freely through the tree, are pruned away to throw all the energy for blossoming into the terminal branches. No water is allowed near the trees for fully six weeks—that is, the whole of November and part of December. Water is then applied, say about the second week in December, and the trees thoroughly flooded, the cultivator being passed over two days after, to save the earth drying and cracking and conserving the moisture below the surface.

Pruning roots and branches and cleaning the trees coupled with the rest that the trees get for the six weeks while suffering for want of water, compel a large number of the trees to commence to blossom about three weeks after the first application of water, and from then, each watering (three weeks apart), brings out more blossoms; so that blossoms first appear during the first week in January. This year fully a thousand trees commenced to bloom during the first ten days of January; of course in the majority of cases, only partially.

I have had quite a few trees that I picked fruit from as late as the middle of November, bloom in January slightly, but of course the trees that had been relieved of fruit earlier than November, bloomed earlier and heavier.

This coming season I do not intend to pick any fruit in November; so that I will have all fruit shipped by end of October. All blossoms after the 15th March will be picked off so as to save the trees carrying late fruit needlessly and thus ensuring an early bloom next season.

The above method can only be adopted in the irrigated districts of Vere and St. Catherine, as only with irrigation can the trees be controlled in a great measure; and as you are aware, there are barely half a dozen groves altogether in the two parishes named; but I am certain that a great deal of good could be effected in the hills where practically, all the fruit comes from, if the trees were treated as you recommend them to be. Of course the trees in the hills are entirely at the mercy of the seasonal rains and would not, even with irrigation, bloom very early in the year owing to the climatic conditions.

Even at the present time of writing, many of the wild trees are loaded with over-ripe and unmarketable fruit, thus perpetuating a lot of the mischief and compelling the sending away of immature

fruit in August and September, the trees not blossoming until April; in consequence, our fruit continues to have such a bad name in the market.

A very important fact also must not be lost sight of, and that is, that the fruit grown in the lowlands only take from seven to seven and a half months to mature, whereas fruit in the hills take from eight to nine months.

Hoping the above will prove that not only can fruit be grown in the irrigated lowlands, but what is more important still, that groves established and properly cultivated, can be made to produce early ripe oranges to supply the best market. That would give Jamaica an unrivalled position as a citrus fruit centre. Florida, California, and the Mediterranean, owing to the climatic conditions, would never be able to supply mature fruit in the months of August and September.

Cuban groves under go-ahead American management, with irrigation, would be our only competitors. I will with great pleasure give all the facts and figures after the coming season to the public as I feel sure there is a great future before the industry on these lines.

Yours faithfully,

(Sgd.)

HARRY G. TILLMAN.

FORWARDING DISEASED PLANTS AND INSECT PESTS.*

Much disappointment has lately been experienced, both by the sender and also by the receiver, through plants, supposed to be diseased, and insect pests reaching the laboratories of the Imperial Department of Agriculture in an unfit condition for scientific examination. It is hoped that officers of the department and others will carefully study and follow the suggestions that have been given by the Department on former occasions. (See *Agricultural News*, Vol. I, p. 243, and Vol. II, p. 235.) The chief reasons for this state of things are one or more of the following:—

(1) The fragmentary nature of the material sent for investigation. (2) Lack of care in transmitting, the specimens arriving shrivelled or dead or mouldy. (3) Absence of information as to the conditions under which the plants grew.

It must be pointed out that a few fragments of a diseased plant are of little use for investigation, and sufficient material should be sent so that the primary cause of the trouble may be located.

In order that time and labour may not be wasted in the examination of unsuitable material, care must be taken in collecting and packing specimens so that they may arrive at Barbados in good condition. Fresh specimens of moist vegetable matter should not be sent packed in boxes or in envelopes, but should be either suitably dried and sent in a well-ventilated package or, preferably

* Reprinted from the *Agricultural News*, Vol. IV., p. 366.

placed in spirit immediately after collection and forwarded in a bottle or corked tube. Care must be taken with the strength of the spirit used. A 30-per cent. spirit is quite sufficient to act as a preservative, and this can easily be obtained by taking distilled rum and adding two parts of water to one of the rum. If material is sent in undiluted spirit or high wines, it becomes so hard and brittle that examination is exceedingly difficult.

When leaves, buds, or twigs are attacked, the specimens should show as many stages of the disease as possible. Detached leaves alone are, as a rule, useless. If practicable, the root, after the soil has been shaken off, should be sent, as in many instances, the primary cause of the trouble is located there.

When fruits or herbaceous stems are attacked, pieces showing all stages of the disease, should be placed in spirit as before. When it is thought desirable to send very large specimens, such as portions of branches, roots, or whole cacao pods, these should be collected as late as possible before the mail steamer leaves and sent in a well ventilated case.

Full particulars should also be forwarded, giving details of the time of appearance of the disease, the damage done, the part attacked, the nature of the soil, drainage, and also whether an apparently similar kind of disease had been previously observed.

With regard to the forwarding of insects for examination, directions have already been given in the *Agricultural News* (Vol. IV. p. 168), but on account of the repeated disappointment resulting from material being badly packed the following detailed instructions have been prepared :

Insect material for transmission must be packed in such a way (1) that it will not be broken, bruised, or crushed, and (2) that it will not be spoiled by the growth of moulds, mildew, or bacteria.

In considering the manner of forwarding insects, these may be divided roughly into these three groups : (1) Larvæ that is, grubs, maggots, caterpillars, including borers, etc. (2) Hard insects, such as beetles, bugs, grass-hoppers, crickets, bees and wasps. (Scale insects may be included in this group.) (3) Frail insects, such as butterflies, moths, flies, etc.

In packing for transportation the following rules apply to these groups :—

Group I.—When sent alive, larvæ should be packed with a supply of the food plants on which they have been found feeding or in the plant material they infest, in such way that they should not be rattled about in the package or crushed by portions of the food plant, etc. When not sent alive they should be preserved in a tightly-corked tube or vial in diluted spirit or formalin.

Group II.—When sent alive these insects should be provided with food, as for instance, in the case of lady-birds, leaves and twigs infested with the plant lice or scale insects on which they feed should be included and packed in such a way that they cannot rattle about in the box. Footholds, such as crumpled pieces of blotting paper, should be given the insects also. When not sent alive insects of this group should be dried and wrapped loose

ly in soft tissue-paper, each insect in a separate paper, and then packed in a strong box. In the case of scale insects, each infested leaf and twig should be folded or wrapped in soft paper and dried before being enclosed in a tight package.

Group III.—Insects of this group should be killed and handled carefully to prevent injury, folded or wrapped in paper and well dried before being packed. Butterflies, with their wings folded together, may be folded in paper, moths may be wrapped loosely in tissue paper, and flies may be included in layers of tissue paper between cotton wool, in small boxes.

Full notes should accompany all insect specimens, stating the nature of the damage done, the part of the plant attacked where insects were found, and whether larva or adult does the damage; if the larva, a specimen of the adult should be included also, if possible. Notes on their habits such as whether night feeder or day feeder, where eggs are laid, etc., should in every case be added so far as known.

Disappointment is most likely to result from (1) insufficient material, (2) insufficient notes and information as to habits, etc., (3) bad packing which allows specimens to be crushed or to decay in transportation, and (4) from sending specimens so broken and battered that it is impossible to identify them.

THE COCO DE MER, OR DOUBLE COCONUT.

Several "double coco-nuts" were received from the Commissioner of the Seychelles Islands in 1896. There is one plant now growing in the Hope Gardens close to the Casuarina tree on the other side of the stream, and a plant also in Castleton Garden.

They grow very slowly, no stem being yet seen above ground; the height of the top of the largest leaf is 10½ feet. A nut which failed to germinate may be seen on application at Hope Gardens, and another at Castleton Garden.

The history and the structure of this palm are of such an interesting nature that the following articles on it are reprinted.

1. By GEORGE V. NASH.*

In the Indian Ocean several hundreds of miles to the eastward of Zanzibar, and about four degrees south of the equator, is a group of islands known as the Seychelles. These were discovered by the Portuguese as early as 1505; were occupied by the French in 1743; seized by the British in 1794, and formally ceded to them in 1814. Here at the time of the French occupation in 1743 was discovered a beautiful palm, the fruit of which had been known for many years, but the origin of which had been one of the mysteries of those early times. As in those times mysteries always give rise to most fabulous tales, so was it with this unknown fruit, which, on account of its obscurity, was accredited with most

*Journal of the New York Botanical Garden, January, 1906, p. 7.

wonderful properties and given a worth far in excess of its intrinsic value. It was known as *coco de mer*, *coco de Solomon*, and *coco des Maldives*, this last name being applied because so many of these nuts had been found floating in the sea near the Maldive Islands. It was averred by these ancient people that it was not a product of the earth but of the sea, and the Malay and Chinese sailors insisted that it grew on a tree deep in the water off the coast of Sumatra, but that the tree instantly disappeared when they dived down to see it. The negro priests were firm in the belief that it grew near the island of Java, its branches protruding above the water, and that here a monstrous bird had its home, from which it made nightly sorties to the land, killing tigers, elephants and other large animals; they further asserted that ships were attracted by the waves which surrounded the tree, an attraction from which there was no escape, and that the sailors fell an easy prey to this voracious bird. One can well understand with what care the poor superstitious sailors of the Indian Archipelago must have avoided this spot.

Not only did these tales serve to bring the fruit into notice, but its reputed value as an antidote to poisons made its acquisition greatly to be desired by the princes of Hindostan, who, prone to use such poisons on others, were constantly in fear of being made victims themselves of some wily poisoner.

It is not strange that they were willing to pay large sums for these mysterious objects which would protect them from their enemies. They firmly believed that water which had been kept in one of these was purified from all harm, and could be drunk with impunity, no matter how active may have been the poison placed in the liquid. The sovereign of the Maldives was not long in turning this to his own advantage as a means of increasing his wealth, for he made it a matter of death for any one to have in his possession one of these nuts—all were his property, which he disposed of at a high price or used in making royal presents. But in 1743, upon the discovery of the tree which bore these fruits, this value and repute quickly subsided, for, so they must have reasoned, where there is no mystery how can there be any virtue.

One of the earlier accounts of this palm occurs in a book of voyages published in 1776 in Paris.* A plate illustrating the Seychelles themselves and several other plates depicting features of the palm and its fruit are given. It is there stated that many of these palms grow near the shore of the sea, most of the fruit of such trees dropping into the sea and floating upon its surface. The winds waft them, and the currents, the direction of which in those parts is E.N.E., carry them to the shores of the Maldives, the only part of the world where these fruits had been known previous to the discovery of their origin on the Seychelles.

The palm grows upon three of the islands of the Seychelles, occurring in all parts of them, the best trees growing in deep gorges. One such gorge on the island of Praslin is known as the Ravine

* Voyage a la Nouvelle Guinee par M. Sonnerat. Paris. 1776.

of the Coco de Mer, and is said to be one of the most beautiful spots in tropical climes, the trunks of these charming palms rising to a height of ninety or a hundred feet and bearing aloft a crown of magnificent fan-shaped leaves, often twenty feet long and ten or twelve feet wide.

The many economic uses of this palm make it of exceeding value to the natives of the Seychelles. The heart of the crown of leaves is eaten as a vegetable, as is done with the cabbage palm. The leaves, perhaps, are the most important, being used extensively in house-building, not only for thatching, but also for making walls and partitions; and the down of the young leaves is used in filling mattresses and pillows. The nuts are made into utensils of various kinds, and the young leaves furnish material for making hats.

II.*

On the Double Cocoa-nut of the Seychelles (Lodoicea Sechellarum) "Sea Cocoa-nut," "Double Coconut," "Coco de mer."

By SWINBURNE WARD, ESQ., Civil Commissioner, communicated by Sir W. J. Hooker, F.R.S., & L.S., &c.

This extraordinary specimen of the palm tribe, the largest and most curious of all the many varied kinds scattered over all tropical regions, is found only in two small islands belonging to the Seychelles group, "Praslin" and "Curieuse," which lie in juxtaposition between 4° and 5° of S. lat., and 55° and 56° E. long.,—nearly three hundred miles north-east of Madagascar, which, though itself an island, may, from its immense size, be legitimately considered the nearest mainland.

The name by which it is best known, that of "Coco de mer," was given to it by some French navigators who had picked up the nut floating at sea, and being unable to ascertain anything respecting the tree that produced it, supposed it to be the production of some unknown submarine plant. It has often been found on the coasts of Ceylon and the Maldivé Islands, drifted thither by some of the mysterious currents which perplex mariners all over the Indian Ocean. The nuts attained in these countries to an almost religious value, and were sold in India for fabulous prices. A medicine was made of the kernel, which was said to possess restorative qualities much in request in those countries where polygamy prevails.

It was not until the discovery of the Seychelles Islands by the French in 1742 that authentic information was obtained respecting the true nature of the tree, and the astonishment of those previously acquainted with the Coco de mer may well be imagined upon their finding large forests entirely composed of this palm, growing most luxuriantly upon a small and quite uninhabited island, and towering far above all ordinary tropical vegetation.

But little is even now known respecting the growth and peculiarities of this extraordinary palm, owing to the great length of time it requires to arrive at maturity, and the consequent difficulty

*Journal of the Linnean Society, VIII, 1865, p. 135

of obtaining accurate information with regard to its development. The information gathered from the inhabitants is not of much value, they are very unobservant, and the truth of their replies to any questions that may be put to them can never be depended upon.

The shortest period before the tree puts forth its buds is thirty years, and one hundred years must elapse before it attains its full growth. No one can tell how long it will last, or how old some of the gigantic specimens may be. No nuts planted since the British came into possession have arrived at their full growth. One in the garden at Government House, planted fifteen years ago, is still quite in its infancy, about sixteen feet in height, but with no stem yet visible, the long leaves shooting from the earth like the Traveller's Palm and much resembling them in shape, only much larger. Nine months after the nut has been planted, supposing germination to have begun at once, the leaf sprouts at an angle of 45° from the root; it is very closely folded, with a smooth hard surface, terminating in a sharp point. When about two feet above the surface it expands, and nine months after another leaf follows, coming up the grooved surface of the midrib of that which preceded it, and so on at intervals of nine months, each succeeding leaf becoming larger in size. All these leaves cluster together and support each other, no stem appearing above the ground. From the age of fifteen to twenty-five the tree is in its greatest beauty, and the leaves at this period much larger than they are subsequently. They consist of two layers of fibres crossing each other at right angles, imbedded in a thick stratum of parenchyma enclosed in a tough skin.

The stem of the full-grown tree, like that of all Palms, consists of hard fibres imbedded in medullary substance enclosed in a hard sheath, so hard that a good axe is required to cut it. It splits readily, but is extremely durable. Unlike the Cocoa-nut trees, which bend to every gentle gale and are never quite straight, the Coco de mer trees are as upright as iron pillars, undisturbed in their position by the heavy gales and violent storms so often occurring in tropical regions.

At the age of thirty the tree first puts forth its blossoms. The male and female trees are quite distinct; and the female blossom may be considered as the germ of the nut, as it offers nothing of the appearance of what is generally regarded as a blossom. The female tree alone produces the nut, and it is twenty feet shorter than the male tree, which frequently attains a height of one hundred feet.

The male flower is an enormous catkin, about three feet in length and three inches in diameter, of a reddish-brown colour, and covered with rhomboidal valvate scales disposed spirally about the stem, from the angles of which the stamens spring. Within its circumference, at intervals corresponding to the apertures from which the stamens shoot, are found little masses containing such a succession of stamens in progressive stages of development that the flowering is maintained for eight or ten years, each coming

stamen thrusting off and replacing the one that preceded it. The whole has a most disagreeable, oily odour, and if cut and put in any accessible place, is greedily attacked by ants. It may be seen in all stages upon the same tree—in full bloom, faded, and quite decayed.

The female blossoms spring from a strong stem forming a regular zigzag, and are composed of three bracts three or four inches in diameter. A gummy secretion exudes from the apex of these, which secretion doubtless arrests and secures the pollen necessary for their fecundation. The fruit stalk is supported by three very strong bracts; the outer one of these, the top of which is wedge-shaped, penetrates the stalk of the leaf immediately above it, in the under side of which nature has left a fissure accessible to it. By this provision the stalk is enabled to support the weight of fruit which hangs upon it, sometimes exceeding four hundred-weight. Eleven nuts have been seen on one stalk, the probable weight of each being about forty pounds. Such clusters are, however, very rare, and four or five may be taken as the average number on one stalk.

From fructification to full maturity a period of nearly ten years elapses. The fruit attains its full size in about four years, and is then soft, and full of a semi-transparent jelly-like substance of an insipid, sweetish taste. The mesocarp is a leathery substance of a brownish-green colour, adhering to the shell. As the nut ripens this gradually dries up into a white, horny kernel, about half an inch in thickness, and of no use whatever, supposed to be poisonous, but, probably, only quite indigestible. The nut in its perfect state is about eighteen inches long, and of the same breadth, something in the shape of a heart, with two separate compartments. It is enveloped, like the Coco-nut in a fibrous husk; but its texture is not nearly so thick or so strong, and it drops off soon after the nut falls from the tree. The nuts, sawn in half, and divested of the kernel, form excellent calabashes, and are universally used for baling boats. The entire nut is frequently used as a water-keg, and holds three or four gallons of water. It has, however, to be "caulked" in the centre, where germination takes place, before it becomes completely watertight.

The arrangements provided by nature for the roots of both male and female trees are of a most peculiar nature, quite distinct from those provided for any other known tree. The base of the trunk is of a bulbous form, and this bulb fits into a natural bowl, or socket, about two and a half feet in diameter and eighteen inches in depth, narrowing towards the bottom. This bowl is pierced with hundreds of small oval holes about the size of a thimble, with hollow tubes corresponding on the outside, through which the roots penetrate the ground on all sides, never, however, becoming attached to the bowl; their partial elasticity affording an almost imperceptible but very necessary "play" to the parent stem when struggling against the force of violent gales.

This bowl is of the same substance as the shell of the nut, only much thicker. As far as can be ascertained, it never rots or wears

out. It has been found quite perfect and entire in every respect sixty years after the tree has been cut down. At Curieuse many sockets are still remaining which are known to have belonged to trees cut down by the first settlers on the island.

This curious arrangement renders it impossible that the trunk could grow in a slanting position; and there is no known instance of its doing so, either on the flat, or on the steep sides of the mountains, in both of which situations the tree thrives equally well.

The high price still fetched by the nuts will ultimately be the cause of their complete extinction in these islands. The growth of the palm is so very slow that no one can expect to reap where he has sowed, and the people consequently never take the trouble to plant any for the benefit of posterity. Not content too with digging up those nuts that have fallen and taken root they ruthlessly destroy whole trees by cutting them down for the sake of the nuts and the heart leaves, which latter are used for making hats, fans and baskets. Many of the trees still standing are quite spoilt by the practice of cutting out these centre or heart leaves, leaving the tree shorn of its beauty, and with an untidy, ragged appearance. Besides the ravages of man, fire is a terrible enemy to these forests, a year seldom elapsing without there being sufferers by accidental conflagrations, especially those forests situated at the north-west end of Praslin, in which are now found only such male trees that from their height overtopped the flames that destroyed the females. At the south-east end of Praslin they are more plentiful the dry season being in the south-east monsoon, and as the forests are to windward, they are not exposed to much danger from spreading fire.

No suggestions will induce proprietors to abandon their present habit of wilfully destroying the trees for the sake of the nuts and leaves, or to take some pains for the cultivation and reproduction of this magnificent palm. Not many years will elapse before the *Coco de mer* becomes in reality as rare as it was supposed to be when first picked up at sea by the wondering mariners, and the only relics left of its former magnificence will be the decaying blackened stumps of the trees so wantonly destroyed, and the curious sockets in which they stood for so many years.

Seycelles, April 16, 1863.

III*

Letters from SIR H. BARKLEY and SWINBURNE WARD, ESQ.,
relative to the *Coco de Mer*

Government House, Mauritius,
6th June, 1864.

Sir,

Having brought the resolution adopted by the Linnean Society, on 3rd of March, relative to the destruction of the Sea Cocoa-nut Tree in the Seychelles Islands, under the notice of the Civil Commissioner of that group, and called upon him to suggest officially

* Journal of Linnean Society, IX, 1866, p. 118.

what measures could be taken to ensure the preservation of the remaining trees, I have received the report of which I now beg to enclose a copy.

The Society will be glad to learn that Mr. Ward did not find on a visit of inspection, that that destruction had been carried so far as had been represented to him, but that, on the contrary, one forest of these palms in Ile Praslin is carefully preserved by its owner, and still contains magnificent specimens.

As this island is almost entirely private property, the interference of the Government would be difficult, except in the way of exhortation and remonstrance; but as Ile Curieuse, where a certain number of trees are found, is still vested in the Crown, and used for a purpose which renders it inaccessible to the public, I trust there can be no danger under any circumstances of the extinction of this most interesting species.

I am confident that whilst Mr. Ward remains in his present post he will do all in his power to protect the existing trees, and to secure the planting of others.

I remain, Sir,

Your obedient Servant,

HENRY BARKLEY.

*To George Bentham, Esq.,
President L.S., &c., &c.*

Preservation of the Coco de mer.

Civil Commissioner's Office,

Seychelles, May 17, 1864.

Sir,

I have the honour to acknowledge the receipt of your letter (No. H. 890) of May 6th enclosing a communication from the Linnean Society on the subject of the destruction of Coco de mer trees at Praslin, and directing me to report, for the information of His Excellency the Governor, upon the measures which ought to be taken for the preservation of such of the Lodoicea trees as now remain.

The paper on the Coco de Mer, to which the Linnean Society alludes, was written a short time after my arrival; but although I had made a tour of inspection round the islands, including Praslin and Curieuse, I had not then visited the district in which this palm principally flourishes.

There is no doubt that the Coco de Mer has entirely disappeared from many parts of the island of Praslin, where it formerly abounded—destroyed by accidental conflagrations, and ruthlessly cut down to make room for manioc cultivation. The land in these parts of Praslin, with a very small exception, is entirely in the hands of private individuals, and no steps could have been taken by Government with respect to preserving the trees.

I returned, on the 9th instant, from a visit to the more distant islands of the group in the "Pleiad," which was placed at my disposal by Colonel Playfair, and I took the opportunity during this tour, of visiting the Lodoicea forest at Aulse Marie Louise, on the southern point of the island of Praslin—a small lovely valley reaching to the sea-board, surrounded by lofty hills, the sides and crests of which are covered with Lodoicea several hundred in number.

This forest is in the property of a Mr. Campbell; and I am glad to be able to report that more care is taken of the trees here than is the case in any other part of the island. They may be seen in all stages of growth, from the sharp, sword-shaped spathe just shooting from the ground, to palms one hundred and twenty feet in height, long since arrived at maturity, and at whose age it is impossible even to guess. None are actually planted by the proprietor; but he occasionally allows nuts to remain and take root where they fall; and as the trees are usually surrounded at the base by thick undergrowth, many other nuts are overlooked by the men employed to collect them, a certain amount of reproduction being thus ensured.

The leaves of the male trees alone are cut for the sake of the material from which hats, fans, and baskets are made. Cutting these leaves prevents the trees from giving any blossoms; but the male trees preponderate over the female, and these growing in almost inaccessible spots, which flower undisturbed, are quite sufficient to fecundate all the female trees in the district. The flowering process continues for years; and the small blossoms that spring from the huge catkin forming the basis, as it were, of the flowers, are reproduced, apparently, *ad infinitum*.

A comparatively small number of trees are found on Curieuse Island, and these never attain the same size and perfection as those at Praslin. Soon after my arrival, I gave directions to Mr. Forbes, in charge of the lesser establishment, to keep up the supply by planting germinating nuts; but he succeeded with but a small proportion of those planted. Unfortunately, too, several trees which were thriving in the vicinity of the cemetery were accidentally burnt. I have directed him to plant all the germinating nuts that he can find for the future, and to take all the care he can of the trees now remaining.

When at Praslin, I selected a Coco de Mer with a perfect healthy germ nearly a foot in length, which I forwarded to Sir William Hooker, by the 'Nomo,' on the 11th instant.

I have the honour to be, Sir,

Your most obedient servant,

SWINBURNE WARD,

Civil Commissioner.

*The Honourable The Colonial Secretary,
Mauritius.*

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The monthly meeting of the Board of Agriculture was held at Headquarter House on Monday, the 12th March, at 11.15 a.m. There were present :—The Hon. H. Clarence Bourne (Chairman); Director of Public Gardens; Superintending Inspector of Schools; Island Chemist; His Grace the Archbishop of the West Indies; Messrs. J. W. Middleton, G. D. Murray and Jno. Barclay (Secretary).

Commercial Agent.—The Secretary read the report of the committee appointed in matter of a commercial agent for Jamaica in London, the adoption of the report was unanimously agreed to.

The Chairman asked the Archbishop, Mr. Middleton and Mr. Murray to form a deputation to wait on His Excellency and present the report; and the Secretary was instructed to write the Colonial Secretary and ask when it would be convenient for the Governor to receive the deputation.

Day of Meeting.—As Mr. Murray reported that he could not attend the meetings of the Board if they were held on Mondays, the Archbishop proposed that the meetings should be held on the Wednesday of the same week of the month at 2 p.m., instead of 11.15 a.m.

This was agreed to.

Contagious Diseases.—The Secretary reported that the committee appointed had again revised the draft of the proposed Bill and it had been sent on by the Agricultural Society to the Governor.

Cotton Gin.—The Secretary reported that he had received the Hand Cotton Gin from Mr. Levy, that it had been sent to the Railway workshop for repair and it would be stored in the office for future use.

Diseased Coco-nuts.—A letter was read from the Colonial Secretary informing the Board that Mr. G. P. Dewar had pointed out that he especially desired to call attention to the need for owners of blighted coco-nut trees to be compelled to cure or burn them, as until they were made to do so their neighbours would suffer. He said that when the trees showed any symptoms of unhealthiness they were beyond remedy as the leading bud was rotten and decayed, and that while spraying was good, eradication was better.

The Governor asked the views of the Board on Mr. Dewar's proposal.

The Director of Public Gardens said that Mr. Dewar was wrong in saying that when the trees showed signs of unhealthiness they were beyond remedy, that bud-rot could be cured in its earlier stages by spraying with Bordeaux mixture, which arrested the decay. He had arranged for Mr. Cradwick to visit Lucea on the 19th May and Mr. Dewar could arrange to meet Mr. Cradwick there.

The Secretary was directed to reply to the Colonial Secretary to this effect.

Mr. Nolan's Work.—The Colonial Secretary also forwarded a letter from Mr. Nolan, forwarding cutting from *The Wine and Spirit Gazette*, and also a report of the case which he had instituted under the Merchandise Act with a copy of a prosecution which took place in Lanark under the Food and Drugs Act in which the defendants were convicted.

These were directed to be circulated.

Resignation of Mr. Teversham.—A letter was also read from the Colonial Secretary intimating the resignation of Mr. T. F. Teversham as from the 28th February on account of ill-health.

The chairman stated that various alternative proposals were before the Government and provisions had been made in the estimates of £200 for carrying on the work.

Standardisation of Jamaica Rum.—The following papers which had been circulated but had not yet been before the Board were submitted :

With regard to the standardisation of Jamaica rum, the Director of Public Gardens' minutes on the subject were read to the effect that a standard of this kind was unnecessary and would be injurious to our interests.

Of the members present Mr. Cousins, Mr. Murray, and the chairman were in favour of the proposed standardisation.

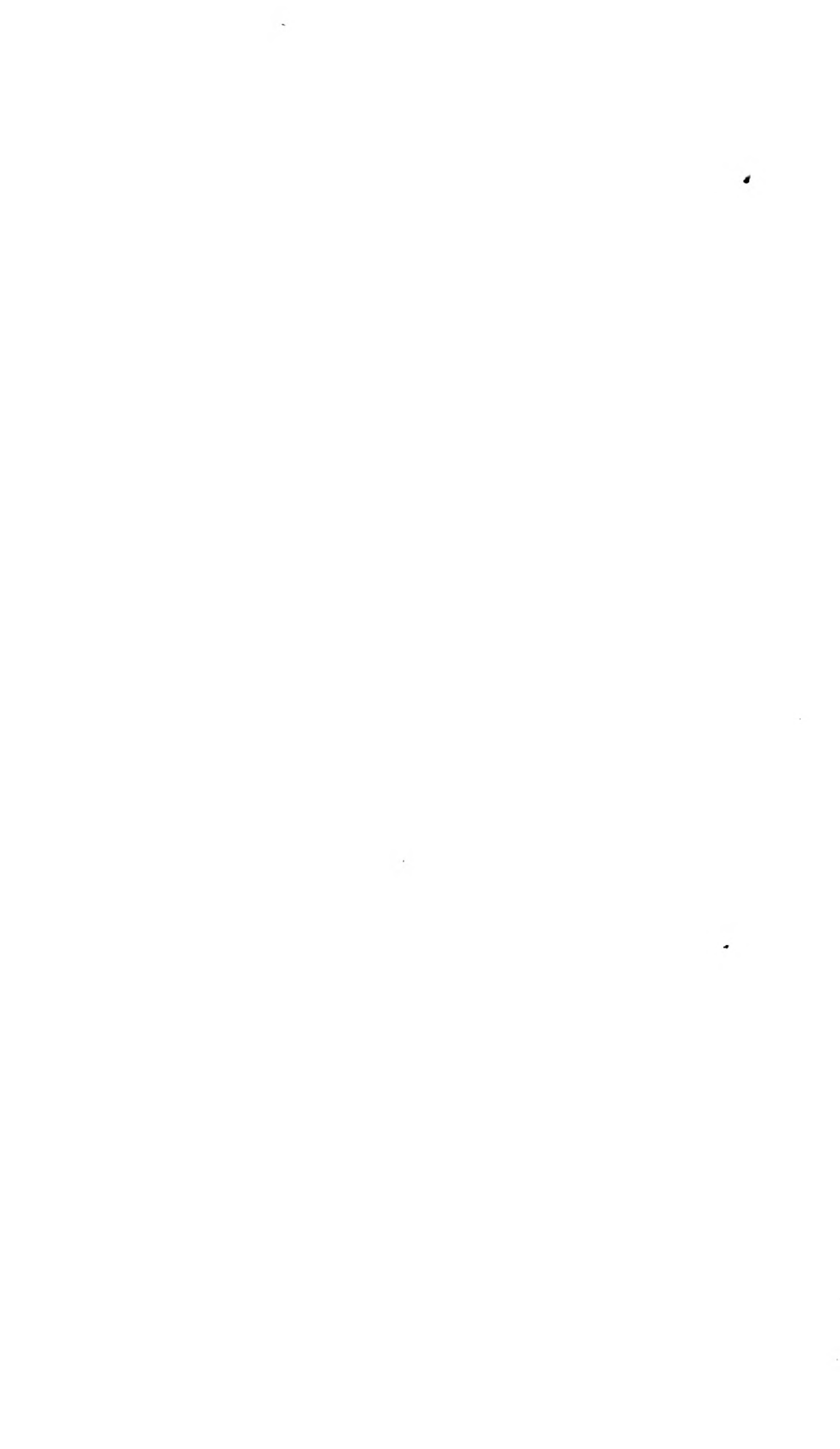
Mr. Fawcett was opposed to it and the Archbishop thought that the facts as contained in the papers should be reported to the Governor to form his own opinion.

The Chemist was asked to make a summary of the arguments in favour of his case to be sent first to Mr. Fawcett to state his arguments against it, both then to be circulated among the members of the Board.

Agricultural "Don'ts."—In reference to the above, these having been revised by the Superintending Inspector of Schools with the suggestion of the members of the Board before him, were approved. The Archbishop said that he hoped to get the Board of Education to adopt them and have them hung up in the form of a large chart for use in schools.

Report from Mr. Cousins on his visit to Trelawny and Westmoreland and Report Hope Experiment Station were also presented.

[Issued 12th April, 1906.]



BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

MAY, 1906.

Part 5.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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P R I C E - Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :

HOPE GARDENS.

1906.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

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GARDEN

Vol. IV.

MAY, 1906.

Part 5.

NOTES ON THE "CASTILLOA" RUBBER TREE.

By "A Forester," Bluefields, Nicaragua, Jan., 1906.*

The roots of young plants of *Castilloa elastica* (the Central American rubber tree) are well developed and branch a good deal. They are very thickly clothed with root hairs at the tips. These hairs are very fine and fragile and in transplanting young seedlings great care should be taken not to injure them. I believe that the condition of the roots of a tree makes more difference with the amount of rubber it will give than the leaves. A tree with small yield is generally healthy in the leaves, but has some defect in the roots. Transplants are likely to have defective tap roots and on this account blow over.

There are two distinct types of branches on the *Castilloa* tree—temporary and permanent. All the branches for the first three or four years are temporary. They grow alternately on different sides and almost at right angles to the trunk. After some time the temporary branch drops, when besides the scar which is left will be found a small bud. This bud is either to the right or left of the scar, but never above or below it. Whenever one such bud on a tree grows to the right all the other buds do the same, and *vice versa*. I have never found a tree with buds on both sides. Such buds are the beginning of permanent branches. Only a small number grow into branches, but any of them can be forced by cutting through the bark to the wood, above the bud, and thus severing the sieve tubes connecting the leaves and roots. These permanent branches project upward at an angle of 45° or less. Forced branches do not grow as fast as natural ones. The permanent branch bears temporary branches of its own, and later may bear other permanent branches.

This question of branching may prove important. Some planters claim that trees that put out permanent branches early grow faster and yield better than later branching trees. Others

* From the India Rubber World.

JUN 6 - 1906

claim that branching is not good for the trees. I believe that branched trees grow somewhat faster because they get a larger leaf surface, but I do not think that this leaf surface affects the amount of latex. Trees planted far apart branch more freely and earlier than those which are close together. There also seem to be more branches on trees grown in the sun than in the shade. It has been suggested that it would be well to grow branches on the trees—by the forced method above described—in such manner that the trees could be ascended by tappers without a ladder. The fact that some temporary limbs turn permanent might be investigated, and perhaps a way could be found to make them turn permanent at will, if desirable.

The *Castilloa* is a fast growing tree. It appears to grow faster between the ages of two and four. The leaf surface of the tree, and consequently the amount of light it gets, has a great deal to do with its growth. Shade grown trees are not nearly so large at the same age as those grown in the sun. Some planters believe that trees grown in at least partial shade yield more latex, but if this is so, I do not believe that they yield enough more to pay for the loss in growth, for under any ordinary conditions the trees yield in proportion to their size. Monthly measurement of a large number of *Castilloa* trees shows that they grow on an average of about $\frac{1}{4}$ inch per month in circumference. This varies, however, the trees sometimes growing not at all for a month and growing $\frac{1}{2}$ inch or more the next month. An experiment in the effect of tapping on growth did not show that it made any difference.

The proper distance in planting depends a good deal on how soon the plantation is to be tapped. Trees planted 10 x 10 feet begin to crowd each other at about six years. If the plantation is to be tapped at this age, or earlier, this is a good distance for planting. When the trees get older, the poorer and weaker ones can be bled out. The experiment of planting four trees in a hole shows that it is possible for two, three, or even all four to grow well and apparently not to hinder each other. If these trees continue as they have begun, it seems to me that the way to grow the most good trees on a given piece of land would be to stake the land at a distance of 15 or 20 feet, and to plant a circle of 8 or 10 trees about each stake. Any trees grown in this way which did not keep up to the others should be cut down, and by the time they are ready to tap there should be three or four good trees in each group. This method would avoid one trouble which has shown itself where one tree was planted to a hole, and that is that when the time for tapping came many of the trees were poor and stunted and not worth anything. This irregularity of growth loses much time and can be avoided where only the best trees are allowed to grow.

Whatever the method of tapping employed for *Castilloa*, the healing of the cut requires to be considered. The general idea has been that the cut must not be made too deep and this is true to a certain extent. But it may also be made too shallow. Be-

tween the bark and the wood is the growing part of the tree, a tissue called cambium. This part alone has the powers of forming new bark and new wood. If a cut is made which does not go into the cambium, the cut will not heal over with new material. Of course, it will dry up and turn black, and in this way protect the tissue under it, but the piece of bark taken out is gone for good. On the other hand, a cut made just to the cambium will heal quickly.

The Pará rubber tree (*Hevea*) shows some important differences in latex from the *Castilloa*. Of course all that I have noted on this tree is done here in Nicaragua and it may behave differently in Brasil or Ceylon. The first noticeable thing in cutting the Pará tree is the small yield. When a *Castilloa* is tapped, the cut is immediately filled with latex, which runs in a small stream from the lower end. The *Hevea* when first cut shows no latex. In a few seconds it begins to appear in drops on the cut surface and after 3 to 5 minutes begins to drop from the end of the cut. The small yield at the first tapping seems to be balanced by the fact that more can be got by multiple tapping. In Ceylon, according to report, the yield increases each day, but here I have noticed no increased yield. I tapped one tree nine days in succession, and though it yielded every day (a thing which *Castilloa* would not do) the yield decreased instead of increasing. The *Hevea* tree will not do here because there is too much labour involved in multiple tapping. I think the trees here, if tapped rightly, would yield as much as those in Ceylon, but as labour cost so much more, it would not pay. I am confident from comparing yields printed in *The India Rubber World* that *Castilloa* will yield as much with four tapping operations a year as *Hevea* will with ten or twenty when the trees are the same age.

COAGULATION OF CASTILLOA RUBBER.

Mr. S. W. Sinclair, *Manhattan Plantation, Bluefields, Nicaragua, to Director of Public Gardens.*

Manhattan Plantation,
February 2nd 1906.

Dear Sir,

Your favour of June 23rd 1905 has just reached me.

Replying to your enquiry about the Sinclair Coagulator, beg to say that it consists of a piece of board through which holes are bored 2 ins. by 2 ins. (holes should be about $\frac{1}{4}$ inch). Over this board a sheet of absorbent paper is placed, (I enclose sample); paper must be laid on the board wet, if put on dry, it will warp and give an uneven sheet of rubber. Having the board and paper laid on wet, now proceed to tack on the rim or frame, which should be from $1\frac{1}{4}$ in. high to $1\frac{1}{2}$ in. and your box will be ready for coagulating. As soon as the latex is brought in from the field, I add four times its volume of water, then strain through a fine metal sieve; then I place the whole in a cone bottom tin tank to settle, which takes about one hour. I then decant off the water until the

latex becomes as thick as when it came from the tree, then I pour it in my boxes and the water that is in the latex, which can't be decanted off, will pass through the absorbent paper in about 10 minutes leaving the rubber.

I then expose it to a heat of 110 degrees F. for 5 or 6 hours, when the rubber can be lifted off the box.

A new sheet has to put on after being used 10 or 12 times.

The time of exposure to heat varies and it is hard to give a correct formula in this respect, but one soon learns by the feel of the sheets, just when to take them from the boxes. I take them off as soon as my fingers don't stick, when pressed against them.

I may mention here that this method is for *Castilloa elastica*.

The *Hevea* latex passes through the absorbent paper.

I am carrying on experiments now and expect soon to be able to handle both kinds of latex.

Rubber coagulated on the above method becomes transparent like Ceylon biscuits, and runs it a close second in price, we aim to bring it up to par.

With respects, I am,

Yours sincerely,

S. W. SINCLAIR.

GRASS OILS.*

I. CITRONELLA AND LEMON GRASS IN CEYLON.

By HERBERT WRIGHT, Controller of Experiment Station,
Ceylon.

(*Paper read before the Ceylon Agricultural Board.*)

The Citronella industry is far from being in a flourishing condition in Ceylon, and many persons who in the old days found it a profitable cultivation now declare it to be unremunerative. It is common knowledge, however, that Citronella oil exported from Java obtains a much higher price than that from Ceylon, and it has been argued that, if the same price could be realised for the oil exported from this island, it might once more become an industry worthy of serious consideration. Planters in the Straits and the authorities of the Imperial Department of Agriculture for the West Indies are taking up the subject in earnest, and residents in this island are beginning to send in numerous enquiries as to the possibilities with this product. The moment, therefore, seemed opportune to present a few facts regarding Citronella and also Lemon Grass, as results have been obtained at the Experiment Station, Peradeniya, and in various parts of Ceylon.

CITRONELLA.

We will first consider Citronella oil. I have brought with me a sample of one of the grasses from which the oil is obtained, and also a quantity of pure oil fresh from the still. As you are probably not concerned with the exact botanical identity of Citronella grass, I may dismiss that vexed question by saying that the speci-

For previous articles on Grass Oils, see *Bulletins*, March, 1903, p. 53; Dec. 1903 Feb. 1904, p. 43; Oct. 1904, p. 224; March, 1905, p. 49.

men as here presented is as near the wild "Mana" grass as it can be, and is by most botanists regarded as being a variety of the "Mana" grass so common in many parts of this island. The cultivation of Citronella has hitherto been confined to the Southern and South-West Provinces, the Matara, Galle, and Hambantota districts being well-known in connection with this product. Exactly why it has been more or less limited to these localities it is difficult to say, as the grass grows well in districts having an annual rainfall of 80 to 100 inches, and, as will be shown later, has been successfully cultivated at an elevation of 2,000 feet in the Central Province. It is not easy to obtain reliable information as to the yield per acre in these provinces, but it is usually estimated that about 36 bottles each containing $1\frac{1}{2}$ lb. of oil are obtainable per acre per year. If such is the case it can be asserted that the Peradeniya district, at an elevation of 2,000 feet, is as good as any part of the Southern Province for this product. At Peradeniya one acre of the Maha-pangiri variety gave in 1904 19,320 $\frac{1}{4}$ lb. of grass, from which 84 lb. of pure oil were obtained; in 1905, the same plot produced 5,757 $\frac{1}{4}$ lb. of grass, which yielded 38 lb. of oil. This one-acre plot gave in the second and third year from planting 122 lb. of oil or 61 lb. per year. From other plots in their first year 60 lb. of oil were obtained per acre.

VALUE.—Messrs. Chas. P. Hayley & Co., of Galle, have offered 85 to 88 cents per lb. for the crude unfiltered oil. The yields I have given you were obtained from a plot on the rocky hill-side facing the Peradeniya Gardens, which was previously occupied by Mana grass and Lantana. It is not a rich soil but a typical patna-like compound similar to what may be seen in many parts of the Island. The results show that we can obtain a crop of 60 lb. of oil per acre per year (210 to 250 lb. of grass giving 1 lb. of oil), the oil realising from Rs. 51 to Rs. 53 per acre in Galle. It must be admitted that this is not a very big return, but it is about as much or even more than what is obtained on many Citronella estates. The yearly expenditure for weeding, cutting, transporting and distilling is probably about Rs. 20 to Rs. 30 per acre, and if the good variety is cultivated it will require re-planting every third year at a cost of Rs. 3 per acre. In addition to such current expenditure one must allow for clearing, for plants, and the wear and tear of the machinery. It is obvious from these remarks that Citronella cultivators are not rolling in profits, and various points will require attention if the prospects of the industry are to be made brighter.

POINTS REQUIRING ATTENTION.—The first and foremost is to check the adulteration which has been practised, so that Ceylon can obtain a better reputation and command a price equal to that paid for the oil exported from Java. This matter is, as most of you are aware, receiving the attention of Government, and it is not necessary for us to make any remarks beyond pleading for a cessation of adulteration, or exporting the adulterated article under definite grades, so that buyers will know what they are purchasing. Another point of practical importance is the complete condensa-

tion of the oil. Often the oil and water, as they pass into the receiver, are quite warm instead of being cold. The cold water should enter the condensing chamber at the end furthest from the distilling chamber, so that the oil-vapour will meet a cooler atmosphere the nearer it gets to the receiver. I find in practice that a 60 foot coil of piping, 3 to 4 inches in diameter, is sufficient to effect perfect condensation, and it is the opinion of many that the good yield of oil obtained at Peradeniya is partly due to the completeness of the condensation which is obtained. There are other points of importance which might be touched upon, but beyond advising the planting at definite distances, instead of at haphazard, selecting the better variety and paying attention to the seasons and the time of cutting, I propose to dismiss the subject of Citronella. As most of you are aware, certain Citronella planters have found relief in quite another way, namely, by taking up the cultivation of Lemon grass in place of Citronella.

LEMON GRASS.

The main reasons which have led to this change are, first, that Lemon grass oil is valued at 35 to 40 cents an ounce in Galle; and, secondly, the grass can be cultivated and distilled in just the same manner as Citronella. Of course, the demand is not an unlimited one, and the price may be lowered if too much oil is placed on the market. The Lemon grass is quite a different plant, but, as you can see from this specimen, it is similar in many respects to Citronella grass. It yields a valuable oil, a pure sample of which I have placed on the table for your inspection. The practical details connected with Lemon grass cultivation are identical with those of Citronella, and therefore need not be dealt with here. The points to consider are the yield and value of the oil. I cannot give you the figures of outsiders, but the results at the Experiment Station are probably similar to those obtained elsewhere. At Peradeniya, at an elevation of 1,600 feet, the grass can be cut six months after planting, and from one plot, which was planted in July, 1904, we obtained in December of that year 8,063 lb. of grass yielding 13½ lb. of oil per acre, the same plot cut in April of this year gave 5,281 lb. of grass and 13 lb. of oil per acre so that the yield per acre in the first year has already been 26½ lb. of oil. This works out at 40 cents per ounce in Galle, at over Rs. 160 per acre in the first year. You will remember that the Citronella may give a gross return of Rs. 51 to Rs. 53 for the same period. The ease with which these products are cultivated is remarkable. All that is necessary is to make holes, mamoty wide and mamoty deep, and plant young shoots in rainy weather. Nearly all the plants will grow well, and the grass can usually be cut and distilled six months after planting.

CONSTITUENTS REMOVED.—In comparing the value of Lemon grass as against Citronella, it is as well to bear in mind the effect of cultivating these products on the soil. In each case the weight of grass removed is considerable, and it is somewhat surprising that crops so exhausting can be grown on relatively poor soils. In order to emphasise this point I now quote the results of analyses

made by Mr. Bruce, which show that every 10,000 lb. of Lemon grass contain about 65 lb. of potash, 12 lb. of nitrogen, 12 lb. of lime, and 9 lb. of phosphoric acid. The same quantity of Citronella grass removes less potash and lime but more nitrogen and phosphoric acid. The weight of Citronella grass per acre is usually much greater than that of Lemon grass, and is in most cases the more exhausting of the two.

Sufficient has been said to show that we have in Lemon grass and Citronella two products which can be regarded as catch crops since they gave a return six months from planting; the cultivation is simple, the plants are very hardy and seem to be comparatively free from disease. They can be grown on poor soils in a very large part of this Island, and there is a fair demand for the oil. It is proposed to publish the results in detail in the Magazine of the Society, and to show by means of diagrams and photographs the nature of the plants and also the machinery, used in these industries, and it is therefore unnecessary for me to prolong my remarks.

THE DISCUSSION.

H. E. the GOVERNOR: You mentioned that the cost was Rs. 30 an acre?

Mr. WRIGHT: That was for cutting the grass, transporting, and distilling, and also weeding.

H. E. the GOVERNOR: Does anybody know about the range of these grasses—the elevations at which they would grow?

Mr. WRIGHT: Hitherto they have been confined to the Southern Province; and this is the first time, I believe, that we have grown them at 2,000 feet elevation at Peradeniya.

H. E. the GOVERNOR: I have seen some plants growing very freely at Nuwara Eliya, 6,000 feet elevation, apparently in Patana land?

Mr. WRIGHT: Citronella grass, as is well-known, is a variety of the Mana grass, which grows wild. Wherever Mana grows you might undoubtedly grow Citronella grass.

H. E. the GOVERNOR: We might try it somewhere in the hill country.

Mr. WRIGHT mentioned the Horton Plains.

The Hon. Mr. J. FERGUSON enquired if Mr. Wright would recommend planters who had Mana grass fields to try Lemon grass or Citronella.

Mr. WRIGHT thought there would be no objection provided the planting was considered a part of the co-operative experiments being carried on by the Department. Any particular product that the authorities considered experimental they would help the planters to grow, provided they gave the results in return.

The Hon. Mr. J. FERGUSON: Are co-operative experiments to be introduced at different elevations?

Mr. WRIGHT said that was a matter they wished to see brought forward. They would carry out experiments and see if certain plants would grow at every thousand feet elevation.

Mr. FERGUSON remarked it would be well for the Society to get planters to make co-operative experiments. As regarded elevation, Mr. Campbell mentioned to him that in the Himalayas at 7,000 feet elevation that grass grew.

H. E. the GOVERNOR: What I observed two days ago showed that this grass will grow up to 7,000 feet; we can try several elevations. We have got at the present moment a certain number of gentlemen in various parts of the Colony who are prepared to assist us in experiments, and whose names are noted as being affiliated for the purpose.

VARIATION IN YIELD AT CERTAIN SEASONS.—MR. FERGUSON: Mr. Wright might be able to give us details as regards crops in relation to acreage.

Mr. WRIGHT said that there was a great variation in the weight of grass obtained at certain times of the year and in the weight of the oil. In the case of Citronella, taking three seasons' records it roughly worked out at 1 lb. of oil from 250 lbs. grass. On the other hand from Lemon grass they roughly got 1 lb. of oil from 500 lb. grass. Lemon grass, of course, was smaller. He pointed out that at the end of the dry season they got more oil from a given quantity of grass.

SOIL EXHAUSTION AND ROTATION.—Dr. H. M. FERNANDO remarked that it was well-known that Citronella grass exhausted the soil to a great extent, would it therefore be advisable to plant it as a catch crop among coco-nuts, etc.?

Mr. WRIGHT explained that Citronella was very exhausting to the soil if grown alone, but if it was associated with other products the exhaustion was far from being at all dangerous to cultivation. If at the end of two or three years they did not re-open land in Citronella or Lemon grass but adopted a rotation crop, either of crotalaria, or ground nuts, or even chillies—he had seen that product used in the Southern Province—they would get better results from the soil after that. Of course, if they did not grow anything with coco-nuts or cocoa or rubber the land would lose all the same by being allowed to remain exposed.

Mr. FERGUSON pointed out that the gross return from Lemon grass was given at Rs. 160 an acre, and Citronella Rs. 54. Was there any particular reason for the difference?

ADULTERATED OIL.—Mr. WRIGHT explained that in the old days Citronella oil obtained a better price than Lemon grass oil. The price was simply the result of the greater demand for the one article than the other. They might be able to raise the price of Citronella oil by exporting it under a Government guarantee of purity. At the present time Citronella oil was simply adulterated.

H. E. the GOVERNOR: Am I to understand that the price obtained for Citronella oil, at the present time, is the price of adulterated Citronella oil exported from Ceylon?

Mr. WRIGHT:—It is the price of crude, unfiltered oil.

The Hon. Mr. W. H. JACKSON wished to know if any analysis had been made of the waste grass after the oil had been expressed.

He had seen it used for stocking the still. It might be returned to the soil.

Mr. WRIGHT remarked that he, too, had seen it used as fuel and also to feed cattle which seemed to relish it greatly. The only thing that was lost by using it as fuel was the nitrogen. The potash would be there and the lime. The ashes might be used on the land.

PLANTING UP PATANAS.—The Hon. Mr. W. H. JACKSON said that if the grass grew like Mana they might try it on waste land which, in places, grew nothing but Mana.

H. E. the GOVERNOR: That is what is proposed to do near Hakgala—to grow it on Patana land.

Mr. WRIGHT:—I have already established places at Bandarawela. Will that place answer?

The Hon. Mr. W. H. JACKSON:—I think so. That is about the barest place.

II. LEMON-GRASS OIL FROM MONTSERRAT*

A specimen of lemon-grass oil was forwarded to the Imperial Institute in September, 1903, by the Hon. F. Watts, Government Analytical and Agricultural Chemist to the Leeward Islands, with the request that its commercial value might be ascertained.

In the letter accompanying the sample, analyses of this and other West Indian lemon-grass oils were given, and the characteristic partial solubility of these oils in alcohol was noted. No information was given, however, regarding the exact botanical origin of the Montserrat oil, and as a knowledge of this point is of some importance in placing such products on the market a request was made for a herbarium specimen of the plant from which the oil was distilled, in order that it might be identified; at the same time a larger sample of the oil was asked for. These supplementary materials were received in January, 1904.

Identification of the Plant.

The herbarium specimen of the plant was submitted for examination to the Director of the Royal Gardens, Kew, who identified it as *Andropogon nardus*, L. var *genuinus*, Hack. which is commonly known as the true lemon-grass.

Chemical examination of the oil.

The oil was examined in the Scientific and Technical Department of the Imperial Institute, and gave the following results:

The specimen measured about eight fluid ounces, and consisted of clear, limpid, yellow liquid, with a pleasant lemon grass odour. It dissolved to the extent of about 97 per cent. in 70 per cent. alcohol, and on distillation about 25 per cent. of the oil was obtained between 180°–220° c., and 50 per cent., which was principally citral, between 220°–230° c.

The following table shows the analytical results obtained with the Montserrat oil both at the Imperial Institute and in the West

* From Bulletin of the Imperial Institute, II.

Indies, and for convenience of comparison the corresponding figures for commercial lemon-grass oil distilled in India from *Andropogon citratus*.

—	Montserrat Lemon-grass Oil.		East Indian Lemon-grass Oil.
	Imperial Institute Analysis.	Mr. Watts' Analysis.	
Specific gravity at 15 c. ...	0·906	0·886	0·899 to 0·903
Angle of rotation in 100 m.m. tube	—0 10'	—0 12·6'	+1°25 to 3°5'
Citral determined by the sodium bi-sulphite method	74·6%	74·2%	70 to 75%

These results indicate that the Montserrat oil contains as large a proportion of the valuable constituent citral as the East Indian oil, and only differs from the latter product in being incompletely soluble in 70 per cent. alcohol.

Lemon-grass is now principally employed as a source of citral, and the commercial value of the oil depends principally upon the amount of this constituent contained in it.

Commercial valuation of the oil.

Specimens of the oil, accompanied by a statement of the results of its chemical examination, were submitted to dealers in essential oils both in this country and on the Continent for commercial valuation. The reports from these firms indicated that, although in some cases there was a tendency to quote a low price (4½d. per oz.) for this oil owing to its being incompletely soluble in alcohol, yet the general opinion appeared to be that, if placed regularly on the market in fair quantities, it would be worth from 5d. to 6d. per ounce, which is about the price of good quality East Indian oil at the present time.

These results indicate that Montserrat lemon grass oil, in spite of its peculiar partial insolubility in alcohol, would probably find a ready sale at remunerative prices in this country and on the Continent.

AGRICULTURE OF PORTO RICO.*

Porto Rico is essentially an agricultural country. This follows, as a natural result, the even climate, the cheap labour, and the good market for the various products of the soil.

* From *Register of Porto Rico for 1905, Compiled by the Secretary of Porto Rico, December 1905.*

Since the American occupation there has been a steady increase in the acreage under cultivation, and, owing to the generally good prices obtained in the fiscal year just passed a marked impetus has been given to the raising of sugar, coffee, cattle, tobacco, cotton, citrus fruits, pineapples, coconuts, &c.

Land suitable for agricultural purposes has increased at least 20 in value during the past year, and hardly an acre of ground within a radius of 15 miles of San Juan can now be purchased for less than \$100. In the country districts, within easy access of the railroad or macadam roads, fairly good land will average \$40 per acre; and in the interior and in places remote from transportation, grazing land can still be purchased as low as \$5 to \$10 per acre.

Much credit is due to the United States Agricultural Experiment Station for its practical demonstrations of what crops can be grown to advantage in Porto Rico, and of the most modern methods of cultivation. This information is made public by bulletins issued by them from time to time.

There has been a marked increase in the importation of modern agricultural implements, which admit of the cultivation of larger tracts of land with little additional labour.

Fertilizer is also used much more extensively than in former years, and in order to guarantee the quality of the same, the last Legislative Assembly of Porto Rico passed an Act to regulate the registration and inspection of commercial fertilizers, fertilizer materials and chemicals in Porto Rico. This law makes it a misdemeanour to sell for offer or sale in this island any fertilizer or fertilizer material which does not conform to the formula given on the tag attached to the package.

As a further incentive to agricultural pursuits, the Legislative Assembly appropriated the sum of \$10,000 for the development of the fibre plants of the island, this sum to be expended under the direction of the Governor in the purchase of fibre or other product grown by planters on the island, the purchase and operation of machinery for the preparation of such products for marketing, or in such other ways as in his opinion will best tend to the demonstration of the possibilities of growing and marketing such products upon a remunerative basis to persons engaging in such work.

In order to afford every possible protection to coffee, cotton, and citrus fruits, the last Legislature also passed a law to guard against the importation of plant diseases or insects harmful to plants. This law provides that no coffee tree or plant, or any portion thereof, or the seeds of same (except roasted coffee for domestic consumption), and no rooted citrus plants or cuttings, and no cotton seed, seed cotton, cotton lint, loose or in bales shall be brought into the island of Porto Rico from any state or territory or other country whatsoever, without having attached thereto in a prominent and conspicuous place, a certificate under oath signed by a duly authorized state or government entomologist, stating that such trees, plants, roots, seed hulls or seed, and any

and all portions thereof are free from disease; provided that in the case of cotton seed, seed cotton, cotton seed hulls or cotton lint, such certificate shall state in addition that the shipment originated in a locality where, by actual inspection by said attesting official or his agent, the Mexican Boll Weevil was not found to exist.

Sugar has been grown in Porto Rico since 1548 and unquestionably has now supplanted coffee as the chief source of the Island's wealth.

For the fiscal year 1904-1905 there was exported (almost entirely to the United States) 271,325,118 lbs. of an estimated value of \$11,925,804, as against 259,294,060 lbs. of an estimated value of \$8,690,814 for the fiscal year 1903-1904.

The good price obtained for last season's crop has boomed the sugar industry of the Island and great activity is now being shown in the opening up of new land, formally used only for grazing purposes, in order to supply the growing capacities of the mills. New centrals have been built, others are in course of construction and all the old factories of any importance are installing modern machinery.

The introduction of improved agricultural implements into the island during the past few years, has permitted the more rapid exploitation of great areas of land at a considerably less rate of expense than was formerly possible. The use of fertilizer has become more prevalent and has amply repaid those who have made use of it.

The manufacture of sugar can be undertaken profitably only by capitalists, and on a large scale with modern machinery. Sugar land is easily worth \$100 per acre and a sugar central will cost approximately \$1,000,000. A net profit of \$75, to \$100 is a fair yield per acre.

COFFEE.

Coffee, which has always formed one of the three principal staples of the island, is now attracting much interest in the United States, and the tide of public opinion seems to have at last turned in its favour. This is evidenced by the fact that previous to the Spanish-American war but one-half of one per cent. of the coffee crop of the island went to the United States, while in the fiscal year ending June 30th, 1903, the States took three per cent. of the crop, and in the fiscal year ending June 30th, 1905, they took nine per cent. This shows a steady increase in the quantity exported to the United States, and, as a convert to Porto Rican coffee can never be induced to use anything else, it is confidently expected that in the near future the coffee crop of Porto Rico will again reach the high water mark of 60,000,000 pounds as in 1896, and will be almost entirely consumed in the United States. Every effort is being made to create a market there for the Porto Rican bean and the last Legislative Assembly passed an Act providing for the establishment of a Commercial Agency in the United States for the sale of coffee and other products of Porto Rico. This agency is now open for business

at No. 91 Wall Street, New York City, and it is the duty of the agent in charge to correspond with the coffee planters and dealers, and other producers in Porto Rico, with a view of putting such growers and producers in direct communication with purchasers of such products and to promote in every way possible the opportunity for growers and producers to market their products directly with purchasers. All products consigned to the agency will be disposed of to the best advantage and without charge to the shipper other than for cost of transportation, storage, and actual expenses incurred in marketing the same.

Coffee can be grown profitably on nearly all kinds of soils, provided there is a good drainage. Virgin forest soil on the mountain sides, however, is the best, and much of this land can still be had for about \$10 per acre. In order that the Porto Rican coffee may command the highest prices it must be able to compete with the fine grades of Java coffee. With this end in view the Coffee Experiment Station is now experimenting with fine coffees from all parts of the world. Samples of these and their breedings will be sent to the United States markets, and after it has been demonstrated which best suit the American taste, these selected varieties will be recommended to the coffee growers and, if possible, seeds or seedlings will be placed at their disposal. Experiments are also under way to increase the production per acre, which now averages about 250 pounds as against a far larger output in other countries. Until quite recent years the cultivation of coffee was conducted in a very primitive way, but the cultivation now is conducted along up to date lines and seed and nursery beds are found in the coffee districts where a few years ago only volunteer plants were used.

TOBACCO.

The poor prices paid for ordinary leaf tobacco on the field during the past two years, disheartened the farmers, and, in consequence, the 1905 crop was a very small one. There was a good demand this season and much higher prices were paid, and the few fortunate farmers who had not exchanged their crops for provisions or sold their field of tobacco before picking, made very fair profits. It was a somewhat unusual occurrence for the bulk of the profit to be made by the farmers, as they usually sell to speculators, who, in turn, sell to the factories. The farmers have been greatly encouraged by the rise in price and knowledge that in future the factories will buy direct from them, and as a result a large crop is being prepared for 1906.

The new system of picking the leaves for wrappers from the standing plants and drying separately from the stalk, has given very good results, and wrappers treated in this way have greatly improved in quality and have brought a much better price. Tobacco grown under cheese-cloth continues to give good results; this method of planting is gradually extending and proves very profitable if carried out on a large scale.

The cultivation and curing of leaf tobacco in Porto Rico is still in a very crude state: the land is badly prepared and the

seed not judiciously selected; for instance, some districts whose speciality is fillers use the same seed as those that grow tobacco for wrappers. and vice versa: there is no uniformity of leaves among the plants, the seed principally used is mixed, and therefore, gives a variety of plants; and finally, practically no fertilizing is done, although an increase of from 25 to 30 per cent. can be obtained by its careful application. It is worthy of note, however, that the stimulus of this year's good prices has made the farmers more careful in the selection of seed, in cultivating and in fertilizing.

The style of barn in which the drying is carried on (very little curing being done by the farmers) is responsible for the spoiling of half the tobacco brought in from the fields, they are usually open at the sides and the tobacco is at the mercy of the wind and rain. Very fine tobacco is often destroyed by careless handling and improperly built barns, and tobacco which would be worth \$15 to \$18 per quintal if properly dried, will not bring more than \$10 or \$12 if carelessly handled. The barns should be so constructed that they may be immediately and tightly closed, or opened for ventilation.

There is a great future for leaf tobacco in Porto Rico, especially for light wrappers, if modern methods are adopted, but it is difficult to persuade the average farmer to give up his old way of doing things.

CATTLE.

Cattle raising in Porto Rico has always been a profitable business, as there is a continual demand both for beef cattle and for draught animals. Some few American mules and horses have been imported for ploughing and other agricultural work, but, while they accomplish more in a given time, they are more expensive to keep, as they require grain if used for heavy work. Oxen, on the contrary, feed entirely on grass, and, although slow, are steady workers and accomplish a great deal of work. Practically all the hauling to the towns in the Island which are not connected by railroad, is done by bullock teams which draw immense loads. While it is true that, owing to the increased area which is being devoted to the raising of cane, the available pasturage has been greatly reduced, still there is plenty of land in the interior of the Island suitable for cattle raising, which can be bought for from five to ten dollars an acre. Prior to the American occupation there was a large export trade to Cuba and adjacent islands, but this has been gradually falling off, as is shown by the fact that 13,110 cattle were exported during the fiscal year 1903-1904, while only 8,185 were exported during the fiscal year 1904-1905.

The native horses, though small in size, are tough and wiry, and as they live exclusively on grass they are inexpensive to keep. They make good coach and saddle horses and almost all the travel from one part of the island to another is done either by coach or on horseback.

The native mules, although small, make very satisfactory pack animals, and are used extensively for the transportation of coffee from the mountains to the shipping points.

All the livestock in Porto Rico has deteriorated greatly owing to the continual in-breeding, but steps have been taken to improve the breeds by crossing with good stock brought from the United States.

CITRUS FRUITS.

It is estimated that there are 7,000 acres under cultivation at this time in citrus fruits, of which about 70% is planted in oranges, 25% in grape fruit (pomelo) and 5% in lemons. This acreage is continually increasing and there will be approximately 1,500 acres more planted during the next twelve months. Among the varieties of oranges most commonly planted here are the Parson Brown, Ruby, Washington Navel, Pineapple, Hart's Late, Valencia Late, Enterprise Seedless, Jaffa and the native: and among the grapefruit are the Duncan, Walters, Bowen, Marsh Seedless and Thomson Seedless. This acreage has all been set out in citrus fruits since the American occupation, and although sufficient time has not yet elapsed for the marketing of a full crop, yet some shipments were made from these groves last winter which reached New York in good condition and brought a fair price. This has demonstrated that Porto Rican oranges, if intelligently handled, have the necessary keeping qualities and will bring good prices. In past years shipments were made of the native orange gathered from trees scattered around, but they were shaken from the trees, carried to the point from which shipment was made in baskets on pack animals, and then packed promiscuously in boxes and barrels without any attempt at sorting. Naturally this fruit arrived at its destination in poor condition and required so much re-handling and sorting that there was very little margin for profit, and the Porto Rican orange acquired the reputation of being a poor shipper. Now, however, that the oranges can be gathered from the groves where they receive intelligent supervision from the time they are picked until they are placed aboard the steamers, it will take but little time to overcome any bad impressions that may have been created.

The present rate of freight from Porto Rico to New York on a box of oranges is about 28 cents, as compared with 35 cents freight and 56 cents duty from Cuba, 98 cents freight from California, and 72 cents freight from Florida. This allows quite a margin in favour of the native fruit as far as the question of freight rate is concerned. While it is true that the two steamship companies running between Porto Rico and New York do not at this time provide adequate facilities for the shipping of fruit, yet they have made every assurance that as soon as there is a sufficient quantity of fruit to warrant it, they will undoubtedly meet the situation.

A careful study of the conditions in Porto Rico would seem to indicate that in order to obtain the best results, oranges and grapefruit should be budded on the native rough lemon stock. In a

majority of the groves the trees are set out 25 feet apart, making about 70 trees to the acre. One advantage of this system is that pineapples may be planted between the rows for the first two or three years. The principal drawbacks with which the orange growers here have to contend are the wind, scale and ants; the former may be overcome by a wind-break, and the scale and ants can be kept within bounds by constant spraying and washing.

The Porto Rico citrus fruit proposition is an enticing one and there is apparently little risk in the venture. It does not require a large capital, as nursery trees of all kinds can be bought in Porto Rico at \$25.00 a hundred; land, according to location, from \$20.00 to \$100.00 per acre, and unlimited labour can be secured at from 30 to 50 cents a day. There is absolutely no reason why a grove that has received careful and intelligent cultivation should not return to the grower a net profit of \$200.00 per acre at the end of the fifth year and a proportionately greater profit in the succeeding years.

PINEAPPLES.

Pineapple culture has been taken up largely by the orange growers as a means of deriving some income while waiting for their groves to come into bearing. When planted between the rows of trees, about 4,000 pineapple plants can be set out to the acre without interfering with the trees, and when planted by themselves from 8,000 to 10,000 pines can be set out to the acre. The pines which appear to grow best in Porto Rico are the Red Spanish, the Cabezona, the Pan de Azucar and the Smooth Cayenne. Red Spanish is the favourite with the planter as it has shown good keeping qualities and shipments have brought on an average of \$2.50 per crate, thus allowing a handsome profit to the grower. The good returns from last season's crop has resulted in the planting of a greatly increased acreage and it is estimated that at least 4,000,000 plants have been set out this year.

The climate of Porto Rico seems to be peculiarly adapted to the raising of pineapples and careful cultivation and a little fertilizer show a corresponding increase in the size of the fruit. Several canning factories are now in operation and as a good supply of fruit is now assured, more factories will soon be erected.

COTTON.

Forty years ago the cultivation of cotton in Porto Rico had developed into an important industry, the larger portion of the crop being planted in the southern districts. From 1879 to 1903, however, the cultivation of cotton was practically abandoned. In 1903 interest in cotton was again revived and some few farmers planted small tracts as an experiment. The quality of the fibre obtained was so desirable that the acreage has been gradually increased and it is estimated that there are now about 6,000 acres under cultivation. The quality of the fibre of the crop of 1904 met with favour both in the United States and in Europe, but this year the fibre has been found to be very weak and inferior and the planter has been discouraged by the low prices obtained. It is claimed by the cotton experts on the island that the inferiority of

this year's crop is due to the fact that poor land was used for planting, that fertilizer was not used, that the cultivation was indifferent, and that the cotton was picked before it had sufficiently matured.

Experiments have proved that a good quality of Sea Island cotton can be grown in Porto Rico which will average a yield of 1,200 to 1,700 pounds per acre. Suitable land can be procured for about \$40.00 per acre.

As yet neither the Boll Weevil nor other serious pests has made its appearance. The caterpillars have done some inconsiderable damage but they were quickly exterminated by the use of Paris Green—they only attacked the leaves and generally left the bolls uninjured.

COCO-NUTS.

Coco-nut trees are scattered all through the island but grow to best advantage along the coast, and where these trees can be found in any large number close to some shipping point the coco-nuts can be handled quite profitably. There are some few groves on the island now in full bearing and many more are being set out. About fifty trees are planted to the acre and a good crop can be gathered at the end of the seventh year with a corresponding increase in the quantity of coco-nuts as the trees become older. Coco-nut trees require very little care from the time they are planted until they come into full bearing, and land suitable for the growing of coco-nuts can be bought as low as \$10.00 per acre, but the price increases according to the proximity to a shipping point.

THE NATURE AND COMMERCIAL USES OF BEN OIL.*

[The first part of the article condenses the information published in the Bulletin of the Department of Agriculture, Jamaica, Jan., 1904, on MORINGA, then comes the following:—]

A firm of oil manufacturers in Kingston, Jamaica, have recently made an experiment to ascertain the cost of production of the oil. They paid 8s. per cwt. for the seed, and found that the husks constituted 40 per cent. and the decorticated seeds 60 per cent. The seed when expressed warm, but not hot, yielded about 12½ lbs. of oil per cwt. Their final result showed a cost of £80 per ton for the oil. A sample of this oil was sent to England for valuation, and a report was received which stated that "Oil of Ben" was now superseded by an oil obtained from the head of the sperm whale, and that the value of the sample submitted was about equal to that of the best cotton seed oil.

In May, 1903, a small specimen of Ben oil was supplied to Dr. J. Lewkowitsch from the Imperial Institute. A report on this sample has been published in "The Analyst, 1903," vol. 28, p. 343, from which the following extract is taken:—"The chief interest in this oil depends on its low iodine value; this explains why the

* From Bulletin of the Imperial Institute. II., 1904, pages 117-120. •

oil is specially applicable for lubricating watch-springs and other delicate machinery." The following constants were determined:

Specific gravity at 15°C. (water at 15°C.—1)	0·91267
Iodine value	72·2
Iodine value of the liquid fatty acids	97·53
Refraction (butyro-refractometer)...	50·0°

A sample of pods and seeds which were identified as those of *Moringa pterygosperma* has been received recently at the Imperial Institute from Northern Nigeria. On examination in the Scientific and Technical Department, the seeds were found to contain 38 per cent. of a pale yellow oil which was almost odourless, and possessed a bland agreeable taste. This oil (obtained by extraction with ether) consisted of a liquid and a solid portion which were separated by filtration at 17 to 18°C. and separately examined.

The analytical constants of these two portions are given in the following table:—

	Liquid portions.	Solid portions.
Specific gravity at 15°C. ...	0·914	
Acid value	15·3	
Free fatty acids (calculated as oleic acid)	7·7	
Saponification value	189·2	194·4
Ether value	173·9	
Iodine value	70·7	68·3

Samples of the seed and of the oil were submitted to brokers for valuation. They reported that in order to obtain trustworthy commercial quotations, large samples of the oil would be necessary for practical trials, and that if the results of these trials proved satisfactory the oil would probably be able to compete for edible and culinary purposes with American refined cotton seed oil, which is at present worth about £22 per ton. The seeds were valued at about £7 per ton delivered in London.

Another sample of Ben oil from Jamaica was received at the Imperial Institute in December, 1903. It had a very slight, pleasant odour, and an agreeable taste. On examination in the Scientific and Technical Department it yielded the following results. When filtered at 17 c. it was found that 60 per cent. of the material was liquid, whilst the remaining 40 per cent. consisted of a nearly white solid fat. The liquid portions was clear, bright and of a pale yellow colour. The constants of these two portions were found to be as follows:—

	Liquid portions.	Solid portions.
Specific gravity	0·9124 at 15°C.	0·8650 at 100°C.
Acid value	8·7	7·2
Free fatty acids (calculated as oleic acid)	4·4 %	3·6 %*
Saponification value	196·3	193·6
Ether value	187·6	186·4
Iodine value	70·1	65·2

* Compared with water at 15°C.

From these accounts of Ben oil, it appears that although it would not yield the extravagant profits expected in 1817, yet if it could be produced at a sufficiently cheap rate it would be likely to find a market for dietetic purposes, and possibly an opening might be secured for the liquid portion of it as a lubricant for fine machinery.

The cost of producing the oil as given by the firm of oil manufacturers at Kingston, Jamaica, appears very large; it must be pointed out, however, that the initial cost of the seed was very considerable, the yield of oil was less than would be expected from the fact that the decorticated seed contains from 35 to 38 per cent. of oil, and no allowance seems to have been made for the residual cake which might be of value as a cattle food.

SNAILS AND SLUGS.*

NATURAL ENEMIES.

By far the greatest natural checks are birds, which not only eat slugs, but are especially partial to snails, breaking their shells against a stone and picking out the mollusc. Toads are great devourers of slugs and small snails. Poultry and ducks eagerly search for them. Centipedes attack slugs, and ants frequently kill snails, but none of the foregoing save birds do any appreciably good in keeping down an excess of these molluscan creatures.

PREVENTION AND REMEDIES.

The following may be mentioned as tending to prevent and lessen the attacks of these pests:—

- (i) Drainage, because dampness favours them.
- (ii) Avoid long manure, or in fact any organic manure where slugs are abundant in the soil. Employ artificials *for a time*.
- (iii) Dry dressings of some irritant to kill the pests. (a) Soot and lime; (b) salt and lime; (c) lime and caustic; soda or to act mechanically, (d) powdered coke.

The lime must be in a very finely-divided state and quite fresh. *Two or three dressings must be given*, the second some 15 to 30 minutes after the first. Lime and caustic soda is found to act best—four parts of caustic soda to 96 of lime well mixed. Dry dressings, except powdered coke, should be applied very early in the morning.

- (iv) “Rings” of slaked lime or fine ash soaked in kerosene may be put round choice plants.
- (v) Heaps of bran-mash or moist oatmeal or cornmeal may be placed here and there. These baits attract the slugs, which may then be easily collected.
- (vi) Heavy applications of soot are best to keep off snails, which should be dealt with mainly by hand picking and by trapping with cabbage leaves.

*Extract from Leaflet No. 132, of Board of Agriculture & Fisheries of England.

- (vii) Rows of peas, &c., are best protected either by spreading cinders and lime along the rows, or by heavy dressings of slaked lime.
- (viii) Hedge bottoms, and rough herbage at the base of walls should be cleaned out and the masses of hibernating snails crushed.
- (ix) Land that is thoroughly fouled with slugs should be treated with gas-lime and in the winter deeply trenched.
- (x) Ducks and poultry should be kept, as they greedily devour both kinds of pests.
- (xi) Birds should be encouraged. It is easier to keep them off fruit than to suppress the snails and slugs which they largely devour.

INSECT PESTS.

The following letter has been received from Dr. Howard, Chief of the Bureau of Entomology of the U.S. Dept. of Agriculture.

This weevil was killing the Camphor trees at Cinchona, but has not been noticed on any other trees. If it be a fact, as Dr. Howard supposes, that this insect pest has been imported in some way from Central America, it is an additional proof of the necessity of stringent precautions against such importations by careful fumigation.

Dr. L. O. Howard, Chief of Bureau of Entomology, Dept. of Agri. U.S.A., to Director of Public Gardens and Plantations, Jamaica.

Washington, D.C.
December 21st, 1905.

Dear Mr. Fawcett,

I have received yours of the 7th instant, with specimens of larva and beetle found attacking young camphor trees at the Botanic Garden at Cinchona.

Mr. Schwarz reports that the weevil is *Hilipus elegans*, Guérin, of the family Curculionidae. There are several hundred species of this tropical or sub-tropical genus known from Central and South America, including a few species from the West Indies. Your species is not a native of the West Indies, but has been manifestly imported during recent times from some part of Central America where the insect is said to be quite abundant. Nothing is known of the habits of any of the species, but since the genus *Hilipus* is closely allied to our northern pine weevils it may be inferred that they live under bark of various deciduous trees. I am not able to give you any remedial measures, but any camphor tree that shows the least sign of being affected by the weevil should by all means be uprooted and burned.

Yours very truly,

L. O. HOWARD,
Chief of Bureau.

A NEW SPECIES OF FERN OF GENUS POLY- PODIUM FROM JAMAICA.

By WILLIAM R. MAXON, U. S. Nat. Museum, Washinton, D. C.*

Among the ferns collected in Jamaica by the writer in 1904 is a simple-leaved *Polypodium* which is distinct from the several related species of middle America. It may be known as *POLYPODIUM NESIOTICUM*, new species.

Rhizome suberect, about 1 cm. long, densely clothed with closely appressed imbricate lanceolate dull light-brown scales; fronds few, approximate, 15 to 22 cm. long; stipe relatively very short (1 to 2 cm. long), densely beset with slender spreading rigid reddish hairs; lamina (largest) 20·5 cm. long, 0·9 cm. broad, bright green, firm, moderately thick, linear-lingulate, rather blunt at the apex, attenuate and decurrent at the base, the under surface sparsely hairy, the upper surface glabrate, the margins regularly marked by broad shallow undulations, ciliate; midvein apparent on the under surface nearly throughout, on the under surface concealed by the parenchyma except towards the base; venation free, the oblique veins for the most part alternately 3 to 5 times forked; sori round, either terminal or dorsal, wholly superficial, 2 to 4 to each group of veins irregularly disposed in two or four interrupted rows.

JAMAICA—Founded upon a single specimen, U. S. National Herbarium, No. 520,770 from the vicinity of Vinegar Hill, altitude 1200 meters; William R. Maxon, No. 2773; June 23, 1904. Growing upon the trunk of a forest tree, ten feet from the ground.

The present species appears to be a very rare member of a group of tropical American species represented in Jamaica by the well known *Polypodium trifurcatum*, L. and by *P. Fawcettii*, Baker,† and *P. dendricolum*, Jenman‡ the last apparently very close to the Colombian *P. parietinum*, Klotzsch.§ *P. Fawcettii* and *P. dendricolum* have been well distinguished by Jenman|| since their original publication. *P. nesioticum* is very distinct from both, but for the benefit of those who have not material of these rare species the following notes may be of use.

P. Fawcettii is correctly said by Jenman to be "infrequent at 4,000 to 6,000 feet altitude in damp forests on the trunks and branches of trees." Two numbers (2723, 2760) were collected in such situations by the writer in 1903 and 1904. It is characterized, briefly, by its dark villous slender conspicuously upright rhizome, numerous closely set small, very narrow fronds, and almost simple veins,—the sori being borne in two rows near the midvein, each upon a short spur given off by the otherwise simple

* Reprinted from SMITHSONIAN MISCELLANEOUS COLLECTIONS (QUARTERLY ISSUE) volume 47. Published April 5, 1905.

† *Journ. Bot. Brit. and For.* 27: 270. 1889.

‡ *Gard. Chron.* III. 16; 467. 1894.

§ *Linnaea* 20; 373. 1847. Illustrated by Kunze, *Farrenkr.* 2: 41. pl. 117, f. 1. 1848-1851.

|| *Bull. Bot. Dept. Jamaica* II 4, 68-69. 1897.

vein. In all these characters the plant contrasts strongly with *P. nesioticum*.

P. dendricolum appears to be a very rare species. Professor Underwood states (*in litt.*) that it is "represented at Kew only by a tracing of the type," the type being presumably in the Herbarium of the Jamaican Botanical Department at [Hope Gardens] Kingston, Jamaica.* There is, however, a single frond from the type specimen preserved in the Jenman herbarium at New York, and this agrees absolutely with two other numbers of Jamaican specimens, *viz.*: one (without definite locality), collected by D. Watt in 1903; and another from the slopes of Monkey Hill (above New Haven Gap), altitude about 1,800 meters, Maxon, No. 2,736; both of which numbers are represented in the herbarium of the New York Botanical Garden and the U.S. National Herbarium. This species is somewhat more closely related to *P. nesioticum* than is *P. Faracettii*. It is distinguished by its reduced stature (5 to 7 cm.), thicker texture, more general villous covering, deeply scalloped (instead of undulate) margins, simpler venation, and particularly (1) by having the mid-vein covered on both surfaces by parenchyma, and (2) by what Jenman calls "embossed spectacles," *i.e.*, having the parenchyma considerably raised (on the under surface) above the concealed veins toward their extremities, thus imparting a marked rugose effect to the under surface. The last character is sufficient in itself to distinguish *P. dendricolum* at sight.

The venation of *P. nesioticum* is peculiar and shows an approach to that of *P. trifurcatum*. . .

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Wednesday, 11th April, 1906, at 2 p.m., present:—The Hon. H. Clarence Bourne, in the chair, the Director of Public Gardens, the Superintending Inspector of Schools, His Grace the Archbishop, the Island Chemist, Messrs. C. A. T. Fursdon, G. D. Murray and the Secretary.

Commercial Agent.—In the matter of a Commercial Agent to represent Jamaica in London, the Secretary reported that His Grace the Archbishop, Mr. G. D. Murray and himself, (Mr. Middleton being ill with fever), met His Excellency in the forenoon of the day of the meeting, who, after discussing the matter, promised to put it before the Privy Council.

The Secretary was directed to forward to the Colonial Secretary the report of the Committee on the matter; and letters from Mr. A. R. Davey of London to the Archbishop which the latter submitted in confidence.

Standardization of Rum.—The papers referring to the standardization of rum were put before the meeting, but as they had not circulated round the Board, the Secretary was directed to send them on.

* The type with Jenman's name in his own handwriting is in the Herbarium at Hope Gardens. *Editor Bulletin of the Department of Agriculture.*

A cutting from the *Glasgow Herald* forwarded by the Chemist, pointing out the variation of the contents of ethers in Jamaica rum and the necessity for a standard, was submitted.

Agricultural Don'ts.—A letter from the Superintending Inspector of Schools to His Grace the Archbishop, referred to the Board, was submitted, asking the Board if it could supply a copy of "Agricultural Don'ts" Chart to every school in the island.

After discussion the Secretary was directed to write the Colonial Secretary informing him that this Chart has been prepared at the instance of, and was approved by the Board, that it had been revised by and had the approval of the Superintending Inspector of School, and asking His Excellency to approve of the cost of such charts to be issued to all schools being placed on the estimates either of the Agricultural or Education Department for next year.

Letters from the Colonial Secretary's Office were submitted among others on the following subjects:—

1 *Salary of Superintendent of Field Experiments.*—*Re* increase in salary to Superintendent of Field Experiments, advising that the Governor approved of the reduction of £30 of the amount for "Distillery Materials for Estates" and of the increase by £20 per annum of the salary of the Superintendent of Field Experiments.

2 *Resignation of Mr. Teversham.*—*Re* resignation of Mr. Teversham.

Agricultural Scholarship.—Forwarding copy of a Bill entitled "The Scholarship Law, 1901, Amendment Law, 1906," His Grace the Archbishop and the Superintending Inspector of Schools thought it was not advisable to reduce the Scholarship below £180 per annum which they thought the lowest figure that a student could pay his way at Cambridge. Mr. Cousins, Mr. Fursdon and Mr. Murray considered that £156 per annum was under the circumstances sufficient. Mr. Fawcett thought that it was not desirable that there should be any change in the Scholarships, but that the examination for the Jamaica Scholarship might be so arranged as to ensure the teaching in schools of the principles of Agricultural Science and so encourage the students to adopt agriculture as a profession. Under the circumstances the Chairman agreed with the majority.

The Secretary read two letters he had received from the Secretary of the Schools Commission as follows:—

(1) *Examination for Agricultural Scholarships.*—In reply to the report by the Island Chemist expressing regret at the disappointing results of the recent examination for agricultural scholarships at the Government Laboratory, pointing out that it was no doubt due to the existence of an impression among students that learning in scientific agriculture, as a profession, would not afford them as good means of livelihood as the practice of one of the learned professions.

(2) *Cambridge Local Agricultural Section.*—Transmitting copy of

letter from Dr. Cairns, Cambridge, in reply to one addressed to him conveying suggestions by the Island Chemist for the amendment of the second part of the Agricultural Science Section of the Cambridge Senior Examination, intimating that the syllabus had been modified in the direction suggested by Mr. Cousins; also asking Mr. Cousins if he had any further remarks to make on the schedule. A copy was referred to the Chemist for his remarks.

Cotton Gin.—The Secretary submitted an offer of Mr. Sharp of £5 for the Cotton Gin now in his possession.

It was resolved not to accept the offer, and meantime to retain ownership of the Gin of which Mr. Sharp had the use.

Mr. Cradwick in St. Mary.—The Secretary submitted a letter from the Hon. R. P. Simmonds making application for the services of Mr. Cradwick in connection with the St. Mary show to be held on the 5th July, asking if he would be allowed to spend the first week in June, and the week of the show in St. Mary.

After discussion it was agreed that Mr. Cradwick could spend the first week in June and the week of the show in St. Mary, but that he should return to his ordinary duties the day after the show.

Reports.—The following reports from the Director of Public Gardens were submitted and directed to be circulated:—

1. Hope Experiment Station.
2. Instructors.

The following reports from the Chemist were submitted;—

1. Proposal as to distillers' course at the Laboratory. This was approved of.
2. Report on successful working of new plant at Hampden estate.
3. Distillery progress in Westmoreland.
4. Appropriation Accounts Government Laboratory and Sugar Experiment Station for 1905-06.
5. Mr. Calder's enquiries as to Agricultural Students with memo from Chemist. All these were directed to be circulated.

The following papers, which have been circulated, were now submitted for final consideration:—

1. Reports of two cases instituted under the Merchandise Marks Act.
2. Letter from Mr. Nolan forwarding cutting from the *Wine and Spirit Gazette*.
3. Report Hope Experiment Station.
4. Reports Mr. Cradwick.
5. Letter from Mr. J. B. Sutherland re apprenticeship of his son at Hope Gardens.

The meeting then adjourned till 16th May at 2 p.m.

[Issued 14th May, 1906.]

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

JUNE, 1906.

Part 6.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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P R I C E—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :
HOPE GARDENS.

1906.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

1928
NEW
BOTANICAL
GARDEN

Vol. IV.

JUNE, 1906.

Part 6.

NOTE ON SILK WORMS FROM COLOMBIA.

By M. GRABHAM, M.A., M.B.

Notes on *Attacus jorulla** :—250 young larvae received from M. Patin, (Belgian Consul to Colombia) in June 1900. Eggs brought by him from Sta. Fé de Bogota, Colombia. He stated that their natural food was a species of *Hippomane*, as this food plant was not obtainable here, the sandbox (*Hura crepitans*) and Plum (*Spondias purpurca*) were used at his suggestion. Branches of the trees were isolated in bags of mosquito netting and the larvae placed on the leaves. They grew well in their early stages, but in the final moults most of them refused to eat and died. It was thought that this might have been due to the lack of moisture, M. Patin said that in the Andes about Sta. Fé the moisture was intense. The leaves were frequently sprayed but this had no effect. Some larvae were kept in an insectarium and fed on freshly gathered leaves; these fared no better. About ten spun very indifferent cocoons and about six moths developed—all of very feeble vitality. A few eggs laid by these moths did not hatch. Specimens of the moths were placed in the Museum of the Institute of Jamaica; and some were sent to the U.S. National Museum at Washington for identification.

The common Wasp (*Polista* sp.) proved the most formidable enemy, killing and devouring the caterpillars whenever they approached too close to the netting.

REPORT ON THE TANNING MATERIALS AND MANUFACTURE OF LEATHER IN JAMAICA.†

By M. NIERENSTEIN, Ph. D.

Plants.

The following plants yielding tanning materials are stated to occur in the Island: *Acacia Catechu*, *Bauhinia variegata*. ‡ *Caesalpinia coriaria* (Divi Divi), *Laguncularia racemosa* (white mangrove). Of

* The identification was made by Dr. Dyar of the U.S. National Museum.

† Quarterly Journal. The Institute of Commercial Research in the Tropics, Liverpool University. Vol. 1, 2, April, 1906.

‡ *Acacia Suma* (not *A. Catechu*) occurs in Jamaica: it closely resembles *A. Catechu*, and has similar properties. *Bauhinia variegata* is generally known as the "Butterfly Tree." Editor, Bulletin of the Department of Agriculture, Jamaica

these "Divi-Divi" pods and the barks of the red and white mangroves appear to be in regular use in the Colony.

There appears to be a small export trade in tanning materials; thus, in 1903, 478 tons* of Divi-divi pods were exported, principally to Germany, France, and the United Kingdom, and in the same period, 133 tons of bark were exported, part of which was probably bark for tanners' use. Comparison with Dominica, where tannin-yielding plants, such as *Cassia fistula*† *C. Siamca*† and (*Terminalia Catappa*),‡ "are found, and with Mauritius, where "Badamir bark" (*Terminalia Catappa*), and "Jamrose bark" (*T. Mauritanica*) occur, lends support to the supposition that these plants also occur in Jamaica.

Only about a year ago different Australian species of *Eucalyptus* appeared on the European market, such as *Eucalyptus occidentalis* (Mallet Bark) and *E. olcosa* (Morrel Gum), containing 52 to 55 per cent. of tanning materials: the export of these new materials has been a great success. I find that in the West Indies different kinds of *Eucalyptus* are to be found, especially *E. punctata*.‡

It seems that the Logwood industry suffers in Jamaica through the so-called "Bastard Logwood," which does not contain the dye stuff, and according to F. S. Earle, late of the New York Botanical Garden, who has been in Jamaica,§ "a wise policy would ensure the prompt destruction of such trees whenever detected, as they have no value except for firewood, and should not be allowed to produce seeds." A. G. Perkin, and also the present writer have found that there is a close relationship between the tannins and colouring matters in the plants. The relation between the Divi-divi and Algarobilla¶ plants containing 40 to 50 per cent. tannins, with the logwood, makes it probable that the "Bastard Logwood" could find use as a tanning material.

A similar relationship exists between *Quercus tinctoria*, from which the dye stuff "Quercitron" is obtained, and some different kinds of oak used for tanning, such as *Quercus robur*, *Q. pendunculata*, &c., where, with the increase of the tannins, the amount of colouring matters becomes less. From the tanner's point of view the cultivation of *Laguncularia racemosa* (white mangrove), which has been mentioned as being found in Jamaica, should be very successful, as it would be one of those very seldom obtainable exotic plants which could be used for tanning light leather, and if produced on a large scale could compete successfully with "Mangrove extract;" this substance, which is principally derived from the bark of a tree found in the German Cameroons, produces only dark leathers.

* See figures in succeeding article.—Editor.

† These trees are all cultivated in Jamaica.—*Terminalia Catappa* is commonly known as the "Almond" although it is very different from the almond of commerce. There is a native *Terminalia* (viz.: *T. latifolia*), called "Broad Leaf."—Editor.

‡ Species cultivated in Jamaica include *E. Globulus* (in Blue Mts.) *E. citriodora*, *E. saligna*, *E. robusta*, *E. rastrata*.—Editor.

§ See *Bulletin of the Department of Agriculture, Jamaica*, Vol. I. Part 2, Feb. 1903, pages 30, 31. Editor.

¶ Algarobilla is the name given to seed-pods of *Prosopis Algarobilla*, a native of the Argentine Republic, and *P. juliflora*, native of Mexico, and mountainous lands south to Chile. Editor.

There is also a good opportunity for introducing other plants which contain tannins, and would grow successfully in those one and a half million acres not cultivated at present. Of course according to the reports of the Kew Botanical Gardens, the attempts to introduce Gambier in the West Indies has not been a success, but I have reason to believe that this is due to the sensitiveness of the plant to climatic changes. Similar observations have been made by M. Greshoff on Gambier of the Malay peninsula.

But greater success can be expected from the introduction of "Quebracho Colorado."* Quebracho belongs to those trees which would probably prosper there, and which are very important in the tanning trade. 3,525 tons of Quebracho Extract were imported in the years 1898-1902 from Argentina into the United Kingdom, and about one quarter of the 11,786 tons, which have been imported to Germany, were sent afterwards to British ports.

HIDES AND SKINS.

It seems that there is not much breeding of cattle, sheep, &c., done in Jamaica, † which is rather astonishing, as the island seems to have open waste pastures and plenty of Guinea and Scotch grass, both well adapted for the feeding of cattle. As to the cattle of Jamaica, Mr. B. M. Greaves, of Portmadoc, who recently visited the island, writes to me, "I think I saw more Shorthorn cattle than any other sort, and some of them were really good looking beasts." The sheep seem to be of a similar build to the Welsh, and could be used in this case for making "roller leather;" (this is used for covering the wheels of cotton spinning machinery). There is a good market for this kind of sheep skin in Great Britain.

G. M. Rummel, of the Bureau of Animal Industry, U. S. A. Department of Agriculture, describes the Barbados sheep in the *Breeders' Gazette* as follows:—"The skin is thicker over the upper part of the ribs than in other parts of the body, and becomes thicker towards the tail, the difference of the rump being quite perceptible. Loose skin (not folds, however) may be seen on the top of the neck." A leather tanned from a sheep's skin as described is sure to have a market.

According to the reports of Messrs. P. C. Cork and J. M. Gibb, V.S., the conditions of introducing and breeding sheep in Jamaica are favourable.

LEATHER MANUFACTURE.

The Leather manufacture seems to be quite in its infancy. There are in Jamaica only twenty-one tanneries, employing in all fifty-five persons, and producing from twenty-eight to thirty-one tons of leather per annum. There is, however, a large import trade in raw and manufactured leather; thus unwrought leather to the value of £6,027, and leather manufactures valued at £66,999, were imported in the year 1903-4.

* *Quebrachia Lorentzii*, growing chiefly in province of Corrientes, Argentine Republic. *Editor.*

† The official statement by the Collector General gives the number of horned stock as 107,694 in the year ended 31st March, 1905. *Editor.*

CONCLUSIONS.

What has been stated above indicates that there is a possibility of developing the leather industries in Jamaica. The following methods might be mentioned:—

1. To develop the cultivation of tanning trees and plants, especially the White Mangrove.
2. To investigate the question of the Bastard Logwood in respect to tanning properties.
3. To introduce tannin-containing plants from the other West Indian islands, and the *Quebracho Colorado*.
4. To encourage the breeding of cattle and sheep, and to try to introduce the Barbados sheep.
5. To develop tannin extract works: it would be advisable to try with primitive methods, similar to those used in South America, and to develop them afterwards into more modern methods.
6. To develop the present important industry of leather manufacture.

Probably the Bastard Logwood would contain a tannin which yields "bloom" on the leather.

I notice in the last number of the *Collegium* that the German Consul in Freemantle (Australia), has been ordered by his Government to collect the seeds of *Eucalyptus occidentalis* (Mallet Bark) and *E. olcosa* (Morrel gum), mentioned in my paper, for the purpose of introducing into Hereroland, western parts of West Africa and inner parts of the Togo.

STATISTICS OF TANNING MATERIALS AND LEATHER FOR JAMAICA.

EXPORTS OF TANNING MATERIALS.

Statement showing the export of Divi Divi and bark of all kinds
for the three years 1902 to 1905.

Countries.	DIVI DIVI.		
	1902-3.	1903-4.	1904-5.
United Kingdom	...	45,800 lbs.	2,600 lbs.
Canada	...	...	2,050 "
Germany	274,387 lbs.	98,504 "	84,137 "
France	44,646 "	30,154 "	59,403 "
Mexico	7,000 "	...	...
	BARK OF ALL KINDS.		
United Kingdom	£1 1 0	1,782 lbs.	29,472 lbs.
United States of America	20,990 lbs. (Mangrove)	3,500 "	810 bags
" "	£20 6 0		

*Supplied by the Hon. Collector General, Jamaica.

France	£42 19 0	294,215 "	213,362 lbs.
Canada	...	...	18,900 "
Holland	...	...	2,240 "
Germany	£112 0 0		
Bermuda (Lace)	£7 6 0		

IMPORTS OF LEATHER MANUFACTURED AND UNWROUGHT.

IMPORTS 1903-4.

Leather manufactured, viz.: Boots and Shoes.

United Kingdom	...	£21,455 19 10
United States of America	...	35,587 10 11
Canada	...	134 2 4
Germany	...	220 1 10
Foreign States	...	7 5 2
Cuba	...	4 12 4
British West Indies	...	0 11 0
Austria	...	20 5 8
Hayti	...	0 11 0

 £57,431 0 1

United Kingdom	...	219 13 6
----------------	-----	----------

 £57,650 13 7

Leather, viz.: Other manufactures unenumerated.

United Kingdom	...	£3,377 10 3
United States of America	...	994 14 3
Canada	...	5 12 9
Germany	...	39 0 1
France	...	27 2 3

 £4,443 19 7

United Kingdom	...	22 15 6
----------------	-----	---------

 £4,466 15 1

Saddlery and Harness.

United Kingdom	...	£7,518 0 4
United States of America	...	1,653 12 9
Canada	...	21 15 10
Germany	...	19 15 9
Cuba	...	3 6 0

 £9,216 10 8

United Kingdom	...	1 0 0
----------------	-----	-------

United Kingdom	...	127 4 0
----------------	-----	---------

United States of America	...	4 17 6
--------------------------	-----	--------

 £9,349 12 2

Leather Unwrought.

United Kingdom	...	£4,179 14 10
----------------	-----	--------------

United States of America	...	1,848 2 4
--------------------------	-----	-----------

 £6,027 17 2

IMPORTS 1904-5.

Leather manufactures, viz.: Boots and Shoes.

United Kingdom	...	£17,981	19	10
United States of America	...	31,302	18	9
Canada	..	40	6	3
Germany	...	206	4	6
Hayti	...	0	16	6
British West Indies	...	48	9	11
Austria	...	121	4	4
British East Indies	...	5	8	9
Cuba	...	0	11	0
Foreign States	...	17	18	0

 £49,725 17 10

United Kingdom	...	692	13	0
----------------	-----	-----	----	---

 £50,418 10 10

Leather, other manufactures.

United Kingdom	...	£2,365	4	7
United States of America	...	470	5	0
Germany	...	58	17	6
Foreign States	..	0	17	7

 £2,895 4 8

United Kingdom	...	49	13	3
----------------	-----	----	----	---

 £2,944 17 11

Saddlery and Harness.

United Kingdom	...	£5,158	14	8
United States of America	...	912	5	8
Canada	...	19	5	0
Germany	...	4	19	0
Cuba	...	6	12	0
Bermuda	...	6	12	0

 £6,108 8 4

United Kingdom	...	4	8	0
----------------	-----	---	---	---

 £6,112 16 4

Leather unwrought.

United Kingdom	...	£3,441	8	10
United States of America	...	2,111	2	0
Germany	...	5	11	10
Norway	...	0	2	2

 £5,558 4 10

BRAZILIAN COFFEE LEGISLATION.

The "Times" says :—In our *Financial and Commercial Supplement* for February 19 we published a letter from our Rio de Janeiro correspondent describing the new law which empowers the Executive to regulate the trade in coffee, in agreement with the governments of the coffee States of the republic. On Monday Reuter received a telegram from Rio de Janeiro to the effect that the Presidents of the States of Rio de Janeiro, Minas Geraes, and St. Paulo have signed an agreement with regard to the pricing of coffee, and stipulating for a *minimum* price on the home markets of 55f. to 65f. (gold) per sack of 60 kilogrammes of No. 7 grade coffee. "The contracting parties also agree to take measures of a nature to prevent the export of the inferior qualities of coffee, to push advertising in Europe, and to reduce the acreage under cultivation. They finally authorize the State of St. Paulo to raise a loan of £15,000,000."

SEA ISLAND COTTON SEED FOR 1896.

Hon. Sir D. Morris to Director of Public Gardens, Jamaica.

Imperial Department of Agriculture for the West Indies,

Barbados, March 31, 1906.

Sir,

I have the honour to enclose, for your information, copies of an extract from the "Agricultural News" containing a statement of the arrangements proposed to be adopted by this Department for supplying specially selected and disinfected Sea Island cotton seed during the coming planting season.

2. I also enclose a copy of an announcement which I have recommended to appear in the *Official Gazette* and of a "Notice" in regard to the conditions under which selected seed will be shipped by this Department.

3. It is desirable, in order to maintain the high quality of the West Indian product that, as far as possible, only the specially selected and *disinfected* seed supplied by the Department should be planted in these colonies. I trust you will do all you can to encourage and advise planters in this direction. Recent prices ranging from 17d. to 20d. per pound prove that by a systematic selection of seed West Indian cotton is steadily attaining a higher standard of quality than the average cotton produced in the Sea Islands. During the last few weeks applications for West Indian seed on a large scale have been received from Florida, Cuba, and Porto Rico.

I have the honour to be,

Sir,

Your most obedient servant,

D. MORRIS,

Commissioner of Agriculture for the West Indies.

ENCLOSURE.

[Reprinted from the *Agricultural News*, Vol. V. p. 97.]

It is recognized that the most important matter requiring attention, in order to maintain the high quality of the Sea Island cotton produced in the West Indies, is to plant seed obtained from healthy plants that have given a good yield per acre, and that have produced lint which has fetched the highest price during the current season. The experience of a successful cotton grower is:—The selection of seed is the one thing that cannot be overlooked.

As it will be impossible to obtain further supplies of seed from the Sea Islands, the West Indies have to depend on their own resources. This is not a difficult matter, provided growers realize the necessity of making the selection of seed a matter of the first importance. They should be prepared to take some trouble in making themselves acquainted with the subject, and in carrying out for themselves the process of seed selection, or they should be prepared to pay a reasonable price for selected seed. Seed of inferior quality should not be planted on any account. The difference in cost between good seed and inferior seed is a small matter as compared with the difference in the price realized for the crop.

The general lines on which cotton growers are recommended to make a choice of cotton seed for planting during the coming season are these: First, the plants from which it has been obtained should be thoroughly healthy, and they should not have suffered severely at any time from the cotton worm or other pests. The next point is to ascertain that the plants are of good habit and are prolific, yielding, on an average, say, not less than 200 lb. of lint per acre. The third point, and perhaps the most important of all, is that the plants have yielded lint that obtained the highest prices during the current year.

As already stated, the Imperial Department of Agriculture has undertaken a series of experiments in seed selection that are likely to prove of great value to the industry. These experiments are intended to cover the careful selection of seed, on field results, for immediate planting, as well as the systematic selection of improved seed from individual plants, as described in the *Agricultural News* (Vol. V, p. 38), for future years.

It has been abundantly proved by general experience both in the Sea Islands and in the West Indies, that it is impossible to obtain first-class cotton from inferior seed. In Egypt, also, the importance of selecting good seed is fully recognized. Mr. Foaden states:—‘Of all plants, cotton responds the most liberally, as far as both yield and quality are concerned, to careful treatment, and the sowing of good seed is the very first essential to the production of good stapled cotton. However careful our land may be prepared and manured, the production of superior cotton from inferior and mixed seed is an impossibility.’ Further, there is the opinion of the British Cotton-growing Association, as fol-

lows: 'The bulk of the cotton from the West Indies is turning out very well, but you must impress on all the growers the necessity for *very careful selection of seed*, and extreme care in cultivation and handling, for unless Sea Island cotton is quite right in all respects, it suffers severely in price.'

As announced in the columns of the *Agricultural News* (Vol. V. p. 89), the Imperial Department of Agriculture is prepared to supply specially selected and disinfected cotton seed for planting during the months of May to August next, and to deliver the seed at any port in the West Indies at the rate of five cents ($2\frac{1}{2}$ d.) per lb. Applications for such seed will be received by the principal agricultural officers in each island, as follows: For Antigua and Montserrat, by the Hon. Francis Watts, C.M.G.; for St. Kitt's, Nevis, and Anguilla, by Mr. F. R. Shepherd; for Barbados, by Mr. J. R. Bovell, F.L. S., F.C.S.; for St. Vincent, by Mr. W.N. Sands. Applications from Jamaica, British Guiana, Trinidad, and other colonies not mentioned above, may be forwarded direct to the Imperial Commissioner of Agricultural, Head Office, Barbados. All applications will be dealt with in the order in which they are received.

In order to prevent disappointment in regard to the germinating qualities of the seed, it is recommended that immediately on its arrival it be turned out of the bags or barrels, in which it is packed, and spread out on a dry floor in order that any excess of moisture may be removed. After the lapse of a day or two, the seed may be replaced in the bags or barrels, and kept until it is planted.

It is also recommended that about 100 seeds, taken from the bulk, be sown in soil, or placed between folds of damp cloth, as described in the *Agricultural News* (Vol. II, p. 153), in order to test its germinating power. In the event of doubt arising as to the condition of any selected cotton seed received from the Imperial Department of Agriculture, a sample of not less than 100 seeds should be forwarded within seven days from the date of the arrival of the seed, to the agricultural officer through whom it was ordered, in order that it may be carefully tested. It should be borne in mind that the best results are likely to be obtained when the selected cotton seed is sown within a period of one month after it has been received.

CAMPHOR IN CEYLON.*

By M. KELWAY BAMBER, Government Chemist, and J. C. WILLIS, Director Royal Botanic Gardens.

The recent establishment by the Government of Japan of a monopoly of the production and sale of camphor in Formosa has attracted much attention to this product, and at the same time, by raising the market price, has rendered it by no means unlikely that this may prove to be a profitable cultivation in Ceylon. The

* From Circular, Royal Botanic Gardens, Ceylon. Series I.—No 24, November, 1901

present circular is issued to lay before the planting public the chief facts connected with this industry, and to describe the methods of cultivation and preparation which have been found best suited to Ceylon in the experiments so far tried with this tree.

The total export of camphor to Europe and America is perhaps about 60,000 piculs annually, or 8,000,000 lb. The market value of crude camphor in Europe is at present about 155 shillings per cwt., or about 1s. 4½d. per lb. Camphor was formerly used chiefly as a drug and for the prevention of insect ravages in clothing, &c., but of late years, in addition to these uses, it has been largely employed in the manufacture of smokeless powders and of celluloid. The tree also produces an oil—camphor oil,—obtained with the camphor in the preparation of the latter, and which is used in the manufacture of soaps and for other purposes.

BOTANY.

Common, Formosa, Chinese, or Japanese camphor is the product of *Cinnamomum Camphora*, Nees, a tree occurring native along the eastern side of Asia, from Cochin-China to Shanghai, and in the islands from Hainan to South Japan; its limits of latitudinal range are from 10° to 34 N., but it is cultivated in Japan to 36° N. In the southern parts of its range it occurs chiefly in the hills.

Two other forms of camphor are frequently met with, though rarely exported to Europe. Barus, Bhimsaini, Borneo or Malay camphor is the product of *Dryobalanops Camphora*, Colebr., a large tree of the family Dipterocarpaceæ, occurring in the Islands of Sumatra, Borneo, &c. This camphor is slightly heavier than common camphor, and is highly prized by the natives of India and China, who purchase the entire very small produce at fancy prices, from 100 to 200 shillings per pound. A third form, Ngai, or Blumea camphor, is prepared in S.E. China from *Blumea balsamifera*, one of the family Compositæ. In Ceylon the natives prepare a small quantity of camphor from the roots of cinnamon, *Cinnamomum zeylanicum*, a plant nearly related to the true camphor. In the remainder of this paper only the common camphor, *Cinnamomum Camphora*, will be dealt with.

In its native country the plant grows into a tree about 100 feet high with a trunk 2 to 3 feet in diameter. It is evergreen, with moderate sized laurel-like leaves, which when crushed smell strongly of camphor. It may be well to mention in this connection that the tree is very handsome when young and forms one of the best ornamental trees for roadsides, parks compounds, &c., in Ceylon.

The native habitat of the species is not widely extended, but it has been successfully cultivated in Ceylon, India, Australia, Florida, California, and elsewhere. It was introduced into Ceylon by the Royal Botanic Gardens in 1852. In 1895 plants were largely distributed from Hakgala to many planters and others. These were the result of seeds obtained in the autumn of 1893 from Japan. Mr. Noek, Superintendent of Hakgala, has collected

information about these trees, some 950 in all, and reports as follows:—

“During 1895 plants of camphor were distributed from Hakgala to planters in various parts of the Island at elevations ranging from 250 to 6,450 feet, with annual rainfalls varying from 54 inches on 104 days to 217 inches on 212 days. Replies as to the growth of the plants have been received from thirty localities, and I think it is pretty well proved that under certain conditions of soil and climate camphor will thrive at all elevations in Ceylon from about sea level to the highest mountains.

“It appears to thrive best in a well-drained deep sandy loam in sheltered situations with a rainfall of 90 inches and over, and dislikes poor or close, stiff, undrained soil. The growth is slow in sterile soil, but, under favourable conditions, in good soil is very rapid, the tree reaching a height of 18 to 20 feet in five years, with a spread of branches of 8 to 12 feet and a stem of 6 to 7 inches in diameter. This compares very favourably with the growth of the trees in their native habitat, where a tree 30 feet high and 6 inches in diameter at ten years old is considered good. The best five-year old tree (from planting) in Ceylon is at Veyangoda, at an elevation of about 100 feet with a rainfall of about 100 inches on 180 days. It is 25 feet high and growing luxuriantly. The next best are at Hakgala, where the largest is 20 feet high, with a spread of 13 feet, and a stem-diameter of $7\frac{1}{2}$ inches at the ground.

“The habit of the trees in Ceylon in good soil is bushy, with a tendency to throw up many stems. This is a point of importance, as it shows that the tree will coppice well and stand frequent cuttings or prunings, and possibly even plucking of the flush as with tea. In close, hard, undrained or stiff clayey soil the growth is poor, and the habit stunted or dwarfed, and this is also the case in exposed windblown situations.

“Of course it is only in the experimental stage here yet, but judging from my experience of it for some years, it is my opinion that as a minor product it should be grown in the form of hedges, planted at distances of 6 to 9 feet apart and 2 to 3 feet apart in the row. The rows should run N.W. and S.E., or across the directions of the prevailing winds, and the plants be allowed to grow 6 to 9 feet high. Planted in this way there would be ample room for cultivation, and each row would shelter the other from the N. E. and S.W. winds, besides forming a large surface for clipping. As the young shoots appear to yield the most camphor, the crop could be obtained by clipping the hedge with a pair of light shears, and the expense would be very slight. The trees might also be planted at 6 feet apart, and treated in the same way as tea bushes, or they might be planted 12 feet apart, and trained as pyramids, or again planted 4 feet apart and alternate plants coppiced in alternate years.”

PROPAGATION, CULTIVATION, &C.

Mr. Nock states:—

“Camphor plants are best and easily propagated from seeds.

The seeds do not keep well, and should be sown as soon as possible after ripening. They ripen in Japan, which at present is the only important source of seed, in October and November, and should be ordered some time in advance, so as to obtain them as soon as they are ripe. I find it a good plan to soak the seed in water for twenty-four to forty-eight hours before sowing, agitating the water occasionally. The best seeds, being heavier, will sink to the bottom, and these should be sown thinly by themselves; the lighter ones should be sown thickly, as only a small percentage will germinate.

"The seeds should be sown in well-prepared beds of sandy loam and leaf mould; they should be sown from $\frac{1}{2}$ to $\frac{3}{4}$ inch deep, making the bed firm, but not tight. The beds should be kept shaded and just moist. Too much wet will cause the young seedlings to damp off, and if allowed to get too dry the germs will quickly dry up and die.

"We have been most successful when the seed has been sown in boxes (made of $\frac{1}{2}$ inch wood) 18 by 13 by $3\frac{1}{2}$ inches, filled with the kind of soil described above. The boxes are handy to lift about, and can be easily protected from heavy rain and strong sun. Sheds made after the style of the old cinchona seed sheds answer well for standing the boxes in, and if made light and airy would do well to sow the seeds in direct, but care should be taken not to allow the young plants to be 'drawn.'

"We find it a good plan to prick out the seedling into supply baskets as soon as they are large enough to handle comfortably, or transplant them into beds, placing the plants 6 inches apart every way, and keeping them shaded and watered until they begin to grow, when they will bear the full light of the sun, but will require to be freely watered in dry weather.

"When the plants are from 9 to 15 inches high they are at their best for final planting, but if the weather is unsuitable they may be kept in the nursery till they are 2 feet high, or until good planting weather occurs viz., dull showery weather. In such weather they require very little shading, and soon take hold of the soil.

"Cuttings do not strike root readily, and only under certain conditions will they be successful. If the prevailing weather should be too dry they soon go off, and if too wet and cold they decay before roots are formed. We have had batches of cuttings with 70 per cent. beginning to callus over, and young shoots forming, that have gone off after three or four days of rough weather—cold high winds and heavy rains—and others that have gone the same way after a week of dry sunny weather. The favourable conditions are equable heat, light, and moisture; with these, and wood for cuttings in a proper state, a large percentage will strike root and make good plants.

"The nursery beds for seeds as well as cuttings should be made in a well-drained situation, and as near water as possible. The beds may be any length, and from 3 to 4 feet wide. The soil for cuttings should be composed as follows: one part good sandy

loam, one part leaf mould, and one part clean sharp sand (to this it would be beneficial to add a good sprinkling of powdered charcoal), all thoroughly mixed. The soil should be 6 to 9 inches deep. A layer of good sharp sand one inch thick should be laid on the surface. As a protection against hot sun and heavy rains it would be well to put a roof of thatch over the beds in the form of a shed but it should be constructed with open sides to allow plenty of light and air. A shed 4 feet wide, with a lean-to roof on stout posts, open at the back and front, will be found a useful size. The posts should be 6 feet high in front and 3 ft. 6 in. at the back. The roof may be thatch, shingles, or other light material. If more than one is required, a space 4 feet wide should be left between the sheds to give room for watering, weeding, and general attention.

“The best material for cuttings is that from straight, healthy, and well matured shoots of the current year’s growth, not too soft or too hard. If too hard they will not root readily, and if too soft they will be liable to damp off. The cuttings may be of any size from the thickness of a lead pencil to $\frac{3}{4}$ inch in diameter. They should be cut into lengths of from 6 to 9 inches. A clean cut with a very sharp knife immediately below a joint to form the base of the cutting is of the greatest importance. If the cut portion is torn or jagged, or too far away from the joint, it is almost certain to decay, though it may remain green for a long time.

“The operation for inserting the cuttings is best done by opening a trench with a sharp spade so as to form a straight edge. The prepared cuttings should be laid against this and the soil pressed firmly round them. They should be placed in rows 9 to 12 inches apart and 3 inches apart in the rows, and at a sufficient depth to leave only two or three buds above the surface.

“The sooner the cuttings are made and put in after being taken from the trees the better. After the cuttings are put in, the beds should be watered to settle the soil, and if in the open, they must be carefully shaded and sunlight must be only gradually let in as they become rooted and can bear it. If all goes well they should be rooted in 2 to 3 months, but they will not be ready for planting out for three or four months.

“Camphor may also be propagated by layers. The operation of layering is very simple. The shoots should be bent down to the soil. The branch at the bend should be cut half-way through, then cutting upwards for about $1\frac{1}{2}$ to 2 inches, so as to form a tongue. The cut portion must be kept apart by a slight twist, or by placing a piece of brick or a small stone in the cleft. The shoot should then be pegged down firmly into a groove made in the soil for its reception and covered with soil. The end of the shoot must be kept upright by tying it to a stick.

“Another simple way is to split the branch at the bend where it is to be laid in the ground, making the split about 2 inches long, and keeping the cut parts open by inserting a piece of wood or stone. Peg down well into the soil and stake. The ends of the shoots should be cut back a few inches with a sharp knife.”

It is thus evident that the plant will thrive almost anywhere in the Island if the water supply be sufficient and the soil well drained. The best method of treatment is probably to grow it as hedges, which are easily managed and clipped. It may also be planted along roads, jungle edges, &c., but *should never be mixed with the tea*, as the young leaves are very like those of tea, and a twig or two of camphor will spoil a whole break of tea.

The following analyses of two soils at Hakgala—on one of which (A) camphor does very well, on the other (B) only moderately—will help to guide to the selection of suitable spots:—

CAMPHOR SOILS.

“Six samples of soil were received from Mr. Nock at Hakgala, which represented the character of the soil and sub-soil, where camphor trees grew well and only fairly well.

“*No. 1 A*, represents a section 15 inches deep between trees showing the best growth, viz., 20 to 25 feet high and 12 to 15 feet in diameter at five years and nine months from the time of planting. The surface soil here is about 1 foot deep. It is composed of agglomerated particles of dark brown colour and yellow fragments of decomposing gneiss. It is very rich in nitrogen and the lower oxide of iron, has a fair amount of lime, but is deficient in potash and phosphoric acid.

“*No. 2 A*, representing the upper 6 inches, is of a dark brownish colour when dry, and is almost entirely composed of the agglomerated particles mentioned in *No. 1 A* and rootlets, &c. The analysis shows it to contain the bulk of the nitrogen, and an excess of the lower oxide of iron, but it is deficient in potash and phosphoric acid.

No. 3 A, represents the sub-soil at 15 inches deep or 3 inches below the actual surface soil. It is composed of yellow pieces of decomposing light-coloured gneiss, more or less bound together with a clayey matrix. It also contains a fair amount of nitrogen and rather more phosphoric acid and potash than the surface soil, and would be fairly easily penetrated by roots.

“*No. 1 B*.—This is taken from a section 15 inches deep, where the camphor is only doing fairly well. The plants five years and nine months old are from nine to ten ft. high and 6 to 8 ft in diameter. It is more finely divided than *No. 1 A*, and is of a lighter brown colour. Chemically, it is also somewhat poorer, though containing a good amount of nitrogen. Lime and mineral plant food generally may be considered deficient, especially potash, and this no doubt accounts for the poorer growth of the camphor trees in this part.

“*No. 2 B*, representing the top 6 inches, is a dark coloured loam, somewhat richer in nitrogen and phosphoric acid than *No. 1 B*, but is very poor in lime, magnesia, and potash.

No. 3 B, representing the sub-soil 15 inches from the surface, is a yellow loam much more finely divided than *No. 3 A*, but otherwise of somewhat similar composition. When wet it is of a retentive clayey nature requiring drainage.

HAKGALA, NUWARA ELIYA.

ANALYSIS OF SOIL (CAMPHOR).

Mechanical Composition.

	No. 1 A.	No. 2 A.	No. 3 A.
	Per cent.	Per cent.	Per cent.
Fine soil passing 90 mesh ...	20.00	26.00	34.00
Fine soil passing 60 mesh ...	15.00	24.00	18.50
Medium passing 30 mesh ...	7.00	5.00	7.50
Coarse sand and small stones ...	58.00	45.00	40.00
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Chemical Composition.

	No. 1 A.	No. 2 A.	No. 3 A.
	Per cent.	Per cent.	Per cent.
Moisture ...	5.100	5.000	5.900
Organic matter and combined water	14.500	17.700	11.500
Oxide of iron and manganese ...	8.200	7.080	9.800
Oxide of iron and aluminium ...	11.346	7.575	10.000
Lime ...	.140	.124	.050
Magnesia ...	.072	.075	.020
Potash ...	.030	.011	.061
Phosphoric acid ...	.012	.035	.069
Sand and silicates ...	60.600	62.400	63.000
	<u>100.000</u>	<u>100.000</u>	<u>100.000</u>
Containing nitrogen ..	.308	.490	.182
Equal to ammonia ..	.374	.595	.221
Lower oxide of iron ...	Good	Much	Fair

Mechanical Composition.

	No. 1 B.	No. 2 B.	No. 3 B.
	Per cent.	Per cent.	Per cent.
Fine soil passing 90 mesh ...	25.00	17.50	47.50
Fine soil passing 60 mesh ...	23.00	16.50	26.50
Medium soil passing 30 mesh ...	8.50	6.50	5.00
Coarse sand and small stones ...	43.50	59.50	21.50
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Chemical Composition.

	No. 1 B.	No. 2 B.	No. 3 B.
	Per cent.	Per cent.	Per cent.
Moisture ...	5.100	5.100	5.800
Organic matter and combined water	11.900	15.500	11.400
Oxide of iron and manganese ...	8.000	8.200	8.520
Oxide of iron and aluminium ...	9.210	8.050	12.502
Lime ...	.080	.060	.040
Magnesia ...	.070	.014	.046
Potash ...	.015	.007	.054
Phosphoric acid ...	0.25	.069	.038
Sand and silicates ...	65.600	63.000	61.600
	<u>100.000</u>	<u>100.000</u>	<u>100.000</u>

Containing nitrogen	...	·259	...	·371	...	·128
Equal to ammonia	...	·314	...	·450	...	·156
Lower oxide of iron	..	Fair	...	Much	...	Trace

“The ash of the camphor leaves was analyzed to determine the constituents most required by their growth. The leaves contained—

				Per cent.
Water	...	...	...	74·32
Organic matter*	...	...	..	19·58
Ash	...	...	...	6·10
				<hr/> 100·00

*Containing nitrogen 1·47 per cent.
Equal to ammonia 1·78 “

<i>Composition of Ash</i>				Per cent.
Lime	...	...	...	32·90
Magnesia	...	...	...	6·48
Oxide of iron	...	...	...	2·00
Alumina	..	...	...	3·11
Potash	...	...	...	14·86
Soda	...	...	...	4·21
Phosphoric acid	...	...	...	2·16
Sulphuric acid	...	...	...	2·00
Sand and silica	...	...	...	1·20
Carbonic acid	...	...	...	26·10
Carbon and undetermined	...	...	...	4·98
				<hr/> 100·00

“The chief mineral ingredients required by the camphor plant for the growth of leaves are lime and potash, an average yield of prunings removing 196 lb. of lime and 87 lb. of potash, which could be returned to the soil after the distilled wood had been burned for fuel purposes.

“M. KELWAY BAMBER, F.C.S., &c.”

PREPARATION OF THE CAMPHOR.

As soon as the plants have reached a fair size and formed stout woody stems below—say in three years or less in very good situations—they may be clipped. The simplest method will perhaps be to use hedge shears, placing a long basket below the hedge to catch the clippings. Only the leaves and young twigs are required; woody twigs yield little or no camphor.

In Japan, where however, they only use the wood of full-grown trees as a source of camphor, the chips of wood are distilled in a primitive-looking but effective still, with bamboo tubes (these have the advantage that they can afterwards be split to remove any camphor from them) and a wooden condenser with water running over its lid. In Ceylon probably the best method will be to fix up

a small still of any good pattern with a glass condenser and plentiful water supply, working it by means of steam from the factory boiler. As the distillation is a somewhat uncertain operation, especially to the beginner, and as it is probable that more efficient methods will be discovered, the details of the principal experiments tried are given below. Material for these experiments was obtained from the gardens at Peradeniya (1,600 feet), Hakgala (5, 600 feet), and Anuradhapura (300 feet).

CAMPHOR DISTILLATION.

The first distillations were from 112lb. of prunings received from Hakgala on the 28th June, 1900. These were conducted in a large cask fitted with a metal cover leading to a metal condenser which was cooled by a constant flow of water. Distillation was effected by means of steam from a boiler, passing into the lower part of the cask below a perforated iron plate. The prunings were chopped up into fragments about 1 inch long, covered with water, the top, connected with the condenser, luted on, and steam turned on to gradually bring the water to the boil.

A strong pungent smell of camphor and eucalyptus came off as soon as distillation commenced, which persisted for some time even when the distillate was cooled to 50° F., a temperature below that which could be obtained practically. The loss was minimized by bringing the water to the boil very slowly, and only admitting just sufficient steam to keep it at the boiling temperature. It was found that the metal cover to the cask retained a good proportion of the camphor, but it was not so pure as when condensed in a wooden box similar to that in use in China and Japan. The purest camphor was obtained when the distillate was made to pass through a long glass tube surrounded with a jacket of cold (running) water, the crystals being deposited when the temperature of the glass did not exceed 50° C. or 122° F., a temperature that could easily be maintained in a condensing apparatus up-country at all times of the year. In the low-country a more rapid flow of condensing water and a proportionately longer condensing apparatus would be required to obtain the same results, as the water is much warmer and the steam also is at a higher temperature.

In all the experiments the camphor had almost entirely distilled over during the first three hours, as several distillations conducted for twelve hours and longer resulted in no better yield, and the smell of the camphor under these circumstances was contaminated with that of decomposition products from the nitrogenous matter, &c., in the leaves and twigs. Three distillations could be made in the same apparatus during the day.

The amount of steam required for the distillation even of large quantities would be nominal, and would hardly be felt in an ordinary boiler working in a tea factory.

YIELD OF CAMPHOR.

The first distillation from part of the prunings obtained from Hakgala in June, 1900, only yielded 35 per cent., but this was

increased to '62 per cent. by better regulation of the steam pressure and the condensing water. The camphor had a slight smell of eucalyptus, and was not so strong as ordinary camphor. The leaves were quite fresh when distilled.

Separate distillations were again made in August with fresh leaves and twigs, and the green branches of about half inch to 1 inch thick the former yielded '85 per cent. camphor, but the latter a mere trace, both of camphor and oil.

7th September, 1900.—Three distillations of camphor leaves from Peradeniya were made in the usual manner, the yield from the first being 1'10 per cent. of camphor and camphor oil. In the second distillation, when the leaves had partly dried, 1'06 per cent. of camphor and oil was obtained, calculated on the fresh leaves. In the third distillation the leaves had undergone partial decomposition, the result of becoming heated to a temperature of 106 F. The yield in this case was '68 per cent. camphor and '38 per cent. of oil, so that it would appear advisable to distil the leaves as fresh as possible, as the oil is less valuable than the camphor.

9th October, 1900.—A sample of young camphor flush weighing 11½ lb. plucked from two trees in Hakgala, one 8 feet in diameter and 12 feet high, yielding 8 lb., and the other 5 feet in diameter and 7 feet high, yielding 3½ lb. This was carefully distilled in a copper retort over a lamp, and the vapour condensed in a glass vessel. In the first four hours '63 per cent. of pure camphor was obtained, which smelled only of pure camphor; on further distillation '08 per cent. more camphor was obtained, which did not smell quite so pure. Heating by the direct flame beneath the vessel appears to take longer in removing all the camphor than driving it over with steam under slight pressure.

24th October, 1900.—A distillation of camphor clippings from Hakgala yielded '77 per cent. camphor and '27 per cent. oil.

30th October, 1900.—A distillation of 12 lb. of camphor flush was made in a copper vessel with a glass condenser, yielded '69 per cent. camphor and '34 per cent. camphor oil. The trees were in active growth when this flush was plucked.

9th January, 1901.—A camphor tree that had become slightly cankered was received from Hakgala in separate parcels of leaves, branches, stem, and roots. Several distillations of the leaves and twigs were made both in the fresh state and when air-dried, some of them being continued for twelve hours. The yield of camphor and oil varied somewhat, but appeared to depend on the proportion of leaves to twigs, the latter containing much less than the former. A glass condenser was employed for all these distillations, the camphor and oil being obtained quite pure.

The first experiment yielded '875 per cent. camphor and '986 per cent. oil, a far larger proportion of oil than in any previous distillation of similar leaf.

A second distillation, which was continued at a low temperature for eleven hours, yielded 1'08 per cent. pure camphor and 0'32 per cent. oil.

Five other distillations at intervals of some days with the air-dried leaves gave the following yields:—

- No. 1.—2.310 per cent. camphor and .114 per cent. oil, equal to 1.02 per cent. on fresh leaf.
 No. 2.—2.149 per cent. camphor and oil, equal to .98 per cent. on fresh leaf.
 No. 3.—2.425 per cent. camphor and traces of oil, equal to 1.05 per cent. on fresh leaf.
 No. 4.—2.30 per cent. camphor and traces of oil, equal to 1.01 per cent. on fresh leaf.
 No. 5.—2.08 per cent. camphor and traces of oil, equal to .96 per cent. on fresh leaf.

From these figures it will be seen that air-drying the leaf before distillation does not cause any appreciable loss of camphor, though a certain amount of oil disappears, either by volatilization or oxidation. The camphor obtained from the air-dried leaf also had a somewhat purer smell than that from the fresh leaf, though this latter was easily rendered pure by re-distillation with steam.

Three distillations were made of the branches and stem of the camphor tree, but no appreciable quantity of camphor was obtained from either, nor did the bark of the stem appear to contain more than traces. The roots, however, contained an oil, 5lb. of roots yielding 1.22 per cent. This oil was located mainly in the bark and in a thin layer of wood beneath it. It had only a slight smell of camphor, and more resembled a mixture of aniseed and peppermint.

On the 7th August, 1901, 5lb. of young flush was received from Hakgala in a slightly heated condition. It was at once put into a copper vessel with fifteen pints of water, and a glass dome luted on, which was connected with a glass condenser. The water was heated slowly from below, and a thermometer placed, so as to register the temperature of the vapour 2 inches above the water and camphor leaves.

At 50° C. (122° F.) crystals of camphor condensed on the glass dome, which at 90° C. (194° F.) were carried back into the water by the condensed steam. At 100° C. the steam and camphor vapour was passing rapidly into the glass condenser, while the leaves were covered with oily drops of camphor and oil. Distillation at 100° C. was continued for two hours, when 4½ litres (7.93 pints) of water containing camphor and oil had collected in the condenser. This was then passed through a wet paper filter to separate the camphor and oil from the water, 24.53 grams of the mixture being obtained, equal to 1.10 per cent. The oil was separated from the camphor as much as possible, the yield of each on the original flush being .755 per cent. pure camphor and .345 per cent. camphor oil. Another distillation was made in the same way of 10lb. of coppice shoots one year old from a tree that had been cut down. The yield of camphor from this was very small, only .192 per cent. and shows that the first year's growth from a tree cut down to the ground is practically valueless, but it is probable that young flush from such coppiced trees would increase in the camphor contents during the next and succeeding years.

Further distillations were also made of the entire prunings

weighing 50lb. of a five year and nine months old tree of average growth, the leaves (27lb.) and branches (23lb.) being distilled separately, the former yielding 767 per cent. of pure camphor and some oil, the latter only traces of oil, showing that the whole of the camphor is practically in the leaves and not in the young wood. The reason of this should be investigated, as it is from *old wood* that the bulk of the camphor of commerce is obtained.

CHARACTERS.

The camphor obtained from all the above experiments has the usual crystalline form, and is perfectly colourless unless condensed in an iron vessel, when it is tinged with red from the oxidized iron. It floats on water, in which it is almost insoluble, and small fragments rotate rapidly when floated on this liquid. It burns with a yellow smoky flame, leaving no residue, and volatilizes readily at the ordinary temperature. It is easily soluble in alcohol, ether, and chloroform, and is precipitated from the former in white flocculent masses, when the solution is poured into water. It sublimes readily, and has an odour of camphor, but not so powerful as ordinary camphor from old wood. Its specific gravity is 987; it melts at 175 C. (347 F.) and boils at 205 C. (400 F.). It dissolves readily in nitric acid, with some development of heat, and immediate separation of the solution into two layers, the upper of a red colour and the lower pale yellow or colourless. The addition of water precipitates the camphor as a white mass from the upper layer of the solution apparently unchanged.

SUBLIMATION EXPERIMENTS.

These were conducted at varying temperatures and under different conditions in order to try and obtain the translucent state common to commercial camphor. The most successful method was by mixing the crude camphor with slaked lime in the proportion of 40 to 1, and subjecting this in a closed vessel to a low heat for twelve hours, the heat being gradually increased up the sides of the vessel in order to drive all the camphor into the upper portion. Copper vessels are the best for the purpose, as glass is liable to fracture from condensed moisture running down to the heated sides.

Before sublimation can be effected it is essential that all the camphor oil should be expressed from the camphor. The camphor when first distilled appears to be practically free from oil, but after standing some days oil gradually separates and sinks to the bottom of the mass of crystals, and this appears to continue for months. Filtration with the aid of a vacuum effects a partial separation, but in practice on a large scale it would be best effected by means of a centrifugal machine similar to that employed for the separation of crystalline sugar from molasses.

OIL.

The oil obtained with the camphor from the leaves is of a clear yellow colour, having a specific gravity at 80° F. of 9662. It con-

tains a certain amount of camphor in solution, which can be separated to some extent by cooling to 10° C. It would therefore be advisable to cool the mixture of camphor and oil, as much as possible, before submitting it to centrifugal expression.

The root oil, of which 1·22 per cent. was obtained from the air-dried roots, was almost colourless, and had no smell of camphor. It consisted of a mixture of two oils, one lighter and one heavier than water, the specific gravity of the mixed oils being 1·058 at 80° F.

YIELD AND PROSPECTS.

The figures above given show that the yield varies a good deal, but that on the average about 75 to 1 per cent. of camphor may be expected from the young leaves and twigs, as well as a small quantity of camphor oil, which also has a market value. Samples of camphor mixed with the oil were valued lately at Rs. 126 per cwt. If we assume that clippings will yield about 1 per cent. of camphor and oil worth Re. 1 per lb., we should be well within the mark. The cost of obtaining this should be about Rs. 53 per acre, made up as follows:—

Pruning 1,210 trees and carrying to factory	Rs.	c.
Distilling, fuel, packing, &c. ...	37	0
	16	0
	<hr/>	
	53	0
	<hr/>	

I. e., camphor can be put on the market as cheaply as tea per pound if the yield be at the rate of 177 lb. per acre (cost of tea being estimated at 30 cents.) Now 177 lb. will be yielded by 17,700 lb. of clippings. In the case of bushes 6 feet apart this means 14½ lbs per bush per annum, or about seven times the weight of flush obtained from a prosperous tea bush. On the other hand, the bushes are only half as many to the acre, and the plucking is much coarser, so that this estimate is not unreasonable, and the product is more valuable than tea. It seems not unreasonable to expect that where a bush, with 36 square feet of space to grow in, yields 12 to 15 lb., of clippings a year, the cultivation will prove remunerative—not a bonanza, but yielding a fair profit. In Hakgala Gardens this yield is exceeded, so far as rough experiments show.

PARIS GREEN: APPLICATION TO COTTON.

*Mr. Wm. B. Seabrook to Director, Public Gardens and Plantations.**
James Island, South Carolina,
U. S. A., February 21st, 1906.

My Dear Sir,

I remember the interest you took in the appliance used for applying Paris Green to the cotton plant for destroying caterpillars. I am now trespassing upon your time to give you some further information on this subject. Last summer there was introduced a

* For previous letter by Wm. Seabrook on Paris Green, see Bulletin July, 1904, page 159.

small kind of bellows, called a "powder gun," with long handles, and the nozzle terminating in a little fixture like the sprinkling nozzle of a watering pot. The Paris Green powder is put in a receptacle in the bellows, the nozzle is put in the middle of the cotton bush, a very slight convulsive movement of the bellows handle—that is all. The little puff of powder that is blown out is so slight that it is hardly possible to see it, pump it out until you can see it, and you will be sure to burn up the cotton. It is the simplest to operate of any contrivance yet devised; is more efficacious in its deadly work on the worm, and the most convenient to handle. When I wrote to Sir Daniel Morris about it, he immediately asked to be put in communication with the manufacturers, looking forward to obtaining a supply another season, should they be needed. While instructing them to send him one of their catalogues I took the liberty of instructing them to send one to you too. I hope you will get it safely.*

My thoughts are full of pleasant memories of Jamaica—beautiful Island—and of the pleasant acquaintances made, and friendships enjoyed during my brief stay there. I remember with kindest interest Mr. Fursdon and Mr. Sharp, who were very kind to me. Give them my kindest regards, should you see them.

I am very sincerely and truly yours,

WM. B. SEABROOK.

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Wednesday, 16th May. Present: The Hon. H. Clarence Bourne, Colonial Secretary, in the chair, the Director of Public Gardens, the Island Chemist, His Grace the Archbishop, the Superintending Inspector of Schools, Messrs. C. E. DeMercado, J. W. Middleton, G. D. Murray and the Secretary.

Standard for Jamaica Rum.—The Secretary read letter from the Colonial Secretary's Office stating that the Governor was not prepared at the present moment to prescribe a standard quantity of ethers for Jamaica rum.

The Secretary also read a letter from the Secretary of the North-side Sugar Planters Association stating that it was the opinion of the Association that any law to standardise Jamaica Rum was unfortunate and likely to deal a stiff blow against the rum industry.

He also submitted the papers giving the Chemist's arguments in favour of standardisation and the criticism of members of the Board.

He was directed to reply to Mr. Shore informing him of the Governor's decision regarding standardisation.

Agricultural Don'ts.—The Secretary read a letter re "Agricultural Don'ts" from the Colonial Secretary, stating that when next year's estimates were under consideration the amount required for printing the charts of "Agricultural Don'ts" might be submitted for con-

* One of these powder guns is now in use, and can be seen at Hope Gardens.

sideration under Agricultural Vote. Also letter from the Education Department stating that the Board of Education was willing to recommend that the chart be placed in schools if the Board of Agriculture was willing to print it.

Commercial Agent in London.—The Secretary read a letter from the Colonial Secretary on the matter of the appointment of a Commercial Agent in London, stating that the Governor had consulted the Privy Council on the matter and they had advised that the rule laid down by Mr. Chamberlain when Secretary of State should be followed, viz.: that such an Agent should be appointed and maintained by the commercial community in the Colony and be entirely unconnected with the Government, though there would be no objection to the Government making if necessary, and the Legislative Council was willing, a small grant to some such body as the Royal Jamaica Society of Agriculture and Commerce if that Society were willing to take the matter up, but on a previous occasion when this decision was intimated to that Society, the Secretary replied that its funds were unable to stand the expense and they desired the Government largely to increase its suggested grant. This the Government was unable to do. It remained for those interested to make some arrangements whereby the funds necessary for carrying out their suggestion be provided by those likely to profit most by the Agency.

Sugar Grant.—The Secretary submitted copy of Law 3 of 1906 entitled "A Law in aid of Law 45 of 1903" to give the Board of Agriculture, with the sanction of the Privy Council, a wider discretion as to the expenditure of the £10,000 therein mentioned, in the interest of the sugar industry.

Demerara Rums.—The Secretary submitted a copy of the Official Gazette of British Guiana, also an extract from the Demerara Argosy showing the variation in the contents of ethers in Demerara Rums which ranged from 30.1 to 122.7.

Truck System.—The Secretary submitted a private letter, referred by the Governor, where complaint was made of a practice found prevailing on the writer's estate and others, of overseers supplying bread, beef and pork to the labourers and stopping the cost of it out of their wages when they were charged for more than they got, and that they did not get work unless they agreed to purchase these things. The writer suggested that there should be a law here similar to the Truck Act in England to prevent this.

After discussion in which it was said that there were very few estates where this practice would be carried on, it was resolved to refer copies of the letters to the Westmoreland and Northside Sugar Planters Associations for their remarks.

Cotton Seed.—The Secretary read letters from the Imperial Department of Agriculture calling attention to the importance of using the Department's selected and disinfected Sea Island Cotton seed.

It was stated that matter on the subject was being published in the *Bulletin* and in the *Agricultural Journal*.

Leave for Mr. Cousins.—The Secretary submitted a letter from the Colonial Secretary's Office stating that Mr. Cousins had ap-

plied for leave of absence for three months from the 23rd July next and proposed that the Assistant Chemist should act as Government Chemist and manage the routine work of the office, while the Fermentation Chemist should be placed in charge of the Sugar Department and act for Mr. Cousins on the Board of Agriculture, and asking him to ascertain from each member of the Board whether there was any objection to the proposed arrangements.

The Secretary stated that none of the members of the Board had had any objection to offer and the Governor had accordingly granted leave to Mr. Cousins.

Chemist's Reports. The Secretary submitted Reports of the Chemist as follows :—

1. Applications from Distillers to attend special Course. This was referred to the Advisory Committee of Sugar Experiments.

2. Work of Agricultural Students for Easter Term. This was directed to be circulated.

Director Public Gardens' Reports. The following reports from the Director of Public Gardens were submitted :—

1. Hope Experiment Station.

2. Instructors—Mr. Cradwick and Mr. Briscoe. These were directed to be circulated.

Lecturer in Agricultural Science and Assistant Chemist. The following paper which had been circulated but had not yet been before the Board was submitted :—

1. Letter from Mr. Cousins recommending Mr. E. J. Wortley to fill the appointment of Lecturer in Agricultural Science; and stating that the best plan for filling the post of Assistant Chemist would be to offer a salary of £220 rising to £240 by annual increments of £10 through the Crown Agents on a three years' agreement, the funds to be provided as follows :—

Present salary of Assistant Chemist £150 to £200 by £10, salary of Assistant in Sugar Laboratory (vacant) £70.

It was agreed that this latter recommendation should be adopted. A letter was submitted from the Colonial Secretary intimating that Mr. Wortley had been appointed in Mr. Teversham's place.

The following papers which had been circulated were now submitted for final consideration :—

1. Re Standardisation of Jamaica Rum.

2. Proposals as to Distillers' Course.

3. Report on the successful working of the high ether Installation at Hampden Estate.

4. Distillery Progress in Westmoreland.

5. Appropriation Accounts, Government Laboratory and Sugar Experiment Station for 1905-06.

6. Reports Instructors.

7. Report Hope Experiment Station.

[Issued 14th June, 1906.]



BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

JULY, 1906.

Part 7.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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P R I C E—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :

HOPE GARDENS.

1906.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

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Vol. IV.

JULY, 1906.

Part 7.

A MEXICAN RUBBER PLANTATION.*

We have received particulars about the fine La Zacualpa rubber plantation in Mexico, of the Hidalgo Plantation Co., in an interesting pamphlet entitled "Rubber: what it is and how it grows," by the general manager of the company. This is the second edition of the pamphlet, (which is illustrated from photographs), and in his foreword the author says: "Since the first edition was issued, rubber has advanced in price, with every prospect of its going higher, and the attention of the business world is more than ever turned to this profitable industry. This book is dedicated to the young people of our public and private schools, with the hope that the matter it contains will be found interesting as well as instructive."

The first part deals with rubber generally, but here we only quote some particulars about La Zacualpa estate, which show how a big rubber estate in Mexico is run, and give information of use to planters of *Castilloa elastica*,

LA ZACUALPA RUBBER PLANTATION.

La Zacualpa rubber plantation is, without doubt, the foremost of its kind in Mexico, and for depth of soil, requisite rainfall, systematic drainage and intelligent management has not its equal in the world. It is situated between the towns of Huistla and Es-cuintla, about 20 miles from the Pacific Ocean, and near the Pan-American railroad which is to connect Tapachula with the Tehuantepec railroad at San Geronimo. This road has already reached Tonalá, and will be pushed through to completion under a most favourable concession from the Mexican Government. The planted trees are easily accessible at all points by avenues running for miles; seven of these have already been named, as follows: Harrison avenue, Van Court avenue, Alicia avenue, Butler avenue, San Carlos avenue, La Reina avenue, Santa Helena avenue. These are crossed by streets that are numbered, and the

* From "Ceylon Observer."

visitor can ride for miles through groves of healthy rubber trees, the branches of the older trees arching overhead. At the present writing some 8,000 acres are planted.

CASTILLA LACTIFLUA.

In a letter received from Mr. O. F. Cook, of the Agricultural Department, Washington, he says: "You will doubtless be interested to know that I have recently described the Soconusco rubber tree as a distinct species under the name *Castilla lactiflua*. The Castilla of the Soconusco District of the State of Chiapas ("C. lactiflua"), is peculiar in having the complementary inflorescence flattened and with a broad mouth; it is very similar to the primary, except in the smaller size. The specific name alludes to the fact that the milk of the tree flows freely when the bark is cut, so that it can be collected in quantity and coagulated by improved (creaming) methods, instead of the rubber being harvested wholly or partly by pulling the 'scrap' (*burucha*) from the gashes in which it has dried."

The Department (or County) of Soconusco, in the state of Chiapas, one of the twenty-seven States forming the Republic of Mexico, is the natural home of the *Castilloa elastica*, or Mexican rubber tree, as is proven by the great number of wild rubber trees which grow spontaneously in its forests. In their wild state they grow tall and lank, reaching a height of over fifty feet and a diameter of twelve to eighteen inches.

As far as known the trees are long-lived, and increase their output of latex yearly until as many as twenty-five pounds of crude rubber have been taken from a single tree. It is only within a few years that attention has been called to the cultivation of this tree. During the years 1889 and 1890 a grove of some 5,000 of these trees was planted on La Zacualpa, a plantation in the above Department, which trees are now (1905) on an average, eighteen inches in diameter and forty feet in height, and are yielding about two and one-half pounds of rubber to the tree.

They stand about 400 to the acre, and are in prime condition. These are the trees referred to by Mr. O. F. Cook, Bulletin 49, issued by the United States Department of Agriculture, as follows: "The planted trees at La Zacualpa abundantly demonstrate the practicability of rubber culture."

The successful production of rubber and growth of these trees, combined with their present healthy state, has proved the fact that *Castilloa elastica* can be easily cultivated in its native habitat, with large profits. Cultivated trees are raised from the seed, and begin to yield milk during the sixth year from date of planting. The trees have no natural enemies, as by reason of the quantity of resin and albuminoids contained in the milk, they are not molested by worms, insects, birds or animals.

Owing to the successful conditions noted above, this plantation has been extensively developed, and under the care of expert rubber cultivators about 3,000,000 rubber trees are growing vigorously. The cultivation of rubber is a new enterprise, calling for the most

careful study, and is a notable addition to the world's varied industries. Consequently, the questions of soil, rainfall and climatic conditions must enter largely into the calculations of those contemplating its future.

The rubber tree requires a rich loam soil; warm, moist climate; low altitude; a large and evenly distributed rainfall, and perfect drainage. All these conditions exist in the Department of Soconusco.

The rain record, taken daily by the British Vice-Consul, R. O. Stevenson, has averaged 160 inches for many years past.

The plantation consists of 18,791 acres of land, of which 12,000 acres have been set apart as La Zacualpa Rubber Plantation and are now being planted with rubber trees.

LABOUR.

The management is entrusted to one superintendent, two major-domos, or sub-managers, and one corporal to every thirty men. During the planting season about 300 men are employed, with ten corporals. All the planting is done under the supervision of rod-men who have formerly worked with engineers, and the lines outlining the planted squares and avenues between are run with great care. At sunrise the plantation bell calls the labourers to work, all assembling in the patio, or yard, in front of the manager's house. The major-domos receive their instructions from the manager and communicate them to the corporals, who in turn direct their men regarding the work of the day, and are responsible for the performance of their respective duties. The bell, which can be heard in all parts of the plantation, announces the noon hour, and at 1 o'clock work is resumed, continuing till sunset. Everything is done in the most systematic manner, and the plantation is kept clean and in good order at all times. The supplies needed are furnished from the company's store, and a large bake oven is provided for the use of the labourers. Generally four or five women do all the baking, and sell bread to those wishing to buy.

THE LOCATION OF THE PLANTATION

is an ideal one, level for the most part, but sufficiently rolling for good drainage, well watered, entirely free from stones and gravel, and has the reputation all through that country of being a very choice strip of rubber land. The elevation at no point exceeds 400 feet, and at some places is as low as 100 feet. La Zacualpa Rubber Plantation is a most interesting place, and improvements are constantly being made. A sawmill is in constant use, preparing timber for the construction of permanent houses for the native labourers and other buildings for the company's use. Excellent tiles have been made from clay found on the plantation, and are used in roofing buildings. The population of La Zacualpa today, including men, women and children, is over 600. The same plan has been carried out in the buildings for the labourers as that used in the plantation proper, the buildings being situated on plazas, or squares.

THE CASTILLOA ELASTICA TREE.

The *Castilloa elastica*, or Mexican rubber tree, is between five and six years old when it blooms. Before blooming the tree sheds its leaves. The blossoming season begins in January and continues until April. Clusters of small, whitish blossoms first put forth, and three weeks later the tiny petals fall, leaving a little green centre which gradually enlarges, and is filled with seed points sticking fast to a round disc. The blossoms are as numerous as the leaves, and each one has at least twenty seeds about the size of an ordinary pea. When the blooming and seeding time is over the trees put forth new leaves.

SEEDS.

The seeds are encased in a shell which is hard while green, but it soon softens into a sticky substance like fish gelatine. The first turning in the ripening process is to a sickly yellow, which gradually changes to a bright red. As soon as the seeds are ripe, with the first rains they begin to fall. This is a busy time on the plantation. The seeds literally cover the ground underneath the trees, and the labourers gather them into sacks and carry them to the nurseries. There they are dumped into pails filled with water and washed thoroughly to detach them from the discs and rid them of the enveloping gelatine substance. When the seeds have been ripe sixty days they will no longer germinate, and to get the best results should be planted immediately after washing, which is done to facilitate handling and prevent them from germinating in the gelatine coating.

PLANTING.

There is some difference of opinion among planters as to the best methods of planting, some advocating partial shade, and again some would plant from a nursery previously formed, and others with the seed at stake. Difference of local and climatic conditions is no doubt the cause of this diversity of opinion, as each section calls for different methods. The method adopted on La Zacualpa, and that which has been productive of the best results in that locality, is the following:—

The land is first surveyed into squares of thirty-three acres each, which includes avenues and roads twenty-four feet wide between them. The roads run in straight lines, and are cleared of all trees and shrubs, thus making them available for the use of the workmen and inspection of the plantation. The roads running north and south are called avenues, and those east and west streets, the former being named and the latter being numbered. The roads are now several miles long, and in order to facilitate transportation of the labour to various parts of the plantation, the Company is about to put in a small electric railroad. The land is cleared by cutting down the forest and is then burnt off. Some of the largest trees are left, and most of them escape the fire and send out new foliage, which then acts as partial shade to the young trees. After the burning the land is then staked out to

allow for 400 trees to the acre. A small mound of earth is made at each stake, and the rubber seeds are imbedded therein.

The seed will germinate in from eight to fifteen days, and one month from the time of planting the plant attains a height of about eight inches, and its growth from this time on is rapid and may roughly be put down as one foot per month. Our three-years-old trees are over thirty feet high, and those of four years about thirty-five feet. After the planting has been done, great care is taken that the forest growth does not choke out the young tree. This growth is kept down continually, thus giving the young rubber tree a good start until it is able to take care of itself, which it can do two years after planting, after which time it requires very little attention.

TAPPING METHODS.

The native Indian method of tapping is as follows:—Before beginning to tap, a place is selected on the tree, preferably on the inclined side, and a hole made in the ground below, lined with a wide green leaf. The tapper makes two incisions with his machete at right angles, coming together in the centre. This is done to ascertain where the milk runs best. Once decided, the tapper makes a narrow incision at the point of convergence and improvises a funnel of the same leaf used in lining the hole in the ground. This acts as a conduit for the milk, which runs from the tree in a steady stream into the hole until it coagulates along the line of incision, when, if desired, it is scraped off twice or more before the stream finally ceases. Very often the milk spurts out, and one could not stand close to the tree where the machete is at work without getting one's clothes spoiled. The rubber coagulates where it falls on the clothes, and will not wash out; only a solvent will remove it.

The bark of the tree is not only cut once, but at least four or five times, at intervals of two feet. The next year the angles cross each other, giving the tree a peculiar criss-cross appearance. Once the milk is flowing freely, the tapper leaves the tree and goes to another, repeating the process already described. By the above method a dozen trees are considered an average day's work. When the milk ceases to flow the tapper returns and carefully picks up the leaf in the hole and pours its contents into a large gourd. This is naturally a crude and wasteful process. An unskilled tapper either gets all the milk on his own clothes or else it runs round the tree and is lost. It is usual to begin tapping in May and continue until December inclusive.

THE LATEX.

The latex, or milky juice of the bark of the rubber tree, is quite distinct from the sap which circulates through the wood, and contains from 32 to 44 per cent. of gum. Pure rubber milk is white when it first runs from the tree, closely resembles that of the cow; but in the drying process it gradually oxidizes and turns black.

COAGULATING—NATIVE INDIAN METHOD.

When the milk is brought in from the forest it is thinly spread on the long, palm-shaped leaves of the *oja blanca*, which have first been laid on the ground in the hot sun. Toward the stem, where the milk lies thickest, it is necessary to stir it while drying; otherwise it would coat over thickly on the outside and be full of the residue fluid, bringing a lower price in consequence. When the leaves are coated evenly, a quarter of an inch thick, they are piled one above another and pressed hard enough to cause the rubber strips to adhere closely. Then by a dexterous movement, the tough leaves are pulled off and the thin layers are rolled into slabs ready for packing.

CLEANSING THE RUBBER.

The slabs of dried rubber are packed in bales of 150 pounds each, covered with the native-made matting, sewed up in sacks, shipped per steamer to various countries and sold to the rubber manufacturers. The first process in the manufacture of crude rubber—necessary on account of its being prepared by the native method—is to pass the slabs through large corrugated steel rollers, water falling from a reservoir upon the rubber as it passes through. This is repeated a number of times until all the dirt and foreign matter is eliminated, and the rubber rolled into thin perforated sheets having a rough surface. These sheets are from eight to twelve feet long, and eighteen inches wide. They are then hung in the dry room, where they remain until all the moisture has evaporated. The rubber is then ready for the next process.

WASHING THE RUBBER.

By the methods now adopted the foreign matters are washed out of the latex before coagulation takes place, thus producing a very high grade of rubber from the *Castilloa*, having a marketable value equal to that of *Para*.

Until now it was generally assumed that the Central American rubber was of much inferior grade to that of *Para*. It has now been proved, however, that the actual difference is very slight, if there is any, and resolves itself into the question of preparing it for the market at the time of tapping. During the past few months the best qualities of some rubber from cultivated *Castilloa* trees brought \$1.54 and \$1.56 gold per pound on the London market. This price was higher than that of best South American *Para* sold at the same time. Mexican rubber from wild *Castilloa* trees and shipped in the old way already referred to was quoted at 60 and 65 cents per pound, or less than one-half the price obtained for the same rubber prepared according to modern methods. As it is necessary to treat the latex as soon as possible after it is collected from the tree, receiving stations should be established on a large plantation, such as La Zacualpa, so as to avoid the transportation of the latex to any great distance.

BLACK-LEG.*

By W. H. DALRYMPLE, R.C.V.S.

From time to time the Veterinary Department receives requests for information regarding "Black-leg," a disease quite fatal to young cattle frequently in the best of condition, but which does not appear to be recognized by many, and it is for the purpose of supplying to our cattle owners something like accurate data on the subject that the Station publishes this short bulletin at the present time. We are not prepared to say that this disease is of more frequent occurrence than heretofore in the State: but, on account of the greater tendency on the part of our people to raise and own animals of better breeding, and, in consequence, of greater value, losses occurring in their stock may be receiving more attention as to cause, with the result that the trouble is being more frequently recognized rather than becoming more frequent.

The value of young "scrub" cattle is relatively so inconsiderable that when a few of them die on the farm little thought is taken of the probable cause of death and, therefore, no investigation is made to endeavour to discover it. Black-leg may have been at the bottom of many of such fatalities in the past, unrecognized, and because of the proper sanitary measures not having been taken to destroy infection in the bodies of the victims, the disease may, no doubt, have become established in certain localities, laying the foundation for the cases in the more valuable animals, and which, because of their greater value, has caused owners to seek more information regarding the fatal ailment. Fortunately, although the disease is a very fatal one among young cattle, it can be almost wholly prevented by vaccination. In fact, statistics recorded by the National Department of Agriculture at Washington go to show that out of 1,500,000 animals vaccinated, the loss reached only about one-half of one per cent.

Besides being known as black-leg, the disease has other names, such as black-quarter, quarter-ill, symptomatic anthrax, symptomatic charbon, etc. To avoid confusion, however, we will confine ourselves to the first name, black-leg. The use of the terms, symptomatic anthrax and symptomatic charbon has led to a good deal of misunderstanding and error in our State, so far as this disease is concerned, because, having anthrax or charbon as a part of the name, many have been led to think that the disease was genuine anthrax or charbon. Some writers on veterinary medicine use the terms, symptomatic anthrax and charbon symptomatique (the French), because of its apparent resemblance to the external appearance of that disease, especially a swelling that is usually to be found in those parts of the body thickly clothed with muscular tissue. But since bacteriology has assumed the rank of a most important science, it has been found that the two diseases are separate and distinct and produced by entirely

*Bulletin No. 85, March, 1906, of the Agri., Experiment Station of Louisiana.

different organisms or germs. So that, in reality, the one has nothing at all to do with the other; the only similarity of importance being perhaps that both are rapid and fatal in their effect. For the information of our German settlers we may mention that this disease is known in their language as "Rauschbrand."

CAUSE.

Black-leg is a rapidly fatal infectious disease of young cattle, and is caused by a spore-bearing organism, the *Bacillus Chauvoei*. Spring and fall are said to be the most favourable seasons for the development of the ailment, and cattle between the ages of six and eighteen months are the most liable to become affected, although partial susceptibility seems to remain up to about four years.

The manner of infection is by indirect contact with the germ on infected soil, the organism gaining entrance to the body through abrasions of the skin, and, perhaps, in rare cases, through the mucuous membrane of the mouth and other parts of the alimentary canal. The wounds or abrasions are generally quite minute in size, but sufficiently deep to penetrate through the skin into the tissues underneath. Punctured wounds, such as those received from barbed wire fences or from stubbles or briars in pastures, seem to be the most likely method of infection, and correspond somewhat closely to the only manner in which the disease may be produced artificially—viz., through injection of the virus hypodermatically.

SYMPTOMS.

The disease is easy of recognition on account of the symptoms being quite characteristic. It is characterized, first, by the symptoms of a more or less intense fever, and by the appearance of a specific tumour, or swelling, upon the body, neck or upper part of the limb above the knee and hock, causing stiffness or lameness. This swelling is almost constantly found in the thick flesh or muscles of the parts mentioned. It consists of a progressive inflammatory enlargement, of firm and uniform consistence, rapidly extending in area and depth, and later becoming insensitive, crepitant and resonant, or in other words the swelling emits a crackling sound when the hand is passed over it. This crepitant sound is due to the collection of gas in the affected flesh, and which is produced by the germs of the disease. When the swelling is cut into, a frothy, dark red fluid escapes, and the flesh of the swelling is dark in colour, with the appearance of being mortified.

With few exceptions, the disease terminates fatally, death usually occurring in from twelve to thirty-six hours after the first appearance of the symptoms.

TREATMENT.

With regard to treatment, it may be said that curative (?) agents are of little or no avail—prevention being the only satisfactory method of attacking the disease. This may be divided into the following, viz., hygienic and preventive or protective.

Hygienic.

This aims at destroying or preventing the spread of infection in all places where cattle are kept, and the second, to endeavour to fortify the systems of susceptible animals against an invasion of the black-leg germs.

Similar to anthrax (charbon) in this respect, black-leg infection is largely spread from the dead animal through the medium of carnivorous animals and birds (dogs, buzzards, etc.), or omnivorous animals (hogs) attacking the carcasses and carrying the germs broadcast, or the victim may be skinned for its hide, or incisions made into the swellings to "doctor" the patient, and the infection scattered from the cuts made in the swelling. These and other processes naturally assist in disseminating the virus or poison. In a circular on this disease, issued by the United States Department of Agriculture, at Washington, D. C., the following paragraph is italicized in order to give it emphasis: "It is, therefore, of the utmost importance that cattle owners in the infected districts be made to realize that an animal affected with black-leg may be the cause of large subsequent losses from the same disease, perhaps not immediately, but within a period of years to follow, and it can not be recommended too urgently that they make every effort to reduce the danger by taking adequate measures to destroy, as completely as possible, this source of renewed infection."

The best method of disposal is to cremate or burn the dead animal, and in order to ensure complete destruction of it, it should be placed on a couple of logs, or over a trench, and plenty of dry wood heaped around it. A few quarts of coal oil should then be poured on, and fire set to it. It has been claimed that in some parts of the State it is not possible to obtain sufficient wood for the purpose of burning up the bodies of animals that have died from infectious diseases, such, for example, as in certain parts of southwest Louisiana. This section, however, has the advantage of having oil in abundance, and an inexpensive and convenient method is, first, to dig a trench of sufficient size, and placing in the bottom of it a quantity of old sacking to act the part of a "wick," then saturating the sacking by directing a pipe from a barrel filled with oil into the trench. By regulating the flow of oil, a continuous flame may be kept up until the carcass is completely consumed, and at a minimum of cost where such a method can be conveniently undertaken.

It is important that the carcass be entirely destroyed. The place, also, where the body has lain should be subjected either to heat or it should be sprinkled with some powerful disinfectant, such as crude carbolic acid, creolin, zenoleum, lime, or other agent.

Unfortunately, there has as yet been no sure method found of completely eradicating black-leg infection from a pasture.

Preventive or Prophylactic.

It is to the division of prevention which we term prophylaxis, combined, necessarily, with the hygienic, that we have to look for the most gratifying results, which are to be found in preventive

vaccination of susceptible animals, and for which we are indebted to the discovery of Arloing, Cornevin and Thomas, that animals could be protected against black-leg by injecting them with more or less virulent material obtained from the tumours of animals that had died of the disease. The beneficial results of this treatment may be appreciated by the reference made in our preliminary remarks concerning the record of the United States Department of Agriculture. And, further, it may be mentioned that during the fiscal year ending June 30, 1904, the Department distributed over 1,000,000 doses of black-leg vaccine, which were used and reported upon by over 10,000 persons with highly satisfactory results, the mortality reaching only 0.44 per cent.

Black leg vaccine is now a commercial commodity and may be obtained from, or through, any of our large wholesale druggists, directions accompanying the material, or it may also be had, free of cost, by making application to Dr. A. D. Melvin, Chief of Bureau of Animal Industry, United States Department of Agriculture, Washington, D. C., and subscribing to certain stipulated conditions.

In conclusion, it may be stated that, although sheep and goats, as well as cattle, are susceptible to black-leg, they are rarely attacked by it, the disease being most common and destructive in the young bovine species.

NEW METHOD OF KEEPING FRUIT BY THE USE OF FORMALIN.*

A good method of conserving fruit in as nearly as possible its natural state has been largely sought after for a long time, but whatever means have been employed, a perfect result has not been obtained. One reason is the rapidity with which fleshy fruits ferment and rot under the action—as Pasteur has demonstrated—of various organisms, fungi and bacteria. Taking this view, and believing that if these micro-organisms could be destroyed, the period during which the fruit can be kept in perfect condition might be considerably prolonged, the English agricultural authorities have instituted a series of experiments under the direction of the Jodrell Laboratory, Kew. These have been very successful. The English Journal of the Board of Agriculture reviewed them in a recent number (No. 5, August, 1905, "Method of preventing the rapid decay of ripe fruit.") This high authority gives its fullest support to the scheme.

The method which has produced the best results is to immerse the fruit in cold water containing 3 per cent. of trade solution of formalin (40 per cent. of formaldehyde.)

There are two methods employed, according as the fruit has a soft pulp or is firm-fleshed, and whether it is eaten whole or not. With the former class, to which cherries, strawberries, grapes, &c., belong, the fruit is plunged into the solution for ten minutes.

*From the *Journal d'Agriculture Pratique*, in *Agricultural Gazette of N. S. Wales*.

Then it is taken out and steeped for five minutes longer in cold water, and is finally spread out on a metal strainer, or in any other suitable place to allow it to drain and dry. In the second case, when the fruit has a peel or skin which is not eaten, it is subjected to the formalin solution only.

The Kew experiments were carried out on five kinds of fruit—cherries, strawberries, gooseberries, pears, and grapes. These had not been specially selected, but were bought in fruit-shops, and in some cases from street vendors.

The following figures show the number of days during which the fruit so treated remained perfectly sound, after an equal quantity of each fruit, non treated, taken for comparison, had become rotten :—cherries, 7 days ; strawberries, 4 ; gooseberries, 7 ; pears, 10 ; and grapes, 4. These results apply in every case to fruits which were perfectly ripe at the time of treatment ; but if they are subjected to the process before maturity, they keep just as well, while the normal development and flavour undergoes no more alteration than when the fruit is placed in a refrigerator.

It would have been interesting to know the length of time which elapsed between the beginning and end of the experiment, in addition to the number of days during which the treated fruit remained in good condition longer than the other. The practical English people, having proved that this method of conservation is excellent for their indigenous fruits, are hoping to see their markets supplied with several delicious varieties of tropical fruits, which, under former conditions, has been impossible.

A minute examination of ripe fruit from the West Indies intended for the Colonial Produce Exhibition at the Crystal Palace, clearly showed that the decomposition of the mangoes, for instance, during the journey was entirely owing to mould and fermentation caused by bacteria and fungi attacking the outer surface, and not owing to a tendency of the fruit to decay or ripen too quickly. A similar treatment could be profitably employed on a number of tropical fruits which are imported in a good condition (such as bananas), but which often have a dark and disagreeable appearance, caused by an exterior fungus. Pears, apples, oranges, citrons, &c., might all be treated with the same advantage.

In England great importance is attached to this new means of conservation, which is at once very simple, inexpensive and absolutely harmless. Several other preservatives have been tried, but taking all conditions into consideration—ease of application, smallness of cost, and perfect safety during its application—formalin comes easily first. It is easy to understand why the English, who are the greatest importers of fruit from all parts of the world, should be eager to discover a process for preserving as long as possible its quality and appearance ; and it is because of their incontestable and official statements that we think it obligatory on us to bring this new process under the notice of all producers, merchants, and consumers, to whom the preservation of fruit is a daily problem.

But although the use of the preservative is chiefly directed towards the keeping of table fruit, it might be applied quite as advantageously to cider fruit. Many cider apples and pears, in spite of the great resistance of their anatomical structure, as compared with that of the garden varieties, have just as much need of protection. The greatest enemy to cider apples intended to be kept for a long time is rot. It originates in the same way as on eating-apples, and there can be no doubt that the same treatment will produce the same results on similar subjects. We repeat the mode of procedure. Plunge for ten minutes in cold water containing 3 per cent. of formalin. A tub or a cask cut in halves will serve for the purpose of a bath. Take out the fruit, and drain and dry on trays, then place in the storeroom as usual, putting on one side for comparison a lot of the same species and weight which have not been sterilised. The expense of this new method of conservation is quite insignificant, and the profits must be very high if the fruit will keep for some time in a perfect state as is alleged; and if the treatment can be as successfully carried out with the more delicate garden fruits, it will become of immense importance, and affect every species under the sun.

COCO-NUT BUD ROT DISEASE.

Coco-nut trees are often unproductive for various reasons, and they die from diseases due to different causes. But for some years it has been evident that a specific disease has been attacking these trees independently of unsatisfactory or unhealthy conditions.

This is known now as the "bud-rot" disease, from its habit of attacking those portions of the tree which are in the young, immature, or bud stage.

The flowers, while still in a very immature stage of budding, are most liable to attack; but instances also occur where the "cabbage" is first attacked while the tree is in full bearing and shows no sign of disease. As the "cabbage" is the vegetative bud of the whole tree on which its life depends, the disease is fatal when it reaches it.

The appearance of the flowers is well known. There are several long branches, covered with numerous small flowers, which contain pollen only, and a few larger knob-like flowers, which gradually grow and become coco-nuts.

The flowers and branches are at first all enclosed in a sheath or spathe, and in this condition the whole thing is commonly called a "sword." The earliest appearance of the "sword" is as a small protuberance just above the base of the leaf-stalk.

The disease is most liable to attack the tree when the "swords" first bud out. If it attacks these when they first appear, the probability is that they rot away without growing much, and the tree has the appearance of being sterile. Or, it may insinuate itself at a later stage, and grow up amongst the flowers possibly even without affecting the outer sheath. The effect is to cause the nuts

to drop at various stages, either when they first appear after pushing out from the sheath or even when they are nearly full-grown.

The disease extends from the flower bud along the stalk of the adjacent leaf, causing it to turn a yellow colour, and spreads along the stem itself, until finally it reaches the "cabbage" and kills the tree.

Although bacteria have been found in great numbers in diseased spots, it is not yet decided whether they constitute the disease itself, or whether they are only the accompaniment of another disease.

But the practical point is that by means of experiments which have now been carried on for some time, it has been shown that this disease can be checked by two methods. One plan is to fire the tree by putting a light to the fibrous material, the so-called "strainer," at the base of the leaves during dry weather. The fire burns the leaves, and scorches all the tender parts, killing the disease.

Another plan is to spray the head thoroughly with Bordeaux mixture. Several instances can be pointed out where trees have been sprayed, and are now healthy-looking and are holding their nuts. It is advisable, however, to spray diseased trees every six months, for say two years, as a prevention against its breaking out again.

Firing a tree is the easier method, and there is no expense for spray pump and for the Bordeaux mixture: but the leaves have been burnt, and it will take about two years before any fruit is obtained. If the average annual crop is worth 4s., this delay means a loss of 8s. a tree.

The expense of the Bordeaux mixture and its application is estimated to cost about 2d. a tree, without counting the cost of the spray pump.

The spray pump can be worked by two boys, one to climb the tree, and point the nozzle at the end of the hose downwards all round the head, while the other works the pump.

When the cabbage is rotten, or when a tree dies, it should be cut down, and the head with its leaves should be thoroughly burnt, otherwise it remains a source of infection to other trees, not only in the neighbourhood, but probably for long distances round.

BORDEAUX MIXTURE.

Bordeaux mixture is best made according to the following formula:—

Blue Stone (Copper Sulphate)	6 pounds
Unslacked Lime	4 pounds
Water	50 gallons

It requires careful mixing, or the ingredients will not combine properly. Put 25 gallons of water into a barrel. Tie up 6 pounds of copper sulphate in a piece of coarse sack, and hang this by a stick laid across the top of the barrel so as to be just beneath the surface of the water until it has slowly dissolved.

In another barrel slake 4 pounds of lime very slowly and carefully, at first only adding about a quart of water at a time, until a perfectly smooth paste, free from grit is obtained. Add water to make the whole 25 gallons, and wait until cool. Now pour both together into a cask holding 50 gallons. The milk of lime should be thoroughly stirred before pouring, and finally the mixture should be well stirred for four or five minutes with a wooden paddle.

If not perfect, the mixture is liable to injure the foliage, and in order to test this, put the blade of a penknife into the mixture and leave it for one or two minutes. If there is any deposit of copper on the blade, showing a brownish colour, it is not safe to use it, and more lime must be added until the knife is not discoloured.

HOW TO KEEP MOSQUITOES FROM THE HOUSE.

The following rules for preventing the mosquito plague is adapted from the United States *Bulletin*:—

1. Mosquitoes breed *only* in water; usually standing water in artificial places, not running streams.
2. Mosquitoes occur in the vicinity in which they breed. Invasions from long distances are exceptional.
3. The young mosquito or "wiggler" lives in water at least 10 or 12 days.
4. Although the wigglers live in water, they *must* come frequently to the surface to breathe.
5. Kerosene oil on the surface of the water prevents the wiggler from breathing.
6. Destroy the breeding places and you will destroy the mosquitoes.
7. Empty the water from all tubs, buckets, cans, flower pots, vases, etc., once a week.
8. Fill in or drain all pools, ditches and various excavations, such as post holes left unfilled, etc.
9. Change regularly all water needed in chicken-runs, yards, etc.
10. Treat with kerosene oil all standing water which cannot be screened or drained (1 oz of oil (two tablespoonsful) will cover 15 square feet of surface). The oil does not affect the water for use if the water is drawn from below.
11. Put wire netting over cisterns, wells and tanks of water in every-day use.
12. Places in which it is undesirable to place oil, such as watering troughs for stock, ponds, etc., can be kept free of the wigglers by putting in gold fish. The nymphs of dragon flies and tadpoles of frogs also feed on the wigglers.
13. See that the plumbing about the place is in perfect order. Prevent leakage of pipes or clogging of eaves and gutters.
14. Inspect all cesspools and see that the covers are *absolutely* tight.

15. Clean away all weeds, grass and bushes about ditches, ponds, and other possible breeding places, since these afford a hiding place for the adult mosquitoes.

16. Clean up vacant lots and back yards of all cans, tins, bottles and rubbish.

17. First do away with or treat all places where mosquitoes are known to breed, and then begin to work on places where they might breed. Remember that large quantities breed in wild pines, hollows in trees and in banana leaves. Keep the vegetation low near the house.

18. As a citizen of your community you should feel a personal responsibility for the destruction of the mosquitoes in your district, and seek to co-operate with your neighbours in the work of doing away with breeding places. Inspect and treat with kerosene-oil, gutters, culverts, ditches, man-holes, catch-basins, etc., along the roadside. Man-hole covers should be screened.

19. Where oil is applied to standing water it must be distributed evenly over the surface. Use a hand syringe, or, if the area is great, a knapsack sprayer.

20. Houses should be cleared of all winged mosquitoes by the burning of insect powder. The mosquitoes will fall to the floor, and should be collected and burned.

21. Relief in any community or district depends entirely upon the co-operation of the members of the community.

EXPORTING SEED OF PARA RUBBER.

By H. N. RIDLEY, M.A., F.L.S., Director of the Botanic Gardens, Straits Settlements.*

As is well-known, the seed of the Para Rubber tree deteriorates very rapidly after it is ripe and soon loses its germinating power, it is not always easy to send seed long distances without a very large percentage of losses, at the same time the demand for seed in distant parts of the world is very considerable, and a good many experiments have been tried in the Botanic Gardens in various methods of packing to ensure their arrival in good condition. The reports received from the recipients of these seeds have been remarkably good, as the following records will show:— Of 7,500 seeds sent to Jamaica on August, 31st, were received on 25th October, and Mr. Fawcett writes:— “The 7,500 seeds sent in biscuit-tins are all germinating very well and we shall scarcely lose 500 of them.” †

One hundred were sent in a similar manner to Calabar on the date July, 6th and arrived on September, 20th. The Acting Secretary writes in reply:— “The seeds were soaked in water for

* Agricultural Bulletin of the Straits and Federated Malay States. Vol. V., No. 1., Jan., 1906.

† Over 87 per cent. of the seeds sown germinated, but some of the seedlings were constitutionally weak and died, so that only 5,071 plants survived, or about 68 per cent. of the seeds sown. A Warlian case arrived with 2,500 seeds, but only 18 plants were raised out of the whole number. Director, *Bulletin of the Agricultural Department, Jamaica.*

two days on their arrival and were then planted with the upper portion left above the soil. Ninety out of the hundred seeds have already germinated (Nov. 7th.) and appear healthy young plants.

To the Royal Gardens, Kew, 135 seeds were sent on July, 6th, packed in charcoal, in a biscuit-tin. They arrived in a month, and 123 germinated. On February, 12th, 1903, 20 seeds were sent to Mr. J. C. Harvey, Vera Cruz, Mexico, who writes, May 19th, 1903, that "out of the 20 seeds of *Hevea brasiliensis* I have 14 young plants. They came up in a few days, and possibly a few more may germinate, though three seeds were decayed." These were all sent in biscuit tins. Those sent to Jamaica were packed in slightly damped incinerator earth, but it was necessary to replace the upper part of the packing with sawdust to reduce the weight, as incinerator earth is very heavy and the box, a two-pound tin, which contained 150 seeds would have been over parcel post weight.

The other tins were filled with damp charcoal finely powdered. In packing, a certain amount of care is required in damping the charcoal so as to get it equally moistened all through, and not either over wet or over dry. This is best done by damping the charcoal thoroughly and then drying it in the sun constantly stirring and turning it over, till it is uniformly slightly damped. The incinerator earth which had been exposed to the elements was damp when received and only wanted partial drying to fit it for packing. Its weight is against its use, but both it and the powdered charcoal have the great advantage of preventing any attacks of mould or bacteria likely to cause decomposition. Other experiments with powdered coir fibre, and coir dust, sawdust and variously prepared soils have been tried, but the results do not seem to have ever been as successful. One experiment was made in putting the seeds in water for a month, and though that might be effective for a fortnight or so, they had all perished by the end of the month.

ACREAGE IN RUBBER.

Sir Frank Swettenham writes with regard to an article which appeared in *The Standard* of August 8 last :—The acreage planted with Para rubber in the Straits and Malay States on January 1 last was 30,000 acres, and in Ceylon 25,000 acres. Since that date the total area planted in the Malay States does not amount to 10,000 acres.

The United Planters' Association in the Malay States have taken pains to go into this question, and in their latest report they give the following figures: Total acreage planted with rubber in the Straits and Malay States 30,000 acres; Sumatra, 5,000 acres; Java, 5,000 acres; Ceylon, 25,000 acres; India and Burma, 5,000 acres; total 70,000 acres. Allowing that all this is good, and will give the

good yield of 200 lb. per acre, the amount produced would be 14,000,000 lb. This acreage cannot, however, be all in full bearing till the end of 1911, and they calculate that no more than this acreage can be in bearing till 1911, because it is not yet planted.

The exports from Para for the last three years have remained practically constant at about 30,000 tons, and the world's production was, in 1898, as nearly as it can be ascertained, about 60,000 tons, or 134,000,000 lb. The present production is estimated at 70,000 tons, or 156,000,000 lb., of which Asia can only produce 14,000,000 up to the year 1911. What she can produce after that date will depend upon the area planted and successfully cultivated between now and 1911.—*Standard*, Dec. 6.

PLANTING OF HARD AND SOFT WOODED PLANTS.

By W. J. THOMPSON, F.R.H.S., Travelling Instructor.

In travelling about the country I am surprised to find how few people seem to remember that hard and soft wooded plants need totally different treatment to enable them to develop properly. People go on planting young cocoa and orange plants just as they plant banana suckers, with the result that most hard wooded trees are not giving more than half the crop they should.

Two typical types of soft wooded plants are banana and cane; two typical types of hard wooded plants are cocoa and oranges.

The soft wooded plants, which consist chiefly of water, need to have their bases covered with a considerable amount of damp soil if they are to continue thriving. On the other hand, hard wooded plants, consisting chiefly of wood, need just the reverse condition to get them to grow as they should, viz., the base of the plant must be kept level with the surrounding ground, so that it can get enough sun, light and air.

It is most important that planters of all degrees should realize the different requirements of the two different classes of plants. In almost all cases where I am asked to inspect sickly plants and trees of cocoa, &c., I find that most of the cases where the young plants are not growing, or old plants are not fruiting, or dying off, can be traced to the plants having been planted too deeply. I have come across scores of cases where cocoa plants have had their bases from 3 ins. to 12 ins. below the surface of the ground; and although when the bases of this class of plants are planted too deeply, nature comes to the tree's assistance by young roots being formed just below the surface of the ground, these surface roots do not compensate for the loss of the natural upper roots of the tree which have died off, or are in a half dead condition through not getting enough light and air. With deep planting, if the plant does not die after a few years, it does not give the amount of fruit that a properly planted tree will do. Too much time and care cannot be given to the planting of these hard wooded plants to see that they are planted properly.

In July last, in St. Catherine, I inspected about 20 cocoa trees—old trees, about 12 feet high; only three of the trees had their bases showing level with the surrounding ground; and although this is the season when we do not expect to see many cocoa pods on the trees, one tree had 60 pods, the other two had from 40 to 50 pods each, while the rest of the 17 trees had not 60 pods between them.

Within the last few months I have been paying a good deal of attention to the question of shade for cocoa, but I have found that in all cases, if the cocoa tree has been properly planted that the trees gave good returns whether they were shaded or not; but where the tree had been planted too deeply, whether shaded or not, the condition of the tree and the yield were not satisfactory.

In planting out hard wooded plants, intelligent workmen should be employed, and it should be strongly impressed upon the workmen which the base of the plant is and that when the soil has finally settled down, the base of the plant should be level with the surrounding ground.

I observe that when the workmen are going to plant out seed or young plants of cocoa after the soil has been cultivated, that they are careful to make a kind of shallow basin, and when it comes to planting the seeds or plants are placed from two to six inches deep. This way of planting is wrong, and is responsible for such a large percentage of plants not giving satisfactory results.

The way to prevent the plant from settling down too low after planting is to leave the cultivated soil six inches higher than the surrounding ground where the plant or seeds are to be planted.

As a rule if seeds are being planted, there is not so much risk in putting them too deeply; but even with seeds, after the soil has been made somewhat fine, care should be taken to see that they are not planted more than an inch under the ground. I find that it is when seedlings are planted out, that the greatest loss takes place.

When transplanting the young cocoa plant from the bamboo pots or beds, care should be taken to take off a little of the surface soil till the base of the young plant is reached, and after this is found, make a small hole in the raised soil and put the young plant in the soil; just deep enough for the base of the plant to be on a level with the raised soil. It is better to place the young plant an inch too high than half an inch too low.

This may seem a small matter to some people, but I have looked into the subject minutely, and to say that one-fourth of the young plants planted out each year die, and that from the fruiting trees we are not getting as much cocoa as we should by 40 per cent. through the trees being planted too deeply, is making a very low estimate of losses.

This deep planting of such plants as cocoa and oranges is a most serious matter for the planter.

If all small, stunted cocoa trees, such as make a little growth in the dry weather and die back in a wet season are examined, it will

be found, if the soil is taken away from the stem, that the base of the plant is several inches below the surface of the ground. In such cases I would strongly recommend that the plants be dug out and thrown away; they cannot be transplanted and would never do any good if left to grow. The same advice applies to citrus plants.

Unless care is taken to get these young plants properly planted, good soil, manure, labour, etc. are all wasted, and those who will look into the matter will find that all the cocoa trees that are giving good returns, have their bases level with the surface, and those that are not giving good returns or are in a half dead state will be found with their bases several inches below the surface of the ground.

The reason why these hard-wooded trees do not thrive when planted too deeply in the soil, is because the base of the tree is kept too damp and cold, the lower roots of the tree die off and the few surface roots cannot support the tree. That Jamaica has the climate and soil conditions suited for producing very fine cocoa can be judged from the fact that we have cocoa trees in the Island measuring 60 inches round the trunk two feet from the ground, the trees being in a healthy condition and giving large crops of pods each season. These trees are exposed to all the sun that passes, and the bases stand level with the surrounding ground.

TURMERIC.

Turmeric* is extensively cultivated all over India for its root-stocks, and is now found more or less wild in Jamaica, especially in the western districts. It is the well-known *haldi* universally used as a condiment with curry-stuffs and also as a dye, and is one of the most profitable of crops in India. The dye-yielding rhizome is harder and much richer in colour than the edible.

CULTIVATION.

The preparation of the soil necessary for turmeric is similar to that for ginger, but lands intended for turmeric need not be worked so fine. The usual planting time in India is about the 20th of May. The plants spring up in about a fortnight. One or two weedings are necessary, and care must be taken that the fields are not inundated. After about a year and nine months turmeric is lifted. When it is raised the first year, as is the practice in some places, the produce is less in quantity and inferior in quality.

PREPARATION OF THE ROOT-STOCK.

Various systems are apparently practised for preparing the rhizome for the market. Of Bengal it has been said: "After the rhizomes have been dug out of the ground, they are freed from the fibrous roots and cleaned. They are then put in earthen pots, the mouths of which are to be carefully closed with earthen covers

* *Curcuma longa*, Linn. Information from Dictionary of Economic Products of India; and Bentley and Trimen's Medicinal Plants.

and cow-dung. These pots are then very carefully heated. The turmeric is made to boil in its own juice, a process which gets rid of the raw smell of turmeric. It is then dried in the sun, the drying taking nearly a week, during which the turmeric requires to be covered in the night to protect it from dew. In some places turmeric is boiled in water in which a little cow-dung is mixed."

Of the north-west provinces, Sir E. C. Buck says:—"When dug up the roots are boiled and dried in the sun; in this form they are the turmeric sold in the Indian bazaars. When the dye is to be used the roots are again boiled and powdered while wet. A decoction is then made of this paste in water, in which the cloth is well steeped, being subsequently dried in the shade. In the Kumaon district the roots are soaked in lime-juice and borax before being powdered instead of being boiled." Of the Punjab, Mr. Baden Powell says the tubers are taken up in November and dried partly by the action of fire and partly by exposure to the sun. Of Coimbatore it is reported:—"The roots are carefully sized and separately boiled in a mixture of cow-dung and water, dried and sent to market."

CHARACTER AND VALUE IN COMMERCE.

There are two sorts of turmeric seen in commerce—the *round* and the *long*, but both are the produce of the same plant; the central rhizomes or root-stocks constituting the round, and the lateral or secondary rhizomes (*tubers*) the long; the latter are the more abundant. The *former* are roundish or somewhat ovate, usually from about one inch and a half to two inches in length, and one inch in diameter, pointed at one end, and marked externally with annular ridges. They are often found cut into halves. The *latter* are somewhat cylindrical, more or less curved, pointed at the two extremities, frequently having on their sides one or more short knobs or shoots, about the thickness of the little finger, two or three inches long, and marked externally with annular ridges. Both sorts are yellowish externally, very hard and firm, and when broken having a waxy-resinous appearance, and an orange-yellow or reddish-brown colour. The powder is orange yellow. Turmeric has an aromatic taste and odour somewhat resembling ginger, but peculiar. When chewed it tinges the saliva yellow.

The following is a quotation from the Market Report published in the *Chemist and Druggist* for 23rd September last:—

"Good Madras finger has been sold at from 17s. to 17s. 6d. per cwt., being steady, and Cochin split bulbs are quoted at from 7s. 9d. to 8s. per cwt., according to quantity."

DYE.

A special form of turmeric is grown for this purpose, namely, a harder root, much richer in the dye principle than in the ordinary condiment form.

The colour is only deposited in the rhizome with age, and hence, in all probability, the above mentioned forms have been obtained by a process of careful selection of stock

observed to produce the colour freely. It is of importance, however, that the European merchant, in purchasing for dye purposes, should see that he gets the hard dye-yielding form and not the softer aromatic condition, which is used as a condiment.

The rhizome is still largely used by the European dyers, though the fluctuation in the trade may be viewed as due to the development of the aniline industry. Professor Hummel says of it:— "Notwithstanding the very fugitive character of the colour it yields, it is still much used, especially by the wool and silk dyers for the production of compound shades—olives, browns, &c. It gives a bright yellow colour without the aid of a mordant, but when mordants are used with it, it yields other colours not unlike those obtainable from the yellow dye-woods. The colouring matter of turmeric is one of the few for which cotton has naturally a strong attraction."

Although turmeric is rich in colouring matter, its want of permanence is a hindrance to its application as a dye-material.

Some time back the use of turmeric was almost exclusively limited to printing and dyeing silks. It is now employed to a vast extent in stuff-dyeing, forming an important constituent in certain compound colours, especially the so-called "sour-browns."

FOOD.

Turmeric forms one of the indispensable ingredients in curries, and is used for colouring confections, etc.

MEDICINE.

Turmeric contains about one per cent. of a *volatile oil*, to which its odour is due, some *starch*, a yellow colouring matter called *curcumin*, and other unimportant substances. The alkalies change the colour of curcumin to reddish brown; and boracic acid produces an orange tint; hence paper tinged with tincture of turmeric is largely employed as a test of the presence of alkalies.

Turmeric is not now used as a remedial agent, but is introduced into the pharmacopœias as a test of the presence of alkalies. For this purpose the British Pharmacopœia directs unsized white paper to be steeped in tincture of turmeric and dried by exposure to the air. It is also occasionally employed in pharmacy in colouring ointments and other preparations.

Used as a stimulant in native medicine in India: externally applied in pains and bruises, and internally administered in disorders of the blood. Its use as an external applicant in bruises, &c., is perhaps its most frequent medicinal application. The fresh juice is said to be an anthelmintic. A decoction of the rhizome is applied to relieve catarrh and purulent ophthalmia.

JAMAICAN GINGER. *

According to Gillespie Bros. & Co's. New York Market Report for March 16, ginger continues to be the principal factor in the spice market. The continued upward movement of the European market, and the situation in Jamaica as reported by cable, make it almost impossible to attempt to predict what price Jamaica root will reach, or even to name quotations. London has advanced 2s. per cwt. within the past fortnight, and buyers here have advanced their offers 1ct. per lb., but were unable to obtain any ginger even at the advance. With the situation as it is to-day, it is possible to obtain almost any price within reason for the small parcels that are coming to hand. On to-day's market we quote from 8c. to 8½c. per lb. for dark scraggy root, and from 10c. to 11½c. per lb. for the small white to bright bold ginger.

STUDY OF CASTILLOA RUBBER. †

On La Zacualpa plantation in Chiapas, Southern Mexico, there has been established a botanical station, the principal object of which is to study the Central American rubber tree (*Castilloa elastica*), its culture, and the preparation of commercial rubber from this tree. On La Zacualpa and affiliated plantations there are now planted over three million trees, and at least two additional million trees will be planted. In connection with the botanical station, there is a laboratory for chemical and physiological investigation of the latex. A complete meteorological observatory will soon be ready on La Zacualpa, and two meteorological substations, will be established in the mountains close by, where simultaneous observations will be made at the elevations of 2,000 and 3,500 feet. The main station is situated at 250 feet above the sea, twelve miles from the Pacific Ocean, on the lowlands at the foot of Sierra Madre, about sixty miles from the border of Guatemala. The director of the station is Dr. Pehr Olsson-Seffer from Stanford University.

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES

The usual Monthly Meeting of the Board of Agriculture was held at Headquarter House on Wednesday, 13th June. Present:—The Director of Public Gardens, the Island Chemist, His Grace the Archbishop, the Superintending Inspector of Schools, Messrs. C. A. T. Fursdon, C. E. DeMercado, J. W. Middleton, and the Secretary.

Acting Chairman—The Secretary read letter from the Colonial Secretary's Office intimating that the Governor had appointed Mr.

* Extract from the *Agricultural News*, April 14th, 1906.

† From *Science*, March 16, 1906, p. 439.

T. L. Roxburgh, Acting Colonial Secretary, to act as a Member of the Board, and as Chairman in the room of Mr. Bourne, Colonial Secretary, who had been granted leave of absence from the 9th inst. Mr Roxburgh then took the chair.

The Secretary read the minutes of the previous meeting which were confirmed.

Commercial Agent in London—The Archbishop said as a matter arising out of the minutes he would like to ask the opinion of the Board whether they should drop the matter of a Commercial Agent in London owing to the adverse reply of the Governor, or whether they should go on with it, and if so what should be done. He quoted from a lecture delivered at the Colonial Institute, what South African Colonies were doing to find new markets for their products. He believed that what His Excellency had quoted as Mr. Chamberlain's decision against Crown Colonies having Agents did not refer to Commercial Agents, but referred first to a political agent and second to a man doing business on his own account, but what we wanted was purely a Commercial Agent whose attention would be wholly devoted to the commercial interests of the Colony. There was need in this Colony for Government support, not only for the stimulus it would give the matter but for the status it would give the Colony.

Mr. Middleton supported the idea of going on with the matter.

Mr. DeMercado said he supported the idea, but in this matter almost everything would depend on the personality of the agent.

The Board unanimously agreed that the Committee already appointed to deal with the matter should take it up again, viz: the Archbishop, Mr. Middleton and Mr. Murray.

Elder Dempster & Co. £500 & Instructors—The Secretary read letter from the Colonial Secretary's Office transmitting copy of a despatch from the Secretary of State for the Colonies stating that this Government would receive £500 a year to be paid by Messrs. Elder, Dempster & Co. in lieu of their Instructors, provided the money was devoted by the Government to the same purpose.

The Secretary submitted letter from the Colonial Secretary's Office stating that the Governor had perused with interest the report on the successful working of the High Ether Instalation at Hampden Estate.

Labourers on Estates—The Secretary read letter from the Secretary of the Northside Sugar Planters' Association in reply to his letter, stating that with reference to the sale of beef, pork and bread by overseers on sugar estates the practice did not prevail on the northside estates as it was the general rule on them that particular care be taken to pay the labourers in full, and no compulsion was put on them to buy anything, and that it appeared the present law was sufficient to meet such cases.

The Secretary stated that he had no reply from the Secretary of the Westmoreland Sugar Planters' Association.

Mr. Cradwick & St. Mary Show—A letter from the St. Mary Show Committee was submitted stating that as rains prevented Mr. Cradwick from carrying out his programme for week ending June 9th

they would ask the further concession of allowing him to be in the parish for week ending 23rd June, besides week ending 30th as at present arranged.

The Board agreed that if this could be carried out, without disarranging Mr. Cradwick's itinerary materially, it might be done.

The following reports from the Director of Public Gardens were submitted :—

1. Hope Experiment Station.
2. Instructors.

The following report from the Chemist was submitted :—

Candidates selected by the Advisory Committee to attend Distillers' Course.

These were approved with the addition of Mr. F. L. Clark, Richmond Estate, who was one of the first applicants but whose name had been omitted in error from the list, the extra £10 grant to be met from savings in the Sugar Experiment Station vote.

The following papers which had been circulated but had not yet been before the Board were submitted :—

Resignation of Mr. Rudolf—Letter from C. S. O. for the information of the Board *re* resignation of Mr. Rudolf.

The Secretary stated that the Report of the Board of Agriculture and of the Chemist for the year ending 31st March, 1906, had not been returned from circulation yet.

The following papers which had been circulated were now submitted for final consideration :—

1. Work of Agricultural Students for Easter Term.
2. Report Hope Experiment Station.
3. Reports by Mr. Cradwick and Mr. Briscoe.

The meeting then adjourned till Wednesday 11th July, at 2 p. m.

[Issued 11th July, 1906.]

Printed at the Govt. Printing Office, Kingston, Jam.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

AUGUST, 1906.

Part 8.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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P R I C E—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :

HOPE GARDENS.

1906.

JAMAICA.

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Part 8.

PARA RUBBER.

REVIEW BY W. G. FREEMAN, in *Botanisches Centralblatt*.

WRIGHT, HERBERT, *Hevea brasiliensis* or Para Rubber. Its botany, cultivation, chemistry and diseases. (A.M. and J. Ferguson, Colombo. 106 and VII. pp. With 28 plates. 1905.)

The first plants of Para Rubber were received at Heneratgoda, Ceylon, from Kew in 1875, having been raised from seed collected by Mr. Wickham in the Ciringals of the Rio Tapajos. Propagation, first by cutting and later by seed, was carried on and now there are some 40,000 acres of this plant in Ceylon whilst large quantities of seed have been distributed to many parts of the world. Although at first it was thought that *Hevea* should be planted in places but little above the sea-level it has been shown that it will grow up to 2,000 feet and even higher in some districts of the island. The laticiferous system is briefly described and the functions of the latex discussed.

At Para itself there is a rain-fall of 80 to 120 inches and a mean temperature of 75° to 81° F., and although it is pointed out that these conditions are not absolutely necessary for the cultivation of Para rubber, many parts of the tropics possess them and in these areas the industry promises to become as important as in Ceylon, the Malay Peninsula and India.

The cultivation of the plant is dealt with in detail, and illustrated by views of trees grown in various conditions, e.g., drained swampy lands, rocky hillsides, &c. With wide planting coffee and cacao can be grown with success amongst *Hevea*, whilst as "catch crops" for the first few years, Groundnuts (*Arachis hypogaea*), Cassava (*Manihot utilissima*) and lemon grass (*Andropogon*) have given good results.

A chapter is devoted to soils and manuring. Three chapters treat fully of the important question of tapping. The harm done by bad tapping by which the wood is injured is illustrated. Various patterns of tapping instruments are described and illustrations given of several; Gollidge's knife, and Bowman's and Northway's

knives are spoken of as having given good results. The use of scrapers of any kind is deprecated on the ground that in practice they tend to clog the freshly opened latex tubes. There are four principal methods in vogue of tapping trees, (a) single oblique lines, (b) V-shaped incisions, (c) single oblique cuts joined by a vertical channel; known as "half-herring-bone" when all the cuts are on one side of the vertical line, and "full herring-bone" when on both sides, (d) spiral curves. The advantages and disadvantages of the various methods are discussed. Owing to the favourable results obtained, the last method has recently gained favour in Ceylon and elsewhere. The main stem is practically the only part of the tree to be tapped and the greatest yields are obtained from the lower portion, up to six feet from the ground level. Some doubt appears to exist as to the quality of the latex obtained from higher levels and contrary results are reported from different localities. It is most important in practice to take advantage of what is now generally known as the "wound response" which is usually obvious within 24 to 48 hours after the first tapping. In an experiment quoted the yield of latex obtained from the same number of incisions, over approximately the same area on one tree, increased from 61 cc. on the first tapping, to 449 cc. on the fourteenth tapping, about two and a half months later. Tapping every day either for the whole of the rainy season or during alternate months has given excellent results on a large scale on several Ceylon estates. Trees to tap should, in Ceylon, be not less than 20 inches in circumference 3 feet from the ground and at least 4 to 6 years old. Such trees may be expected to yield 1 to 3 lb. of dry rubber per tree up to their tenth year and much more in subsequent years. Exceptionally well developed trees have given as much as 12 to 25 lb. a year without shewing any ill effects or signs of exhaustion.

The general physical and chemical properties of latex are briefly touched upon and analyses quoted of that derived from the plant under discussion. The production of rubber from latex is fully discussed, and the various methods and machines employed are described, as also the purification, vulcanisation and uses of rubber.

The commercial varieties of Para rubber are enumerated, their preparation described, and comparative chemical analyses given of various kinds of plantation rubber from Ceylon and the Straits Settlements.

The recently established value of the seeds of *Hevea brasiliensis* as a source of oil is pointed out, as also the possible use of the residual cake as a feeding stuff. The methods of transporting the seeds in a living condition are discussed; the best results appear to have been obtained by packing them in powdered charcoal and sawdust in sealed tins. The use of Wardian cases is however still the most satisfactory method. A chapter is devoted to the diseases of the plant, and an appendix contains estimates supplied by planters of the cost of planting rubber in Ceylon.

LAGOS SILK RUBBER.

The following notes on the Silk Rubber of Lagos are taken from an article by M. E. De Wildman published in the *Revue des Cultures Coloniales*, and translated in the *Agricultural Bulletin of the Straits and Federated Malay States*, Vol. II., 4 April, 1903, p. 136.

The plant is specially cultivated at present in Western Africa in the Congo Free State and on the Cameroons, and is, according to the author, the best rubber plant to cultivate in these regions, and this is so for several reasons, it is easy to procure seed as the plant is wild in this part of the world and one can be sure that it will grow well as the soil and climate are naturally suitable for it. The German Colonial reports show that Funtumias of the same age as Castilloas are relatively more advanced, the Funtumias give seed at the end of two years and a half, while the Castilloa fruits only at the end of from three and a half to four years. If one compares the latex of the two, at the same age, one can see that it is much more concentrated, less watery and sticky in Funtumia than in Castilloa, and that it can give a return more quickly. Castilloa, according to M. Koschny can only be milked when eight years old. As to the rubber itself, that of Funtumia is as good or better than that of Castilloa. The results of comparative researches with Funtumia and Castilloa in West Africa are in favour of the former.

The seed, sown freshly gathered, sprouts after about 15 days and grows very rapidly, and the plants are readily transported. If at first the stem bifurcates forming a bush, either a shoot is developed above the bifurcation, or one branch grows more strongly than the other eventually forming the trunk. Among the advantages of Funtumia one may mention that the latex flows more easily and quickly than that of Castilloa or Ficus and the seeds keep good for 6 weeks and even germinate after three months. Nor is the Funtumia particular as to soil, it grows equally well in lateritic or basaltic soils, in soils rich in humus or stony. As to altitude, it has been noticed that it does best below 800 metres. It is reckoned that in April, 1902, there were in the Cameroons 200,000 plants, exclusive of wild ones. The plan of planting Funtumias in a lightly cleared forest as has been frequently done is not recommended. They do not grow so well in shade as in full sun when they are too weak to resist the drying action of sun and wind, they naturally should be protected, but when they are strong enough to resist this they develop better when fully exposed to the sun, provided that the ground is damp enough. From the experiments made in plantations in German territory the Funtumias should be planted 6 metres apart.

The tree is one of the best shade trees for cocoa, but as it is pyramidal in form it will be necessary to plant close which is not a disadvantage. It is also recommended to use the tree to grow vanilla on as in ten years when the vanilla is dying out the rubber trees will be ready for tapping. The latex is coagulated by boil-

ing, but this must be done gently and can only be done after the addition of water. It is advisable also to stir the mass while boiling slowly to prevent the formation of a porous mass in which portions of uncoagulated latex may be included. After coagulation the rubber must be carefully washed.

NOTES ON THE "CASTILLOA" RUBBER TREE—II.*

By "A. FORESTER," Bluefields, Nicaragua, February 1906.

What latex is to the tree is still a debatable question. I think that it is simply a protection against insects and evaporation whenever the tree is wounded. Anything striking against the outside bark, if it hits hard enough, will bruise the inner bark so that the latex flows. An examination of this place a day or two later will show a thin coat of rubber entirely covering the bruise. Tropical trees do not have the thick outer corky bark of northern trees. Anything striking them is liable to bruise the inner bark. This sheet of rubber forming would protect the bruise from too much evaporation and from insect attacks. Leaf cutter ants do not attack the leaves of *Castilloa* and cattle do not seem to be fond of them, but I believe that this is not due to the latex but due to the thick coat of epidermal hairs, a thing which few tropical trees seem to possess. It is noticeable that ants do attack *Hevea* which has not a hairy leaf.

The study of the structure of the latex shows that it has two distinct parts—watery solutions and a solid substance in minute globules. The watery solutions contain no rubber. They do contain the substance which forms the residue of the black water, though this substance is apparently changed by oxidation before becoming black water. They may also contain sugars and proteids, as these substances are evidently there, but it is more than likely that these substances are not in the original latex but come from some other bark tissue than the "milk tubes."

The solid globules are principally rubber but they are said to be surrounded by protoplasm and contain a nucleus. In that case they would be cellular in their nature. As the tube in which they are enclosed is already a cell, it would be a case of a cell within a cell, which is rather rare in botany. At the same time they are very small for cells. I have not been able to examine the structure of the single globule, as my microscope is not powerful enough, but I think that they are not cellular but are originally chromatophores in which rubber has been stored. In that case they would be formed in a similar manner to starch grains in a potato and other roots. I believe that this is the case and that the substance in solution, later forming the black water, bears the same relation to rubber that sugar does to starch; that is, they are similar forms of

*From the India Rubber World. Continued from *Bulletin* for May.

carbohydrates which can be readily changed from one to the other by the action of an enzyme, and when they are to be transported from the soluble substance and, when stored, the solid substance. This state of things seems to be the same in all latex bearing plants, as all that I have examined contain this watery solution and the solid globules, though the watery solution does not always turn black and the solid globule is not always rubber, but some times a sticky substance.

Dr. Weber asserted that the black water was due to oxidation and he believed that rubber itself was an oxidation product. Latex which is gathered and quickly corked up away from the air, forms no black water. Black water gets blacker for longer standing in the air until about five days after gathering. Fresh black water can immediately be turned to its deepest black by ammonia, but ammonia will not affect black water five days old. I believe that the action of ammonia is the same as the oxidation in the air. Contact with metals will make black water blacker. Sugar slowly takes the black colour away and latex which has not been allowed to oxidize has water which resembles that formed by sugar. I believe that sugar reduces it to its former state. I do not see any reason to think that rubber itself is an oxidation product. It is possible, but if so it can be further oxidized by the use of nitric acid.

The problem of tapping has a great deal to do with how the latex is situated in the tree. According to most writers it is carried in "milk tubes" which are in the bark and are arranged vertically. I have not found any writers who seem to know what these milk tubes are like—whether the latex runs up or down in them, or what connection these milk tubes have with other parts of the plant. When I first got here I tried a number of experiments, trying to increase the flow of latex by multiple tapping, gradual tapping, and so on, but all these failed. The reason for these failures I now attribute to the shape and position of the latex carrying tissue in the plant. This tissue, I believe, is the part known as the bast fibre. Bast fibres are long fibrous threads, tapering to a point on each end, having a thick, tough wall and in most plants dead, and containing nothing in the cell cavity.

In the *Castilloa*, the microscope shows that the bast fibres have a larger cell cavity than in most plants. It is reasonable to suppose that they are in such cases alive and contain something. I have seen no other tissues in the *Castilloa* bark which contain the latex and therefore believe that these bast fibres do. The bast fibres are arranged vertically and are probably only a few inches long. Those I have examined in temporary branches were from 1 to 3 inches, but they are probably longer in older parts of the trees. The fibres are probably connected to each other by pits but I have not been able to locate these connections. These pits would not allow solid substances to pass from one fibre to another, but would allow water and watery solutions.

The rubber being in solid globules is probably formed right in the fibre itself. The fibres are not arranged in regular joints, as

was the opinion of Carlos Berger, but are irregularly arranged, the tapering end of one fibre fitting between other fibres. When the fibres are cut across by a tapping instrument their content is ejected by bark pressure. Such a cut will take latex from the tree only for a distance of 3 or 4 inches each side of the cut. This shows that the latex does not run up and down the tree or from one fibre to another. If no more cuts are made, the latex will not be renewed in the cut fibre for some time (not entirely for about 3 months), although the surrounding fibres are full of latex. This shows that all the latex from the tree cannot be taken from one cut.

The distance apart that cuts should be made around the tree is a disputed subject, and depends not only on the length of the bast fibres and the way to get the most yield, but also on the amount of injury done to the tree. If yield were the only consideration, one foot would be a good distance and would give, I believe, the maximum yield. Eighteen inches will give close to the maximum, giving enough more latex from each cut to make up for the fewer cuts. Both of these distances, however, are objectionable, because a large number of cuts appears to detract from the healing powers of the tree, and the more cuts, the greater the chances of the tree being injured by the borer. Another point in the number of cuts is the time and labour in making the cuts. Six cuts to a tree is twice as much labour as 3 cuts, but if it does not give twice as much rubber it would be cheaper to make 3 cuts and tap a larger number of trees in a day.

The tapping is now being done with only 3 cuts per tree; one at the base, one at 5 feet from the ground, and one halfway between these. Tapping above 5 feet necessitates the use of ladders, and this would mean more labour and would hardly pay with young trees. I believe the making of 4 cuts, the top one 6 feet from the ground, would give enough more than 3 cuts to pay, if it is not too great an injury to the tree.

The first signs of healing appear between one and two weeks after the cut is made, and in two months at the latest the cut is well healed. In time the old cut will fill with new material which contains latex and can be tapped again if necessary. Another strong reason why the tool should cut to the cambium is that not only does the shallow cut miss cutting some "milk tubes" but it misses a very large proportion of the tubes. The milk tubes are formed by the cambium in layers. The ones closest to the outside bark were formed when the tree was very young and small in circumference. At that time the patches of tubes were close together. Since then the same number of tubes had to spread out and cover a circumference of, say 18 or 20 inches. The spaces between these tubes are filled by medullary rays which run from the pith outward through the wood to the outside bark. Therefore the outermost layers contain very few milk tubes, the next more, and so on, until the innermost layer has the most since it was formed when the circumference was greatest. This is borne out in facts.

A much larger yield is actually obtained by cutting into the cambium than by cutting almost into it.

Another thing to be avoided is cutting too deep. When a cut goes through the cambium into the wood the healing commences at the edges of the cut cambium, and has to spread slowly, making new cambium before it can make new bark or wood. If too much wood is exposed in this case it will often dry up before the cambium can heal over and in that case it never heals. I have seen an old machete cut with a half inch of wood exposed, with the bark thoroughly healed all round it. I was told that it had been that way without healing for two years.

As to the time to tap, there appears to be no reason why the trees should not be tapped at any time during the rainy season. I should imagine that the driest season in March and April would be a poor time, but I have not been here during that season. Rain generally makes the milk rather watery and makes it flow more freely, but I have never seen it so watery that it would not pay to tap, except in a tree which had been recently tapped. Tapping in heavy rain would not do, as it would wash the latex, which does not flow into the cups and might fill up the cups and spill the latex in them.

Temperature affects the flow of latex very noticeably. The yield of rubber is much greater in the early morning than at any other time of the day, and always decreases toward noon and increases toward night. This is not so noticeable on cool cloudy days. It would probably not be so noticeable in a shady plantation and for this reason some people have claimed that shade grown trees yield more. I believe that the reason temperature affects the flow is because a large amount of the water is evaporated and the latex is more solid and does not flow so freely.

Experiments of others have shown that young trees and younger parts of old trees contain a large percentage of resin in their rubber. I have made one observation which suggests a reason for this. In cutting a temporary branch, or leaf stem, it is noticeable that the latex comes very close to the outside bark and that there appears to be a second ring of tubes in the inner bark. Microscopic examination of these parts shows a large number of collenchyma cells close to the outside bark. These cells are similar to bast fibres, but the thick part of the walls is not uniform. Collenchyma cells are never formed by older trees except in their young parts. I think it possible that these collenchyma cells carry latex which is richer in resins than ordinary latex and which may possibly be entirely resin. Of course these collenchyma cells remain in the plant as it grows older but form a very small proportion of its tissue at that time. It is possible that rubber or resin may have some chemical relation to the cellulose of which the thick walls of both collenchyma and bast fibres are formed.

PLANTING SEED COCO-NUTS.—II.*

The following notes on the preparation of seed coco-nuts for planting, from the Report of the Philippine Bureau of Agriculture, are worth noting:—

“In preparing nuts for planting the best results have been obtained in the following manner. The nuts are selected from trees known to be good bearers, bearing not less than 150 nuts per year, these uniform in size, brown in husk, rich in copra and fully ripe. Fully 98 per cent. thus selected will germinate successfully. After cutting they should be placed immediately in the nursery provided (of course in the shade), on the ground—not hung on poles as the native is said to do. Prior to placing in seed beds, a bit of the husk should be chipped off on one side, it should then be laid, cut side up, and left to germinate. Nine months usually elapses before they are ready for planting. The nut when placed on end, as is sometimes done, sends out a spindling plumule, easily broken at the point of protuberance, and at best never gains the vigour of those germinated according to the method given. Two thousand nine hundred and thirty-one trees have been planted this year, most of them on ground that has been ploughed and pulverized and put in the same condition as for a corn crop. The result has been a marvellous growth, the trees being more than twice as large as those left to themselves.”

BRAZILLIAN COFFEE.

The “Times” correspondent Rio Janiero says:— †

EXCHANGE.

The downward course of exchange continued apace from 17 $\frac{5}{8}$ on the 1st February last to 14 $\frac{1}{4}$ on the 14th of this month. The recent movement was little short of hysterical. Between Good Friday and Easter Sunday, there was no reason to believe that there would be any greater demand for bills this year than usual, yet the Banco da Republica changed the bank rate fifteen times! Every one of these changes is telegraphed up and down the coast at enormous expense, and yet the only difference between opening and closing rates was $\frac{5}{32}$ or three points—that is to say, the market opened at four points below the closing on the previous working day, and oscillated round 15d. at intervals of about 20 minutes for no other visible reason than to keep the brokers running and the cable busy. If the 15 millions for valorisation is borrowed and remitted (a contingency not more improbable because it has been repeatedly denied) the balloon will once more be filled with gas, but otherwise the ballast thrown out by the Banco da Republica can only help for a little while, and we may soon rest again

* From the *Hawaiian Forester and Agriculturist*, April, 1906.

† See Bulletin, Oct., 1905 p. 215; June, 1906, p. 127.

on the hill of 12d., dangerously near the precipice over which we fell in 1897.

THE PROPOSED COFFEE TRUST.

The coffee valorisation scheme continues stagnant, owing to the refusal of President Alves to call a special Session of Congress. Dr. Nilo was very well received at the capital of Minas, which appears to indicate that both the States of Minas and Rio are lukewarm regarding the project. In Sao Paulo, on the other hand, planters and politicians are highly indignant at the dilatory action of the Federal Government, and a seditious spirit is commencing to make itself felt. Valorisation or separation is now the motto of the extreme faction, and the government is doubtless now bitterly repentant at having been induced to play with fire. The position is extremely difficult, and it will be very interesting to see how the executive will set about reconciling the Paulistas until November, when President Penna will have to shew his hand.

Daily entries of coffee are much larger than usual for the time of year, and Rio already shows an increase of over 300,000 bags in comparison with last year. It is quite possible that we may receive nearly ten thousand bags per diem until the end of the season. An optimistic estimate of only 3,500,000 bags for next season has been widely disseminated.

CAMPHOR IN CEYLON.—II.

An article on this subject was published in this Bulletin for June, page 129. The following extract is from a speech of His Excellency Sir Henry Blake a short time ago in Ceylon.

I want to read you the results of an experiment made by Mr. Kelway Bamber from four camphor trees growing at Hakgala, which, as you know, is 5,500 feet above sea-level, Camphor is growing and growing well at Henaratgoda almost on sea-level. Therefore, we may assume, it will grow over almost any part of this Island. These four trees were of different sizes. They took the prunings of six or eight inches, and these six or eight inches gave at the rate of 47 lbs. of prunings per tree. They calculated that each tree would bear pruning four times a year, and that would give 188 lbs. of prunings per tree per annum. Planted 12 by 12, it would give 56,400 lbs. per acre per annum of fresh prunings. Now Mr. Bamber distilled from the fresh prunings 1·5 per cent. of camphor, and from that 56,400 at 1·5 there would be 864 lbs. of camphor per acre. Then take the cost of planting, etc., at R144, distilling, fuel and labour at R30, weeding per acre R6, in all R180, and you get a net result of £74 4s. per acre. That is calculating camphor at 2s. per lb., camphor being 3s. per lb. at present. Taking half the weight of prunings, take even a quarter and you get about £18 per acre; and it seems to me this additional product is worth considering."

TOBACCO DUST AS A FERTILIZER AND INSECTICIDE.

By GEORGE LOUTREL LUCAS.

The waste product of all the American tobacco factories, in the form of stems stripped from the leaves in the manufacture of tobacco products, is saved and finely ground and forms a valuable by-product in the shape of a fertilizer and insecticide.

Good unsoaked stems contains 2 to 3% of nitrogen and 6 to 10% of potash, and only a trace of phosphoric acid; the nitrogen exists in both the nitrate and organic forms.

The potash occurs principally in the soluble form, and is free from chlorides judging from analysis.

The *stalks* are richer in nitrogen than the *stems* ranging from 3 to 4 nitrogen, but are considered poorer in potash. Tobacco is an exhausting crop, and the dust would prove an excellent fertilizer to apply to tobacco fields.

A ton of good tobacco stems should contain nitrogen equivalent to 500 pounds of nitrate of soda and potash equivalent to the amount contained in 200 pounds of sulphate of potash.

I have used hundreds of tons of tobacco dust in the past 20 years, and my faith in its fertilizing properties is unshaken, and could I procure it in any quantity in Jamaica, I would take all offering; but it is unprofitable to use unless finely ground, because, being so bulky in the form of stems, it becomes too expensive to haul and handle.

Tobacco dust is especially valuable as a fertilizer and insecticide for pine-apples, and it is the only safe article that can be used for dropping in the bud or heart of the plants; my plan is to go over the pine-apple fields after the suckers or slips have been planted 4 or 5 weeks and drop about a good pinch or two teaspoonsful into the heart of each plant; this acts as a splendid stimulant and kills the mealy bug and discourages ants from building their nests at the base of the plants, and whilst it will not kill ants, it will eventually drive them away for the want of mealy bugs to feed upon; the potash and ammonia contained in the dust will stimulate the plants and force them to make a vigorous growth and keep them free from insects and in a healthy condition.

THE LLEREN: A RARE ROOT CROP.*

By O. W. BARRETT.

Though perhaps one of the oldest cultivated plants, *Calathea Allouya* is almost unknown outside of the West Indies; it is occasionally cultivated in Trinidad and several other of the British Antilles but appears to attain its greatest development and popularity in Porto Rico.

* From *Plant World*, Vol VII, No 6, June 1907.

Taxonomically it stands in the Zingiberaceae near *Phrynium*. In habit above ground it resembles the Turmeric (*Curcuma*) but has the pseudo-stem of *Anomum*; the subterranean habit is very similar to that of some of the *Phryniums*. According to Grisebach, the flower is small, white, and borne in roundish heads, like those of ginger—very unlike the large, fragrant, pale lilac, radical flower of *Calathea (Phrynium) zebrina*.

The clumping habit of the family is exemplified in the slow-spreading cluster of 10 to 25 loosely attached "heads," each of which bears a false stem composed of 4 to 8 erect, sheathing petioles. These "heads" may be considered as a kind of short stem, some 2 to 3 inches long and about 1 inch in diameter, or as a rhizome lying just beneath the surface of the soil and receiving at its base the roots and tuber stipes. New shoots are produced either from the tip of the "head" or from the side; thus the individual head is at least biennial while the clump is, of course, perennial. Growth ceases at the end of the rainy season, about December, and begins about April: the mat of dead leaves serves to protect the succulent, truncate "heads" from the fierce winter's sun.

The oblong-linear or linear-lanceolate leaf blade tapers abruptly at the tip but runs very gradually at the base into the slender, yellowish, channelled petiole. The strong veins, running at a rather small angle with the mid-rib, especially near the base, give the lamina a somewhat corrugated appearance; and though the petiole is always erect and rather stout, the mid-rib allows the long blade to droop gracefully.

Strong clumps growing in rich, cool soil or in partial shade attain a height of 3 or even 4 feet, the leaves from the central heads being much taller than those from the outside of the clump. By nature the Lleren is evidently a plant of the jungle and shaded river banks. At present it does not appear to grow wild anywhere in Porto Rico; like the "Yautia" (*Xanthosoma* spp.), it seems to have become through its hundreds of centuries of domestication an utter slave to human husbandry. In fact it rarely flowers and never (?) produces seed; while it is not impossible to find natives who will admit having seen the large "Yautia" (*Xanthosoma*) flowers, I have been unable to find one who remembered seeing those of the Lleren.

The most important part of this interesting plant, however, is the peculiar tuber-like bodies which are borne on slender roots or stipes, from 3 to 6 inches beneath the soil surface. This pseudo-tuber is oval or elliptic in shape, from 1 to 2 inches in length, and covered with a thin smoothish cuticle of a pale yellowish colour; a few small rootlets are attached to the outer skin as well as to the stipe. The fact that no "eyes" are present precludes its being termed a tuber, but the abruptness with which it arises at the tip of the more or less specialized root which is not continued within the starch body, mark it as the limit of a root running tuberward. The centre of this body, to the extent of about one-third of the entire content, is occupied by a translucent

portion of a firm and crisp but gelatinous nature ; the main portion resembles the interior of the common potato but is finer-grained and much more gummy. Though the glutinous character disappears upon cooking, the crispness remains even after prolonged boiling.

The thin cuticle being removed after cooking, there appears a delicious morsel, snow-white outside, semi-transparent in the centre, which may be eaten as a side dish with butter, or, as many prefer, as a relish with salt, like radishes ; it is also good in soups. From December to May it is fairly common in the markets and is also frequently sold, cooked but not peeled, in the streets in the evening—a dozen or so tied in a bunch with the attached root-stems, at 1 cent. per bunch ; they thus take the place of pea-nuts.

The flavour of the Lleren is difficult to describe—there is certainly a taste like sweet-corn, and something quite its own besides. The surest thing about it is that if you try it once, you will again.

TANIER, THE OLDEST CROP.*

By O. W. BARRETT.

Of all the plants which made life possible to the wild men of old Caribea, the handiest was undoubtedly the Tanier. It grew in the loose alluvium along the forest streams and its tempting tubers were continually in evidence to the savage ancestors of the forefathers of the Arawaks. The idea of the goodness of these roots once grasped, a few worthless plants pulled out from among the edible ones, a sprouting tuber fragment purposely trodden into the soil—and agriculture was begun.

There is very good reason, as Mr. O. F. Cook has shown,† for believing that the cultivation of economic plants originated in Tropical America ; and in many ways the Tanier appears to have been cultivated longer than any other plant in this region. Nearly all the cultivated plants of the world readily produce seed ; but the Tanier, though flowering under favourable circumstances, has entirely lost its natural power to ripen seeds. Some varieties of the yam, the sweet potato, and even of the banana occasionally bear seeds in the home of the Tanier ; but many of their varieties have been introduced from other regions and their varieties are not so numerous in islands like Jamaica and Porto Rico as those of the Tanier.

As a vegetable slave this remarkable old crop has been spared the fate of most economics—exile from its own home ; for, strange as it may seem, the Tanier still remains almost unknown outside of Tropical America. Other food-plants have been carried to the far corners of the earth ; others less easily propagated and less productive, like the taro and the yam, have become staple

* From the *Plant World*, October 1901.

† "The American Origin of Agriculture," *Popular Science Monthly*, October, 1902.

articles in all hot countries, Central America included. This apparently paradoxical fact will undoubtedly be explained when the history of agriculture is better known.

The family Araceae is one of the most interesting and important in the realm of plants, the genus *Colocasia* alone includes about fifty edible varieties (the taros) and *Xanthosoma* (the taniers) holds about the same number of kinds. Until recently the taniers were confused with the taros, the usual local confusion of names helping to perpetuate the error even amongst those who must have known better. To be sure there is some similarity between the two plants in their appearance above ground, but the intrinsic characters of the leaves, flowers, and roots are very distinct.

Though its varieties have scores of names throughout Tropical America, "Yautia" is probably the oldest name of which we have any record; this was the general term applied by the aborigines when the Spaniards arrived in Porto Rico, the island which, from the first, was most famous for its agricultural advancement. And in this island has the "Yautia" reached its highest development—running here into some twenty distinct native varieties. About ten kinds are grown in the Windward Islands; northern South America has but very few; Cuba and Hayti have half a dozen or less; and the few varieties of Central America appear coarse and unproductive in comparison with the Porto Rican sorts. Taya, Tanier, or Cocoe are the common names in the British West Indies; in Cuba and Santo Domingo both Taro and Tanier are included under the name "Malanga;" while in the Central American republics it passes under almost as many names as there are Indian tribes.

Few plants yield a higher proportion of food material for the weight of the entire plant than does the Tanier; in fact fully 75 per cent. of the weight of some types is food. In the "Rollisa" variety of Porto Rico the tubers comprise about 35 per cent. of the weight of the living plant and the edible rootstock about 20 per cent. more; the young leaves are also edible, closely resembling spinach when boiled, but having more "body" and a richer flavour. The central stem, or rhizome, of many varieties is commonly eaten by the poorer classes but contains some fibre and only 15 to 20 per cent. of starch.

The obovoid or roundish tuberous roots are borne just below the surface of the soil, loosely attached at right angles to the central stem. In cropping, the leaves are grasped in the hands and the whole mass of tubers usually comes up with one good pull, and a quick shake will detach most of them from the parent root. Individual tubers weigh from a few ounces in some types to one and one-half or even two pounds in the better sorts. Each plant produces from two to four pounds, but since six thousand to ten thousand plants can be grown on an acre the yield is six to twenty tons of superior roots containing 20 per cent. to 30 per cent. of starch and little fibrous matter. Five to ten tons of the rhizomes, which may be utilized for feeding swine or for making starch,

may be added to these figures. By removing the first tubers as soon as ripe, by means of a "machete" and allowing the plant to remain *in situ* for six months longer, a second crop may be harvested; by this method, called "castration" in Trinidad, it is estimated that an acre of Taniér can be made to yield thirty tons of tubers at one planting; few crops can produce one half of this amount.

Though preferring rich, moist loam, the Taniér is content with almost any soil; like its near relative, the Taro, or Elephant's Ear, it revels in plenty of fresh water, but while the leaf development may be greater in wet situations the tuber percentage suffers. The leaves vary from pale green to deep mauve purple; in some sorts, like the "Palma," leaves three feet wide by four feet long are common. A Taniér field in its prime is a beautiful sight.

Boiled, fried, or baked, the better kinds of Taniér are superior to the Irish potato; though most varieties are not so "mealy" they are richer, firmer, and possess more distinct flavour. Most sorts are pure white, but four are pinkish purple, and several are of various shades of yellow. The roots keep fairly well after harvesting and would undoubtedly endure shipping to the Central States.

And now that the days of popular prejudice against anything new in the food line are dying out fortunately, we may expect to see the rare and royal old Taniér soon entering the northern markets and rapidly gaining favour as one of the best of many good things to come out of the Tropics. Twenty thousand years late but it will win!

RING-BARKING.

By A. TATHAM, Australia.*

Seeing what a vast amount of ring-barking has been performed in Australia in the past, it may seem somewhat of an anomaly to describe the process now. This article, it is hoped, will be of use to future operators, and tend to prevent, or at least lessen, some of the annoyances and expense usually connected with it. The subject will be discussed under the following heads:—

Why does ring-barking kill a tree?

How to ring-bark.

When to ring-bark.

Ring-barking compared with felling and burning-off.

WHY DOES RING-BARKING KILL A TREE?

The only way to answer this question is to describe the structure and functions of the roots, stem, and leaves of a tree. A tree cannot grow unless it gets moisture, as it is utterly incapable of getting nourishment from the soil except in a soluble form. The roots that perform this office are the very fine thread-like ones

*Agricultural Journal of Victoria, III. 9, 1905, p. 642.

found at the ends of the large ones. They are composed of elongated cells, the walls of which contain numerous thin spots on their surface. So thin are these that water can pass through them but absolutely nothing else, not the smallest particle of solid material, except the root is in any way injured. These cells are packed close together, and the thin spots in each coincide with those of the adjacent one. There is no opening whatever in their walls. So far, science has not actually proved exactly how moisture ascends to the leaves of a tree. As many cells are found in the stem that have such dense walls, it almost appears impossible for moisture to penetrate them. And yet it is by these cells in the stem that the sap ascends, the action being different to that of the root cells. Whenever two liquids of different densities are separated from each other by a membranous partition, it is nature's law that the denser fluid will attract the lighter, until both become the same density. This action is called endosmose. Now the cells in the roots of trees contain reserve material, stored there from the previous year's growth, and composed of mucilage and protoplasm, which is far denser than water. When the soil gets moist, the water in it is attracted through the cell walls to the denser liquid in the cell. This action goes on from cell to cell till it reaches the stem. Here capillary action starts. The sap ascends to the leaves, through the wood cells of the vascular bundles. These, in addition to other kinds of cells, form what is known as the sap-wood. The action of the rising sap is very rapid. As soon as it gets to the leaves it is elaborated and reverts again to the roots. The water taken up is largely evaporated by the leaves; the matter retained by them being the nourishment obtained from the soil, plus the reserve material from the roots. This at once causes a denseness of cell contents, that attracts the thinner rising sap, and so the action goes on till want of moisture in the soil prevents it. A tree, as is well known, is composed of two kinds of wood—heart and sap. The heartwood is to all intents and purposes dead, it takes no part in the life of the tree, other than to support the crown. It is in the heart that decay first sets in. It is possible for a tree to live for years with little or no heartwood, as may be seen in the case of a hollow one. The sapwood on the other hand, is the life of the tree, as by it the sap ascends and descends.

Having now seen how sap rises in a tree, the next and most important point is how does it come down, for it does come down, otherwise tree stems would never increase in girth. The leaves are the organs of nutrition, as well as respiration. The substance sent up by the roots has been utilized to form new shoots and leaves, in other words, height growth. As soon as warm weather sets in, the leaves begin to collect material from the atmosphere, mostly, carbon. Quite four-fifths of the carbon used in the structure of a tree is obtained in this way, the quantity used may be gauged by the amount of charcoal left after the wood has been burned. They also return to the atmosphere oxygen. The process of respiration is carried on through minute cells, found chiefly

on the under side of the leaf, called stomata. During dull, cold, or wet weather these cells are closed; but on a bright warm day they open, and the work of the tree growth is briskly carried on. The leaves collect the gases from the atmosphere, digest the carbon dioxide with the moisture, and dilute plant food from the roots, and pass it down along the branches and stem to them again. As this substance passes down, it takes a totally different course to the sap that came up. Instead of going down through the cells in the wood, it descends between the stem and the bark, and, as it does so, adheres to the stem, and gives birth to the cambium layer which forms the annual ring, or a year's growth of new wood. It is as well to remember this growth begins at the top of the tree; if it were not so, ring-barking would be work thrown away. The roots of the tree are also supplied with nutrition, which is stored in their cells, and is used the following season for future height growth. Having seen now the uses of the different parts of the tree and the system adopted by nature to keep life going, it is not very difficult to understand why ring-barking kills a tree. When a ring of bark is removed from the stem it severs, so to speak, the connection between the leaves and the roots. The downward flow of sap is voluminous, as well as rapid, and if only a narrow strip of bark be removed the wound is soon healed over. But let a broad band be taken, the sap, as a rule, cannot repair damages and the drying influence of the atmosphere and sunlight cause it to perish. But even this can be healed, if paper is wrapped round the ringed portion, so as to exclude air and light. Now, above the cut or ring, growth, still progresses. The root still send up sap. The leaves still send it down, but it cannot pass back to the roots. The roots are now isolated; they are unable to get nourishment for themselves, or to store up any for next season's growth. Their cells are at last emptied of nutriment. They contain only the material procured from the soil. Nature's law no longer acts. Passing up moisture to the leaves ceases, and the tree dies.

HOW TO RING BARK.

Although this operation is simplicity itself, still, unless care is taken it will result in endless trouble, and unnecessary expense. More especially in the case of young trees; in fact, the younger the tree the harder it is to kill, as a rule. Before describing the manner of doing the work, it will be as well to explain some often misquoted terms. *Suckers* are, strictly speaking, shoots that grow from the roots only, not from the stem. *Shoots* grow from the stem and branches. To ring bark properly, a band of bark should be removed from round the stem of the tree of sufficient width to prevent the possibility of the renewal of the bark. Not less than 10 inches is advisable, and in the case of gum trees 15 inches is not too much, as they seem to possess greater recuperative power than other trees. Great care should be taken that the bark is entirely removed, and that the stem of the tree is cut into as little as possible. It is advocated by some that to give a cut

into the stem tends to hasten the death of the tree; but it is not, as a rule, an economical system. First, by cutting into the sapwood, the rise of sap is arrested; not being able to get up to the leaves, it causes a dense mass of shoots to grow below the cut. These often take two stripping operations before the stump is killed. Second—the cutting into the wood, especially in young trees under 8 inches in diameter, causes them to be so weakened that the first gale breaks them off. The result is double work getting rid of the shoots, and also the fallen tree. It must be admitted that the tree-top often does die very quickly after this style of work; but as it is the roots that have to be killed, and as it fails to do so, it cannot be recommended. “More haste less speed,” is very applicable to ring-barking. Where trees of a large size have to be operated on, say 2 feet and over in diameter, what is often permissible, and, in fact, preferable, is to “chip-ring,” *i.e.* cut well into the sapwood; the death of the tree is speedy, and only in a few cases do shoots grow. The reasons for this are: A large or old tree has fewer dormant buds existing on the lower portion of the stem. The dormant buds are very numerous in young trees, and lie under the bark. It is one of nature’s provisions to enable a tree to recover in case of accident. In aged trees the germs of the buds may be buried by successive growths of wood, and the bark is thicker, especially near the ground. Again, an aged tree makes very little height, or circumference growth annually. Its energy is chiefly concentrated on the production of seed. This seed bearing is a severe tax on a tree, so much so, that, after bearing a crop, it takes two or more years to recover enough material to enable it to bear another. Therefore, when a tree of this description is ringed, it is not in a state to bear the shock, and a speedy death results. It often happens that an old tree, in spite of chip-ringing, still continues to live. This is caused by the existence of what is known as “internal bark.” When a tree has been severely wounded, and has renewed the bark over the place, decay will often commence under the bark on the wounded surface. The new bark will, so to speak, follow the decay trying to cover it, and, although the external appearance shows no indication of this and even after ringing it cannot be perceived, a strip of bark exists that connects the top and bottom of the cut. This is sufficient to upset all calculations, and if not rectified will enable the tree to make a good recovery. The only method is to fell a tree of this description. From the preceding remarks it may be gathered that in the case of young trees full of vitality, ring-barking is best, as it does not prevent the sap rising, and therefore enables the roots to exhaust themselves; but it allows no additional nourishment to return to them. In aged trees chip-ringing is permissible, the tree does not possess vitality or nutritive material enough to cope with the shock it receives.

WHEN TO RING-BARK.

This is undoubtedly the most important part of the operation. There can be no question, that the time for doing it is when the

sap is moving freely, so as to facilitate the removal of the bark. But as often as not the operation is undertaken too early in the season, the result being a dense growth of shoots, whereas if the ringing is left over till spring has set in, a speedier death of the tree is assured, few, if any, shoots are thrown, and most of the shoots will die, when the crown dies. Nourishment for the roots is only collected on warm, bright days, and it is highly probable that the storage of reserve material only takes place towards the end of summer. However, owing to climatic differences, no hard-and-fast rule can be laid down, for in the northern portions of Victoria, August might prove the best month; south of Dividing Range, September; whilst at an elevation of 1,000 feet or over, October.

RING-BARKING COMPARED WITH FELLING AND BURNING-OFF.

Both these systems have their advocates where small areas are concerned, but where the acreage runs into hundreds, only one is mentioned—ring-barking. Seeing the object in view is to destroy the timber, so as to allow sunlight into the soil, and so induce a growth of sweet grass, naturally the cheapest and quickest method is the one to be favoured.

Undoubtedly ring-barking is at first the cheapest, if not in the long run; but it is the slowest method. No good results can be looked for under twelve to fourteen months, and probably no really decent grazing can be expected under three years, unless a fire has run through the area. By the time the last tree has fallen, and the logs have been cleared up, can it be said to be a cheaper method than direct felling? Certainly the operation is spread over a number of years, therefore the annual outlay, especially as the necessary work can be done in slack seasons, is often so slight, that it can almost be made to appear an inexpensive system. Hence its adaptability to the requirements of the usual run of graziers. It has many disadvantages; the incessant accumulation of rubbish by windfalls, and especially after a fire; the greater danger of fire being carried from dead tree to dead tree, with the least chance of stopping or preventing it; the great harbour it affords to rabbits, attracted by the grass and sheltered by the decaying roots and logs, and the least chance of eradicating them; and the surprising growth of seedlings that takes place, which, if not destroyed in the earliest stages of growth give endless trouble, and often lead to the abandoning of the area. On the other hand, in some districts the resulting firewood has a not insignificant market value, so much so, that instances are not wanting in which, after deducting all charges connected with ringing of trees, and cutting of fuel, a balance has been left of ten shillings and more per acre. The humus caused by ages of decayed vegetation, and the addition of the leaves and twigs of the rung timber, must add materially to the value of the land, and though at first is often detrimental to a sweet growth of grass, will eventually cause a thick sward to form.

Felling and Burning-off.—As a rule, this is only practised on small areas, its initial cost being far too heavy to suit most selec-

tors. Its chief advantage is that in twelve or fifteen months, work can be accomplished equal to ten years or more where ring-barking is done. It has the further advantage of affording a quick growth of sweet grass, especially if seed has been sown broadcast over the ashes of the burn, as ought always to be done. Its disadvantages are its first cost; its destruction of what is often a marketable commodity, the resulting firewood is too charred to be acceptable for household purposes, and very little remains if the work is properly done. The intense heat of the fire destroys the humus layer, even burning into the soil in places. These patches of burnt ground, especially where piling has taken place, are often the cause of the introduction of one of the worst pests to the grazier in the cooler and moist districts—the bracken fern. Its spores are blown considerable distances by wind, and find the best of material for germinating on when they strike a patch of burnt earth or charcoal debris. Grass, on the other hand, avoids the severely burnt patches. The burning-off is also a source of great danger to neighbouring properties.

Ring-barking, prior to burning of the dense undergrowth, is a good method where practicable. In districts like Gippsland, a lot of rubbish is destroyed, including shoots from the trees. But it may not always be possible to combine the two, the undergrowth being too dense to permit of ringing till after the burn.

An argument is often put forward in favour of ring-barking, as compared to felling or grubbing, and that is the loss of "goodness" to the soil. It is maintained that a ringed tree returns something to the soil, which is lost to it otherwise. Such a theory cannot be accepted, except it be that the resulting decaying debris acts as a top dressing, in other words, humus. If a tree can directly return "goodness," then the object of ring-barking will fail. The tree grows from the top downwards. The operation of ringing, if successful, is as effectual in severing connection between head and root as felling would be. Even allowing the possibility of such an action, its influence would be restricted to the roots and the soil directly surrounding them. If any reason exists for the better growth of grass near stumps or on sites previously occupied by them, it may be put down to the influence of decayed vegetable matter, and the, so to speak, trenching operations, caused by the roots of the tree having given the soil an up-ward lift as they increased in size.

This article is written after a series of experiments, extending over three years. The question, when to ring-bark, may not be actually proved to satisfy all districts and species of trees. But it is hoped that the remarks made, may, in addition to the experiences gained by others, assist future operators and lessen the often tedious work.

FORESTS AND RIVERS.*

At the recent meeting of the International Navigation Congress at Milan, one of the questions taken into consideration was "the influence which the destruction of forests and the desiccation of marshes has upon the *régime* and discharge of rivers," and seven papers bearing on the subject were read and discussed. Of these, three were from Austria, and the others from Germany, France, and Russia. The problem as to the effect of forests on the water supply of rivers and on climate is of great social importance on account of the agricultural and commercial interests which are so closely connected with the use of timber, and with the utilisation of running water.

It is allowed by all the authors of these papers that, due to the improvident way in which the forests have been dealt with, there has been a marked change in the water supply of the neighbouring rivers; that where forests have been cut down brooks have disappeared, and many small rivers that at one time were useful as sources of power are so no longer for want of water; that in the larger rivers torrents have become more impetuous, and flooding more frequent; while, on the other hand, navigation suffers at times for want of water.

The greatest harm has been done in the mountain districts, where the steep slopes allow the rain-water to run off too rapidly, carrying away the surface soil and transporting pebbles and boulders into the rivers, causing shoals, thus decreasing their capacity to discharge the flood water.

The extent to which forests, both on the Continent and in America, are being cut down and destroyed, and large areas of land, which at one time were covered with primæval forest, have become barren wastes by fire or the lumberman's axe without any attempt at re-forestation, was one of the subjects dealt with in the presidential address of Mr. J. C. Hawkshaw at the Institution of Civil Engineers in 1902. Mr. Hawkshaw pointed out that, notwithstanding the displacement of wood in building structures by iron, yet large quantities of timber are still required, not only for building purposes, but for temporary structures, such as coffer dams and scaffolding; pit props for mining; sleepers required for the railways, which, in this country, he estimated at an annual value of 18 million pounds, and those required for renewals at three-quarters of a million pounds; while for the railway service of the united States there are required 15 millions of acres of forest land to maintain a supply of sleepers.

The question for consideration at the Congress was whether the wholesale destruction of forest land for cultivation or for timber supply is having any material effect on the rainfall and consequent water supply; and the effect of forest destruction on the rivers of the country from which the trees are removed was also considered.

* From "Nature," February 1, 1906,

The physical conditions of forest land are that, owing to the shelter from sun and wind, the atmosphere is generally colder and damper than in the open country, and evaporation consequently less. It is calculated that a hectare of forest land ($2\frac{1}{2}$ acres) gives off every day 37 cubic metres of oxygen and 37 metres of carbonic acid, leading to a great expenditure of heat; and that from every hectare of forest land sufficient heat is abstracted to melt 316 cubic metres of ice. Ligneous plants also withdraw from the ground and discharge as vapour more than 40,000 gallons of water per hectare per day, which causes a sensible reduction of temperature. When clouds pass over a forest they encounter a cool, damp atmosphere, the point of saturation comes closer, and rain is caused. This condition of forest land has been remarked on by aëronauts, who find that a balloon is invariably affected, and drops when passing over forests.

The advantages claimed for forests with regard to water supply are that the trees act as regulators of the rainfall; that the average quantity of rain falling on land covered with forests is greater than in the open ground to the extent of about one-sixth; that it holds up the water for a time and discharges it later on when water is most required in river basins, the rain being held back by the leaves of the trees and coming to the ground more gradually; the rain that falls on the surface is also taken up by the layer of dead leaves on the ground, which permits of a gradual percolation to the sub-soil. Observations show that in summer the ground of the forest is damper than that of the adjacent cleared land, and snow remains for a much longer period in forest land before melting than in cleared land.

On the other hand, it has been contended by some of those who have made a study of sylviculture that forests do not increase the quantity of water flowing to the springs and rivers, but reduce it. The numerous striking facts quoted do not bear out this contention, which is mainly based on the fact that the substratum water stands at a lower level on forest land than in the adjacent cleared ground. This fact is generally admitted to be the case at one period of the year. As the result of many years' observations, it has been found that the maximum level of underground water is reached in May, that the water accumulates in the ground from August to January; and that the rivers are supplied by this reserve, and were it not for this accumulation many brooks and river feeders would cease to flow in summer.

Several very striking examples are given by the authors of the papers as to the deleterious effects of cutting down forests', especially in hilly districts. In the commune of La Bruguière, the forests on the slopes of the Black Mountain were cut down; the consequence of this removal of the trees was that a brook which ran at the foot, and the water from which was used for driving some fulling mills, became so dried up in summer as no longer to be of any use, while in winter the sudden floods caused very great damage in the valley. The forests were re-planted, and as the

trees grew up the water coming to the brook was so regulated as to serve its former useful purpose in driving the mills, and the torrents in winter were moderated. Several other examples of a similar character are given.

In Switzerland, amongst other examples is quoted one that occurred in the canton of Berne, where, owing to the re-planting of the mountain-side with fir trees, the water again appeared at a spring which had ceased to flow. After a period the trees were cut down and the land converted into pasturage, since when the spring has almost disappeared only opening out at occasional intervals.

In the Kazan district of Russia, once celebrated for its forests of oaks and linden, which are now nearly all cut down, there were formerly seventy water-mills constantly at work. Less than half now can be worked, and even they only run half time, and are idle in summer for want of water; while in winter the little rivers that worked these mills are converted into impetuous torrents, breaking up the mill dams and doing other damage. These abandoned water-mills stand out as a striking proof of the consequences of the destruction of forests.

In Sardinia, where the surface consists of plutonic rocks covered with a thin layer of earth, all the streams have a rapid slope. The woods, which occupied in 1870 an area of more than $2\frac{1}{2}$ million acres, or about 43 per cent. of the whole surface of the island, now are reduced to about one-sixteenth of this area. Since the removal of the trees the floods in the rivers rise with a rapidity and flow with a velocity never known before, and a great number of bridges have been destroyed by the floods. The beds of the channels have been raised in some places above the surface of the land, owing to the detritus brought down in floods.

In Wisconsin, U.S.A., the settlers cut down the forests and converted the land into tillage and pasture. During a period of about seventy years nearly the whole of the forest land was thus cleared with the result that, as the forest disappeared, the water in the river became lower; finally thirty miles of the channel entirely dried up, and many water-mills that were formerly worked by the stream are now deserted and useless, owing to the want of water to run them.

In Sicily, owing to the cutting down of the forests on a vast scale in the province of Messina, the bed of the river has been raised by the stones and earth carried down by the torrents so as to stop all drainage from the land, and great damage has been done by the floods. Several other examples are given to the same effect where forests have been cleared in the same district, and these are compared with other streams where the forests still exists and their condition remains unaltered. In the former case, landslides from the mountains have become very frequent.

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Wednesday, 11th July, 1906. Present:—The Hon. T. L. Roxburgh, Acting Colonial Secretary in the chair; the acting Director of Public Gardens, the acting Isand Chemist; the Superintending Inspector of Schools, Messrs. C. A. T. Fursdon, J. W. Middleton, G. D. Murray and the Secretary.

His Grace the Archbishop sent an apology for absence, as he would be away in Trelawny and St. Ann for 11 or 12 days.

No Truck System—The Secretary submitted a letter from the Westmoreland Sugar Planters' Association with reference to the matter of estates compelling labourers to purchase bread, beef and pork from the estates, saying that the Association was not aware of any estates doing so.

The Secretary was instructed to acknowledge receipt of the letter, and he was also instructed to write the Colonial Secretary that the Board had not been able to find out that the practice complained of existed on more than the estate given.

Official Letters—The Secretary read the following letters from the Colonial Secretary's office:—

1. *Re Agricultural Instructors*, that the suggestions of the Board with regard to the Instructors, to be employed with the £500 from Elder, Dempster & Co. would be conveyed to the Agricultural Society.

2. *Asst. Superintendent at Hope Gardens*, that the Governor has already approved of the employment of foreman Taylor temporarily as Agricultural Instructor at the Experiment Station at a salary of £100 a year, and that the matter of permanently filling the post of Asst. Superintendent would be considered with the estimates for 1907-08; and that His Excellency had authorised the Director of Public Gardens to insert £150 as salary for the officer to be selected.

Mr. Middleton moved that a committee be appointed to go more thoroughly into the matter and report to the Board. This was agreed to and Mr. Middleton and Mr. Fursdon were appointed.

3. *Standard of Rum*.—Sending copy of minute by the Chemist *re* standard quantity of ethers for Jamaica rum.

It was agreed that the Secretary should acknowledge receipt of the letter, and say that the Board would allow the consideration of this matter to lie over for a time.

4. *School Gardens*—Special grants to school gardens; referring minutes by the Superintending Inspector of Schools and the Director of Public Gardens on the matter.

The Secretary was instructed to reply that the Board would approve of the transfer of £30 under the allocation for model gardens

from the estimates of the Public Gardens to the amount on the estimates of the Education Department for school gardens and would approve of there being one vote in future for this purpose, and that should be on the estimates of the Education Department.

Course Postponed.—The Secretary submitted a letter from the Island Chemist to the acting Chairman, stating that owing to the recent heavy rains sugar crops were so backward that many distillers would not be able to attend the Distillers' Course as arranged; that he was convinced that the only way was to postpone the Course to October 8th to 26th when Mr. Allan would be able to take part, and if his (the Chemist's) leave commenced on July 5th he would get back in time for the Course. As the matter was urgent he asked the acting Chairman to approve, which had been done.

The Board approved of the action taken.

Reports Presented.—The following reports from the Chemist's Department were submitted :—

1. Postponement of Distillers' Course.
2. Work of Agricultural Lecturer.

3. Suggestion by Mr. Cousins that he be permitted to visit various centres in Great Britain and Germany in the interest of Jamaica rum, to be on half pay for a fortnight, his travelling expenses from London as a centre to be paid from the Laboratory allowance for travelling, and asking that the Colonial Office in London be requested to furnish him with introductions to the British Consuls at Bremen and Hamburg.

It was agreed to inform the Colonial Secretary's Office of the proposals and that the Board approved of them.

4. Proof of Chart of "Agricultural Dons" for approval. With some alterations in the type of printing, this was approved of.

Reports 1 and 2 were directed to be circulated.

The following reports from the Director of Public Gardens were submitted :—

1. Hope Experiment Station.
2. Instructors.

These were directed to be circulated.

The meeting adjourned till Wednesday, 15th August at 2 p.m.

[Issued 4th Aug., 1906.]

Printed at the Govt. Printing Office, Kingston, Jam.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

SEPTEMBER, 1906.

Part 9.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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P R I C E—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :

HOPE GARDENS.

1906.

JAMAICA.

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RENOVATION OF WORN-OUT SOILS.*

By W. J. SPILLMAN.

There is a vast difference in the natural fertility of soils. Some do not produce well from the start unless special attention is given to making them productive; others produce large crops for a short time and then rapidly diminish in fertility; while others, known as strong soils, remain productive for many years without attention to their fertility. But even the strongest soils will wear out in time unless they are intelligently managed.

NATURE OF THE SOIL.

In order to understand the methods necessary for restoring worn-out soils, let us consider what occurs in a fertile soil that is growing a large crop. Imagine a cubic inch of ordinary field soil magnified into a cubic mile. It would then present very much the appearance of a mass of rocks varying from the size of a pea to masses several feet in diameter. Scattered among these rock masses would be many pieces of decaying plant roots and other organic matter, resembling rotting logs in a mass of stones and gravel. The masses of organic matter would be found to contain large quantities of water, and to somewhat resemble wet sponges, while every mass of rock would have a layer of water covering its surface. The open spaces between the solid masses would be filled with air.

If a crop were growing on this soil, its roots would be found threading their way among the masses of rock and decaying roots, and pushing these aside by the pressure exerted by the growing roots. From the surface of the growing root, near its tip, small hollow threads (the root hairs) extend into the open spaces and suck up the water covering the rock particles. The root hairs are not open at the end; they absorb the water through their walls. The plant food is dissolved in this water, but is usually present in

* *Farmers' Bulletin* No. 245, U. S. Dept. of Agriculture.

exceedingly small quantities. While the plant is growing a constant stream of water flows up through it and evaporates at its leaves. For every pound of growth in dry matter made by the plant, from 300 to 800 pounds of water flow up through it.

The plant food substances dissolved in the soil water may be divided into two classes according to their ultimate source.

MINERAL PLANT FOOD.

Plants in their growth make use of thirteen chemical elements, nine of which they secure directly from the soil. These are called the mineral plant foods; they are phosphorus, potassium, calcium, magnesium, sodium, iron, silicon, chlorine, and sulphur. We have already seen that the soil consists mainly of small particles of rock. The rock particles are of many kinds, but nearly all kinds contain more or less potassium, calcium, phosphoric acid, &c. Every year the soil water dissolves off a thin surface layer from each particle. Plants appropriate this water and thus secure mineral plant food.

Many generations of plants have thus been collecting their small toll of food from the soil and storing it up in their tissues. The amount of plant food made ready for plant use during each growing season through the slow solution of the mineral particles of the soil is doubtless supplemented to a considerable degree by the same kinds of materials set free from the organic matter also found in the soil—that is, the mineral matter originally secured from the dissolving minerals, but built into plants during some former season, may again be used by other plants when the old matter is given an opportunity to decay in the soil. These foods derived directly from the mineral matter of the soil and indirectly from it through the growth, death, decay, and return of former crops are also supplemented in many cases by the application of mineral matter in the form of commercial fertilizers.

NITROGEN COMPOUNDS.

In addition to the nine elements already mentioned, the growing plant requires four other elements, as follows: hydrogen, which it secures from water (water is a compound of hydrogen and oxygen); oxygen, which it secures partly from water and partly from the air; carbon, which is secured from carbonic-acid gas in the air; and nitrogen.

Nitrogen is in many respects the most important of all the plant-food elements. It is not found in appreciable quantities in the rock particles of the soil. Ordinary plants depend for their nitrogen entirely on decaying organic matter. As decay proceeds nitrates are formed from the nitrogen contained in organic matter. The nitrates are exceedingly soluble, and unless soon made use of by growing crops they are washed out of the soil. Nitrogen is therefore usually the first element to become exhausted in the soil.

Fortunately, there are certain species of bacteria that can use atmospheric nitrogen, of which there is an inexhaustible supply. One family of plants—the legumes—has learned to exchange work

with these bacteria, and these plants are thus easily supplied with an abundance of nitrogen in a form which they can use. When these nitrogen-fixing bacteria are present in a soil on which a leguminous crop is growing, the bacteria invade the roots of the legume and live there. Their presence is usually made manifest by swellings—the so-called tubercles—on the roots of thrifty plants of clover, alfalfa, beans, peas, and other legumes. Nitrogen from the soil filters into the roots, where the bacteria appropriate it, manufacture an abundance of nitrates, and give a portion to the plant in exchange for starch. The tissues of leguminous plants become very rich in nitrogenous compounds, and when they decay in the soil they set free large amounts of nitrates for the use of any crop which may be growing at the time.

The cultivation of leguminous crops is one of the most important and economical means of maintaining a supply of nitrogenous plant food in the soil. Nitrates may, of course, be supplied in commercial fertilizers; but fertilizers containing nitrogen are very expensive, and it usually pays better to supply nitrogen by growing legumes or by the application of stable manure, which is rich in nitrogen when properly handled. In good farm practice both stable manure and leguminous crops are used as sources of nitrogen.

SOIL MOISTURE AND HUMUS.

In order to produce a ton of dry hay on an acre of land it is necessary that the growing grass should pump up from that acre approximately 500 tons of water. In order to supply this enormous quantity of water, the soil must not only be in condition to absorb and hold water well, but it must be porous enough to permit water to flow freely from soil grain to soil grain. The presence of large quantities of decaying organic matter (humus) adds enormously to the water-holding capacity of the soil. One ton of humus will absorb 2 tons of water and give it up readily to growing crops. Not only that, but the shrinkage of the particles of decaying organic matter and the consequent loosening of soil grains keep the soil open and porous.

Furthermore, humus of good quality is exceedingly rich in both nitrogen and mineral plant food. The maintenance of fertility may almost be said to consist in keeping the soil well supplied with humus. The first step in renovating worn-out soils is to give them an abundant supply of humus of good quality. Perhaps the best source of humus is stable manure containing both the liquid and the solid excrement, especially when the stock are fed with rich nitrogenous foods. Even a poor quality of barn-yard manure, which has had much of the plant food leached out of it, has considerable value because of the humus it makes.

Another cheap and valuable source of humus, but one which must be used understandingly, is crops grown to turn under as manure. The legumes are especially valuable for this purpose because of the nitrogen they contain, but other crops, such as corn sown thickly, may sometimes be made to supply large quantities

of humus of fair quality. Crops thus used are called green manures.

SOIL AIR.

A proper circulation of air in the soil is just as important as any other factor of plant growth. Nearly half of the volume of ordinary soils is occupied by air spaces. The air spaces in the soil wind in and out between the soil particles, just as they do in a heap of larger stones. If the layer of water on the surface of the soil grains becomes so thick as to stop the air passages here and there the soil is then too wet for most crops and needs drainage. Plants have no special breathing organs, the oxygen required in their breathing finding entrance all over the surface of the plant. Plant roots must therefore be supplied with air, and hence the soil must be porous enough to permit of free circulation of air. A good supply of humus and proper tillage will accomplish this result in clay soils. Sandy soils are usually too porous, needing humus to help them to retain water.

Another reason why air must circulate freely in the soil is that large quantities of oxygen are required to insure proper decay of organic matter to supply plant food. Also, carbonic acid gas is produced by the decay of organic matter, and this must escape easily to make room for the atmospheric oxygen needed in the soil. The movement of air in the soil is frequently shown by the bubbles which appear at the surface of the soil just after a heavy rain. As the water soaks into the soil it drives the air out, and bubbles may be seen at the surface if water enough is present to form them.

One of the most important objects of ploughing is to loosen up the soil and mix fresh air with it.

SUBSTANCES THROWN OFF IN THE SOIL BY GROWING PLANTS.

Considerable evidence has been accumulated during recent years to show that the cause of the failure of some soils to produce satisfactory crops may be ascribed to unfavourable conditions produced in the soils by the plants themselves. It is thought that during the growth of the plant certain unknown organic substances are given off which, when they accumulate in the soil to any extent, are harmful to the further growth of plants of the kind that produce them. It is possible that some of the benefits known to arise from systematic crop rotation may be explained on this basis. These harmful substances seem to be disposed of rapidly by certain soils, usually those in which organic matter is readily converted into humus. Other soils, usually marked by a lack of the brown carbonized organic matter, do not seem to possess this property of removing harmful plant products to such a degree. This idea is in accord with the common experience that dark-coloured soils, well filled with organic matter, are usually very productive.

In connection with the study of these poisonous organic products, it has been found that they may be destroyed or at least

rendered harmless in a variety of ways. Barn-yard manure or decaying organic matter, such as a green crop of cow-peas, turned under has a very marked effect in freeing the soil from them. Thorough and complete airing of the soil will often destroy or overcome these poisonous substances. The beneficial effects of ploughing and of thorough surface tillage are thus explained, in part at least, on the basis of the thorough aeration secured. When the same crop is not grown oftener than every three or four years on the same land the injurious substances the crop throws off seem to have time to disappear before the same crop is grown again ; hence the benefit from crop rotation. When the soil is well supplied with humus there is seldom any trouble from this source, and the same crop may be grown year after year with good yields, though continuous cultivation of the same crop may invite injury from certain insects and fungous diseases which live over in the soil or in the remains of the crop.

EFFECTS OF TILLAGE.

Improper methods of tillage add very greatly to the evil effects that result from lack of humus. In many parts of the country the land is ploughed only 3 or 4 inches deep. Below the ploughed stratum the soil becomes sour, densely packed, and unfit for plant roots. When such soils are ploughed deeply and this sour packed subsoil is mixed with the upper portion, the growth of many crops is greatly retarded. This has led many farmers to believe that deep ploughing is ruinous. Some farmers have tried to remedy the difficulty by subsoiling. The subsoil plough breaks up the packed layer but does not throw it out on top. But while subsoiling does break up the hard layer into chunks it does not pulverize it or put humus into it. In most cases work done in subsoiling is practically wasted, and it is doubtful if it ever pays. A much better method is to plough a little deeper each year until a depth of 8 or 10 inches is reached. This gives a deep layer of good soil, particularly if the supply of humus is kept up.

When new soil, or that which has lain undisturbed for several years, is broken up, it is always best to plough deep from the beginning, for the deeper layers will be about as fertile as any, except the top inch or two. It is wise too, never to plough the same depth twice in succession. In general, autumn ploughing should be from 7 to 9 or 10 inches and spring ploughing from 5 to 7 inches deep. There are special cases in which these rules do not apply, but their discussion would take us too far from the purpose of this paper.

We plough the soil in order to loosen its texture and get air into it ; also to turn under stubble, manure, &c., to make humus. Killing weeds is another object accomplished by ploughing. After a soil has been thoroughly pulverised to great depths, so that there is no danger of turning up packed clay, the deeper the ploughing the better the crops. But the cost also increases with depth so that ordinarily it does not pay to plough more than about 10 inches deep.

EFFECT OF PLOUGHING SOIL WHEN TOO WET OR TOO DRY.

Sandy soils are usually not injured by handling when wet ; but the case is different with clay soils. A fair quality of brick can be made from any heavy clay soil by working it thoroughly when wet and then drying it in the sun. The effect produced by working wet clay soils is known as puddling. Irrigation ditches in the west are puddled by first flooding them to make them muddy, and then driving bands of sheep along in this mud. This makes the bottom impervious to water and prevents loss from leakage. If a clay soil is ploughed, or even harrowed, when too wet, it is more or less puddled. In this condition it becomes cloddy and impervious to air and water. Old roadways that have been thoroughly puddled from traffic in all kinds of weather may be distinguished in fields many years after they have been ploughed up and put into cultivation.

The proper time to plough land is when it is just moist enough to break up mellow, neither wet enough to leave a slick surface where rubbed by the mouldboard nor dry enough to break up in large clods ; or, as the southern farmer puts it, when the soil has a good season in it. If continued rain follows wet ploughing, little harm follows ; but hot, dry winds would soon leave only a mass of unmanageable clods. In spring and midsummer ploughing, particularly, it is of the utmost importance to run the harrow immediately after the plough. This prevents the formation of clods.

TERRACING AND SOIL WASHING.

One of the most serious results that follow shallow ploughing, at least in hilly regions, is the washing away of the soil in torrential rains. When terraces are properly laid out they do prevent washing, but they are a very expensive means of accomplishing the end sought. They occupy land that ought to be in crops. They seed the land with weeds. When improperly constructed, and they usually are, they cause great ditches to be washed in the hillsides. Besides this they cut the land up into small, irregular patches and greatly increase the cost of tillage. There is a better way of preventing washing in nearly all cases.

In the first place, where land has been ploughed only 3 or 4 inches deep for several years the subsoil becomes impervious to water and can not absorb a heavy rainfall fast enough to prevent its flowing over the surface. But when the land is ploughed gradually deeper until a good depth of loose soil is obtained, and particularly when an abundance of humus is supplied from grass roots and stubble, or from green crops turned under, or, better still, from barn-yard manure, the soil becomes so porous that the heaviest rains cause little or no flowing of water on the surface.

IMPROVING THE SOIL.

We have seen that poverty in soil may be due to poor texture, unfavourable structure, lack of humus, deficiencies in the amount, form, or proportion of plant food, and to the presence of harmful mineral or organic compounds. With the exception of nitrogen,

most soils, even those that are very poor, usually contain an abundant supply of plant food, though sometimes other elements are lacking or are present only in those forms that plants can not use.

To increase fertility we must improve texture and add plant food and humus. Tillage may do much to improve texture, but tillage alone will not suffice. We must add humus. In doing so we add plant food, and make the soil more permeable to air and water.

INCREASING THE STOCK OF HUMUS.

There are three general methods of supplying humus to the soil. The first and best is the addition of stable manure. When properly managed it adds large quantities of both plant food and humus. But manure is not always available. When such is the case, the best thing to do is to make it available. Raise more forage, keep more stock, and make more manure. But this takes time and capital so that other means are sometimes necessary. When stable manure is not to be had, we may plant crops for the purpose of turning them under, thus adding large quantities of humus at comparatively little cost. Ploughing under green crops is called green manuring. Under certain conditions this is an excellent practice.

STABLE MANURE.

Properly handled, stable manure is by all means the best remedy for poverty of the soil. Very few farmers handle manure so as to get even as much as half the possible value from it. There is probably no greater waste in the world than in connection with the handling of manure by the farmer. Five-eighths of the plant food in manure is found in the the liquid part of it. This is usually all lost. Not only is this the case, but the solids are heaped beside the stable, frequently under the eaves, where rains wash away much of their value. Fermentation in these manure heaps also sets free much of the nitrogen to escape into the air.

GREEN MANURES.

The practice of ploughing under green crops as manures is not very general, and we do not know as much as we should like to know of the value of this method. Some crops do not thrive when sown on land into which a green crop has recently been ploughed. This is particularly true of those crops that like a solid seed bed, or which are sensitive to acids. When a heavy green crop is ploughed under, it goes through a fermentation not unlike that which occurs in a barrel of kraut, resulting in the formation of a considerable amount of acid.

Alfalfa is particularly sensitive to acids, and it also requires a compact seed bed. It is unwise, therefore, to green manure the land just before sowing with alfalfa.

Generally speaking, when it is desirable to plough in a green crop before fall-sown crops, it should be done a month or six

weeks before planting time, and the soil should be harrowed frequently or otherwise compacted. A few good rains will wash out most of the acids and aid in compacting the soil. The acids may also be counteracted by adding lime.

COW-PEAS.

The cow-pea has been a boon to the farmers of the Southern States, and its value is coming to be generally recognized. During the past few years the demand for cow-pea seed has exceeded the supply, and high prices have resulted.

It seldom pays to turn under a crop of cow-peas in the green state. It is better practice to make hay of them, feed the hay, and put the manure back on the land. As is the case with all legumes, the roots of the cow-pea crop add a great deal of nitrogen to the soil, and have a marked effect on fertility. If a heavy green crop of cow-peas is ploughed under in the autumn it is best not to plant the land until the following spring.

SUMMARY.

We may sum up the matter briefly thus: To build up and maintain fertility in the soil, feed a large part of the crops and return the manure to the land. If manure is not available, plough under crops grown for the purpose. Plough deep (but do not subsoil). Grow leguminous crops for the nitrogen they add to the soil.

TOBACCO FROM JAMAICA. VII. *

This sample of tobacco was sent to the Imperial Institute by the Director of the Department of Public Gardens and Plantations of Jamaica. It was grown experimentally under shade cloth during the season 1904-1905 from Sumatra seed.

DESCRIPTION OF SAMPLE.

The sample consisted of six leaves of the "wrapper" type of cigar tobacco, showing a dull, olive-brown tint. The leaves were of fair length, uniform in colour, thin and free from "stains" and "burns." They were somewhat brittle when handled, but this was probably due to their having been packed between sheets of cardboard, which had absorbed the moisture, rendering the leaves abnormally dry.

When ignited the tobacco burned evenly and steadily, evolving a fairly fragrant aroma and leaving a greyish-white ash.

As the sample was very small, it was impossible to submit it to chemical examination. It was therefore sent to a firm of tobacco experts to be tried for wrapping cigars and for the determination of its commercial value. The experts' report on the tobacco was as follows:—

"The tobacco is of very handsome appearance, thin in texture and therefore highly productive as a 'wrapper' for tobacco; in use it is somewhat 'tender' and does not appear to have quite as

* From *Bulletin of The Imperial Institute*, Vol. IV. No. 2.

much elasticity as Sumatra tobacco of similar texture [see note under 'Description of Sample' as to probable reason of this 'tenderness']; the burning is very fair, and the flavour not unsatisfactory.

Similar tobacco, well put up, would fetch on the English market up to about 3s. per lb. for first lengths, say 2s. 3d. per lb. for the second lengths, and from 1s. 3d. to 1s. 6d. per lb. for the third lengths.

"We feel sure that the soil and climate which have produced this tobacco are suitable for growing 'wrapper' tobacco equal to most in the world, and if labour is plentiful and cheap and the area of suitable ground large enough there is a chance in time of this district of Jamaica becoming a serious competitor of Borneo, Sumatra, and Java."

The experts also suggest that it might be worth while to carry out a similar cultivation experiment in Jamaica with Java tobacco, as this would probably yield a "wrapper" leaf which would be stronger in texture and of even better flavour than the present sample.

The results of the experts' trial of this tobacco show that it is of good quality, and that if a similar quality can be placed on the English market in quantity, it will probably realise remunerative prices.

A NEW BOTRYCHIUM FROM JAMAICA.*

By WILLIAM RALPH MAXON.

The systematic status of the members of the group of *Botrychium ternatum* has been the subject of a good deal of comment within the past ten years. Naturally there have developed legitimate differences of individual judgment and interpretation; and, while in one or two instances the results offered have been such as to suggest doubt that the author was in actual possession of some of the forms under discussion, it is probably true that no two students working with the same series of specimens would arrive at conclusions absolutely identical. It becomes often an exceedingly difficult matter to decide whether a given series of plants—and too often a small series—constitutes a sufficiently marked and coherent assemblage to stand apart, specifically distinct, from an obviously related form; or, whether, on the other hand, it is to be regarded as a mere local variation induced, it may be, by habitat.

Of the so-called species recently recognized,† several—and they are, in the opinion of the writer, very few in number—do not appear to be valid species in the ordinary sense of the term: they lack distinctive diagnostic characters and pass insensibly into another form. And, it must be confessed, a study of the entire

* From the *Bulletin of the Torrey Botanical Club*, 32: 219-222, pl. 6. 1905.

† Underwood, An index to the described species of *Botrychium*. *Bull. Torrey Club* 30, 42-55. *Jan.*, 1903.

group must of necessity be more truly comparative and involve a wider view than is usually to be required in most groups of pteridophytes. But the fact remains, that there *are* distinct groups, inhabiting definitely restricted areas and comprising individuals in close agreement in habital and foliage characters, which offer comparatively small but absolute differences from allied groups of individuals from other regions; and it appears to the writer that, unless reduction of the most sweeping sort is to be made, it is undoubtedly the most logical proceeding to recognize these as species and to designate them as binomials. The recognition of sub-species implies or ought to imply the existence of specimens showing the transition from the typical form to the sub-specific centre of variation. In two or possibly three instances among the recently recognized "species" referred to above, such intermediates seem to exist, and the writer hopes to discuss these later at greater length; but in the majority of cases intermediates (if existent at all) have not found their way into herbaria, and the supposed justification for the reduction practised by several American writers appears to be contained in the fast disappearing fallacy that the sum of the differences and not their constancy is the criterion for specific segregation,—a logical pursuit of which principle would lead by no very circuitous route to the treatment accorded the group by Hooker and Baker.

The plant here to be described is not associable specifically with any described form. It may very appropriately bear the name of one whose studies must necessarily prove largely instrumental in a final elucidation of this perplexing group.

BOTRYCHIUM UNDERWOODIANUM sp. nov.

Plant of large stature (3 dm.), to be placed between *B. Jenmani* and *B. decompositum* of the ternatum group. Roots copious, stout, cordlike, corrugate above, fasciculate from a short (1-2 cm.) underground prolongation of the axis: common stalk short (about 2 cm.), bud densely covered with a compact growth of silky hairs; sterile division short-petiolate (5-10 cm.), 12-20 cm. broad and nearly as long, commonly pentagonal in shape, tripinnate, the basal pinnules of the lowermost lateral divisions usually much elongated and again deeply pinnatifid; ultimate segments relatively very large, bluntly obovate or broadly spatulate, the margins evenly and finely crenate-dentate with an occasional shallow lobation; texture slight, resembling that of *B. obliquum*; venation manifest: sporophyl about 30 cm. long; panicle rather lax, about 8 cm. long, bipinnate; sporangia large, sessile.

JAMAICA.—Type in the herbarium of the New York Botanical Garden, Jenman collection. Co-type in the U.S. National Herbarium (no 521103). Of the several specimens collected by Jenman only one is fertile. Other Jamaican specimens are: *Underwood* 179 and 2620, *Maxon* 1573, and *D. E. Watt* (U. S. N. M. 520982), all from the vicinity of Cinchona, altitude about 1500 meters; and two specimens in the herbarium of Capt. John Donnell Smith, communicated

by Hart. The last, though indicated by Dr. Christ as representing a new species, were not described, presumably on account of their immature condition.

The series at hand indicates that *B. Underwoodianum* is one of the most distinct species in the *ternatum* group. As stated, it appears to be most nearly related to *B. Jenmani*, Underw.* and *B. decompositum* Mart. & Gal.† From the former it differs conspicuously in its greater size and more delicate texture; and from the latter imperfectly known species very noticeably in the following distinctive characters: (1) the peculiar shape and spacing of the segments, and (2) the wide divergence of the main divisions which spread ordinarily at an angle of nearly or quite ninety degrees. There is, moreover, in most specimens so pronounced a basisopic development of the first lateral division as to give a decided pentagonal shape to the leaf, though this feature is not especially noticeable in the type specimen.

(United States National Museum).

THE MANGOSTEEN.‡

The species included in the genus *Garcinia* are a comparatively small but valuable group of oriental tropical economic plants. For, not only are the timbers furnished by the *Garcinias* well adapted for building-construction and furniture, but some of the tamarinds, the gamboge of commerce, as well as the much esteemed mangosteen of Malaya are among the products yielded by them. Of all these products, the luscious mangosteen, which, by universal consent, has been admitted to be the most delicious of oriental fruits, is perhaps the best-known to the layman. In the sunny regions of the Malayan sea-board where, for the major portion of the year, sunshine and shower regularly alternate to result in a truly marvellous equability of climate, the *Garcinia Mangostana* grows to perfection. Its artificial cultivation in those regions as well as on the friable loams of the evergreen forests that follow the courses of the rivers of the Peninsula has always been attended with considerable success. For, within the favoured localities of its limited but indigenous distribution, few fruit-crops demand less attention in cultivation; while, after it survives the early stages of its growth, no operations of a cultural nature, beyond manuring, require to be done for the maintenance of the crop.

Well-grown seedlings would be at least a foot in height at the close of the first year and bear from four to six leaves each. At the commencement of the south-west monsoon, the seedlings should be removed from the nursery beds and planted out in pits previously prepared on the plantation. These pits are best excavated at distances of 20 ft. from one another, and should be located in open,

* Fern Bull. 8. 59. 1900. (Type from Jamaica).

† Mém Acad. Sci. Brux. 15^e: 15. pl. 1. 1842. (Type from Mexico).

‡ From "The Tropical Agriculturist, March 1906.

well-drained loamy land. They should each be 3 ft. square and 3 ft. deep, and be filled in with surface soil, vegetable mould and cattle droppings worked up to a friable and fine degree of tilth. In planting, care should be taken to see that every transplant occupies the centre of the pit in which it is put out; for, the species being a surface feeder, the fullest facility should be afforded it for developing its feeding-roots evenly around it. The plants should be shaded with light bamboo-and-grass tatties placed horizontally over each and supported upon bamboo uprights 6 ft. high. This shade should be given directly the transplants are put out and be maintained for at least one year. The tatties may be removed when there is rain as well as at night and in the cooler parts of the day. The plants should also be copiously watered throughout the warmer months of the year for at least two years after they are put out.

The mangosteen plant has been known to bear fruit in the fifth year from planting out or in the sixth from germination. At this age it ordinarily attains to a height of 10 ft. and a basal girth of 1 ft., and its conical crown, which is formed low on the bole, casts a cover of about 10 ft. in diameter. The yield of fruit varies with locality as well as care in manuring and general cultivation; but it usually is small and continues to be poor until the plant reaches its tenth year. Again, the earlier fruits are small and irregularly developed and contain very few pulpy seeds. Thus, the number, size, shape and flavour of the fruits are improved only with advancing years; but, even in young crops, considerable improvement could be effected by heavy periodic manuring and watering. A healthy plant in its tenth year is capable of yielding from two to three hundred mangosteens valued at from Rs. 3 to Rs. 5 per hundred. An acre stocked with plants standing at distances of 20 ft. from one another would hold at least 100 plants. And if, at the end of the tenth year, they yield, on an average, 200 fruits each, valued at the rate of Rs. 4 per hundred, the plantation would yield an approximate income of Rs. 800. The species is well adapted for cultivation in all localities with heavy rainfall, a loamy soil, and enjoying freedom from frost. It luxuriates in bright and vigorous sunshine and demands plenty of light for its most perfect development. The soil, however, should be moist and well drained. It is best grown as a pure crop, unmixed with species other than itself.—*Madras Mail*.

CORN PRODUCTION AND CONSUMPTION *

It is evident from the experience of the past few years of good crops that the consumption of corn [maize] in the United States has increased much more rapidly than the production. Indeed it may be doubted whether there has been any enlargement in the corn area during the past eight years. The statistics of the Agricultural Department show an area last year 14 millions greater than in

*From "The Louisiana Planter and Sugar Manufacturer," Vol. XXXVII, No. 2.

1897, but the census of 1900 show conclusively that the figures of the Agricultural Department were grossly inaccurate for at least five years prior to and including those of 1900. In the past eight years the population has increased 13 millions, or nearly 20 per cent. The prevailing relatively high prices, therefore, seem to be due to the fact that consumption has caught up with production and consequently low prices for corn are not to be expected again unless there is a large increase in the area devoted to producing this crop.

An important factor affecting prices of corn in recent years has been the changed method of marketing the crop. Farmers have taken their time in disposing of their surplus. The policy has prevailed generally of holding ample reserves through the year, so as to provide for deficiencies in case of crop failures. This has prevented the accumulation of large stocks "in sight" which always have a more depressing influence on prices than liberal supplies in farmers' hands. The remarkable situation exists to-day of an almost complete exhaustion of stocks of corn at market centres, notwithstanding the fact that last year's crop was the greatest on record. Under such conditions the farmer is in a position to dictate the price, within a reasonable limit, and he is likely to continue in that position. Speculators who have undertaken to depress prices by short selling have not yet met with any success.—*Kansas City Star*, May 21.

AGRICULTURE IN BERMUDA.

The following notes of interest are taken from the Report of the Superintendent of the Public Garden, Bermuda for 1905:—

Tomatoes.—"The opening up of new sources of supply has contributed not a little to the low prices and a now somewhat limited demand for Bermuda produce in New York; indeed the once very profitable tomato trade was brought to an end in 1900 by large quantities being sent in early from the Southern States; and now that it has been proved possible to export from Cuba and Jamaica excellent fruit from November to March and April, the year round supply is complete: the resuscitation of this colony's lost tomato trade is not, therefore anticipated. In 1871 the boxes of tomatoes exported to New York numbered 115,868 valued at £13,718; in 1900, 146 were sent, valued at £11."

Lily Bulbs.—"The lily bulb industry was, until quite recently, in danger of being destroyed, through the disappointing results obtained by American forcers from Bermuda bulbs; many having given up growing them. Happily some four or five of the larger Bermudian growers realized the importance of selecting and carefully cultivating pure *Harrisii* stock, though, perhaps, somewhat late in the day, for already a large proportion of the trade has been diverted to Japan.

It may be assumed, however, that Bermuda growers will, by careful attention to the requirements of the American and English

forcing trade, be able to secure the present prices for unmixed *Harrisii* bulbs of £5 to £6 per 1000 for many years to come."

Onions.—"These comprise in value about three-fifths of the total output of produce from Bermuda: during the year under review 400,138 boxes were shipped, valued at £62,454."

Potatoes.—"The figures for 1904 shew that the potato at any rate pays for the labour expended upon it: 23,417 barrels were imported from Canada and the United States, valued at £7,260; assuming that one-fourth of these were sets for planting, the cost would be about £1,815. Against these, 31,134 barrels were exported, valued at £23,805: shewing a yield of 5½ barrels to one planted and a balance in favour of the colony of £22,020. This year 28,590 barrels were shipped yielding £21,214".

Tobacco.— Professor Dunstan states as follows: "It may be pointed out that although 5d. per lb. is quoted for the sample of Connecticut wrapper leaf it does not follow that it will ultimately pay best to cultivate this variety. The Connecticut leaf is not economical as a wrapper and for this reason is falling out of favour with cigar manufacturers, and it may be taken as a general rule that a 'filler' of the Cuba type and a wrapper of the Sumatra type, are what is principally in demand for the cigar trade at the present time.

"Having regard to the fact that it would be useless to introduce to Bermuda, as a new crop, anything that yielded less than 50 per cent. on the outlay it was decided by the Board to proceed with a preliminary experiment in growing tobacco under tent cloth on the lines practised in Florida and Connecticut as it was seen by the reports of United States Department of Agriculture that these tobaccos were being sold for from 6/ to 10/ per lb. The writer had also seen bales of wrapper tobacco opened at Jamaica which had cost 10/ per lb. A sum of £100 was granted by the Legislature for this experiment, which was commenced in April."

Oranges.—"The destruction of citrus trees in Bermuda by scale insects is almost complete; the extreme virulence with which these parasites attack their host is almost beyond belief.

In view of the desirability of resuscitating the growing of oranges in the colony, having regard more especially to their added value during the tourist season, special efforts have been made to settle the question as quickly as possible of whether it is possible to give back to Bermuda her lost oranges.

As a result of close observation and of previous experience it soon became evident that the solution lay in the selection of a variety immune, or in some degree resistant to the scale insect.

It has come within the writer's experience among citrus trees in Jamaica to observe that the "Navel" orange enjoyed almost complete immunity from the attacks of scale insects, and moreover was a very satisfactory all round fruit to grow.

And now, judging by the behaviour of this variety in the collection at the Public Garden, the statement may be recorded that it is only a question of time, or rather of the rate at which they can be

propagated, when budded trees of this practically immune variety will be available for distribution.

Twelve thousand Rough Lemon and Seville Orange stocks have been raised from seed obtained from Jamaica; these are now ready for transplanting to the nursery rows where they will be budded and prepared for distribution. Buds can be imported from America at a cost of \$1.50 per 100."

Bananas.—"The Canary Island banana (*Musa Cavendishii*) thrives exceedingly in Bermuda, probably better than in any other part of the world; including that part of China which is its native habitat.

Its doing so well here is another instance of the peculiar effect of our unique climate upon certain plants.

There are in Bermuda probably not more than thirty acres under bananas, planted and cultivated in a style that did very well when there was plenty of land and some to waste, but which would have to be replaced by more up-to-date methods if the banana became an article of export. There is evidently a good demand for Canary bananas in America, for the United Fruit Company, the great collecting and distributing firm, sends as far as the Canaries for them; and it is quite possible that if constant supplies were forthcoming from Bermuda this firm would undertake to receive them at New York.

Planted ten feet by eight apart and given even less care than is bestowed upon potatoes, an acre of bananas could be made to yield in Bermuda quite 2,000 bunches per annum."

VANILLA STATISTICS.*

Mr. Hermann Mayer Senior, vanilla importer, gives the following figures, which approximately represent the world's output of vanilla during the seasons 1905-6: Bourbon, 70 tons; Seychelles, 45 tons; Mauritius, 5 tons; Comores, Mayotte, Madagascar, &c. 120 tons; Guadeloupe, Java, Ceylon, and Fiji, 10 tons; Mexico, 70, tons; Tahiti, 100 tons—total, about 420 tons. Comparing the above figures with 1904-5 it may be noted that the world's output was larger by about forty tons. A British Consular report on Tahiti states that the exports during 1905 amounted in value to £12,087 against £15,969 in 1904, £23,424 in 1903, and £47,417 in 1902. Last year the exports by weight amounted to 122½ tons against 134½ tons in 1904. The U. S. A. received 92 tons, France 25¼ tons, New Zealand 3¼ tons, and the United Kingdom 1¾ tons. No steps have yet been taken to conserve this industry at Tahiti, remarks the Consul, and as a consequence, the local price has further fallen from the equivalent of 1s. 0¾d. per lb. in 1904 to 10½ per lb. in 1905.

* From "The Chemist and Druggist," June 30, 1906.

THE CULTURE OF THE DATE PALM.*

The date palm (*Phoenix dactylifera*) is cultivated principally in Northern Africa and in the countries bordering on the Persian Gulf. Its tall, straight trunk, covered with the scars of fallen leaf-stalks, and surmounted with a tuft of feathery leaves attains a great height—often of over 80 feet. It has the male and female flowers on separate individuals, and in its natural state the female flowers are pollinated by the wind. Each female tree produces from six to twenty flower clusters, each of which gives rise to a bunch of dates. The trees live to a great age and have been known to produce good crops up to 200 years of age. At the base of the stem a number of suckers arise, and by these offshoots the tree should be propagated, since the date palm is very liable to variation.

The average exports of dates from the Persian Gulf region for the five years ended 1902 amounted, according to figures contained in the Consular Report on the trade of the Persian Gulf for the year 1903, to 167,301 cwt.

As will be seen from the following pages, many attempts, some attended with considerable success, have been made to introduce the cultivation of the date palm into different parts of the world and to establish a date industry. Up to the present, so far as we know, the only place out of Africa and the Persian Gulf region, in which real success has been achieved, is in the island of St. Helena. It appears likely, however that good results will be obtained in certain districts of the south-west of the United States.

In the following short account of the culture of the date palm free use has been made of three publications of the United States Department of Agriculture, viz., a paper in the *Yearbook* for 1900, entitled 'The Date Palm and its Culture,' and *Bulletin* No. 53 of the Bureau of Plant Industry, 'The Date Palm and its utilization in the south-western States,' both by Mr. Walter T. Swingle; and *Bulletin* No. 54 of the Bureau of Plant Industry, 'Persian Gulf Dates and their introduction into America,' by Mr. David G. Fairchild.

CLIMATIC REQUIREMENTS OF THE DATE PALM.

The date palm requires above everything else, a plentiful supply of water for its roots, and a hot, dry atmosphere in which to mature its fruits. There are many districts, including parts of the West Indies, where the tree has grown well, but where it is doubtful if good fruits will be obtained on account of the humidity of the atmosphere. On the other hand, such climatic conditions as are required by the date palm are known to exist in parts of the United States, and it is upon this fact that the hopes for its successful introduction as a new industry in that country are based.

It would appear advisable to state clearly the requirements of the date as to climate and water supply.

Heat.—One of the principal requirements of the date is a high temperature, especially when it is maturing its fruit. In the win-

* From the "*West Indian Bulletin*," Vol. V, 1904, p. 139.

ter they are able to withstand a fair amount of cold ; but for the ripening of the fruit a high temperature is absolutely necessary. Swingle states : ' There is little hope of growing even early sorts unless the mean temperature in the shade goes above 80° F. for at least one month in summer, and the mean temperature of the fruiting season, from May to October, is above 70° F. It is, further, fairly certain that during the months when the fruit is developing, viz., May to October, inclusive, the mean temperature must be about 75° F., and during June, July, and August above 80° F., if moderately late varieties of dates are to be brought to maturity. In regions where late varieties of dates come to maturity, the mean temperature for June, July, and August must be 90° F. or thereabouts.

Dry atmosphere.—In this case, again, while the date palm grows fairly well in a moist climate, the fruit matures properly only in a dry atmosphere. Consequently, dates are grown most successfully in the hottest and driest regions.

Water supply.—Although the date delights in a dry, hot climate it requires a constant, though not particularly abundant supply of water at its roots. The subject of irrigation is therefore one of primary importance to the date grower.

PLANTING AND CULTIVATION.

The Arabs of Mesopotamia plant only suckers ; these are seldom over 6 feet long and generally with few roots. They are planted with the growing bud only 2 or 3 inches above the surface of the soil, and for the first month are watered every four days, and later at longer intervals as the season may demand.

The French colonists give much more attention to the careful planting of dates. They plant in regular rows, the arrangement depending, as a rule, on some properly conceived system of irrigation. It is held by them that the palms should be placed at distances of 30 feet, and in intervening spaces are usually occupied by garden crops.

It is found in the Sahara that one male tree will provide sufficient pollen for about 100 female trees, and the male and female trees are accordingly planted in this proportion.

Little has been done in the way of working out the manurial requirements of the date palm. The Arabs use what manure they can obtain from their camels and goats. On the larger plantations it has been found impossible to obtain a sufficiently large supply of farmyard manure. There can be no doubt that a proper system of green manuring, with such leguminous plants as alfalfa, horse bean, cow-pea, and others, would be a great advantage. Neither in Africa nor on the Persian Gulf does any such system appear to be known.

As subsidiary crops between the palms, in addition to garden produce, cereals are frequently grown, but the yield is rarely good : grape vines appear also to thrive well and produce good fruit. Many fruit trees, including olives, seem to appreciate the shade afforded by the date palms.

IRRIGATION.

In the Sahara, irrigation is practised by means of trenches, where no crops are grown under the palms. These are excavated alongside of the trees and occasionally filled with water. Where barley or alfalfa is grown, the land is divided up into small beds from 10 to 30 feet in diameter, which are surrounded by a raised rim. The bed can then be flooded. On account of the alkalinity of the soil, it is found especially necessary to provide a good drainage system.

Mr. Fairchild gives the following account of the method of irrigation practised at Dassorah :—

'The method of planting is determined by the irrigation ditches, which are large (often 3 feet by 3 feet) and cut the ground up into small rectangular peninsulas, 10 to 15 feet by 20 to 30 feet in size. On each peninsula two, or sometimes three, palms are set. Often the peninsulas are much larger and hold from four to five or even as high as ten palms. The size of these peninsulas depends somewhat on the permeability of the soil and the height to which the irrigation water rises in the ditches. On an average 100 palms are planted to a "djerib," which unit of measure is a trifle less than an acre.'

'In order to prevent the waters receding too quickly from the canals when the tide falls, dams of mud are built, and pipes, or the hollow trunks of palms, are run through them, which permit the water forced into the canals by the rising tide to flow away slowly. The length of time during which the canals are filled with water is more or less under the control of the proprietor, and as the supply is practically unlimited, no tax of any kind is paid, nor is any regulation necessary regarding its use.

'In short, the Bassorah date grower has only to see that his ditches are kept in order, which is an easy matter where the soil is as pure adobe as the clay of a brick-yard, and the back water of the river will fill and empty them twice every 24 hours. The conditions of this form of irrigation, which might be called a tidal one, are quite ideal and so far as known are found on such a scale no where else in the world.'

POLLINATION OF THE DATE PALM.

Male and female plants are produced in about equal numbers. As has been stated, date palms are pollinated in the wild state by wind, but where the trees are pollinated artificially, only one male tree is required for every 100 females.

'The male flower cluster of the date consists of a stalk bearing a considerable number of short twigs to which the flowers are attached, the whole contained in a sheath, at first entirely closed, but which finally ruptures, disclosing the flowers. The Arabs cut the male flower clusters from the trees shortly before the flowers have fully opened. The separate twigs to which are attached the male flowers are from 4 to 6 inches long, and bear probably from twenty to fifty male flowers, each containing six anthers full of pollen. One of such twigs suffices to pollinate a whole female

flower cluster, and to bring about the development of a bunch of dates.

'The female flowers, like the male, are borne inside of sheaths which are at first entirely closed. Finally the sheath is split open by the growth of the flowers within, and at this stage pollination is accomplished. The two tips of the cracked-open sheath are separated, and the cluster of female flowers pulled out. A twig of male flowers is then inserted into the cluster of female flowers and tied in place by a bit of palm leaf or with a string. This completes the operation of pollination.

'The fruit cluster soon begins to grow rapidly, and in a few weeks the piece of palm fibre or thread with which the male flowers are held in place, is broken by the pressure of the growing fruit clusters.'*

YIELD, &C.

The age at which date palms commence to bear depends very much upon the climate, the fertility of the soil, and the water supply. In Arizona, United States, it is stated by Swingle, trees have been known to bear within four years of the planting of the seed. It is, however, usually considered that trees do not yield paying quantities of fruit till they are from six to eight years old.

In regard to the bearing of the date palm, Swingle writes: 'When date cultivation is practised scientifically, practically no seedlings are grown, but instead orchards are started by planting fairly large offshoots, which soon strike root, and which often bear abundantly four or five years after being transplanted. However, in the large plantations made in Algeria by the French, it is not considered advisable to allow the palms grown from offshoots to bear fruit until six years after they are transplanted, and the trees are not in full bearing until ten or eleven years after they are planted.

'They continue bearing from this age, if well cared for until they are 100 years or more old, a good tree producing an average of from 100 lb. to 200 lb. of fruit a year, although some trees have been known to produce as much as 400 lb. or 600 lb., when grown in rich soil and abundantly irrigated.'

DATE CULTURE IN THE UNITED STATES.

Efforts have been made to establish a date-growing industry in various districts of the United States. There are portions of Nevada, California, and Arizona, where it is thought the date palm will thrive. In 1898, efforts were made to secure suckers of the best kinds of dates from Algeria. With these was started a special date garden in conjunction with the Arizona Agricultural Experiment Station, where a very large number of varieties of dates has been gathered together, and an attempt is being made to establish the cultivation of the date in some of the irrigable areas of the district.

* *Bulletin* No. 53, Bureau of Plant Industry, U. S. Department of Agriculture, pp. 26-7.

In concluding his article, in the *Yearbook* for 1900, Swingle says :

'It has been shown that there is good ground for the hope that enough dates to supply our markets may be produced within our boundaries, thus retaining in this country nearly half a million dollars now paid annually for foreign dates. It is even possible that a still larger trade may be built up by producing the choicer varieties suitable for serving as table fruit, such as the "Deglet Noor," now so rare on our markets and so costly as to preclude its being sold in any large quantities.

'The date palm has been shown to be adapted to special soil conditions occurring only in a few areas of limited extent in the south-west. It requires a long, extremely dry and hot summer in order to mature its fruits properly, yet the roots demand a constant supply of water. It is unable to endure severe cold in winter, although more hardy than the orange tree. It is pre-eminently suited for culture in irrigated areas in desert regions, and, fortunately, is able to endure without injury large quantities of alkali in the soil and in the water used for irrigating, conditions often occurring in desert regions, and which prevent the growth of most cultivated plants. There are many places in Arizona and California where the culture of the date can be undertaken with a good hope of success. Marketable dates of good quality have already been produced in considerable quantities in the Salt River Valley, Arizona, and excellent fresh dates ripen every year at Winters, in northern California.

'The Department of Agriculture and the University of Arizona have undertaken in co-operation the establishment and maintenance of a special date garden at Tempe, in the Salt River Valley, Arizona, and in 1899-1900 about 420 young palms, comprising about twenty-seven of the best known varieties, including the famous "Deglet Noor," were imported by the Department from the best date regions of the western Sahara and sent to this garden, where they are now growing. Some three dozen plants of the "Rhars" one of the best early dates for drying, were distributed at the same time in California in co-operation with the University of California.'

Three years later, in *Bulletin* No. 53 Swingle writes:—

'The collection of varieties at Co-operative Date Garden at Tempe is by far the most complete in the world, since it comprises the best known varieties from the Algerian Sahara, from Egypt, and from the regions about Bassorah and Maskat, where most of the dates imported into America are produced, as well as a large collection of varieties from the Pangh Ghur region in Baluchistan. Together with the seedlings that have originated in the valley and the sorts growing at the experiment station farm at Phoenix, there are something over ninety named varieties now on trial in the Salt River Valley. It is very probable that some of these will prove to be adapted for profitable culture in this valley, even if the Deglet Noor can not mature.

‘There are several seedling dates that have originated in the Salt River Valley in Arizona, which promise to be valuable.

‘In addition, there are several other seedling varieties of considerable value which have already fruited in central Arizona, some of which may prove adapted to culture on a large scale.

‘Two of the varieties introduced from Egypt by the Department of Agriculture in 1890 have been fruiting for some time at Phoenix, Arizona. In 1900, one of the sorts, the Amreeyah, bore over 300 lbs., while another, the Seewah, bore over 200 lbs. These dates were packed in $\frac{1}{2}$ lb. boxes, and Professor A. J. McClatchie writes that they sold readily for 20c. a box wholesale and 25c. retail, and there was a demand in the local market for ten times the quantity that could be furnished. The Seewah, in particular, is a very promising date for culture in the Salt River Valley, in Professor McClatchie’s opinion, as it is fairly early and of excellent quality.

‘The choicest date that reaches America and Europe, the famous Deglet Noor of the Algerian and Tunisian Sahara, is very sweet, of exquisite flavour, and is adapted to serve as a dessert fruit; it sells for more than Smyrna figs, being the most expensive dried fruit on our markets. The demand for these dates during the holidays is nevertheless greater than the supply, and if they could be sold somewhat cheaper, the consumption of this fruit would be enormous.

‘The Salton Basin or Colorado Desert, in south-eastern California, recently put under irrigation, has a hotter and drier summer climate than the Algerian and Tunisian Sahara, where the best grades of Deglet Noor dates are grown, and is, indeed, better adapted to the culture of this fruit, since not only is the climate more favourable but the soils are richer, and the irrigation water is of better quality.

‘The date palm will prove of equal value on the more alkaline areas of other arid regions in the south-western States where the winters are warm enough to permit it to grow. Most regions do not have sufficient summer heat to mature the Deglet Noor date, and other sorts which ripen earlier must be planted.

‘It is very probable that the culture of the best second-class dates, suitable for employment in confectionery and for household uses, will prove a profitable industry in the Salt River Valley, Arizona, and it is possible that the Deglet Noor variety may mature there.’

DATE CULTURE IN JAMAICA.

The following extracts are from the Annual Report (1900-01), of the Director of Public Gardens and Plantations, Jamaica:—

‘Seventy-five date palms were received from Algiers in November 1899. They were in tubs, pots, and wicker baskets. To enable them to recover from the effects of their long journey, and to get acclimatized, they were placed in the nursery, looked after there, and gradually exposed to the sun and hardened.

'In February and March 1901, sixty-nine of the plants were planted in prepared holes on the lawn between the Director's office and residence. The plants are placed 36 feet apart in rows which are 27 feet asunder. Five of the original plants have died.

'A 4-inch water main runs along the side of the drive, parallel with the palms, and connexions have been made with this by means of $\frac{3}{4}$ -inch galvanized pipes with brass cocks, and laid to the root of each palm, so that each tree has its own supply of water.

'Three suckers have been established, so that we have at present seventy-three young trees.

FUNGOID DISEASE OF THE DATE PALM.

The only fungoid disease reported as attacking date palms in the West Indies is recorded from Antigua, Jamaica, and Trinidad.

The following description of the fungus is taken from TUBEUF and SMITH'S *Diseases of Plants* (p. 325):—

'*Graphiola phoenicis*, Poit. This fungus is a parasite on leaves of palms, e.g., *Phoenix dactylifera* and *Chameroops humilis*, in the open in Italy and other Mediterranean countries, in hot-houses elsewhere. The sporocarps make their appearance as little black protuberances on both sides of the leaf. The mycelium forms a close hyphal tissue, which encloses and kills parenchymatous cells, displaces the bundles of sclerenchyma and ruptures epidermis and hypoderm. Deformation is, however, localized to these spots.'

The following is translated from Frank's *Die Pilzparasitaren Krankheiten der Pflanzen* (Breslau, 1896, p. 127):—

Graphiola phoenicis occurs on the leaves of the date palm both in its natural habitat and in our houses. The fruit-bodies appear as scattered, hard, dark swellings, about 1.5mm. across, and which are sometimes surrounded by a clearer border showing the part of the leaf-tissue containing the mycelium of the fungus. E. FISCHER (*Botanische Zeitung*, 1883) has sown spores of the fungus on date palm leaves and has thus made successful infections. Other species of this genus occur on other palms.

[This fungus can be kept in check by spraying with Bordeaux mixture. Ed. Bull.]

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Wednesday, 15th August, 1906, Present:—The Hon. T. L. Roxburgh, Acting Colonial Secretary, Chairman, the Acting Director of Public Gardens, the Acting Island Chemist, the Superintending Inspector of Schools, His Grace the

Archbishop, of the West Indies, Messrs. C. A. T. Fursdon, J. W. Middleton, G. D. Murray and the Secretary, John Barclay.

The Minutes of the previous meeting were read and confirmed.

The Secretary read the report of the Committee appointed to go into the matter of the Assistant Superintendent at Hope Gardens.

It was agreed to acknowledge receipt of the letter from the Government, and to forward the recommendations of the Committee.

The Secretary reported that the Government Printing Office had returned the draft of the "Agricultural Don'ts" chart to the Acting Chemist with the remark that they could not carry out the recommendations of the Board as they had not the type, and that to save time he had replied that under the circumstances to simply alter the type of the numbers would be sufficient.

The Secretary read a letter from the Westmoreland Sugar Planters' Association acknowledging his letter with regard to the truck system alleged to prevail on sugar estates in that parish.

The Secretary read letters from the Colonial Secretary's Office as follows:—

1. Re the Island Chemist's visit abroad to gain information with regard to the Rum Industry, stating that the Governor had adopted the recommendations of the Board and approved of the travelling expenses being charged, as suggested, but pointing out that no estimate of the amount required had been given and that his consent was given strictly on the understanding that the Vote should not be exceeded.
2. Copy of letter to the Superintending Inspector of Schools stating that on the advice of the Board of Agriculture, the Governor had approved of the appropriation of £30 of the item of £50 for "Model School Gardens in Country Districts" on the Estimates for Agricultural Services, in aid of the item on his estimates of £50 for School Gardens, for the purpose of making grants for tools, and that in future there should be one Vote on the Estimates, and that should be on those of the Schools Department.
3. Re Board's Report for last year, stating that the paragraph relative to the adoption of a legal standard of ether contents in Jamaica Rum was incorrect and suggesting a paragraph to be substituted.

The Secretary stated that the report had been prepared by the Chairman (Mr. Bourne) and Mr. Cousins and they had in error included a matter which appeared in the April minutes and therefore occurred this year, and he had replied that the whole matter would be deleted from last year's report.

This was approved of.

4. Papers re Swift's Arsenate of Lead, containing an application from J. M. Crosswell & Co., for the admission of this insecticide free of duty like Paris Green, with minutes from the Collector General and the Island Chemist. The Secretary reported that it would come slightly cheaper than Paris Green, and it was resolved to recommend to the Government that it be admitted free of duty.

The Secretary read letter from the Northside Sugar Planters' Association asking for a report on the working of the High Ether Process at Hampden.

The Secretary was instructed to reply that the Board was not in a position to give the information asked for until the return of the Government Chemist from his leave of absence early in October.

The Secretary submitted letter from Mr. J. Briscoe, Superintendent of the Parade Gardens, asking for an increase of salary.

The Board directed the Secretary to reply that they could not recommend the increase asked for.

The Secretary submitted the following reports :—

From the Chemist on the work of the Students for mid-summer term, which was directed to be circulated.

From the Acting Director of Public Gardens on the work of the Experiment Station and the work of the Instructors. These were directed to be circulated.

The meeting then adjourned till Wednesday, 12th September.

[Issued 10th Sept., 1906.]

Printed at the Govt. Printing Office, Kingston, Jam.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

OCTOBER, 1906.

Part 10.

NOTES ON THE CULTIVATION OF VEGETABLES.

By W. HARRIS, *Superintendent of Hope Gardens.*

In view of the existing demand for fresh vegetables on the Isthmus of Panama, the following notes are published in the hope that they will be useful to those who may feel inclined to venture on the cultivation of any or all of the crops named.

PREPARATION OF SEED BEDS.

Select a level piece of ground in the open, but sheltered from strong winds, where the soil is light and good. Mark off the number of beds likely to be required. The beds should be 4 feet wide with paths 18 inches wide between them. Having marked off the beds with a peg at each corner, they should be thoroughly dug up and the soil broken fine. Before sowing seeds the surface of the beds should be raked over to remove all stones, hard lumps of earth, etc. Seeds of very tender plants should be sown in boxes.

TO DESTROY GRUBS, BEETLES, ETC.

When the ground is ready for sowing seeds, or for planting out young seedlings, spread all over the surface a layer of dry grass, banana trash or such like. The beetles, grubs, etc., collect under the trash and after 3 or 4 days fire is set to it, and large numbers of the pests are destroyed. A double purpose is thus served, as the ashes of the burnt trash are very beneficial to the young plants.

SOWING THE SEEDS.

Having prepared the seed bed, get a rod four feet long, lay this across the bed, and whilst holding it in position with one hand, mark off the shallow drills with the forefinger, or a piece of stick along the four foot rod. For coarse seeds such as beans to be sown in long rows, a line should be stretched along the full length of the bed, and the drills opened out with the corner of a hoc. It is better to sow all seeds in drills at the proper distance apart

the seedlings are easier to thin, and weeds can be pulled out without destroying a number of the young plants.

Small seeds should only be covered very slightly with fine soil, but the larger seeds may be covered to a depth of half an inch, or an inch.

The best time to sow seeds and transplant young plants is during showery weather.

BEEF ROOT.

Sow the seed in drills where the crop is to grow, in a sandy, open situation. Ground that has been manured for a previous crop will not require to be again manured for beet. Allow a distance of 15 inches between the drills, and as soon as the young plants are large enough to handle, thin them out to 9 inches apart in the drills. The young plants taken out may be used to supply vacancies, or to plant elsewhere, but these beets are never so good as those which are not disturbed.

The seed should be soaked in luke-warm water for about twelve hours before sowing, then taken out, allowed to drain, and sown whilst still damp, and covered to a depth of 1½ or 2 inches.

Quantity of seed—The quantity of seed required to sow a row 1 chain in length is 1½ ounces.

Varieties—The “turnip-rooted” varieties are best for culture here, and the following are highly spoken of:—*Carter's Early Crimson Ball, Egyptian Turnip-rooted, Eclipse, Dewings Improved Blood Turnip, Bassano, Landreth's Very Early, and Early Blood-red Turnip.*

Prices of seed—The price of English seed varies, according to the variety, from 6d. to 2 per ounce, and American seed from 10 to 20 cents per ounce.

CABBAGES.

A good soil, heavily manured is requisite for the production of tender and succulent cabbages. They should occupy the coolest and moistest situation in the garden as heat and drought are injurious to them. The seed should be sown in beds of light, rich soil, and as soon as the plants begin to crowd each other they should be transplanted to their final positions. The distances between the plants will depend on the size of the variety grown, but, generally, 2 feet between the rows and 18 inches from plant to plant will be sufficient. They should, whenever possible, be planted out in moist weather, and in absence of rain should be irrigated or watered regularly.

Quantity of seed—A quarter of an ounce of seed will produce sufficient plants for 7 rows one chain in length.

Varieties—The following should be tried:—*Carter's Early Heartwell, Carter's Model, Carter's Little Pixie, Carter's Mammoth Beefhearted, Early Jersey Wakefield, Carter's Early Dwarf Ulm Savoy, Henderson's Charleston Wakefield, Henderson's Early Summer, Henderson's Autumn King, Landreth's All the Year Round, Bloomsdale Early Dwarf Flat Dutch, Redland Early Drumhead.*

Prices of seed—English, 4d. to 1 6d. per ounce; American 25 to 50 cents per ounce, according to variety.

CARROTS.

Sow in the open where the crop is to grow. Carrots require a good light soil which has been previously well dug and manured. The seed is sown either broadcast on a bed, or in drills, but the latter is the preferable method as the young plants can be thinned more uniformly. A distance of 12 inches between the rows and 6 inches from plant to plant is generally allowed. The seedlings are usually thinned twice; the first thinning when they are quite young, leaving a space of 3 inches between the plants in the row; a second thinning takes place when the roots are small but of edible size, when every second plant should be pulled to allow the requisite space between those that are left to grow.

Quantity of Seed.—The quantity of seed required to sow a drill one chain in length, or a bed about 16 feet by 4 feet marked off in drills, is one ounce. On account of the bristles on carrot seed it is somewhat difficult to sow with regularity; it is usual, therefore, to mix the seed with fine sand or sifted dry earth and sow the mixture.

Varieties.—The short-rooted kinds are worth a trial:—*Early Short Horn, Carter's Improved Early Horn, Carter's Summer Favourite, Danvers' Early French Forcing, Early Scarlet Horn, Half-long Red, Extra Early Forcing, Nantes.*

Prices of seed.—English, 4d. to 1'6 per ounce; American, 10 to 25 cents per ounce.

CUCUMBERS.

The American method of cultivation is to plant in hills about 4 feet apart each way, in rich sandy soil. The hills are previously prepared by thoroughly mixing with the soil of each a good shovelful of well rotted manure. The seeds are planted in the hill, and three or four strong plants allowed to each. When the fruit is in fit condition it is gathered whether required for use or not, as if allowed to ripen it destroys the productiveness of the plants. The plants should always have plenty of moisture regularly supplied during growth.

In one or two counties in England, the soil and climate of which seem unusually well adapted to the growth of cucumbers, large quantities are grown in the open air for the London markets; from such sources there are said to be sent not less than 600 tons a week during the cucumber season, and of these 100 tons have been known to be sent to Convent Garden in a single day. The seed is sown where the plants are intended to grow, two feet apart in the rows, and the rows four feet asunder. They soon push into active growth and cover the ground with vines, which spread in all directions, and come into bearing. During their growth weeding and thinning their superfluous shoots are well attended to, and in the fruiting season, fruit from 10 to 12 inches in length green and solid though sometimes unshapely, is continually being cut.

Seed required.—One ounce of seed will plant 50 hills. The seeds should be soaked in luke-warm water for a few hours before planting, and only those that sink to the bottom of the vessel

ought to be used ; the seeds that float on the surface of the water are often imperfect and would not grow.

Varieties.—*Carter's Best of All, Stockwood, Improved Early White Spine, Livingston's Evergreen, Extra Early Green Prolific, Nichol's Medium Green, Long Green Turkey, Landreth's First, Landreth's Choice.*

Prices of Seed.—English, 6d. to 1s. per packet ; American 5 to 20 cents per packet, or 10 to 40 cents per ounce.

GARDEN EGGS.

Soil and Situation.—A good rich soil is necessary, plenty of thoroughly rotted short stable or cattle manure should be dug in. A sheltered position should be chosen, where abundance of water can be given.

Sowing seed.—The seed is sown in nursery beds. About one ounce of seed should give 1000 plants.

Planting.—The plants are set out at 3 feet apart in rows, the rows being 5 feet apart. About 3,000 plants go to the acre.

Cultivation.—If well grown, large fruits are desired, only a certain number should be allowed to each plant in proportion to the strength and peculiar variety. The ends of the branches should be pinched when the fruits are ripening. The varieties differ in the length of time they take to ripen their fruit, from two to six months. In a tropical climate like Jamaica, it is preferable to grow those varieties which require the longest time, as the fruit is larger and better flavoured. In temperate climates, on the other hand, the "early" varieties are preferred.

Varieties.—The following are the chief varieties—

(1) *Long Purple.*—The fruit is from 6 to 8 inches long, and 2 to 3 inches in diameter. It is best in quality before it is fully grown. Five or six months are necessary for its growth. There may be 8 or 10 fruits on a large healthy plant.

(2) *Early Long Purple.*—This is only an early variety of the preceding, and the plant is not so strong nor so large.

(3) *Round Purple.*—The fruits are large and somewhat pear-shaped. Not more than 3 or 4 should be left to grow on a plant.

(4) *New York Improved.*—The fruit is like that of the Round Purple, but the plant is smaller. Not more than 2 fruits should be allowed to a single plant.

(5) *Early Dwarf Purple.*—This is an early variety. The plant is low-growing and branching, and may carry 10 or 12 fruits. The fruit is of a longer shape than the Round Purple, 3 or 4 inches long and about 2 in diameter at the thick end.

(6) *White China.*—This is a very distinct variety, with long slender white fruit.

(7) *Landreth's Thornless Large Round Purple.*—This is a variety recommended by Messrs. Landreth.

Prices of seed.—American 30 to 60 cents per ounce ; French 3d. to 1/ per ounce.

KIDNEY BEANS.

The cultivation of *Kidney Beans* (*Red Peas*) is well understood here, as they form one of the principal crops grown by the peasantry, but they are grown as a field crop and the pods are allowed to ripen on the plants. They should be grown in rows at least 2 feet apart, and the plants 9 to 12 inches apart in the rows.

Quantity of Seed.—A little over half-a-pint of seed will plant a row a chain in length.

Varieties.—*Carter's White Advancer, Carter's Newington Wonder, Monster long podded Negro, Improved Golden Wax, Flagcolet Wax, Henderson's Earliest Valentine, Cylinder Black Wax, Yosemite Mammoth Wax, Early Warwick, Early Mohawk.*

Prices of Seed.—English ranges from 10d. to 2s. per quart; American 25 to 60 cents per quart.

KOHL RABI.

This vegetable holds a place intermediate between the cabbage and the turnip. It is very hardy and resists drought better than the turnip.

Sow the seed thinly in a seed bed, and when the young plants are a couple of inches high they should be transplanted into any good, well-manured piece of ground, planting them about 9 inches apart in the rows, and the latter 18 inches asunder. If the weather be dry, water should be given till the plants take fresh root. With the exception of weeding and stirring the ground occasionally, no further cultivation is necessary.

LETTUCE.

The soil for lettuce should be well manured with good rotten manure. The seed should be sown in drills about 15 inches apart, and as soon as young plants are large enough to handle they should be thinned out to about 12 inches. The plants removed in thinning should be transplanted at the usual distances and they will be ready for pulling from two to three weeks after those left in the seed drills. After transplanting it will be necessary to water the plants for some days till they get established.

The surface of the soil between the rows should be kept stirred during growth, and an occasional application of weak liquid manure, when the plants begin to form heads, will be beneficial.

Quantity of seed required.—Half an ounce of seed will sow a drill one chain in length.

Varieties.—*Boston Market, Tennis Ball Black Seeded, All the Year Round, Henderson's New York, Perfected Salamander, Big Boston, Virginia Solid Header, Largest of all, Yellow Seeded Butter, Golden Queen.*

Price of seed.—American 10 to 30 cents per ounce.

MUSK MELONS.

Melons thrive best in a moderately enriched light soil; the hills should be from three to six feet apart each way, according to the richness of the soil, if the soil is poor or sandy, plant at four feet. Previous to planting, incorporate well with the soil in each hill a couple of shovelful of thoroughly rotted manure; plant twelve or

fifteen seeds in each hill, and when well up, thin out to three or four of the most promising. Pinch off the leading shoots as the growth becomes too luxuriant, and if the fruit sets too numerously thin out when young, which will increase the size of those remaining and cause them to ripen more quickly.

Quantity of seed.—One ounce for sixty hills.

Varieties.—*Early Hackensack, The Newport, Emerald Gem, Baltimore or Acme, Extra Early Citron, South Jersey, Atlantic City, Extra Early June.*

Price of seed.—American, 10 to 30 cents per ounce.

MUSTARD AND CRESS.

No plants are more easy to grow than these; they may be sown in any kind of soil, but preferably in a moist and shaded position, with the certainty of having plants fit to cut in a couple of weeks. Sow each broadcast in a bed, and rake lightly over.

Quantity of seed required.—One ounce of seed will sow a bed 16 feet by 4 feet.

MUSTARD Varieties. *Finest White, Brown or Black, New Chinese.* Prices of seed, English, 3d. & 4d., per ounce or 1 3 per pint, except *New Chinese*, which is 2 per pint. American 5 cents per ounce or 40 cents, and \$1 per lb.

CRESS Varieties:—*Plain or Common Golden.*—A delicious salad—*Carter's Cut and Come Again, Australian.*

Prices of seed:—English, 3d. and 4d. per ounce; American 10 to 15 cents per ounce.

OKRA.

Plant beginning of August, October, December and February to keep a supply of young pods from October to May.

Okra is extensively grown, its young pods being used in soups stews, etc. It thrives well in any moderately rich soil, the richer the better. The seed should be planted about 3 feet apart in rows where the plants are to remain.

Quantity of seed.—A couple of ounces of seed will plant a row one chain in length.

Varieties.—*White Velvet, Dwarf Prolific, Landreth's Long Green, Landreth's Long White.*

Price of seed.—American, 10 cents per ounce.

ONIONS.

Onions succeed best in an open situation in a rich loam, rather light than heavy. If the soil is too light, means must be taken to make it firm. It should in the first place be dug and broken up fine, to ensure an equal looseness throughout; it should then be trodden down with the feet in order to render the bed uniformly compact.

Well-rotted stable manure, the sweepings of poultry and pigeon houses, and bat manure are recommended. Sheep's dung, and well decomposed night soil are likewise excellent.

Shallow drills about 12 inches apart should be drawn, and the seeds sown thinly along the drills and very lightly covered with

fine soil, then the whole surface should be well trodden, and smoothed with the back of a rake. The young onions should be thinned to a distance of 3 inches when large enough to pull, and the seedlings thus removed may be transplanted, if desired. Later on a second thinning will be necessary, when every second plant should be pulled, leaving a distance of 6 inches between the plants in the drills.

Even to keep down weeds, deep hoeing is not advisable, as the ground must be kept solid, but the soil between the drills should be lightly hoed occasionally.

When the bulbs have attained their full size, the leaves are bent down at the neck of the bulb by the back of a wooden rake. This checks the flow of sap and causes the leaves to decay, and the bulbs to ripen more quickly. When the leaves wither, the onions are taken up and left lying for 3 or 4 days to dry in the sun, with an occasional turning over; they are then fit for market.

PARSLEY.

Parsley likes a good but not too rich soil, in a somewhat shady situation. The seed should be sown in drills 1 foot apart, and covered with fine mould to the depth of half an inch. The seed germinates very slowly, often taking several weeks, and the drills should be frequently watered till the young plants are well above the ground.

Quantity of seed.—Half an ounce will sow a drill one chain in length.

Varieties. *Carter's Ferned-leaved*, price 1'6 per ounce, *Carter's Perpetual*, price 1 per packet, *Champion Moss-Curled*, price 1 per ounce, *Covent Garden Garnishing*, price 9d. per ounce. *Double Curled*, price 4d. per ounce, *Henderson's Emerald*, price 10 cents per ounce.

PEAS. (English)

Sow from beginning of September to beginning of March, once a fortnight, or once a month, to have peas for market from November to May.

Soil.—A good friable loam, in which there is plenty of lime, is the best for peas. The soil should be dug to a good depth, and left rather rough so that the rain water may not run off it, but pass through the soil.

Manure.—Well-rotted stable manure should be applied in greater or less quantity according as the soil is more or less poor, and it should be dug in about a foot below the surface.

The ground having been prepared, the first thing to be done is to mark the distances for the rows, and this will depend on the heights of the varieties selected. Tall growing varieties require to be planted not less than 7 or 8 feet apart, and in England they are often planted at twice or thrice that distance apart, and other low growing crops, such as turnips, etc., planted between the rows, it having been abundantly proved that the further the rows are placed apart, the better the yield and produce. As a rule, however, the distance between the rows may be about the same as the height to which the varieties usually grow.

Sowing the Seeds.—Having decided on the distances apart for the rows, and marked them with pieces of stick, a line should be stretched and drills made with a garden hoe, about 3 or $3\frac{1}{2}$ inches deep, and about 6 inches wide, then the seeds should be sown, not too thickly, but allowing room enough for them to grow, without robbing each other of nourishment and moisture. When the seeds have been sown, the soil taken out of the drills should be broken fine with a rake if lumpy, and the peas covered with it, and lightly trodden.

As soon as the plants have grown a few inches, a little earth should be drawn by a hoe towards them, and this should be repeated as they advance. They should then be at once staked, and as soon as the tendrils appear the sticks will be in readiness for them to lay hold of. Small sticks may be used at first, but as the plants advance in growth, taller, twiggy branches will be necessary. Two rows of sticks are needed for each row of peas, one on either side of the plants. In staking begin at one end of the row, put the sticks firmly in the ground, and slant those on one side slightly in the same direction in a line with the row, and if those on the other side of the peas, are equally slanted in an opposite direction a kind of lattice work will be formed and will be a good support for the plants.

If the weather be hot and dry, a thick layer of litter spread between the rows will be advantageous, by keeping the ground moist and comparatively cool.

Quantity of seed. For a row of one chain in length $1\frac{3}{4}$ pints of seed are required, making allowance for a proportion that either will not come up at all, are so weakly as to be of no account.

Varieties. The varieties of the Pea are so numerous that a mere list of the names would occupy several pages. From experiments carried out at the Hill Garden, for productiveness, the following can be recommended:—*Carter's Balmoral Castle*, *Carter's Princess Royal*, *Laxton's Alpha*, *Duke of Albany*, *Laxton's Prolific*, *Kentish Invicta*, *Abundance*, *Carter's Telephone*, *Carter's Telegraph*, *No Plus Ultra*, *Henderson's First of all*, *Horsford's Market Garden*, *Landreth's French Canner*.

Prices of seed. English, 9d. to 2 6 per quart; American, 25 to 80 cents per quart, according to variety.

PEPPERS.

They should be planted about $2\frac{1}{2}$ feet apart in rows, and the latter should be about 3 feet asunder in good mellow soil.

Quantity of seed.—Half an ounce of good seed should produce sufficient plants for five rows of one chain each, planted at $2\frac{1}{2}$ feet apart.

Varieties. County Fair.—Particularly sweet and mild, being thicker in the flesh than any other sort and enormously productive. Seed, 10 cents per packet, 40 cents per ounce.

Cardinal.—Glossy bright red in colour; five to six inches in length, being about an inch broad at the base and tapering to a point. Very sweet and thick fleshed. Seed, 5 cents per packet 40 cents per ounce.

Ruby King.—An exceedingly large and handsome pepper of mild flavour; the fruits of a bright ruby red. Seed 10 cents per packet, 25 cents per ounce.

Large Bell.—An early variety of mild flavour, a favourite for pickling and for use in the natural state. Seed 5 cents per packet, 25 per ounce.

Golden Dawn.—Of similar shape and size as *Large Bell*, but of more delicate flavour; colour yellow. Seed, 5 cents per packet, 25 cents per ounce.

POTATOES.

Plant from October to January to have new Potatoes ready for market from end of December or beginning of January to April.

Soil.—Potatoes will grow in almost any kind of soil with good cultivation, but a good friable loam, rather light than otherwise, and free from stagnant water is the best. Good potatoes are produced in light sandy soil, but a liberal supply of manure is necessary to ensure a heavy crop.

Manure.—The quantity and kind of manure to be employed must depend on the nature of the soil, to a light sandy soil, a liberal supply of thoroughly decomposed manure should be given, but if the soil is of a heavy, damp nature, half rotted long manure is best. In hot, dry soils, cow dung when it can be obtained, is preferable, as it retains more moisture than stable manure, but it should be well mixed with litter. Pig's dung is too powerful in an unmixed state, but when mixed with about twice its own bulk of earth it forms an excellent manure. Generally speaking, however, for the hills of Jamaica, farm-yard manure, that is the excrements, both solid and liquid, of the various animals kept about a place, mixed with litter and refuse and allowed to decompose, is probably the best.

"Seed" or Sets.—There is some difference of opinion as to whether the tubers should be planted whole or cut, but from experiments made in the Gardens of the Royal Horticultural Society at Chiswick, London, it was found on the mean of two plantations that the produce from cut sets exceeded that from whole tubers by nearly one ton per acre. Good sized tubers are considered best for sets. The eyes in the Potato are true buds, and it stands to reason that good sound tubers with strong eyes or buds, will produce much more healthy and vigorous plants than small tubers with comparatively weak eyes. This, also, has been proved by actual experiment.

When good sized tubers are used for sets they may be cut in halves passing the knife through from the bunch of eyes at the top, and generally the halves may be divided again. One good eye to each set is all that is really necessary, but it is safer to cut the set so that it may have two eyes, as sometimes an eye is blind, or so weak as to be unable to push.

The sets should not be planted for a few days after being cut, but kept in a dry place, and some wood ashes or such like material mixed with them to absorb the juice exuding from the fresh cuts, and thus prevent decay setting in.

Modes of planting—For garden cultivation, or small patches of ground, drawing drills with the hoe, if the soil is well pulverised, or digging trenches are probably the best methods. I have no doubt that drawing the earth into hills, as is done for Sweet Potatoes, and planting a set in each hill would be an excellent plan. By this means each plant could be moulded with fine soil when needed, and the hills being above the level of the ground would ensure good drainage, and it should always be borne in mind that two of the main things necessary to ensure success in the cultivation of the Potato are good drainage, and a good body of pulverised soil. In heavy wet ground a good plan is to throw the soil up in ridges. These are really raised beds about $4\frac{1}{2}$ feet wide, with trenches 18 inches wide between them; the soil taken from the trenches is thoroughly broken up, and used for covering the sets, and for moulding the plants later on. The trenches act as so many drains during heavy rains and keep the ridges comparatively dry.

Some growers spread the manure on the ridges, or in the drills or trenches just previous to planting and lay the sets on it; but this is not considered a good plan, as later on the young tubers come into direct contact with the manure which causes them to scab, and as the manure is provided to afford nourishment to the fibrous roots, not the tubers, it is a mistake to run the risk of spoiling the appearance of a crop by adopting this method. For field cultivation I should recommend opening trenches or drills from end to end of the ground, spread the manure evenly in the bottom of the trenches, or on the tops of the ridges if that system of cultivation is adopted, and cover it to the depth of a couple of inches with fine soil, then lay the sets and cover up. If only a garden, or small piece of ground is to be planted it will be better if it is evenly manured and well dug over sometime previous to planting, and when the season comes round the trenches can be opened and the sets planted without any further manuring.

Dibbling in the sets is a system followed in England to a considerable extent, but unless the soil has been well cultivated previously it is not a system to be recommended here. The sets are likely to be placed at unequal depths, and the chances are that the eyes will be turned down in the holes instead of being placed uppermost, and in performing the work the ground gets trodden unnecessarily, the consequence being that if dry weather follows, the soil cakes and the buds are unable to push through it, whereas if rain follows immediately after planting, it collects in the holes and as likely as not causes the sets to rot.

Distance apart.—The distance at which the sets should be placed apart varies with the nature of the soil and vigour of the kind grown; in rich soils a greater distance should be allowed than in poor soils. In general, the distances should be $2\frac{1}{2}$ to 3 feet between the rows, and 12 to 15 inches between the sets in each row, but as a rule, the greater the distances the better the yield.

Depth.—The depth to which the sets should be covered also

varies somewhat, but 4 to 5 inches in heavy, and 5 to 6 inches in light soils are about the proper depths.

Subsequent culture.—This consists in keeping the ground free from weeds, earthing up the plants as they advance in growth, and keeping the soil stirred and fine, as the more it is pulverised, the better, but taking care not to injure the young roots or tubers.

Lifting.—When the tops are observed to wither from natural decay the crop may be lifted, and this should not be delayed too long, as if so, in this climate the new tubers are apt to vegetate. Choose fine, but if possible cloudy weather as potatoes should be exposed to light, and specially bright sunshine as little as possible. Exposure to the sun causes the tubers to turn green, and it is well known that the green parts of a potato contain a more or less poisonous principle. After lifting, the potatoes should be stored in a dry airy room or shed, but light should be excluded as much as possible. Potatoes are too often exposed to the light, and when such are cooked they are yellow in appearance and have a decided bitterish flavour, whereas if kept in the dark till required for cooking they would be white and floury.

Varieties.—The varieties of the Potato are exceedingly numerous, but the kinds to be grown for shipping during the winter months are those known as “new potatoes”—the various kinds of Kidney potato—*Carter's First Crop*. A re-selected stock of the earliest, most prolific and best Kidney in cultivation. Price 5' per peck (14 lbs), per $\frac{1}{2}$ cwt. or bushel 17 6.

Carter's Improved Early Ashleaf.—The first early White Kidney Price 4'6 per peck (14 lbs), per $\frac{1}{2}$ cwt. or bushel 14'.

Myatt's Early Prolific Ashleaf.—This is the variety so largely grown in Cornwall and Jersey as an early Potato for the English markets, and it is probably the most certain early-cropping Kidney in commerce. Price 2'6 per peck (14 lbs), per $\frac{1}{2}$ cwt. or bushel 8'6.

Victor (Sharpe). Several seasons' trial have fully confirmed all that has been said of the *Victor Kidney Potato*. It is proved to be one of the earliest, most prolific, and best flavoured of all early potatoes. Price 3'6 per peck (14 lbs), per $\frac{1}{2}$ cwt., or bushel 12'.

Snowdrop.—Of sterling merit, both as to quality and productiveness. One of the handsomest Kidneys grown. Price 3 per peck (14 lbs), per $\frac{1}{2}$ cwt. or bushel, 10'6.

Early Norther.—This variety seems to do well everywhere. Its table qualities cannot be excelled, cooking dry and floury, whether baked or boiled. Price 70 cents per peck, \$2.25 per bushel.

PUMPKINS.

Plant at same time as Squash, in hills 8 feet apart each way, and only allow one plant to each hill.

Varieties.—*Calhoun, Winter Luxury, Yellow Cashaw, Jonathan, Large Cheese.*

Price of seed.—American, 5 to 10 cents per packet.

RADISH.

The radish will succeed in any light, open soil, but rather a shady spot should be selected. To grow them properly the ground should be dug deeply, and the surface raked fine. The seed is usually sown thinly broadcast in beds about four feet wide, and the surface lightly raked over after sowing. In dry weather the beds should be watered early in morning.

Quantity of seed required.—One and a half ounces of seed will sow a bed 16 feet long by four feet wide.

Varieties.—*Earliest Long Frame, Carter's Violet French Breakfast, Carter's Early White Turnip, Carter's Extra Early white-tipped Scarlet, Mixed Turnip, Early Round Dark Red, Market Gardeners' Early Long Scarlet.*

Prices of seed.—English, from 4d. to 8d. per ounce; American, 10 cents per ounce.

SPINACH.

By sowing at intervals of two or three weeks from beginning of August till March, a succession of spinach is easily kept up from about October till May. The soil for spinach should be deep and rich, neither very stiff nor very light, and should be rather moist, otherwise frequent waterings will be necessary. The seed should be sown in drills about an inch deep, and 15 to 18 inches apart, and the plants should be thinned out to about 6 inches apart in the rows. Beyond keeping the ground free from weeds, the soil stirred occasionally, and watering frequently and copiously in dry weather, no further cultivation is needed.

Quantity of Seed required.—To sow a drill one chain in length $\frac{3}{4}$ of an ounce of seed will be needed.

Varieties.—*Carter's Market Favourite, The Carter, Bloomsdale Spinach, Ever Ready, Prickly Seeded-Curled, Round or Summer.*

Prices of seed.—English, 3d. and 4d. per ounce; American 10 to 15 cents per ounce.

SQUASH.

Plant in hills, prepared as for Melons, 4 feet apart each way for the bush varieties, and 6 to 8 feet apart for the running sorts. About 2 plants may be allowed to each hill. If very large fruit is desired only two or three should be left on each plant, selecting the best, and the branches should be cut off about two or three leaves beyond the last fruit.

Quantity of seed.—One ounce for 50 hills.

Varieties.—Bush kinds—*Long Island, White Bush, Golden Custard Bush, White Bush Scalloped, Yellow Bush Crookneck.*

Running kinds—*Landreth's White Turban, Henderson's Delicate Winter Crookneck.*

Price of seed.—American, 10 to 25 cents per ounce.

SWEET CORN.

Plant once a fortnight from beginning of August to beginning of January to have young, tender corn from end of October to April.

“ All varieties of Sweet or Sugar Corn may be either sown in rows four and one-half feet apart, and the seeds placed about eight inches apart in the rows or planted in hills at distances of three or four feet each way, according to the variety grown, or the richness of the soil in which it is planted. The taller the variety, or the richer the soil, the greater should be the distance apart.

Quantity of seed.—One quart of seed will plant 200 hills, or a row 100 yards in length; 8 to 10 quarts for an acre.

Varieties, Perry's Hybrid—An early twelve-rowed variety, growing only 4 to 5 feet high. Kernels white, large, sweet and very tender. Price of seed, 25 cents per quart.

Moore's Early Concord.—Ears large and well-filled; and unsurpassed for richness and delicacy of flavour. Price of seed 25 cents per quart.

Stabler's Early.—A valuable second early corn, remarkably large for so early a ripener. Yields an abundant crop, is desirable for family use, and one of the most profitable for market or canning. Price of seed, 25 cents per quart.

Squantum.—One of the sweetest varieties, and is largely used for market and canning. It is a general favourite and is wonderfully productive. The *Squantum* is the variety used almost exclusively at the famous Rhode Island clambakes, which is sufficient evidence of its quality. Price of seed, 25 cents per quart.

Extra Early Minnesota.—Maturing for table in about seventy days from germination. Ears well made out. Desirable in the family garden and profitable to shippers. Price of seed 20 cents per quart.

Early Landreth Market.—Cultivated on large areas and almost exclusively by the market gardeners of Burlington County, New Jersey. The edible grain is white and sweet. This variety will mature ears for market in about eighty days from germination. The stalk is leafy and grows to a height of 6 feet. A very profitable sort as a money maker. Plant in rows 4 feet apart, and thin the plants to two feet in the rows. Price of seeds 20 cents per quart.

Landreth's Sugar.—A remarkably productive variety; two ears on every stalk, often three, and sometimes four. The ear remains long in milky condition for the table, the edible grain being pure white and exceedingly sugary. Matures for market in about 82 days. This Sugar Corn will afford to growers more baskets of marketable ears to the acre than any other variety in cultivation. Plant at distances of $4\frac{1}{2}$ feet between the rows, and 3 feet from plant to plant in the rows. Price of seed 27 cents per quart.

TOMATOES.

The seed should be sown in prepared beds or in boxes, and as soon as the plants are a couple of inches high they should be pricked off into another bed, a few inches apart, when they have attained a height of about 6 inches they may be planted out. If the seeds have not been sown too thickly the young plants may be allowed to remain in the original bed or box till they are strong

enough to be transplanted at once to their permanent positions. They like a light, sandy, well manured soil. They should be planted about three feet apart in rows which should be about four feet asunder. A strong stake should be driven in at the root of each to tie the plants to, and particular attention should be paid to stopping the lateral growths to throw all the strength into the main stem. The tomato is a gross feeder and should be liberally supplied with rich mulching material, and irrigated freely till the fruit begins to ripen, when they should be kept rather dry at the roots.

Quantity of seed.—Half an ounce of seed will produce 750 plants.

Varieties.—These are so numerous that it is a somewhat difficult matter to make a selection, the following however, are recommended:—*Carter's Perfection* (a winner of 38 first prizes at Horticultural Shows), *Carter's Dedham Favourite* (a winner of 22 first prizes), *Carter's Market Favourite*, *Harefield Gem*, *Carter's Sandwich Island* (specially recommended as being better suited for long journeys, and rough handling than the general run of tomatoes), *Ham Green Favourite*, *Trophy*, *Acme*, *Chiswick Red*, *Duke of York*, *Carter's Blenheim Orange*, *The Mikado*, *Table Queen*, *Poundrosa*, *Trophy extra selected*, *Early Bermuda*, *Early Jersey*, *The Money Maker*.

Prices of seed.—English seed ranges in price from 6d. to 3'6 per packet; American seed from 5 to 25 cents per packet, or from 30 to 60 cents per ounce.

TURNIPS.

The turnip succeeds best in light sandy soils. Stiff retentive soils are ill adapted for the growth of good, well flavoured roots. Land that has been well manured seldom fails to produce good turnips, it is, therefore, well to see that the land has been properly prepared for them before sowing the seed. Drills should be drawn about 2 inches deep and 12 inches apart, and seeds sown thinly. As soon as the young plants can be handled they should be thinned to 3 inches apart, and later on a second thinning will be necessary when every other one should be removed. The surface of the soil between the rows should at all times be kept open and free from weeds.

Quantity of seed.—To sow a drill one chain in length half an ounce of seed will be required.

Varieties.—*Carter's White Swan's Egg*, *Carter's Jersey Lily*, *Carter's Purple Top Strapleaf*, *Henderson's Golden Ball*, *Purple Top White Globe*, *Early Snow Ball*, *Early White Milan*.

Prices of seed.—English ranges from 3d. to 6d. per ounce; American, usually 10 cents per ounce, except for new varieties.

WATER-MELONS.

Cultivate as stated for Musk Melons, except that the hills should be double the distance apart, and only one plant allowed to each hill.

Quantity of seed.—One ounce to 30 hills.

Varieties.—*Florida Favourite*, *Henderson's Green and Gold*, *Kolbs*

Gem (this variety is stated to be largely grown in the Southern States for shipments to the northern markets), *The Jones, Landreth's Boss, Arkansas Traveller*.

Price of seed—American, 10 to 15 cents per ounce.

PACKING, &C.

The list here given, though a fairly comprehensive one, does not include the names of all the vegetables that might be grown for export, but if the kinds named, or a few of them at least were grown and shipped, a start would be made and next year a few more varieties might be included. I have been careful to name only such things as can be raised quickly and without much trouble, and at the same time such as are pretty certain to meet with a ready sale at remunerative rates if put on the market in good condition. I do not wish to be understood to mean that one grower can successfully cultivate all the kinds named; soil, climate, water supply and other things will have to be duly considered, and each grower will have to use his own judgment in these matters. One man might try Tomatoes, Garden Eggs, Sweet Corn, and Kidney Beans, another might try Melons, Squashes and Cucumbers, &c.; another Potatoes, Cabbages, Green Peas, Turnips, Carrots, and Beet-root; another Salads and so on. What I should like to impress on one and all, however, is, that the time for planting is near at hand and he who would like to try and grow and ship vegetables during the coming winter and spring must be up and doing. The seeds which are named in this list may be obtained from *Messrs. Jas. Carter and Co., 237 and 238, Highholborn, London*; *Messrs. Sutton and Sons, Reading, England*; *Messrs. Vilmorn-Andrieux and Co., 4, Quai de la Mégisserie, Paris, France*, and the American kinds from *Messrs. Peter Henderson and Co., 35 and 37 Cortlandt St., New York*; *Messrs. D. Landreth and Sons, 21 and 23 S. Sixth St., Philadelphia*; *Messrs. Atlee Burpee and Co., 475 and 477 N. 5th St., Philadelphia, Pa.* A remittance to cover cost of seeds and postage should accompany orders to ensure prompt attention.

The only difficulty I apprehend in this matter is in the packing. There is no doubt that vegetables of excellent quality can be grown here, but careful means will have to be devised to get them to the markets in the best possible condition. In the United States there would appear to be a regulation-size box, crate, or hamper for nearly every vegetable product grown there, and a well recognised method of packing each product, and what we need now is more precise information on these points. It might be possible to procure samples of the various packages for the guidance of intending shippers, who could either have similar boxes, etc., made here, or import them as required if found cheaper to do so. These, however, are matters of detail which can be attended to whilst the crops are growing. The first thing to be done, and that soon, is to decide on what is to be grown, and get the seed in the ground.

CAMPHOR CULTIVATION.*

There has been much talk of late in Ceylon planting circles concerning the possibility of camphor cultivation in that Island, and many are anxious to learn whether operations are likely to prove profitable, especially in view of the extreme scarcity and high prices which now appear to be more or less permanent. Camphor has been cultivated for experimental purposes in Ceylon and India for a number of years, but not until quite recently has it been successfully produced. So far as we can learn, the planter has not the best methods of distillation at his disposal, and has not been able to extract camphor in paying quantities. This is well illustrated by the fact that nine months ago there were over one hundred acres under the camphor plant in Ceylon, yet up to the present not more than a ton of crude camphor has been produced. Recently the Governor of Ceylon has been talking of the potentialities of camphor culture and since then there has been an unprecedented rush for seed. Concessions of land have been granted in Ceylon, and planting will shortly commence on a substantial scale: and as the climatic conditions are said to be similar to those of Formosa, there seems every reason that the experiment should ultimately be successful. It appears, however, there is great difficulty in obtaining true camphor-seed from Japan, as, naturally, the Japanese are prepared neither to assist the planter nor to give away the secrets of their distillation. If it were possible to get hold of a Japanese or Chinaman actually engaged in the camphor industry, the difficulty might be quickly solved, as the Ceylon planter has everything to learn regarding distillation. In other words, he has a certain quantity of raw material at hand, and is as yet unable to obtain an adequate yield of the crude product. Mr. Kelway Bamber, the Ceylon Government chemist, has been at work for some time at Peradeniya, and has succeeded in perfecting an inexpensive still which it is hoped will render the process an easy one. The profit at present prices would be considerable, but a grower would probably have to take a much lower price than the ruling quotation of 350s. per cwt. The demand for camphor is only a limited one, but we believe the danger of over-production in Ceylon is remote, and that planters would be justified in going ahead.

Ever since the Japanese monopoly was established some eight years ago, the crude-camphor market has been more or less starved or only supplied with extremely limited quantities. This, of course, is not entirely the fault of the Japanese Government, as they have encountered many difficulties in working their monopoly in Formosa. Labour-troubles, native rebellions, earthquakes, and the late war have all contributed their quota in regard to diminished shipments. One fact, however, stands out prominent since the institution of the monopoly—*i.e.*, the refining of camphor in Europe and the United States has dwindled to a mere shadow compared

* From "The Chemist and Druggist" Aug., 18, 1906, p. 303.

with what it was a decade ago; and, in spite of official denials to the contrary, the refining is gradually passing into Japanese hands.

With the advent of extremely high prices undoubtedly the consumption has fallen off considerably, and where possible the public for certain disinfecting purposes have had to fall back upon the less-esteemed naphthalin, in which a large business is now done. This is, of course, only natural when it is considered that the wholesale price of refined balls in large quantities in the open market has been from 4s. to 4s. 3d. per lb. for over eighteen months. It was thought that after the Russo-Japanese war there would be a fall in price, but, on the contrary, the price rose to its present quotation, and at the moment the position is regarded as exceedingly firm. It must not be forgotten, however, that there have been some exceedingly dull periods this year, and at times the article has almost "gone a begging," the extreme prices having frightened buyers.

RUBBER IN THE FEDERATED STATES.*

In his annual report for the year 1905, Sir William Taylor, K.C.M.G., the Resident General of the Federated Malay States, states that the high price of rubber and the proved suitability of land in those States for its cultivation have led to numerous applications for land in the four States, but more particularly in Selangor, where almost all the accessible land between the Klang and the Selangor rivers has been taken up for rubber planting. Large areas of land have been applied for and granted for the purposes of this industry, and most of the large estates have been converted into, or sold to, limited liability companies. Next to the coast districts of Selangor, the Sungei Ujong district of the Negri Sembilan appears to be the locality most in favour with rubber prospectors.

According to Mr. Carruthers, the Director of Agriculture, the area alienated for the planting of Para rubber is some 100,000 acres, of which about 38,000 acres has already been planted. Most of the Para rubber trees of the age of five years or more have been planted 200 to the acre; some estates have as many as 300 to the acre. The number of trees of all ages in the Federated Malay States may perhaps be put at six to seven millions.

The rubber production of 1905 is estimated to have been 300,000 lbs.

KAPOK.†

According to H. M. Consul at Guayaquil (Mr. H. Cartwright) kapok (the fibre of the silk cotton tree) is a new article of export from that port. It has been enquired for from California, Liverpool and Belgium. The product is gathered from the districts lying along the coast between Guayaquil and Manta, at Puna,

* From the "*Board of Trade Journal*," Aug. 23, 1906, p. 379.

† From the "*Board of Trade Journal*," Aug. 16, 1906, p. 328.

Bahia de Caraques and many other places. The price paid varies from 12s. to 18s. per quintal (100 lbs.) uncleaned. The loss of weight in cleaning is about 50 per cent., consisting of oily seeds, parts of the pod and the inner core of the pod. There is no doubt, says Mr. Cartwright, that a very large quantity of this could be collected in the country, but for the fact that there is such a scarcity of labour, and also that the people in some of the districts where it is gathered find the manufacture of hats more remunerative. The quantity of kapok exported is, so far, small—in 1902, 21 tons; in 1903, 23 tons; in 1904, 18 tons.

COFFEE CULTIVATION IN BRAZIL.*

The coffee planters of Southern India, wishing to know exactly how their industry stood in relation to that of Brazil, the Government of India in April, 1905, at the instance of the Government of Madras, sent a Despatch to the India Office asking for information regarding the Brazilian coffee industry. Very detailed questions were asked regarding labour and wages, cultivation, area, soil and forests: the system of cultivation; the type of trees; the raising of bye-products, shade on estates, abandonment of old and opening up of new estates, &c.; crops and the curing of coffee; diseases, and pests; finance, and cost of production; climate, and physical features of the coffee districts; transport and duties. This despatch was transferred through the Foreign Office to the British Minister in Brazil, who distributed the lists of questions to the various Consuls, in order that they might make personal enquiry into the subject. The answers to these questions have now been collected and issued as a white paper by the India Office.

Transmitting the replies from the Consuls, the British Minister in Brazil, in his Despatch dated the 6th February, 1906, says:

“The difficulty of obtaining trustworthy information of a statistical nature in this country is sufficiently recognised to render all explanation of the inability to furnish full and exhaustive reports from the various Consular districts unnecessary. The enormous area of the country, the difficulties of communication and the expense of travelling preclude the possibility of acquiring minute information which could only be obtained by a personal visit to the numerous coffee planters scattered throughout a large portion of Brazil, except by experts specially appointed for the purpose, without other occupations to attend to and with considerable funds at their disposal for travelling purposes.”

RIO DE JANEIRO.

The British Consul-General at Rio de Janeiro writes of his district:—

“Coffee planting is the principal industry of Brazil and coffee is the principal article of export. The consumption of the world is estimated at 16,000,000 bags, the bulk of which is produced in

* From “*The Tropical Agriculturist*” July 15th, 1904, p.74.

Brazil which yields some 9,000,000 to 15,000,000 bags. The limited demand for the quantity produced caused a crisis in recent years owing to bumper crops and over-production. Since then there have been schemes to restrict production, but these have only taken effect in the State of Sao Paulo, in which State alone can any official statistics on this subject be obtained.

Sao Paulo is the principal coffee district.

LABOUR.

The conditions of labour are different in each locality. It may, however, be calculated that men earn about \$2 a day and women \$1 beside food. "Colonials" or those labourers established on the estate receive land and a certain number of trees in lieu of wages; others have an interest in the crop. The labour is chiefly Italian and negro, and is bad and scarce. Immigration is required, but has been so badly treated that it is discouraged. Owing to extravagance, the planters are mostly in difficulties and do not pay wages when due, or the men are fleeced by the truck system. It is possible for the labourers to live by the cultivation of their own plots. The work on the estate takes some nine months of the year.

Note.—1 melries = 2s. 2'934d. formerly, now 1s. 5d. say Re. 1 cts. 6.

CULTIVATION.

It is only the principal coffee districts which are comprised in the newspaper reports; and there are large tracts of land unplanted and suitable for coffee, and these lands are likely to remain unplanted until the demand for coffee increases. It would probably not be practicable to obtain land for coffee-planting where restriction is in force, nor under the circumstances would it be likely to be profitable. There are extensive railways through the principal coffee districts, the rates vary but are high.

Old fazendas are abandoned and not cultivated, but coffee is picked when the trees happen to yield. When the trees no longer bear, the plantation is abandoned, and as the land is privately owned it does not revert to Government, nor is it taxed. Coffee trees yield berries up to 30 years. After bumper crops the next crop or two is smaller. Land in Sao Paula in some districts produces 3 or 4 times as much as that in Rio de Janeiro. There does not seem to be any extension of planting, and that planting is to replace those trees that go out of bearing. There is not much planted that has yet to come into bearing. Trees begin to bear three years after planting. In Rio the land is hilly, and in Sao Paulo undulating and flat, with a red soil. There is some heavy forest and much scrub, and the undergrowth is very thick, with creepers, thorns and grass; heavy timber is found in the forests.

SYSTEM.

The cost of production and placing at local railway stations may be estimated at \$4'3000 a bag of 60 kilos (or 132½ lbs.)

THE CULTIVATION OF CACAO IN CEYLON*

By HERBERT WRIGHT.

It is a matter of common knowledge that the value of the Ceylon cacao has, during the last few years, fallen considerably, and had it not been found that this product could be profitably cultivated as a permanent intercrop with Para and *Castilloa* rubber, the industry would in all probability have remained stationary. While the value of Ceylon cacao has recently shown a decline, that of many other countries has not done so, and judging from the numerous local applications regarding the varieties to be selected, the suitability of each kind in conjunction with rubber and other matters, it appears necessary to consider our position and see what improvements are possible. In the Matale, Kurunegala, Dumbara and other districts the combined cultivation—cacao and rubber—is rapidly extending, and seems likely to prove a very remunerative one.

The output and value of cacao from Ceylon are obvious from a consideration of the following supplied by the Principal Collector of Customs, Colombo:—

Year.	Quantity.		Total value.	Value per cwt.	
	Cwt.	qr. lb.		Rs.	Rs. cts.
1880	121	1 24	3,500	28	92
1885	7,466	1 22	298,657	40	00
1890	15,942	2 1	797,125	50	00
1892	19,176	3 2	1,342,373	70	00
1895	27,522	3 20	1,128,440	41	00
1900	33,696	3 12	1,651,146	49	00
1905	69,431	0 0	2,433,556	35	04

The price of Rs. 70 per cwt. obtained in 1892, as against that of Rs. 35 per cwt. in 1905, takes us back to the most vital consideration *i.e.*, the variety or quality of the cacao grown and exported during these periods. Since the ravages of the disease or diseases affecting the stems and pods first became prominent in Ceylon, there has been a tendency to replace the old Criollo or Caracas variety with the more prolific varieties of Forastero and Amelonado, in the belief that the latter was not as liable to the ravages of parasitic fungi. Now, however, the planters are beginning to realise that all varieties of cacao at present cultivated in Ceylon are liable to be affected by the same diseases, and when the latter appear in the fluted and high stems of the Forastero variety, are very difficult to effectively excise. There has been, during the last two or three years, a distinct tendency to plant the old Caracas type in preference to the Forastero; the change of variety can be shown to be one of the factors responsible for the varying value placed upon the cacao exported from Ceylon.

* From "*The Tropical Agriculturist*," July 15, 1906, p. 73,

During recent years the cultivation of shade trees for cacao has also undergone considerable change, and whereas the original plantations contained mixed species of forest types, or a preponderance of *Erythrina umbrosa*, they are now giving way to *Hevea brasiliensis*, *Erythrina lithosperma*, *Castilloa elastica*, &c., : furthermore, the results of experiments indicate that the shade of *Erythrina lithosperma* need not be permanent throughout the whole year, but may be treated so as to form a shade of varying intensity according to the seasons.

In all the species mentioned above there is observable one important and common agreement *i.e.*, they all change their foliage annually and return large quantities of organic matter, in the form, of leaves, to the soil. Methods of manuring have also changed to some extent, during the period under consideration, and the effect of the change in modes of cultivation can be shown to affect the quantity or quality of the article produced. The Ceylon methods of cultivation, particularly with regard to pruning, weeding and manuring, are almost unique, and the differences observable in Surinam, Trinidad, Samoa, Cameroon, &c., provide interesting material for our consideration.

In Ceylon the methods of fermenting, washing and curing are often quite different and sometimes quite in contradiction to those of other countries, and the effect of these processes on the quality of the article is only too fully recognised. In the opinion of many, the condition of the trees, whether they are free or suffering from disease, is of importance in determining quality and quantity.

It is therefore obvious that there are several factors which need to be considered in connection with the present and the past condition of the cacao industry in Ceylon.

The factor which is perhaps more responsible for the range in value of the cured beans than any other is the variety of cacao selected, and with this we will deal.

GENERAL INSTRUCTIONS TO TEACHERS ON SCHOOL GARDENS.

In planning the School Garden, run the boundary lines to harmonise with the lines of the School building and the road by making them parallel or at right angles to them.

Draw a plan of the proposed Garden to scale, marking adjacent buildings and roads, garden foot-paths and beds, and noting what crops it is intended to cultivate.

This plan must be submitted in duplicate to the Superintending Inspector of Schools, and approved by him and by the Director of Public Gardens before a grant is made for the commencement of the garden.

The first requisite is such a fence as will keep out pigs and goats as well as the larger animals. The gate should be strongly made and well hung.

In dry districts provision for watering or irrigating should be carefully considered.

The land will probably require at first much preparation by tillage and manuring before it is fit to lay out as a School Garden, but such preparation is of the highest educational value.

It should be thoroughly forked throughout first, removing stones and stumps and burying weeds.

Then mark out the main path 6 ft. wide, and the side paths 3 ft. wide, according to the directions given in the leaflet on School Gardens. A good strong line 66 feet long is essential for this work, and for lining out beds afterwards—such a line costs 1/10d. in Kingston.

It is recommended to put the whole ground at first under such crops as corn, peas, yams, sweet potatoes. A preliminary plan (in duplicate) of the ground under such crops should be submitted with the main plan.

The plan given in the leaflet is merely suggestive and need not be rigidly followed. The chief crops of the district should have an important place in the scheme.

When the plans have been approved, they should be mounted on a board, hung up in the school, and if necessary, carried out to the Garden for reference when work is being done. They should be strictly adhered to unless permission is first obtained from the Superintending Inspector of Schools.

An estimate (in duplicate) of the expense for fencing and tools should be sent to the Superintending Inspector of Schools with the plans. In exceptional cases it may be necessary to hire labour to remove stumps, plough up very hard land, or erect a fence; in such cases an estimate of expenditure should also be submitted.

The Agricultural Instructor of the district should be consulted as to both plan and estimate, before they are submitted to the Superintending Inspector of Schools.

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES

The usual Monthly Meeting of the Board of Agriculture was held at Headquarter House on Wednesday, 12th September, 1906, at 2 p.m.: Present:—The Hon. T. L. Roxburgh, Acting Chairman, the Acting Director of Public Gardens, the Acting Island Chemist, the Superintending Inspector of Schools, His Grace the Archbishop, Messrs. C. A. T. Fursdon, J. W. Middleton and the Secretary, John Barclay.

The Secretary read the minutes of the previous meeting which were confirmed.

The Secretary read copy of letter from the Colonial Secretary to the Jamaica Agricultural Society, forwarded for the information of the Board of Agriculture, in which the Governor agreed to the recommendation of the Conference on Agricultural Instructors, with the exception that Mr. Cradwick and Mr. Briscoe, being

public officers, would not be under the control of the joint Committee of the two Boards. The Secretary also read letter from Mr. Cradwick saying that his engagements already made would carry him up to the 25th March 1907, and to interrupt these would cause a great deal of inconvenience and dissatisfaction to the different local Agricultural Societies and Show Committees, and as he would be away from the district in connection with the Prize Holdings Competition and the Teachers Course three months of this time, he suggested that he should be allowed to remain in the western district till the end of the financial year, and if a new Instructor were appointed he could initiate him to his duties there during the remaining period.

It was resolved to advise the Agricultural Society of the circumstances, and, in the absence of the joint Committee proposed but which had not been appointed, and as Mr. Cradwick's duty was so intimately connected with the Branches of the Agricultural Society, to state that the Board thought it advisable for Mr. Cradwick to carry out his engagements in his present district to the 31st March, and from 1st April next take up his new district, and to ask their opinion on the matter.

The Secretary submitted resolutions from the Central Cornwall, Santa Cruz, Appleton, Petersfield and Hanover Agricultural Societies asking that Mr. Cradwick's services might be retained for the western district.

The Secretary submitted letter referred from the Colonial Secretary's Office regarding the supply of arrowroot to the General Penitentiary which was usually obtained from St. Vincent at about 2½d. per lb., with a minute asking whether the arrowroot could not be obtained at the same price or even a little over in Jamaica.

The Secretary was instructed to write the Collector-General to ask what quantity of arrowroot was imported into Jamaica. The Secretary reported that he had some time ago made enquiry on the subject and had letters. He found then that although arrowroot was not cultivated but grew in old cultivations from ratoons, people usually would not sell under 6d. per quart which worked out at about 4d. to 4½d. per lb. and that he could not get anybody to undertake it under 3½d., that even at that figure they would require to know of a certain outlet before they would prepare it in quantity. He was, however, again making enquiry.

The Secretary submitted a letter from the Hon. H. Cork, asking whether the articles that have been published in the Journal of the Agricultural Society and in the Bulletin of the Department of Agriculture on Rubber could not be collected and published in pamphlet form.

After discussion, Mr. Harris was asked to edit a pamphlet to contain all the practical instruction as regards rubber growing that was available up to date, and submit the pamphlet at next meeting.

The Secretary submitted a letter from Mr. A. B. Lindo, Montego Bay, making application for the post of Assistant Superintendent at Hope Gardens.

The Secretary was instructed to forward same to the Government.

The Secretary submitted letter from Mr. W. M. N. Henry, Enfield, asking the Board to supply seeds for his school garden. He was directed to reply that the Board had no funds to supply such.

The Secretary supplied the following reports ;—

From the Chemist :—

1. Arrangements for holding Distillers Course in October, which were approved.
2. Examination of Students for Diploma in Agriculture asking the Board to sanction a grant of £10 to be paid, as usual, as examiner's fee to Prof. d'Albuquerque out of the amount provided on the Estimates for "Instruction in Bookkeeping", etc., under the heading "Agricultural Education."

This was authorised.

3. Resignation of Mr. S. W. Brown from the staff of the Sugar Department, having been appointed Science Master at Wolmer's School, as from the 1st September, also suggesting that the vacancy be not filled until Mr. Cousins' return.

This was agreed to.

From the Director of Public Gardens :—

1. Report Hope Experiment Station.
2. Mr. Cradwick's Report.
3. Mr. Briscoe's Report and Itinerary.

These were directed to be circulated.

The Secretary read letter which had just been handed in from Messrs. Walcott, Robinson & Dunn, stating that the Directors of the Amalgamated Products Co., Ltd., desired to obtain a fair, impartial and reliable report as to the quantity and portions of the lands of their estate called 'Longville' in the parish of Clarendon which were suitable for and could be cultivated in cassava on profitable and commercial lines, and asking if Mr. Cradwick could be permitted to inspect the property and furnish such a report.

It was agreed that the Secretary should write Mr. Cradwick and ask him if possible to arrange to take an early opportunity to do so, his expenses being paid by the Amalgamated Products Co.

The Meeting then adjourned till Wednesday, 17th October, at 2 p.m.

[Issued 6th Oct., 1906.]

Printed at the Govt. Printing Office, Kingston, Jam.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

NOVEMBER, 1906.

Part 11.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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P R I C E—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :

HOPK GARDENS.

1906.

JAMAICA.

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Part 11.

NOTES ON RUBBER PRODUCING PLANTS.

Compiled by W. HARRIS, F.L.S., Superintendent of Hope Gardens.

At the request of the Board of Agriculture the following information on rubber producing plants, much of which has already appeared in various issues of the Bulletin, has been brought together in pamphlet form for the use of intending rubber planters in Jamaica.

Rather copious quotations have been made from Mr. Herbert Wright's valuable book on Para Rubber,* this being the most recent work on the subject, a copy of which should be in the possession of every grower of Para rubber.

It is impossible to say precisely at this stage of the industry which kind of rubber tree will be found best suited in every respect to the conditions that obtain here, but the indications would appear to be in favour of *Castilloa*. Personally I am inclined to think that the Lagos Silk Rubber (*Funtumia elastica*) will prove to be one of the best if not actually *the best* for many of our districts. The young trees at Hope Gardens abound in latex which flows freely and we know that the marketable rubber is of very fine quality, and said to be superior to *Castilloa*.

PARA RUBBER.

(*Hevea brasiliensis*).

CLIMATIC CONDITIONS.

What is known as Para Rubber of commerce is obtained chiefly, if not entirely, from the species known as *Hevea brasiliensis*, a tree indigenous to the vast region drained by the Amazon and its tributaries, estimated to embrace a territory nearly two-thirds the size of Europe. Para is in about south latitude 1°, but the district of the same name extends over a vast forest region to the south and west throughout which, and the enormous forests of

*" *Hevea brasiliensis* or Para Rubber, its Botany, Cultivation, Chemistry and Diseases," By Herbert Wright. 2nd edition Colombo, A. M. & J. Ferguson.

Central and Northern Brazil, the rubber trees are abundantly found. The climate is remarkable for its uniformity of temperature, usually not exceeding 87° F. at mid-day or below 74° at night. The greatest heat recorded is 95°, and the mean for the year is 81°. "The rainfall occurs principally during the months from January to June, the maximum being in April when it reaches 15 inches. For the remaining six months of the year very little falls but there are fine days in the wet season and occasional showers in the dry." (*Kew Bull.* 1898, p. 244.)

According to E. Ule, in his book dealing with rubber in the Amazon district,—the annual rainfall is usually between 80 and 120 inches, and the mean temperature between 76° and 81°.

Mr. H. A. Wickham states* :—The whole of the Hevea which I procured for the government of India were the produce of large grown trees in the forest covering the broad plateaus dividing the Tapajos from the Madeira River. The soil of these well-drained, wide-extending forest-covered table-lands is stiff, not remarkably rich, but deep and uniform in character. The Hevea found growing in these unbroken forests rivals all but the largest of the trees therein, attaining to a circumference of 10 feet to 12 feet in the bole. These forest plains having all the character of wide-spread table-lands occupy the space betwixt the great arterial river systems of the Amazon, and present an escarped face, which follows at greater or less distance and abuts steeply on the igapo or bagas, *i.e.* the marginal river plains subject to inundation by the annual rise of the great river. So thorough is the drainage of this highland that the people who annually penetrate into these forests for the season's working of the rubber have to utilize certain lianas (water-bearing vines) for their water supply, since none is to be obtained by surface-well sinking, in spite of the heavy rainfall during a great part of the year.

The Climate in Ceylon. In Ceylon, according to Mr. Herbert Wright, an elevation of 2,000 feet in the Central Province, and 3,000 feet in the Uva Province [south-eastern] is considered to be near the maximum, and a rainfall of 70 inches near the minimum for the cultivation of this species . . . It is being tried in districts having 200 inches of rain per year and also in dry irrigable areas, but reliable results cannot be obtained for many years,

Federated Malay States. In the Federated Malay States, Mr. Wright says, there is no evidence of the highest elevation at which Para Rubber will thrive. According to Carruthers the growth of the Para rubber from sea-level up to 300 feet in the Federated Malay States is better than at most places The climate of the Federated Malay States is very uniform and can be described in general terms as hot and moist. The annual rainfall except in places close to the mountain ranges, is about 90 inches. . . . There is no well-marked dry season. Generally speaking July is the driest month, but has seldom a less rainfall than 3½

* In Bull. No. 49, Bureau of Plant Industry, U. S. Dept. of Agri.—"The Culture of the Central America Rubber Tree" by O. F. Cook, copious extracts from which were published in *Bulletin of Dept. of Agriculture* for 1904 and 1905.

inches. The wettest season is from October to December, and there is another wet season of slightly less degree during March and April

The average maximum temperature occurring between noon and 3 p.m. is in the low-country just under 90°, and the average minimum occurring before sunrise is just over 70°. The general mean temperature is about 80°.

Soil—The soil in which the trees grow in the forests on the Amazon and its tributaries is deep and rich, mainly alluvial, sometimes a stiff clay, sometimes a vegetable mould; and it is frequently inundated along the banks of the rivers. Young plants however, are not often observed to grow actually within reach of the tides.

For sake of comparison the following analyses of Para rubber soil in Ceylon (from Mr. Herbert Wright), and a typical banana soil from the parish of St. Mary are here given.

Rubber Soils at Henaratgoda Soil under old rubber.		Banana Soil in St. Mary Jamaica.	
	Per cent.		Per cent.
Coarse sand and small stones	38'00 100'00	Fine earth	Nil 100'00

Chemical Analyses.

Insoluble matter	83'00	...	42'93
Moisture	1'20	...	6'96
Organic matter and combined water	7'8	...	8'38
Potash	0'046	...	7'453
Lime	0'040	...	17'22
Phosphoric acid	0'031	...	1'223
Carbonic acid as } Carbonate of lime } Humus (soluble in } ammonia) }	} not determined do	... ... ...	26'92 2'5
Nitrogen	0'154	...	1'161
Available potash	0'005	...	0'0048
Available phosphoric acid	trace	...	0'0008

SUITABLE LOCALITIES IN JAMAICA.

It will be seen from the foregoing that there are many districts in Jamaica suitable for the growth of Para rubber. Portions of St. Andrew, St. Thomas-in-the-East, the lower lands in Portland, St. Mary, St. Ann, St. Catherine, Upper Clarendon, Manchester, St. Elizabeth, Trelawny, St. James, Hanover and Westmoreland. There are available districts in every agricultural parish in the island, districts in which cocoa is or might be successfully cultivated.

“To secure land at the right elevation, with the requisite rainfall and proper soil, is the first consideration in connection with the successful culture of the Para rubber tree. The elevations most suitable are from sea-level up to 1,200 or 1,300 feet. It will grow at a higher elevation; indeed there are reports of it growing at over 2,000 feet; but it would probably take longer to come to

maturity than if it were planted at a lower elevation. A rainfall of 80 in. to 100 in. per annum is usually considered more suitable than an excessive rainfall of 150 in. to 200 in." (R. Hoffman: See Bulletin of Department of Agriculture, December, 1905, p. 263.)

CULTIVATION.

Propagation--The tree may be propagated by cuttings of the green lateral twigs as soon as they begin to harden, and by seeds, the latter method being the more expeditious.

Seeds soon lose their vitality on exposure to the atmosphere and should therefore be planted as soon as possible after gathering.

We have found that a good method is to place the seeds on a thin layer of sifted coco-nut refuse, or powdered charcoal or a thick layer of sand in a shaded position, then cover them with sacking which should be kept continually moist. The sacking is removed every morning and all the seeds that have germinated since the previous morning are picked out and potted in bamboo pots.

Last year we received a consignment of 7,500 seeds by post from Singapore, and owing to the careful way in which they were packed for transport we were able to raise and distribute 68 of them.

Nurseries--The practice in Ceylon appears to be to plant the seedlings in nursery beds, and when nine to twelve months old, these are cut back and the stumps are planted in the field. In Jamaica, they are planted out in their permanent places, as soon as they are a few inches high; and our experience is that there is no check, and they grow rapidly in favourable situations.

PLANTING OPERATIONS.

Distance--Various distances from 10' x 10' to 20' x 20' have been tried in Ceylon, but Mr. Herbert Wright states that in order to allow the plants to develop freely in circumference the maximum distance should be allowed, as the desired length of trunk is usually obtained even when the Para rubber tree is grown in the open. From considerations of the condition of trees from 2 to 20 years old, the following table is compiled in order to show the probable number of Para rubber trees of known age an estate can bear without interfering with the natural growth of the plants:--

Age of trees.	Total spread of the branches in diameter.	Number of trees per acre.
Four years old	12 feet	302
Six "	15 "	193
Eight "	25 "	70
Ten "	30 "	48
Twelve "	35 "	35
Fifteen "	40 "	27
Twenty "	40 "	27

This shows the approximate number of trees to the acre at different ages without any interference of the branches of adjacent trees with one another. There is, however, no objection to the

branches of trees partially overlapping, and it is more than likely that any excessive branch development will be kept back by pruning or pollarding rather than by reducing the number of trees below 200 to the acre.

Holing--With regard to the preparation of the holes, Mr. Wright recommends that they should be $1\frac{1}{2} \times 2 \times 2$ feet. The larger the holes, the better for the plant. Good holing will give the plants an excellent start; the dribbling in of seeds in small holes is not to be recommended. It is hardly necessary to point out that the planting operations should be carried out when rain is plentiful.

As a mixed crop--Para rubber is much more likely to be grown as a mixed crop with cocoa, bananas, &c., in Jamaica than as a pure crop, at any rate for some time to come, and the question thus arises as to the proper distance to plant amongst other crops. Cocoa has been found to be the best and most profitable crop to grow with rubber trees for the reason that the trees help each other. The cocoa has a heavy fall of leaf and thus manures and benefits the rubber, and the rubber acts as a wind-break to the cocoa.

The successful and continued cultivation of inter crops with Para rubber mainly depends on the distance the plants are from one another. The rapidly-growing surface roots of Para rubber will ultimately take possession of the soil, and the inter crops of tea, cocoa, or coffee cannot be expected to thrive except the rubber plants are widely planted. The cultivation of tea under closely-planted rubber is more or less of a catch crop; but several estates are known where the rubber is widely planted amongst tea and both are bearing and doing well. Cocoa and coffee planted in the middle of the lines will last for several years under rubber. The roots of these plants do not as closely ramify the soil as those of the crowded tea plants, though they will ultimately have to face the struggle for existence with the roots of Para rubber and will probably be choked out. Cocoa may be planted 10 to 20 feet apart, and the amount of soil on good cocoa estates which is free from roots is often very large and permits of the growth of other trees on the same acreage. Cocoa under rubber will last much longer than tea, and the protection by the Para rubber trees against excessive exposure is no doubt greatly in favour of the two products being grown together. The planting of both products on the same soil is done in such a way as to allow free root areas for both species during the first five years, many planting the cocoa and rubber both twenty feet apart so that there will be approximately 100 rubber and 100 cocoa trees per acre.* Though the rubber ultimately becomes the stronger component, it is surprising how long both products can be successfully grown together. In the cultivation of inter crops with Para rubber it is essential that both products be planted at the same time, as the Para rubber

* But if it is intended to keep both crops growing permanently, it is suggested that the cocoa and rubber be planted alternately at distances of 15 feet apart, so that there will be approximately nearly 100 cocoa and 100 rubber trees to the acre. *Editor, Bulletin of the Department of Agriculture, Jamaica.*

tree is about as strong as the coconut palm in its root system and quickly takes possession of the soil. (H. Wright in Para Rubber.)

Manuring.—"The Para rubber does not necessarily require a soil with a high percentage of organic matter and mineral food as was imagined by early investigators, although rubber grows well on such soils. Under cultivation the trees can be made to grow well on light sandy loams at the proper elevation in districts having the necessary rainfall and temperature. So, given a fair balance of plant food the Para rubber tree will flourish, as there is not much drain on the soil by food material being permanently removed—only the mineral matter and nitrogen taken away in the rubber. Although the loss is small, yet it should be taken into consideration after a number of years, and an attempt made to replace the mineral matter and nitrogen. We do not at present advance any opinion as to the effect of manuring on the yield of latex in old trees, nor yet can we refer to any reliable results which would allow us to put forward even an hypothesis. We are at present of the opinion that manuring at the young stage would help on the young plants and thus prove to be beneficial, giving rise to good wood and large supplies of leafy material. We would strongly recommend that the fallen leaves be buried with lime or basic slag in trenches, or round the trees at a distance of 4 to 6 feet from the trunks; this basic dressing will promote nitrification and give rise to the more rapid decomposition of the organic matter. Light forking is recommended to break up the hard surface of the soil and so aerate it and allow penetration of the rain and air."*

Draining.—† It is erroneous to suppose that because Para rubber is a forest cultivation draining is unnecessary. Draining is as necessary for rubber trees as it is for any other product in order to encourage the free circulation of air, water, and food solutions throughout the soil, and to check wash on steep hillsides. The distance of the drains from one another and their size must depend upon the soil conditions. In swampy and boggy land, little above the water level, the drains should be as wide and deep as possible, either between each row of trees or in exceptional cases around individual trees. Several areas in the low country of Ceylon, consisting of bogs rich in organic matter, have been converted into good rubber land by making drains two to three feet wide and three to four feet deep, and heaping the earth in the middle to form a dry soil on which the rubber plant can live for a couple years. On hillsides the drains need be only about one to one and a half feet deep. They should be made at right angles to the slope in order to check the formation of gorges. The distance of the drains from one another will vary according to the slope and climatic conditions; on flat land a distance of 60 to 70 feet seems sufficient, whereas on steep hillsides 20 to 30 feet is not too close. . . .

* *Circular R. Bot. Gard., Ceylon*, Vol. III., No. 6, p. 82.

† *Para Rubber*, by H. Wright.

DISEASES.

"It is often relatively easy to successfully grow a small number of plants in any particular district without their suffering from the ravages of innumerable insects and fungi. But if the same crop is grown on a large scale matters often take a different turn. . . . There are already several insects and fungi which live on the leaves of the Para rubber trees, but none of them are very harmful. To a very limited extent the annual fall of leaf that takes place on all Para rubber trees after they have passed their second or third year is an advantage when dealing with leaf pests, as the foliage can be easily and regularly collected and burnt. . . .

"*Fruit disease.*—Para rubber planters in many parts of Ceylon have occasionally been alarmed at the curious behaviour of certain fruits; some dry up and remain attached to the twigs, and others of all ages fall to the ground without expelling the seeds. The fall of the unexploded fruits is often due to wind, and there is no parasitic fungus to be found in the tissues. It has been stated that the fruits are subject to the attack of a parasitic fungus belonging to the genus *Nectria*, and Carruthers reports having successfully inoculated Para rubber fruits with this fungus, but was not certain as to whether it attacked the fruits when on the tree or only when they fell to the ground.

"The most effective way of fighting the fruit disease is to collect all dried fruits which are on the trees and those which have fallen to the ground and burn the lot on the spot. On the average rubber estate there can be no real objection to burning such small quantities of fruits as this treatment involves.

"*Stem Disease. Fungus.*—In his account of canker (*Nectria*) of Para rubber, Carruthers points out that a parasite fungus occurs on the stems and branches, which may prove fatal to the trees. The area attacked by the fungus can be detected often by the change of colour of the bark or by the exudation of the latex. When, however, the fungus has got a firm hold of any local patch of tissue, the latex tubes become quite empty and dry up, so that it not only threatens the life of the tree, but also robs the planter of the latex or rubber for which the tree is being cultivated. It is necessary that all cankered areas should be excised and the tissue burnt on the spot. All the discoloured areas should be removed, even if the woody tissues below the cambium are permanently damaged in the operation. In some cases it is true that the cankered area is, by means of a layer of cork, prevented from extending to other parts of the stem, but it is unwise to leave the matter to chance.

"*Root Disease. Fungus.*—A root disease due to a fungus has already been mentioned as occurring in the Straits and Ceylon in association with white ants, but probably preceding them. Petch has shown that the Ceylon fungus can spread underground on roots of grasses, &c., and that it is a species of *Polyporus* (*Fomes semitostus*). The hyphae are described as occurring on the first six inches of the trunks as well as the roots. Any trees

so affected should be isolated by digging a deep trench round them about a foot wide, as in the case of the root disease in tea, and, if possible the diseased specimens should be uprooted and burnt. As Messrs. Ridley and Derry have pointed out, this fungus, the mycelium of which is underground, is the worst feature against close planting, as under such conditions it might spread very rapidly. The uprooting of all dead stumps of trees would appear to be necessary if this disease is to be kept in check.

PRUNING YOUNG TREES.

"The Para rubber naturally grows to a tall slender tree, and it remains to be seen how by pruning or pollarding the young plants an increase in circumference may be obtained at the expense of the growth in height. Considering what has been accomplished with tea, where plants ordinarily growing into fairly stout trees over twenty feet high have been converted into small bushes two to four feet in height, it would be idle to predict the possibilities with Para rubber. The prevention of the unnecessary growth in height may well form the subject of many experiments. The plants can be prevented from growing into slender woody structures by removing the terminal bud with a knife or thumb-nail pruning, or, as is more commonly the case, by pruning the terminal young leaves and the enclosed bud. If the central bud is effectively and repeatedly removed, without doing considerable damage, the stem cannot grow in height except by means of lateral shoots; these will subsequently require bud-pruning once they have attained the required size At Heneratgoda the trees which have forked at 7, 9 and 11 feet from the ground show an increase of about 30 inches in thirty years or an average of one inch per year, throughout a long and fairly reliable period. Young trees which have been bud-pruned in the manner suggested above show an increased rate of circumferential growth, and this means the attainment to a tappable size at an earlier period."—(Herbert Wright.)

TAPPING*.

"When one considers that the rate of growth of the Para rubber tree in Ceylon is such that a circumference of 20 inches cannot be attained much before the fourth, fifth or sixth year, it is obvious that, under ordinary methods of cultivation, all ideas of extracting rubber from trees under these ages should not be encouraged If the tree has a circumference of much less than 20 inches, tapping cannot be recommended, because the available tapping area is too small. The production of new tissue would be a strain on the young plant, and the thin bark tissues would probably be quickly cut away long before the desired quantity of rubber had been obtained.

The best Season to Tap. The Para rubber trees in Ceylon drop their leaves in February or March, produce new leaves and flowers after a leafless phase of a few days or a couple of weeks, and yield ripe fruit in August and September. There is an active vegeta-

* H. Wright, Para Rubber.

tive period from September to February, a short resting period in February, and a floral and foliar condition from February to September. The yield of latex should be most abundant when the trees are leafless, as they cannot then lose much water by transpiration, and it is of interest to note that the experiments made by Arden in 1902 seem to give support to this view. Arden states that the yield from trees tapped when they were leafless was much greater than from trees tapped when the leaves were beginning to appear or when in full foliage. In Nicaragua the latex from other rubber trees contains the highest percentage of caoutchouc during the dry season. The possession of abundance of latex during the dry season lends support to the theory of its function as a water store during drought. In many parts of the tropics, however, the leafless period occurs when the dryness and temperature of the air are at the maximum, and the collecting of latex would, during such a time, be limited to the very early part of the day and the evening.

What part of the day to Tap. "The best flow of latex with the minimum quantity of scrap rubber is obtained in the early morning or evening on sunny days, but tapping may be done further on into the day, when the temperature is low and clouds and moisture are abundant. In a district like Peradeniya the tapping may be continued up to 8 or 9 a.m., and recommenced at 3 to 4 p.m. All-night tapping is of course only possible when the artificial lighting of estates is more perfect than at present. In the early and late parts of the day the temperature is lower, the air usually more moist, and there is less transpiration of water from the leaves; the combined effect of these factors is a better flow of latex during such times. According to Ridley* the girth of the tree decreases during the day and increases towards evening, an observation which may throw some light on the theories regarding tension of the laticiferous tissue and transpiration.

Frequency of Tapping. "The frequency of tapping varies considerably, but it is by no means clearly proved that the tree will not stand tapping every alternate day throughout the greater part of the year. The fact that an interval of one day is sufficient for the wound response to become obvious is of interest and importance. It is perhaps not advisable to judge the effect of very frequent tapping from the results obtained in the Amazon districts, as there the trees are usually very old and in many cases have never been tapped before. Nevertheless, it is of interest to learn that in those districts, the Para rubber tree is often tapped for 180 days continually without apparently doing very serious damage to the trees."

Mr. R. Derry says:—"I consider the latex flows most freely when the new leaves appear, which with most *Hevea* trees is about March, and the advantage of tapping about that time is not so much a question of actual yield as it is of the amount of bark removed in the operation, which would be less at the best season.

* Annual Report of the Director, Botanic Gardens, Singapore.

There would also be another season commencing in September with those trees then flowering. As with all trees, the ratio of growth is variable at different periods, but taking the girth of Hevea trees here, a 3-year old tree at 3 feet from the ground being 13-15 inches, and an 18-year old tree 100 inches: the annual increment would average nearly 6 inches in circumference, and I am sanguine that Hevea trees can be tapped in Malaya when 6 years old, if not earlier, when I estimate the girth at 24-30 inches on good free soil*. Tapping should be commenced at the base of the tree, working upwards to 6 or 8 feet if necessary, and if a tree be operated on in a workmanlike manner, three annual tappings could be executed before going over old incisions."

RUBBER YIELDS.†

Yields in Ceylon. "The yield of rubber varies from 7 lb. per 400 trees in one tapping to a maximum of 25 lb. per tree in twelve months' tapping. The first series of reliable yields‡ are those obtained at Henaratgoda from 1888 to 1896. One tree at Henaratgoda was lightly tapped every second year, and gave for nine years an average annual yield of 1½ lb. of dry rubber:—

27¼ oz. in 1888
42 oz. in 1890
45 oz. in 1892
51 oz. in 1894
48¼ oz. in 1896

This tree was twelve years old when first tapped, and the annual yield of 1½ lb. was from the 12th to the 20th year of the tree's life. The method of tapping consisted of scraping off the rough outer bark and making numerous V-shaped incisions to a height of about five feet. The tree had a circumference of 50½ inches and was growing with other trees of nearly equal size, distanced 30 feet apart. Other experiments have been made at Henaratgoda which indicated similar results by consecutive weekly tappings of the trees.

Yields on Estates. "To form an estimate of the yield to be obtained from large acreages of Para rubber trees of known age is no easy task, and the best way to deal with this part of the subject is to give only the results which have been obtained on rubber estates in this island.

Matabele District. "In the Matabele District there are estates where an average yield of ¾ lb. of dry rubber per tree from 5,000 trees has been obtained in one month's tapping. The average circumference of these trees was 35 inches a yard from the ground. On another property a yield of 3½ lb. of rubber per tree has been obtained from 499 trees in seven months' tapping. Another estate, in the same district, has obtained an average yield of 3½ lb.

* In his report to the India Office Cross mentioned that Hevea trees of 6-8 inches diameter are tapped in Brazil.

† H. Wright, Para Rubber.

‡ Dr. Trimen, Notes on Rubber Experiments.

of dry rubber per tree from 311 trees in one year. The age of these trees varied from 10 to 15 years, and the trees varied in circumference from 30 to 70 inches at a yard from the ground. These trees were tapped on the full herring-bone system; the tapping area covered half the tree and extended from the base to a height of seven feet. The tapping was done very carefully, the distance of seven feet being worked through in 240 days of continuous tapping. The yield from these particular trees will probably be increased by a change in the method of tapping and tapping instruments during the current year. On a third Matabele estate the Para rubber is inter-planted among cocoa the cocoa is planted 12 by 12 feet, and the rubber through alternate lines of cocoa, 24 by 12 feet. By the V method of tapping a yield of 3 lb. of dry rubber from each of 10,000 trees is expected during the present year, the trees being 8 to 15 years old. On this estate several encouraging experiments in tapping from 6 feet upwards to a height of 15 feet have been made, light ladders being used for the purpose.

The Province of Uva. "The most successful results at high elevations in Ceylon have probably been obtained in the Province of Uva. On Passara Group estate, Passara, Para rubber is being cultivated up to and over 3,000 feet above sea-level. The trees are of various ages, and one specimen, 13 years old, measures 54 inches in circumference a yard from the ground, and 60 to 70 feet in height, though growing at an elevation of about 2,600 feet. Tapping is being carried on with promising results up to 2,800 feet, and from the trees at an elevation of 2,600 feet, varying in age from 7 to 13 years, an average yield of 2 lb. of dry rubber per tree was obtained during 1905.

South Ceylon: Kalutara, Ambalangoda, Rayigam, &c.—"In the South of Ceylon equally good and often better results have been obtained. On one estate, 8,731 trees, having a minimum circumference of twenty inches, gave in one year, an average of 1.72 lb. of dry rubber per tree . . . A section of another rubber property in the South of Ceylon has given, from 11-year-old trees, the average circumference of which is 30 inches only, no less than $5\frac{1}{2}$ lb. of dry rubber from each of 255 trees."

COAGULATION.

"If* the pure latex is allowed to stand in a receptacle, it finally coagulates and the caoutchouc globules with other substances float to the top, leaving a more or less clear liquid behind. By the addition of chemical reagents or by subjecting the latex to different temperatures coagulation may be hastened or retarded. The coagulated substance after washing, pressing, and drying is ultimately known as the rubber of commerce. In the production of rubber from latex the planter may either take advantage of the presence of coagulable constituents in the latex or adopt chemical and mechanical means for the separation of the caoutchouc globules from the rest of the latex . . .

* H. Wright, Para Rubber.

Smoking and Coagulation.—"The coagulation of the latex may be hastened by exposing it to heat and the products of combustion of a fire. The latex can be coagulated fractionally by such a process, and the finished product, when properly manufactured, is less liable to putrefaction than the rubber prepared by many other methods. The smoke from burning palm nuts used in the Amazon district, contains, among other substances, small quantities of acetic acid, acetone, and creosote. The acetic acid is probably the agent responsible for effecting the coagulation; the other substances, particularly the creosote, are absorbed, the latter acting as an antiseptic in preventing the rapid decomposition of the albuminoids present. In Brazil the latex is poured into a shallow basin 60 cm. to 1 metre in diameter and 20 to 30 cm. deep, and pieces of bark, dirt, &c., removed. A fire is then made of wood and resinous substances, and is kept going either with green branches of *Mimusops elata*, or with palm nuts from *Attalea excelsa*, and *Maximiliana regia*, these palms are usually grown in the Botanic Gardens in various parts of the tropics, the latter species being more commonly known as the "Cocurito" palm. A chatty, open at both ends, is placed on the fire and the smoke allowed to issue from the upper aperture. A paddle like implement is then dipped into or covered with the latex, and held over the smoke until the latter is coagulated. It is stated by Bonnechaux* that 8 litres of latex are completely coagulated in about 1½ hours by these means.

"The decomposition of the albuminous substances in the rubber may be prevented by the addition of suitable antiseptic reagents to the latex, when the rubber is prepared in other ways, though quickness in drying or complete extraction of the moisture from coagulated rubber is often sufficient to bring about the same result. Dickson's apparatus is devised to meet many of these requirements."—(Herbert Wright.)

"Samples of rubber prepared at Kuala Kangsar have been reported on as equal to good Para (Brazilian) and would fetch best Para prices. I have always found the latex to coagulate readily with only the addition of a pinch of alum, and by placing immediately in smoke, both putrefaction and mould are avoided. If the rubber is sound, the market value depends on the state of dryness in which it is received. What has been prepared at Kuala Kangsar has been kept smoked until shipped. A parcel sent to London 3½ years ago was reported to have lost 26½ per cent. in washing, and the manufacturers thought that if sent home in bulk, the loss would reach 30 per cent. This, however, is a question for the planter himself; smoke has a chemical action in the coagulation of latex from Hevea as well as saving decomposition, and assists in gradually drying. To be as dry as possible depends on the time the rubber has been kept smoked, and I am of opinion that dry marketable rubber could not be prepared under two months."—(R. Derry, Singapore).

* Jumelle.

ACREAGE IN RUBBER.

Sir Frank Swettenham, K.C.M.G., writes with regard to an Article which appeared in *The Standard* of August 8, last :—The acreage planted with Para rubber in the Straits and Malay States on January 1, last, was 30,000 acres, and in Ceylon, 25,000 acres. Since that date the total area planted in the Malay States does not amount to 10,000 acres.

The United Planters' Association in the Malay States have taken pains to go into this question, and in their latest report they give the following figures : Total acreage planted with rubber in the Straits and Malay States 30,000 acres : Sumatra, 5,000 acres : Java, 5,000 acres ; Ceylon, 25,000 acres ; India and Burma, 5,000 acres ; total 70,000 acres. Allowing that all this is good, and will give the good yield of 200 lb. per acre, the amount produced would be 14,000,000 lb. This acreage cannot, however, be all in full bearing till the end of 1911, and they calculate that no more than this acreage can be in bearing till 1911, because it is not yet planted.

The exports from Para for the last three years have remained practically constant at about 30,000 tons, and the world's production was, in 1898, as nearly as it can be ascertained, about 60,000 tons, or 134,000,000 lb. The present production is estimated at 70,000 tons or 156,000,000 lb. of which Asia can only produce 14,000,000 up to the year 1911, what she can produce after that date will depend upon the area planted and successfully cultivated between now and 1911. *Standard*, Dec. 6.

Information on Para rubber may be found in the Bulletin of the Botanical Department, Jamaica, as follows :—1894, pp. 99–105 ; 1899, pp. 82–84 ; 1900, pp. 186–190. And in the Bulletin of the Department of Agriculture as follows :—1905, pp. 258–269 ; 1906, pp. 20–21, 159–160, 169–170, 233.

CASTILLOA OR CENTRAL AMERICAN RUBBER.

(*Castilloa elastica*.)

This tree grows in Central America from south of Mexico, south-wards to the west coast of South America.

The tree has a variety of local names, the most important of which are 'Hule' or 'Ule' and 'Caucho.'

Distinct from this plant is *Castilloa Tunu*, a tree also found in Central America and sometimes confused with the true Central American rubber tree which it closely resembles in appearance.

In an article in the *Beihfte zum Tropicnplanzer* for July, 1901, Mr. Th. F. Koschny, a planter of long experience in Costa Rica, distinguishes the following varieties of 'Hule' trees :

Castilloa elastica :

'Hule blanco'	White rubber tree
'Hule negro'	Black rubber tree
'Hule colorado'	Red rubber tree

Castilloa Tunu :

'Hule tunu'	Gutta percha.
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The names of the three so-called varieties are given from the colour of the bark of the trees. 'Hule blanco' is described as the only one worth cultivating, giving thick and abundant latex.

The tree is not shade-loving, being seldom found in forests, and not easily injured by tapping. 'Hule negro' gives a watery latex, and that of 'Hule colorado' whilst good, is scanty.

The plants distributed from Kew and now under cultivation in various tropical colonies, would be more correctly termed, according to the place of their origin, Darien, "Castilloa" or Darien "Caucho" trees. This would distinguish them from the Ule trees of Mexico, British Honduras, and Nicaragua, and indicate their history. (*Il. I. Bulletin*, 1901, p. 350.)

CLIMATE AND SITUATION.

The study* of *Castilloa* furnishes evidence that with this tree there is a relation between climate and rubber production, and that this relation is the opposite of that commonly supposed to exist. Practical experiments in Central America soon showed, that *Castilloa* will not thrive in swamps or where the drainage is deficient though the need of continuous humidity for *Castilloa* is still insisted upon.

The total rainfall of a place affords but the slightest intimation of its climate in relation to vegetation. A sudden, heavy shower may wet the soil much less than the same amount of water falling as a steady rain, and in the supply of water to plants the difference is even greater; the period during which the atmosphere and soil are moist is of importance to them, but not the amount of water which patters off their leaves or falls into the rain-gauge. Humidity even to the point of saturation for six months may be of no avail to plants unable to survive an equal period of drought.

The lowland forests of the west-coast districts of Guatemala and southern Mexico, while composed in the main of the same tropical elements as those of eastern Guatemala, yet showed a striking deficiency of plants requiring continuous humidity. Nevertheless wild *Castilloa* seems to have existed in the past as in the present in far greater abundance, the wild product having long been an article of export in quantity far more considerable than from the eastern districts.

Freer flow of milk in drier regions.—A second contrary fact to the popular supposition that rubber production is confined to continuously humid climates was encountered when it was found that, in spite of the greater dryness, the milk flows down from the rubber trees of Soconusco with a freedom unknown in eastern Guatemala where it merely oozes out into the gashes made by the "uleros."

Decrease of milk with altitude and continuous humidity.—That rubber milk is obtained with greater freedom on the drier western coast shows that continuous humidity is at least not indispensable, but it does not prove that the larger production is due to the drier climate. There may be, and probably are, differences in the trees

* Extracts from Bull. No. 49, Bureau of Plant Industry, U. S. Department of Agriculture.

of the two regions, though these have not been detected. But that there is a climatic element even on the west coast is made plain by the fact that as the coastal plain is left behind and the slopes increase in altitude and humidity, the production of rubber gradually declines. At an altitude of about 1,800 feet on the Esmeralda coffee estate, only a few miles from La Zacualpa, wild *Castilloa* trees apparently normal in other respects yielded milk very sparingly, while at an elevation of 2,500 feet no milk dropped from the cuts. *Castilloa* trees grew vigorously and attained a diameter of 15 inches in twelve years at "Quien Sabe," in the coffee district above Tapachula. The trees grow naturally up to 1,500 feet and beyond. Above 1,000 feet the rubber gatherers do not expect to find much rubber. Trees planted at an altitude of 2,000 feet from seed brought from the coast do not yield rubber.

Castilloa on the Isthmus of Panama.—The idea that the *Castilloa* sent from the Isthmus of Panama to British India came from a continuously humid district seems not to be justified by the statements of Mr. Cross, who secured seeds and cuttings in the vicinity of Colon. He says :

"The interior of the Darien forests would frighten most people. The undergrowth is composed of boundless thickets of a prickly leaved species of *Bromelia* often 8 to 10 feet high, the ground swarms with millions of ants, and the snakes raise themselves to strike at any one who approaches. The Caucho tree grows not in inundated lands or marshes, but in moist, undulating, or flat situations, often by the banks of streamlets and on hillsides and summits where is any loose stones and a little soil. It is adapted for the hottest parts of India, where the temperature does not fall much below 74° F. The tree is of rapid growth, and attains to a great size, and I am convinced that, when cultivated in India, it will answer the most sanguine expectations that may have been formed concerning it. I have been up the Chagres and Gatun rivers. I came out on the railway about 7 miles from Colon. I go back to the same place (the village of Gatun), from which place by the river the India-rubber forests are reached."—(Trans. Linn. Soc., London 2d. ser. 2: 213.)

BEST DISTRICTS IN JAMAICA.

Where cocoa grows there also will *Castilloa* thrive. In Portland a tree growing in dry limestone was, at 5 years of age, 18 feet in height of clean stem before branching, and 15 to 18 inches in diameter.

PROPAGATION.

The propagation of this rubber tree is most easily effected by seed, but the seeds must be sown as soon as they are ripe as they very quickly lose their vitality. Cuttings can also be made.

SHADE FOR CASTILLOA.

"In good soil and in moist situations no shade at all is required for the young tree, but otherwise it does want a certain amount of

shade for the first two or three years after planting. Too dense shade, however, is not beneficial to it and plants set out in the forest make very slow progress and develop into spindly trees." (Capt. M. Short, in *West Indian Bull.*, 1905, p. 139.)

"The *Castilloa* is a fast growing tree. It appears to grow faster between the ages of two and four. The leaf surface of the tree, and consequently the amount of light it gets, has a great deal to do with its growth. Shade grown trees are not nearly so large at the same age as those grown in the sun. Some planters believe that trees grown in at least partial shade yield more latex, but if this is so, I do not believe that they yield enough more to pay for the loss in growth, for under any ordinary conditions the trees yield in proportion to their size. Monthly measurements of a large number of *Castilloa* trees show that they grow on an average of about $\frac{1}{4}$ inch per month in circumference. This varies, however, the trees sometimes growing not at all for a month and growing $\frac{1}{2}$ inch or more the next month. An experiment in the effect of tapping on growth did not show that it made any difference."— ("A Forester in the "India Rubber World.")

AS A SHADE TREE FOR COCOA.

"I find that cocoa bears well under the shade of *Castilloa*. Nine years ago I planted an acre of rubber and cocoa together—the rubber at 24 feet apart, and the cocoa at 12 feet—and so far as I have noticed there is very little, if any, difference in the bearing of these cocoa trees and those under the shade of *Bois Immortel*. On finding this I planted last year fifteen acres in the same manner, and there is every reason to expect that in another eight, or nine years they will give a gross return of about £50 per acre. Coffee also bears well under *Castilloa*."—(Capt. Short, in "*Tropical Agriculturist*," Aug. 28, 1900.)

As bearing on this phase of the subject, the following extracts from an article by Mons. P. Cibot, in Vilbouchevitch's *Journal d'Agriculture Tropicale*, descriptive of cocoa cultivation in Venezuela are likely to be of interest:—

"I have recently had the opportunity in Venezuela of visiting one of the principal plantations which produce that cocoa, so justly reputed, known as Caracas. I found opportunity there to study also a plantation of *Castilloa elastica* used as a shade tree.

"General Fonseca, installed in the fertile Valley for some twenty years, has gradually acquired the greater part of the plantations laid out in it. He owns to day thirteen plantations, producing a total of 480,000 lb. cocoa in 1903-4.

"Going over General Fonseca's plantations, I could not but admire their beautiful appearance and the care taken with the irrigation of the whole property; but my attention was specially drawn to the plantation of *Castilloa elastica* mentioned above.

"In 1895-6 about 8,000 plants were put out in places where shade was wanted for the cocoa trees. These trees, aged eight to nine years now, are a beautiful sight; they have attained a height of 36 to 45 feet, and have an average circumference of 33 inches.

"At about four or five years the Castillos easily out-grow the cocoa trees and commence to give them a little shade. As they plant up Castillos on the property, they kill out the "Bucares" or other shade trees, ring-barking them with the axe at about a yard above the ground.

"The yield of Castilloa plantations is no longer to be doubted; the result obtained at Ocumare is a new proof, but the experiment made by General Fonseca is specially remarkable as it shows that the Castilloa can be grown among cocoa without in any way harming their production. Indeed, at Ocumare they have noticed no diminution in the number of pods carried by the trees shaded by Castilloa, nor any change in the quality of the bean."

In the *Tropical Agriculturist* for February, 1905, (p. 529) the following extract is published from a letter from a planter at Matabele, Ceylon, in which he sums up his experience in regard to Castilloa and cocoa as follows:—

"I have very large Castillos growing both along roads and also scattered through cocoa, the latter of about fourteen years' growth showing no evidence of prejudicial influence from the Castillos. My clearing of some 30 acres of Castillos and cocoa planted together six years ago so far supports the contention that these two products may be grown together."

Captain Short says:—There is little doubt that the return per acre would be greater from a plantation of cocoa and Castilloa than from cocoa shaded by Bois Immortel.

"On Richmond estate there is an acre of cocoa twelve and a half years old, planted 12 feet by 12 feet, shaded by Castillos and Bois Immortel. The rubbers are at 24 feet by 24 feet. The Immortels are being gradually killed, many of them being already dead.

The cocoa crop for 1903-4 from this field was 3 bags. This would give a return per acre of from £22 10s. to £25 3s. thus:—

3 bags cocoa @ £4	... £12
75 rubber trees $\frac{3}{4}$ lb. each @ 3 6 per lb.	10
	£22

"If the average yield were 1 lb. per tree, this would give a return of £25 3s. per acre.

"The return from other cocoa fields of the same age, planted on similar soil and shaded by Bois Immortel was $3\frac{1}{2}$ to $4\frac{1}{2}$ bags per acre. Taking the average of 4 bags this gives £16 per acre, so that deducting the cost of the rubber extraction, the return from the cocoa and rubber would be from £4 to £6 more.

"By applying some nitrogenous manure to supply the deficiency in the soil arising from the absence of the Bois Immortel tree, this figure would doubtless be increased. It is also probable that the rubber could be planted closer than 24 feet.

DISTANCE IN PLANTING.

The proper distance in planting depends a good deal on how

soon the plantation is to be tapped. Trees planted 10 x 10 feet begin to crowd each other out at about six years. If the plantation is to be tapped at this age, or earlier, this is a good distance for planting. When the trees get older, the poorer and weaker ones can be bled out." (*Bulletin, Department of Agriculture, Jamaica, 1906, p. 98*).

Mr. Orde, who is managing the West India Rubber Syndicate, in Tobago, has furnished the following information on young Castilloas:

The Castilloas on Louis d'Or estate are still young. Planting was begun in the autumn of 1898, and the oldest trees are six years or thereabouts.

The larger number of the trees have been planted to stand finally at a distance of 17 feet. Some fields are planted at $8\frac{1}{2}$ feet by $8\frac{1}{2}$ feet, others at $8\frac{1}{2}$ feet by 17 feet, in the hope that a yield might be obtained from the cultivation while young, by tapping the intermediate trees before they grew large enough to necessitate being cut out.

It has been found that a well-grown field, planted at $8\frac{1}{2}$ feet by $8\frac{1}{2}$ feet, cannot stand longer than about five years without being thinned out, as at that age the branches begin to interfere with each other, and the tree tends to become thin and spindly.

Experiments were made in tapping some of these young trees, averaging five to six years old, in 1904. Large numbers of them were tapped as severely as possible with chisel and mallet. The latex was in some cases taken wet and washed before coagulation and in others it was allowed to dry on the tree, and picked off afterwards as scrap.

There are some twenty to thirty trees on the estate, aged seven years from seed, and experiments have also been made on these, from which it appears that the yield increases fairly quickly as the tree gets older.

Six of these trees were tapped, not severely, in March 1904, and gave $12\frac{1}{4}$ oz. dry rubber. The same trees were tapped again in September and gave 10 oz., or nearly $\frac{1}{4}$ lb per tree in the two tappings. These trees, however, were rather above the average in growth for their age.

Trees planted at $8\frac{1}{2}$ feet by $8\frac{1}{2}$ feet could not be left growing to this size without injury to each other; and if a field is planted with the idea of getting rubber from the intermediate trees, as soon as they get old enough to yield, and before it is necessary to cut them out, it would seem that $8\frac{1}{2}$ feet is too close a distance, and that 12 feet would be about the most suitable distance. (*West India Bulletin, 1905, pp. 140-141*)

Professor O. F. Cook,* says: "As yet there have been no experiments yielding any definite information on the above point, but the recent trend of opinion among planters seems to be distinctly in the direction of closer planting. There has been a

gradual decline from 20 feet and upward between trees to 12 feet and under.

"The questions of shade and of distance between trees are closely related and need to be considered together because several of the arguments for shade can be met, wholly or partially by close planting. The first of these is that of the greater expense incidental to open culture. The frequency with which the land requires to be cleaned, and the period of years during which it would be necessary to continue such cleaning, depends largely upon the amount of overhead shade present to discourage the under-growth. Some planters on the Isthmus of Tehuantepec are evidently taking advantage of this fact and are setting close with the intention of removing alternate trees before they are large enough to injure their neighbours by crowding; and it is expected that if they are "tapped to death" they can be made to yield enough rubber to more than cover the expense of planting. At least there seems to be no reason why, if the land is to be cleared it should not be made to produce as much rubber as possible, instead of being planted with useless trees for a purpose which can be attained quite as fully by setting the rubber trees closer together.

There is danger, however, that any suggestion which promises earlier returns from rubber culture will be over-done. The rubber of very young trees is of low grade and expensive to collect; also it would be very poor policy to risk permanent injury from weak spindling growth which overcrowding would undoubtedly cause. More is likely to be lost than gained by trees standing at less than 8 feet for even a few years. Better than uniform close planting would be to set the north and south rows farther apart than the trees in the rows. With a given number of trees this would secure the maximum of shade on the ground, because the morning and afternoon sun would not shine down the rows. The cleaning of the land or the cultivation of a catch crop or a shade crop between the rows would also be facilitated. The distances would depend on the size which the *Castilloa* trees were expected to attain in any given locality, the rows from 12 to 20 feet apart, the trees from 8 to 12 feet in the rows being fair average estimates.

CULTURE.

"In attempting* to plan a rational culture for *Castilloa* it will be worse than useless to insist upon all or any of the cultural measures which have been found desirable with coffee, cacao, or other tropical crops. *Castilloa* is not cultivated for the pods like cocoa, for the flowers like cloves, for the fruits like oranges, nor for the seeds like coffee. The increase of the size of the trunk and of the amount of milk contained in its inner bark are objects of cultural solicitude."

"Open culture with relatively little cleaning at first would be more practicable if the weeds and undergrowth cut down in the

* Extracts from Bull. No. 49, Bureau of Plant Industry, U. S. Dept. of Agriculture.

dry season could be left spread over the ground. This would do more to conserve the moisture of the soil than the same vegetation alive, but the danger of fire will in most localities forbid the use of this method of culture."

"With shade recognized as a means of influencing natural conditions of soil or climate it becomes evident that each planter will need to use his best judgment in determining what local conditions require. In Costa Rica, Koschny advises the thinning of the forest by the removal of two or three trees out of every five. At La Zacualpa more are cut out. Some of the planters on the Isthmus of Tehuantepec practice clean culture. No general principles will determine which is best, because no one method is applicable everywhere.

AGE AT WHICH TREES MAY BE TAPPED.*

"The earliest age at which *Castilloa* trees may be tapped with safety and advantage has been stated all the way from four to twelve years, while from eight to ten years is the conservative estimate. At the same time it must be admitted that little in the way of positive knowledge exists on this point, and careful experiments may be necessary to determine whether, for example, the taking of half a pound of rubber from each tree in the sixth year will retard growth so as to diminish the yield of succeeding years. As the trees approach maturity and have occupied most of the available space, as much may be taken as will not weaken the tree and shorten its life.

"The inferior quality of the rubber obtained from young trees also lessens the inducement for tapping them. It has been known for several years that the rubber and gutta-percha obtained from young plants or from the leaves and twigs of the trees is different from that yielded by the trunk of mature age, in that a smaller or larger percentage of rubber is replaced by non-elastic, brittle, or sticky substances commonly referred to as "resins." Dr. C. O. Weber has recently published the following results of analyses of samples of rubber from trees varying in age from two to eight years :

Resins in rubber from trees.	Per cent.
2 years old	42.33
3 do	35.02
4 do	26.47
5 do	18.18
7 do	11.59
8 do	7.21

"The same writer also gives a table showing the varying amount of resin in samples from different parts of the same tree :

Resin in rubber from—	Per cent.
Trunk	2.01
Largest branches	3.77
Medium do	4.88
Young do	5.86
Leaves	7.50

* Extracts from Bull. No. 49, U. S. Dept. of Agri.

If these figures represent facts at all general, they lessen very distinctly the prospects of any plans which contemplate the tapping of very young trees, and it will be necessary to agree with Dr. Weber that eight years is the minimum age at which a plantation can be expected to furnish rubber for the market."

TAPPING.

The following* is a description of a method of tapping the trees in the forests of Nicaragua :

When the collectors find an untapped tree in the forest they first make a ladder out of the lianas or "vejucos" that hang from every tree. This they do by tying short pieces of wood across them with small lianas, many of which are as tough as cord. They then proceed to score the bark with cuts which extend nearly round the trees, like the letter V, the point being downward. A cut like this is made about every 3 feet all the way up the trunk. The milk will all run out of the tree in about an hour after it is cut, and it is collected into a large tin bottle made flat on one side and furnished with straps to fasten on to a man's back. A decoction is made from a liana (*Calonyction speciosum*), and this, on being added to the milk in the proportion of 1 pint to the gallon, coagulates it to rubber, which is made into round, flat cakes. A large tree, 5 feet in diameter, will yield, when first cut, about 20 gallons of milk, each gallon of which makes 2½ pounds of rubber. I was told that the tree recovers from the wounds and may be cut again after the lapse of a few months ; but several I saw were killed through the large harlequin beetle (*Aerocinus longimanus*) laying its eggs in the cuts, and the grubs that are hatched boring great holes all through the trunk. When these grubs are at work you can hear their rasping by standing at the bottom of the tree, and the wood dust thrown out of their burrows accumulates in heaps on the ground below.

That improved methods and tools are to be used for cultivated trees is one of the points on which all the rubber planters agree, but as yet none of the many improvements suggested has attained any popularity, and it is at least doubtful whether any of the devices brought forward at this time is to be looked upon as a practical solution of the problem. Some inventors have worked on the erroneous idea that the rubber comes from the sap, like sugar from the maple, and have thus completely wasted their time.

An enumeration of some of the features essential for a good tapping instrument may save further labour on wrong lines.

The cutting edge must be keen, and must therefore be easy to sharpen. A thick or blunt edge bruises the wood and milk tubes, and this interferes with the flow of milk.

There should be a means by which the depth of the cut can be regulated, since it is important to cut deep enough to reach the milk and yet not so deep as to reach into the wood, but axes and chisels with shoulders to prevent too deep penetration are not promising because the thickness of the outer bark is variable. The

* From Bull. No. 49. Bureau of Plant Industry.

shoulders also bruise the bark if the cutting is by blows. *Bull. No. 49, Bureau of Plant Industry.*

*Mr. Hart states that "the invention of the new tool described by Dr. Weber is a step in the right direction, and working on the same lines we are now in possession of an instrument which allows still more freedom to the operator and enables him to make a narrow, deep, or broad channel at will, with ease and despatch."

Washing the latex--By the methods now adopted the foreign matters are washed out of the latex before coagulation takes place, thus producing a very high grade of rubber from the *Castilloa*, having a marketable value equal to that of Para.

Until now it was generally assumed that the Central American rubber was of much inferior grade to that of Para. It has now been proved, however, that the actual difference is very slight, if there is any, and resolves itself into the question of preparing it for the market at the time of tapping. During the past few months the best qualities of some rubber from cultivated *Castilloa* trees brought \$1.54 and \$1.56 gold per pound in the London market. This price was higher than that of best South American Para sold at the same time.

Coagulating the latex--"The separation of rubber from the latex, a process commonly called coagulation, is in a somewhat more advanced state of investigation than the subject of tapping, if, indeed, the recent experiments of Dr. Weber do not mean that a final and satisfactory conclusion has been reached. Dr. Weber finds that by the simple expedient of diluting the fresh latex of *Castilloa* with five times its volume of boiling water and adding 8 ounces of formaldehyde to each barrel of the resulting fluid, all the impurities to which the inferiority of *Castilloa* rubber are due can be removed, since they will remain in solution, while after twenty-four hours the clean rubber will be found in a "snow-white-cake" which can be lifted off the top. Dr. Weber contends that rubber prepared in this way is "absolutely free from solid impurities of any description . . . either soluble or insoluble, organic or inorganic," and that it is equal or superior to the finest brands of Para rubber. *Bull. No. 49, Bureau of Plant Industry.*

Yield--"It may be said that at the present stage of this inquiry, 2 pounds per tree is looked upon as the reasonable maximum yield to be expected from adult trees of twelve years and upward, growing under favourable natural conditions. This is the highest estimate which is known to the writer as having been made by reliable planters of intelligence and experience; and some such hold that the probabilities lie nearer to half a pound than to 2 pounds. It is appreciated that this estimate is much smaller than many claims based on wild trees and that it is much larger than the results reached on some of the earlier plantations would seem to promise. The estimate is not, however, made as an average of all published figures, but is reached rather by the elimination of unwarranted expectations from one end of the series, and from the

other of disappointments due to adverse local conditions.—*Bull. No. 40, Bureau of Plant Industry.*

Captain Short states: Tapping was carried on (at Richmond estate) in February, 1904 with the following results:

	Total yield	Average per tree.
Feb. 4, 19 trees gave ...	4 lb. 6 oz.	3 $\frac{3}{4}$ oz. dry rubber
Mar. 19 do ...	3 " 10 "	3 " "
Feb. 8, 16 do ...	4 " 1 "	4 " "
Mar. 15 do ...	2 " 11 "	2 $\frac{3}{4}$ " "
Feb. 17, 15 do ...	5 " 11 "	6 $\frac{3}{4}$ " "
April 27 do ...	3 " 0 "	3 " "

These fifty trees gave an average yield of just under $\frac{1}{2}$ lb. of dry rubber in the two tappings.

The yield of latex varies greatly in trees of the same size and age. Two trees out of these fifty gave 7 $\frac{1}{2}$ to 8 $\frac{1}{2}$ cups of latex at each tapping, the one tree yielding 1 lb. 10 oz. of dry rubber in the two tappings, the other 1 lb. 9 oz. Other trees tapped in the same month gave 1 lb. in the two tappings and another gave $\frac{3}{4}$ lb. in one tapping. Trees of the same age and size gave less than half these amounts. Why this should be I cannot say, and I believe no explanation has yet been given to account for the difference in the yield of latex. As far as my own observation goes, trees in the open, or only partially shaded, appear to be better yielders, as a rule, than those in denser shade.

In comparing this tapping with that of 1899, it appears that, at nine years old, a tree on an average yields about one-half of what a tree thirteen to fourteen years old does.

The results of the different tappings have led me to conclude that from $\frac{3}{4}$ lb. to 1 lb. of rubber per annum may be safely reckoned on, as the average yield of a tree thirteen to fourteen years old.

It is intended at the next tapping to use a ladder, and to tap as far as possible up the stem. No doubt the total yield of rubber would then be greater. It is also intended to tap a few trees continuously for twelve to fourteen days, or every second day for a month, although it is very doubtful if the yield of latex would be much increased by so doing, or that the extra yield so obtained would compensate for the greater damage to the tree. In this respect the *Castilloa* appears to differ from the *Para*, and the experiments to be tried in 1905 will probably do something towards settling the point.

The cost of collecting was 8d. to 9d. per lb., but this cost would be reduced when tapping is carried on regularly and on a larger scale. The rubber extracted from the nine-year old trees in 1899 to 1900 was valued at 3s. 9d. per lb., a good price at the time.

Information on *Castilloa* rubber may be found in the Bulletin of the Botanical Department, Jamaica, as follows:—1895, pp. 34-38; 1898, p. 37; 1899, pp. 74-76, 85; 1900, pp. 2-7; 1901, p. 141. And in the Bulletin of the Department of Agriculture, as follows: 1904, pp. 101-103, 162-168, 188-192, 231-236, 257-260, 283-285; 1905, pp. 13-20, 43-46, 67-70, 84-85, 133-134, 156-158, 181-183, 229-230, 233-243; 1906, pp. 97-100, 145-150, 172-175.

LAGOS SILK RUBBER OR IRE.

(Funtumia elastica.)

Locality.—A new rubber-yielding plant suddenly came into notice in the colony of Lagos in 1894. This proved to be a handsome tree, locally known as Iré, Ireh, or Ereh. It belongs to the same natural order as the Landolphas. The particulars respecting it were gradually accumulated at Kew. It was at first known as *Kickxia africana*, but is now more correctly named *Funtumia elastica*. It is widely distributed in West Africa from Sierra Leone to the delta of the Niger, the island of Fernando Po, and the Gaboon. It is believed that rubber was first obtained from it on the Gold Coast in 1883. (*Agricultural News*, 1902, p. 185.)

Mr. J. H. Hart states: Plants put out in Trinidad at one of the trial sections at St. Clair in July, 1898, averaged in January, 1901, thirteen and a half feet in height, with a stem circumference of seven inches. . . . Mr. Millen of Tobago, who has been in the native forests of this plant, reports it as being a large forest tree. . . . The St. Clair trees even at their present early age of three years, bleed freely, but are not yet of sufficient size to base any reliable estimates as to yield or value. . . . The rubber keeps well and appears to stand near to good Para in value. A point which will recommend it to some is the fact that although it certainly grows faster under shade, it can make good growth when fully exposed to the sun.—(*H. I. Bull.*, 1901, p. 108.)

In Western Africa.—The following notes on the Silk Rubber of Lagos are taken from an article by M. E. De Wildman published in the *Revue des Cultures Coloniales*, and translated in the *Agricultural Bulletin of the Straits and Federated Malay States*, Vol. II., 4 April, 1903, p. 136.

"The plant is specially cultivated at present in Western Africa in the Congo Free State and in the Cameroons, and is, according to the author, the best rubber plant to cultivate in these regions, and this is so for several reasons; it is easy to procure seed as the plant is wild in this part of the world and one can be sure that it will grow well as the soil and climate are naturally suitable for it. The German Colonial reports show that *Funtumias* of the same age as *Castilloas* are relatively more advanced, the *Funtumias* give seed at the end of two years and a half, while the *Castilloa* fruits only at the end of from three and a half to four years. If one compares the latex of the two, at the same age, one can see that it is much more concentrated, less watery and sticky in *Funtumia* than in *Castilloa*, and that it can give a return more quickly. *Castilloa*, according to M. Koschny can only be milked when eight years old. As to the rubber itself, that of *Funtumia* is as good or better than that of *Castilloa*. The results of comparative researches with *Funtumia* and *Castilloa* in West Africa are in favour of the former."

"If at first the stem bifurcates forming a bush, either a shoot is developed above the bifurcation, or one branch grows more

strongly than the other eventually forming the trunk. Among the advantages of *Funtumia* one may mention that the latex flows more easily and quickly than that of *Castilloa* or *Ficus* and the seeds keep good for six weeks and even germinate after three months. Nor is the *Funtumia* particular as to soil, it grows equally well in lateritic or basaltic soils rich in humus or stony. As to altitude, it has been noticed that it does best below 800 metres (2625 ft.) It is reckoned that in April, 1902, there were in the Cameroons 200,000 plants, exclusive of wild ones. The plan of planting *Funtumias* in a lightly cleared forest as has been frequently done is not recommended. They do not grow so well in shade as in full sun; when they are too weak to resist the drying action of sun and wind, they naturally should be protected, but when they are strong enough to resist this, they develop better when fully exposed to the sun, provided that the ground is damp enough. From the experiments made in plantations in German territory the *Funtumias* should be planted 6 meters [20 ft.] apart."

"The tree is one of the best shade trees for cocoa, but as it is pyramidal in form it will be necessary to plant close which is not a disadvantage."

Best Districts in Jamaica. Small trees of this species are growing at Hope Gardens and at Castleton. It will probably be found that it will succeed best in the districts recommended for Para rubber.

Pruning. In Jamaica, Trinidad and Tobago it is noticed that the young trees if left to themselves are liable to assume a bushy habit and are thus rendered less valuable for rubber-yielding qualities. To correct this it is recommended that the trees be pruned by gradually taking off all the lower branches and that one central, clean stem be encouraged. In Lagos the tree attains a height of 90 to 100 feet before branching, which makes it easy for the collector to tap the trunk.

Collecting and preparing the rubber. "In tapping the trees the bark is first cut in a vertical direction from the bottom to the top. This single line is about $\frac{1}{2}$ to $\frac{3}{8}$ of an inch broad, and deep enough to reach the inner bark. This forms the main groove. On each side of this two series of oblique grooves, about two feet apart, are cut, each running into the main groove. The side grooves are made beginning at the top, and gradually reaching the base of the tree. All the milk exuding from the lateral grooves will find its way into the main groove and so ultimately reach the bottom, where a vessel is placed to receive it. When sufficient milk has accumulated it is then collected and made into rubber.

The methods adopted for coagulating the milk are at present of two kinds, viz., "the cold process" and "the heat process." The cold process is chiefly practised by the Fanti men introduced from the Gold Coast. A cavity is excavated in the trunk of a fallen tree so as to form a cistern of the capacity necessary for holding the milk collected during several days. Into this the rubber gatherers pour the milk, after straining it, from day to day, until it is quite full. It is then covered with palm leaves and left for 12 to 14 days and sometimes much longer, depending on the

season, until most of the watery portions have either evaporated or sunk into the wood. After being kneaded and pressed together the rubber thus obtained has a dark, brownish colour, with the inner portions of a slightly lighter colour. Such rubber is known locally as "silk rubber."

"The heat process is the one generally adopted by the natives of Lagos. This is much simpler in working, as it disposes of all the milk collected at the close of each day. After being strained the milk is placed in a vessel and boiled. The rubber begins to coagulate almost directly the heat is applied, and after the boiling is over is removed in a somewhat sticky condition, owing to being burnt, and of a blackish colour. It is pointed out that the heat process, though simpler, impairs the quality of the rubber, and is calculated to injure the industry. It is probable that if the heat process were somewhat modified the results would not be so injurious. An experiment was tried at the Botanic Station to coagulate the milk by heat, but not applied directly to it. The result was much more satisfactory. The rubber came off of a milky white colour, and after being pressed it was clean and firm without being sticky." (*Bull. R. Gardens, Kew*, 1895, pp. 245-246.)

Value of the rubber. "The question of making West African rubber more marketable is now exercising the minds of merchants engaged in that trade. The rubber that comes from Para (South America) fetches on the English market double the price of that product from West Africa. The only reason for this is the different method of curing the rubber when taken from the tree—a very simple process. . . . The difference between Para and African rubber is similar to that between a loaf of bread just made up into dough and a loaf that has been through the oven and been properly baked. In other words while the substance is the same, the one is an imperfect article; the other a finished one, so far as the production of rubber is concerned." (*Agricultural News*, 1904, p. 343.)

It appears that in Lagos, owing to the wholesale destruction of the trees in the hinterland, a most promising and valuable industry has been practically ruined. In 1894 the exports of rubber shipped from the colony amounted to 5,867 lbs. valued at £324 6s. 4d. In 1895 these figures rose to no less than 5,069,576 lbs. of a total sterling value of £269,893."

"There is, unhappily, reason to fear that the usual result may follow this sudden discovery. Already there seem to be grounds for the belief that, in so far as the term 'rubber industry' implies the intelligent growth and cultivation of the plant for profit, it conveys a false impression of the methods in vogue in the interior."

"Judicious tapping with due regard to the life of the tree, and its future usefulness, is the exception; rubber-bearing trees are ruthlessly sacrificed by irresponsible seekers after wealth, and dead trunks are becoming a too familiar feature in the landscape of the productive districts. Sooner or later a purely destructive policy of this kind must exhaust the richest country; adventurers will have to stray further afield, and the cost of transport will

equal or exceed the value of the article." (*Annual Report on Colony of Lagos for 1895.*) (*Colonial Office Reports, No. 185, 1896.*)

In 1897 the Governor of the colony sent Messrs. Leigh and Dawodu of the Botanical Department [two natives of Lagos who were trained at Hope Gardens, 1890-1893, and subsequently spent a year at Kew] into the interior to report on the condition of the rubber trees in the forests, and to give advice to the kings and chiefs on the proper methods of tapping, and to induce them to devote as much care and attention to the raising and cultivation of this tree as they give to kola and oil palm.

Messrs. Leigh and Dawodu reported that the forests abounded with Iré trees, but through over-tapping they were almost ruined and rubber working had practically ceased. And they go on to say "rubber collectors have now to go 15 or 16 days off Ibadan for rubber beyond the Protectorate of this colony. The countries where active rubber working is going on, are Benin and Aboko forests,"

In the Annual Report on Lagos for 1897 the following statement occurs:—"As was anticipated, the falling off in the production of rubber, due to the reckless way in which it was collected, has come to pass, the amount shipped in 1897 being 4,458,327 lbs, as against 6,484,365 lbs, in 1896. It is early to talk pessimistically of the 'extinction of the industry,' inasmuch as the opening up of fresh country to peaceful commerce cannot fail to revive the production. At the same time the greed and guile of the small minority that collects and adulterates rubber, coupled with the apathy of the large majority that only looks on, must inevitably deal a severe blow to the trade. Steps are, however, being taken to encourage the native chiefs to have the rubber collected in a thrifty and systematic manner, which, it is hoped, will show good results in the near future."

It would appear from the following that Funtumia is now being largely planted in West Africa:—"From an interesting report issued by the London Chamber of Commerce in June, 1905, we gather that rubber planting in West Africa is progressing rapidly, some 15,900 plants of *Funtumia elastica* having been planted at Aburi in 1902, and reported in 1905 as twelve feet high."

"It is reported that caterpillars have been very destructive to the rubber plants." (*Bull. Botanical Department, Trinidad, July, 1906, p. 74.*)

Information on Lagos silk rubber may be found in the Bulletin of the Department of Agriculture, 1906, pp. 171-172.

CEARA RUBBER.

(*Manihot Glaziovii.*)

Ceará or Maniçoba rubber is produced by *Manihot Glaziovii*, a tree related to the cassava, but attaining to a height of 30 to 50 feet.

Locality, Soil and Climate—"Ceará is a coast town of Brazil in lat. 4° S., and the flat country which runs back to the hills is

described by Mr. Cross as manifestly possessing 'a very dry, arid climate for a considerable part of the year. This is evident from the fact that mandiocca and other crops require to be irrigated. The rainy season is said to begin in November and end in May or June; torrents of rain are then reported to fall for several days in succession, after which the weather moderates for a brief space. According to some statements there are occasional years in which hardly any rain falls. This assertion concurs with the aspect presented by the country in general. The daily temperature on board the ship ranged from 82° F., but inland in is often probably 90°. The localities traversed by me nowhere seemed to be elevated more than 200 feet above the sea.' At Pacatuba, about forty miles from Ceará, the actual place where the specimens were obtained, 'the general forest was tolerably high, but the sparse small foliage did not afford much shade from the fierce rays of the sun. The soil was in places a sort of soft sandstone or gravel which was bound up in the most extraordinary manner. Neither grass nor weeds grew among this underwood, and there was an entire absence of ferns, mosses, and other plants.' In another place somewhat further from the coast, the traveller, shortly after entering the bush-like forest, 'came on a large tract of land covered by immense masses of grey granite, some of which might be fifty tons or more in weight. These had been broken where they lay, and were the result of a volcanic explosion. Rounded masses of the same rock also cropped out in many places Many good-sized rubber trees were growing in the spaces between these granite masses . . . The situation was very dry, but no doubt some seedlings had sprung up, which owing to numerous thickets of shrubs, were not perceived.' (*Journal of Botany*, 1880, p. 323.)

United States Consul Furniss reported recently that vast forests of this tree have just been discovered in the interior of the State of Bahia. The area is said to be very large, but cannot be defined as the region has not been fully explored. The attention called to the first discovery, has led to further explorations, with the result that from time to time comes notice of other sections where like trees occur in profusion.

It is native to many parts of Brazil and when planted will grow on the interior plains and highlands as well as close to the sea . . . It is also cultivated in many sections, large plantations having been set out during the last few years in Sergipe, Bahia and other States." (*Bull. Dept. of Agri.*, Jamaica, 1905, p. 72.)

In Nicaragua—The cultivation of Ceará, or Maniçoba rubber was begun in Nicaragua about four years ago. The splendid condition of the plantings and the large yield and excellent quality of the product taken in trial tappings, give promise of the success of the enterprise. The Ceará rubber tree is a dry land plant, and will not prosper in a wet soil. It is being planted in the districts of La Pas and Momotombo (300 feet above sea level), where the Momotombo mountain by driving the clouds to one side, protects this section from the force of the tropical rains so that it is com-

paratively dry, receiving just about enough water to grow corn, which is abundant for Ceará rubber. The soil is sandy, with an admixture of a little clay, and very deep and level or slightly rolling. The Nicaragua Rubber Co.'s plantation is the "San Nicholas," on which are the oldest and largest trees in this section. Three-year-old trees on this plantation measure 26 inches in girth 3 feet above the soil, and are more than 30 feet high. Ceará rubber trees yielded latex at two years of age. Twenty-one trees from fourteen to twenty-one months old, with an average age of fourteen months, were tapped, and together gave 7½ lb. of dry rubber. A tree fifteen months old gave 3 oz. of rubber. However, it is not intended to tap until the trees are four years old in order not to retard the best development. It is expected that four-year-old trees will produce 1 lb. of rubber each, and from that time the product will augment rapidly. There are now in the district outside of native plantings, four American plantations of *Manihot Glaziovii*, on which are planted some 200,000 trees, while as many more will be planted in another year. (*Work.**)

"In Hawaii—It is considered unlikely that the climate of Hawaii will prove suitable for the Para rubber tree; for a similar reason, it is doubtful whether the cultivation of *Castilloa elastica* should be attempted on more than an experimental scale.

"The Ceará rubber (*Manihot Glaziovii*), on the other hand, finds the climate of Hawaii quite suitable; it makes rapid growth in Hawaii, thriving from sea-level up to 2,500 feet. As this tree will stand a moderate tapping at three years, comparatively early returns may be obtained. A company has already planted 100,000 seeds of this species, and expects to have half a million growing within another two years." (*Agricultural News*, 1905, p. 393).

In the German Colonies—"The German East Africa Plantations Company of Lewa continues to extend its plantations of rubber trees, *Manihot Glaziovii*, and at the end of 1902 they had reached 250,000 in number." (*Agricultural News* 1905, p. 7).

Best districts in Jamaica—Considering the character of the country in which the Ceará rubber tree is a native, the most likely districts in the island for its success in yielding rubber are the Liguanea plain, Palisadoes, sea-coast parts of western St. Thomas-in-the-East, southern portions of Clarendon and St. Catherine, districts round Black River, and the country along the sea-coast of St. James and Trelawny.

Propagation and Planting—"The seed-coat is of remarkable thickness and very hard, and the natural process of germination occupies a long period—it is said more than a year. All that is necessary to hasten this, if desired, is to assist the seed-coat in splitting. This is best effected by holding the seed firmly, and rasping off with a file both edges at the radicular end.† It is best not to file off the actual end, as it may thus easily happen that the

* From *Bull. Dept. of Agri. Jamaica* 1905, p. 269.

† This end is to be recognized externally by possessing at its side a flat two-lobed appendage technically known as the caruncle.

radicle of the embryo may be injured, After this treatment, properly performed, the young plant appears above ground in two or three weeks. The seedlings require no particular attention. They grow rapidly, and may be finally planted out at distances of twenty feet. A peculiarity which they share with their close relative the mandioc, is the possession of large tubers on the spreading roots.”—(*Journal of Botany*, 188, p. 324.)

“It can also be propagated by cuttings of about one foot in length taken from the ends of strong shoots. In planting, each cutting may be put in the ground to the depth of 6 inches. In loose, sandy soil, or dry, gravelly wastes, if found to support any kind of bush, plantations might be formed at little expense.”—(*Cross*.)

Collecting the Rubber, and Yield—“According to Cross (*Report* p. 14) this is an operation of a very simple description. On commencing work, the collector takes with him a stout knife and a handful of twigs to serve as a broom. Arriving at a tree, any loose stones or dust is swept from the ground around the base, and some large leaves are laid down to receive the droppings of milk which trickle down. Some do not go to the trouble of sweeping the ground or laying down leaves, for which reason the milk adheres to sand, dust, decayed leaves, and other impurities. The outer surface of the bark of the trunk is pared or sliced off to a height of four or five feet. The milk then exudes and runs down in many tortuous courses, some of it ultimately falling on the ground. After several days the juice becomes dry and solid, and is then pulled off in strings and rolled up in balls or put into bags in loose masses. Only a thin paring should be taken off, just deep enough to reach the milk vessels; but this is not always attended to. Nearly every tree has been cut through the bark, and a slice taken off the wood. Decay then proceeds rapidly, and many of the trunks are hollow. In this condition the trees must yield far less milk, and many no doubt are broken over by the wind or wither away. Collecting is carried on during the dry season only, when rain seldom falls.”

“In the *Tropical Agriculturist* for March, 1887, Mr. W. B. Lamont furnished the following results of experiments carried on by him in the districts of Henaratgoda and Mirigama:—“No satisfactory result will follow any attempt to obtain produce before the tree is at least four years old; no system of cutting or piercing the bark will give a satisfactory yield; and it is only in the dry season, when the tree is leafless, and the growth at a standstill, that a satisfactory result can be obtained in the way of harvesting. The plan of obtaining the rubber that my experiments led up to, was, as soon as the leaves begin to fall, to remove the outer bark in vertical strips of not more than two inches wide, and not less than four inches apart. The tender inner bark thus exposed to the sun breaks out in something like running sores, from which the rubber slowly exudes and drips on the surface as fast as discharged. In this process the strip of exposed bark is destroyed, but a vigorous tree will close in the bared part in the

course of the year, if the width is not more than two inches. Ceara rubber, planted at 100 trees per acre, will, after the second year, require hardly any expense in cultivation. As for harvesting, I collected 30 lbs. last January and February by one boy at 15 cents a day, or say 23 cents per lb., the local value being about 80 cents. Supposing each tree gave an average yield of 1 lb. per annum, and allowing 30 cents for cultivation and collecting, 50 cents would remain as profit, or R50 per acre."

"Dr. Trimen, in his Report for 1893 (p. 13), remarks;—"Ceará rubber has not taken any hold on planters here as a permanent cultivation; yet it might, I think, be worked at a profit by a system of annual planting, and the sacrifice of successive crops of trees when they reach ten or twelve years. About 1½ lbs. of dry rubber is at that age obtained from each tree."—(*Kew Bulletin*, 1898, pp. 4, 6-7, 8.)

Analysis of rubber—"At the request of the Inspector-General of Agriculture in India, 1 lb., of moulded Ceará rubber (in 17 pieces) and 1 lb. of Ceará "Scrap" rubber were sent to the Agricultural Chemist by the Government of India for analysis, and the result is given as follows:—

Report on the composition of two samples of Ceará rubber, 'Scrap' and 'Prepared,' sent by R. L. Proudlock, Esq., Government Botanic Gardens and Parks, the Nilgiris, Ootacamund, 16th September, 1902.

Water	4·92	3·64
Pure caoutchouc	87·67	90·09
Resins	2·86	4·09
Ash	4·55	2·18
	<hr/>	<hr/>
Total	100·00	100·00
	<hr/>	<hr/>

"The rubbers are of excellent quality as regards colour and texture and the analysis shows a high amount of pure caoutchouc." *Bulletin of The Straits and Federated Malay States*, October, 1903, pp. 329-330.

Information on Ceará rubber may be found in the Bulletin of the Botanical Department, Jamaica, as follows:—1895, pp. 31-34; 1897, pp. 242-243; 1898, pp. 37-38; 1899, p. 84. And in the Bulletin of the Department of Agriculture as follows:—1905 pp. 72-76, 269.

VIRGEN RUBBER, OR COLOMBIAN SCRAP RUBBER.

(*Sapium sp.*)

Mr. Robert Thomson, until lately one of Messrs Elder, Dempster and Company's Agricultural Instructors in Jamaica, and formerly of Bogota, Colombia, in 1888 wrote as follows concerning this rubber:—

"This rubber is known in commerce as Colombia Virgen. It has been exported chiefly to the United States, and next to the Para rubber, it has realized the best prices in the market . . .

"I have established in this country during the last five years a plantation of this rubber, consisting of about 70,000 trees, this being, I believe, as yet the only plantation made of this sort. Under cultivation this tree thrives admirably, growing with great rapidity, and averaging about five feet a year.

"Crops are obtainable in from six to eight years, but a tree five years old yields as much as 1 pound of rubber. It is a large forest tree, the trunks attaining six and seven feet in circumference.

Four *arrotas* (100 lbs.) of rubber have been extracted from a single tree, but the average yield is far less.....

"The important consideration as regards this species, apart from its intrinsic value, is that it grows at great elevations on the Colombian Andes, viz., at from 6,000 to 8,000 feet above the sea.

"Prior to the wholesale destruction of this tree (but few now remain) by the rubber collectors, I explored, some five years ago, the forests wherein it abounded in order to examine the soil, climatic and other conditions affecting its growth. It may be mentioned that its area of distribution has been peculiarly limited to a small section of the Cordilleras some 1,500 miles from the sea. The total quantity of rubber exported during the few years the article existed could not have amounted to many hundred tons.

"It is very difficult to propagate the tree from cuttings, hence I have had to resort, during my supervision of the plantation, to propagation by seeds, which, moreover, were always procured with much difficulty."

Messrs. Hecht, Levis, and Kahn, wrote in May, 1890, to Royal Gardens, Kew:—

"We beg to say that Colombian scrap rubber has been known in the market for the last few years, and is of a very superior quality indeed.

"It would be difficult to give you the exact average market value, but it has varied during the last few years between 2 3 and 3 per lb. At the present moment the value is about 2 11d. to 3."

(*Bulletin of the Botanical Department, Jamaica, 1894, pp. 110—111.*)

In the Journal of the Jamaica Agricultural Society for May, 1906, Mr. Thomson gives some further information with regard to virgen rubber, as follows:—

"This is the only important species of rubber indigenous to the cool bracing temperature of lofty tropical mountains. The other important species grow in the hottest zones of the earth. Hence to prospective planters settling in Jamaica the climatic conditions involved are of the greatest consideration. The temperature on the mountains is like a perennial English spring. As is well-known, Englishmen flock to the island of Ceylon to settle on the mountains; there the mountain climate is duly appreciated. In like manner the varied resources of our mountains are destined to attract attention.

The elevation above the level of the sea at which the virgen rubber was found growing in a state of nature, four degrees from the equator, ranged from 5,000 to 7,500 feet.....

"From a cultural point of view, I have never in all my experi-

ence of tropical planting cultivated a tree that flourished like this rubber tree. Every plant with its striking foliage and abounding vigour grew with great rapidity. In the course of a year the plants attained a height of from six to eight and ten feet. In three years the stems were five to six inches in diameter.....

"I remember having collected one lb. of rubber from a wild seedling which was about five years old. Under the elaborate cultural treatment to which the other species of rubber are now subjected, there can be no doubt that when 50 to 60 feet high, in less than 10 years, not less than one pound per tree will result. And in a few years subsequent thereto, double and treble this quantity per annum.

"I have the pleasure to express my conviction that in certain parts of the temperate climate of the parish of Manchester, with its abundant humidity, and its peculiarly constituted soil, the virgen rubber could be cultivated with great success. Sites should be selected near the foot of the gentle rolling hills characteristic of the district—a district capable of being turned to more important account than any other in the island. Though this tree grows freely on high ridges in its native habitat, far greater returns are yielded by trees at the base of such ridges. There are thousands of acres of land obtainable above an elevation of 2,700 feet eminently fitted for this culture in Manchester.

"I have elsewhere pointed out that plants cultivated near the equator at high altitudes (coffee for instance) are cultivated in Jamaica under precisely similar climatic conditions at about 2,000 feet less altitude. Hence the altitude at which the virgen rubber flourishes in Colombia from 4,500 to 7,500 feet, is equalized here at an altitude of 2,000 feet less.

"As the virgen rubber is a gigantic tree, care must be taken to plant it wide apart. The permanent distance might be 24 feet asunder. In 10 or 12 years the trees would cover the ground. Subsequently the trees would not expand materially, inasmuch as tapping the trees would interrupt growth. Regular crops, I feel sure, would result from the trees when eight years old, and of course annually afterwards."

The rubber produced by another species of *Sapium*, native of Brazil, is used for adulterating Hevea rubber, and even in some cases to replace it altogether. It seems that the great demand has led to the practice for some years past.

Dr. Huber, the author of the report, questions if the practice, which he says has passed unnoticed for twenty years, can be described as fraudulent. He considers that if the union makes no difference to the manufacturer, then no harm is done; and, on the other hand, the knowledge is gained that the sources of supply are greater than was formerly known, as the tree in question is plentiful, and exists over a very wide area, and is known in the State of Amazonas by the name of 'Taparu,' and in the neighbourhood of Para as 'Murupita,' 'Seringa-Rana,' &c."—(*Agricultural News*, 1905, p. 271).

Information on Virgen rubber may be found in the Bulletin of the Botanical Department, Jamaica, as follows:—1894, p. 110.

ASSAM RUBBER, RAMBONG.

(*Ficus elastica*.)

Source—Assam Rubber* is obtained from large trees of *Ficus elastica*. This fig tree generally germinates in the fork of another tree, sending down immense aerial roots into the ground and from the top of these (60 to 100 feet high) it throws out its branches.

Locality—It grows in the damp forests which clothe the base of the Himalaya Mountains in Sikkim, and stretch away into Assam and Burma.

Effect of Soil, &c. on Yield “As the distance from the hills increases, and the atmosphere in which the tree grows gets drier, the quantity of rubber to be obtained from a tree decreases; and whilst it is stated by the men who fetch it from the hills, that one tree is able to produce from 2 to 3 maunds (160 to 240 lbs.), the men who gather it from the forests at the foot of the hills, only get from 20 to 30 seers (40 to 60 lbs.) per tree, and if far from the hills, only half that quantity is obtained, especially if the ground is gravelly or otherwise severely drained.” *G. Mann, Conservator of Forests, Assam.*

Yield—In Algiers, this tree thrives but does not form milk in sufficient quantity to make it a profitable source of rubber. Continuous tapping for 6 months year after year, Mr. Mann affirms, will kill the trees, and accordingly he urged either that tapping should be restricted to three months a year (January, February, and March), or that a regulation should be made prohibiting the tapping of forests more frequently than once every three years. Mr. Mann further gives instructive figures as to the value of the rubber trees and their yield of caoutchouc. “Assuming that a tree reaches its full size at fifty years without tapping, and would after that, yield every third year, one maund of rubber, which would be collected, manufactured, and delivered in Calcutta at 15 rupees per maund, and should realise the present price of good rubber, viz., 35 rupees per maund, it would have a net profit of 20 rupees, per tree every third year. Besides this, one maund of lac may be reckoned on from every tree per year, which, if collected at its present rate, could be delivered in Calcutta at 10 rupees per maund, whilst it fetches 15 to 20 rupees per maund there now, which is a profit of 5 rupees at least per tree yearly.

“All these figures are the lowest, and the tapping the most cautious; still if the tree planted lives a second fifty years, which it is sure to exceed, it produces 320 rupees for rubber and 250 rupees for lac, which is more than any two timber trees of fifty years each, which might be grown in that time could equal.”

Mr. Mann then deals with the two kinds of rubber manufactured by the people of Assam, viz., one in irregular solid lumps or loaves

* The notes on this rubber in India are chiefly derived from the information given by *Wall's Dictionary of Economic Products of India*

about 16 to 20 oz., in weight, and the other in balls of rubber threads each weighing 12 to 16 oz. The price paid (in 1869) for the two kinds varied, he says, from 8 rupees to 12 rupees, but this was paid for by pieces of Eri silk cloth of that value in exchange for a maund of rubber. This fetched in Calcutta from 20 rupees to 40 rupees per maund, but Mr. Mann adds "if care were bestowed on the manufacture, it beyond doubt would fetch much higher prices." Messrs. Martin Ritchie & Co., however, purchased their rubber only in the fluid state from the people who tapped the trees. It was brought to them either in earthen pots or cane baskets made water proof with a previous coating of rubber. This coating of rubber, Mr. Mann states, was held to retain the sap in its fluid state. He goes on to say that, rubber in this fluid state was first purchased at 1-8 rupees per maund, but soon rose to 5 rupees for the best or thickest procured from the aerial roots, and 4 rupees for the next best procured from the lower part of the stem, and 3 rupees for the worst supposed to come from the upper branches of the tree and to have been mixed with the juice of other species of Fig and water.

A full grown rubber tree of about 50 years old will yield at the very lowest 10 lbs. of rubber, if very carefully tapped, and this quantity may be expected about 16 times, which will be an equally safe estimate for calculating the yield of a rubber tree. To be quite on the safe side, calculate 10 trees per acre which would give about 1,600 lbs. of rubber from every acre. This, at the price at which rubber was collected in the Darrang district and sold, and deducting the expenditure incurred in collecting it, would give a net profit of 54 rupees per 80 lbs., or 1,080 rupees per acre in 50 years, and if the rubber trees have a longer life, the yield may be reckoned for their remaining years of life at the same, if not a higher rate.

Collection—Among forest trees and in regard to dimensions, this is *facile princeps* and there is no other, not even the Banyan that approaches it in dimensions and grandeur. Mr. C. Brownlow points out that every portion below the head of the foster tree is strictly root and incapable of throwing out a branch, and as the head is rarely less than 60 to 100 feet high, it is no easy matter to procure a branch. These cables and buttresses as they approach the ground, throw out smaller and subsidiary rootlets of all thicknesses down to that of twine. If any of these be cut they die below, but from above grow again downwards. It is only necessary to see the tree to appreciate the fearful risk encountered by the gum gatherers, who by no means confine their operations to the base, but climb up as high as the roots extend, and higher along the horizontal branches, chopping at intervals of every few inches, the cuts answering as well for their foothold as for the sap to exude from. Were the base of the tree alone tapped, the yield would be very insignificant, especially in trees that have been frequently tapped before. And as the trees occur very sparsely, and long distances have to be gone over to meet them, it becomes an object to get as much off at each cutting as possible. The trees must be

twice climbed, once to cut it, and a second time, after the gum has dried (which takes a day or two) to gather it. This is done by pulling off the tear which gathers below the wound, which brings away with it all the gum that has exuded, and these tears have only to be moulded together to agglutinate into a ball. The quantity that can thus be collected at one cutting does not exceed 8 to 10 lbs. Of course no mercy is shown to the trees, all of which suffer severely; and many are killed outright. The damage they sustain is apparent in the large cankers, and buttresses rotted off, owing to the bark being unable to heal over the frequent wounds they have received all round. The foliage is wanting in luxuriance and dried branches and roots lying about testify to the injury in health that the tree has sustained.

Mr. Mann specially insists on the following points being observed:—

- “(1) Fresh cuts to be made only in February, March and April, and the trees to have rest for two years between each tapping.
- “(2) The cuts to be at least 18 inches apart, to penetrate into the the bark only, not into the wood, and to be made with an instrument more suitable than the ones at present used. Mr. Mann prefers the German timber scoring knife.
- “(3) As far as possible, the milk to be collected in a fluid state in narrow-mouthed rattan baskets, and to be brought to central manufactories.
- “(4) Endeavours to be made to convert the milk into a solid state by a process of slow drying similar to that practised in Para.
- “(5) Those varieties of caoutchouc which dry naturally on the tree to be collected with care, and to be picked so as to get rid of all impurities.

Planting—In his report for 1884, Mr. Mann gives the following particulars:—“The present area under cultivation is fully stocked containing 12,511 trees; they have been planted at 25 feet apart in the lines, which latter are 100 feet apart; this is double the number of trees that was planted on an acre at the commencement. The oldest trees are about 30 to 40 feet in height, and a few from 45 to 50 feet, but this cannot be put down as the average growth of *Ficus elastica* in ten years, since half this time and longer, these plantations were entirely experimental, and everything had to be learned, as, for instance, the first trees were all raised from cuttings, which mode of propagation has been given up, since the trees raised from seed have proved much hardier and faster growing, and as to the planting of rubber seedlings high up in the forks of other trees, this also has almost entirely been given up, because such trees in most instances, did not make more than a few leaves in the year, and it would, as a matter of course, be out of the question to plant rubber trees where they would take a century to become large enough for tapping, when such trees can be grown in a different way in one-fourth of the time. On the other hand,

it has been found that trees planted on small mounds of earth, 3 to 4 feet in height grow very much better than if they are planted on ordinary level ground, and this plan has therefore also been adopted, although it adds considerably to the cost of making these plantations, but the faster growth of the trees amply compensates for the higher expenditure. The method of planting adopted from the beginning has been to clear lines from east to west through the forest for the young trees a hundred feet apart; the width of the lines is 40 feet, so that a broad strip of forest 60 feet wide is left standing between these lines to ensure the utmost amount of moisture in the atmosphere for the young rubber trees. At first the lines were only cleared 20 feet broad, but it was found after a few years that these closed up very soon and thus retarded the growth of the young trees by shutting out the requisite amount of light. However, the widening of the lines also brought about the faster growth of the scrub in them, besides that of the rubber trees, and more money, time, and attention has in consequence to be spent, especially in the rainy season, on those plantations, than had at first been anticipated, but the greatest and most costly difficulty that had to be overcome was the effectual protection of rubber trees against deer, which during the first few years, constantly bit off the young plants, and, where they were not entirely ruined by this, they were so much injured and retarded in growth that a considerable increase in expenditure on these plantations had to be incurred on fencing to prevent it. But for the future this expenditure will not be necessary, since it has been found that saplings 10 feet and more in height can be transplanted without difficulty and with perfect success, and if such saplings are tied firmly to stakes, the deer can do little or no damage to them."

Assam Rubber in Jamaica—There are a number of these trees in various parts of Jamaica. Mr. W. M. Douet has extracted good rubber from a tree at Sweet River, near Sav.-la-Mar, by making V-shaped incisions with others leading into the lowest point. He says:—"By making several incisions in the roots, branches, and lower parts of the trunks I have extracted 2 lbs. from a tree at one time. The juice runs very slowly and hardens on the tree; I strip it off and roll it into balls. The trees are large, 12 to 15 feet in circumference and 50 to 60 feet high. They appear to be very old. The late Mr. H. O. Vickers made some experiments in extracting the rubber from these trees, and found that he obtained a greater flow at full moon, also during rainy weather. . . . The average annual rainfall for the last ten years is 64 inches 17 parts."

Mr. M. S. Strickland also extracted good rubber from one of these trees at Great Valley, Flint River. He wrote, "The manner in which the rubber is taken is a rough one; the trunk and branches are cut with a machete, a small lump of clay is taken to catch the milk as it drops, and formed into a ball. But the milk can be taken by cutting the tree and allowing it to drop into a calabash. . . . The tree here would not do for cocoa shade, as it branches out 5 feet from the ground, and the branches are large

and low. The roots run a long distance, and are also very large. The measurements are: girth of trunk, 16 feet; girth of nearest branch to ground, 8 feet. I estimate the height of the tree to be 65 feet."

Mr. W. Harris made some experiments on three trees at Pleasant Hill just below the Hill Garden. Incisions were made in the bark of the trunks, branches and one large root, but nearly the whole of the rubber was obtained from the trunk of the oldest tree. When any part of the bark was punctured, the milk appeared immediately, but the flow quickly ceased, though it could be prolonged by removing the milk as it flowed from the incision. Only about one-fifth of a pint of milk was obtained each day for three days from the three trees, making in all three-fifths of a pint. The following method was adopted in preparing the rubber; the milk was kept in the tins in which it had been collected until the following day in each case. Through evaporation of the water, it had become thick, but in order to hasten coagulation, boiling water was added. The milk readily mixed with the water and was easily removed from the tins. The whole was poured into saucers and placed on the top of a cooking stove. The rubber soon coagulated, was removed and pressed out into flat pieces. This is a sufficient indication of the plan that might be adopted on a large scale. The total amount of rubber thus obtained amounted to 4 ounces, which shows that this rubber tree would not be profitable at an elevation of 3,500 feet.

Preparation of the rubber in Assam—Collins states that the preparation on a commercial scale is to pour the milk into large wooden bins, 6 feet square, and partly filled with water, the caoutchouc after a time floating on the top. The caoutchouc (being still fluid) is then taken out and boiled over a slow fire in iron pans, 4 to 6 feet in diameter, and 2 to 2½ feet deep, 2 parts of water being added to the caoutchouc, and the whole stirred constantly. As soon as the caoutchouc coagulated into a mass it was taken out with iron forks and pressed, and again boiled and pressed, and then dried in the sun, and finally washed over with lime.

Information on Assam rubber may be found in the Bulletin of the Botanical Department, Jamaica, as follows:—1894, pp. 105–109; 1895, pp. 55–56; 1901, pp. 139–141.

AFRICAN RUBBER.

(*Landolphia* spp.)

African rubber is furnished by several species of the genus *Landolphia*, which are woody climbers, with stems 4 to 6 inches in diameter. The best quality from the Zanzibar coast is derived from *Landolphia Kirkii*; two other species, viz., *L. florida* (the chief source of Mozambique rubber), and *L. Petersiana* are also sources of the East African supply.

On the West Coast *L. owariensis*, which has a very wide distribution, is the principal species furnishing Congo and Sierra Leone

rubbers. *L. florida*, which occurs on the East coast, and *L. Mannii* also afford part of the West African supply. (*Kew Bulletin*, 1892, p. 68.)

Landolphia Heudelotii, which produces a good quality of rubber, is being largely planted in the French African possessions. Owing to the climbing habit of the Landolphias it is not practicable to cultivate them in regular plantations as they require the support of trees, and when once tapped several years must elapse before they will yield another crop, but it is well to remember that from these, and similar plants, a very important rubber industry was started at the Gold Coast in 1882; and although previous to that year no rubber whatever was exported from that colony, it had attained in 1893 to the annual value of £200,000.

I would suggest that plants of these climbers be established in the forest lands belonging to the Crown, e.g., the Cockpit Country, and in course of time they would probably become naturalized and add to the value of such lands.

Information on Landolphias may be found in the Bulletin of the Botanical Department, Jamaica, No. 10, p. 4.

JAMAICA RUBBER.

(*Forsteronia floribunda*.)

This rubber is not yet known in commerce although attention has been called to it in the Annual Reports, and in the Bulletin of the Botanical Department.

Source—It is obtained from the stems of a climber known locally as "Milk Withe" or "Rubber Withe" which are generally as thick as a man's wrist, but I have seen great lianas in the Cockpit Country in St. James with stems six inches or more in diameter for a distance of 20 to 30 feet from the ground, then branching into several stems and growing to the tops of trees over 100 feet in height. Such stems on being slightly cut with a machete exuded latex in the greatest profusion. The plant also grows over the rocks fully exposed to the sun, or climbs over bushes.

Locality—The "Milk Withe" grows plentifully in the limestone districts of the central and western parishes where the surface is exceedingly rough and difficult to traverse on account of the sharp and jagged edges of the hard crystalline limestone. The soil is lodged in hollows of varying extent and depth between the projecting rocks.

Collection of Milk—When a cut is made through the bark of the Milk Withe a milky juice flows out for about two minutes, but a number of incisions are necessary before sufficient fluid is collected to fill a four-ounce bottle. Care should be taken not to cut into the bark deeper than is necessary so that the wound may soon be healed by the formation of new bark.

Yield—Messrs. Silver, of Silvertown India Rubber Company, reported on samples sent to them in 1888, that one quart of juice yielded one pound of dry and washed caoutchouc, or about 22 ounces of ordinary crude caoutchouc, but the sample sent in 1890

yielded only at the rate of two ounces per quart. Probably the difference was due to collection in the former case during the dry months and in the latter during the wet season. The value of the rubber in 1890, was stated by Messrs. Silver to be 3 2d. per pound.

Preparation of the Rubber—The rubber coagulates simply on exposure to a dry atmosphere, but from experiments made, it is probable that the method described under Assam Rubber as the one used on a large scale would prove the most successful.

Propagation—This plant may be propagated by seed or by cuttings.

Information on Jamaica Milk Withe may be found in the Bulletin of the Botanical Department, Jamaica, as follows :—No. 10, pp. 2-3 ; No. 21, pp. 3-4 ; 1894, pp. 109-110.

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BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES

The usual Monthly Meeting of the Board of Agriculture was held at Headquarter House on Wednesday, 17th October, 1906, at 2 p.m. : Present :—The Hon. T. L. Roxburgh, Acting Colonial Secretary, Acting Chairman, the Director of Public Gardens, the Acting Island Chemist, His Grace the Archbishop, Messrs. C. A. T. Fursdon, J. W. Middleton and the Secretary.

The minutes of the previous meeting were read and confirmed.

Rubber—Mr. Fawcett handed in the manuscript of the article on rubber which Mr. Harris was asked to prepare. It was agreed that this should be published as a Bulletin and that the Secretary should write Mr. Harris thanking him for the trouble he had taken in getting up the matter.

Mr. Cradwick—The Secretary read letter from Jamaica Agricultural Society stating that they agreed to the recommendations of the Board of Agriculture that Mr. Cradwick should remain in the western district till the end of the financial year and carry through his engagements till that date, but from 1st April it was expected that he should take up his work in his new district; that as His Excellency had not approved of the recommendation of the Joint Conference with regard to the control of the Instructors the Board of Management took it that the control of the work remained as before.

Longville Cassava Plantation—The Secretary reported that as directed by the Board, Mr. Cradwick had visited Longville Cassava Plantation and had made a report to the Amalgamated Products Co.; his expenses amounting to £2 2s. 3d. had been paid by the Company.

Swift's Arsenate of Lead—The Secretary read letter from the Colonial Secretary's Office stating that with the advice and consent of the Privy Council the Governor had, under Section 8 of the Tariff Law of 1899, agreed to admit Swift's Arsenate of Lead free.

Mr. Fawcett asked for a copy of the report that had been made on the subject and the Secretary was directed to send him this.

Tobacco—The Secretary read letter referred from the Colonial Secretary's Office from Granda Bros. & Co., Montreal, stating that they were desirous of becoming better acquainted with the tobacco grown here with the object of perhaps using same, and asking that a few sample hands of tobacco suitable for wrappers be sent to them by mail.

The Secretary was directed to publish this letter in the newspapers and send a copy to Col. Kitchener.

The Director of Public Gardens stated that when he was in London, he had met Mr. Chalmers, the Tobacco expert, who stated that the blend of Jamaica and Virginia Tobacco which had been used experimentally in the Navy would probably be found suitable, and when the experiment was completed, they would probably want as much as 500 quintals of the third quality at a cheap rate.

The Secretary submitted letter from the Director of Public Gardens asking whether the experiment of growing Sumatra Tobacco under shade should be continued this year, and if so, a special warrant for £25 to cover the expenditure would be required.

It was agreed not to continue the experiment.

Mr. Cradwick and Montpelier Show—The Secretary read letter from Montpelier Show Committee urging that Mr. Cradwick be allowed to remain in that part of the Island until the end of the financial year so that he could carry through matters in connection with the Show.

The Secretary was directed to reply that it had already been decided that Mr. Cradwick should carry through all his engagements in that district up to the 31st March.

Free Postage—The Secretary read letter from Central Cornwall Agricultural Society pointing out the inconvenience correspondents with the Travelling Instructor had in having to prepay postage to him.

The Secretary was directed to say that this same matter had already been brought before the Governor when it was decided that letters to all the Instructors as well as to the Agricultural Society could not be granted free postage, but that letters to the Director of Public Gardens and to the Secretary of the Board of Agriculture were free.

Reports—The following reports from the Director of Public Gardens were submitted:—

1. Hope Experiment Station.
2. Instructors.

These were directed to be circulated.

The following papers which had been circulated were now submitted for final consideration:—

1. Report Hope Experiment Station.
2. Mr. Cradwick's Report for August.
3. Mr. Briscoe's Report and Itinerary.

There were no remarks on these reports and they were accordingly passed.

Mr. Middleton brought up the matter of the report that had been made by the Committee on the post of Assistant Superintendent at Hope Gardens, and asked whether a reply was expected.

The Chairman said that he had no doubt that a reply would yet be received.

School Gardens—The Archbishop said that he had received a communication from Mr. Murray, Superintendent of Field Experiments, with regard to school gardens which he thought contained suggestions worthy of consideration and perhaps adoption; he asked that a Committee be appointed to consider these suggestions. The following Committee was appointed:—Mr. Fawcett, Mr. Capper, Mr. Middleton and the Archbishop.

The meeting then adjourned till Wednesday 14th Nov. at 2 p.m.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. IV.

DECEMBER, 1906.

Part 12.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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P R I C E—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA :

HOPE GARDENS.

1906.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

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Vol. IV.

DECEMBER, 1906.

Part 12.

RAMIE, RHEA, CHINA GRASS.

BOMBERIA NIVEA, Hook. & Arn.

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About 13 years ago much interest was taken in the subject of Ramie, and notes were published in the Bulletin* for the guidance of planters; now again some inquiries are being made, and as the above-mentioned Bulletin is out of print, some of the notes are here republished with the addition of the latest information in the form of a lecture and discussion at the Society of Arts last March. Later still Mr. Hubert J. Bøeken has published a pamphlet describing a new machine for decorticating Ramie stems, manufactured by Bøeken & Co., of Düren, Germany and offered for sale at the moderate price of £60.

Description—This plant belongs to the Nettle Family (*Urticaceæ*). It grows to a height of from 4 to 8 feet. The leaves are alternate, toothed, 3-nerved, broadly ovate, rough above, snow-white on the under surface in one variety, greenish in another. The flowers

* Bulletin of the Botanical Department, Jamaica, March and April, 1894.

are very small in clusters along a branched stalk, and both male and female flowers occur on the same plant.

Varieties—Ramie is the Malay name for the variety native in the Malay Archipelago, which is greenish on both sides of the leaf. It has been cultivated in Assam for long periods, and is there known as Rhea. This variety is distinguished by the name *tenacissima*. The variety with the whitish under-side of the leaves (*nivea*) is a native of China and has been conveniently designated the Chinese White Nettle. The fibre prepared from it, and imported into England, is known under the inappropriate name of China Grass.

China grass fibre generally obtains double the price in London of Rhea. Some writers state that the variety *tenacissima* produces the strongest fibre.

Introduction into Jamaica—The white-leaved variety was introduced into Jamaica in the year 1854 by Mr. Nathaniel Wilson, Island Botanist, and was grown with great success in the Botanic Garden at Bath. Plants were distributed from that centre as early as the year 1855. In 1884, Sir D. Morris, at that time Director of Public Gardens and Plantations, issued *Instructions on the Cultivation of Ramie*, and also discussed the subject in a Public Lecture at the Jamaica Institute on "Native and other Fibre Plants." Shortly after the delivery of this lecture, the late Hon. Dr. Phillippo delivered another Institute Lecture specially devoted to the subject of Ramie, giving results of his own experiments as well as general information on the whole subject. Dr. Phillippo had already in 1881 introduced the green-leaved variety into the Island from Haiti. At this time and for 3 or 4 years subsequently, it was confidently expected that the Favier-Frémy process had solved the difficulty of preparation of the fibre.

CULTIVATION.

Climate—The Malayan Ramie is essentially a native of an equatorial insular climate, with an equable temperature all the year round, and abundance of moisture. It has not succeeded well in India, except in the south, where a company is growing it, because in summer it is subjected to long-continued droughts and in winter to cold weather. In Jamaica there are no great extremes of temperature, and therefore wherever there is a sufficiency of fresh water for the roots, Ramie will flourish. Even in localities where the annual rainfall does not exceed 50 inches, it would succeed with irrigation.

The Chinese White Nettle is a continental plant, and apparently more accommodating as regards moisture and drought than the Malayan variety. It has grown luxuriantly in Jamaica from sea level up to 5,000 feet, and there is no reason to suppose that there would be any difficulty in cultivating it at the highest elevations. In America, it is said that the Chinese variety is the more successful.

Soil—This plant will grow in Jamaica in almost any soil except stiff clay. It grows best in a rich sandy loam, which is 12 to 15 inches deep, with a free subsoil. It is important to have perfect drainage, for it is intolerant of stagnant water.

Preparation of Ground—The more thoroughly the ground is tilled before planting, the quicker will the roots penetrate the soil, and the more satisfactory will be the result.

Propagation and Planting—Ramie is propagated with some difficulty from seed, but easily by cuttings from the stem, and very readily and quickly by division of the roots. The difficulties in the way of obtaining a yield of seed, and afterwards in growing the seedlings, as compared with the ease with which cuttings strike, make it unnecessary to discuss propagation by seed.

To propagate by stem-cuttings, let the stem become ripe, indicated by its turning brown; cut it into pieces, each containing 3 eyes or buds, close below the lowest eye, and close above the topmost; then plant so that the middle eye is just at the surface. It is not advisable to put these cuttings out at once into the open field, as they require a moist soil and shading from the sun for 10 days. It will be found better to grow them for some time in a nursery until they have well-developed roots, then plant them out at distances of $1\frac{1}{2}$ to 2 feet apart, in straight rows.

To propagate by division of roots is the best plan. It is better done in showery weather. The roots should be cut so that there are 5 or 6 eyes to each portion. Plant out in straight rows at distances of $1\frac{1}{2}$ to 2 feet apart. Some have recommended 4 feet as a proper distance, but this plan necessitates extra expense in weeding; and besides the fibre will be of better quality with close planting which prevents branching. At distances of $1\frac{1}{2}$ feet there is room for hoeing the weeds, until the plants are strong. If the ground is shaded, as some recommend, then it is not so important to plant close.

After some time every alternate row each way may be taken up altogether, and transplanted in new ground so as to extend the plantation.

A Chinese Treatise on Agriculture, says of this plant: "When the tufts are strong enough, the earth round is dug, and new stocks are detached and transplanted elsewhere. The principal stock then grows more vigorously. At the end of 4 or 5 years, the old stocks becoming excessively strong, they are divided and replanted in other beds."

Col. Hannay, in speaking of the cultivation of Rhea in Assam, says:—"Between the cuttings, all that seems necessary is a fresh opening up of the ground around the roots, which in a regular plantation is best done by hoeing between the rows with a spade-shaped hoe set in a long handle: the person, as he performs this, going backwards, so as not to step over his work; in fact nothing can be more simple than the cultivation of this plant, all that is required being a loose rich soil, and protection to the crop by a

good strong fence. The roots throw up at least twelve shoots when in full bearing; should they increase, and the crops get too thick, the roots require to be separated; and by this means the cultivation can be carried to any extent."

To put in roots at $1\frac{1}{2}$ feet apart requires nearly 20,000 roots per acre. At 2 feet apart there are 10,890 plants to the acre.

*Notes on Planting Ramie.**—The plants as sent from the Gardens are ready for planting without further preparation.

If the land is such that ploughs and cultivators can be used, thoroughly plough up the whole of the land, then form beds five feet wide, with walks between the beds eighteen inches wide, the beds can be any reasonable length but intervals should be left for the passage of carts, &c.; raise the beds by taking soil from the space left for walks and throwing it on the beds. This will increase the depth of soil for the plants to grow in, and by lowering the walks make them serve as drains, the depth of which would be regulated by the rainfall of the district. If manual labour has to be utilised, simply fork up the space to be used as the bed, leave the walks hard, but the top soil can be shovelled off and put on the beds in the same way, to form the walks and drains; it must be borne in mind that this is the best of the soil and will enrich the beds.

The soil must be thoroughly pulverised, the plants can then be planted by opening a hole with the hand just deep enough to cover the plant about half-an-inch, not deeper; cover the plants lightly with the hand but do not press the soil or only very slightly, if the weather is dry; do not plant nearer the edge of the beds than six inches, put the plants in nine inches apart, or if on very rich soil a foot apart.

Keep the young plants quite free from weeds by hand weeding. The plants put out at Hope treated as above, were weeded three times the first year, and then the Ramie kept down the weeds itself except on the paths.

Our reasons for planting in beds, clearing paths and intervals is to obviate the necessity of walking between the plants, and so trampling the soil round the roots, and making it hard and cakey, which from experience has been found to be very detrimental to the growth of the plant. In the beds planted at Hope the soil was almost as loose and friable a year later as it was on the day the beds were planted; and if the crop were taken off then the only thing requiring to be done is to hoe the paths, and perhaps pull out a few climbing weeds which no plants can keep down without assistance.

By planting as close as above described the plants shoot up very rapidly with little or no tendency to branch.

The above may seem rather troublesome, but if the plants are treated in this way the growth will be more than satisfactory and

* W. Cradwick in *Bulletin*, June, 1896.

it will be many years before the plant requires replanting, but if carelessly dealt with, allowed to get weedy when young, trampled on or between, the plant will soon become enfeebled and the whole trouble of replanting will have to be gone through again in a short time.

Mature.^{*}—"The exhaustive nature of the plant is shown by the following analysis of dry ramie stems. The ramie stems were found by Dr. T. K. Hornidge to contain, in 100 parts :—

Carbon	...	47·28
Hydrogen	...	6·26
Nitrogen	...	0·09
Oxygen	...	42·23
Ash	...	4·14
		100·00

"The ash consists of :—

Potash	...	32·37 per cent.	} 48·76 per cent. of alkalis.
Soda	...	16·39 "	
Lime	...	8·40 "	
Magnesia	...	5·39 "	
Peroxide of iron	...	— "	
Chloride of sodium	...	9·13 "	
Phosphoric acid	...	9·61 "	
Sulphuric acid	...	3·11 "	
Carbonic acid	...	8·90 "	
Silicic acid (with a little charcoal and sand)	...	6·60 "	
		99·90	

"It will be noticed that the alkalis contribute almost one-half, and the phosphoric acid about one-tenth of the ash. If the weight of dry stems obtained at one crop be taken at only 1,000 lbs. per acre, this gives, with three crops in the year, a yield of about 3,000 lbs. of dry stems per acre per annum. The quantity of ash in that quantity will amount, according to the foregoing analysis to 124 lbs., and the quantity of alkalis subtracted from one acre in the course of the year will be about 60 lbs., and of phosphoric acid about 12 lbs. In England a crop of wheat is usually assumed to subtract from the soil about 30 lbs. of alkalis, and 28 lbs. of phosphoric acid; and a crop of flax about 50 lbs. of alkalis, and 24 lbs. of phosphoric acid. In comparison with these numbers it seems that ramie requires a very large amount of alkalis, especially of potash, more than either flax or wheat, whilst the quantity of phosphoric acid is only one-half of that contained in a crop of flax, owing to the large quantities of phosphoric acid contained in the linseed.

* Forbes Watson.

"The large quantity of mineral matters contained in the ramie stems explains the importance attached by the Chinese to the careful manuring of the plant. This is a point which ought not to be neglected; and even if it should be difficult to provide sufficient quantities of manure, the dry sticks after the separation of the fibre, and all the refuse during its preparation, should be carefully collected, burnt, and the ashes returned to the soil. If this is systematically done, there need be no fear that ramie as a crop should prove very exhaustive to the soil, as the proportion of valuable material constituents taken away in the fibre itself is quite small."

HARVESTING.

Cutting the Stems.—The stems should be cut before they turn brown, and before they flower. Dr. Forbes Watson states in a lecture before the Society of Arts:—

"One of my objects, in the experiments which I carried out in Paris was to determine, as far as I could, the height to which the plants should be grown in order to give the largest yield of fibre. Some people say that the plant should be grown to the height of 6 feet; some say they should not be more than 3 feet; but the results of my experiments, point to the fact that $3\frac{1}{2}$ to 4 feet is about the right height to grow them. If the length is not more than 2 feet, the fibre is very fine, but the chances are you get waste, and not such a good percentage of fibre. In the long stems the fibre is not so fine as in the medium ones; in short, the medium stems from 3 ft. to 4 ft. are about the right length to cut. This has an important bearing upon the question of the number of crops which can be obtained. It is clear that if you allow the plant to grow 6 or 8 ft. high, you cannot expect to get as many crops as when only 4 ft. Moreover, there is this characteristic; all these stalks which you see here are from the same plant, that is to say, the shoots have come from the same root. Having determined the proper length, the stems should be gathered accordingly, only those being cut which have attained the right height; in this way a continuous crop may possibly be secured.

"We find that with China grass there is a great variety in quality. These variations in quality give rise to the complaints which are frequently made. If you grow it, however, a certain standard length, it will be likely to produce it of a definite quality and that is what is wanted for commercial purposes."

The following paragraphs are taken from a Report on Formosa by Mr. Alex. Hosie, acting Consul at Tamsui, submitted in March, 1893:—

"The workman seizes each stem 9 inches above ground between the thumb and fingers of the right hand, snaps it over to the right causing a fracture, lays hold of the stem below the fracture with his left hand, pushes down and sideways the upper part of the stem on the fracture to complete the division of the wood, inserts the forefinger of the right hand in the fracture, which is now com-

pound, and draws it up between the peel on the left and the wood and adhering peel on the right, removing on its way branchlets, leaves, and tip. He then draws down the peel on the left with his left hand to the root, where it is readily detached. In like manner the peel and wood on the right are removed at the root, and the wood, being but loosely attached, can be readily separated from the peel. The whole operation is simplicity itself, and can be conducted with the greatest rapidity. The result of repeated timing is that 100 stems can be peeled without haste in fifteen minutes, that is, at the rate of 400 an hour. The peeled stems and the discarded leaves, &c., remain on the field as manure. . . .

"The next process is the removal of the cuticle and the bleaching of the fibre. The ribbons are made up into loosely tied bundles which are placed in a tub of cold water. When the workman is about to remove the green cuticle from the fibre, he places on the thumb of his right hand a wide copper ring, on which a small flat piece of bamboo has been fixed, the piece of bamboo resting against the face of the thumb. In the same hand he holds an iron instrument like a shoe-horn, in such a position that he can grasp anything between the piece of bamboo and the blunt inner edge of the hand instrument. A bundle of the ribbons is then taken from the tub and unfolded. Taking ribbon by ribbon from the bundle with his left hand he grasps it about 6 inches from the wide or butt end,—the cuticle or outside of the ribbon against the piece of bamboo,—and scrapes it to the tip. After a couple of scrapings the whole of the cuticle, with the exception of the 6 inches or so at the butt, is removed, and when ten or a dozen ribbons have been treated in this manner, the workman reverses them, and removes the cuticle at the butt ends. The fibres, which remain in his left hand, are hung out over bamboos in the sun to dry and bleach for six hours, when they are white and ready to be packed into bundles for market. One man can extract some 8lbs. weight of fibre in a day of ten hours, and an English acre of land yields about 900lbs. of fibre."

Retting:—Mr. W. J. Hollier, who addressed the Jamaica public in 1894 on the merits of a Ramie Decorticating machine invented by S. B. Allison, recommended retting before passing through the machine. This could be done simply by soaking in water, but the process he stated, could be improved and hastened by using chemicals. Retting is a process involving but a nominal outlay, no technical knowledge, and but little care. It could be carried out by each settler for himself.

If chemicals are used the following is the process:—A tank or trough is required of six cubic yard capacity (i.e., about nine feet long, six feet wide and three feet deep) lined with cement, or made of pine-board, with a clay backing. This tank will hold about 3,000 lbs. of green stems with the leaves on. Enough water should be added to immerse the stems. To every 1,000 lbs of stems should be added 5 lbs. of flour of sulphur, 5 lbs. caustic potash and 5 lbs. of good charcoal; but if ashes from a furnace be added,

half the quantity of potash will suffice. The process of retting is completed in from 4 to 8 days. The bundles when partially opened and dried in stacks can be stored, and will keep for a considerable time. The sun would be available for drying in the greater part of Jamaica. The liquid which is over, mixed with cattle, sheep or horse (not hog) manure, makes a most suitable manure, and the leaves would make good paper stock. The cost of chemicals is nominal.

Yield.—It is estimated that each cutting gives 20,000 lbs. of green stems with leaves, or 5,000 lbs. of dry stalks, as the yield per acre, and the minimum product from the dry stalks is 15 per cent. that is 750 lbs. of raw merchantable fibre, or not quite 4 per cent. of the living stem and leaves. In good soil and plenty of moisture, five crops may be expected annually. The caution, however, must be given that until the end of the first year at any rate when the roots have at length penetrated the soil, a full crop can scarcely be expected.

CONCLUSIONS IN 1875 WITH REGARD TO THE FUTURE PROSPECTS OF RAMIE BY DR. FORBES WATSON.

“Ramie possesses qualities which will always make it a comparatively high-priced fibre, standing as it does between the vegetable fibres, hemp and flax, ranging from £30 to £70 per ton, and the usually much higher priced animal fibres, wool and silk, ranging from £130 per ton upwards. It is only in competition with these latter that ramie will have to rely on its cheapness; since, as regards the other vegetable fibres, it has already been noticed that, at equal or even superior prices it may yet in many cases be used with advantage instead of hemp and flax. The details supplied prove however, that the prices of the raw material have in reality been hitherto prohibitive. On any greater demand for it, the prices of the raw fibre rose at once to £70 or £80 per ton, which corresponds to £100 or £120 per ton of available fibre, exclusive of cost of preparation. Prepared or combed fibre was usually sold at 2s. 6d., sometimes 3s. 6d. per lb., or £280 to £392 per ton, prices such as, with the exception of the best kind of Sea Island cotton and of some superfine kinds of flax, which may almost be called fancy varieties, no vegetable fibre commands. The combing wastes or noils of ramie even now, find a ready sale at from £80 to £100 per ton, a price which, with the present prices of rough China grass, might make it remunerative to convert its whole quantity into combing waste, if so be that this could be practically carried out. Under such conditions, it is a striking acknowledgment of its value that it should ever have been considered as having any chance at all, and have come so near to actual success as it has done.

“In considering what range of prices would be sufficient to secure a large demand for this material in the present state of the market, several circumstances must be taken into account.

“It is important to bear in mind that, like all other fibres, ramie exhibits remarkable differences of quality. In China, where alone it is used for any fine purposes, a difference is even remarked

between the various layers of fibre on the same stem, the outside layer close to the bark being stronger and rougher, whilst the inner layer is glossier and finer, and more suitable for high-class fabrics. It is also highly probable that, as in flax, the fibre at the base of the stem is rougher than at the top. Well-marked differences arise from the season of cultivation and the time of cutting. The first crop of the plant is usually shorter and more woody and branched, and yields inferior fibre to the second or third crop, which, in turn, appear to differ from each other. It seems also certain that, like jute, the early-cut stems yield a finer fibre, but in proportionably small quantities, whilst in the perfectly ripe stems the fibre increases in weight and strength, but diminishes in fineness and lustre. If the ramie stems be worked up in their fresh state, and if the time of cutting should have extended over four or six weeks, this in itself would be sufficient to produce fibre of different qualities, even from the same plantation.

“A difference in the soil or mode of cultivation is as sure to produce remarkable differences in the qualities of the fibre as it does in the case of flax or jute. In the ramie stems obtained from France, there was a proportion of strong branched knotty sticks, more than half an inch in diameter at the bottom, whilst there was also a considerable proportion of thin shoots, hardly a quarter of an inch thick, and straight and smooth, although as high as the former, and containing a much finer fibre. The difference arose obviously from the former growing as central stems with a number of lateral branches, while the latter grew as parallel shoots thrown out from the same root—a difference which the mode of planting and cultivation would produce.

“On the part of several correspondents who have long given their attention to this fibre, it has been suggested that, for very fine purposes, this plant should not be grown to a greater height than three or four feet, the superior value of the fibre compensating for the diminished out-turn per acre, although even the out-turn might be increased or at least remain unchanged, if the smaller height to which the plant is grown should allow of planting it closer together, or of obtaining more crops per annum than when the plant is grown to its usual height of six or eight feet. The fibre from the smaller stems is likely not only to be finer, but it is also likely to suffer less loss in combing. Although the bark peeled off the six to seven foot stems may be of the same length as the stems, yet the fibres do not run the whole length. At each joint a certain proportion of the fibres stops, so that along with the full length fibre there is always a certain proportion of short length, which, in scutching and combing, mostly run to tow. With stems of less height, this difficulty is likely to be lessened.

“All these are differences in the natural properties of the fibre itself, and independent of variations produced by a different mode of preparation. The latter, which will be superadded to those inherent in the fibre as grown, will be hardly less considerable. There is the difference between the fibre obtained from the green

stems and that from the dry stems. The subsequent chemical treatment may result in a greater or less disaggregation of the original fibre, and materially influence its character. On all these grounds it appears that the ramie brought into the market will, under any circumstances, even with the most perfect methods of cultivation and preparation, manifest considerable differences in its quality and property—differences greater than is the case with other fibres. As before explained, it is quite likely, that even from the same plantation, some of the produce may be remarkable for strength, but deficient in fineness and gloss; another portion, fine and glossy, but less strong; another, by its roughness and hairiness, approaching wool in its character.

“Ultimately, this very range in the quality may prove an advantage; but first, in the experimental stage, it is a decided disadvantage; and it can be easily shown that this is, in itself, a sufficient reason why it is impossible to expect that ramie should, from the first command such high prices as its good qualities are likely to ensure to it, after its cultivation and preparation have become more developed. A high price of necessity restricts the application of the fibre to the very finest purposes. Now, it is the invariable characteristic of high-class manufacture to require perfect uniformity in the quality of the material used in it. Not only must each bale of fibre used for fine purposes be as nearly as possible uniform in its quality, but it is likewise necessary to ensure the steady supply of other bales as uniform, and of the very same quality. It is an established fact, that in the case of any inequality in the material, the whole quantity will sink almost to the value of the lowest quality contained in the mixture, and that no high-class expensive machinery will ever be established, unless there are grounds for expecting that the quality of the raw material will be uniformly maintained. In any other case, the fibre can only be used for rougher purposes, and worked on simpler machinery, in which such variations in quality are of no moment.

“As before explained, there will be in the case of ramie even greater difficulties than in the case of other fibres, in ensuring this perfect equality in condition, as a considerable amount of variation in the character of the fibre is unavoidably connected with the very nature of the growth of the plant. It will require a perfect knowledge of the nature of the plant, and of the fibre and its working, and a perfect mutual understanding between the agriculturist growing it, the machinist cleaning it, and the manufacturer spinning it. This can only be the slow result of time, and will only have been attained when cultivation being more extended, the trade conducted on a larger scale, it will be possible to carry out a complete sub-division of the crop according to its various qualities, and when the best practical uses of each quality will have been ascertained. Moreover, in any case, even with the agricultural and mechanical treatment, it is likely that only a certain part of the crop will be suitable for fine uses, whilst a considerable proportion will only be available for rougher purposes. So that, unless the

method of preparation allows of utilising this rougher portion of the crop also, the remaining portion suitable for fine purposes will always be disproportionately dear.

“It is clear, therefore, that a rapid development of the ramie trade cannot be expected, until the bulk of the raw fibre can be supplied at a price much below that which it will eventually attain when its higher qualities have been more fully developed, and below that which the finer portion of the crop is likely to command even now. It may finally come to be applied to the manufacture of damask, cambric, and lace, but for some years to come, even if its use for such purposes should prove successful, it will have to be worked up by manufacturers only gradually discovering its properties, and on machinery with processes imitated from those used with other fibres, and therefore not specially adapted to ramie. The consumption of the fibre for fine purposes during that experimental stage will be necessarily small, and restricted only to the best qualities. No real outlet, therefore, will have been obtained for ramie unless it be applied for purposes for which, in the opinion of some of its sanguine advocates, it is far too good, such as for cordage, as also for canvas, mixture with rough wools, lower kinds of carpets, hangings, linings, certain kinds of linen, &c. It is also to be remembered that only by becoming suitable for the manufacture of comparatively cheap articles produced in large quantity, is there any hope of its becoming a great staple. If it were able to compete with only the Courtrai flax, and no cheaper fibres, however successful it might be in this respect, it would never develop into a large trade.

“It will appear clearly from this discussion, that in all probability the standard price of £50 per ton for machine-prepared ramie in the London market, which was considered sufficiently low in 1870 to ensure its extensive introduction, is in the present condition of the market too high to effect this object. Such a price of raw material for fibre available for spinning would correspond, as already calculated, to a price per ton of £75, with the addition of the cost of chemicals, a price which would amount to rather more than that of the finest variety of flax, which enter extensively into the commerce of the country. If ramie with all the disadvantages attending the introduction of a new staple, is to compete successfully with the fibres which already have possession of the market, there must be some likelihood of obtaining steady supplies of the rough fibre at prices which correspond more nearly with the prices of the other vegetable fibres, such as flax and hemp, that is, at an average price of (at the outside) from £30 to £40 per ton for the better and from £20 to £25 per ton for the lower, qualities. Even with such prices, the fibre freed from gum, and in a condition similar to that of undressed flax, could not be prepared at less than from £35 to £60 per ton, plus cost of chemicals. Considering its superior qualities, however such a price would seem sufficiently low to bring ramie into competition with flax and hemp, even if the latter were somewhat cheaper. It has also to be considered

that the limits of prices for ramie will, of course, always depend on the state of the market with regard to fibres generally, and that, at present, the values of all the fibres are much lower than they were some years ago. With a recovery in the value of other fibres, the limits of prices here indicated for ramie would have to be proportionately increased."

"With regard to what is known in commerce as 'China grass,' this is hand-cleaned fibre shipped usually from Chinese ports. It arrives in this country in small parcels, the yearly importation being only about 100 tons. It is nearly all taken up by continental buyers. Rhea is the term applied to machine-cleaned fibre, generally in the form of ribbons or half cleaned stuff. The price is much less than China grass, and in case of large shipments would probably not exceed about £7 or £8 per ton. It is important therefore for Ramie planters to aim at the production of ribbons at cost not exceeding about £4 or £5 at the port of shipment. Important elements in such production would be to plant Ramie only in places where the soil and climate will allow of three or four crops to be reaped per annum; where labour is very cheap and abundant, and where good facilities exist for transport and shipment." (*Kew Bulletin*, November, 1889.)

In Ide & Christie's *Monthly Circular*, dated 15th November, 1906, China Grass is quoted at 32s. to 35s. per cwt.; and Rhea "none here."

Extracts from Lecture at Society of Arts.*

"RAMIE AND ITS POSSIBILITIES."

BY MRS. ERNEST HART.

Fifteen, twenty years ago, numerous companies were formed with large capitals, pledged to make ramie one of the great staple textiles of the world,—the mills of all of which are now silent, and in most cases dismantled and turned to other uses.

The causes of this remarkable and almost universal failure in Great Britain, are stated to have been want of raw material, imperfect methods of degumming which rotted the fibre, the difficulties of manipulating the fibre in machines not specially constructed to deal with it, and the intractable behaviour of ramie yarns in the loom. It should also be added that in many cases the companies were promoted in a purely speculative spirit, and the management was in the hands of those who did not aim by patient investigation at overcoming the difficulties of ramie manipulation in the factory, but were unfortunately too much interested in the more exciting game of manipulating shares on the Stock Exchange.

Promises of immense profits were made in the prospectuses, charming samples of fabrics were produced, quotations of shares rose by leaps and bounds to high figures, but when orders were placed the samples could not be reproduced in pieces, shares fell

as rapidly as they had risen, and a spirit of despair settled down on the ramie world of England and her dependencies. Factories were closed, companies liquidated, plantations in India and elsewhere were rooted up, and the whole subject was quietly disposed of by manufacturers, in the statement "We have tried ramie and nothing can be done with it." The loss of money, however, rankled, and ramie became the *bête noire*, the skeleton in the cupboard of British commerce.

But while British manufacturers simply gave up ramie, or a few small spinning factories were carried on on an unprofitable basis for a few years longer, steady progress was being made on the Continent in the effort to overcome, by scientific methods, the difficulties of degumming without injury to the fibre, and to ascertain the correct principles and processes of spinning. A new use was discovered for the fibre, which gave a great impetus to ramie spinning: this was the use of ramie in the manufacture of gas mantles. What was required was an absorbent netting which would absorb the mineral salts and be afterwards burnt away, leaving the least amount of a perfectly white ash behind. Egyptian cotton had been used for this purpose, but gas mantle manufacturers found, in a webbing made of ramie yarns, a material which suited their requirements exactly. This discovery led to a great development of the existing ramie spinning mills of Germany and France, and to the perfecting of their processes and machinery.

The German mills then took up the manufacture of ramie stockingette for underwear, of hosiery, and of knitted goods in which the yarn used is mixed more or less with wool. In France and in Switzerland the weaving of coarse linens for restaurants has been carried on in a moderate degree, though the representative of Messieurs Favier in Paris told me that owing to the extraordinary durability of these linens, made at one time by themselves, they were boycotted by the buyers of the great French retail houses, so that they consequently gave up weaving them, and confined themselves to spinning. The making of plushes from ramie has been also accomplished at Chemnitz; in Japan the blending of ramie with silk has been successfully carried out; in Holland fishing nets are manufactured of ramie yarns, and both in Sweden and in the United States stockingette for underwear is made on frames, of imported yarns: in Germany and France ramie yarns are used in a limited degree as weft on woollen or cotton yarns to give brilliancy to fabrics; and sail cloth for yachts has also been made on a small scale.

I think I have mentioned what had been done in the use of ramie in various textiles till I started with the avowed intention of manufacturing pure ramie fabrics warp and weft; the known difficulty being to weave with a pure ramie warp, for though the fibre is of surprising strength, the strongest yarn breaks at the knot with the greatest facility, and it does not stand well the shock of the loom at the opening of the shed.

As I am frequently asked what induced me to take up the question of ramie weaving, and as my audience will expect an answer to this enquiry, I will give a brief account of my own work in weaving ramie.

As is well known, I was engaged for many years (and am still) in encouraging Irish village industries by founding various industries and training workers. The weaving of hand-made linens of beautiful colours in cottages was one of these. Looking round always for new ideas, I noticed in the Colonial Exhibition of 1885 a case of ramie in which the fibre was shown in the raw state, degummed, as silver, and as dyed yarns. I sought out the man in charge of this exhibit, and asked if yarns could be supplied of this brilliant, silky fibre, but I was told that the exhibit was only of scientific interest, and that to make weaving yarns was not yet practicable.

A few years later I read a notice in the papers that the difficulties of ramie spinning had been overcome. I immediately wrote to the factory mentioned, and obtained white yarns, which I used as weft on linen warps, and one of the first things woven on our looms was a piece of cloth for a waistcoat, which has figured in many letters to the press, and which I know is still in wear. On the closing down of this factory we bought up stocks of ramie yarn, and continued weaving it in conjunction with unbleached linen and exporting the cloth to India, where it obtained a high reputation for its wearing qualities, and its stubborn resistance to dhobie washing.

Stimulated by the assertion that it could not be done, I determined in the summer of 1902 to attempt the weaving of pure ramie fabrics, warp and weft. I put up a small Swedish hand-loom in a shed in my garden at Totteridge, and engaged an expert hand-loom weaver—a Finn girl to come and work as a sample weaver. On this simple loom we got out our first samples, and boldly submitted them to one of the first dress goods houses in London. They were approved, and I was encouraged to go on. A witch loom and a Domestic loom, with power-loom action worked by the feet, were added to the plant, and while I designed or copied patterns and pegged them on the witch, the weaver wove them, and together we proved the point that ramie could be woven in piece lengths, warp and weft.

The looms were then transferred to a weaving shed in a village in Yorkshire, the number of hand looms was brought up to sixteen, and they were placed under the direction of a manager, who added to the most intimate knowledge of looms and weaving, a rare sense of colour. Orders began to come in from good houses, but they soon necessitated the use of broad-width power looms. Another small mill was rented and fitted with ten power-looms, gas engine and winding, beaming, and twisting machinery. Then began the true difficulties of the undertaking, for we had to meet and overcome the difficulties of weaving, in this inelastic fibre,

fine dress fabrics on broad-power looms, difficulties which in England had vanquished those who had attempted the same before. One by one, however, they were steadily overcome, and there is now scarcely anything that we cannot weave in pure ramie, warp and weft, from the lightest gossamer to cloth that has a breaking of nearly 500 lbs. to the inch, from heavy tapestries to light dress goods, from fancy upholstery repps to muslins. All the fabrics here shown, are of pure ramie, warp and weft, and were woven at our mills under my personal direction.

Again and again we were fairly beaten, the workers would not stay to be so worried, the looms broke down under the strain put on them, the winding of the yarns drove everybody silly; but we always began again, determined to succeed, and would not accept failure.

Not the least of our difficulties were created by the yarn spinners. To get weaving yarns spun for me I applied to the spinners of gas mantle yarns, or of ramie thread, to worsted spinners, flax spinners, and jute spinners. Numerous and costly experiments were made in England, but none of the yarns were satisfactory, as the spinners had not the proper plant on which to spin ramie yarns, and were unwilling to put up the same, and they soon tired of making experiments to reach the perfection of manufacture I required. I then went to France; but the yarns though beautiful in appearance, were too brittle. I then went to Germany, and at last found spinners willing to take any amount of trouble to do what I required. "We do not care what trouble Mrs. Hart gives" they wrote, "so long as we please her in the end." In England the spirit of the replies to my requests, used to be in those early days. "Well—it is the best we can do, and if you do not like it, you must lump it." It is the scientific spirit of painstaking industry which gives Germany her increasing commerce, in spite of hampering tariffs; it is the conservative spirit of anti-scientific ignorance which loses Great Britain her commercial supremacy, in spite of the benefits of free trade. In nothing is this more visible than in the ramie industry; once almost solely in the hands of Great Britain, whose colonies could supply her with indefinite supplies of raw material, and lost through over-reaching speculation and lack of science, this industry passed to Germany, who applied to the elucidation of its secrets and the perfection of its methods, the science and patience lacking in this country.

To return to the story of our own work. Having now overcome the technical difficulties, my next care was to place the goods on the market, but though orders were placed by the best dress and upholstery houses our plant, was then too small, our possible output too limited, and our capital too narrow to do ourselves justice. I had borne all the expense of the great experiment, and not being a capitalist, this was only done at the cost of great personal sacrifice. I was assured by business friends, and by willing promoters, that it would be easy to find capital to enable me to increase the plant, take advantage of the trade offered, and create

a sound industrial enterprise ; but English capital was shy ; it had been hit too heavily in the past by ramie to believe in the genuineness of a new ramie industrial undertaking : incredulity as to ultimate success was expressed on all sides in such terms as " It is absurd to think that Mrs. Hart can succeed where Lister failed." " Oh, yes, Mrs. Hart will make samples as they all did, but she will never make pieces," and so on, and the enormous sums of money lost by the speaker or by his friends, were instanced as proofs of the disastrous character of ramie undertakings.

But help came from another, a more confident and bolder country than old England, namely, from America, and it was with American capital that " A. M. Hart, Limited," was formed and the enterprise was lifted from the experimental stage to that of a sound commercial industry. English capitalists have since joined us, but at a critical time it was due to the action and initiative of my American co-director that the enterprise was firmly established on a commercial basis. From that date we have gone forward with no uncertain steps ; we have rented a large mill, have put up a considerable amount of machinery, and are engaged in executing orders and Government contracts, which are only an earnest of what we expect and which we are prepared to carry out.

Everywhere I have tried to allay one bogey which has always frightened the intended planter, namely, that it is necessary to have a costly machine for decorticating the fibre in order to make it marketable. So long as there are millions of people in this world willing to work for 6d. a day or less, ramie is better, in such countries, stripped and decorticated by hand than by any machine that has been or will be invented. In India as in China, in West Africa, in East Africa where native labour is abundant, and in the West Indies, no decorticating machines are necessary ; but in Mexico, in the Straits Settlements, in the Southern States of America, where labour is scarce and dear, and on the great rubber lands where ramie would be a valuable catch-crop, decorticating by machinery is essential.

A great many machines have been invented for this purpose since the Indian Government in 1869 offered two prizes, one for £5,000, and another for £2,000, for machinery or processes by which the fibre could be prepared at such a cost per ton as would render it easily marketable. This offer of prizes was renewed in 1877, for sums of £5,000 and £1,000. Various competitive trials were made, and though small prizes were awarded, no machine was found equal to the requirements of the Government, so some years ago the chief of the Economic Department advised the Indian Government to withdraw the competition.

This offer of the Indian Government to give prizes for decorticating machines was unfortunate, as it led those who were interested in ramie on a wrong tack : for it was more important to ascertain the correct scientific principles of treating the fibre in order to prepare it for manufacture, than to decorticate it by machinery on the fields, particularly in India, where, owing to the

abundance of cheap labour, ramie can be better decorticated by hand than by any machine. China does not ask for decortivating machines, and the hand-stripped China grass—which is only ramie stripped and debarked on the fields with Chinese care and laboriousness—will always command a higher price in the market than any machine-decorticated fibre. Various machines claiming to do all that is required are now on the market, and I have reason to believe that a machine, the invention of a foreigner, which will be introduced in the autumn of 1906* will give quite the best returns, both in the matter of perfectly cleansing the fibre of the outside brown pellicle and in the output it can produce per diem.

The difficulty of the whole proceeding will be understood by those who are not ramie experts if I briefly describe the process. Ramie stems, when grown to the height of about 8 or 9 feet, are, when matured, cut down, and the outer bark is at once stripped off. This outer bark, which can be easily stripped off, much in the same way as a willow cane is whittled, is found to consist of two layers, namely, a thin outer, closely adherent, brown pellicle, and an inner, thicker, white, bast layer. It is this bast layer which is composed of ramie fibre. When it is stripped from the woody stem in the green state it is full of a sticky gum. The object is now to free the bast layer as much as possible of its soluble gums and of its outer brown pellicle.

This the Chinaman does by sitting in or near running water while he rubs off the outer brown pellicle with a blunt bamboo knife, and strips off the bast layer, washing away the soluble gums at the same time. The long strips of fibre are then dried, baled and exported, and obtain a price per ton in Europe out of all proportion to the cost of cultivation and manipulation. In the case where the ramie stems are decorticated by machinery, they are sent, within three days of being gathered, to a central decortivating station; or in large plantations to the mill on the estate. The canes are first passed through corrugated iron rollers, which break up the woody stem and pith, leaving long strips of the bark more or less free from wood: these are then passed into a machine, the principle of which is approximately, the same in all which have been invented, namely that revolving steel blades pare off the outer brown bark of the ribbons, very much in the same way as the surface of a cloth is cut by a revolving cutting machine, and they are finally brushed clean of all adhering particles of pellicle.

The disadvantages of machine decortivating are—the initial expense of the machine; the delay in bringing the stems down from the plantations, so that some of the gums undergo fermentative changes; the smallness of the output of most of the machines in use, and the fact that after all the fibre is not so completely cleaned of its brown pellicle as in the case of hand stripping, nor are the fibres left in such a perfectly parallel condition, which is essential to avoid waste in the subsequent processes of spinning. I do not deny but that machines for decortivating are absolutely

* See paragraph below on Machinery, page 304. *Editor.*

necessary in some cases, particularly where ramie will be grown on large plantations, and where labour is scarce and dear, but it has been unwisely put forward by the Indian and other Governments, as an absolute necessity before the cultivation of ramie had been entered upon on anything like a large scale.

I make bold, however, to say that though hand-stripped China grass will always command the best price for the finest ramie goods, yet for a large number of purposes it is not necessary to deprive the ramie of its outer brown pellicle. The whole bark, pellicle and bast layer, can be easily stripped off in long ribbons by hand, or the process may be aided by passing the canes through corrugated iron rollers to break up the wood and pith of the stems.

These ribbons, which are known in the trade as brown ramie or rhea ribbons, must be thoroughly dried, and are then baled, and exported: and by those who hold the secrets, these brown ramie ribbons can be debarked and degummed at the same time, producing a very useful *filasse*.

This statement, made by me in many letters to growers in remote parts of the world, has given great hope and a considerable stimulus to ramie growers, as they were holding back, unwilling to plant on a large scale, waiting for the introduction of the long-promised, perfect decorticating machine.

The next process in manufacture is to free the fibre from its gum and to turn it into what is called *filasse*. The gums and pectines which bind the ramie fibres together in the bast layer are among the most irreducible and complicated in nature. Some of them are easily soluble in water, others can be reduced by alkalies, but some of them are more intractible, and the object of the investigators and chemists who have studied the subject of degumming ramie for the last 50 years has always been to recover the natural white fibre, free of its gums, without injuring its strength or destroying its brilliancy. To obtain this result numerous patents have been taken out, and still more numerous processes are kept secret. Some of the processes which were in use some years ago resulted in rendering the fibre so fragile that the yards dissolved in powder after the cloth is woven. Some of the processes still in vogue, render the yarns brittle in the extreme; but I may, nevertheless, say with confidence that the difficulty of degumming has now been solved, and that there are those among us who can teach, if they would, how to degum ramie without destroying its strength or diminishing its brilliancy.

One of the great arts of the process is to keep the long fibres of ramie intact and parallel so that very little tow is produced in spinning. It is often stated that it would be well to degum the fibre on the fields at the time of gathering and decorticating. This assertion I always contravert as degumming is essentially a scientific process, which must be watched over and directed by scientific experts; indeed every bale of ramie, and the product of every single crop, must be carefully examined and specially treated on its merits.

If ramie is to become, as we anticipate, one of the great textiles of the world, it will be grown, like cotton or sugar or rice, in plantations often widely separated, and frequently small in extent, and the great thing is to teach the planter how to prepare the fibre for export so that it may arrive at the mills in a sound condition, and there is nothing that protects the fibre in the course of transit as well as to be embedded in its own gum.

After degumming, the fibre is then subjected to various manufacturing processes to turn it into sliver, and from sliver it is spun into yarn.

It is a strong commentary on the apathy of British manufacturers that, whereas there is only one spinning mill in Great Britain at present at work which treats ramie from the un gummed fibre to the yarn, there are several of large extent in Germany, France, and Japan; yet it is in England where the best ramie machinery is made, and these foreign mills come to England for their ramie-spinning machinery. I have reason to believe that this reproach to English industrial enterprise will be removed before long; and, inasmuch as I and my friends are doing our utmost to stimulate the cultivation of ramie in British dependencies and colonies, we are also aiming at, and are taking practical steps for, making ramie-spinning a British industry.

In the discussion which followed Mr. Thomas Barraclough said he thoroughly agreed with the bulk of what Mrs. Hart had said. He somewhat differed from Mrs. Hart in her remarks with regard to decorticating by hand labour. It was necessary that the fibre should be degummed as much alike as possible. It was very inconvenient to get a bale of ramie, one-half of which had been properly decorticated by good hand labour, and the other only half decorticated, owing to the fact probably that the work had been done by children, as was the case in China. If the ramie had a good deal of the outer pellicle left on it, it must be treated specially before it was degummed, whereas good decorticated ramie could be degummed straight away without any preliminary treatment. It was very necessary, therefore, that ramie should be decorticated equally. Hand labour was very good when it was good, but it was irregular, and machines must, sooner or later, take the place of hand labour. The Chinese decorticating was the best in the world, due to the fact it was the custom all over China, where ramie was grown, for the payment for decorticating to be the perquisite of the wife and the children with which they bought their clothes. Hence the diligence with which they worked. There were two or three difficulties connected with the brown or black ribbons which were sent to this country. A great mass of stuff was sent over, on which freight had to be paid, which might just as well be left in the fields where ramie was grown. As a consequence the material had to undergo special treatment, and even though he had known it to be bought for £13 a ton, it was dear at the price. Mrs. Hart had said that the plants would last fo

twenty years. In his opinion the outside limit to the age of a ramie plant was fourteen years, and probably twelve was nearer the average. If the roots were too old the fibre was deteriorated, and was worth considerably less for spinning purposes. But as Mrs. Hart had said, the plants themselves provide so many means for obtaining new plants that it was not a serious consideration if the twenty years were reduced to twelve. The industry had now been put on a commercial basis. There was an immense demand for ramie yarn, in fact, so great was the demand that the largest mill in Germany was said not to be able to accept further orders for a considerable time. Consequently, if there was an ever-growing demand for the yarns in England and they could not be obtained except by going to Germany and France, it seemed to him that the English would be a very benighted people if they did not put up some spinning mills and spin the yarn they required. He hoped the excellent paper which Mrs. Hart had read would have a powerful influence in that direction.

MACHINERY.

Mr. Hubert J. Böeken states in a pamphlet just lately published that he has for many years been engaged with machinery for all kinds of textile fibres, and that in his last voyage to the West Indies he succeeded in finding a machine which had been wanted for so long,—one which could easily and economically decorticate ramie. Mr. José García Hernández of Havana had been occupied for 18 years with indefatigable perseverance in the construction of a decorticator. Mr. Böeken saw the little model machine of Mr. García, and at once recognised the possibilities of utilising the principle of this machine. He constructed a larger machine on this principle with the improvements suggested by his experience, and named it the "Aguiles." This machine is now manufactured by H. Böeken & Co., Düren, Germany. The advantages which it possesses over other inventions of the same kind according to Mr. Böeken are the following:—

1. Simplicity of mechanical construction, as there are neither scutching drum, nor knives, nor feeding chains.
2. Very feeble expenditure of motive power necessary; a child can put the machine in motion.
3. Continuous feeding of the machine.
4. Output considerable: 10,000 stalks an hour giving about 40 lbs. of Chinagrass an hour.
5. Facility of transport. The machine is not more difficult to move than an ordinary sewing machine.
6. Moderate price which puts it within the reach of every planter: £60.
7. Total weight 990 lbs.

FIBRE MACHINE.

Among the articles exhibited by the Jamaica Society of Arts in Kingston on the 17th and 19th of February 1855, and subsequently sent to the Paris Exhibition were fibres from the Jerusalem dagger,

Yucca aloifolia, and from the plantain, *Musa paradisiaca*, prepared by a machine invented by a Mr. Clarke who was employed at the General Penitentiary.

They were handed into the Society by the Rev. James Watson. Information about this machine is desired by a correspondent.

NOTES ON THE CULTIVATION OF VEGETABLES. II.

By W. HARRIS, F.L.S., Superintendent of Hope Gardens.

In the Bulletin for October will be found some Notes on Vegetables. A correspondent has now asked for information showing the time required by each crop to arrive at maturity. This will depend largely on soil, situation and the care bestowed on cultivation, but, speaking generally, the time required by each of the crops named below is approximately as follows:—

Beet-root	...	Three months
Cabbages	...	Three to four months
Carrots	...	Three to four months
Cucumbers	...	Two to three months
Garden Eggs	...	About five months
Kidney Beans	...	Six to eight weeks
Kohl Rabi	...	Two to three months
Lettuce	...	Two months
Musk Melons	...	Three months
Mustard and Cress		Two to three weeks
Okra	...	Three months
Onions	...	Six to seven months
Parsley	...	Three months
Peas (English)	...	Three to four months, according to variety grown
Peppers	...	Two to three months
Potatoes	...	Three to four months
Pumpkins	...	Three months
Radish	...	Six weeks
Spinach	...	Two months
Squash	...	Two to three months
Sweet corn	...	Three months
Tomatoes	...	Three months
Turnips	...	Two to three months
Water Melons	...	Three months.

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Wednesday 14th November, 1906, at 2 p.m.; present: Hon. H. Clarence Bourne, Chairman, the Director of Public Gardens, the Island Chemist, the Superintending Inspector of Schools, His Grace the Archbishop, Messrs. C. E. deMercado, J. W. Middleton and the Secretary John Barclay.

Rubber—The Secretary read letter from Mr. Harris acknowledging receipt of the vote of thanks from the Board for preparing the manuscript on the subject of rubber.

Tobacco—The Secretary reported with regard to the samples of leaf tobacco asked for by Messrs. Granda Bros. & Co., Montreal, that he had received samples from Mr. Crowden of leaf grown at Suttons, Clarendon, and had sent them on; he understood also that Col. Kitchener had sent samples.

School Gardens Committee—The Secretary read the report of the Committee on School Gardens.

The Chairman asked if this was intended to supersede the inspection of Schools Gardens by the Inspector of Schools.

After discussion it was resolved, to alter the words "Inspector or Superintendent" and insert "Instructor for School Gardens" as the description and add a paragraph to the effect that this arrangement was an additional effort and was not intended to interfere with the inspection of School Gardens by Inspectors of Schools.

The Secretary was instructed to send the report to the Colonial Secretary.

Book on School Gardens.—The Chemist asked whether arrangements were made for the publication of Mr. Williams' book on School Gardens in Jamaica.

The Secretary was instructed to write the Colonial Secretary drawing his attention to the fact that a book on School Gardens is being written by Mr. Williams at the request of the Board of Agriculture and recommending that provision should be made on the estimates for 1907-8 of the Printing Office for publication.

The Secretary submitted the following letter from the Colonial Secretary's Office:

Agricultural Conference--1. Enclosing a copy of letter written to the Director of Public Gardens, stating that the "Port Kingston" would visit Barbados both on her outward and homeward voyage in January next, without transgressing contract time, in order that the members of the conference might travel in her both ways and requesting him to send in as soon as possible the programme of the Agricultural Conference proceedings also requesting him to make proper arrangements for the accommodation of the conference.

In this connexion a letter was read from the Director of Public Gardens asking for the approval of the re-appointment of the same committee which had been appointed last year in connexion with the Conference. This was approved.

It was reported that the Government had arranged for free Railway passes for the members of the Conference.

Assistant Chemist--2. Intimating that the Secretary of State for the Colonies had selected Mr. Robert Simmons, for appointment on an engagement for not more than three

years from the date of his arrival, as Assistant Chemist, in this Island, with salary at the rate of £200 a year rising by annual increments of £10 to £220 a year.

Arrowroot—3. Stating for the information of the Board that about 4,650 pounds of arrowroot were annually consumed at the General Penitentiary, District Prison and Reformatory, and about 12,000 pounds at the Lunatic Asylum, Lepers Home and the several Public Hospitals.

The Secretary stated that he had the matter in hand trying to get a native supply.

Instructors—4. Referring letter from the Upper Trelawny Agricultural Society to the Chairman, expressing its appreciation for Mr. Arnett's appointment as Agricultural Instructor for the parish, but suggesting that instead of one local Instructor to serve the parishes of St. Ann, Trelawny, Eastern St. James and North Clarendon, it would prove more workable, ensure more visits, secure greater interest and more effective teaching to have, say three Instructors at £100 per annum, or four at £80 per annum.

The Secretary was instructed to reply that the Board did not consider it expedient to make any alteration.

Tobacco—Forwarding copy of the Director of Public Gardens on Tobacco, stating that he had seen Mr. Chalmers several times in London and had gone to see Mr. Murray, the Director of Victualling at the Admiralty, and also Mr. Olivier at the Colonial Office with reference to using Colonial Tobacco in the Navy, that it was probable that the Admiralty would undertake to import and prepare its own tobacco for the use of the sailors; that the tobacco from Havana seed required blending with leaf of the character of Virginian tobacco and that it was Mr. Chalmers' opinion that the latter could be grown in the West Indies, and that it was his intention to try it at Hope Gardens this season.

6. Submitting correspondence with Mr. Ashby regarding his appointment as Fermentation Chemist.

It was directed to be circulated, but was first to be returned to the Colonial Secretary's Office to be sent to the Chemist for his information.

The Chemist submitted the following reports :—

1. Report visit to the United Kingdom and Germany to investigate the commercial aspect of Jamaica Rum.
2. Estimates for Government Laboratory, 1907-8.
3. Estimates for Sugar Experiment Station for 1907-8.
4. Proposed experiments for forcing early Oranges.
5. Report on Distillers' course.

As regards the estimates for the Government Laboratory for 1907-8 these asked the approval of the Board for alterations in

the items of the estimates, the proposals not involving any increase in the total appropriation for the Government Laboratory.

As regards the estimates for Sugar Experiment Station for 1907-8 these recommended that the estimates should remain unchanged except for a slight re-arrangement under the heading "Personal Emoluments."

These were agreed to.

The following reports from the Director of Public Gardens were submitted :--

1. Hope Experiment Station.
2. Instructors.

These were directed to be circulated.

The following papers which had been circulated were now submitted for final consideration :--

1. Report Hope Experiment Station.
2. Report Mr. Cradwick.
3. Report Mr. Briscoe.

[Issued 17th Dec., 1906.]

Printed at the Govt Printing Office, Kingston, Jan.

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