BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

New Series. Vol. II.

KINGSTON, JAMAICA:
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New Series.] JANUARY, 1895. Vol. II. Part I.

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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, Gordon Town P.O.

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CATERPILLARS ATTACKING COCOA TREES

(Theobroma Cacao.)

Information has been received of caterpillars attacking the young shoots of cocoa trees in one district of the Island, and it is desirable to call the attention of planters at once to this pest, and to the necessity of immediate and combined action to stop its ravages in the very beginning.

The only remedy that appears feasible at present is hand-picking. A small payment should be made for the caterpillars by number or weight.

It is quite evident that if some measures are not taken, the larvæ will soon become perfect insects, and these will lay eggs which in the next season will enormously increase the ravages made, and the difficulty and expense of coping with the plague. It is within the bounds of possibility that the Cocoa plantations of the island which have such a bright and promising future before them, may be utterly destroyed by such a pest, and that then the insects may turn their attention to some other plant.

Every Cocoa planter will also see how important it is to use every endeavour not only to exterminate the pest on his own plantation, but to induce his neighbours to do the same.

The Government of Hong Kong has spent very large sums of money in re-afforesting the bare hills of that island with Pine Trees, and these extensive plantations have lately been threatened with extermination from the attacks of a caterpillar How this danger has been met, and successfully grappled with, is told in a very interesting Report by the Superintendent of the Botanical and Afforestation Department of Hong Kong; and this report is published below as a warning to our planters of the danger of neglecting timely precautions, and as an example of the method employed in such insect-plagues for their extermination.

It it desirable that information should be received from planters of the presence or absence of the pest on their plantations, so that some idea may be obtained of the extent of the mischief.

NOTE.—It is satisfactory to learn from the planter who reported on caterpillars, that by attacking them at once, and hand-picking, he has got rid of them. The article in this Bulletin was written for the 'Gazette' of 6th December and sent to several Cocoa-planters, but fortunately the caterpillars did no damage elsewhere. It is considered advisable to print the article in the Bulletin, in order to keep the Hong Kong Report as a permanent record and warning.

Report on the Caterpillar Plague in Hong Kong.

Discovery and Prevention.—The caterpillar which has been attacking the Pine trees (*Pinus sinensis, Lamb,*) in nearly all parts of the Island and Kowloon, is the caterpillar of a large moth (*Eutricha punctata*).

2. It was first seen this year towards the end of April, when the insects were not more than two or three lines in length.

3. At that time the pest had not commenced its ravages, but knowing its habits by past experience, and in view of the fact that the numbers were greatly in excess of anything seen before, as many as two and three hundred being observed on a single tree, representations were made to the Government, to the effect that the Chinese should be invited to collect them, and that all brought in should be paid for by weight.

4. The Government readily consented to the suggestion, and the Captain Superintendent of Police kindly agreed to allow the caterpillars to be brought into the Police Stations nearest to where they were collected. The Botanic Gardens' Office was also a receiving station.

5. The method of catching these pests was by shaking the trees and then picking up the insects from the ground by means of pincers, or with the fingers enclosed in cloth. A sudden shake of the tree brought most of the caterpillars down, but they soon regained their former positions unless prevented from doing so.

6. When the insects were brought in to the Police Stations, they were destroyed by pouring boiling water over them or some other efficacious substance, as sea water, after which they were buried, due precautions being taken that everything was carried out satisfactorily from a sanitary point of view.

7. *Duration.*—The length of time the plague has lasted may be put down as two months—from the end of April to the end of June. The first lot brought in by the Chinese was on May 24th, and the last on June 28th. No cocoons were observed until the beginning of June, when arrangements were at once made to have them collected and paid for in the same way as the caterpillars. The first lot of cocoons brought in was on June 6th, and at the present time they are still being collected, although the quantities are becoming less and less. In all probability the cocoons would have been all collected by this time, were it not for the difficulty of getting coolies to do the work, owing to the great scarcity of labour in the Colony during the last few weeks.

8. *Quantities.*—The quantity of caterpillars brought in and paid for, at the various Police Stations and the Botanic Gardens, was over 60,000 catties, or nearly 36 tons. Cocoons to the weight of 5,000 catties have been received up to date. There were 511 caterpillars in the particular catty counted, and the cocoons numbered 800 to the catty. This gives the enormous number of 35,000,000 insects destroyed to say nothing of future generations.

9. *Cost.*—The expense of getting rid of the scourge has been about $5,000, or an average of 7 cents per catty for both caterpillars and cocoons. The price paid per catty was varied according to the quantity of caterpillars and cocoons found in the several districts. From four to fifteen cents have been offered for caterpillars, although the latter price failed to attract collectors when the insects had become scarce. Cocoons have been paid for at a price varying from twenty to forty cents per catty.

10. *Effects on Vegetation.* -The caterpillars damage the trees by eating their leaves, commencing on the old leaves, and when these are consumed going on to the younger ones. When the trees have been entirely denuded of leaves, they are practically dead, as leaves are the principal organs where the conversion takes place of various inorganic substances into organic matter, for the food and building up of the plant. There are very few trees, however, which have lost all their leaves, and these few are located in various parts of the Island. There are some around Aberdeen, at Deep Water Bay, at Causeway Bay and North Point at Shaukiwan and near Chaiwan. Many trees have been stripped of their old leaves and are consequently in a rather sickly condition. I am of opinion, however, that they will rccover in time, as most of them have sufficient young leaves to enable them to make new growth, in fact, a good number of them are already starting to grow.

11. *Previous Visitations*—If the Chinese are to be believed, this caterpillar has been known on the mainland for several years past, and the natives regarded it as an annual visitor with no very great destructive powers. A few leaves were eaten yearly, but no practical damage done. It was not observed in this Colony until the end of the summer of 1892. Little damage was then done to the trees, which may be explained by the fact that the number of insects was comparatively small, only two or three being seen on each individual tree. The localities which they appeared in were Deep Water Bay and Kowloon.

12. The second appearance was last year, at Quarry-Bay and Kowloon, towards the end of July. Their numbers had very much increased on the previous year's, as twenty, or thirty were sometimes found on a single tree. At Quarry-Bay upwards of 30,000 trees were killed, as the Chinese from various reasons could not be induced to collect the pest. One of the chief objections to take part in the work was the pain caused by the hairs of the caterpillars stinging their hands and feet, as well as other parts of their bodies. Another objection was the great difficulty in finding the insects after they had fallen amongst the long grass underneath the trees. Great numbers were collected by our own staff, but owing to the unhealthiness of the district the men had to be taken away, and, as it was, two of the men died from fever contracted whilst at work in that neighbourhood.

13. *Probable cause of Plague*—The cause of the very greatincrease in the number of the insects this year on anything previously known is in my opinion, as follows. The winter of 1892-93 was exceptionally severe, and it is quite probable that the natural foe of the caterpillar succumbed to the extraordinarily low temperature. What its enemy is, or was, so far has not been discovered, but no doubt one existed. This idea is very much strengthened by looking at the colour and marking of the caterpillar. When it is full grown its colour closely resembles that of the Pine tree branches, and its markings correspond with the scars left on the branches after the leaves have fallen away. On account of this, in examining Pine trees, it is most difficult to see the caterpillars on them, until the trees have been very closely scrutinised for a few minutes; this too when the caterpillars have attained their maximum size, nearly three inches in length and a quarter of an inch in breadth. This close resemblance to the branches of the trees on which these insects thrive, undoubtedly

points to a form of protection from some other insect or bird. Another point in favour of the above suggestion is, as mentioned before, that the caterpillar had been known on the mainland for several years past, but previous to the winter of 1892-93 it had not been known to do any damage.

14. If the enemy of the caterpillar was destroyed in the way suggested above, it is quite easy to account for the great increase in the numbers of the pest last year and the still greater increase this year. The chrysalids formed at the end of the summer of 1892, would become moths, and the female moths would probably deposit their eggs in the spring of 1893. One moth is capable of laying an enormous number of eggs, but a good percentage of these do not hatch. The caterpillars hatched in the spring of last year would, in their turn, become chrysalids about the beginning of June, and these chrysalids would become moths about the latter end of the same month. The moths would then deposit their eggs in July, and the caterpillars seen last year at Quarry Bay and Kowloon would, in all probability, be the second hatching. As previously mentioned many of these were collected, and those which remained formed chrysalids and afterwards moths, and these moths would be the ones which deposited their eggs on the trees this spring.

15. The history of the life of the insect since the end of the summer of 1892 is based chiefly on observations made this year which are as follows :—The first eggs were laid at the end of April, and the caterpillars which escaped the collectors became chrysalids at the end of May or beginning of June, the moths appeared in the middle of June, and now they are depositing the second lot of eggs. It is very gratifying, however, to be able to state that very few eggs or caterpillars have been seen of this second lot, although the plantations have been well examined.

16. Another probable reason for the very large number of the insects which appeared this spring, is the drought which prevailed at the time they were hatched. At this stage of their existence they are extremely small, being only a few lines in length and about the fiftieth part of an inch in breadth, so that it may readily be imagined what the effect of a tropical shower would be upon them at this early period of their life. On several occasions, when I was examining the plantations, it was raining very heavily, and underneath the trees full grown catapillars were lying on the ground, in hundreds and thousands, in a half dead condition. A prolonged heavy rain would undoubtedly have killed them.

17 *Remarks*—The eggs of the moth are deposited on the upper part of the leaves, and thus the caterpillars have food to go upon as soon as they come out of the shell. The eggs are pink in colour and oval in shape, about the sixteenth of an inch in length and the twenty-fifth part of an inch in breadth. The size of the moths varies, the largest of the females being 2½ inches across the wings, and 1¼ inches long, whilst the males are 2 inches across the wings, and an inch long. Both sexes are fawn-coloured, but the male sometimes has a few white and black markings on its wings. The chrysalids are enveloped in a stiff papery cocoon, which is fastened very firmly to the leaves or other parts of the trees. It will thus be noticed that from the time the eggs are laid until the moths are produced, the insects remain on the trees.

18. In conclusion, it is satisfactory to know that the methods employ-

ed for the extirpation of the scourge have been decidedly successful. Of the many thousands of trees which were attacked, only a very small percentage have been killed, and many of those which have had some of their leaves destroyed, are in a fair way towards recovery. The pest which at one time threatened the destruction of all the Pine trees in the Colony has, for the present at any rate, been most successfully coped with.

COCCIDÆ OR SCALE INSECTS.—VI.

By T. D. A. Cockerell, Professor of Entomology at the New Mexico Agricultural College.

Genus *Ceroplastes*; the Wax Scales.

These scales are allied to the convex species of *Lecanium*, but are distinguished very easily by their coating of wax.

(26.) *Ceroplastes floridensis*, Comst. (The Florida Wax Scale).

Diagnosis.—A small, moderately convex scale, covered with white or whitish wax, which is not divided into distinct plates.

Distribution.—Probably a native of the West Indies, though first described (in 1881) from Florida. It is plentiful in Kingston, Jamaica. Also found in Louisiana.

Food-plants.—*Ficus*, guava, oleander, red bay, sweet bay, *Ilex glaber* myrtle, *Andromeda*, *Citrus*, pomegranate, quince, &c. Anyone wishing to find this species in Jamaica may look on the leaves of the large *Ficus* in the yard of the Jamaica Institute.

Destructiveness.—Not at all a serious pest, as observed in the West Indies. This harmlessness arises from the fact that it usually occurs singly on the leaves, never in very great numbers and never gregariously.

Enemies—It suffers from an undetermined parasite in Jamaica.

Pink Variety.—Mr. H. A. Morgan of Louisiana has figured a variety tinged with pink (Bull. La. Exp. Sta., 1893); and on oleander at Cavaliers, Kingston, I found a pink specimen. This latter appears to agree quite sufficiently with the *Ceroplastes Myricæ* from the Cape of Good Hope, a species which was described by Linné, but is not known to modern Entomologists. The original *C. myricæ* was on *myrica quercifolia* and until it is rediscovered on that plant at the Cape we cannot be positive as to its identity. Of course, if the pink form of the Florida wax-scale is the true *myricæ*, as surmised, the Linnean name will have to be used for the species.

(27.) *Ceroplastes cirripediformis*, Comst. (The Barnacle Wax-Scale.)

Diagnosis.—Larger than the last, and higher—that is, more convex. The wax is distinctly divided into plates.

Distribution.—Like the last, originally described from Florida in 1881. In the West Indies it is fairly common in Kingston, Jamaica, and has been found by Mr. Barber in Antigua.

Food-plants.—Soushumber, quince, orange, *Eupatorium*, *Eranthemum*, lignum-vitæ. Found on the stems and twigs, whereas the last species occurs on the leaves.

On Feb. 1, 1893, I found *Ceroplastes cirripediformis* (one adult and one young), *Ceroplastes florridensis* (three or four), and *Lecanium oleæ* (one) all on the same lignum-vitæ tree in Miss Long's garden in Kingston.

Destructiveness.—Not a serious pest as so far observed, but is a more dangerous species than the last, should it become very numerous.

(28.) *Ceroplastes plumbaginis*, Ckll. (The Plumbago Wax-Scale).

Diagnosis.—Extemely like the last, but somewhat higher, the breadth and height being the same (3 mm.), the length slightly greater (4 mm.). Eggs pink; larva yellowish, oval. It is possible that this species is not distint from the last, except as a variety.

Distribution.—Only known from Antigua, where it was discovered by Mr. Barber.

Food-plants.—Found on *Plumbago.*

Destructivensss.—To judge from the twigs sent by Mr. Barber, I should say it must be rather troublesome.

Enemies.—A small beetle, *Scymnus ochroderus* var. *cyanipennis*, was sent with the original specimens. It is without doubt predatory on the scale, or its eggs after the manner of its kind.

(29.) *Ceroplastes jamaicensis*, White. (The Lance-Wood Wax-Scale).

This was found by Gosse on the trunk of a lance-wood tree at Basin Spring, Jamaica. It is said to be yellowish-green, with distinct plates after the manner of *cirripediformis*. As in the case of *C. myricæ*, the description will not enable it to be certainly identified, unless specimens are brought from the same place, taken from the same kind of tree. Should it prove to be the same as *cirripediformis*, White's name will have to be used, as it was published in 1846.

(30.) *Ceroplastes depressus*, Ckll. (The broad Wax-Scale.)

Diagnosis.—Much like *cirripediformis*, but flatter, longer and circular or rearly so in outline.

Distribution.—Known only from Kingston, Jamaica, where it was found by Mrs. Swainson.

Food-plants.—It lives, in company with *Icerya rosæ*, under the bark of lignum-vitæ. Its flattened shape is adapted to its environment.

Destructiveness.—Not known to do any perceptible harm.

Enemies.—It is attacked by a parasite, *Eucomys albicoxa*, Ashm., notwithstanding its sheltered position.

(31.) *Ceroplastes denudatus.*, Ckll. (The denuded Wax-Scale.)

Diagnosis.—In its earlier stages, it is covered with wax, which is divided into plates; but it finally loses the waxy covering, the result being that old scales look extremely like *Lecanium hemisphæricum.* A naturalist unacquainted with the earlier stages, would be almost sure to regard the insect as a *Lecanium.*

Distribution.—Discovered by Mr. Barber in Antigua. Since reported from Demerara.

Food-plants.—On Sour Sop in Antigua. Mr. Maskell wrote me that he thought the Demerara specimens he had received through Mr. Douglas were on *Croton.*

Destructiveness.—From its gregarious habit, clustering on the twigs like the *Lecanium* it imitates, it must surely be a very troublseome species..

Enemies.—In Antigua it suffers greatly from the attacks of a predaceous lepidopterous larva.

(32.) *Ceroplastes ceriferus*, Anders. (The Indian Wax Scale.)

Diagnosis.—A large species, with very thick wax, not divided into plates. The wax of adjacent specimens often runs together. If the wax is removed, the scale is seen to present at one end a long horn or spine.

Distribution.—Described in the last century from India; now known also from Mexico, Antigua and Australia. The Antigua specimens, found by Mr. Barber, were referred to the *C. cassiæ* of Chavannes, which was first described from Brazil in 1848. So far as can be judged from present information, it seems that this identification was correct, *cassiæ* being a synonym of *ceriferus.*

Food-plants.—*Bursera gummifera* in Antigua; elsewhere on *Melaleuca hypericifolia, Myrica cerifera, Celastrus ceriferus, Malvaviscus arboreus, M. acerifolius, Terminalia arjuna*, &c.

Destructiveness—From its large size, gregarious habit, and various food-plants, it is not unlikely to prove troublesome.

Utility.—This insect produces the Indian White Wax of commerce. In Spon's Encyclopædia, Vol. II. (1882) p. 2,045 we read that "though an article of undoubted value, it would perhaps scarcely repay expenditure of European time and capital; but the natives might surely render its cultivation a very profitable undertaking."

(33.) *Ceroplastes albolineatus*, Ckll. (The thick Wax Scale.)

Diagnosis.—Not so large as the last, but resembling it in its thick coating of wax; the wax in fact, is as thick as the breadth of the insect it encloses. When the wax is removed, it is seen that the horn at one end is quite rudimentary, whereas in *ceriferus* it is very large.

Distribution.—Only known from Kingston, Jamaica.

Food-plants.—On some ornamental plant, the leaves of which are green above and pinkish-purple below. I did not find the scale in Jamaica, and the only specimens I have seen were forwarded to me by Professor Townsend. I suppose it not unlikely that the insect was introduced into Jamaica, although not at present known fron anywhere else.

Destructiveness.—Probably quite injurious if occurring in numbers.

(34.) *Ceroplastes utilis*, Ckll (The Grand Turk Wax-scale.)

Diagnosis.—Gregarious on twigs, the wax of the several individuals running together; so that the twig is actually surrounded, as the wick of a candle is, with wax.

Distribution.—Only known from the Island of Grand Turk, discovered by Dr. Strachan.

Food-plants.—On a tree or bush with brownish-grey bark and small entire or slightly crenate leaves with oblique bases. It is very much to be desired that this plant should be identified.

Utility.—I am not aware that any use has ever been made of this insect, but if it is abundant at Grand Turk, it might surely be made a source of wax, for local use if not for export. It produces much more wax than the Indian species.

The following table may assist in the determination of the West Indian wax-scales :—

(A.) Wax so abundant as to surround twig, that of all the individuals running together. . . . . *C. utilis.*

(B.) Wax not so abundant, but persistent to old age.

(*a.*) Wax very thick, not distinctly divided into plates.
i. With a large horn or spine . . . *C. ceriferus.*
ii. Spine rudimentary . . . . . *C. albolineatus.*
(*b.*) Wax not very thick, not distinctly divided into plates, size small *C. floridensis.*
(*c.*) Wax not very thick, distinctly divided into plates.
i. Broad and low, height less than half the breadth. *C. depressus.*
ii. Higher, height more than half the breadth. *C. cirripediformis.* *C. plumbaginis.* ? *C. jamaicensis.*
(C.) Wax not thick, and disappearing in old age . . . *C. denudatus.*

UTILISATION OF BANANAS FOR MEAL, &c.—II.

In the July number of the Bulletin, the subject of Machinery for making Banana Meal was discussed.

Messrs. Hartogh and Asser were anxious to ascertain whether if they paid in Jamaica at the rate of 7d. per 100 lbs. for small bunches, including the stalk, they could get a supply for a factory which they proposed to start in the island.

The Director of Public Gardens communicated with several planters, and the general opinion was that the price mentioned would not pay them to supply their small and unsaleable bunches.

The following letters will show how far the subject is now advanced

Mr. L. E. Asser to Director of Public Gardens.

The Hague, 12 October, 1894.

Dear Sir,

I am very much obliged for the papers you sent me with your letter of 6th inst., and I must give you my warmest thanks for the great number of letters you were kind enough to write to Jamaica, as I saw by the many interesting answers you received.

I read all the papers with the greatest interest and sent them afterwards to Mr. Hartogh.

We think by reading the proceedings of the Committee of which you were the Chairman, that the interest of making a flour is generally valued very high, and that the principal objection was the high price and the failing of the proper machinery necessary for manufacturing the flour on a large scale. We are certain now that our process makes both obtainable. Another point in view is that it is certain that a great deal of unsaleale fruit is found in Jamaica; the only objection is that the price of 7d. per 100 lbs.* we have mentioned seems too low. If it is profitable to give more depends very much on the possibility of finding a market for the flour as food can be sold at the much lower prices we can now attain. If the flour at the rate of $2 per 100 lbs., two or three pence† more per 100 lbs. bananas could be paid, and I think by the answers

*For small bunches including stalk.
†*i. e.* 9d or 10d per 100 lbs.

that in that case the planters will be willing to furnish their small bunches. I also read with pleasure that the price of 7d. might be obtained by our own cultivation, especially with the purpose of having only small bunches and by planting the suckers nearer to each other. By all this we think that Jamaica would be a very good place for beginning such a new industry; that it will be necessary to have our own plantations in order to remain independent, and that there will be much probability that it will be profitable to buy a great deal of 6, 5 and 4 hand bunches from the surrounding plantations, if only the factory can work even without that supply.

Mr. Hartogh could go to Jamaica and see if persons there would agree to invest some money in the business. I think this specially desirable in order to have competent persons in the place itself interested in a matter that can become of great value to this Colony not only, but to all tropical countries.

I am much pleased to make a collection of our different samples and to send them at once to your address in Jamaica.*

Very truly yours,

L. E. Asser.

The Hague, 2nd Nov., 1894.

Dear Sir,

Since I wrote to you last, we received very interesting details about a very large quantity of bananas growing wild in Deli, as you know, one of our Tobacco producing colonies As all circumstances would be favourable there, we think to examine the question by starting a factory in the first place for that country. So it is probable that Mr. Hartogh will go to Deli in some weeks in order to see if the informations we received are quite as available as was said.

It will be well to try to interest Jamaica planters in founding a manufactory of banana flour. It can be safely certified that our process can be managed in a quite industrial way and in very large quantities at a very low cost, so that there might be every possibility of finding a market in America. The drawback pointed out as to the failing of suitable machinery is in my belief totally eliminated by our process, whilst the experience of almost two years has showed that the product is not deteriorated. As you ask me, I send you by the same Mail, as you will take, per parcels post, a series of samples of our different products and still some copies of the notice for the Antwerp Exhibition.

If you will show them to those gentlemen that can take interest in the matter you will highly oblige me and perhaps some of them might take the matter in hand and come to us for the informations they should like and with some propositions for the application of our process that at this moment must be patented in Jamaica.

In every case I would very thankfully receive some indications from yourself of what is thought about the matter in your country. I think as there are many unsaleable bunches an employment of the same must be of great interest as also is sufficiently shown by the papers you were kind enough to communicate to me. Very truly yours,

L. E. Asser.

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* These are placed at the Jamaica Institute for general inspection.

COFFEE PULPERS FOR SETTLERS.

In consequence of representations made to Messrs John Gordon by the Director of Public Gardens, they designed a small Coffee Pulper, the "Jamaica," some time ago, the price of which was quoted at £14.

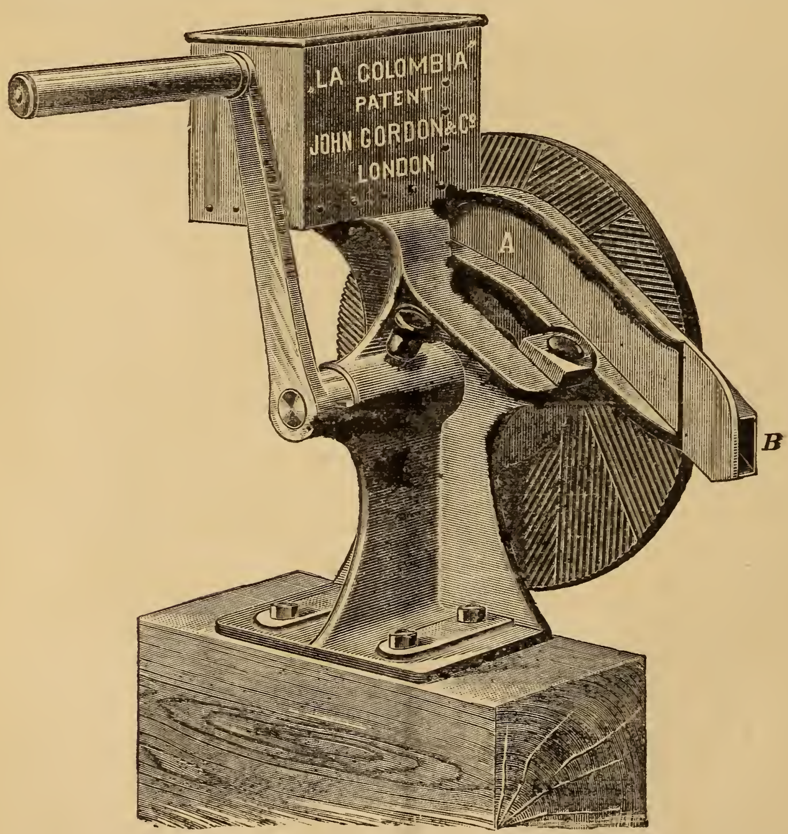
They have now been able to construct two different machines at a much lower price, viz.: £10 each. The Director inspected the models lately in London, and is inclined to think that the "India" would prove a more useful pulper than the "Colombia."

The following information (with electros) has been kindly furnished by the makers:—

Gordon's Patent Coffee Pulping Machines, "The Colombia" and "The India."

Both these Pulpers have been especially designed to meet the requirements of Planters of very small estates and they will be found to be very strong, simple and serviceable machines.

The ripe Coffee Cherries and feed water should be delivered into the water box, which is formed in the hopper, so that the water may float the Coffee over the division into the machine: the supply is regulated by the feed-water.



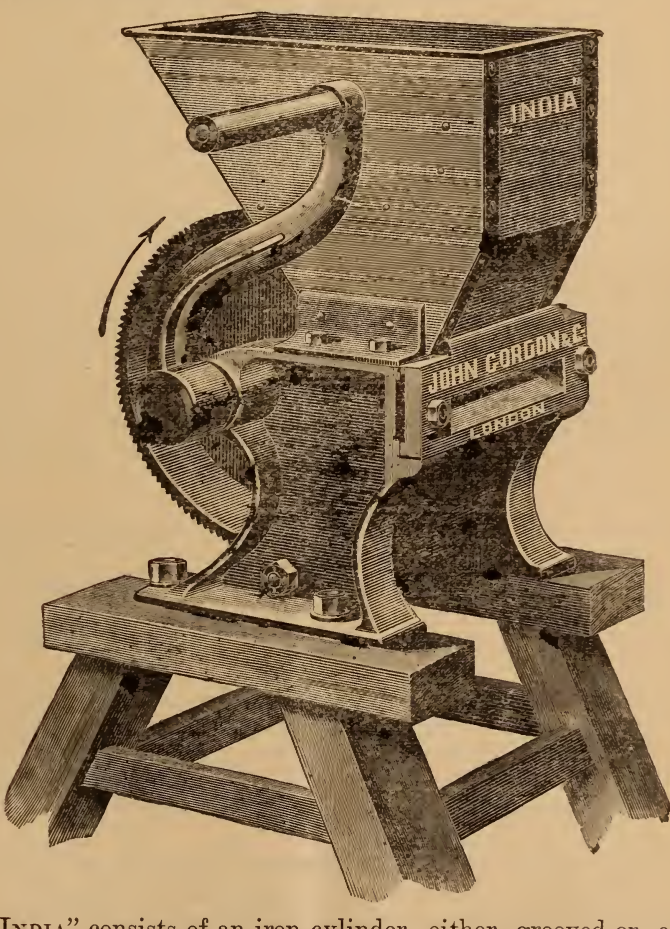
The "Colombia" consists of a grooved disc of hard cast iron, fixed to a shaft which runs in a long bearing mounted on a suitable standard, which also carries the bar A and a hopper.

The bar A has a channel on its side along which the coffee passes while being pulped ; the pulp and skins are dragged down past the bar by the revolving disc, and the cleaned beans are discharged at B. The bar should be kept as close to the disc as possible, but without touching it.

The hopper is fitted with a division which forms a water box for retaining any stones, etc., that may be among the coffee and preventing them from passing to the disc and damaging it.

The bearing is specially long to minimise wear, and is fitted with a brass syphon lubricator, which should be kept supplied with oil.

This machine weighs 82lbs., and when packed in a case, 130lbs. Price, packed for shipment, £10 0s. 0d.



The "India" consists of an iron cylinder, either grooved or covered with a punched copper sheet, mounted on a spindle running in two side frames which carry the hopper and the pulping bar.

The hopper is provided with a division for retaining stones, as in the "Colombia."

On revolving the cylinder, the cherries are drawn down past the top half of the pulping bar, which is fixed at such a distance that the cherries are pulped in passing—the beans being delivered through the open ing in the bar, while the skins and pulp are discharged down the shoot between the side frames.

This machine weighs 76 lbs., and when packed in a case, 116 lbs. Price, packed for shipment, £10.

16th November, 1894.

AGRICULTURAL DEPARTMENT.

DESPATCH FROM THE SECRETARY OF STATE FOR THE COLONIES, TRANSMITTING A COPY OF A LETTER FROM MR. THISELTON-DYER.

Copy.

Downing Street,
3rd November, 1894.

Jamaica.—No. 333.

SIR,

With reference to previous correspondence on the subject of the Botanical Department of Jamaica, and to your recent conference with the Director of Kew Gardens at this Office, I have the honour to transmit to you a copy of a letter from Mr. Thiselton-Dyer, enclosing a summary of the subject discussed with you, a summary of the chief services rendered to the Colony by the Jamaica Botanical Department, and a Memorandum on the constitution and functions of a proposed Board of Agriculture.

I do not doubt that you will give full consideration to the suggestions made in paragraphs 5 and 6 of Mr. Thiselton-Dyer's letter.

I have, etc.,
(Signed.) RIPON.

Governor Sir. H. A. Blake, &c. &c. &c.

Copy.

Royal Gardens, Kew, October 26th, 1894.

SIR,

Referring to the conference which took place yesterday at the Colonial Office with Sir Henry Blake, I have now the honour to transmit to you, for the information of the Secretary of State, the enclosed documents :—

i. A brief summary of the subjects which were under discussion.
ii. A short summary drawn up from official records of the chief services rendered to the Colony by the Botanical Department of Jamaica.
iii. A memorandum on the constitution and functions of a proposed Board of Agriculture.

2. Kew can only bring to a conference of this kind, the fruits of its continuous experience in watching the extension of botanical enterprise in the Colonies and the work of their botanical establishments. How far suggestions made from home can be acted upon in matters of this kind must always be for the consideration of the local Governments, and Kew would not venture to offer an opinion in that respect.

3. I trust, however, I maybe permitted to say how much I was impressed with the intimate knowledge which Sir Henry Blake possessed of everything relating to the material prosperity of the Colony under his charge, and how much I appreciated the courteous consideration

with which he received everything which Mr. Morris and myself thought it would be useful to place before him.

4. I think it only right to add that having had occasion in connection with this conference to pass under review the work of the Jamaica Botanical Department for a long period of years, I am astonished at the magnitude and variety of what has been done. I have no hesitation in saying that whether in general efficiency or organization, the Botanical Department of Jamaica is a long way ahead of any other in the New World.

5. I am disposed to think that this might be brought with advantage into greater prominence. A great deal of the past work of the Department is buried in Annual Reports, which, like other Government publications, are practically inaccessible after the year of issue. I feel convinced that it would be extremely useful and would put the work of the Department in a new light if Mr. Fawcett were instructed by his Government to put together from the records a brief history of what has been done by the Botanical Department, for the introduction and development of the inumerable staples which have been added to the natural resources of the Colony, The sketch prepared by Mr. Morris for the Handbook of Jamaica, 1894, pp. 404-409 might be taken as a basis.

6. It is also evident to me that a popular flora or account of the native plants of the Island with their properties, useful or otherwise, is now much needed. Such a book would not only be interesting and useful to the inhabitants but might be introduced, as is now so general in America, into the higher grade schools. Its preparation, which would be based upon the materials preserved in the Herbarium of the Department, would of course take some time, but Mr. Fawcett is well qualified for the task and would, I am sure, be willing to undertake it, if invited to do so by his Government.

I am, etc.,

(Signed.) W. T. Thiselton-Dyer.

Edward Wingfield, Esq., C.B.,
Colonial Office.

Jamaica.

I. Extent to which the Botanical Department can be advantageously used for Agricultural Development.

1. Experimental Culture.
2. Training at Hope.
3. Apprentices.

II. Sugar Industry.

1. Improved varieties of Canes.
2. Investigation of Disease.
3. Rum Ferments.

III. Encouragement of Peasant Proprietary.

1. Best means of instructing peasants in cultivation.
2. Lectures in rural districts on curing produce.
3. Dissemination of Bulletin and Leaflets.
4. Technical Education in Elementary Schools.
5. School Gardens.

IV. Extension of Fruit Trade.
1. American, Canadian and European Markets.
2. Bananas, varieties, utilization of waste products.
3. Oranges, (Garden at Mid-elevation for experimental culture,) Lemons, Limes, Citrons; Grafting and Budding.
4. Mangoes; East Indian, and grafted sorts.
5. Grapes.

V. Minor Industries.
1. Arabian and Liberian Coffee, Cacao, Rubbers, Fibres, Vanilla, Sarsaparilla, Nutmegs, Ginger.
2. Vegetables, Potatoes, Tomatoes.

VI. Forest Conservation.
Central Ridge of Blue Mountains.

VII. Upkeep of Herbarium.

Services rendered in the Island by the Botanical Department of Jamaica.

1. The preparation of Reports and Papers on Economic Subjects. Maintaining an extensive correspondence with persons interested in the development of new industries. Giving lectures and demonstrations in the cultivation of plants and the curing of products.

2. The investigation of the diseases of plants. Diseases affecting the following have been studied and recommendations made for remedial treatment:—Sugar Canes, Eddoes or Cocoes, Oranges, Cacao or Chocolate, Coco-nut Palms, Coffee, etc.

3. Collecting and preparing articles of Island produce for various International Exhibitions. Naming specimens and affording information respecting their properties and uses in arts and manufactures. Investigating the medicinal plants of Jamaica and obtaining reports upon them.

4. Collecting and arranging specimens of the indigenous plants of the Island. The maintenance of a scientifically arranged Herbarium of Jamaica plants for purposes of reference. Also the maintenance of a named collection of Jamaica plants at the Institute of Jamaica for convenience of reference in Kingston.

5. Turning to purely industrial subjects, the Fruit trade of Jamaica was consistently fostered and encouraged by the Botanical Department for more than 20 years. It is entirely due to this Department that the Island now possesses so extensive and superior a supply of fruits. Orange plants have been distributed from the Gardens at the rate of 10,000 to 50,000 annually; also, Lemons, Citrons, Mandarin Oranges, Tangerine Oranges, Brazil Nuts, Tree Tomato, Grape-vines and Olives. Nearly all the best Pineapples in the Island were introduced by the Department, also East Indian grafted Mangoes, Mangosteen, Durian, &c.

6. It is generally acknowledged that Jamaica is better supplied with ornamental and flowering plants than any other portion of tropical America. It has numerous well kept gardens and local Horticultural Societies. The Department has fostered these at considerable trouble and expense and it has brought their civilizing influence to bear upon all classes of the community.

7. The cultivation of English vegetables carried on in the Blue Mountains is due to the influence of the Cinchona Hill Garden. The

Kingston Market is well supplied with vegetables of all sorts. The English residents in the Island are thus benefitted in health and comfort, and the black people are provided with a remunerative industry. Vegetable growing was started at Cinchona under Sir John Peter Grant twenty-five years ago, and the first large supplies of English vegetables were furnished by this garden. Since that time the black people have taken to growing English vegetables and they supply the market themselves.

8. Other industries started by the Botanical Department are associated with the following plants grown in the Island, viz.:—Liberian Coffee, Nutmegs, Vanilla and fibre-yielding plants. In five years, from 1880 to 1884, inclusive, the Department distributed nearly 5,000 packets of seeds and more than two million economic plants (Report of the Director, 1885, p. 2). The plants alone taken at the nominal sum of threepence each would reach a total value of £25,000. This would be more than the whole cost of the Department during the same period. Hence, if we regard merely the nursery work done by the Botanic Gardens, they have more than paid their way in the plants distributed by them.

9. New varieties of sugar canes (more than 60 in number) have been introduced and cultivated by the Department. Further, their merits have been carefully and exhaustively examined (Report of Director, 1884, pp. 31-34.) These new sorts including the Selangore, Elephant, Lahinia, and others, have been distributed amongst planters and they have been gradually incorporated amongst the older sorts in the Island. The general health and vigour of the Jamaica canes have thus been maintained. At the present time there is less disease amongst these canes than any others in the West Indies.

10. As a special effort, the Department, during the last 15 years, has started and fostered the Cacao industry in the Island. Nearly half a million plants have been distributed. Lectures and demonstrations have been given by the officers and, although only in its infancy, the exports from this industry have now reached a yearly value of about £15,000.

11. Another signal service associated with the Botanic Gardens is set forth below,—

The logwood plant was introduced from Honduras to Jamaica by the Botanist Barham in 1715. In the year 1824, it was laid down as one of the objects of the then Botanical Garden, at Jamaica, that it should devote attention "to the investigation of many unknown native "plants of the Island, which, from the properties of those already "known, it is reasonable to infer would prove highly beneficial in aug- "menting internal resources by supplying various articles either for "food, for medicine, or for manufacture . . . . . . by means of which "great commercial advantages might be obtained, among others, the "various vegetable dyes claim particular attention, as promising a "fruitful field of discovery." As indicating the direct bearing which this one field of enquiry (vegetable dyes among many others) had upon the future of Jamaica, it is interesting to note that while no dye-woods whatever were exported from the island in 1824, a small trade of the value of £1,859 was started in 1833, which since that time has steadily increased, until now it has assumed relatively large dimensions.

The exports of dye-woods in 1892-93 reached a gross value of £356,752, Handbook, 1894, p. 30.

Board of Agriculture.

I. The Board of Agriculture to consist of the Governor as President, and representatives of the chief industries of the Island nominated by the Governor. As ex-officio members, Director of Gardens and Plantations, Surveyor-General (in charge of Crown Lands), Government Chemist, Chairman of Institute of Jamaica, Chairman of Society of Agriculture and Commerce, Chairmen of District Boards, etc.

II. District Boards to be established in correspondence with the Central Board, and Chairmen of District Boards to be members of the Central Board.

III. Central Board to be supported by Annual Grants from the Legislature and to have a paid Secretary. The latter preferably to be a trained Agriculturist, but competent to carry on correspondence and collect information for circulation in the Island bearing upon general Agriculture (especially subjects not already covered by the Botanical Department) such as Horse and Cattle Rearing, Dairy Farming, Sugar Planting interests, Logwood Industry, and the movements in foreign markets bearing upon Jamaica industries.

IV. The position of the Botanical Department to remain distinct as heretofore. The Department to carry on experiments at the Gardens in regard to horticultural matters, raise plants from seeds and cuttings and distribute them throughout the Island. The Officers to continue to afford assistance by correspondence, bulletins, leaflets, lectures and demonstrations in promoting the best methods for cultivating economic plants. Also to train young boys and apprentices and fit them for horticultural pursuits. The Botanical Department would thus take charge of the small industries and of scientific questions relating to plants, while the Secretary of the Agricultural Board, and the other officers employed by it, would take charge of the more general questions affecting Agriculture and especially the animal industries of the Island.

V. Board to publish a Journal dealing with the subjects mentioned in Section III, to be edited by the Secretary. To have power to make grants for the encouragement of experiments in Agriculture, to vote money in support of local shows and to engage the occasional or regular services of a Veterinary Surgeon to investigate vital questions affecting the animal industries of the Island.

VI. Board to use its influence to assist in framing a scheme for teaching Agriculture in Elementary Schools, for training teachers in the principles of Agriculture, for extending a system of instruction in cultivating and preparing produce among the peasantry and to act as a court of reference in all Agricultural matters for the Government.

New Series.] FEBRUARY, 1895. Vol. II. Part II.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Twopence.

A Copy will be supplied free to any Resident in Jamaica, who will send Name Address to the Director of Public Gardens and Plantations, Gordon Town P.O

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JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] FEBRUARY, 1895. Vol. II. Part 2.

UNITED STATES TARIFF.

COMPARATIVE STATEMENT showing the RATES of IMPORT DUTY leviable under the UNITED STATES TARIFF ACTS of 1894 and 1890, on sundry products of the VEGETABLE KINGDOM that are, or may be, exported from JAMAICA. (*See Note*).

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Under Old Tariff.
CHEMICALS, OILS, AND PAINTS.	Dolls. cts.	Dolls. Cts.
Acids :		
Citric – – – –	25 p. c. ad val.	*Lb. 0·10*
Tannic, or tannin – – –	Lb. 0·60	*" 0·75*
Alcoholic perfumery, including Cologne water, and other toilet waters	Gall. 2·00 and 50 p. c. ad val.	*Gall. 2·00 and 50 p. c. ad val.*
Alcoholic compounds not specially provided for	Gall. 2·00 and 50 p. c. ad val.	*Gall. 2·00 and 25 p. c. ad val.*
Drugs; such as barks, beans, berries, balsams, buds, bulbs, bulbous roots, excrescences, fruits, flowers, dried fibres, grains, gums and gum resin, herbs, leaves, lichens, mosses, nuts, roots and stems, spices, vegetables, seeds (aromatic, not garden seeds), seeds of morbid growth, weeds and woods used expressly for dyeing: any of the foregoing which are not edible, but which are advanced in value or condition by refining or grinding, or by other process of manufacture, and not specially provided for	10 p. c. ad val.	*10 p. c. ad val.*

NOTE.—It is to be understood that the classification quoted in this Statement is that of the 1894 tariff, and that where italic type is used the reference is to the old tariff of 1890 only.

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Under Old Tariff.
CHEMICALS, OILS, AND PAINTS—*continued.*	Dolls. Cts.	Dolls. Cts.
Ethers:		
Fruit ethers, oils, or essences	Lb. 2·00	*Lb. 2·50*
Extracts and decoctions of logwood and other dyewoods	10 p. c. ad val.	*Lb. 0·00⅞*
Extracts of barks, such as are commonly used for dyeing or tanning, not specially provided for	10 p. c. ad val.	*" 0·00⅞*
Oils:		
Castor Oil	Gall. 0·35	*Gall. 0·80*
Preparations:		
All medicinal preparations, including proprietary preparations, of which alcohol is a component part, or in the preparation of which alcohol is used, not specially provided for. Provided that no such preparation shall pay less than 25 per centum ad valorem.	Lb. 0·50	*Lb. 0·50*
All medicinal preparations not specially provided for	25 p. c. ad val.	**25 p. c. ad val.*
Products or preparations known as alkaloids, distilled oils, essential oils, expressed oils, rendered oils, and all combinations of the foregoing, and all chemical compounds and salts, not specially provided for	25 p. c. ad val.	*25 p. c. ad val.*
Preparations used as applications to the hair, mouth, teeth, or skin, such as cosmetics, dentifrices, pastes, pomades, powders, and all toilet preparations and articles of perfumery not specially provided for	40 p. c. ad val.	*50 p. c. ad val.*
WOOD, AND MANUFACTURES OF.		
House or cabinet furniture, of wood, wholly or partly finished, manufactures of wood or of which wood is the component material of chief value, not specially provided for	25 p. c. ad val.	*35 p. c. ad val.*
SUGAR.		
So much of the Act entitled "An Act "to reduce revenue, equalise duties, "and for other purposes," approved 1st October, 1890, as provides for and authorises the issue of licenses to produce sugar, and for the payment of a bounty to the producers of sugar from beets, sorghum, or		

Tariff Classification.	Tariff Rates of Duty.	
	Under New Tariff.	Under Old Tariff.
SUGAR—*continued.*	Dolls. Cts.	Dolls. Cts
sugar cane grown in the United States, or from maple sap produced within the United States, is hereby repealed, and hereafter it shall be unlawful to issue any license to produce sugar or to pay any bounty for the production of sugar of any kind under the said Act.		

(The provisions of the Tariff Act of 1890 affecting sugar referred to in the foregoing paragraph were as follow:—

Until the 1st July, 1905, there will be paid from any moneys in the Treasury, not otherwise appropriated, to the producer of Sugar from beets, sorghum, or sugar cane grown within the United States or from maple sap produced within the United States, and testing not less than 90 degrees by polariscope, a bounty of 2 cents per pound; and upon such sugar, testing less than 90 degrees by the polariscope, and not less than 80 degrees, a bounty of 1¾ cents per pound, under such rules and regulations as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may prescribe.

In order to be entitled to the said bounty, the producer of the sugar must have first filed, prior to 1st July of each year, with the Commissioner of Internal Revenue, a notice of the place of production, with a general description of the machinery and methods to be employed by him, together with an estimate of the amount of sugar proposed to be produced in the current or next ensuing year, including the number of maple trees to be tapped, and an application for a license to so produce, to be accompanied by a bond in a penalty, and with sureties to be approved by the Commissioner of Internal Revenue, conditioned that he will faithfully observe all rules and regulations that shall be prescribed for such manufacture and production of sugar.

Upon receipt of the aforesaid application and bond the Commissioner of Internal Revenue shall issue to the applicant a license to produce sugar from sorghum, beets, or sugar-cane grown within the United States, or from maple sap produced within the United States, at the place and with the machinery and by the methods described in the application; but said license shall not extend beyond one year of the date thereof.

No bounty shall be paid to any person engaged in refining sugars which have been imported into the Unitad States, or produced in the United States, upon which the bounty herein-before provided for has already been paid or applied for; nor to any person unless he shall have first been licensed as herein-before provided; and only upon sugar produced by such person from sorghum, beets, or sugar-cane grown within the United States, or from maple sap produced within the United States. The Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall from time to time make all needful rules and regulations for the manufacture of said sugar, and, under the direction of the Secretary of the Treasury, exercise supervision and inspection of the manufacture thereof.

And for the payment of these bounties the Secretary of the Treasury is authorised to draw warrants on the Treasurer of the United States for such sums as shall be necessary, which sums shall be certified to him by the Commissioner of Internal Revenue, by whom the bounties shall be disbursed, and no bounty shall be allowed or paid to any person licensed as aforesaid in any one year upon any quantity of sugar less than 500 pounds.

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Tariff Rates of Duty. Under Old Tariff.
SUGAR—*continued.*	Dolls. Cts.	Dolls. Cts.

Any person who shall knowingly refine or aid in the refining of sugar imported into the United States, or upon which the bounty herein provided for has already been paid or applied for, at the place described in the license issued by the Commissioner of Internal Revenue, and any person not entitled to the bounty herein provided for, who shall apply for or receive the same, shall be guilty of a misdemeanour, and upon conviction thereof shall pay a fine not exceeding 5,000 dollars, or be imprisoned for a period not exceeding five years, or both, in the discretion of the court.)

Tariff Classification.	Under New Tariff.	Under Old Tariff.
On all sugars and on all tank bottoms, syrups of cane juice or of beet juice, melada, concentrated melada, concrete and concentrated molasses, there shall be levied, collected, and paid a duty of	40 p. c. ad val.	*Free.*
All sugars above No. 16 Dutch standard in colour, and all sugar which have been discoloured	Lb. 0·00⅛ and 40 p. c. ad val.	*Lb.* *$0.00\frac{5}{10}$
All sugars, tank bottoms, syrups of cane juice or of beet juice, melada, concentrated melada, concrete, or concentrated molasses, which are imported from or are the product of any country which at the time the same are exported therefrom pays directly or indirectly a bounty on the export thereof, shall pay a duty of one-tenth cent per pound in addition to the foregoing rates. (See Note * below as to provision of 1890 Tariff Act regarding imports of bounty fed sugar). *Provided*, That the importer of sugar produced in a foreign country, the Government of which grants such direct or indirect bounties, may be relieved from this additional duty under such regulations as the Secretary of the Treasury may prescribe, in case said importer produces a certificate of said Government, that no indirect bounty has been received upon said sugar in excess of the tax collected upon the beet or cane from which it was produced, and that no direct bounty has been or shall be paid. *Provided further*, That nothing herein contained shall be so construed as to abrogate or in any manner impair or affect the pro-		

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Under Old Tariff.
SUGAR—*continued.*	Dolls. Cts.	Dolls. Cts.
visions of the Treaty of commercial reciprocity concluded between the United States and the King of the Hawaiian Islands on the 30th January, 1875, or the provisions of any Act of Congress heretofore passed for the execution of the same.		

* The Tariff Act of 1890 stipulated that all sugars above No. 16 Dutch standard in colour should pay one-tenth cent. per lb. "in addition to the "rate above provided, when exported from, or the product of any country "when and so long as such country pays, or shall hereafter pay, directly or "indirectly, a bounty on the exportation of any sugar that may be included "in this grade which is greater than is paid on raw sugars of a lower sac- "charine strength; and the Secretary of the Treasury shall prescribe suita- "ble rules and regulations to carry this provision into effect."

Molasses testing above 40 and not above 56 degrees, polariscope	Gall. 0·02	*Free*
Ditto, if testing above 56 degrees, polariscope	" 0·04	
Sugar candy and all confectionery, made wholly or in part of sugar, and on sugars after being refined, when tinctured, coloured, or in any way adulterated	35 p. c. ad val.	—
Sugar candy and confectionery valued at 12 cents or less per pound, and sugars tinctured, &c., as above	—	*Lb.* *0·05*
All other confectionery not specially provided for	—	*50 p. c. ad val.*
Glucose or grape sugar – –	15 p. c. ad val.	*Lb.* *0·00¾*
TOBACCO AND MANUFACTURES OF.		
Wrapper tobacco, unstemmed, imported in any bale, box, package, or in bulk	Lb. 1·50	*Lb.* *2·00*
Ditto, if stemmed – – –	" 2·25	" *2·75*
Filler tobacco, unstemmed, imported in any bale, box package, or in bulk	" 0·35	" *0·35*
Ditto, if stemmed – – –	" 0·50	" *0.50*
Note.—The term wrapper tobacco shall be taken to mean that quality of leaf tobacco known commercially as wrapper tobacco. The term filler tobacco shall be taken to mean all leaf tobacco unmanufactured, not commercially known as wrapper tobacco. If any leaf tobacco imported in any bale, box, package, or in bulk, shall be the growth of different		

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.		Under Old Tariff.	
TOBACCO, AND MANUFACTURES OF—*continued.*	Dolls.	Cts.	Dolls.	Cts.
countries, or shall differ in quality and value, save as provided in the succeeding provision, then the entire contents of such bale, box, &c., shall be subject to the same duty as wrapper tobacco. If any bale, box, package, or bulk of leaf tobacco of uniform quality contains exceeding 15 per cent. thereof of leaves suitable in colour, fineness of texture, and size for wrappers for cigars, then the entire contents of such bale, box, &c., shall be subject to the same duty as wrapper tobacco. Collectors (of Customs) shall not permit entry to be made, except under regulations to be prescribed by the Secretary of the Treasury, of any leaf tobacco imported in any bale, box, package, or in bulk, unless the invoices covering the same shall specify in detail the character of the leaf tobacco in such bale, box, &c., whether wrapper or filler tobacco, Quebrado or self-working bales, as the case may be. In the examination for classification of any invoice of imported leaf tobacco, at least one bale if less than ten bales, and one bale in every ten bales and more, if deemed necessary by the appraising officer, shall be examined by the appraiser or person authorised by law to make such examination, and for the purpose of fixing the classification and amount of duty chargeable on such invoice of leaf tobacco, the examination of ten hands out of each examined bale thereof shall be taken to be a legal examination.				
Tobacco, manufactured or unmanufactured, of all descriptions, not specially enumerated or provided for	Lb.	0.40	*Lb.*	*0.40*
Snuff and snuff flour, manufactured of tobacco, ground dry or damp, and pickled, scented or otherwise, of all descriptions	"	0.50	"	*0.50*

Tariff of Classification.	Tariff Rates of Duty. Under New Tariff.	Under Old Tariff.
TOBACCO, AND MANUFACTURES OF—*continued.*	Dolls. cts.	Dolls. cts.
Cigars, cigarettes, & cheroots, of all kinds	Lb. 4.00 and 25 p. c. ad val.	*Lb. 4·50 and 25 p. c. ad val.*
Note.—No cigars shall be imported unless the same are packed in boxes of not more than five hundred cigars in each box; and no entry of any imported cigars shall be allowed of less quantity than three thousand in a single package; and all cigars on importation shall be placed in public store or bonded warehouse, and shall not be removed therefrom until the same shall have been inspected and a stamp affixed to each box indicating such inspection, and also a serial number to be recorded in the Custom House.		
AGRICULTURAL PRODUCTS & PROVISIONS.		
Farm and Field Products:—		
Vegetables prepared or preserved Pickles and sauces of all kinds	30 p. c. ad val.	*45 p. c. ad val.*
Honey – – – –	Gall. 0·10	*Gall. 0·20*
Onions – – – –	Bush. 0·20	*Bush. 0·40*
Potatoes – – – –	Bush. of 60 lbs. 0·15	*Bush. of 60 lbs. 0·25*
Seeds:—		
Castor beans or seeds – –	Bush. of 50 lbs. 0·25	*Bush. of 50 lbs. 0·50*
Other oil seeds not specially provided for	Bush. of 56 lbs. 0·20	*Bush. of 56 lbs. 0·30*
Garden seeds, agricultural seeds, and other seeds, not specially provided for	10 p. c. ad val.	*20 p. c. ad val.*
Vegetables in their natural state, not specially provided for	10 p. c. ad val.	*25 p. c. ad val.*
Fruits and nuts:		
Fruits:		
Pineapples – – –	20 p. c. ad val.	*Free*
Grapes – – – –	20 p. c. ad val.	*Barrel of 3 cub. ft. capacity or part thereof 0.60*

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Under Old Tariff.
[AGRICULTURAL PRODUCTS AND PROVISIONS—*continued.*	Dolls. Cts.	*Dolls. Cts.*
Fruits and nuts—*continued.*		
Fruits—*continued.*		
Oranges, lemons and limes :		
In packages of capacity of 1¼ cubic feet or less	Cubic foot of Capacity 0·08	*Pkge. *0·13*
Ditto, exceeding 1¼ cubic feet, and not exceeding 2½ cubic feet in capacity	Cubic foot of Capacity 0·08	*" *0·25*
Ditto, exceeding 2½ cubic feet, and not exceeding 5 cubic feet in capacity	Cubic foot of Capacity 0·08	*" *0·50*
Ditto, exceeding 5 cubic feet, for every additional cubic foot or fractional part thereof	Cubic foot of Capacity 0·08	*" *0.10*
Ditto, in bulk - - -	1,000 *1·50	*1,000 *1·50*
* In addition to the above duties there will be levied on the boxes or barrels containing such oranges, lemons, or limes	30 p. c. ad val.	*30 p. c. ad val.*
Note.—The thin wood, so-called, comprising the sides, tops and bottoms of orange and lemon boxes of the growth and manufacture of the United States, exported as orange and lemon box shooks, may be re-imported in completed form, filled with oranges and lemons, by the payment of duty at one-half the rate imposed on similar boxes of entirely foreign growth and manufacture.		
Plums, prunes, figs, raisins, and other dried grapes, including Zante currants	Lb. 0·01½	—
Plums and prunes - -	—	*Lb. 0·02*
Figs - - -	—	*" 0·02½*
Raisins - - -	—	*" 0·02½*
Zante Currants - -	—	*Free*
Comfits, sweetmeats, and fruits preserved in sugar, syrup, or molasses not specially provided for, and jellies of all kinds	30 p. c. ad val.	*35 p. c. ad val.*
Cocoa-nut or copra, prepared or desiccated	30 p. c. ad val.	*10 p. c. ad. val.*
Fruits preserved in their own juices	20 p. c. ad val.	*30 p. c. ad val.*
Orange peel and lemon peel, preserved or candied	30 p. c. ad val.	*Lb. 0·02*

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Tariff Rates of Duty. Under Old Tariff.
AGRICULTURAL PRODUCTS AND PROVISIONS—*continued.*	Dolls. Cts.	Dolls. Cts.
Fruits and Nuts—*continued.*		
Nuts:		
Peanuts or ground beans, unshelled	20 p. c. ad val.	*Lb.* *0·01*
Ditto, shelled		" *0·01½*
Cocoa-nuts in the shell	20 p. c. ad val.	*Free*
Other nuts, shelled or unshelled, not specially provided for		*Lb.* *0·01½*
Miscellaneous products:		
Cocoa, prepared or manufactured, not specially provided for	Lb. 0·02	" *0·02*
Chocolate, sweetened, flavoured, or other:		
Valued at 35 cents per pound or less	" 0·02	—*
Valued at exceeding 35 cents per pound	35 p. c. ad val.	
Chocolate confectionery		
**Chocolate (other than chocolate confectionery, and chocolate, commercially known as sweetened chocolate)*	—	*Lb.* *0·02*
**Chocolate confectionery valued at 12 cents or less per lb.*	—	" *0.05*
**Ditto valued at over 12 cents per pound*	—	*50 p. c. ad val.*
Cocoa butter or cocoa butterine	Lb. 0·03½	*Lb.* *0·03½*
Starch, including all preparations, from whatever substance produced, commonly used as starch	" 0·01½	" *0·02*
Orchids, lily of the valley, azaleas, palms, and other plants used for forcing under glass, for cut flowers or decorative purposes	10 p. c. ad val.	*Free*
Spices, ground or powdered, not specially provided for	Lb. 0·03	*Lb.* *0·04*
Capsicum or red pepper, unground	" 0·02½	" *0·02½*
Vinegar:	Gall. 0·07½	*Gall.* *0·07½*
Note.—The standard for vinegar shall be taken to be that strength which requires 35 grains of bicarbonate of potash to neutralise 1 ounce troy of vinegar.		
SPIRITS, WINES, AND OTHER BEVERAGES.		
Spirits:		
Brandy and other spirits manufactured or distilled from grain or other materials, and not specially provided for	Proof gall. 1·80	*Proof gall.* *2.50*
Each and every gauge or wine gallon of measurement shall be counted as at least 1 proof gallon; and the standard for determining the proof of brandy		

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Under Old Tariff.
	Dolls. cts.	Dolls. cts.
SPIRITS, WINES AND OTHER BEVERAGES—*continued.*		
Spirits—*continued.*		
and other spirits or liquors of any kind imported shall be the same as that which is defined in the laws relating to internal revenue; but any brandy or other spirituous liquors imported in casks of less capacity than 14 gallons will be forfeited to the United States: Provided that it shall be lawful for the Secretary of the Treasnry, in his discretion, to authorise the ascertainment of the proof of wines, cordials, or other liquors, by distillation or otherwise, in cases where it is impracticable to ascertain such proof by the means prescribed by existing laws or regulations.		
On all compounds or preparations (except as specified in the preceding paragraph of the chemical schedule relating to medicinal preparations, of which alcohol is a component part), of which distilled spirits are a component part of chief value, not specially provided for, there shall be levied a duty not less than that imposed upon distilled spirits.		
Cordials, liquors, arrack, absinthe, kirschwasser, ratafia, and other spirituous beverages or bitters of all kinds containing spirits, and not specially provided for	Proof gall. 1·80	*Proof gall.* *2·50*
No lower rate or amount of duty is to be levied, collected, and paid on brandy, spirits, and other spirituous beverages than that fixed by law for the description of first proof; but it is to be increased in proportion for any greater strength than the strength of first proof, and all imitations of brandy, or spirits, or wines imported by any names whatever will be subject to the highest rate of duty provided for the genuine articles respectively intended to be represented, and in no case less than 1 dollar per gallon (*1 dollar 50 eents in 1890 tariff*).		

Tariff Classification.	Tariff Rates of Duty.			
	Under New Tariff.		Under Old Tariff.	
	Dolls.	Cts.	Dolls.	Cts.
Spirits—*continued.*				
Bay-rum or bay-water, whether distilled or compounded, of first proof, and in proportion for any greater strength than first proof	Gall.	1·00	*Gall.*	*1·50*
Wines:				
Still wines, including ginger wine or ginger cordial and vermouth:—				
In casks or packages other than bottles or jugs:				
If containing 14 per cent. or less of absolute alcohol	"	0·30	"	*0·50*
If containing more than 14 per cent. of absolute alcohol	"	0·50		
In bottles or jugs, per case of 1 dozen bottles or jugs, containing each not more than 1 quart and more than 1 pint, or 24 bottles or jugs, containing each not more than 1 pint	Case	1·60	*Case*	*1.60*
Note.—Any excess beyond these quantities found in such bottles or jugs will be subject to a duty of 5 cents per pint or fractional part thereof; but no separate or additional duty will be assessed on the bottles or jugs. Any wines, ginger-cordials, or vermouth imported containing more than 24 per cent. of alcohol will be classed as spirits and pay duty accordingly.				
No constructive or other allowance for breakage, leakage, on wines, liquors, cordials, or distilled spirits will be made.				
Wines, cordials, brandy and other spirituous liquors imported in bottles or jugs shall be packed in packages containing not less than 1 dozen bottles or jugs in each package, or duty shall be paid as if such package contained at least one dozen bottles or jugs.				
The percentage of alcohol in wines and fruit juices shall be determined in such manner as the Secretary of the Treasury shall by regulation prescribe.				
SUNDRIES.				
Miscellaneous manufactures:				
Manufactures of chip, grass, palm-leaf, straw, weeds, or of which these substances or either of them is the component material of chief value, not specially provided for	25 p. c. ad val.		*30 p. c. ad val.*	

Tariff Classification.	Tariff Rates of Duty Under New Tariff.	Tariff Rates of Duty Under Old Tariff.
SUNDRIES—*continued.*	Dolls. Cts.	*Dolls. Cts.*
Miscellaneous manufactures—*continued*:		
Note.—The terms grass and straw in the foregoing paragraph are to be understood to mean those substances in their natural form and structure, and not the separated fibre thereof.		
Sticks for umbrellas, parasols, and sun shades:		
If plain, finished, or unfinished	30 p. c. ad val.	*35 p. c. ad val.*
If carved - - -		*50 p. c. ad val.*
FREE LIST.		
Annatto, and all extracts of - -	Free	*Free*
Arrowroot, raw or unmanufactured -	"	"
Articles in a crude state used in dyeing or tanning, not specially provided for	"	"
Articles the growth, produce, and manufacture of the United States, when returned after having been exported, without having been advanced in value or improved in condition by any process of manufacture or other means; casks, barrels, carboys, bags, and other vessels of American manufacture, exported filled with American products or exported empty and returned filled with foreign products, including shooks when returned as barrels or boxes; also quicksilver flasks or bottles, of either domestic or foreign manufacture, which shall have been actually exported from the United States; but proof of the identity of such articles shall be made, under general regulacions to be prescribed by the Secretaiy of the Treasury, but the exemption of bags from duty shall apply only to such domestic bags as may be imported by the exporter thereof; and if any such articles are subject to internal tax at the time of exportation, such tax shall be proved to have been paid before exportation, and not refunded; Provided that this paragraph shall not apply to any article upon which an allowance of drawback has been made, the re-importation of which is prohibited except upon payment of duties equal to the drawbacks allowed; or to any		

Tariff Classification.	Tariff Rates of Duty. Under New Tariff. Dolls. Cts.	Tariff Rates of Duty. Under Old Tariff. Dolls. Cts.
FREE LIST—*continued.*		
article manufactured in bonded warehouse and exported under any provision of law; and further provided, that when manufactured tobacco which has been exported without payment of internal revenue tax shall be re-imported, it shall be retained in the custody of the Collector of Customs until internal revenue stamps in payment of the legal duties shall be placed thereon.		
Barks, cinchona or other, from which quinine may be extracted	Free	*Free*
All binding twine manufactured in whole or in part from New Zealand hemp, istle or Tampico fibre, sisal grass, or sunn of single ply and measuring not exceeding 600 feet to the lb.	"	*Lb.* *0·00$\frac{7}{10}$*
Cabbages - - - -	"	*Each* *0.03*
Cocculus indicus - - -	"	*Free*
Cocoa, or cacao, crude, leaves and shells of	"	"
Coffee - - - - -	"	"
Coir, and coir yarn - - -	"	"
Cork-wood, or cork-bark, unmanufactured	"	"
Cotton, and cotton waste or flocks -	"	"
Divi-divi - - - -	"	"
Dragon's blood - - - -	"	"
Drugs, such as barks, beans, berries, balsams, buds, bulbs, bulbous roots, excrescences, fruits, flowers, dried fibres, grains, gums and gum-resin, herbs, leaves, lichens, mosses, nuts, roots and stems, spices, vegetables, seeds aromatic, seeds of morbid growth, weeds, and woods used expressly for dyeing; any of the foregoing drugs which are not edible and which have not been advanced in value or condition by refining or grinding, or by other process of manufacture, and not specially provided for	"	"
Fans, common palm-leaf, and palm-leaf unmanufactured	"	"
Fruit-plants, tropical and semi-tropical, for the purpose of propagation or cultivation	"	"
Fruits and nuts:—		
Fruits, green, ripe, or dried, not specially provided for	"	"
Tamarinds - - - -	"	"
Brazil nuts, cream nuts, palm nuts, and palm nut kernels, not otherwise provided for	"	"

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Tariff Rates of Duty. Under Old Tariff.
FREE LIST—*continued.*	Dolls. Cts.	Dolls. Cts.
Gambier	Free	Free
Grasses and fibres :—		
Istle and Tampico fibre	"	"
Manilla	"	"
Sisal grass	"	"
All other textile grasses or fibrous vegetable substances, unmanufactured or undressed, not specially provided for	"	"
India-rubber, crude, and milk of, and old scrap or refuse india-rubber which has been worn out by use and is fit only for re-manufacture	"	"
Indigo	"	"
Ipecac	"	"
Jalap	"	"
Lemon juice, lime juice, and sour orange juice	"	"
Licorice root, unground	"	"
Lime, citrate of	"	"
Molasses testing not above 40 degrees polariscope test, and containing 20 per cent. or less of moisture	"	"
Oils: Bergamot, cajeput, cassia, cinnamon, cedrat, citronella or lemon grass, cotton seed, croton, jasmine or jasimine, juniper, lemon, lime, mace, neroli or orange flower, enfleurage grease, nut oil or oil of nuts not otherwise specially provided for, orange oil, palm and cocoa-nut, sesame or sesamum seed or bean	"	"
Orange and lemon peel, not preserved, candied, or otherwise prepared	"	"
Paper stock, crude, of every description, including all grasses, fibres, rags, waste, shavings, clippings, old paper, rope ends, waste rope, waste bagging, old or refuse gunny bags, or gunny lboth, and poplar or other woods, fit only to be converted into paper	"	"
Plants, trees, shrubs, and vines of all kinds, commonly known as nursery stock, not specially provided for	"	*20 p. c. ad val.*
Sago, crude and sago flour	"	Free
Seeds: Cardamon, cotton, croton, bread or bean, sugar cane for seed, and all flower and grass seeds, bulbs and roots, not edible; all the foregoing not specially provided for	"	"

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Tariff Rates of Duty. Under Old Tariff.
FREE LIST—*continued.*	Dolls. Cts.	Dolls. Cts.
Spices :		
Cassia, cassia vera, and cassia buds, unground	Free	*Free*
Cinnamon, and chips of, unground	"	"
Cloves and clove stems, unground	"	"
Ginger root, unground, and not preserved or candied	"	"
Mace	"	"
Nutmegs	"	"
Pepper, black or white, unground	"	"
Pimento, unground	"	"
Tapioca, cassava or cassady	"	"
Tea and tea plants	"	"
Tobacco stems	"	"
Wood :		
Logs and round manufactured timber, not specially enumerated or provided for	"	"
Firewood, handle bolts, heading bolts, stave bolts, and shingle bolts, hop poles, fence posts, railroad ties, ship timber, and ship planking, not specially provided for	"	"
Timber, hewn and sawed, timber used for spars and in building wharves	"	*10 p. c. ad val.*
Timber, squared or sided	"	*Cub. ft.* *0 00½*
Sawed boards, plank, deals, and other lumber rough or dressed, except boards, plank, deals, and other lumber of cedar, lignum-vitæ, lancewood, ebony, box, granadilla, mahogany, rosewood, satinwood, and all other cabinet woods	"	—
Hubs, for wheels, posts, last blocks, waggon blocks, oar blocks, gun blocks, heading, and all like blocks or sticks rough hewn or sawed only	"	*20 p. c. ad val.*
Wood, unmanufactured	"	*20 p. c. ad val.*
Woods, namely, cedar, lignum-vitæ, lancewood, ebony, box, granadilla, mahogany, rosewood, satinwood, and all forms of cabinet woods, in the log, rough or hewn ; bamboo and rattan, unmanufactured ; briar root, or briar wood, and similar wood unmanufactured, or not further manufactured than cut into blocks suitable for the articles into which they are intended to be converted ; bamboo, reeds, and sticks of partridge, hairwood, pimento, orange, myrtle, and other woods, not specially provided for, in the rough or not fur-	"	*Free*

Tariff Classification.	Tariff Rates of Duty. Under New Tariff.	Under Old Tariff.
Free List, *continued*—	Dolls. Cts.	*Dolls. Cts.*
Woods, *continued*—		
ther manufactured than cut into lengths suitable for sticks for umbrellas, parasols, sunshades, whips, or walking canes, and India malacca joints, not further manufactured than cut into suitable lengths for the manufactures into which they are intended to be converted	Free	*Free*
Cedar: paving posts, railway ties, and telephone and telegraph poles of cedar	—	*20 p. c. ad val.*
Sawed boards, plank, deals, and all forms of sawed cedar, lignum-vitæ, lancewood, ebony, box, granadilla, mahogany, rosewood, satinwood, and all other cabinet woods not further manufactured than sawed	—	*15 p. c. ad val.*
Veneers of wood - - -	—	*20 p. c. ad val.*
Yams - - - - -	Free	*Free*

EUCALYPTUS.

There is a large number of Eucalyptus trees now ready at Hope Gardens for distribution. They will be delivered free at any port or railway station on receipt of 1s. 6d. for packing.

Notes on the several species are appended taken from Von Mueller's works, concerning the climate and their value as timber.

Baron Sir F. Von Mueller, Government Botanist in Melbourne, writes in October last, calling particular attention to the paragraphs, printed below, on the hygienic value of Eucalyptus, in his well-known and magnificent work Eucalyptographia.

In his letter he says, "E. Globulus would of course only thrive on your higher mountains, but the tropical lowland species such as *E. drepanophylla,* often distributed at my private expense in the interest of the Eucalyptus cause, should have a good chance even in your flat country. All seeds sent during later years to you were a personal gift of my own." Planchon, 30 years ago, in the *Revue des Deux Mondes,* called him as regards *E. Globulus* the Prophet, and Mons. Ramel, the Apostle.

An article appeared in the Bulletin for June 1894, on the influence of Eucalyptus plantations on malarial districts, taken from Dr. Laveran's work on *Paludism.* Credit has not been given by Dr. Laveran to Von Mueller for all his labour in this cause, but his is a familiar name wherever Eucalyptus is grown, and is well known here, not only as a generous contributor of seeds, but as the source of the gift made to this Department of "Eucalyptographia" by the Government of Victoria.

"Mons. P. Ramel, Mons. A. Thozet, the writer and many others have early drawn public attention to the importance of these trees for subduing malaria, after incidentally the febrifugal properties of the Eucalypts had been discovered first by Spanish physicians in 1866 and been confirmed soon subsequently by medical men in France and Italy, to whom the opportunities for hygienic researches of this kind much more readily arose than to us here, [*i e.* in Australia] in places where periodically or even continuously malarian fevers were raging, and where these, so soon as Eucalyptus vegetation copiously arose (and this often through the instrumentality of the writer) the disease was suddenly or gradually checked, mostly even without recurrence. The powerful disinfecting action of the oily volatile emanations of the Eucalypts are mainly due to the evolution of ozone and double oxyd of Hydrogen, as shown by experiments of Dr. Andrews and Dr. G. Day. But irrespective of this, the power of also this Eucalypt to absorb moisture from the ground is enormous, and of vast hygienic significance, and stands in proportion to the intensity of the aqueous exhalation, in which latter respect many Eucalypts vastly surpass Elms, Oaks, Poplars and many other trees. The gradually dropping foliage, unlike that of most other trees, acts also deodorizing on the soil. Sir Will. Macarthur alluded likewise early to the healthiness of Eucalyptus-regions. . . .

"It was through His Grace, Dr. J. A. Goold, R. C. Archbishop of Melbourne, that plantations of *E. Globulus* were first established for subduing the miasmatic exhalations of the Pontinian swamps, as mentioned in a letter of this highly distinguished prelate to the author of this work under date of 17th December 1879: 'The Eucalyptus Globulus was first raised in the Campagna from seeds, kindly presented to me by you, on my visit to Rome in 1869, to attend the Vatican General Council. I handed the seeds to the Superior of the Trappist-Monks, who then occupied the monastery and grounds of the Tre Fontane, a most fever-stricken locality. On my next visit to Rome, made a few years later, I had the pleasure to see the good results of your kind and thoughtful presentation in the vigorous growth of many Gum-trees, acting most wholesomely on poisonous air of that part of the Campagna. The religious able clever men, chiefly French, were most grateful for the gracious gift.' Thus through the enlightened circumspectness of the dignified chief of an ancient church, the sanitary improvements on the fever-swamps were initiated with prospects of that permanency, for which plans and works of drainage since the time of Appius Claudius (long before the Christian era) had vainly striven, and in the prosecution of which the overpowering force of nature had baffled the exertions of Julius Cæsar, Trajanus and many of the subsequent ruler of Rome up to recent history." Von Mueller in Eucalyptographia.

E. acmenoides, Schauer, "White Mahogany," Tropics and beyond.

The wood is heavy, strong, durable, of a light colour, and has been found good for palings, rails, flooring-boards, battens and many other purposes of house-carpentry.

E. citriodora, Hook. "Lemon-scented Eucalyptus." Succeeds in Bengal, Lucknow, Zanzibar, and particularly adapted for a tropical jungle climate. Tropics and beyond.

Supplies a useful timber.

E. corymbosa, Smith. "Bloodwood Tree." On dry ridges and hills or in open forest ground, ascending to considerable mountain-elevations. Tropics and beyond.

A dark reddish wood, soft when fresh, but very hard when dry; very durable underground, and therefore extensively used for fence posts rails, railway sleepers, and rough building purposes. Fence posts from this tree showed hardly any decay after 40 years, but it is too much traversed by kino to serve for sawn timber.

E. crebra, F.v.M. "Narrow-leaved Iron Bark Tree." Chiefly on scrubby ridges, and near the sea-shore. Tropics and beyond.

Wood reddish, hard, heavy, elastic and durable; much used in the construction of bridges and for railway sleepers, also for wagons, piles, fence posts. Bearing an enormous strain.

E. microcorys, F.v.M. "Wangee." In forest country or on arid or even sandy hills along the coast side of the ranges, descending to their base. Tropics and beyond.

Wood very durable, also underground; used for naves, felloes and spokes, also for lasting railway cross-ties. Suitable for culture in humid tracts.

E. microtheca, F.v.M. Occupies hilly as well as flat ground and even dry sandy places, widely distributed through the interior of Australia, it is one of the largest trees in the desert tracts; and is suited to country subject to floods. Tropics and beyond.

Wood brown, sometimes very dark, hard, heavy and elastic; it is prettily marked, hence used for cabinet-work, but more particularly for piles, bridges and railway-sleepers.

E. Planchoniana, F.v.M. It grows on arid, somewhat sandy or more particularly rocky ridges near Moreton Bay. Beyond tropics.

Timber sound, heavy, hard and durable, well adapted for sawing, but not easy to split.

E. platyphylla, F.v.M. Available for open, exposed localities. Tropics and beyond.

Timber curly and durable.

E. rostrata, Schlecht. "Red Gum Tree." Throughout nearly the whole of Australia at low elevations; nearly always found on moist ground with a clayey subsoil. It will thrive in ground, periodically inundated for a considerable time, and even in slightly saline places. Tropics and beyond.

The timber is one of the most highly esteemed in all Australia among that of Eucalypts, being heavy, hard, strong, and extremely durable, either above or under ground or in water. For these reasons it is very much prized for fence-posts, piles and railway-sleepers. For the latter purpose it will last at least a dozen years, but if well selected, much longer. Indeed, Mr. Speight reports that sleepers were found quite sound after being 24 years in use. It is also extensively employed by ship-builders for main-stem, stern-post, inner-post, deadwood, floor-timbers, futtocks, transoms, knighthead, hawse-pieces, cant, stern, quarter and fashion-timbers, bottom-planks, breast-hooks and riders, windlass and bow-rails. It should be steamed before it is worked for planking. Also largely used for felloes, buffers and posts and any part of structures, which come in contact with the ground; but not surpassed in endurance for woodbricks in street-paving and for tramways. Next to the Jarrah from West Australia, this is the best Eucalyptus-wood for resisting the attacks of the crustaceous chelura and limnoria, and teredo-mullusk and white ants, and it has the advantage of being considerable stronger, proving equal in many instances to American white oak.

E. saligna, Smith. In rich soil along banks of streams, in woods, also on the outskirts of forests. Beyond tropics.

The wood employed for rails will last a life-time. Is of excellent quality, and largely used for building purposes.

E. siderophloia, Benth. "White Iron-bark Tree." Beyond tropics.

This furnishes one of the strongest and most durable timbers of new South Wales, with great advantage used for railway sleepers and for many building purposes. It is likewise highly appreciated by wheelwrights, especially for spokes, also well adapted for tool handles and various implements. Its extreme hardness renders this wood difficult to work.

E. tereticornis, Smith. "Flooded Gum Tree." Never very far from littoral regions, occupying generally humid flats or growing round swamps and lakes or along water courses, never on saline ground, or salt water streams; becoming stunted when occasionally growing in rocky exposed localities. Tropics and beyond.

Will thrive on undrained ground. The timber is esteemed for the naves and felloes of wheels. For telegraph poles and railway sleepers it is inferior to some of the ironbark trees, lasting a shorter time.

CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY.

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Plants.

From Royal Gardens, Kew.

Anona senegalensis.
Aristolochia Westlandi.
Brownea Crawfordii
Butyrospermum Kirkii.
Buxus Hildebrandtii
Camoensia maxima.
Centrosolenia bullata.
Chickrassia tabularis.
Cinnamomum Reinwardtii.
Copaifera Mopane.
Croton Eleuteria.
" lucidus.
Excœcaria Agallocha.
Ficus religiosa.
Hæmanthus Kalbreyeri.
" Katherinæ.
Hoffmannia refulgens, var robusta.
Labisia Malouiana.
Landolphia Heudelotii.
Macaranga sp., W. Trop. Africa
Pergularia odoratissima.
Piper porphyrophyllum.
" tiliæfolium.
Plumbago rosea superba.
Raphistemma pulchella.
Solanum Wendlandi.
Strophanthus sp. (Lagos.)
Strychnos Nux-vomica.
Vitex trifolia.
Aglaonema costatum.
Alocasia Curtisii.
" Thibaudiana.
Alloplectus Lynchii.
Anthurium Scherzerianum (good va.)
Begonia argenteo-guttata.
" compta.
" conchaefolia.
" Duchartrei.
" erythrophylla
" "Gloire de Sceaux."
" incarnata var: atropurpurea.
" "M. Hardy."
" Kewensis.
" Olbia.
Begonia undulata.
" Warscewiczii.
Bomarea frondea.
" sp. (Quito.)
Campanula Vidalii.
Dermatobotrys Saundersii.
Dichorisandra undata.
Dracæna Draco.
Eurycles sylvestris.
Hæmanthus albiflos.
Hippeastrum reticulatum.
Phrynium variegatum.
Rhodomyrtus tomentosus.
Senecio Galpini.
Tecoma Mackeni.
Uraria crinita.
Crotolaria longirostrata.
Cryptanthus Beuckeri.
Acanthophœnix crinita.
Rhopalostylis sapida.
Chamærops humilis var. chinensis.
" " " elegans.
" " " flexuosa.
" " " macrocarpa.
" " " palmetto.
Calamus ciliaris.
" sp. (Sierra Leone.)
Calathea argyrophylla.
Codiæum "Aigburth Gem."
Dictyosperma fibrosum.
Dracæna Goldieana.
" "Mrs. Bause."
" pendula.
" thaliodes.
Homalomena Wallisi.
Impatiens auricom.
" Hawkeri.
Nephrosperma Van Houtteanum.
Orania macrocladus.
Philodendron Andreanum.
Manettia bicolor.
Pinanga spectabilis.
Pritchardia grandis.
Ptychoraphis augusta.
Siphocampylos Humboldtianus.

Begonia Paul Bruant.
" peltata.
" polyantha.
" Rex, (5 best vars.)
" sanguinea.
" Scharffiana.
" Semperflorens, var. gigantea.

Susum malayanum.
Wrightia tinctoria.
Xanthosoma Lindeni.
Dichopsis Gutta
Paullinia pinnata.
Rhopalostylis Baueri.
Strobilanthes Dyerianus

From Mr. T. L. Mead, Florida.

Cattleya Leopoldi.
Dendrobium Draconis.
" rhodopterygium.
" tortile, roseum.
" veratrifolium.
" Phalænopsis Schrœderianum.
Oncidium Gravesianum.
Sobralia macrantha.
Epidendrum cinnabarinum.

From J. H. Hart, Esq., Trinidad.

Black Pepper.
Cacao, Nicaraguan and Trinidad.

From G. S. Jenman, Esq., Demerara.

Sugar Canes.

From J. B. Beach, Esq., Florida.

Palms.

SEEDS.

From Reasoner Bros., Florida.

Ampelopsis quinquefolia.
Anona glabra.
Calcutta apple–Guava.
Callicarpa americana.
Cinnamomum zeylanicum.
Sesbania punicea.
Echinocactus texensis.
" setispinus.
Ilex Dahoon.
Myrsine floribunda.
Myrtus tomentosus.
Psidium guineense.
Rhus copallina.
Serenoa serrulata.
Vitis Munsoniana.
Zamia integrifolia.
Metia semperflorens.

Seeds.

From Reasoner Bros., Florida, (continued).

Catalpa speciosa.
" Kœmpferi.
Calycanthus floridus.
Duranta Ellissii.
" Plumierii.
Libocedrus decurrens.
Thuja occidentalis.
Panicum excurrens

From Govt. Botanist, Melbourne.

Agrostis stolonifera.
Bambusa arundiniana
" oliveriana.
Clianthus Dampierii.
Dendrocalamus membranaceus.
" Hamiltonii.
" strictus.
Eucalyptus calophylla.
" ficifolia
" megacarpa.
Medicago lupulina.
Vitis hypoglauca.
Atriplex vesicaria

From Botanic Gardens, Trinidad.

Barringtonia acutangula.
Cassia marginata.
Livistona Jenkinsiana.
" chinensis.
Grias cauliflora.
Mantisia cordata.
Ormosia dasycarpa.
Thrinax argentea.
Vitex capitata.

From Botanic Gardens, Dunedin, New Zealand.

Celmisia sp.
Clianthus puniceus.
Cyathodes acerosa.
Pittosporum sp.
" eugenioides.
Parsonsia albiflora.

From Botanic Gardens, Seebpore.

Phœnix paludosa.
Santalum album.

From Botanic Gardens, Bangalore.

Clerodendron squamatum.
Hibiscus panduræformis.

SEEDS.

From Botanic Gardens, Singapore.

Baccaurea minor.
Kumpassia malaccensis.
Sterculia scaphigera.

From Botanic Gardens, Grenada.

Anona squamosa.
Chamædorea sp.
Ptychosperma Alexandræ.
Stevensonia grandifolia.

From Botanic Gardens, Demerara.

Castilloa elastica.

From Mr. F. Holmwood, H. M. Consul Smyrna.

Rhamnus amygdalinus (Persian Berry.)

From Mr. J. C. Harvey, California.

Dissotis princeps.
Umbellularia californica.
Romneya coulterii.

From Dr. E. Franceschi, California.

Furcræa Bedinghausii.

From Mr. W. D. Keppel, Samoa.

Terminalia litoralis.

NOTE.

The Director will be at the JAMAICA INSTITUTE on the morning of the first Friday in every month between the hours of 10 and 1 o'clock for the purpose of giving information to those who may wish to consult him.

New Series.] MARCH, 1895. Vol. II. Part 3.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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JAMAICA.

BULLETIN

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BOTANICAL DEPARTMENT.

New Series.] MARCH, 1895. Vol. II. Part 3.

RUM ANALYSIS.

By Percival H. Greg.

I do not think I am wrong in saying, that the smell of rum, really good rum that is, is one of the most delicious scents that can be imagined. There is in addition something so peculiar and undefinable about it; it is so different from the smell of any other spirit that the more we smell it, the more we are puzzled to say to what its aroma is really due.

Rum like almost every product of commercial importance has been analysed. The most important work in this direction has been done by foreigners, and those chiefly Germans, who have lately been making a great effort, and will probably continue doing so, to produce a spirit from Beetroot juice, molasses, or cane sugar, to vie with Jamaica rum. So far I am glad to note, these efforts have been unsuccessful, but Jamaica should remember the painful lesson taught by the rise and growth of the Beet-sugar industry, and should take a leaf out of their adversary's book, in not disdaining to study science in connection with their manufactures.

Up to now analysis of rum, and this remark applies with equal force to brandy and arrack, has been rather barren of results. One of the first aims of analysis of any commercial product, has always been to determine what are the normal constituents of the article in a state of purity, and in what proportions these constituents are present. Unfortunately the difficulties in the way of this are manifold. No chemical analysis so far can tell us, whether a rum has been adulterated or not. In this respect an opinion emanating from an experienced rum dealer, is worth far more than that of the analyst. This however is not so surprising as might at first sight appear. Rum is not a definite chemical product, we cannot write the formula of rum, and any one of its constituents may vary in the proportion in which it is present, or indeed some may be absent altogether, without our being able to say, that such a change is due to artificial manipulation. The great obstacles in the way of analysis of rum, brandy, and arrack, are the large quantities required for analysis, and the consequent costliness of the operation; the uncertainty as to whether the spirit, when this is forthcoming in sufficient quantity, has not been adulterated either at the place of its production, or in its subsequent passage through other hands; the fact that all spirits undergo chemical changes during storage; and the fact that the particular substances constituting the aroma are present is such infinitesimally small quantities.

The two most important works on the analysis of rum, brandy and arrack are those of Dr. E. K. Windisch and Dr. Eugene Sell, members of the Kaiserlichen Gesundheit's Amt. Both of these works embrace the results of previous knowledge on this subject, and would. I am sure, be full of interest to those distillers who take a scientific interest in the manufacture of rum.

The chief points touched upon in the analysis of rum are the percentage of alcohol, reckoned as ethyl alcohol, colour, taste, smell, reaction, whether acid or neutral; presence of aldehyd and higher alcohols, percentage of free acids and ethers. The presence of methyl alcohol as a normal constituent of genuine rum, is up to the present time a disputed point.

The following tables are taken from Dr. Eugene Sell's book, Ueber Cognak, Rum and Arak (concerning Cogniac, Rum and Arrack) :—

Ethyl Alcohol.

No.	Description.	Alcohol. Vol. per cent.	Weight per cent.
1	Jamaica 1	74.30	67.09
2	„ 2	74.04	66.82
3	„ 3	74.44	67.25
4	„ L F	74.65	67.40
5	„ T E	79.06	72.46
6	„ C	75.89	68.87
7	„ M N F	74.91	67.77
8	„ F A J R	77.04	70.15
9	„ L G C	75.04	67.92
10	Cuba Rum 1	74.74	67 58
11	„ Los Canos	73.73	66.48
12	„ San Antonio	75.29	68.19
13	Demerara	74.72	67.56
14	„ P M	75.21	68.10

On looking at the table, the percentage of Alcohol will be seen to be fairly uniform, the greatest difference discernible being between No. 5 Jamaica at 79.06 vol. per cent, and No. 11 Cuba at 73.73 vol. per cent.

As regards colour, smell, and reaction whether acid or neutral, nine samples from Jamaica had a reddish brown colour, the two from Demerara might be called black-brown, and the three from Cuba bright-yellow. The smell of the various samples was of course different but they all possessed in a high degree the aromatic smell of rum. All the samples reacted acid.

Aldehyd.—In every case the presence of aldehyd was proved by means of the metaphenylenedianine, as well as with fuchsine-sulphurous acid reaction; with aniline and hydrochloric acid the presence of furfurol (furfurane aldehyd) was established.

Free Acids.

The following table shows the figures obtained :—

No.			Formic.	Acetic.	Butyric.	Capric.
			Free Acid. Grms. in 100 cc.			
1	Jamaica	1	0.009	0.072	0.004	0.005
2	„	2	0.007	0.078	0.003	0.004
3	„	3	0.009	0.091	0.004	0.011
4	„	L F	0.007	0.068	0.005	0.008
5	„	T E	0.004	0.047	0.002	0.005
6	„	C	0.003	0.058	0.003	0.004
7	„	M N F	0.008	0.059	0.007	0.005
8	„	F A J R	0.007	0.055	0.009	0.012
9	„	L G C	0.009	0.081	0.007	0.007
10		Cuba Rum 1	0.012	0.105	0.003	0.003
11	„	Los Canos	0.006	0.056	0.011	0.004
12	„	San Antonio	0.003	0.078	trace	0.005
13	Demerara	1	0.012	0.072	0.007	0.004
14	„	P M	0.011	0.065	0.009	0.005

The Ethers.

These are considered to be the chief source of the aroma of rum, and as some of my readers may not know what are the nature of these bodies, and may perhaps think I am speaking of the ether of the B.P. which is used in medicine, it may be well to offer some explanation. The ethers of which I am about to speak are generally known as the "fruit ethers" so called because they possess a pleasant fruity smell. These ethers are formed by the chemical combination of an alcohol, generally ordinary ethyl alcohol with an acid, generally an acid belonging to the order of the carbon compounds. Everybody is familiar with the smell of pine-apple rum. This is due to the presence in the rum of a minute quantity of butyric ether or ethyl-butyrate, which is a combination of butyric acid with ethyl alcohol. Another ether almost invariably found in rum is acetic ether, a combination of acetic acid with ethyl alcohol, which has a smell of fermented apples. The other ethers most commonly met with in rum are formic and capric ethers. The following table shews the figures obtained in the estimation of the ethers in the fourteen samples specified :—

No.	Description.	Formic Ether.	Acetic Ether.	Butyric Ether.	Capric Ether.
1	Jamaica 1	0.017	0.251	0.005	0.012
2	„ 2	0.017	0.310	0.006	0.009
3	„ 3	0.019	0.612	0.008	0 027
4	„ L F	0.015	0.502	0.0023	0.012
5	„ T E	0.022	0.405	0.0062	0.008
6	„ C	0.019	0.428	0.0064	0.009
7	„ M N F	0.014	0.472	0.0073	0 008
8	„ F A G R	0.014	0.426	0.0164	0.0223
9	„ L G C	0.017	0.542	0.011	0.013
10	Cuba Rum 1	0.014	0.511	0.005	0.008
11	„ Los Canos	0.010	0.092	0.0103	0.006
12	„ San Antonio	0.008	0.363	trace	0.005
13	Demerara 1	0.018	0.297	0.006	0·009
14	„ P M	0.023	0.179	0.0063	0·016

These values are in grammes per 100 cc. In order to obtain the weight of ethers present in a gallon of rum, it is only necessary to multiply the fraction of a gramme given by 10x4.5.

Most writers have attributed the aroma of rum to the presence of Butyric ether, indeed Gaber in his book "Die Liqueur Fabrikation" (Liqueur Manufacture) states that it is only necessary to allow cane sugar molasses to ferment in Europe at a temperature of 40° C. a temperature favourable to the production of butyric acid, and therefore a necessary preliminary condition to the formation of butyric ether, in order to produce a spirit, which after sufficient storage cannot be distinguished from a true rum. But if we glance at the tables we notice that acetic ether is present in far greater quantity than butyric ether, in one case the proportion or acetic ether to butyric is over 200 : 1, and we must therefore conclude that it is to the comparatively large amount of the first named ether, that rum owes its characteristic aroma, in as far as ths characteristic aroma is derivable from the presence of ethers. Now in considering these figures from a practical and commercial point of view, we should like to know, what is the influence of the presence of these ethers on the commercial value of the rum : that is, is an increment of ethers present in the sample followed by a corresponding increment in the market price, and *vice-versa?* On this point the figures given in the preceding table can give us no information, as the money values of the rums are not stated; but in Windisch's "Brandy Analysis," I came across some analysis of rum which possess a greater significance for us, inasmuch as the prices of the rums are also given. In following out this idea I selected from a considerable number of examples four expensive and four cheap rums, and then set myself to compare them together with special regard to the quantities of acids and ethers present. In the original work the prices are expressed in German coinage and for the measure of one litre, but in order to make the figures more intelligible to my readers, I have translated them into the corresponding values in English money per gallon.

Free Acids.

Formic Acid.

Expensive Rums. No.	Price. s.	d.	Grms per 100 cc.	Cheap Rums. No.	Price. s.	d.	Grms per 100 cc.
4	9	11	·008	1	4	0	·010
3	9	2	·010	14	3	2	·013
9	8	7	·010	12	3	1	·003
6	7	8	·003	11	2	8	·007
		Total	·031			Total	·033

Acetic Acid.

4	9	11	·077	1	4	0	·082
3	9	2	·103	14	3	2	·074
9	8	7	·092	12	3	1	·089
6	7	8	·066	11	2	8	·064
		Total	·338			Total	·309

Butyric Acid.

4	9	11	·006	1	4	0	·005
3	9	2	·005	14	3	2	·010
9	8	7	·008	12	3	1	trace
6	7	8	·003	11	2	8	·013
			Total ·022				Total ·028

Capric Acid.

4	9	11	·009	1	4	0	·006
3	9	2	·012	14	3	2	·006
9	8	7	·008	12	3	1	·006
6	7	8	·005	11	2	8	·005
			Total ·034				Total ·023

Fruit Ethers.

Expensive Rums. Formic Ether. Cheap Rums.

No.	Price. s.	d	Grms. per 100 cc.	No.	Price. s.	d.	Grms. per 100 cc.
4	9	11	·017	1	4	0	·019
3	9	1	·022	14	3	2	·026
9	8	7	·019	12	3	1	·009
6	7	8	·022	11	2	8	·011
			Total ·080				Total ·065

Acetic Ether.

4	9	11	·571	1	4	0	·285
3	9	2	·695	14	3	2	·204
9	8	7	·617	12	3	1	·415
6	7	8	·489	11	2	8	·105
			Total 2·372				Total 1·009

Butyric Ether.

4	9	11	·003	1	4	0	·006
3	9	2	·009	14	3	2	·007
9	8	7	·013	12	3	1	trace
6	7	8	·007	11	2	8	·012
			Total ·032				Total ·025

Capric Ether

4	9	11	·014	1	4	0	·014
3	9	2	·031	14	3	2	·018
9	8	7	·015	12	3	1	·006
6	7	8	·010	11	2	8	·007
			Total ·070				Total ·045

On examining these tables we learn that the expensive rums as a class are richer than the cheap rums in the total amounts of acetic and capric acids, and poorer in formic and butyric acids while the table of ethers shews us that the expensive rums as a class are richer in the total amounts of all the four fruit ethers. It would be very rash however to jump to the conclusion, that the richer a rum was in fruit ethers the higher would be the price which it would command; a glance at the total amount of fruit ethers present in each of the expensive rums will show that the rum at nine shillings and eleven pence, is poorer in the total quality of fruit ethers than two of the rums at nine and two pence and eight and seven pence respectively. But on the other hand we may observe in the case of cheap rums, that the rum at four shillings is richer in the total quantity of ethers, than the rums at three and two pence, and two and eight pence. In order to explain this apparent contradiction we must remember that the fruit ethers though contributing a great deal, do not contribute *everything* to the aroma, and also that even if they did, that it is quite possible to have too much of a good thing. It has been found for instance, that by the mere addition of fruity ethers to a neutral spirit, it is not possible to imitate exactly the aroma of a genuine rum. If this were so, in all probability, Jamaica rum manufactured in Jamaica, would belong to the glories of the past! A spirit so treated will have a too pronounced and penetrating odour and a sharp burning taste. "The flavour of a true rum on the contrary is always soft and mild, the aroma appears to be to some extent 'covered,' and leaves a kind of oily impression upon the tongue" (Windisch). As regards the other aromatic constituents of rum there remains, the higher alcohols generally grouped together under the name of fusel oil, the organic bases, the essential oil of rum, and a fatty acid of a fruity nature. Fusel oil has generally been identified with amyl alcohol (Iso-butyl carbinol), which possesses poisonous properties, and is of a disagreeable smell, but since higher alcohols do not necessarily mean amyl alcohols, it would be unwise in the present state of our knowledge concerning the higher alcohols of rum to draw any inference as to their influence on the aroma. For the present we merely give the results arrived at in the determination of the higher alcohols, without comment.

		Fusel Oil.	
No.	Description.	Vol. per cent.	Grms in 100 cc.
1	Jamaica 1	0·141	0·114
2	,, 2	0·132	0·107
3	,, 3	0·106	0·086
4	,, LF	0·058	0·047
5	,, TE	0·106	0·086
6	,, C	0·045	0·036
7	,, MNF	0·104	0·084
8	,, FAJR	0·122	0·099
9	,, LGC	0·037	0·030
10	Cuba Rum	0·140	0·114
11	,, Los Canos	0·115	0·093
12	,, San Antonio	0·074	0·060
13	Demerara 1	0·113	0·092
14	,, PM	0·101	0·082

The Organic Bases.

Lindet (Comp. rend. de I'Acad. des Sciences, 106, p. 280) has found that different kinds of rum from Rénunion, Guadeloupe and Martinique, are especially rich in organic bases, which he considers to have been formed in the molasses by certain micro-organisms, previous to fermentation (Sell). The organic bases are evil smelling substances of a poisonous nature, but according to my experiments which I shall communicate at another time, I find they exist in large quantities in the skimmings, and I therefore think that the supposition of Lindet, as to the intervention of micro-organisms in their formation, is not correct.

The Essential Oil of Rum.

In the estimation of the higher alcohols, which is based on the absorbtive capacity of chloroform for these substances, Dr. Windisch observed both in the case of arrack and rum, that after the chloroform which had been shaken up with the rum was evaporated off, a small drop of an unsaponifiable terpene kind of oil remained behind, which possessed in a remarkable degree the aroma of rum or arrack as the case might be. Two years ago, while performing some analyses of rum in Germany, I repeated the chloroform experiment and having found the same substance, I extracted several portions of rum in the requisite manner, added the residue to another portion of the same, and sent this sample along with another sample of the same rum, but untreated, to a rum seller in London. The report of the expert on the two samples was, that the sample to which the addition had been made, of which addition it is needless to say he was ignorant, was worth about threepence a gallon more than the untreated sample of the seme rum.

The Fruity Acid.

Herzfeld in his analysis of rum (Dr. Alex. Herzfeld, Versuche zűr Darstellűng Rum-artiger Produkte). (The Manufacture of Rum-Products) discovered the existence of an acid of a fruity smell, but the materials at hand were not sufficient to enable him to identify it. It is evident that the presence of this acid in greater or less quantity would have a corresponding effect on the quality and therefore on the price of the rum, and I think that I shall presently be able to give some interesting information as to its occurrence.

With this we conclude the emumeration of the bouquet-producing constituents in rum, which up to now have been discovered by analysis. It seems evident that the points to be aimed at by those desirous of improving the quality of their product, are the production of fruit ethers, the oil of rum, and the fruity acid in the resulting spirit.

NOTES ON PLANTS YIELDING RUBBER II.

(*Continued from Bulletin for July, 1894*).

Ceara Rubber.

Source.—Ceara Rubber is obtained from *Manihot Glaziovii*, Muell. Arg: a tree 30 to 50 feet high, with 3 to 7 lobed palmate leaves, and potato-like tubers on their roots.

Locality, Soil and Climate.—Ceara is a town on the sea-coast of Brazil. Mr. Cross went from Ceara 40 miles inland to Pacatuba to obtain plants. The flat country which he passed on his way has, he says, "a very dry arid climate for a considerable part of the year. This is evident from the fact that mandioca [cassava] 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° to 85° F., but inland it is often probably 90°. The localities traversed by me nowhere seemed to be elevated more than 200 feet above the sea." At Pacatuba, "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 grow 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 dense 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 the numerous thickets of shrubs, were not perceived."

Best districts in Jamaica.—Considering the character of the country in which the Ceara 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.

Collecting the Rubber.—Mr. Cross says that the system of collecting is "an operation of a very simple description. On commencing to 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 are 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.

W. B. Lamont (of Ceylon) states:—

"It is only in the dry season, when the tree is leafless, and the growth at a stand, 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, remove the outer bark in vertical slips 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.

Propagation.—The seeds have a hard thick coat, and take a year in germinating unless they are filed along the sides at the end which bears the caruncle. Cuttings with one bud strike easily.

Experiments in Jamaica Botanic Gardens.—Two trees at Hope Gardens were bled. The outer dead brown bark strips off quite easily like birch bark; this was pulled off tree No. 1 from the ground to a height of 6 feet, and slits made with a knife-point into the green bark. The first day only two narrow strips were taken off tree No. 2, but afterwards the whole of the brown bark was removed.

Tree No. 1, yielded $1\frac{1}{2}$ oz. on first day, 1 oz. on second day, and about $\frac{3}{4}$ oz. on fourth day, that is $3\frac{1}{4}$ oz. in 3 days' tapping. Five weeks later it was tapped on one day, yielding $\frac{1}{4}$ oz.

The other tree No. 2, gave only a little over one ounce in 3 days, and $\frac{1}{2}$ oz. five weeks later.

This rubber was sent to the Silvertown Rubber Works, and the following Report was very kindly furnished on the samples. It appears not only that different trees yield varying amounts, but also that the quality varies :—

The India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., to Director of Public Gardens, Jamaica.

19th February, 1894.

" We duly received your letter of the 8th ulto. referring to 2 samples of rubber, marked respectively No. 1 and No. 2.

" We have examined these samples but they are not large enough for us to apply a practical test which would more correctly give the relative values of them.

" From our examination, as far as we are able to judge, the No. 1 sample appears to be considerably superior in quality to the No. 2.

" We should think that the value of No. 1 would be about 2s. 3d. per lb., whereas No. 2 appears to be worth about 1s. $8\frac{1}{2}$d. per lb.

" The price of rubber as you no doubt are aware fluctuates considerably, but as a rule the fluctuation of the various qualities has a fairly constant relationship to price of fine Para which we take as the standard.

" This at present is selling at about 2s. 10d. per lb.

" Please understand that the above mentioned figures can only be approximate, but could you send us a 2lb. sample of each we shall be pleased to give you any further information we have on the subject.

" We shall always be happy to give you the benefit of any information on the subject.

" We may say that the great difficulty in the way of a more extended use of Ceara Rubber lies in the fact that sufficient care is not taken in the collecting with a result that it is next to impossible for anyone to appreciate the value of this quality of rubber it being so full of impurities.

" Could this difficulty be got over and were it possible to collect and coagulate the rubber in the same way as fine Para we think it is quite possible that the value of the rubber so collected would be very near the price we are now paying for fine Para."

Experiments in Ceylon.—This rubber plant appears to have failed in the northern part of India. In the Madras Presidency and in Ceylon, the trees have grown readily enough, even up to 3,000 feet in Ceylon.

The following extracts are taken from the Reports of the Ceylon Botanic Gardens:—

Report for 1890.—" Interest in this plant has of late years very much died away, the yield of rubber having been found too small to satisfy the planter's expectations Thus I made no report on it since 1884. There are, however, considerable plantations on some estates, and now that the trees are older it is found to be profitable to harvest the product. Several shipments have been made to London during the past year, and have realised very good prices. Of course the quantities have not been large: one shipment of 4 cwt. fetched 1s. 8½d. to 1s. 9½d. per lb. net, showing a profit here of about 37 cents (of a rupee) per lb. A planter estimates the cost of collection at about 36 cents per lb. and reckons that trees of eight years old afford at least 3 oz., whilst some ten years old gave half a pound. The collection is done in a somewhat primitive way during the dry season, January to March. After the outer flaky layers of bark have been peeled off, the inner bark is pricked copiously; the tears of rubber which exude are allowed to dry on the tree and are picked off, the resulting product being quite like the " Ceara Scrap" of commerce, but in small tears.

The present opinion of planters seems to be that this kind of rubber pays to harvest, but not to cultivate, and they are prepared to destroy their trees to get the crop. But even on such a system (which has been largely followed here with cinchona) extensive areas of bad soil could surely be profitably occupied with this tree, so grown as to provide a crop annually ready for tapping."

Report for 1893.—" Ceara 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 1½lbs. of dry rubber is at that age obtained from each tree."

Central American or Panama Rubber.

Locality.—The Castilloa trees, *Castilloa elastica*, Cerv., grow in Central America from south of Mexico, southwards to the west coast of South America.

Climate and situation.—They flourish in the hot steaming forests near the equator. The trees will not grow in swampy ground, like the Para Rubber trees, as the roots require perfect drainage. They grow not only in the rich soil of the valleys but also on ridges, and in climates that are dry during one part of the year. The range of the tree is not only extensive from north to south but in elevation also, being found from the sea-coast up to 1,500 feet. The temperature does not fall below 60° and is usually between 75° and 80° F.

Best Districts in Jamaica.—Wherever cocoa grows, castilloa will also grow. In Portland a tree growing on 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 almost as soon as they are ripe Cuttings can also be made. Cross says, that " in planting out young plants, the petiole or leaf-stalk of the lowest or oldest leaf should be buried in the soil. By following this simple rule the plant commences to grow at once, its growth is vigorous, and the trunk symmetrical. But if at the period of planting there is much bare stem above ground, the growth is usually slow, the plant remains "leggy for some time afterwards and never makes a good tree."

Collection and Preparation of Rubber.—Dr. D. Morris, who spent some time in British Honduras, thus describes, in his book on the Colony, the manner of collecting the rubber. "The Castilloa rubber-tree is fit to be tapped for caoutchouc, or the elastic gummy substance produced by its milk, when about seven to ten years old. The milk is obtained at present from trees growing wild, by men called rubber-gatherers, who are well acquainted with all the localities inhabited by the "Toonu." The proper season for tapping the trees is after the autumn rains, which occur some months after the trees have ripened their fruit, and before they put forth buds for the next season. The flow of milk is most copious during the months of October, November, December, and January. The rubber-gatherers commence operations on an untapped tree by reaching with a ladder, or by means of lianes, or tie-ties, the upper portions of its trunk, and scoring the bark the whole length with deep cuts, which extend all round The cuts are sometimes made so as to form a series of spirals all round the tree, at other times they are shaped simply like the letter V, with a small piece of hoop-iron, the blade of a cutlass, or the leaf of a palm placed at the lower angle to form a spout to lead the milk into a receptacle below. A number of trees are treated in this manner, and left to bleed for several hours. At the close of the day the rubber-gatherer collects all the milk, washes it by means of water, and leaves it standing till the next morning. He now procures a quantity of the stem of the moon-plant (Ipomœa Bona-nox), pounds it into a mass, and throws it into a bucket of water After this decoction has been strained, it is added to the rubber-milk, in the proportion of one pint to a gallon, or until, after brisk stirring the whole of the milk is coagulated. The masses of rubber floating on the surface are now strained from the liquid, kneaded into cakes, and placed under heavy weights to get rid of all watery particles. When perfectly drained and dry, the rubber cakes are fit for the market, and exported generally in casks. In Spanish Honduras, and other places in Central America, instead of the juice of the moon-plant, a solution of alum is used to coagulate the milk, but it is said that the injudicious use of alum tends to make the rubber hard and brittle, and to depreciate its value. As, however, it is desirable to place both methods before planters, in order to lead them to carry on experiments, and to prepare the rubber in the most economical and expeditious manner possible, I quote the following, which appeared in the column of the *Colonial Guardian*, published at Belize:—

"The milk of the india rubber-tree is obtained by making longitudinal incisions on the bark. It must then be strained through a fine sieve to free it from minute portions of wood and other impurities, and placed into a cask standing upright. After remaining for a short time in this receptacle, a quantity of rain or spring water, double the quantity of the rubber milk, is to be added thereto, and strained through a piece of brown cotton into another cask. More water—equal in quantity to that already added—should be thrown into the cask, so that there should be four parts of water to one of rubber milk.

"This mixture is to be allowed to remain in the cask twenty-four hours, after which the india rubber floats at the top of the liquid. The water may then be carefully drawn off by removing the spigot from the lower end of the cask, and watching to stop the flow as soon as any indiarubber begins to pass This is easily ascertained by observing, accompanying the blackish water which flows from the cask. small, long, and thin threads of rubber. When all the dirty water shall have been removed from the cask, other four parts of clean water to one of the rubber are to be again added, and after twenty-four hours the same operation is to be gone through with. The remaining liquid should then be placed in small receptacles, with little spigots through which the remaining water is to be drawn off. After this, add to every 100 pounds of the now purified rubber milk a pint bottle full of a solution containing one ounce of alum dissolved in hot water. The new rubber must be well stirred, and as fast as coagulated lumps appear, they are to be carefully removed from the liquid and shaped into a ball, this is to be then put in a press and all the remaining water squeezed out of it. After being removed from the press the rubber is to be placed in the shade, to await its turn for being packed up, to be sent to a foreign market."

Yield.—Dr. Morris states :—"A large tree of Castilloa, say 2 feet in diameter, is said to yield eight gallons of milk when first cut. Each gallon of milk, in the proper season, will make about two pounds of rubber, of the value of $10."

Mr. R. Cross speaks of trees from 160 to 180 feet high, with a diameter of 5 feet, and a yield of 100lbs. of india rubber.

Experiments in the Botanic Gardens here give results which coincide with those obtained in the Gardens in Ceylon, on which Dr. Trimen in Report for 1893 writes as follows :—

"A sample of this rubber sent home on trial, grown on an estate in Matale, was favourably reported on, being valued at 2s. 3d. to 2s. 7d. per pound. The quality of this kind of rubber produced in Ceylon has always been excellent, but my experience hitherto has been that the amount of caoutchouc obtained from the milk is too little to make it a profitable cultivation ; the yield per tree seems very small."

Prospects in Jamaica.—The following letter addressed to the Governor, expresses a favourable opinion of the prospects of planting this tree in Jamaica :

Mr. Pierre Jay to His Excellency the Governor.

38 West Street, New York City,
December 7th, 1893.

Sir,

Some days ago I had the pleasure of seeing Mr. Frederick J. Grant, who had just returned from Bolivia. He spoke of the interest felt at present in Jamaica about the cultivation of the rubber tree, and asked me to write to you anything I might have learned on the subject in my recent trip to the west coast of South America.

Although the report which I am about to give to my friends on the possibilities of rubber culture in Western Bolivia is an extremely adverse one, yet, I feel very sure that in a comparatively few years "rubber hunting" will be almost as much a thing of the past as the Cinchona bark hunting is to-day. In saying this, I must except the Amazonian rubber, for this tree if planted may not be safely bled for thirty years at least, which fact would be an insuperable barrier to capitalists. The tree which is now being bled in the foothills of Western Bolivia and Peru is the Amazonian tree without the waters of the Amazon to inundate it. Consequently it produces only one quarter as much rubber as it does when found in the swamps.

Judging from its price, Para rubber is hardly any more valuable than that of Panama and Central America, although they are worth, say, 75 cents and 50 cents a pound respectively in New York.

From the Para price there must be subtracted (a) export duty, 14 cents; (b) transportation to Manaos or Para, 2 cents; (c) commissions, 1 cent. To the Panama price must be added some 8 or ten cents which is now deducted from its relative value on account of the water and dirt it contains. The Panama tree will produce rubber in six years according to present opinions, and experiments begun four years ago on the Isthmus. The trees have grown well, and only 5 per cent. were lost in transplanting. It appears to me that in view of the future when rubber cultivation has become general, and the present inflated prices have been reduced to a normal scale by systematic gathering and a supply equal to the demand, any one thinking of starting a plantation now should be especially careful to avoid the conditions which now keep Para rubber at its tremendous price, viz., export duty, high transportation charges, scarcity of labour, a multitude of commissions, risks and fevers. The fevers are almost unavoidable as the rubber tree requires a great deal of water, and when it grows in low, mucky, swampy ground it gives the greatest production.

But it will also grow and produce on the hill sides. This is true of all rubber trees. The rubber tree of Panama is different from that of the Amazon and its milk is not susceptible of being cured by smoke. It may be congealed, however, in a few minutes with infinitely less expenditure of time and labour, by the juice of a vine common in tropical forests, or by soap; and I feel sure that it will congeal without the addition of any chemical whatever. So that the gatherer of rubber on a plantation could finish his labour by 9 o'clock in the morning (the milk stops flowing shortly after sunrise) and could work on sugar or a similar product during the rest of the day. Though I do not know much about Jamaica, yet from what Mr. Grant tells me it seems well adapted for rubber cultivation, and planters there would be hampered by none of the unfavourable conditions under which Brazillian rubber is produced. Whether Brazilian smoked rubber is indispensable to manufactures or not, I do not know. If so there are still vast unexploited regions of rubber for them to draw upon. At the same time Panama rubber will always have its value and its consumption, both of which will be relatively increased as the rubber is brought to market in cleaner condition.

From what has been said it must be evident that the tree of Panama is by far the most advantageous one to cultivate. Whether it grows best from seeds or from slips is still a mooted question.

I shall take great pleasure in writing you more fully, if you so desire and in answering any questsons you may wish to put me, in regard to rubber cultivation, as it is a subject in which I am especially interested

Believe me, Sir,

Very respectfully yours,

PIERRE JAY.

GRUBS AT ROOTS OF COCOA TREES.

(Theobroma Cacao).

Two kinds of grubs attacking the roots of Cocoa plants have been received. One kind appears to be the larva of a beetle (probably Scaribæidæ), the other may be one of the "Cut-worms," the larvæ of lepidopterous insects (probably Noctuidæ).

The grubs do an immense deal of damage in the United States, but the Agricultural Department there is of the opinion that there is no practical remedy in the case of field crops.

Persons who notice their cocoa, and especially their young cocoa plants, attacked, would find it advantageous to employ a boy to go through the cocoa systematically using a light hand fork or some tool of the kind, digging about the roots, and removing grubs and weeds. The loosening of the soil, and the weeding would have an excellent effect and probably pay for itself without any reference to the presence of a grub. With sickly trees the boy could at the same time mix in a little manure with the soil as he turns it back. The plantation should be kept clear of weeds which always encourage grubs; and the refuse of weeds, &c., should not be piled up round the stem.

It is a common practice to scrape together the litter of leaves, weeds, and surface soil close round the base of the stem. This custom is altogether wrong. The intention is evidently to supply plant food to the roots from the decay of vegetable matter, but the feeding roots are at some distance from the stem, as a rule, in trees, below the tips of the branches. A heap of litter forms a good nursery for insect pests, and moreover if placed close round the stem, induces decay in the bark. Therefore, if litter cannot be turned in, or used to make a compost in a manure pit, it should be burnt, and the ashes will supply a small amount of plant food.

ORANGES.

From the information given below, kindly supplied by Messrs. Gillespie of New York, it will be seen that there is a considerable import of oranges and lemons from Italy into the United States.

The reasons given for importing from Europe rather than from Jamaica are, first, the quality of the fruit,—carefully selected, no dropped nor thorned fruit; secondly,—well packed according to size in proper boxes; thirdly,—carriage in specially adapted steamers. Another important matter is the curing of the fruit.

The fruit in the island is of excellent quality, but a trade can never be profitable, unless the essential elements of success, as mentioned above, are strictly observed. Information on curing and packing is given in Bulletins for January, 1891, and October. 1893.

Messrs. Gillespie Bros. & Co. to Director of Public Gardens.

No. 4 Stone Street, New York,
Jan. 11th, 1895.

DEAR SIR,

In reply to your letter of the 24th ult., we think that planters in Jamaica should certainly try to cultivate their oranges so that they could arrive here in November, and the early part of December, which is before the Florida oranges come forward. At that time good quality oranges are worth from $5.00 to $6.00 per bbl., but after the Floridas come forward the price rapidly drops to $2.00 to $3.00 per bbl., and continues at this until late in the spring, say March and April, when sometimes, if the Florida crop runs out, and the supply of Messina fruit is small, there is a demand for Jamaicas at from $4.00 to $6.00 per bbl., but since theFlorida crop has assumed the large proportions it has during the past two or three years, the only chance Jamaica fruit has here seems to be early in the winter. Of course at the present time owing to the recent cold snap, which has almost destroyed the Florida crop, we look for a good demand for Jamaicas from now on, but this is decidedly exceptional. Any further information we shall be very pleased at any time to give you.

And remain, Dear Sir,
Yours faithfully,
GILLESPIE BROS. & CO.

Messrs. Gillespie Bros. & Co. to Director of Public Gardens and Plantations.

DEAR SIR, 18th January, 1895.

Your letter of the 1st inst. was duly received and contents have had our careful attention.

Orange and lemons are shipped here in considerable quantities from Italy. At foot you will find a statement of the importations from the various ports from January 1st to December 31st, 1894.

Oranges.—Before the Florida crop assumed the large proportions it has in recent years this country depended in a considerable measure upon Italy for supplies; and as the fruit from there is of desirable quality, comes carefully packed, and is brought in steamers specially adapted to the purpose, there is still a considerable quantity marketed in the latter part of the winter, say from March to May; but this being done profitably depends in a great measure upon whether supplies from Florida fall off, as they usually do, at that time of the year. Jamaica fruit or any other fruit of equal quality would sell as well; but, unfortunately, Jamaica fruit does not come here carefully selected and sized Quality varies very much. The Italian fruit runs even, is quite free from drops and thorned oranges, and comes in boxes 160, 200, 240, and 300, according to grade (size).

Lemons.—The lemons grown in Florida are not of desirable quality. They are large, thick-skinned and perishable; consequently the bulk of what are used in this country comes from Italy. They come in boxes of 240, 300, or 360 each, all even size.

It is our opinion that if Jamaica oranges were cultivated and as carefully packed as Italian, there is no reason why they should not find as good a market. Of course, as the lemons have to come here from Italy, if steamers are short of freight at any time, they no doubt offer a concession for oranges, for which they know there is not much demand.

Importations.	Oranges.	Lemons.
Catania	21,370 boxes	84,200 boxes
Messsina	129,700 „	506,000 „
Palermo	116,900 „	1,161,350 „
Sorrento	103,500 „	72,750 „
Rodi	55,000 „	26,500 „

As mentioned in our last, the failure of the Florida crop this year upsets calculations.

We are, Dear Sir,
Yours faithfully,
GILLESPIE, BROS. & CO.

———

Messrs. Gillispie Bros. & Co. to Director of Public Gardens and Plantations.

DEAR SIR, 1st March, 1895

Referring to your letters of the 11th and 18th January last, we have to advise that by reason of the exceptionally cold weather which has reached Florida this year, the position of our market for oranges is completely changed.

The cold spell at New Year nearly ruined this year's crop; but the second visitation of about three weeks ago was much more severe, freezing temperatures lasting several days, and this has completed the ruin of the present crop; and we learn from the best informed sources, seriously damaged the trees, especially the young ones, which will have to be cut down and their production delayed for several seasons. This means that, at least, next year's Florida crop will be a very small one; and it is not likely, under most favourable circumstances, to assume the proportions of the last few years for several seasons to come.

We therefore look for a good market for Jamaica fruit all next winter, and possibly for several winters to come; and we should certainly advise growers with you to keep this in view. And if the quantity can be increased and the quality improved by artificial means, the outlook should encourage immediate attention to the subject.

As the Florida fruit comes here regularly sized, and the number of oranges printed on the outside of each package, we strongly advise the use of American sizing machines, which will assist in economical handling and ready sale on arrival here.

We do not anticipate, nor do we wish to lead growers to expect, fancy prices, as, while some of the largest dealers in Florida fruit are looking for other sources of supply for next season's consumption, Jamaica is not the *only* place from which supplies can be obtained. As, however, all imported oranges pay duty, Jamaica will not have to meet unfair competition, as has been the case with the large crop of duty-free fruit from Florida.

Good quality of Jamaica fruit is today worth \$4.59 to \$5.50 per bbl. Some choice sized fruit sold yesterday as high as \$6.00 to \$6.62½ per bbl.

We are, Dear Sir,
Yours faithfully,
GILLESPIE BROS. & CO.

Hon. J. P. Clark to Director.

Kendal, Shooter's Hill P.O.

Dear Sir,

In reply to your questions I will say:—

1st. I think thick skinned fruit keep best, but is not liked in New York.

2nd. Green fruit will keep better than ripe, but must be picked a few days before shipment in order to shrink before packed.

3rd. The bearing of the trees depends entirely on rain. The best shower after a drought in January, will bring a bloom; 5th February, is the earliest I have known.

Yours truly,

J. P. Clark.

Messrs. Reasoner Bros. to Director Public Gardens and Plantations.

Florida, January 19, 1895.

Dear Sir,

Thick skinned fruit usually ships better than thin. We have never noticed any difference between green fruit or that which was almost ripe. If dried two or three days in a cool room before packing it keeps better than freshly gathered and packed, allowing softening of skin and pulp, avoiding crushing in putting up. Small packages carry better than large.

Yours truly,

Reasoner Bros.

Mr. John J. Beach to Director Public Gardens and Plantations.

Melbourne, Fla., January 22nd, 1895.

Dear Sir,

Yours of the 3rd received. In reply will say that fully mature fruit ships far better than half ripe fruit. If the skin is sound, thin-skinned are best. Wrap with paper and pack firmly. Cut from tree, don't pull, don't bruise. Let stand in shade 24 hours and pack while cool. Wrapping is very important. The firmer and heavier the fruit for its size the better it will carry.

Yours very truly,

(Sgd.) John J. Beach.

EUCALYPTUS AS FUEL.

The eucalyptus tree promises to become in time almost as useful to California as the bamboo is to Japan and China. During the past twenty years the eucalyptus has been introduced very extensively throughout the central and southern parts of the State. The eucalyptus tree may be put to many important uses. It has the advantage of requiring little or no attention and of growing with astonishing rapidity. In the vast timberless regions of California it has been an important factor in improving the land. The wood brings a good price when sold for fuel and it is generally acknowledged to have, besides, many valuable medicinal qualities. The eucalyptus is also extensively used to form a windbreak about California gardens and orchards. It has been found very profitable to California to raise the eucalyptus tree for fuel. The tree's remarkably rapid growth makes it possible to raise a crop or forest of these trees to a size suitable for cutting every three years. Within a year from the time the seed has been planted the tree often reaches a height of ten feet, and a height of fifty feet in three years. It is customary to cut the tree off about two feet from the ground, at intervals of from three to five years. The trees are then cut into cord wood. During the past year the wood is reported to have brought from $6 to $9 per cord. A fair profit from such a crop is thought to be about $50 to the acre.

It is estimated that a single acre, if left untrimmed for eighteen years, would, at this rate of growth, produce $10,000 worth of wood. In Australia the wood of the eucalyptus tree is coming to be extensively used for manufacturing purposes, and it is probable that in time new and important uses will be found for the wood in California.—*Scientific American.*

CONTRIBUTIONS TO THE DEPARTMENT.

Library.

Bulletin Royal Gardens Kew. No. 95. Novr. 94. [Kew.]
Bulletin Iowa, Experimental Station and other Pamphlets. [Kew.]
Bulletin Bot. Gardens, Trinidad. No. 1, Janry., 1895, [Supt.]
Bulletin U. S. Dept. of Agri. No. 5. [Dept. of Agri.]
Bulletin Field Columbian Museum, Chicago. No. 1, Decr. 1894. [Director.]
Bulletin de L'Herbier Boissier. No. 12, Dec. 1894. [Conservateur.]
Bulletin Kolonial Museum, Holland. [Director.]
Bulletin Torrey Bot. Club. No. 1, Jan., 1895. [Editor.]
Bulletin Kansas State Agri. College. No. 15. Dec., 1890. [Director.]
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Horticultural Review. Jany. 1895. [Editor.]
Revue Agricole. No. 11 & 12. Nov. and Decr., 1894. [Conservateur.]
Planters Monthly, Honolulu. No. 1. Jany. 1895. [Editor.]
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Report Kansas Exp. Station. 1888. [Director.]
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Sup. to Agri. Journal Leeward Islands. Decr. 1894. [Supt.]
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The New Jersey Forester. No. 1. Jany. 1895. [Editor.]
Field and Garden Crops. N. W. Provinces and Oudh. Part 3. [Director.]
Minutes of the Proceedings of the Agri. Socy. of Trinidad. [Secy.]
Appendix to the Catalogue of the Flora of Nebraska & other papers. [H. J. Webber.]

Plants.

From Hon. E. Parsons, Cayman Islands.

Schomburghkia Thomsoniana.

From His Honour Judge Nathan, Trinidad.

40 Orchids—Cattleyas, Oncidiums.
Bifrenarias, Schomburghkias.

Seeds.

From Botanic Gardens, Trinidad.

Cocos amara.

From Botanic Gardens, Calcutta.

Swertia bimaculata.
Swertia nervosa.

From Botanic Gardens, Bangalore.

Solanum indicum.

From Royal Horticultural Society's Gardens, Chiswick

15 varieties of Tomato.

From Dr. F. Franceschi, California.

Cereus Emoryii.
Echinocactus Wizlizenii.
Prosopis dulcis.
Tecoma Smithii.
Yacca angustifolia.

From Mr. H. J. Webber, Florida.

Zamia integrifolia.

NOTE.

The Director will be at the Jamaica Institute on the morning of the first Friday in every month between the hours of 10 and 1 o'clock for the purpose of giving information to those who may wish to consult him.

New Series.] APRIL, 1895. Vol. II. Part 4.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] APRIL, 1895. Vol. II. Part 4.

REPORT OF THE DIRECTOR FOR THE YEAR ENDED 31st MARCH, 1894.

In the Annual Report two years ago the main divisions of the work 'of a Colonial Botanic Garden were stated; the contents of this Report dealing with the year's work may be tabulated as follows:—

HOPE GARDENS.

Extension of Garden.—The work of extension of the Gardens has progressed very favourably this year, some of the worst portions of the land having been taken in hand first and put into proper shape. The commencement was made on the left hand side at the entrance by the Superintendent's House, this piece of very bad land (the very worst on the place) being in so prominent a position, was first put in order. There were two trees on the ground, a Yoke Wood and a very large Tamarind. The piece of road leading from the gate through the Garden being very badly in want of repairs, it was determined to dig out the gravel from the site of what is now a rose bed, repair the road with it and replace the gravel with good soil. To do this 2,500 cartloads of gravel were placed on the road and a corresponding amount of soil put in its place to form the rose bed.

On the opposite side of the road the land was found to be very poor also, although not so bad as the other. This was thoroughly ploughed up, large quantities of old slates and stones removed, and about 200 cartloads of good soil added to bring it up to a proper level. Two beds of various ornamental plants were put out, a walk made from the carriage drive to the old house and a rose bed reaching to the Teak Plantation.

The size of the rose bed from which the gravel was taken is 232 feet by 40 feet. The area of the beds of ornamental plants is 1½ square chains.

The rose bed formed opposite the Teak Plantation is 100 feet by 10 feet. The length of the four feet verge on the front of all the beds is 1,100 feet. The verges consist of Bahama grass, they were made level and are kept constantly mown. At the back of the rose bed is a grass walk 12 feet wide and 262 feet long; there are also grass walks between the beds.

Along the line fence between the gardens and the water-works a hedge of Aralias and Panax of different varieties to the number of 391 has been planted, the object being to cover up the unsightly wire fence; the hedge is continued on the gutter side to the bottom of the nursery to screen the working portion of the nursery in which some untidiness is inevitable.

The portion of the rose garden made last year has been kept in good condition, the Bahama grass verges have proved to be most excellent turf, and the roses have grown exceedingly well. The lime hedge at the top of the old rose garden has been removed altogether, and the old rose garden has been remodelled entirely; several large trees such as Cotton, Trumpet and Sand-box were removed. The small beds and the narrow walks with the verges nine inches wide have been abolished, one single bed has been made with a grass walk on one side 6 feet wide, on another 12 feet wide, on another8 feet wide. The bed in which climbing roses only are planted, is 48 feet wide and 305 feet long, the remaining part being laid down in Bahama grass as there are some large trees which it is not desirable to cut down on account of their rareness.

The walk between the row of Divi-Divi trees has been gravelled; the length of the walk is 396 feet, and the breadth 27 feet., the depth of gravel from 6 to 9 inches. Forty large palms and tree ferns stand on either side making the walk look very cool and pleasant; five garden seats have been placed in it and it is a favourite resort of visitors to the garden.

The rockeries at the bottom planted with ferns last year are in good order.

Nursery.—The Nursery is still in excellent order; 42,981 plants have been sold and granted free to Public Institutions, etc. The stock is about 70,000 ornamental, economic plants, palms, shade trees, etc., all arranged in different sections. At the close of the year 7,000 Eucalyptus were potted up but deaths have reduced them to 5,478.

On the south and south-east sides of the Nursery a hedge of *Aralia Guilfoylei* has been planted consisting of 239 plants; this is a splendid wind-break without which the Nursery would suffer very severely during the dry and windy time of the year.

Pot Plants.—The number of pot plants has not been increased except to supply the places of those sold, but the quality is steadily improving.

The old glass shed kept for raising Begonias, tender seeds, etc., had to be taken down and rebuilt as it had nearly fallen to pieces.

The Orchid house which was formerly situated between the row of *Pithecolobium dulce* and the large Divi-Divi trees had become much too dark in consequence of the rapid growth of these trees and was accordingly taken down and re-erected in a part of the Nursery where no trees overhang it. The plant-stand which was formerly at the side of the glass house was turned round and placed against the row of Pithecolobiums, the old glass shed having been re-erected on the opposite side, this leaves a fine broad walk, between the pot plants under the Divi-Divi and those on the stage by the Pithecolobiums.

Tree Ferns.—These are growing perfectly; six large ones have been planted out on the east side of the Fernery and are doing as well as they would in their native woods. Near the large Spathodea four small tree ferns and a quantity of other ferns have been planted on a piece of land that has hitherto been very unsightly.

Fern House.—All the ferns in the fern house are in perfect condition, the remodelling at the end of last year has been quite successful.

The Tropical African and Madagascar Section.—This piece of land, rough and stony and very uneven, 7 acres in extent, has been cleared of stones, roots, weeds and trees; it has been nicely levelled, planted with Bahama grass, and the following trees have been put out:

In the Madagascar Section—

Ravenala madagascariensis.
Musa coccinea.
Pandanus utilis.
Chrysalidocarpus lutescens.
Dypsis madagascariensis.

In the African Section—

Stevensonia grandifolia.
Elæis guineensis.
Camoensia maxima.
Kigelia pinnata.

and eight undetermined Tropical African plants lately received from Kew, also a plant of Musa sapientum var. rubra received from Kew.

Bananas and Plantains.—A piece of ground alongside the stream of waste water has been planted with various kinds of Bananas and Plantains, the local names are :—

Banana, Martinique.
" China.
" Fig.
Plantain, Mocha.
" Horse.
" Maiden.

It is intended to form a collection of bananas. The bananas have not yet fruited, in fact very little water can be spared from the canes and cacao plants and this year the supply of waste water has been much less than last year.

Mediterranean Section.—In this section three or four chains of land have been levelled and planted with Bahama grass and some plants of *Nerium Oleander* and *Ceratonia siliqua* planted.

Pipes.—One thousand feet of one inch galvanized iron pipes have been laid down chiefly in the rose garden and nursery for the purpose of affording greater facilities for watering and to prevent the use of long lengths of hose.

Economic Plants.—The economic plants along the stream, the list of which was published last year, have not done so well this year, as the supply of waste water from the Water Works was much less than last year.

It is very important that a few well grown cocoa trees, Liberian coffee, etc., should be grown at Hope, so as to be able to show what can be done by irrigation and also to teach the boys of the Industrial School the work of pruning, etc.

Mangoes.—Attention continues to be paid to grafting East Indian mangoes, so that people may be able to plant these instead of growing the common worthless varieties or the unreliable East Indian seedlings.

Budded Oranges.—Of the oranges budded on the lime stock three plants have growths from two to three feet long. A large quantity of other stocks are being prepared for extending the experiments, not only in budding but in grafting oranges.

Seedling Sugar-canes.—The seedling sugar-canes received from Demerara, the list of which was published in the February Bulletin, have thriven well.

Fences.—A length of eighty chains of fence has been thoroughly repaired during the year. The fences round the inner part of the garden are in good repair, but those around the outer part and on the lines, between the gardens and the small settlers require repairs.

Land in Preparation.—Two and a half acres of land in the African and Mediterranean Section have been cleaned, ploughed and harrowed preparatory to putting it into Bahama grass. Hitherto the work of ploughing up the land, levelling, etc., has all been done by pick-axe, rakes and other hand implements, but this year we have purchased two ploughs, a large and small sized one, and a Scotch harrow. By the use of these implements great economy is effected and the work will be more quickly done. The cost of ploughing land with pick-axe is £4 per acre; but with two mules and plough, it costs 12/6 exclusive of cost of mules and plough. The mules have never done such work before and will probably be able to do the work in less time as they get more accustomed to it. Steers would do the work perhaps better, but the mules can be used for any other purpose.

Fourteen chains of land at the top of the nursery have been cleaned of bush, and as a good quantity of Guinea grass was already growing on the land it is proposed to encourage the Guinea Grass to cover the whole by keeping the land free of bush and weeds; it is an awkward corner of land, but something must be done with it, or it will simply be a nursery for weeds from whence the seeds will be continually spreading over the whole of the garden.

Fodder Plants.—The piece of Alfalfa or Lucerne sown on the 3rd September was cut down on the 18th January, 1894, the growths then being about 12 inches high; the quantity of rain which fell during the time was 31.09 inches. Since the cutting down to the end of the financial year it has made growths of about 8 inches high, the quantity of rain which has fallen during this period is 2.62 inches.

A second piece of Alfalfa sown on the 7th of January was cut down on the 22nd of March, some parts had made growths of about 6 inches high but the greater portion only about two inches. The rainfall for this period was 2.63 inches.

The following fodder plants have also been tried:—

Kangaroo grass (*Anthistiria ciliata*)
Johnson grass (*Sorghum halapense*)
Red Top Grass (*Agrostis vulgaris*).

These grasses are placed in their order of merit; the following were also tried but were not successful:—

Common Sainfoin (*Onobrychis sativa*)
Perennial red clover (*Trifolium pratense*)
Smooth stalked meadow grass (*Poa pratense*).

Alfalfa, Guinea grass, Para grass, Kangaroo grass, *Sorghum halapense, Agrostis vulgaris* might all be tried under irrigation. The chief source of trouble in raising fodder grasses from seeds in ground which has for long lain idle is the terrible crop of weeds which spring up in company with the young grasses.

The second patch of Alfalfa was sown in drills 8 inches apart and was infinitely less trouble than the first patch which was sown broadcast.

Industrial Boys.—The boys of the Industrial School at Hope were placed under the supervision of the Gardens in October, 1893. Since that period all boys who are over 12 years of age work the whole day in the gardens with the exception of an hour and a half passed in School, and the time occupied by meals. They work with these exceptions from 6.30 a.m. to 5 p m.

All the boys in the School attend a demonstration by the Superintendent for half an hour each day. The subjects dealt with up to the end of March are as follow:

Practical—

Pruning Cacao, (large trees.)
" " (small trees.)
Sowing seeds of Cocoa.
Potting seedlings of Cocoa.
Pruning Liberian Coffee.

Forking Land.
Manuring Land.
Watering Land.

Theoretical—

Weeding and cleaning Land.

Roots, Stems, Leaves } their work and the relation of one to another in the economy of the tree.

Selection of fruit in relation to progeny.
Propagation by other means than by seed.

In discussing the above subjects the Superintendent particularly endeavours to make the boys use their own powers of observation. The following illustration may serve to show the plan worked on.

The trees of Liberian Coffee in the gardens were treated thus:—

No. 1 lot—Trees were given manure, forked round, pruned and regularly kept watered.

No. 2 lot—Trees were manured, forked around and pruned, but no water.

No. 3 lot—Trees were pruned, forked and watered, but no manure given.

No. 4 lot—Trees were simply pruned.

Two of the elder boys Burke and Mensey are quite competent to sow seeds, pot plants, put out plants into the open ground and attend to them after planting; other of the boys, particularly East, are quick and receptive, but they are not as yet fit to be trusted.

The boys just mentioned are also capable of curing Cocoa. With reference to the results obtained, that is, only three boys being mentioned as having made really good progress, it must be remembered that the boys have had little home training, perhaps very little schooling, that they have not been selected as having a love for agricultural pursuits or as being particularly suited to them, but that they are just taken haphazard and have to be made the best of.

PLANTS DISTRIBUTED—SOLD.

Economic Plants:—			
Sisal Hemp	...	...	10,408
Nutmegs	...	...	6,673
Cocoa	...	...	3,314
Kola	...	...	3,253
Fruit trees	...	...	2,482
Liberian Coffee	...	...	2,360
Cane tops	...	...	1,412
Grapes	...	...	442
Mangoes, E. Indian	...	...	108
Miscellaneous	...	...	181
Trees	...	...	158
			30,791
Ornamental Plants	...	...	12,190

FREE GRANTS

Eucalypti	... ...	1,373
Ornamental Plants and Shade Trees	...	2,721
Number of Economic Plants distributed		32,164
Number of Ornamental Plants distributed		14,911
Total number of plants distributed	...	47,075

Besides these there were sent to King's House Gardens 182 plants, and to Castleton Gardens 125.

The elevation of the Garden is 600 feet above sea-level.

The average annual mean temperature is 77°.4 F., and the average annual rainfall 52.83 inches.

The amount of rain that fell during the year was 62.73 inches.

January and March were the driest months, and July and October the wettest.

The mean temperature was 77°.4 F. The meteorological tables for the different months are given in Appendix VI. Page 94.

CASTLETON GARDENS.

The Gardens have been kept up in good order throughout the year.

Borders.—The borders have been attended to as before, forked, weeded, pruned, supplied, worn out plants removed, and fresh soil put on a large part.

Rosary.—All the Rose beds have had a deep forking and heavy mulching with stable manure, after a while this was forked in along with a treatment of Albert's Horticultural Manure. The roses have since grown well and have flowered profusely. One hundred and six more plants have been planted out.

Palmetum.—Of the Palms mentioned in last year's Report as added to the collection, three species have grown fairly. Seeds of the Palmy-a Palm, *Borassus flabelliformis,* have been received and planted out.

Lawns.—The Lawns received the usual occasional close cutting, and the rank weeds were rooted out.

Ferns.—The Ferns in the several rockeries have grown well. The roof of the fern house has been renewed, new rafters and thatch put on, two new lights were also added and the centre staging altered and painted. All the ferns were repotted and many new ones brought in.

Orchids—All the Orchids flowered during the year, Zygopetalum rostratum was almost continually in flower. They were well manured with liquid manure and several were repotted.

Walks.—All the Walks were maintained and kept in the usual order. A new walk was formed through the Nursery.

Economic Plants.—The cocoa has been attended to, regularly weeded, and pruned by the Superintendent. The soil is poor, but every effort is made to improve it. Several shade trees,—Cola, Breadfruit, and some *Erythrina umbrosa*—were planted for shading them.

The Liberian Coffee Piece has been kept clean, regularly billed, and the trees pruned, the crop was a small one, owing to the heavy crop last year.

Potatoes.—The results were published in the Bulletin.

Notable Trees, Shrubs, Climbers.—Several of these flowered profusely, but *Amherstia nobilis* did not flower as well as in former years. The tree has been lately manured and fresh soil spread over the roots. The largest Mangosteen tree was similarly treated. The younger trees are in a healthy condition and a few fruit was gathered from two trees.

Notable Trees Planted Out.—Two *Garcinia Mangostana* (Mangosteen), four *Zizyphus Chloroxylon* (Cogwood), twelve *Artocarpus incisa* (Bread-fruit), twelve *Cola acuminata* (Kola Nut), one *Brosimum alicastrum* (Breadnut); also plants brought in by the Superintendent, found on the banks of the Ugly River.

Water Lily Tank.—The *Victoria regia* flowered plentifully for several months in the year.

Nursery.—A large number of plants have been propagated, most of which have been sent to Hope. The demand at Hope for Roses, as well as other plants, has increased considerably, for instance, in the year ended 30th September, 1887, 1,056 Roses were sent, in the year ended 31st March last, 5,220.

A number of plants such as Roses, Palms, Dracænas, Ferns, &c. have been grown in Flower pots and arranged in the nursery along the walk. Every attention is also given to the propagation of economic plants.

Seats.—Another table and a seat have been made under the Bamboos by the river in the lower garden.

Buildings.—The Superintendent's house has been painted internally, and one room papered. A new shed for the cart was also put up, and some repairs were done to the Coolie Barracks and Tool Shed.

Pasture.—The pasture was billed out, and a new wire fence made enclosing it. The mules are kept in the stable during the day and fed, providing manure in this way for the garden.

Seeds Sold at the Gardens.—Nutmegs	...	1,366	
Liberian Coffee	...	32	qts.
Cola	...	100	
Cocoa Pods	...	39	
Misc. Seeds	...	5	pkts.
Mace	...	2	lbs.
Plants Sent to Hope ...	...	15,070	

5,000 Cocoa pods were purchased and sent to Hope Industrial School.

Seeds Received.—Amongst the various seeds from Kew were two packets of Gambier (Uncaria Gambier.) These were carefully sown but they failed to germinate.

All the plants mentioned in the report last year as received from Kew, have grown fairly well with the exception of *Zingiber Zerumbet* which died.

Visitors.—738 visitors signed the visitors' book; this number represents about two-thirds of the whole number of visitors, which was 1,110.

PLANTS SOLD AT CASTLETON.

Economic Plants.—Nutmegs	...	...	464
Cola	...	...	226
Liberian Coffee	...	...	142
Clove	...	...	67
Fruit Trees	...	...	53
Trees	...	...	36
Miscellaneous	...	...	147
Total		...	1,135
Total number of Economic Plants		...	1,135
Total number of Ornamental Plants		...	3,406
Total number of Plants sold		...	4,541

The elevation of the garden is 580 feet above sea-level.

The average annual mean temperature is 76·2° F., and the average annual rainfall 110.01 inches.

The amount of rain that fell during the year was 153.39 inches. January and March were the driest months, and June and August the wettest.

The mean temperature was 74·2° F.

The Meteorological tables for the different months are given in Appendix VI. Page 93.

HILL GARDEN AND CINCHONA PLANTATION.

Roads.—As usual the main roads, about 6 miles in length, through the Cinchona Plantations were cleaned and kept in order.

Fences.—Repairs as required were effected, and the fences kept in good order.

Forest Trees.—Several of the plantations of conifers (Pinus, Cupressus, etc.) had grown so thickly that the trees were smothering each other. To remedy this the plantations were carefully thinned by cutting down and removing about 4,000 trees. This opened up the plantations a good deal, but it will be necessary to go through them again in another year, and by thinning and pruning give more room to the trees that are allowed to remain. In view of the important question of reforesting again being taken up, as it must be sooner or later, the trees at Cinchona will be of the greatest value, in enabling whoever may be responsible for carrying out the work to determine which kinds are suitable for planting in poor soil at high elevations.

In connection with this work Cinchona would become a most valuable station for propagating and distributing trees from temperate climates, such as Pinus, Cupressus, Eucalypti, Acacias, etc , etc., also such native trees as Cedar, Juniper, Yacca, Prune, Naseberry-bully, the Sweetwoods.

Six fair sized trees of *Eucalyptus viminalis,* and *E. loxiphleba* were cut down and the trunks sawn into planks during the year, The planks have been used for rough out-door work such as bridging drains across walks, to test their durability.

Garden.—The usual work of manuring, forking beds and borders, cutting grass, propagating and potting plants, watering, weeding, etc., were carried on during the year.

Ferns in pots are not altogether a success, and this may be attributed to the rapid evaporation which takes place through the pores of the clay pots during dry days and nights. At such times the temperature of the pots and their contents is lowered many degrees below that of the surrounding atmosphere. To check this excessive evaporation the plan has been adopted of packing the spaces between the pots on the plant stages with fibrous peat. A small rockery has been built in one end of the Fern house, and planted with rare ferns that were dwindling away in pots, and they have made already astonishing growth.

Drain Pipes.—In last Report mention was made that drain pipes would be laid at intervals across the walks to intercept and carry off surface water during heavy rains. These pipes were laid during the year and answer the purpose admirably.

Experimental Garden.—Fodder plants: Experiments have been continued with these plants, the most promising grasses so far are Kentucky blue grass (*Poa pratensis*), Texas blue grass (*Poa arachnifera*), Red top grass (*Agrostis vulgaris*) and the Himalayan grass (*Pennisetum triflorum*) ; and of clovers *Trifolium pratense perenne* and *T. incarnatum.* A small patch of Alfalfa was cut in August and the yield was satisfactory.

An addition has been made to our list of Fodder plants by the introduction of a few stems of *Polygonum sachalinense,* a plant that is attracting a good deal of attention in Europe. The stems started freely into growth soon after they were received, but they were quickly discovered, and promptly cut down by the voracious grubs that infest the land. The roots were removed to another site for safety : this, of course, checked their growth, but they are again pushing buds. A short account of this valuable plant is given in Bulletin for February 1894.

Potatoes.—Experiments are also being continued with these, and 12 varieties have been planted.

Iris florentina and *Iris germanica.*—A supply of seed of each of these has been imported from Italy and sown, and the seedlings are now about 2 inches high. The dried rhizomes of these plants form the "Orris root" of commerce, so largely used in the preparation of toilet powders, (Violet powder), perfumery, and to some extent medicinally. As many members of the Iris family grow luxuriantly in the hills of Jamaica, it is hoped that *I. florentina* and *I. germanica* will also find a congenial home, and it is quite possible that in time they will be numbered amongst the plants producing the so-called "minor products."

Strobilanthes flaccidifolius, Nees.—The Assam indigo plant. A specimen of this valuable dye-plant was received from Kew a few years ago, but until recently it has been grown simply as an ornamental plant. Now that a Chemical Dye Factory is being established in our midst, means have been taken to propagate the plant, and our first batch of nearly 100 rooted cuttings has been potted, and another lot put in the propagating bed.

In Watt's Dictionary of the Economic Products of India it is stated that "the plant grows freely on the plains of Manipur in a climate not very different from that of many parts of Bengal, Behar, or the North-West Provinces, and might be extensively cultivated in Assam. It does not require the flooding which is necessary for the early growth of the Bengal indigo plant, and is therefore not exposed to the danger of having its colour extracted during an exceptionally rainy season. In fact in many respects, it possesses the properties eminently suited for a profitable indigo crop, and in China at least the dye is pronounced finer than that obtained from any other plant. It is propagated freely by cuttings, yields prunings twice or three times a year, and is perennial."

The plant grows well at Cinchona and will possibly thrive in most parts of Jamaica.

This is another plant that will possibly be included in the "minor products" list before long.

Chiretta (*Swertia Chirata*, Ham.)—Seeds of this were obtained from Mr. W. Gollan, Superintendent of the Government Botanic Gardens, Saharanpur, N.W.P., India. The following short account of the plant and its uses is taken from Watt's Dictionary. "A small, erect, herbaceous plant 2 to 5 feet in height, met with in the temperate Himalaya at altitudes 4,000 and 10,000 feet from Kashmir to Bhutan, and in the Khasia mountains between 4,000 and 5,000 feet. The drug obtained from the dried plant has long been held in high esteem by the natives of India. By Hindu medical writers it is much esteemed on account of its tonic, anthelmintic, and febrifuge properties, and it is prescribed in fevers of all sorts in a variety of forms, and in combination with other medicines of its class. By European practitioners in India it is very frequently prescribed in place of gentian, and was described by Fleming as possessing all the stomachic, tonic, febrifuge, and anti-diarrhœtic virtues which are ascribed to that drug, and in a greater degree than they are generally found in it in the state in which it comes to us from Europe."

Grafting Oranges.—In December and January last Mr. Harris proceeded to three places at David's Hill near Cinchona for the purpose of inarching oranges, selecting trees that are known to produce early crops of good fruit. On January 20th and 27th notice having been given by placards, a small number of people turned out when practical demonstrations were given, and the advantages to be gained by producing earlier crops of oranges were fully explained to them. The branches inarched have not yet been severed from the trees, but when they are removed they will be planted out in favourable localities for propagating purposes. When speaking to the people about oranges Mr. Harris took the opportunity of urging them to endeavour to produce a better class of vegetables than those now grown by them They grow potatoes, peas, turnips, carrots, cabbages, beet-root, etc., but all of inferior kinds, whereas if they paid a trifle more for seeds of improved varieties of such things, they would have no difficulty in producing really good vegetables that would find ready sale. This is a matter in which they need a little guidance and advice, and they appear willing to be guided and advised.

Assam Rubber.—There are three trees of this rubber (*Ficus elastica*) at Pleasant Hill, near Cinchona, and through the kindness of the proprietors, Messrs. Balguy and Turner, experiments have been made in collecting milk from the trees, and from this a small sample of rubber has been obtained. The trees are apparently of different ages, but all are probably under 20 years. Incisions were made in the bark of the trunks, branches, and a large root, but nearly the whole of the milk secured was obtained from the trunk of the oldest tree.

When any portion of the bark is injured the milk appears immediately, but in the case of the younger trees the flow ceases quickly, and a fresh wound has to be made, and in the older trees also the milk ceases to flow a couple of minutes after the bark has been cut.

Methods adopted in collecting :—A number of small tins were provided, and after making a perpendicular cut in the bark, with one or several slanting cuts leading to this from each side, a tin was inserted in the bark below the central incision, as we hoped the flow of milk would be copious, but in this we were disappointed, as already mentioned in the case of the younger trees, the flow ceased quickly, the milk merely filling up the cuts made by the knife, but in the older trees by keeping the cuts clean and not allowing the milk time to coagulate, the period of exudation was somewhat prolonged, but in neither case was it sufficient to cause the milk to flow into the tins and it had to be scraped off with the blade of a knife. This, of course, is a tedious process, and the amount of rubber obtained would not cover the cost of labour.

The milk glands were found to be chiefly at ⅛ to ¼ of an inch below the surface of the bark.

Preparation of the Rubber.—The following method was adopted in the preparation of the rubber: The milk collected was kept in the tins till the following day, when it was found to have become somewhat glutinous, the water contained in it having partly evaporated during the previous night. To hasten this process some boiling water was poured over it; the milk mixed readily with the boiling water and thus was easily obtained from the tins; then a portion of the mixture was poured into saucers and these were put on the top of a heated cooking stove, and the mixture kept stirred, when the water soon evaporated and the milk coagulated, and when it was of the consistency of putty used for glazing, was removed from the saucers and allowed to cool and harden.

Plants distributed.—The number of plants sold during the year amounted to 992; and of Tree Tomato fruits 457 dozens, weighing 782 lbs.

The numbers and quantities are as follows :—

SOLD.		
Economic plants (including Fruit)	...	36
Ornamental ...	...	956
FREE GRANTS.		
Economic—		
Eucalypti ...	...	359
Strawberries	...	91
Blue Mountain Coffee	...	1,000
Miscellaneous	...	39
Ornamental—		
Various ...	...	692
Total Economic plants distributed	...	1,525
Total Ornamental plants distributed	...	1,648
Total number of plants distributed	...	3,173

SEEDS DISTRIBUTED.

W. Indian Cedar (Cedrela odorata)	...	33 quarts
Cinchona officinalis	...	2 ounces
Tree Tomato (Cyphomandra betacea)	...	10 ounces
Tea (Camellia Thea)	...	900 seeds
English Peas	...	18 packets
Indigo (Indigofera Anil)	...	1 lb.
Miscellaneous seeds	...	9 packets

The elevation of the garden is 4,907 feet above sea-level.

The average annual mean temperature is 62° 9 F. and the average annual rainfall 92.25 inches for 12 years.

The amount of rain that fell during the year was 127.27 inches. May, July and December were the wettest months, and January was the driest.

The mean temperature was 61° 6 F.; the Meteorological tables for the different months are given in Appendix VI, page 96.

KING'S HOUSE GARDENS.

A great deal of time has been taken up in hoeing, weeding and cleaning the road to King's House. Twenty-six chains of the road had become so rotten that it had to be dug up, stones collected off the sides of the road, put on the dug ground and well rolled; this made as good a road as was possible. The whole road is very much in need of a good coating of gravel, an expense the gardens' grant cannot stand, if all the ground now under cultivation is to be kept up. Half the traffic is by vehicles going from the Hope Road to the Constant Spring road and vice versa.

The Borders on the Avenue have been in good condition most of the year. They are however a heavy tax on the garden-grant. In dry weather it takes five men all their time to keep the plants in anything like good condition. There are at least 20 more taps needed on the borders to water with proper efficiency. These borders have been well dug and manured three times during the past year, a number of small plants have been planted, old ones dug out, and others transplanted. These borders will be more expensive to work in the future than they have been in the past, as the more roots there are in the ground the more watering they will need. It will also take twice as long to fork the borders now as it did the first and second years, for the borders are getting so full of roots that half the men's time is taken up with cutting out a certain number of roots.

All the young Palms and Ficus-trees on the Avenue have had the soil trenched to a depth of 18 ins. and 4 ft. wide with plenty of manure dug in. Trenching or deep digging is the best spent money in any garden; it gives the soil so much more power to absorb moisture. When ground is well dug it does not need one half the artificial watering as when the ground is allowed to remain in an unbroken state.

The Croton bed in the Avenue has been re-arranged.

Fifty-four chains of verge on the Avenue have been dug up, manured and replanted with Bahama grass.

Most of the garden-walks have been re-gravelled, hoed, weeded and cleaned twice a week.

The borders about the house are not in as good a condition as they might be, for they are all filled with large trees and shrubs; this is not gardening for it is not possible to grow large trees and small shrubs in the same border although there are exceptions amongst trees, say the Guango tree. The inhabitants of Kingston and St. Andrews would find gardening more of a pleasure than they do if they would make a point not to have large trees, palms and small shrubs all trying to grow in the same border. It is surprising what an amount of drought a garden will stand if the ground be well dug and there are no large trees about the borders. The borders about King's House are so full of roots that they require daily watering to keep the smaller plants alive.

The lawns and verges have received all the attention needed in the way of picking off small stones, weeding, rolling, manuring, &c. The lawns laid down within the last three years have done well considering the thirsty and poor soil that has to be contended with. The Lawns that have been down for years are in a poor condition with the exception of the tennis-lawns, for with the roots and shade of large trees most of the Bahama grass has died. The only thing that can be done if good lawns are to be kept up is for the trees to be carefully pruned, branches and roots, and the ground well trenched, manured and replanted with Bahama grass. The conclusion arrived at from practical observations and much consideration is that lawns and verges in the Liguanea Plain should be dug up and replanted every four or five years. This would be expensive at the time of replanting, but it would be much less costly in the long run and would not take half the labour to keep the lawns in better condition. There are now about three acres of lawn here.

There have been several different kinds of trees planted in this part of the garden, all these trees have to depend on high cultivation, as that can only be given when first planted, all the smaller trees in this part have had the soil about them well trenched and manured; this has a lasting effect on them.

The half acre of waste land north-east of King's House that was added to the garden two years ago has been made into a rose garden. A great deal of labour was spent on this garden as the ground had to be raised 3 ft. in the centre and lowered 2 ft. at the north end to make the ground almost on a level.

The beds, verges and walks are all established, and it has made a great improvement to this part of the garden.

The parasitic Tillandsia (*T. recurvata,* Linn.) that infests trees in the Liguanea Plain has been picked off the trees in the Arboretum, the garden, and some of the trees in the pastures, as funds would allow.

All the bush, &c., has been cleared away from a piece of ground north-west of King's House and the same made into a Fernery. Twelve creepers have been planted to run on the trees already there. A fern-stand has been fixed up by the Public Works Department.

The pot-plants, ferns, orchids, gathering flowers, &c., takes up the time of two men as there is a large number of plants and flowers needed for King's House.

Six hundred feet of piping and 15 taps have been added to the orchid-house and propagating house. Most of the old hose has been repaired on the place. The taps are also repaired by men in the garden. One hundred and sixty young Ficus-trees have been propagated; 140 of them sent to the Hope Gardens, and 10 planted on the Avenue and Arboretum.

1,000 Pine-suckers have been sent away through Hope Gardens.

The Guinea grass pieces (12 acres) have been hoed and cleared all through.

The pastures (90 acres) have been billed all round, five yards wide fired once; all weeds and worthless young trees taken out twice.

The Race-course and cricket ground have been billed twice.

At His Excellency's request a piece of ground in No. 2 pasture has been low billed; and the ground levelled in places to form a drive from King's House to East Lodge.

Penguin fencing 30 chains in length has been laid down from East Lodge to Devon Pen and around the propagating garden to keep out pigs and goats.

The grounds about the Bungalow, laundry and stables are billed when required. A new tool house, potting shed, orchid house, and two new large tanks have been fixed up by the Public Works Department.

There is still a shed very much needed for the mules, carts, and buckeye mowing machine; up to the present all these have to be out in all weathers.

Vine Culture.

In the spring of this year 1,500 vine cuttings were propagated and about 1,200 sent to various parts of the island, and 1,800 vine cuttings are being propagated for distribution.

The vines imported are doing well and are making splendid growth for the coming year.

A number of canes from good kinds of vines have been presented to the Department by S. L. Schloss, Esq. and the Revd. Wm. Griffith.

The Madeira Vines presented by Dr. Grabham have made good growth during the past season, 100 young vines have been raised from them this year.

A course of Demonstrations in Vine-culture has been given at Collins Green, by kind permission of S. L. Schloss, Esq., as the vines at East Lodge King's House were not old enough to demonstrate with. The attendance was not so large as was expected, but there are several people who are taking a keen interest in this culture.

Vine culture is a craft one can hardly learn from books, whereas if any one would only attend one hour a week for one season they would know enough about vine culture to make them feel capable of treating any vine.

It is sad to see so many fine vines in the vicinity of Kingston left to grow in a wild state.

In the Vine Garden at East Lodge, four different kinds of arbours have been fixed up, and four chains of trellis, to demonstrate the different ways in which vines can be grown.

The elevation of the garden above sea-level is 400 feet. The average annual mean temperature is 78° 7 F., and the average annual rainfall 49.20 inches. The amount of rain that fell during the year was

55.62 inches. January and March were the driest months, and July and October the wettest.

The mean temperature was 74° 9 F. The Meteorological tables for the different months are given in Appendix VI. Page 95.

PUBLIC GARDEN, KINGSTON.

The usual gardening operations were carried on during the year. The borders were forked, manured and pruned and they have improved in appearance. The central beds have been manured, remoulded and pruned. Two new beds have been added to the side of the central walk. The grass lawns have been constantly mown. The lawn should be a great feature in the garden, but unfortunately so many people tread on the grass that unsightly tracks are made and probably nothing will remedy this, except having the lawns enclosed by railings. The work of cutting and trimming the edges, and verges has been regularly carried on. Plants have been received from Castleton and Hope and planted out, and were thriving well, but most of them have been rooted up, and stolen by visitors. It seems as if it were impossible to introduce any new or valuable plant in the Garden without its being taken out. The paths have been kept in order, but require to be gravelled. The bridges on the central, and south-west path over the aqueduct have been repaired. On the sides of the aqueduct which passes from the east to the south-west of the Garden, plants of Euphorbia have been planted to hide the unsightliness of the drain. It is hoped that after they have become well established they will become quite an improvement to that part of the Garden. The tanks have been cleaned out, and fresh mould put in the mounds for replanting the aquatic plants.

The plant of Agave rigida var. Sisalana in the Garden, which was the first plant of the kind sent to Jamaica from Kew, has flowered and yielded thousands of plants from the pole. The plants have been sent to Hope.

The benches require repairs and painting. The principal promenades and walks are generally sprinkled in the evenings which imparts a delightful coolness to the air. Infringements of the Garden Regulations have been few during the past year.

The elevation of the Garden above sea-level is 60 feet.

The average annual mean temperature is 79° F,, and the average annual rainfall 37.96 inches.

The amount of rain that fell during the year was 34.73 inches. January, February and March were very dry; the total rainfall registered for the three months being only 1.60 inches. The heaviest rainfall was in the month of October.

The mean temperature was 78°2 F. The Meteorological tables for the different months are given in Appendix VI, page 92.

BATH GARDEN.

Mr. A. H. Groves reports as follows :—

"The chief work performed in the Garden has been cleaning and removing of rubbish, cleaning a few trees and repairing wire fence.

"I have to report the loss of the off-shoot of the Amherstia, and I find the Mangosteen is not thriving although every care is taken of it. The nutmeg trees are not bearing, and I have removed the fallen tree to see if we can improve the return of nuts, but I much fear no good can be expected from the growing trees unless we remove the shade."

IMPORTATION OF SEEDS AND PLANTS.

A large number of seeds and plants have been received from Botanic Gardens all over the world, and from private persons both in the Island and abroad, and I have to express now, generally, my grateful thanks to the donors for their kind assistance.

From the Royal Gardens, Kew, have been received during the year 60 plants in Wardian cases, 139 packets of various seeds, and 300 large seeds of *Raphia vinifera.*

Among the species may be specially mentioned the following:—

Raphia vinifera, the Bamboo Palm which yields the West African Bass fibre, used for brushmaking. His Excellency Sir A. Maloney, Governor of Lagos, was the first to bring this fibre into prominent notice on the London Market. Samples sent to Messrs. Ide and Christie were valued at £25 per ton, but the first consignment realized £42. In Lagos hats, cloth, and cordage are made from the leaves; rafters, fences, and walls from the leaf-stems; and palm-wine from the cabbage or crown of young unopened leaves. It is a native of the swamps and low-lying land along the water-ways. (See Kew Bulletin, 1891).

Uncaria Gambier.—(Gambier). This is a native of Malaya. It is cultivated at Singapore, Sumatra and other Malayan islands for the sake of its leaves from which a powerful astringent is obtained. It is exported in large quantities to Great Britain for tanning and dyeing purposes. The plants received from Kew did not live.

Prinsepia utilis.—A prickly shrub belonging to the rose family, and native of the Himalayas where it grows in barren places. The fruits are not edible but the seeds yield a useful oil.

Nicotiana rustica (Tobacco).—This is a smaller species than the ordinary tobacco, *N. Tabacum.* It grows more quickly, ripens earlier and is hardier. This species produces an East Indian tobacco; also that furnished by the Manilla Isles, and the kind called Turkish.

Atropa Belladonna (Deadly nightshade).—A strong growing perennial of the potato and tobacco family. The whole plant is very poisonous, the principle of which is an alkaloid termed *atropin.* Belladonna is much used in medicine, in small doses in the shape of an extract; this and the alkaloid atropin are also used as an external application. Belladonna is employed to allay pain and spasm, and it is frequently used for the eye in cases where it is necessary to dilate the pupil, this being one of its peculiar effects.

Coriandrum satirum (Coriander).—An annual of the Carrot family, native of Southern Europe, the Levant, &c., and cultivated for the sake of its aromatic fruits or seeds which are used in confectionery, also for flavouring curries, &c. The odour and taste depend upon a volatile oil.

Styrax Benzoin (Benzoin).—This is a tree, native of Sumatra, Borneo, &c., and yields the resin called Benzoin. Incisions are made into a tree, the juice exudes, dries and is removed by a knife or chisel. Benzoin is employed medicinally in chronic pulmonary disorders, also in perfumery, and in the composition of incense.

From the Dublin Botanic Gardens, (Glasnevin), 135 packets of seeds have been received.

From the BOTANIC GARDENS, DEMERARA, have been received 2 packets of seeds and 1 box of the fruit of *Borassus flabelliformis*.

Manihot Glaziovii (Ceara Rubber) — A thick-stemmed, low tree, nearly related to the Cassava. It is a native of Ceara, a Province of Brazil, and produces the Scrap-rubber of commerce, about 1,000 tons of which is said to be annually exported.

Mauritia flexuosa (Moriche or Æta palm).—A magnificent palm found growing abundantly on the banks of the Amazon, Rio Negro and Orinoco rivers. It has a cylindical stem rising to a height of a 100 or 150 feet, terminated by a crown of large fan-shaped leaves, from the base of which is produced a huge bunch of fruits, often measuring 8 to 10 feet in length, weighing 2 or 3 cwts., and containing bushels of fruit. Its fruits, its farinaceous pith (sago), and its juice abounding in saccharine matter, and the fibres of the petioles, furnish the natives with food, wine, and thread for making cord and weaving hammocks.

Borassus flabelliformis (Palmyra Palm).—This is a magnificent palm, widely distributed throughout the tropical parts of Asia, generally growing in low sandy tracts of land near the sea-coast, and forming lofty trees with straight and almost cylindical trunks from 60 to 80 or even 100 feet high and about two feet in diameter. The leaves are from 8 to 10 feet long including the stalk, and of a nearly circular form. These leaves are employed by the natives for a variety of useful purposes; houses are thatched with them; matting for floors and ceilings is platted from strips of them, also bags and baskets of all kinds, hats and caps, umbrellas and fans, and a host of minor articles; they likewise supply the Hindoo with paper which he writes upon with a stylus. The palm produces its fruit in bunches, each fruit being about three inches in diameter, with a pulpy covering, which is made into a kind of jelly. It is a toddy-producing palm, a most important product, and large quantities of jaggery sugar are obtained from it. The seedlings are consumed as an article of food and are cultivated for market, being eaten either fresh or first dried in the sun, or else they are made into a very nutritious kind of meal.

From the ROYAL BOTANIC GARDENS, TRINIDAD, 3 packets of seeds have been received.

MESSRS. REASONER BROS., of Florida have sent 33 growing plants, and 33 packets of seeds. Amongst them may be mentioned:—

Prunus Chicasa (Chickasaw Plum). A small tree, fifteen to twenty-five feet in height. The fruit, which varies greatly in quality, like that of all Plum-trees, is often sold in the markets of the middle and southern States, and it is eaten raw and cooked, and used for jellies and preserves.

Rubus cuneifolius (Sand Blackberry). Fruit blackish, ovate or oblong, good-flavoured. ripening in August. Stems upright, armed with stout, recurved prickles. Height 1 to 3 feet. Native of North America.

Rubus flavus (Indian Raspberry). A tall sub-erect bush, with stout spreading branches. Fruit globose, golden-yellow, succulent. Native of temperate and sub-tropical Himalaya from 2,000 to 7,000 feet altitude. Also of Ceylon, central province, altitude 4,000 to 7,000 feet.

Rhus copallina (Sumach). A tree 25 to 30 feet in height widely and generally distributed from northern New England, occurring also in Cuba. The leaves are rich in tanning, and in Maryland, West Virginia, and Tennessee, they are gathered in large quantities and are ground for curing leather and for dyeing. The Virginian crop reaches 7,000 to 8,000 tons, and is collected between July 1st and the appearance of frost.

From the BOTANIC STATION, LAGOS, 5 packets of seeds have been received. Amongst them were:

Daniellia thurifera (West African Frankincense, or Ogea gum tree.) The tree affording this gum is a native of Sierra Leone and neighbouring regions. The naturally exuded gum-resin mostly appears in a liquid state of white or pale-straw colour; in some seasons, it oozes so copiously from the branches that the ground and shrubs beneath become thickly covered with white spots. This natural exudation would not appear to be gathered. But the tree is much attacked by an insect which perforates the bark in all directions, and through the apertures made by it, the gum-resin issues as a liquid mingled with and coloured by the woody debris, and accumulates in masses, which fall to the earth, harden and are collected for sale. Further quantites are procured by stripping dead or unsound bark from the tree, the more decayed portions being commonly saturated by the exudation. Both kinds, frequently mixed, appear in the market at Freetown, and are largely consumed locally by the native women for anointing.

Dialium guineense—A tree about twenty feet high, known as the Velvet Tamarind of Sierra Leone. It has pinnate leaves, and flowers of a pale rose-colour. The pod is about the size and form of a filbert, covered with a beautiful black velvet down, while the farinaceous pulp which surrounds the seeds has an agreeable acid taste and is commonly eaten.

From the BOTANIC GARDENS, BANGALORE, 6 packets of seeds have been received, the most important being seeds of—

Soymida febrifuga.—This tree is similar in habit to the Mahogany, is a native of India, and known by the name of Rohuna. The bark is very astringent, and some years ago came into repute as a substitute for quinine. It is a useful tonic in intermittent fevers, but if given beyond the extent of four or five drachms in twenty-four hours it was found to derange the nervous system, occasioning vertigo and subsequent stupor. It has been successfully employed in India in bad cases of gangrene, and in Great Britain in typhus fever.

From the BOTANIC GARDENS, RIO JANEIRO, have been received 10 packets of seeds; from BOTANIC GARDENS, CAPE TOWN, 29 packets; from BOTANIC GARDENS, SEEBPORE, INDIA, 5 packets; from BOTANIC GARDENS, SAHARANPUR, 20 packets and 12 tubers; from MR. J. T. BUTTERS, PORT ELIZABETH, 109 bulbs.

From the AGRI-HORTICULTURAL SOCIETY OF MADRAS, 7 packets of seeds have been received, amongst them Strychnos Nux-vomica, (Nux-vomica).

From MR. J. B. BEACH, FLORIDA, the following 227 plants:—76 Pears, 30 Persimmon, 65 Apricot, 26 Cherry, 30 Orange.

From the BOTANIC GARDEN and CINCHONA PLANTATION, OOTACAMUND, 21 quarts of Hill Rice Seed were received.

From Botanic Gardens, Hong Kong, one packet of seed was received; one from the Acclimatization Society's Garden, Brisbane; five from the Botanic Garden, Rockhampton; 75 from the Botanic Garden, Adelaide, South Australia; 50 from Baron Sir F. Von Mueller, Government Botanist, Melbourne; 29 from Botanic Gardens, Melbourne; 10 from Botanic Gardens, New Zealand; 5 from Botanic Gardens, Montreal; 25 from Messrs. Milner and Smith, Sydney; 42 Orchids from Messrs. Sander & Co., England.

From Messrs. Damman, Teduccio, Italy, one lb. of Orris seed, (*Iris florentina* and I. *germanica*).

The *orris-root* of commerce is produced by these plants and a third species, *Iris pallida.* They are all grown for the sake of their rhizomes in the country about Florence, being known to the peasants of Tuscany indiscriminately as *giaggiolo* The cultivation is of secondary importance, the plants being placed on the edges of terraces, and on waste stony places contiguous to cultivated grounds. The rhizomes are harvested in the autumn of every third year. The plants are dug up early in the autumn, before commencing the next year's growth; the leaves are cut back, and each root is severed just below the base of the leaves. The head is then replanted and grows vigorously. It flourishes best in poor soil and receives no manure. The rhizomes are spread out to dry and ripen in the open air and sunshine. They are then peeled and trimmed. The prepared pieces are brought into commerce entire; or, in fragments, as parings; or as powder; or manufactured into "peas." Orris-root is chiefly used as an ingredient in toilet powders, in sachets, and in perfumery– for the latter purpose it is largely employed.

Plants, or bulbs, or seeds have been also received from the following:—

Revd. E. B. Key, Mrs. Heaven, Mrs. Henderson, Miss Roberts, Miss Burke, Miss Gordon, Miss Maclaverty, His Honour J. R. Reece, Dr. Henderson, Revd. H. H. Isaacs, Messrs. Geo. Nash, T. Jackson, J. W. Fisher, C. H. Levy, C. R. Walker, R. K. Tomlinson, S Soutar, Admiral Ammen, Washington; T. Christy, London; H. Caracciolo, Trinidad.

Amongst the ornamental plants received from Kew was *Camoensia maxima.* This plant, a native of tropical Africa, has been described as the most gorgeously beautiful of tropical climbers. According to the *Treasury of Botany*, the flowers are arranged in pendulous six to eight-flowered axillary racemes, ten inches to a foot in length; the calyx, which is densely covered with a reddish tomentum, is six or seven inches long, slit about half way up into five lanceolate ultimately recurved segments; the petals are cream coloured with deeper-coloured veins and a golden border having crisped edges, the standard being much longer than the rest, protruding about 4 inches beyond the calyx; the pod is six to eight inches long. In the catalogue of plants on sale by Mr. Wm. Bull of Chelsea, single plants are put down at 2 and 3 guineas

EXPERIMENTS IN CULTIVATION AND PROPAGATION OF PRODUCTS.

Cocoa—Considerable attention has been paid at Hope to the cultivation and curing of Cocoa. To most people the idea of growing Cocoa in a situation such as the Liguanea Plain would seem absurd; there is a small rainfall of only 53 inches, and the breeze, blowing up from the sea, five miles off, and passing over the thirsty ground, is very hot and dry by the time it reaches the Garden. However it is in just such a case that the value of experiments in a Botanic Garden is evident; and although in Jamaica the Cocoa industry is perhaps hardly advanced enough as yet to induce enquiries as to the possibility of growing the tree under these conditions, yet such enquiries have been addressed to the Director in Jamaica by planters in Ceylon.

Several years ago Cocoa was planted along the sides of the stream of waste water, and sheltering trees were put out as protection against the dry winds and too much sunshine. Whilst these were growing up, they possibly may have been subjected to ridicule, but at the present time they show clearly that Cocoa trees will indeed produce good crops even in a dry situation, if they are sheltered by shade trees, and if their roots are irrigated with sufficient water.

A new patch of Cocoa was planted out by the boys of the Industrial School at some distance from the stream, but unfortunately shortly after the young plants were put out, there was a great scarcity of water, they could not be sufficiently irrigated, and soon perished However, an excellent object lesson was given to the boys on the method of planting, and of the necessity of water and shelter.

The boys are also thoroughly taught the art of curing Cocoa with simple appliances,—a box to sweat it in, and a wooden tray on which to dry it. The Cocoa may not be as well cured perhaps as it would be on large estates with better machinery, but at any rate it is well done and much better than the ordinary Cocoa of the Island, and all the boys understand curing before they leave the school. If the number of boys were larger, the influence of their training in this one respect alone would be felt throughout the Island.

Liberian Coffee has been grown for some years at Castleton, and the small plantation there has served to show what are the possibilities of this new product in the Island. The trees at Hope also are an example of what may be expected by the use of irrigation. It was not considered wise to urge planters to undertake its cultivation until it was certain that machinery had been invented suitable to its requirements. The success which has attended Gordon's Machines in the Malay Peninsula and Java justify Sir Joseph Hooker's anticipations as to its future, and the agricultural world of the tropics has to thank Kew for the introduction of a new product which it might have taken a century to discover and develop for itself.

Kola is another product which this Department has been steadily pushing for some time. Care in curing is important, but simple as the process is, it is not always attended to. Perfect drying is essential and in the London Market it is instructive to see the difference in price obtained by the nuts when separated into their component parts and well dried, as compared with that for the nuts not thoroughly cured, mildewy and of a bad colour.

I am giving attention to the question as to what effect drying in different ways has upon its essential chemical properties. It is possible that the native method in Africa of keeping the nuts as fresh as possible is the way to get most out of them.

Oranges.—The Orange trade should be an important one for the island, and will become so, when only good fruit, well packed, is exported. What should be aimed at, is, to be able to send fruit to the market when Florida cannot do so. If we find it possible to bud or graft in our climate, this problem will be solved. For many years the process of budding oranges in the island have failed to produce satisfactory results; and, it is possible, that the failure has occured, because there is no natural check to vegetation, like a winter season, with a rise of the sap again in spring, when budding is carried on. Experiments are being carried on to determine whether we can successfully give the check in other ways. The particular kind of grafting known as inarching has been very successfully worked, and thousands of good orange plants have been distributed, but the original trees used for this purpose have been worked out. In the hill country below Cinchona, Mr. Harris has given demonstrations on the method of inarching on trees belonging to settlers, and explained why the process is of value.

The following plants imported from Florida are doing fairly well at Hope:—Maltese straight, Maltese Blood, St. Michael's Blood, Mandarin, Tangerine, Mel. Sweet.

The experiments in budding oranges on old Lime trees promise to be successful.

The best elevation for Oranges is between 2,000 and 3,500 feet elevation, and Government land near Cinchona might be utilised for the cultivation of the Orange and other plants suitable to that altitude.

Tea is grown at Cinchona, and if labour by coolies were available, this product might be cultivated for home use, since there is an import duty of 1s. per lb.

Nutmegs.—More than 7,000 plants have been distributed during the year. Selected seeds are imported from the finest plantation in Grenada, germinated and grown at Hope until they are fit for planting out. If planters imported the seed themselves, the plants, by the time they were fit for putting out, would probably cost them at least 6d. each, whereas they can now get strong plants at the Gardens for 1½d. each.

Fodder Plants.—Experiments in fodder plants were originally undertaken at the request of a coffee planter in the hills, who wished particularly to get a grass suitable for a "common." The most promising of the grasses for pasture appears to be the Kentucky Blue Grass (*Poa pratensis*). It is very popular in the United States as a pasture grass and the famous Kentucky mules are fed on it. It is said to be suited to a variety of soils, but it dries up during a protracted drought, springing up again when the rain falls. The Texas Blue Grass (*Poa arachnifera*) so far does not seem quite to equal the Kentucky Blue Grass, but in the southern United States it is said that the longest, driest and hottest summer fails to injure it. Both these grasses are frequently sown together. The clovers experimented with have not been successful. The white clover (*Trifolium repens*) however grows well. *Polygonum sachalinense* grows at the Hill Garden, but at present does not take possession of the ground as it does in the Old World.

Some are inclined to think that having Guinea Grass, there is no need to experiment with any other fodder; but though Guinea Grass springs up naturally in some parts of the island, and is suitable for certain districts, this is not the case in other parts.

The experiments in the Gardens have hitherto been only tentative and on a very small scale. They should now be carried out more extensively.

Experiments are also required to find out suitable plants for "green manuring."

Alfalfa at Hope has been fairly successful, and is promising as a fodder crop in many parts of the island. Reports on trials of seed sent out from the Department are given in Appendix I, page 77, and these are encouraging when it is considered that they refer to the first sowing. Particular attention is directed to the reports from Messrs. J. Shearer, A. C. Kennedy, W. H. Hall, C. Daly, C. A. T. Fursden, and Miss E. Fisher. From their experiments it may be seen that it would be well to sow during light rains before the seasons come on, and that an occasional cutting or feeding down strengthens the subsequent growth.

Onions.—In the Bulletin for August, 1890, attention was called to the cultivation of the onion, and since that time seeds have been distributed free in various parts of the island. Only a very few persons had tried growing them before that date, and there was a general opinion that they would not bulb here. They have been very successfully grown at the Hill Garden, and the reports show that they can be grown in several places. No one has yet attempted the cultivation on anything but a very small scale, but experience is being gained, some of the onions grown have been of remarkable size and I have hopes of an extended cultivation in the future. In gardens where the onion seedlings can be watered and well looked after, the time of year is not so important; but for field culture, it is necessary during the early stages of growth to avoid the "seasons rains" and to have a little rain almost every day up to the time when the bulb is of full size. See Appendix II, page 80.

Grapes.—The culture of Grapes is one which the Department has done a great deal to encourage, and not only has a large number of vines (over 1,000) been distributed but the attention of the public has been directed to the great importance of proper care in pruning the Vines, thinning the bunches, etc. The Liguanea plain is perhaps the most important district in the island in which to give practical instructions. There are more people there interested in the subject, and it has been possible to continue the demonstrations from week to week on account of Mr. Thompson being in charge of King's House Garden. His report on his work is as follows:—

In March 1892 cuttings of nine kinds of Grape-vines were received from Kew. The cuttings were propagated and planted out in the piece of ground enclosed for them at the East Lodge, King's House. They made good growth and in the Spring of 1893, the vines were cut down and about 1,200 cuttings were propagated and we sent out as many young vines as we had orders for. In the Spring of 1894, about 800 more young vines were propagated. In 1893-94, there were about 1,000 young vines sent out from King's House Gardens, and what young vines we had left were sent up to the Hope Gardens to be disposed of when required.

During 1893-94, 36 Demonstrations were given at Collins Green and King's House Vine-Garden. These demonstrations were not attended so well as would have been expected; some said it was too far away, others that the time of day did not suit them,—the days and time were altered, but I do not think it made any difference.

There are several persons who, I think, have benefited from the demonstrations. Most of these gentlemen have either started or extended their vine cultivations, since the demonstrations started.

During the demonstrations all the instruction possible has been given, viz:—soil, cultivation and manures, climate, evil effects of cold or too much wet, need of plenty of water at the proper time, need of ripe wood, difference between ripe and unripe wood, pruning, disbudding, stopping growth, thinning bunches, need for different kinds of vines and to be pruned at different times to produce fruit at certain seasons, evil effects of shade, etc., etc.

It would be hard at present to say what benefit has been derived from the instructions given, as most of the vines the people have are young.

Most of those who attended the demonstrations seemed to know all about vine-culture too soon. I always impressed on them to attend once a week for a season, then they would know enough about vine-culture to grow the finest grapes possible, but they came a few times, then they stayed away for a few weeks. We have good soil and climate ;—with manure, water and attention, at the proper time, we would grow as fine grapes as any other country.

The drawback to vine-culture is that people are impatient to wait a few years to let the vine get some strength before they start allowing the vine to fruit.

Notes on vine-culture have been sent to the Bulletin from time to time, also instruction given to the people as they write for it.

In 1893, Dr. Grabham presented the Department with some Madeira Vines, these have made good growth.

Mangoes and Pine Apples will not produce fruit at Castleton, and therefore attention is paid to them at Hope.

Temperate Fruit Trees. There is a very large area in the higher elevations where these may be grown, but the Hill Garden is the only place where experiments can be carried on with them by the Department. Several young trees have been distributed all over the country, but sufficient time has not elapsed to learn anything very definite about results. At the Hill Garden have been planted out peaches, pears, apples, cherries, Japan persimmons. The Himalayan Blackberry *(Rubus racemosus)* has been a success, and plants have been distributed.

Papaw. The juice of the papaw yields papaine, which would rival pepsine commercially if it could be produced cheaply. A plot of ground has been planted out with papaws at Hope with a view of testing the possibility of getting a cheap product. If successful, it will be a great boon to the small settlers.

Orris Root, Chirata, and Chinese Indigo are other minor products which are being tested at the Hill Garden. They are described in Mr. Harris's Report.

Tobacco. Sir Joseph Hooker, was, I believe, the first, in Sir John Peter Grant's Governorship, to direct attention to the capabilities of the island for growing good tobacco and producing excellent cigars. He sent seeds from Kew Gardens to Jamaica of various kinds, and continues at the present day to take a fatherly interest in the cultivation. Sufficient tobacco is not yet grown to provide all the "wrappers" that are required for the cigar business, and these are consequently imported to make up the deficiency; the difficulty is not one of texture of leaf, which is sufficiently good.

Through the good offices of H.B.M. Consul at Havana, I was able to get a large supply of the best Cuban seed. This was distributed, and the reports printed in Appendix III, page 85 show that the tobacco produced was of a better quality for cigars than the common kind usually grown. I hope that the area under cultivation will increase to such an extent that there will be no need to import "wrappers." That the surplus tobacco can easily be sold at good price in European markets is evident from the fact that in answer to information published in the Bulletin of a prize of £50 offered by the London Chamber of Commerce, Messrs. Machado sent up tobacco and received half the prize which was divided between Jamaica and British North Borneo. The

Liguanea plain has lately been invaded by tobacco growers, and the plantation near Hope is very promising. The soil may not contain enough humus, but this can be obviated by "green manuring" and perhaps the best plants for ploughing in for this purpose is the Cow Pea *(Vigna sinensis)*.

Eucalyptus. The planting of Eucalyptus is of great importance in Jamaica. Seedlings are difficult to raise, and probably can only be done to any extent in the Public Gardens. They are distributed free. A beginning has been made in planting them in different parts of the island, and reports received will be found in Appendix IV, page 87. Seeds are constantly being received from Baron Sir F. Von Mueller, Government Botanist in Melbourne—the "Prophet of Eucalyptus," from Kew Gardens, and from Botanic Gardens, and others in Australia.

Timber Trees of various kinds are also distributed free in order to encourage sylviculture. There is a demand from the Hill Garden for *Pinus Massoniana, Cupressus macrocarpa,* and *Juniperus Bermudiana* by coffee planters. Every endeavour will be made to get seeds of trees that are desired by the public, and to provide strong and healthy seedlings, if notice is given a year or two in advance. The most generally useful tree, where it can be grown, is undoubtedly the West Indian Cedar *(Cedrela odorata)*.

Dragon's Blood Tree. Attention has been directed to this tree, a native of Jamaica, but there appears to be very few of them left. Seeds from the trees at Castleton are sown, and it is to be hoped that several plants will be established in different districts.

Rubber Trees. These have not proved very successful in the island hitherto, but it is possible that some of the different kinds may do well in various parts of the island.

SCIENTIFIC STUDY.

Botanic Gardens should aid in the study of pure science, for science always tells on practice.

On the side of *Chemistry*, I am endeavouring to help in the study of the properties of the fresh Kola nut, and the changes that occur during drying; on a cheap method of obtaining the digestive principle of Papaw; and the analysis of the West Indian Dragon's Blood in order to compare its properties with those of other kinds.

On the *botanical* side, dried specimens of native plants have been sent to the Herbarium of the Botanic Gardens at Berlin. Prof. Dr. Urban, Assistant Director of the Berlin Gardens, is devoting himself altogether to the study of the systematic botany of the West Indies. Grisebach's Flora requires thorough revision, and since its publication (A.D. 1859-1864) a large number of new species have been discovered. Prof. Urban's work will serve as the foundation for separate floras for each of the Islands.

Dr. Bower, Professor of Botany in the University of Glasgow, is studying the development of the sporangium in certain Cryptogamia, and I am endeavouring to help him with material from native plants.

DISTRIBUTION OF PLANTS AND SEEDS.

The distribution of plants in the island from the various Gardens amounted to the following numbers:—

	Economic.	Ornamental.	Total.
Hope ...	32,164	15,093	47,257
Castleton ...	1,135	3,406	4,541
King's House ...	1,200	"	1,200
Hill Garden ...	1,525	1,648	3,173
Total ...	36,024	20,147	56,171

About 11,000 seeds have been distributed from Castleton, and an equally large number from the Hill Garden.

Plants have also been sent to Kew Gardens, Botanic Station Barbados, Botanic Garden, Demerara, J. B. Beach , F. Sander, Reasoner Bros.

Seeds have been distributed to Botanic Gardens in the following places:—

British Isles. Kew, Cambridge, Oxford, Liverpool, Manchester, Hull, Dublin, Edinburgh, Glasgow.

Asia. *India* : Calcutta, Mungpoo, Darjeeling, Saharanpur, Lucknow, Cawnpur, Bombay, Poona, Udaipur, Mysore, Ootacamund ; *Ceylon ; Straits Settlements ; Hong Kong.*

Australasia. *Australia* : Sydney, Brisbane, Rockhampton, Adelaide, Port Darwin, Melbourne ; *Tasmania ; New Zealand :* Wellington, Dunedin, Napier, Invercargill.

America. *W. Indies:* Trinidad, Barbados, Martinique, Grenada, St. Lucia, St. Vincent, Antigua, Dominica, Demerara, British Honduras ; *Canada :* Ottawa, Montreal ; *United States :* Washington, Louisiana, Harvard ; *Brazil :* Rio de Janeiro.

Africa. Gold Coast, Lagos, Gambia, Cape Town, Graham's Town, Port Elizabeth, King William's Town, Graaff Reinet, Uitenhage, Natal, Mauritius.

Seeds have also been distributed to Agri.-Hort. Soc. of India, Agri.-Horti. Soc. of Madras, British Museum (Natural History), Hort. Soc. London, Reasoner, J. B. Beach, Damman, Vilmorin, Carter, Sutton, Veitch, Baron Sir F. Von Mueller, F. Sander, Milner and Smith.

DISSEMINATION OF INFORMATION.

Correspondence.

The correspondence is an important item in the business of the Department.

Information sought has been on the following subjects :—cultivation of economic plants, and their preparation; manures; pests, fungoid and insect; machinery; native plants; on Jamaica from correspondents abroad wishing to settle, etc.

The number of letters are as follows :—

	Received.	Despatched.
Head Office ...	2,823	3,177
Superintendents' Offices	3,691	5,687
Total ...	6,514	8,864

PRINTED MATTER.

Information of general character is provided for by the issue of a Bulletin once a month. By this means the burden of correspondence is lessened in a marked degree, and besides, intelligence is conveyed to many who would not take the trouble to write for it. Bulletins are not issued broadcast, but to those who apply for them; the number distributed each month amounts to 1,035.

The Bulletin deals with subjects coming under the following heads:—

(1). Cultivation and Curing of Agricultural Products.
(2). Machinery.
(3). Fibre and Fibre Machinery.
(4). Vegetables and Fruits.
(5). Fodder Plants.
(6). Economic Plants.
(7). Manures.
(8). Diseases of Plants.
(9). Forestry.
(10). Ornamental Plants.
(11). Botanical Notes.

A list of the native flowering plants of the island was drawn up by the Director, and published in September, 1893.

I have to thank the newspapers for inserting notices from time to time,—an important aid to the work of the Department.

PRACTICAL DEMONSTRATIONS AND LECTURES.

A series on Grape Vine Culture has been given weekly during the season by Mr. W. Thompson, Superintendent at King's House Garden.

Mr. W. Cradwick, Superintendent at Hope Gardens, gave a very successful course of practical instruction in the cultivation and curing of Cocoa to the settlers in the Buff Bay District. Applications have been received since to renew these demonstrations and to repeat them elsewhere. While I am glad to encourage such work, I must point out that it is not the proper duty of the officers on the Staff of the Department who have their time fully occupied and have to make up the time given to such tasks by extra work in their leisure hours; but as soon as the demands for these demonstrations increase, as I hope they will, special instructors must be engaged for the purpose.

In connection with this branch may be mentioned the exhibition of plants by the Department at the Floral and Horticultural Society's Show at Kingston.

STAFF OF WORKERS.

In a properly equipped Botanic Garden, the staff should include (1) gardeners of various grades, (2) botanists and assistants in the herbarium, (3) chemists, (4) clerks.

Three of the Superintendents, Messrs. Harris, Cradwick and Thompson are first rate in their particular business as gardeners, and as gardening is the highest branch of plant cultivation, they are well able to give practical information to agriculturists. Their technical knowledge is such as can only be acquired by years of practical work in the best gardens in England. They have all given demonstrations which have been appreciated, and constantly give information to visitors to the gardens.

* * * * *

LIBRARY.

The *Library* is quite as essential for carrying on the work of the Department as the Herbarium. It is not intended for the use of the Public, though, as a matter of fact, such works as can be spared are loaned to planters and students, and the catalogue of books added to this Library each year is published in the Annual Report for general information.

The Library of the Jamaica Institute contains a large collection of books on Agriculture. These works are always accessible to the public, and there is therefore no need to have a duplicate set in Kingston. Each Garden has already a small Library in the Superintendent's office, and these books are available for consultation by visitors. If it is thought desirable, these collections of books can be added to, and provision made for such increase on the Estimates.

The catalogue of the books added during the year is to be found in Appendix V. page 89.

HERBARIUM.

This is a collection of plants, carefully dried, mounted on paper, named and arranged in regular order in cabinets. It is an essential element in every Agricultural Department, and it was recognised as such in the early days of the Botanical Department in Jamaica, for one of the chief duties assigned to the Island Botanist was "to collect, class, and describe the native plants of the Island."

If a plant is known to have an economic value, it is necessary to describe, class, name it, and keep dried specimens for ready reference. For instance, a planter in the Island supplied a Firm in the United States with a quantity of a certain bark, one of our native drugs. The Firm at first refused payment on the ground that it had not the appearance of the bark wanted. Application was made to me to certify the scientific name of the bark sent as deduced from specimens of flower, fruit and leaf; and on receipt of this certificate payment was at once made.

A Herbarium must be added to indefinitely.

A collection of those plants only that are known to possess useful properties is not by any means sufficient. Those species may be so similar in appearance to closely allied, but worthless species, that it requires careful comparison to enable one to state their distinguishing marks. A complete Herbarium is required for the study of economic Botany; and it is indispensable for the sake of reference when a broader view is taken, and students send up plants generally for determination.

Duplicate sets of Jamaica plants are of great value for the purpose of exchanging with other West Indian Islands and with other Botanical Establishments. A plant may be used for some purpose in one Island, and its economic value may not be known elsewhere. An interchange of plants among the Islands is therefore of importance. Collections are made in various parts of the Island as opportunities offer.

It is evident that the chief value of the Herbarium is for the use of the Director. Duplicates are however prepared for the convenience of students and deposited in the Institute. Small Herbaria could also be placed at each of the Gardens, if there were any demand for them on the part of students.

I consider that the present position of the Herbarium at Cinchona to be one of the best in the Island, as it is freer from the attacks of insects than it would be elsewhere, and it does not suffer from damp which it would be liable to in the Liguanea Plains.

LABORATORIES.

Laboratories are necessary for efficient work, not alone for chemical work, but for botanical re-searches with the microscope, for such investigations, for instance as plant diseases, requiring various apparatus, the use of chemicals, reagents, &c.

SITES SUITABLE FOR STAFF OF WORKERS AND FOR GARDENS.

Site of Head-Quarters.—The present position of the Head-Quarters of the Department with its offices, library, herbarium, &c., is, I consider, about the best place in the island for it. This question has been confused with that of the maintenance of a Hill Garden, and should be considered separately..

It is assumed that if the Hill Garden is not maintained, that the Head-Quarters would be removed.

To move the Head-Quarters would necessitate very considerable expense with no advantages to compensate, and involving many disadvantages in carrying on the work of the Department.

I believe the estimates for buildings that would be necessary, amount to £4,000. Besides this there would be a very large expenditure on the removal of the herbarium, library, furniture, office papers and books, &c.

After carrying on Departmental work for eight years there seems to me no need whatever for the removal of the Head-Quarters.

In the first place, in the nature of the case there doos not appear any necessity for the permanent residence of the Director at Hope Garden or in the capital, Kingston. In Ceylon with an area nearly six times that of Jamaica, the head-quarters of the Botanical Department and the residence of the Director are in the Peradeniya Gardens, more than 70 miles from Colombo the seat of Government. In Java the Botanic Gardens are at Buitenzorg 26 miles distant from Batavia. In India the Director in the Bengal Presidency is stationed at Seebpore, going in the summer to Darjeeling in the hills, the Director in the

North-West Provinces is stationed at Saharanpur with a residence in the hills at Chassoree; in the Madras Presidency the Director lives at Ootacamund in the Nilgiri Hills. Finally the most important Botanic Garden in the world, Kew, is at some distance from London.

The chief functions of the Department have been laid down to be the "diffusion of information" and the "distribution of plants." The diffusion of information must either be in the way of itinerant lecturing, or by correspondence and printed papers such as the "Bulletin;" in either case it does not much matter where the Director lives; and in the latter case a far greater amount of work can be done in the climate of the hills than in the plains. The distribution of plants from the various gardens, (Hope, Castleton, Parade, Cinchona) is carried on by the different Superintendents in pursuance of directions by post from the Director's office, and can be controlled as effectually from Cinchona as from Kingston.

For more than a year during the time of the Exhibition and preparation for it, I spent part of every week in Kingston, and my experience was that all the Departmental business could be transacted quite as well from Cinchona as in Kingston. Nor has any business in connection with the Department during eight years rendered my presence in Kingston necessary or suffered by my absence, although I visited it once or twice a month on the occasions of my periodical visits to inspect the various Gardens. There is a daily post, and if any occasion should occur, I can reach Kingston in less than 4 hours' time. I do not consider that it is necessarily an advantage to be able to communicate by word of mouth. One hundred people in different parts of the island may wish for much the same information about some cultural product. This information, asked for by definite questions in letters, can be given by definite answers in writing or in print, and can be supplied to the hundred probably in as short a time as it would take to talk it over, with the chance of its being soon forgotten, with perhaps only one person out of the hundred who could come to Kingston. The probability is that my time would practically be at the disposal not of planters, but of "globe-trotters" and others as little interested in agriculture. This would be a most serious disadvantage.

Hill Garden.—The question is raised as to whether it is advisable to maintain a garden at an elevation of 4,900 ft.

This is a separate consideration altogether from the question of the locality for Head-Quarters, and whatever may be decided about the latter, it appears to me to be necessary to provide for the wants of the larger half of the island that lies above the elevation of Hope and Castleton.

There are numerous economic plants that will not come to perfection, or grow at all at a low elevation, and the value of high elevation gardens is recognised in all the most enlightened tropical colonies. In Ceylon, one is maintained at an elevation of 5,580 ft.; in Java a garden of 70 acres in extent is kept up at about the same altitude; and in India there is a large number of Hill Gardens.

The idea that, as the Hill Garden has not introduced any new industry besides Cinchona, it is therefore worthless, is not one that is likely to commend itself to any reflective mind. It is probable that if coolie immigration were placed on a different footing, tea cultivation protected, as it is, by the import duty of 1s. per lb., would at once develop into a lucrative industry. Columbian Rubber which grows in the Andes at an elevation of 6,000 feet, might prove profitable, and could scarcely be cultivated at a lower altitude. There are very many other plants which cannot be grown at Hope or Castleton.

There is a serious misconception about the reason for re-afforesting on the Blue Mountains. It is not recommended with the idea that the timber would be of any value as timber except on the spot where it grows; but for the ordinary reasons, (other than timber supply) that induce governments to spend money in such cases. The vote for the Hill Garden has for the past 8 or 9 years been so small that scarcely anything could be attempted in the way of forestry except planting out a few specimen trees and occasionally thinning the plantations. There have been, however, several demands on the part of Coffee planters and others for forest trees. The Government has instructed me to assist by supplying trees, but without a grant of money for the purpose nothing can be done. Why should the reasonable demands of residents in the hills be refused, especially when even small patches of woodland planted by them would be of general benefit?

The trees suitable for the hills cannot be grown at Hope or Castleton. The same applies to the claims of those living in the higher elevations for experiments in fodder, fruit trees, and vegetables, experiments in which were all undertaken at the request of Coffee-planters. The experiments, though crippled by want of money, have nevertheless been of value.

The distance, 20 miles from Kingston, should not be an objection, for Botanic Gardens are not necessarily show places for the general public, and their utility cannot be gauged by the number of visitors to them. The Committee have acknowledged this by increasing grants for those farthest from the capital, viz., Bath and Castleton. Bath, 44 miles from Kingston, has had its vote increased from £20 to £125. Castleton is 19 miles from Kingston and to reach it one has to cross Stony Hill at an elevation of 1,200 feet, and the vote has been increased by £100. The Committee has also evinced a desire not only to curtail expenditure, but to do away with other Gardens near Kingston, viz., Hope 5 miles away, and Parade Garden actually in the town.

Mid-Elevation Garden.—I have stated that a Garden between 2,000 and 3,000 feet would be a valuable addition. To save the expense of another Superintendent, this Garden might be made on Government ground below Cinchona, where there is very suitable land for experimenting with oranges between 3,000 and 3,600 feet at which elevation in this district the very finest oranges are grown. In the three parishes of St. Andrew, St. Thomas, and Portland while there are 288 square miles below 1,000 feet, there are 133 square miles above 3,000 feet.

Castleton and Hope.—Besides the Hill Garden, the present one at Cinchona combined with an Orange experimental station at a lower elevation,—I consider it necessary to maintain also both the low level Gardens at Castleton and Hope, the former for cultivating plants suited to a wet district, and the other for those which will only grow in a dry district.

At Hope, even if we could command a constant and abundant supply of irrigation water, the damp atmosphere is wanting, so essential for the propagation and growth of so many plants, and we have to depend upon Castleton for the propagation of many plants.

But Castleton without Hope, will not suffice, for at Castleton we cannot grow such plants as Grapes, Sisal Hemp, Tobacco, Pine Apples, Senna; and Mangoes for instance will not produce fruit.

Hope is a good experimental spot, for it can be shown there how to overcome natural difficulties; such as want of rain—by irrigation; dry winds—by shelter-belts of shurbs and trees; poor soil—by manuring, for it is in poor soil that the effect of manures can be most easily seen.

Bath.—The Garden at Bath is admirably situated for a Botanic Garden, and I am sorry that it was ever given up. In any scheme for Parochial centres of distribution, this Garden would answer well for all the east end of the Island, for there is no port between Port Morant and Port Antonio, where plants can be landed from the Coastal Steamer.

W. Fawcett,

Director of Public Gardens and Plantations.

Appendix I.

Reports on Alfalfa.

Mr. C. M. Ogilvie, Kingston—I have planted Alfalfa seed at Melrose in Manchester, it is growing but the nature of the soil seems against its doing well.

Mr. T. N. Cripps, Kingston—The Alfalfa seeds which I planted in Kingston all died. My next venture will be at Tankerville in St. Andrew, to which place I am about to move, where I hope I shall be more successful.

Mr. E. J. Mackenzie, Greenwich Park - I am sorry I cannot make any very satisfactory report on the Alfalfa seed sown here last October. The cultivation was very shallow, and the soil clayey.

Mr. P. J. Duncans, Halls Delight, St. Andrew—I planted the Alfalfa seed on the 30th September, it germinated well but the fowls discovered it when 6 inches high, and picked off every leaf: and although I fenced it round and covered it with branches I could not keep them from it, consequently it all died before Christmas.

Mr. J. Keene, Serge Island, Blue Mountain Valley, St. Thomas.—The seeds were sown thickly and lightly covered with fine soil, germination was very rapid as the young plants came up in a few days but owing to the drought, and a sub-soil being of a gravelly nature, the growth up to the present time has been very slow: the highest plants are not more than nine inches in height and the foliage is turning brown.

Mr. W. F. Connolley, Vineyard Penn, St. Andrew.—The seeds planted came up well, and grew luxuriantly during the rains, but since then they have remained where the rains left them, about 18 inches high, with a tendency to layer out, and have flowered freely. I think they have done fairly well considering that my place is so badly supplied with water.

Mr. P. C. Cork, Barbican, St. Andrew—The weather down here (Barbican) has been too dry to admit of planting Alfalfa with any prospect of success. I had some planted at Williamsfield 1,400 or 1,500 feet above sea-level and it has grown very nicely, the tallest being about 18 ins. high. It has not as yet been utilized as fodder for stock.

Mr. R. A. Clare, Hagley Gap, St. Thomas.—I sowed the Alfalfa seeds on the 8th of September. They made ready growth but the heavy, rain which fell during the latter part of the year completely spoilt them. The rest of the seeds were sown early this month (March), their growth is promising.

Dr. Manners, Bull Bay, St. Thomas.—I had a square chain prepared and sowed the seed broadcast: it came up well to about 4 inches when the heavy rains came on and it died out. I think it would do well in dry soil.

Mr. H. Cork, St. Margaret's Bay, Portland.—I am sorry to say the Alfalfa seeds were a complete failure with me. The land was well ploughed, but only a few of the seeds germinated, and they soon died.

Mr. H. P. Deans, Priestman's River, Portland.—The Alfalfa you sent me has not grown as rapidly as I expected. Sown four months ago, the plants are not more than 3 inches high.

Mr. H. R. Walcott, Richmond, St. Mary.—I am sorry I cannot report favourably on the Alfalfa. The continued wet weather delayed the preparation of the soil till the seed appears to have lost its vitality. I intend to try again.

Revd. W. Turner, Castleton, St. Mary.—The Alfalfa sprang up in three days, but none of the plants grew to more than one and a half inches high, then dwindled away and died.

Mr. R. S. Thompson, Guy's Hill, St. Mary.—I have only just planted the Alfalfa seeds, so cannot give you any report at present.

Hon. C. W. Steer, Claremont, St. Ann.—I had one square chain of good, deep pasture land dug up with pick axes: sowed the seed on the 28th or 31st of October in drills, 1 foot apart. The seed germinated and grew well at first but very poorly afterwards. It has been thoroughly weeded and kept clean, but still looks weakly. I purpose giving a dressing of lime as soon as the plants are high enough.

(A later report states) :—The Alfalfa turned out quite a failure. I sowed on ground that had been thoroughly ploughed, cleaned and manured. The seeds grew well, but the plants were poor. They blossomed, but so far as I could see failed to produce seed, and are now all dead.

Mr. J. D. Ormsby, St. Ann's Bay, St. Ann.—The Alfalfa seed came up nicely to about 2 inches high and then all died off. We had almost incessant rain for two months after it was planted. The rest of the seed I planted about 3 weeks ago has not yet come up.

Mr. J. Shearer, Duncans, Trelawny.—The seeds all grew rather puny at first, but after cutting once or twice the plants are more vigorous each time. They throw down a formidable root deep into the soil, but at present have shown no sign of flowering.

(A later account states) :—My small plot of Alfalfa is now growing vigorously, and I can cut it almost once a month.

Mr. R. J. Taylor Domville, Little River, St. James.—The Alfalfa grew remarkably well, but unfortunately it was washed away by a flood before it became established. I shall be pleased to try again if you have any more seed.

Mr. A. C. Kennedy, Bluefields, Westmoreland.—The Alfalfa I planted in trenches about 3 inches deep, half a chain long, 18 inches apart, came up nicely in the early part of 1893, but was a very long time in growing: for months it seemed stationary. It is now about 12 months old, and is of a nice blue-green colour about 18 inches high. The pigs are very fond of it as well as the stock of all kinds.

Miss E. Fisher, Grange Hill, Westmoreland.—I planted four beds in four different places, 2 beds in the mountains about 1,000 ft. above sea-level, the other beds about a mile lower down. The beds in each place were carefully cleaned and raked, and as the seeds were small I had the earth sifted. The seeds germinated well, and grew in a few days to the height of 3 inches. The first few days I had them lightly sprinkled with water, then I left them to struggle on without aid. They grew 3 inches in 3 months, and then died off. The rest I planted in my flower garden where they are constantly watered, it looks beautifully fresh and green.

Mr. W. H. Hall, Manchester.—The Alfalfa is doing fairly well at my property near Mandeville. I kept the seed a considerable time before sowing it, and then sowed it in rows. The plants are now about 10 or 12 inches high, healthy looking and very green. Cattle appear to be very fond of it as they broke into the enclosure and cropped the young plants so severely that my experiment nearly came to an end.

The plants are however coming on again. From what I have seen of it I think it can be grown in Manchester, and if it withstands the drought, as it is said to do, will prove a valuable addition to our fodder plants.

Mr. Henry Nash, Chapelton.—I regret that the Alfalfa seeds have not done well : a few germinated and then died off.

Mr. C. Daly, Porus.—I planted the Alfalfa seeds received from you they came up, but the cattle which seem very fond of it, got into the enclosure and eat it down to the roots, however after a few days it came up again, and although the weather is exceedingly dry it is quite green.

Mr. A. C. Martin, Cross Keys.—Some of the Alfalfa seed which I sowed is growing very slowly, and has to be kept free from weeds and other grasses, this alone would prevent its success as a fodder plant in Jamaica.

Mr. Sidney Moxsy, Chapelton, Clarendon—Weather too dry for large experiment, planted a little in my garden. During my absence from home it appears to have suffered, something has destroyed the leaves, either birds or poultry, shall try again as soon as weather more favourable.

Revd. C. E. Henderson, Spanish Town, St. Catherine —I am sorry that I can give no good report of the Alfalfa seed. I divided it into 3 lots, as the weather was very dry, and in my opinion the time of the year not the best for planting. I laid by one lot; and tried the other two on different soils, one on a rather poor soil, and the other on a rich loam. Both grew. The first grew to almost 4 inches and then died. The second lot reached the height of about 8 inches in 3 weeks, and then remained for some time stationary after which it died. The third lot I will write to you about in a few weeks.

Mr. C. A. T. Fursden, Spanish Town, St. Catherine.—First crop discouraging, it having the appearance of being delicate. Flowered very freely, but no appearance of seed. After seeding I cut some throwing it back on the beds for manure, the result being a second crop very much larger leafed and stronger in every way. It is now growing very thick and vigorously.

Mr. J. Ryley, Spanish Town, St. Catherine.—I planted the seed in some cleaned land, and alongside of it I put in some Guinea-grass, when the latter was about 18 inches high, the Alfalfa was only 2 or 3 inches high.

Thus, this lot has not proved a success. I have a good deal left and intend to try again when the May seasons are done, and I hope I may succeed better. I noticed when I put cattle into the place they feed on it eagerly and I have yet to see whether after this feeding it will come up strong again. Although this trial cannot be considered encouraging so far, I intend to make further planting, and hope to be able to giv more favourable reports.

Appendix II.

Reports on Onion-growing.

Mrs. Gunter, Kingston.—Seeds were planted in April. The weather was very dry and they did not do well.

Mr. T. N. Cripps, Kingston.—None came up. I tried at Kingston and Kingston Gardens with care and good soil.

Mr. C. E. Smith, Kingston.—The seed was put in about October 10, in boxes protected from ants, and out of strong sun-light. It came up very strong, but owing to sickness of the gardener, was not transplanted in time and was lost. I tried three times since and failed to get seed to start.

Revd. A. A. Hedmann, Clifton, St. Andrew.—Although the greatest care was taken in ploughing, manuring and drilling the land, and the young plants were well protected from destructive grubs, the result has not been at all satisfactory. The onions matured very quickly but the return was scarcely worth the trouble of reaping, the largest onion being not more than $\frac{3}{4}$ of an inch in diameter.

Mr. A. George, Mountain Spring, St. Andrew.—I am sorry to say nothing came of my seeds, perhaps the rains at the time had a good deal to do with this, or may be the quantity of manure was not sufficient, but I am willing to try again when you have another supply of fresh seeds.

Mr. Munn, Bryan's Hill, St. Andrew.—The onion seed sent me did not come up at all. I think they were washed away by the heavy rains.

Mr. J. Stephens, Radnor, St. Thomas.—The Indian onion seed from Botanic Gardens, Saharanpur gave a very useful crop of small onions of very good quality. The seed heads gave sets with me (instead of ripe seeds.) These sets on being planted increased well; on the whole the onion is a useful family onion.

Mr. W. A. Sabonadiere, Hagley Gap, St. Thomas.—The onion seed germinated very well. It was sown in December but owing to absence from home the onions were not transplanted till the end of February. From March to May onions were gathered fit for use. Many were very small, but every one made a bulb, the largest may have weighed 4 oz.

Mr. C. Stewart, Bath, St. Thomas.—I planted the onion seed which I received last year. They grew well. I transplanted them but the heavy rains in October destroyed the whole bed.

Revd. D. W. Bland, Hagley Gap, St. Thomas.—Considering that the soil, in which the onion seed was planted, was not as well prepared as it ought to have been, I think that I have been very successful with it, obtaining bulbs averaging 8 ins. in circumference, with 2 ins. of depth. The onion is mild and delicate in flavour, and is a good keeper.

Mr. Clare, Hagley Gap, St Thomas.—I am sorry to inform you that the onion seeds did not prove a success; as soon as they grew to about 6 in. high, grubs destroyed most of them.

Mr. C. H. Levy, Serge Island, St. Thomas.—Two beds were prepared twelve feet in length by four feet wide, on new ground; with a moderate amount of well rotted stable manure forked in, drills drawn two and a half inches deep allowing nine inches between the rows.

The seed was sown in the beginning of February and covered with fine soil, and watered daily, weather being very dry at the time.

The young plants came up in about five days but grew very slowly for the first two weeks. In fact you could hardly discern if they made any growth at all.

When the plants were six inches high, they were thinned out three inches apart and transplanted instead of being thrown away as an experiment to see what they would do.

As soon as the bulbing commenced it was found necessary to mould them as the sun scorched the outside skin, owing to the constant watering the soil was washed away. They were watered daily, and with very weak liquid manure in addition twice a week until commencing to ripen, then withheld altogether. The crop was taken up early in May and weighed in all thirty pounds. The plants that were transplanted did not succeed anything worth mentioning. not producing one twentieth part in weight to those left in the seed beds although occupying three times the space of ground.

In my opinion the seed was sown too late in the season for this elevation or the result would have been better, as they ripened prematurely and did not keep sound very long.

Revd. J. Thomas, Port Antonio, Portland.—The seeds planted were a complete failure.

Mr. C. H. Grossett, Port Antonio, Portland.—I have much pleasure in reporting that the onion seeds you very kindly sent, were planted and grew, but just then we had unusual heavy rains which destroyed them. I therefore had not the pleasure of drawing any, but will give them another trial.

Mr. Davies, Cedar Valley, Portland.—The onion seed, I received from you. I planted, and they are growing well. They would thrive better if I had ploughed the earth before planting them.

The onions I observe bulb quickly when not deeply planted.

Mr. M. J. Bowen, Retreat, St. Mary.—The seeds did not all grow as they were sown just in the rainy season. I got a few nice large ones, however, some weighing about six ounces.

Mr. T. Williams, Retreat, St. Mary.—Some of the onions grown weighed half a pound, but most of the seeds were lost in the rains.

Mr. Ernest H. Kerr, Port Maria, St. Mary.—I am sorry to say I was most unsuccessful with the onion seeds you kindly sent me: I planted twice and got no return. The first planting was on rich soil well ploughed for Banana plants. The second on forest land prepared for Bananas. My idea was to get in a crop of onions before the bananas came in.

Mr. Barker, New Ramble, Retreat, St. Mary.—The onions have not done so well as last year. Of the first two packets only the white seed grew, and bore some very fine onions, but as they did not all come in at one time, I could not keep account of weight.

The last seeds have grown well, but I fear the very hot weather we are having will prevent their doing well.

Mr. S. Pickersgill, Annotto Bay, St. Mary.—The onion seeds I had from you last year were sown and grew well but the heavy rains of December last destroyed all the suckers.

Mr. W. S. Edgar, Brown's Town, St. Ann.—The seeds sprouted but the plants came to nothing owing to the heat which killed them.

Mr. A. J. Webb, Laughlands, St. Ann.—The onion seed came up well but did not bulb to any size. I do not think they are suited to the coast as it is too hot.

Mr. A. N. Sutherland, Moneague, St. Ann.—The seeds were sown, but did not come up at all.

Mr. Alex. Hopwood, Brown's Town, St. Ann.—The onions did not bulb larger than eschalots. I planted them in a bed well mixed with stable manure, and the rainfall was continuous up to the time of bulbing.

Mr. C. L. Walker, Walker's Wood, St. Ann.—On account of the heavy October seasons, a great deal of the onion seed sent by you was washed away, I however made another trial of a few I had left which gave a splended return, many of the single onions weighed over 16 ounces, those that grew in clusters weighed over 21 pounds.

Mr. C. Helwig, Alexandria, St. Ann.—The onions were an utter failure. They sprang up very nicely but never grew higher than about six inches, possibly the drought affected them.

Mr. Cover, Lime Tree Garden, Brown's Town, St. Ann.—Very few of the onion seeds grew to anything, but what did were very good. I shall be glad to have some fresh ones to try again.

Mr. Archer, Cave Valley, St. Ann.—The onion seeds you sent me came to nothing. I attribute the failure to the heavy rainfall in April, 12.87 in.

Mr. Gilbert Brown, Pedro, St. Ann.—I am sorry to inform you that the onion seeds never came up.

Mr. W. T. Groves, Spicey Hill, Ocho Rios, St. Ann.—The first lot of seeds did not grow at all, the last lot did fairly well, but not so well as last year.

Mr. C. Costa, Brown's Town, St. Ann.—I divided the onion seed you sent me last year into 3 lots for planting at different times, to see which did best.

The first lot planted in November did remarkably well, produced a good crop, and some of the onions were exceptionally fine.

The other lot of seed planted in December and January did badly.

Mr. A. J. Hart, St. Ann's Bay, St. Ann.—The Bermuda onion seeds sent me were planted and turned out well, the onions varying from 3 to 10 ozs.

Mr. Townend, Laughlands, P.O., St. Ann.—The onion seeds were not successful. I prepared the ground well, but I think the seeds were sown too late in the year although well watered through the dry weather, only a few poor specimens survived. I intend to try again.

Mr. T. W. Fletcher, Ocho Rios, St. Ann.—The onion seeds were distributed amongst several small settlers—what was sown grew well but the drought overtook them and the parties having no means of watering, they died off except a few plants which brought fine onions.

Mr. B. E. Fullerton, Duncans, Trelawny—The onion seeds you sent me last year were sown and sprouted freely, and as the weather was favourable I got a fine crop. Some of the bulbs measured fully 8 inches round. Both varieties—red and white—did well. I made ready sale.

Hon. J. W. Fisher, Stewart Town, Trelawny.—The onion seed did not prove a success, very few came to maturity, whether it was owing to the wrong season, or excess, or absence of rain, I cannot say but those that did grow (about a dozen) were of fair size and flavour.

Inspector McLeod, Montego Bay, St. James.—As I have only a small garden I sowed a small portion of the onion seeds you sent me in a box. The plants came up thickly, and when 3 inches high I transplanted them 3 inches apart, in two well manured beds, 14 x 15 feet, I watered them daily in dry weather, and all the plants grew well, and bulbed, many of the onions measured 12 to 13 inches in circumferenee, and weighed 8 to 10 ounces each. Some single plants produced clumps of 2 and 3 onions weighing from 18 to 20 ounces.

I reaped the crop in February and March, I sowed the rest of the seeds but they did not germinate having been kept too long.

My garden is within a mile of the sea, and 2,000 feet above sea-level.

Mr. S. E. Barrett. Montego Bay, St. James.—The onion seed I got from you last year did not come to anything, they started beautifully but I conclude my soil is not suitable, besides which there was too much rain.

Mr. R. M. Burnett, Montego Bay, St. James.—None of the "red onions" came up, and comparatively few of the "white" sort, which are now coming on very well.

Mr. Salmon, Lucea, Hanover.—The seeds were planted, but came to nothing, no doubt the soil had something to do with it.

Mr. Stoley, Sav.-la-Mar, Westmoreland.—The onion seeds proved a failure. I received 4 packets from you of which 3 were given to friends. The report of each individual is the same, i.e., the seeds spring up nicely but in a short time wither and die.

Mr. L. A. W. Stradling, Sav.-la-Mar, Westmoreland.—In reply to the query contained in the foregoing Memorandum, I regret to say that my experiment proved to be a failure. The seed germinated freely and the plants seemed to be vigorous and healthy, until they were about four or five inches high when they turned yellow and withered away. The next time that I try onion seed growing here I will either take the soil from an old pigstye, or cattle pen, or use bone or blood artificial manure. Thank you for the Bulletins.

Mr. C. A. Reed, Sav.-la-Mar, Westmoreland.—The seeds received were planted, but grew rather diminutive, and ultimately perished. Cause unknown.

Mr. E. R. Burgess, Grange Hill, Westmoreland.—The onion seeds were not planted at the time recommended, so had not a fair chance, as they were overtaken by dry weather, and could not be watered regularly.

Mr. H. E. Ibbott, Westmoreland.—The seed was sown in beds and boxes carefully prepared, and water applied when necessary, and till now nothing of their growth has been seen.

Mr. R. J. Morgan, Alligator Pond, St. Elizabeth.—I am sorry to report that the onion seeds grew well, but after a while disappeared.

Mr. E. W. Young, Devon, Manchester.—Much care was devoted to the onions and the seed was planted by directions given in the Bulletin, but the plants never grew.

Mr. A. C. Martin, Cross Keys, Manchester,—The onion seeds you sent me have turned out well. I only planted half the quantity and hope to reap over 30 lbs. weight of onions, some of the bulbs measure 10 inches in circumference. I gave away the balance of seed to settlers in my neighbourhood to experiment with, but cannot say how they have turned out.

Mrs. D'Aeth, Mandeville, Manchester.—Some of the onion seeds you so kindly supplied to us were planted shortly after they were received, in boxes, and fine healthy plants came up—the young plants were transplanted into the vegetable garden, and were doing well, when unfortunately we all left Mandeville for two or three weeks, and on our return we found that through the carelessness of the boys in charge, the stock had broken into the vegetable garden and destroyed everything.

Mr. C. S. Senior, Mandeville, Manchester.—I sowed the onion seeds you sent me, and only got a few that came to perfection—the heavy rains had destroyed nearly all the seeds planted. I gave a friend some of the seeds and got a few bulbs.

Mr. M. H. A. Jacobs, Mandeville, Manchester.—I sowed the seeds in a box and planted them out in a bed well manured after they had grown strong enough to be removed, in rows about 8 inches apart I do not know if that is the proper way, and shall be glad of any information.

Mr. G. Sturridge, Mandeville, Manchester.—The seeds grew rapidly but I regret to say did not bulb, and the plants burnt off in a short time. I fear our soil and climate is not adapted for onion cultivation.

Mr. A. W. Heron, Cross Keys, Manchester.—The seeds I planted in November last and am glad to say got a favourable result. I merely planted them in a firm red soil richly manured with sheep manure and made in drills. Elevation of property 2,000 feet above sea-level.

Mr. C. P. Nosworthy, Pratville, Manchester.—The onion seed you sent me were sown last October very thin, and I have now 50 yards of very decent onions, a little larger than Pigeon eggs, which I expect will show well after a little rain. I gave some to my Ranger and they have succeeded well.

Mr. Wright, Watsons Hill, Manchester.—The onion seed sent me turned out pretty favourable, considering the severe drought which lasted from December to April. Manuring could not be carried out as directed in the Bulletin, neither could any transplanting be done. The latter on account of drought.

A good number of seeds grew, but soon after some died. Several of the onions measured $2\frac{1}{4}$ inches in diameter some others $1\frac{1}{2}$ and the rest were like 'eschalots.' With much more favourable weather and careful manuring, onions would thrive well here.

Miss Gordon, Mile Gully, Manchester.—In February I planted the seed in a small piece of a vegetable garden. The spot was well prepared with good soil and manure. After 4 months the result was some small onions, the size used for pickling. The flavour was good and probably had the seed been sown at the proper time the result would have been more satisfactory.

Mr. Arthur Isaacs, Mile Gully, Manchester.—Didn't succeed with onions owing to want of proper care while away from home.

Mr. J. T. Graham, Linstead, St. Catherine.—The seeds were sown but did not come to anything.

Mr. H. Archer, Old Harbour, St. Catherine.—The seeds all took well and came to perfection about 22 weeks from planting and gave a fair crop.

Appendix III.

Reports on Tobacco.

Mr. J. A. Jesurun, Kingston.—The seed sent was planted in December, 1892, on the lands above Constant Spring Hotel, the tobacco produced from the same was of excellent quality, and good strength giving white ashes when burnt.

Mr. P. H. Baxter, 37, East St., Kingston.—I have not got much return from the seeds you sent me, not having had time to attend to it.

Mr. Chas. Plummer, Kingston.—The tobacco seeds turned out well, I sowed part of it and got a fair crop of good tobacco. I planted out about a quarter of an acre and it gave a good return. I had some made into cigars which were tried by a connoisseur and pronounced very good; some of it I sold.

Mr. Lewis, Yallahs, St. Thomas.—I had beds prepared, and seeds sown, but the rains were so heavy and incessant that the piece of land selected was swamped and most of the seeds must have been destroyed as I see very few coming up, and these, only withinthe last month or so.

Mr. Petgrave, Sherwood Forest.—The soil is well suited for the cultivation of tobacco, but the settlers are prejudiced against "Havana seed" because the leaves of the tobacco grown from them are not so large as the leaves of what they call "Virginny" tobacco. The growers prefer the Virginny tobacco as they believe it gives a better return.

Mr. J. A. Fuller, Coopers Hill, Portland.—The tobacco sent me was almost destroyed by a heavy rain which fell just as it was germinating. I only planted about 2,000 suckers which brought 5 cwt. which is very good and will be sold at one shilling per pound.

Mr. R. Elworthy, Priestman's River.—The tobacco seeds grew, but the last year withered the plants. I distributed most of the seeds to settlers, whom I find were disappointed in the leaf, they prefer the large coarse, common tobacco.

Mr. F. H. Barker, Retreat, St. Mary.—The tobacco seed grew well and some very fine tobacco was procured from it, but not knowing that a report would be required, I did not keep any account of the weight.

Mr. J. Williams, Retreat.—I am glad to inform you that the tobacco seeds you sent me have turned out very satisfactory. The tobacco has a very nice flavour in smoking and I am still using it.

Mr. A. Webb, Laughlands, St. Ann.—I gave the tobacco seed to small settlers as I found I could not make use of it myself. They unanimously agree that it has produced better tobacco than any they have yet grown.

Mr. W. S. Edgar, Brown's Town.—I got some capital tobacco from the seeds you sent. I find they do not ratoon so well as the "Cow-tongue." The colour when cured is different, resembling a half decayed cabbage leaf. The smoking quality is excellent.

Mr. J. R. V. Braham, Moneague.—I regret to say the tobacco seed was nearly all lost on account of the dry weather coming on just after sowing, and the plants left were so few I could not make a crop.

Mr. A. B. Ashley, Frankfield.—Owing to the dry weather in September and October the seeds sent me did not turn out well. None of it grew. I intend to try again this year, so please put me on the list of applicants for seeds.

Mr. J. W. Gruber, Montego Bay, St. James.—I distributed the tobacco seeds to 11 persons, each one promising to report on the growth of them. Except one person who returned some time after and showed me a few well-developed leaves, I have heard nothing more of them.

Mr. Taylor Domville, Little River.—I distributed the seed among a number of small settlers, it did remarkably well, and many other settlers are very anxious to get some of the seed. The tobacco grown was the best in this quarter. There is quite a trade in tobacco between here and Lucea.

Mr. W. H. Ramsay, Montego Bay.—When the seeds arrived I was away from home, when I returned I sowed some in an old cattle pen, they have thriven wonderfully, and will soon be ready to cut. Some of the plants I distributed among small cultivators in my neighbourhood they took in their crops about two weeks ago; they are quite pleased at the quality of the leaves, but are perfectly ignorant of the proper method of curing so as to secure the advantages that the superior quality ought to bring.

Mr. H. E. Ibbot, Sav.-la-Mar, Westmoreland.—I distributed the seeds to several persons. Three men to whom I gave seeds tell me the plants thrive well, and are of good quality.

Mr. H. B. Salmon, Black River, St. Elizabeth.—The tobacco seed sent turned out most satisfactorily. I have distributed a quantity of seed from the ratoons to small settlers, all have been satisfied with the tobacco obtained.

Mr. J. S. Owden, Lacovia, Manchester.—The small place we have apart from our works is very poor ground, and is either parched up, or when the river comes down, flooded, which it did soon after planting.

Miss Gordon, Derry, Mile Gully, Manchester —The seed sent has grown well.

Mr. G. Salmon, Frankfield, Clarendon.—Owing to the severe drought during the months of August and September, and the early part of October I did not get the amount of seedlings I should have, from the Tobacco seed sent me. However I am glad to report great success from those I transplanted, and as this soil is so very suitable for it I intend to plant 3 acres this year.

Mr. E S. Salmon, Frankfield, Clarendon.—Owing to the severe drought last year during the best months for sowing Tobacco seed, I had to scatter the seed three times. I was, however successful in my last attempt, and have transplanted over 5,000 seedlings, which have been very productive. I also transplanted not less than 400 Creole Tobacco as I could not get sufficient plants from my own nursery.

Mr. S. Cover, Linstead, St. Catherine.—I sowed the tobacco seeds received from you, and they produced good healthy suckers. These were attacked by caterpillars, and although I managed to save a few I did not do much with them, the leaves did not appear to be as good as those obtained from ordinary seed.

Mr. M. H. Edwards, Linstead, St. Catherine.—I have already reported on the Tobacco seeds received in 1892. The last lot received in 1893 I sowed and got good return.

Mr. J. T. Graham, Mount Hermon, Linstead, St. Catherine.—I regret very much not being able to report favourably on the Tobacco seed sent me. The land which was prepared appeared fertile, but either it was not the right soil, or the sudden change of the season stunted them.

I gave two packets of seed to a tobacco-grower in St. James, he reports, that he gained much from the seeds sent him.

Appendix IV.

Reports on Eucalyptus.

Dr. M. Grabham, Kingston.—Regarding the Eucalyptus plants supplied to the Penitentiary.

E. microtheca has done best, about 19 plants lived many of which have attained a large size being 12 to 14 feet high.

E robusta: 6 living plants do not look healthy, large areas of the leaves get scorched and withered apparently the result of excessive exposure and not from any parasitic influence.

E. rostrata: the only 2 plants are growing luxuriantly and exceed all the others in height, 16 feet.

E. citriodora: one plant has survived and has grown fairly well, but suffers in the same way as E. robusta.

E. sp ? (not *Globulus*) one plant living and growing well, leaves loaded with essential oil.

You will observe the *E. microtheca* and *E rostrata* have succeeded well, although unfortunately the essential oil in the leaves of the former is present only in small quantities.

I have recently been much interested in reading Prof. Leveran's work on Malarial Fever, to find that *E. rostrata* has been planted, 500 trees at a time over large districts in Algeria which had hitherto been altogether uninhabitable by means of marsh fever. *E. Globulus* had failed there, being too delicate, and perishing rapidly in a marshy soil.

Dr. F. A. Carpenter, Kingston.—The trees were planted in the proper manner, but unfortunately they were all destroyed by land crabs.

Mr. H. R. Kidd, Kingston.—The plants died through neglect while I was absent for a few months from home.

Mr. T. H. Cripps, Kingston.—All the plants are in a flourishing condition, several having attained a height of over two feet, and this I confess under very unfavourable circumstances.—(E. robusta, E. microtheca.)

Mr. H. A. Cunha, Kingston.—Plants have grown fairly well—one or two have died.

Mr. A. H. DaCosta, Kingston.—I am glad to report ten of the twelve trees supplied doing well—several being over five feet high.—(robusta and microtheca.)

Revd. A. A. Hedmann, Clifton.—The Eucalyptus plants which I sent to Siloah are doing well. Though they were planted out only 9 months ago, some of them are about five feet high.

Mr. R. B. Breakspear, Morant Bay, St. Thomas.—Most of the trees are from 2 feet to 2 feet 6in. in height, one or two have grown to 4 feet.—(E. microtheca, E. robusta and E. citriodora).

Mr. R. E. Elworthy, Priestman's River, Portland.—Of the Eucalyptus trees 9 are growing—some of which are nearly 3 feet high.—(E. robusta.)

Mr. E. E. Hosack, Annotto Bay.—The trees all died two or three months after planting.

Mr. R. P. Simmonds, Port Maria.—Plants have all grown nicely and are from two to five feet in height.—(E. microtheca and E. robusta.)

Mr. J. S. Wilensky, Port Maria.—The plants took nicely, but were destroyed by crabs which infest this place.

Mr. F. H. Barker, Retreat.—There are seven trees alive—one about 4 ft. 6 in. and others about 3 ft. high. They do not appear to be very flourishing although planted in moist swampy land.—(E. microtheca and robusta.)

Mr. H. B. Walcott Richmond.—The plants were nearly all dead when I got them. The few live ones hardly survived transplanting.—(E. robusta.)

Mr. A. N. Sutherland, Moneague, St. Ann.—Many of the plants are now from 4 to 5 feet high and growing most luxuriantly, throwing out a nice lot of healthy vigorous lateral branches.

Mr. H. M. Rowe, Falmouth.—The plants all died owing partly to unfavourable conditions of soil and weather, and partly because they arrived in a very puny condition.

Mr. J. W. Gruber, Montego Bay, St. James.—I planted the six trees in the swampy land behind the Parish Church, and took great trouble to have them well fenced; but after the very heavy rains which completely flooded the land they all died.

Mr. A. J. Hart, Green Island, Hanover.—The Eucalyptus plants are thriving well.—(E. microtheca and robusta.)

Mr. A. C. Bancroft, Lucea.—The Eucalyptus plants sent me have done well and are growing apace, except some which were planted near the sea and have died from the effects of the salt.—(E. citriodora).

Mr. H. A. Vickers, Sav.-la-Mar, Westmoreland.—Six of the trees are flourishing, the other six have died. One tree is 10ft. high another 9ft. and one is 7ft. The others are smaller, but are all coming on fairly. Great attention is paid to these plants and they are fenced with iron railings imported for the purpose.—(E. citriodora.)

Mr. J. R. Hopwood, Petersfield, Westmoreland.—Of the Eucalyptus trees supplied only one has struck soil. It stands now about 8 feet high with plenty of vigour, the others gave promise at first of doing well but after some months they died.—(E. citriodora).

Mrs. Charley, Little London, Westmoreland.—Two thirds of the trees supplied have grown fine healthy plants.—(E. microtheca and robusta).

Mr. Dennis M. James, Lacovia, St. Elizabeth.—Of the four trees planted by me only one is thriving, the rest are dead.

Mr. R. K. Tomlinson, Lacovia, St. Elizabeth.—The plants have grown well, the majority being about 5 ft. high, four having grown more rapidly, viz. :—E. rostrata, 11 ft. high; E. robusta, 9 ft.; E. microtheca, 8 ft.; E. citriodora, 6 ft.

Mr. A. A. Green, Milk River, Clarendon.—The plants were put out on the wharf premises here, we have 13 growing beautifully, some are 12 to 15ft. high and are very healthy.—(E. melliodora).

Dr. R. C. Gibb, Alley, Clarendon.—With the exception of three all the plants are doing well.—(E. microtheca and robusta).

Mr. W. Charley, Spanish Town, St. Catherine.—The Eucalyptus trees have done remarkably well here; two trees measure respectively 10 ft. 4 in. and 9 ft. 4 in. in height, one of them being 6½ in. in circumference at its base.—(E. microtheca and robusta).

Mr. R. W. Butler, Linstead, St. Catherine.—I am sorry to say I have lost all the Eucalyptus plants, but fear it was more my fault than otherwise as I kept them too long in the pots.—(E. rostrata).

Mr. G. C. Lindo, Old Harbour, St. Catherine.—All the trees are thriving. The majority are fully 8 ft. high.—(E. microtheca and robusta).

Mr. D. H. Mendez, Old Harbour, St. Catherine.—I carefully planted twelve around my house and 9 of them have grown. I also planted 4 at Lancewood Valley and three have grown. I gave away the remaining 8 to friends and they report well of them. I notice that the plants do best in moist ground—around my swimming bath I planted four trees, as the place is continually wet, and they are doing better than the others, two of them being fully seven feet high.—(E. microtheca and robusta).

Appendix V.

Catalogue of Books added to the Library.

(The names of Donors are printed in square brackets.)

Abbay, (Revd. R.) Observations on *Hemeleia vastatrix*, the fungus of the "Coffee-leaf Disease." (Extract) *Journ. Linn. Soc. Bot. XVII.* London. 1878. 8 vo.

Acland (Sir T. Dyke). Introduction to the Chemistry of Farming for Practical Farmers. 2nd Ed. London. 1892. 8 vo.

Aikman (Prof. C. M.) Johnston's Elements of Agricultural Chemistry. Revised and partly re-written. London. 1894. 8 vo.

Bailey (F. M.) Companion for the Queensland Student of Plant Life. Brisbane. 1893. 8 vo. [*Author.*]

Baker (J. G.) Elementary Lessons in Botanical Geography. London. 1875. 8 vo.

Baker (J. G.) Synopsis of the Genera and Species of Museae. (Reprint). *Annals of Botany.* London. 1893. 4 to. [*Kew.*]

Balfour (Prof. J. B. and others). Annals of Botany. Vol. vii, Nos. 26-28, Vol. viii, 29. London and Oxford. 1893. 8 vo.

Barron (A. F). Vines and Vine Culture. London. 1892. 8 vo.

Bentham (Geo.) Flora Hongkongensis London. 1861. 8 vo. [*Kew.*]

Boulger (G. S.) The Uses of Plants. London. 1889. 8 vo.

Candolle (A. de & C. de). Monographiæ Phanerogamarum. Vol. VIII. Guttiferæ, by J. Vesque. Paris. 1893. 8 vo.

Candolle (A. de). Phytographie: ou l'art de décrire les Végétaux. Paris. 1880. 8 vo.

Collins (Jas.) Report on the Caoutchouc of Commerce: information on the plants yielding it, their geographical distribution and the possibility of their cultivation in India. London. 1872. 4 to.

Cooke (M. C.) The Coffee Disease in South America. (Extract) *Journ. Linn. Soc. Bot. XVIII.* London. 1881. 8 vo.

Crombie (Revd. J. M.) A monograph of Lichens found in Britain: Catalogue of species in Herbarium of the British Museum, Part I. London. 1894. 8 vo. [*Trustees, British Museum.*]

DIETRICH (Dr. David). Synopsis Plantarum. 2 Vols. Vimariae. 1839-40. 8 vo. [*Kew.*]

DELTEIL (A.) Vanille: sa culture et sa préparation. 3rd Ed. Paris. 1884. 8 vo.

ELLIOTT (Stephen). Botany of South Carolina and Georgia. 2 vols. Charleston. 4to. 1821–24. [*Kew.*]

FOCKE (W. O). Die Rubus-Arten der Antillen (Extract). *Abh. h. v. naturwiss. Vereine zu Bremen. IX.* Bremen. 1890. 8vo.

GREGG (W. H.) A Text Book on Indian Botany. Chaps. I and II in part. Calcutta. 1881. 8vo. [*Kew.*]

HENFREY (Prof. A.) An Elementary Course of Botany. 4th Ed. by Dr. M. T. Masters and A. W. Bennett. London. 1884. 8 vo.

HOOKER (Sir J. D.) Flora of British India. Part XIX. London. 1893. 8 vo. [*Kew.*]

JACKSON (B. D. and Sir J. Hooker). Index Kewensis Plantarum Phanerogamarum. Compiled by B. D. Jackson under the direction of Sir J. D. Hooker. Parts I and II. Oxford. 1893. 4 to.

JOHNSTON (Prof.) Catechism of Agricultural Chemistry. Revised by C. M. Aikman. London. 1892. 8 vo.

JOURNAL OF THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND. Third series. Vol. IV. Pts. I and II. London. 1893. 8 vo.

KEW, ROYAL GARDENS. Bulletin of Miscellaneous Information. London. 1893. 8 vo. [*Kew.*]

KIAERSKOU (H.) Myrtaceæ ex India occidentali. (Extract) *Botan. Tidsskrift. XVII.* Copenhagen. 1890. 8 vo.

LINDLEY (Prof. John). The Genera and Species of Orchideous Plants. Illustrated by Drawings by Francis Bauer. Part I. London. 1838. 4 to.

LAURIE (A. P.) The Food of Plants. London. 1893. 8 vo.

MACMILLAN (Conway). The Metaspermæ of the Minnesota Valley. Minneapolis, U. S. A. 8 vo. 1892. [*Author.*]

MEZ (Dr.) Lauraceæ Americanæ. (Extract) *Jahrbuch d. Koen. Botan. Gartens zu Berlin.* Berlin. 1889. 8 vo.

MOORE (Charles). Handbook of the Flora of New South Wales. Sydney. 1893. 8 vo. [*Author.*]

MURRAY (Geo.) Phycological Memoirs. Part II. London. 1893. 8 vo.

MURRAY (Geo.) Catalogue of the Marine Algæ of the West Indian Region. (Reprint). *Jour. of Bot.* London. 1889. 8 vo.

NICHOLLS (Dr. H. A. Alford). A Text Book of Tropical Agriculture. London. 1892. 8 vo.

O'CONOR (J. E.) Vanilla: Its cultivation in India. Revised Edition. Calcutta. 1881. 8 vo.

OLIVER (Prof. D.) First Book of Indian Botany. London. 1892. 8 vo.

OLIVER (Prof. D.) Hooker's Icones Plantarum. Vol. III. Part IV. London. 1894. 8 vo. [*Bentham Trustees through Kew.*]

PERSOON (C. H.) Synopsis Plantarum. 2 Vols. Paris. 1805 and 1807. 8 vo. [*Kew.*]

PILLEY (John J.) The Elements of Scientific Agriculture. London. 8 vo.

SARGENT (C. S.) The Silva of North America. Vol. V. Boston and New York. 1893. Fol.

SERINGE (N. C.) Flore des Jardins. Paris. 1845. 8 vo. [*Kew.*]

Sibson (Alfred). Agricultural Chemistry. With Preface by Dr. A. Voelcker. Revised by Author and A. E. Sibson. London. 1892. 8 vo.

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APPENDIX VI.

Meteorological Tables.

KINGSTON PUBLIC GARDEN—ELEVATION, 60 FEET.

Month.	Pressure.		Temperature. Degrees Fahrenheit.					Dew Point.		Humidity.		Direction.	Force.	Rainfall—Inches.
	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Max.	Min.	Range.	7 a.m.	3 p.m.	7 a.m.	3 p.m.			
1893.	In.	In.	°	°	°	°	°	°	°					
April ...	30.039	29.977	72.8	81.3	84.7	69.4	15.3	67.2	69.9	83	69	SE–S	92.1	1.29
May ...	29.986	29.935	76.5	82.1	86.0	71.7	14.3	69.5	71.7	80	71	SSE	94.0	2.67
June ...	30.001	29.960	76.5	83.9	86.8	72.6	14.2	70.0	72.0	80	68	SE–S	105.8	1.80
July ...	29.998	29 963	75.9	84.7	87.8	72.2	15.6	69.8	72.7	81	67	SE–S	91.1	5.94
August ..	29.962	29.930	76.3	85.4	89.1	73.7	15.4	70.9	73.5	83	68	SSE	88.5	2.21
September ...	29 964	29.908	75.9	87.0	89.1	73.7	15.4	70.7	74.6	84	70	SSE	83.1	2.72
October ...	29.891	29.839	74.3	83 6	87.4	72.2	15 2	71.3	74.5	90	74	S	53 8	9.54
November ...	29.972	29.913	72.5	82.1	86.1	70.8	15.3	69.6	73.5	90	77	S by E	54.8	3.57
December ...	30.020	29.960	69.9	81.3	84.5	68.4	16.1	67.0	70.2	90	70	SSE	57.6	3.29
1894.														
January ...	30.053	29.990	68.6	82.0	84.8	66.7	18.1	63.4	67.7	84	62	SSE	70.4	0.19
February ...	30.107	30.046	67.7	80.7	84.0	66.2	17.8	62.9	68.3	85	66	SE	95.7	0.67
March ..	30.079	30.022	69 2	81.0	83.9	66.6	17.3	63.2	69.8	81	69	SSE	102.7	0.74
Means ...	30.005	29.953	73.0	83.9	86.2	70.3	15.8	67.9	71.5	84	69	SSE	82.4	Total 34.63
					Mean 78.2									

Castleton Gardens.—Elevation, 580 Feet.

Month.	Pressure.		Temperature. Degrees Fahrenheit.					Dew Point.		Humidity.		Rainfall—Inches.
	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Max.	Min.	Range.	7 a m.	3 p.m.	7 a.m.	3 p.m.	
1893.	In.	In.	°	°	°	°	°	°	°			
April ...	29.62	29.61	67.0	78.1	83.0	64.5	18.5	64.6	72.1	91	81	10.47
May ...	.57	.57	71.2	78.3	84.9	63.8	21.1	70.1	68.6	96	73	15.63
June ...	.59	.59	72.9	80 0	86.3	68.0	18.3	71.3	74.0	93	81	16.54
July ...	.60	.60	71.5	81.7	88.5	68.0	20.5	70.1	74.5	93	79	13.39
August ...	.57	.57	71.4	80.0	86.9	68.5	18.4	70.5	74.9	98	84	20.75
September ...	.57	.57	71.0	79.5	86.0	68.4	17.6	70 4	75.6	96	87	10.92
October ...	.50	.48	70.3	80.0	84.8	67.7	17.1	68 8	75.2	96	84	15.62
November ...	.57	.55	69.3	77.4	81 8	67 5	14.3	68.9	74.3	99	90	12.19
December ...	.62	.62	68.1	75.3	78.6	63.2	15.4	67 7	71.8	99	90	22.48
1894.												
January ...	.64	.64	65.1	74.2	79.3	62.2	17.1	63.8	67.7	96	81	3.33
February ...	.69	.68	64.0	76.5	76.9	61.7	15.2	63.2	70.3	96	79	7.86
March ...	.66	.65	62.9	77.1	81.0	60.2	20.8	61.4	69.6	93	79	4.21
Means ...	29.60	29.59	68.7	78.1	$\underbrace{83.1 \quad\quad 65.3}_{\text{Mean } 74.2}$		17.8	67.5	72.3	95	82	Total 153.39

Hope Gardens—Elevation, 600 Feet.

Month.	Pressure.		Temperature. Degrees Fahrenheit.					Dew Point.		Humidity.		Rainfall—Inches.
	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Max.	Min.	Range.	7 a.m.	3 p m.	7 a.m.	3 p.m.	
1893.	In.	In.	°	°	°	°	°	°	°			
April ...	29.24	29.20	69.7	83.4	86.2	65.4	20.8	62 9	70.2	78	64	3.68
May ...	.21	.22	74.5	81.8	87.7	71.2	16.5	71.0	72.0	86	71	5.75
June ...	.22	.25	74.4	81.3	89.8	68.8	21.0	69.9	72.0	87	74	5.25
July ...	.22	.26	74.7	82.1	91.4	68.6	22.8	69.3	73.4	81	74	8.88
August ...	.20	.23	75.4	84.6	91.3	69.9	21.4	70.9	76.6	87	76	5.39
September ...	.20	.21	73.3	83.4	90 9	70.1	20.8	71.2	78.3	93	85	5.06
October ..	.13	.13	72.9	80.6	89.8	68.9	20.9	71.6	77.7	96	90	14.56
November ...	.18	.20	71.2	79.8	90.3	65.4	24.9	62.6	74.6	75	84	6 68
December ...	.22	.22	69.7	78.8	89.1	64.9	24.2	68.2	73.3	93	82	4.61
1894.												
January ...	.21	.26	68.6	78.7	86.2	61.2	25.0	65.7	74.6	90	89	0.38
February ...	.29	.30	68.4	78.5	84.8	61.2	23.6	65.3	72.0	90	79	1.76
March ...	.28	.29	70.9	78.0	84 0	61.4	22.6	65.3	68.7	75	73	0.73
Means ..	29.21	29.23	71.9	80.9	88.4	66.4	22.0	67.8	73.6	85	78	Total. 62.73
					Mean 77.4							

KING'S HOUSE GARDEN—ELEVATION 400 FEET.

Month.	Pressure.		Temperature. Degrees Fahrenheit.					Dew Point.		Humidity.		Rainfall—Inches.
	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Max.	Min.	Range.	7 a.m.	3 p.m.	7 a.m.	3 p.m.	
1893.	In.		°	°	°	°	°	°	°			
April ...	29.84	29.78	72.0	81 9	87.8	62.4	15.4	67.6	77.5	87	87	2.80
May ...	.76	.71	73.8	81.6	87.7	64.7	23.0	69.6	77.0	87	84	6.15
June ...	.76	.72	73.8	83.8	87.8	65.6	22.2	69.7	77.3	87	75	3 90
July ...	.77	.75	73.8	84.7	89.0	65.3	23.7	70.6	80.7	90	87	7.42
August ...	.27	.69	73.4	81.2	91.4	66.4	25 0	70.1	73.4	90	76	5.10
September ...	.71	.66	73.7	84.8	90.2	65.3	24.9	70.7	81.3	90	87	3.41
October ...	.64	.60	72.8	84 3	88.9	64.2	24.7	70.5	80.6	93	90	13.59
November ...	.73	.68	71.6	83.3	84.3	60.6	23.7	68.8	79.5	90	87	6.35
December ...	.77	.72	69.5	80.2	86.6	61.7	24.9	66.9	77.9	90	84	4.60
1894.												
January ...	.82	.75	65.9	84.4	87.3	56.5	30.8	63.3	79.0	90	84	0.17
February ...	.87	.80	64.0	84.0	87.8	55.3	32.5	61.8	77.8	93	82	1.30
March ...	.84	.79	64 9	81.9	86.3	55.7	30.6	61.2	75.5	87	82	0.83
Means ...	29.73	29.72	70.7	83.0	87.9	61.9	25.1	67.5	78.1	88	83	Total. 55.62
					Mean 74.9							

Hill Garden and Cinchona Plantation.

Month.	Hill Garden—Elevation 4,907 Feet. Pressure. 7 a.m.	Pressure. 3 p.m.	Temperature.—Degrees Fahrenheit. 7 a.m.	Temperature. 3 p.m.	Temperature. Max.	Temperature. Min.	Temperature. Range.	6 feet underground. 7 a.m.	6 feet underground. 3 p.m.	Dew Point. 7 a.m.	Dew Point. 3 p.m.	Humidity. 7 a.m.	Humidity. 3 p.m.	Wind. Direction.	Wind. Force—Miles.	Rainfall—Inches.	Newhaven Gap—Elevation 5,600 feet. Max. Temp.	Min. Temp	Rainfall—Inches.	Blue Mountain Peak—Elevation, 7,406 Feet. Date of Observation.	Time of Observation.	Temperature.	Max. Temp.	Min. Temp.	Rainfall—Inches.
1893.	Ins.	Ins.	°	°	°	°	°	°	°	°	°						°	°			a.m.	°	°	°	
April	25.350	25.328	59 2	62.4	66 2	54.8	11.4	60.4	60.4	53.3	59.7	80	93	E	26.0	4.52	72.3	51.5	8.50	1 5.93	11	59	65.9	46.3	1.15
May	.344	.329	61.5	63.1	67.3	55.8	11.5	60.3	60.2	56.5	61.0	81	93	E	9 5	17.14	74.3	48.5	12.70	31. 5.93	10	59	69.9	45.3	11.80
June	.359	.359	62.2	65.3	68.6	57.2	11.4	61.1	61.2	57.7	62.1	86	89	E	10.0	6.99	75.3	51.5	8.50	30. 6 93	11.15	64	72.9	45.3	11.60
July	.366	382	62.7	66.3	70.4	57.8	12.6	62.1	62.0	56.2	61.8	77	87	E	35.8	17.29	75 3	53.5	12.00	31. 7.93	11.45	67	70.9	47.3	24.70
August	.352	.344	63.3	66.4	70.7	58.1	12.6	63.0	63.0	55.9	62 9	78	90	E	17.0	11.87	74.3	53 5	9.18	31. 8.93	9 15	60	71.9	46.3	8.75
September	.368	.349	63.1	65.3	69 7	58.2	11.5	63.2	63.2	57.1	62.3	80	90	E	9.8	6.70	75.3	55.5	6.12	30. 9.93	11.30	66	69.9	44.3	8.60
October	.307	.269	61.5	64.8	68 5	57.5	11.0	63.0	63.0	57.4	61.8	83	89	E	19.5	14.25	72.3	59.5	20.10	31.10.93	10.30	52	72.9	43.3	21.00
November	.335	.306	60.1	63.3	67.0	56.5	10.5	62.9	62.9	55.2	60.7	80	93	E	24.0	10.32	–	–	20.07	30.11.93	11.15	57	69.9	41.3	13.30
December	.338	.317	56.9	62.1	66.1	54.2	11.9	62.1	62 1	52.6	57.6	86	86	E	60.6	20.14	–	–	43.07	31.12.93	10.15	54	64 9	40.3	43 60
1894.																									
January	.364	.325	55.2	61.0	65.3	53.2	12.1	61 0	61.0	50.4	55.2	83	80	E	56.4	2.64	–	–	11.25	31. 1.94	11.30	56	68.9	41.3	9.45
February	.392	.368	54.7	61.6	65.7	53.2	12 5	60.2	60.2	48 8	56 9	80	83	E	33.2	8.41	–	–	13.60	28. 2.94	10.45	52	65.9	42.3	16.30
March	.371	.344	54.3	60.9	64.8	53.2	11.6	59.2	59.2	49.5	56.4	86	83	E	24 0	7.00	–	–	6 04	31. 3.94	11.30	56	66.9	40.3	9.70
Means ...	25.353	25.335	59.5	63.5	67.5	55.8	11.7	61.5	61.5	54.2	59 8	81	88	Easterly	27.1	127.27 Total.	74.1	53.3	171.13 Total.	...	...	58.5	69.2	43.6	180.05 Total.
					$\underbrace{\quad}_{\text{Mean 61.6}}$												$\underbrace{\quad}_{\text{Mean for 7 months 63.7}}$						$\underbrace{\quad}_{\text{Mean 56.4}}$		

New Series.] MAY, 1895. Vol. II. Part 5.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Twopence.

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JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] MAY, 1895. Vol. II. Part 5.

DISTILLING THE ESSENTIAL OIL OF LIMES.

Hon. Colonial Secretary to Director of Public Gardens, &c.

28th Febry., 1895.

SIR,

I am desired by the Governor to enclose for your information and for publication in the Bulletin, a copy of a report by Major Blagrove of his experiment in distilling the essential oil of limes.

I have, &c.

J. ALLWOOD,

Asst. Colonial Secretary.

Major Blagrove to Hon. Colonial Secretary.

Orange Valley, Brown's Town, 18th February, 1895.

SIR,

I have the honour to acknowledge the receipt of your letter of 13th instant and beg to express my thanks to the Governor for according permission to run an experimental still, on condition that a report be furnished on the result of same.

The experiment was somewhat hastily carried out, but I was anxious to superintend it personally before leaving the Island on Tuesday next.

I regret to add that an accident to the still which necessitated "blowing off" just at the time the distillate commenced to run, interfered somewhat with the result of the experiment which in most respects, I consider to be a success.

The experiment was conducted as follows :—

The still was charged with 650 gallons lime juice and 150 gallons water, the latter had to be added as it was considered necessary to charge up to 800 gallons to avoid burning, and the lime crop being now over, I was unable to obtain the requisite amount of juice.

The retort was charged with water only. The lime juice had not been clarified or strained in any way.

The distillate commenced to run about four hours after the fire was started and at this time a delay of an hour took place through an accident to the still; as soon as this was repaired, the distillate commenced to run and continued doing so for about two hours.

The distillate contained a fair quantity of pure essential oil and in the end 6½ quarts were obtained. I estimate that about a quart of essential oil was lost through being compelled to "blow off" just as the distillate commenced to run, whereby a large volume of vapour which contained a quantity of essential oil. was wasted.

I am unable to state the value of distilled essential oil at the present time, some months ago it was very low and worth only about 1/9 per lb. or 2/7½ per quart. The value of the essential oil obtained by this experiment would be therefore about 17/.

It must be borne in mind that the lime juice with which the still was charged, was concentrated to a certain extent during the operation, only 550 gallons being contained in the still when it was run off. There would therefore be a considerable saving of expense in concentrating this remainder to the extent required for shipment

It must also be remembered that had the still contained the full charge of 800 gallons of pure lime juice, the amount of oil obtained would have been *at least* 9 quarts which at late low prices would be worth nearly 24/.

The cost of running the still for fuel and labour was 10/6.

It has been demonstrated from this experiment:—

(1) That it is feasible to distil essential oil from lime juice and to concentrate to a certain extent at the same time.

(2) The juice being already reduced by about ¼ the further concentration is thereby rendered easier and cheaper.

(3) The essential oil can be obtained equally well from small stills of the capacity of about 10 gallons and upwards, thereby bringing the process within reach of small proprietors who can only grow a limited quantity of limes and cannot afford the outlay on a large still. The further process of "concentrating" can be carried out equally well on a small scale.

Limes grow easily and rapidly. Machinery to produce oil and concentrated juice on a small scale should not cost above £20 to £25.

It appears to me therefore that an industry of some practical value to small holders might be started in connection with the above.

I have, etc.,

H. Blagrove,

Major 13th Hussars.

UTILISATION OF BANANAS FOR MEAL, &c.—III.

In the Bulletins for last July and January, the subject of machinery for utilising waste bananas was discussed. The following letter has been received from Mr. Asser, and the matter will now be left for planters themselves to deal with. Mr. Asser's samples are in the Museum of the Jamaica Institute:—

L. E. Asser, C.E., to Director of Public Gardens and Plantations.

The Hague. Holland.
11th March, 1895.

Dear Sir,

I should now very much like to know if there will be a possibility to bring out a company in Jamaica for starting a factory in one of the districts. The afforded capital for the machinery buildings, etc., for working 20,000 tons Bananas, would amount with working capital to £25,000. We would agree to sell our patent to the company, principally for a part in the benefit, and are also disposed to send out all necessary machinery and to assist in the starting of the factory. Mr. Hartogh would not object to establish himself some time in Jamaica for this purpose. If now it is thought desirable that one of us or perhaps both come to Jamaica to settle the affair we wait some proposition on this account. It might be desirable in this case if we were put in connection with London friends of the Jamaica planters in question before, in order to interest them also. If necessary for cabling the A B C Code can be used and the address Asser, Hague, will suffice.

Very truly yours,
L. E. Asser.

SHIPPING FRUIT TO ENGLAND.

When in England I had interviews with Shipping Agents on the question of shipping bananas and other fruits to England. I was assured that there would be no difficulty in finding suitable steamers, if planters in Jamaica would guarantee cargoes at certain intervals.

The following letter has been received on the subject, and planters will be able to judge for themselves whether shipping to England is likely to pay.

W. F.

Messrs. Tatham, Bromage & Co., to Director of Public Gardens and Plantations.

St. Michael's Buildings,
9 Gracechurch Street, London.
26th March, 1895.

Sir,

Respecting the banana trade, the kind of ship to take would be the s. s. "Buccaneer," about 950 tons gross register, with a speed of 10½ to 11 knots. She ran in the banana trade to New York during 1893. She is fitted with temporary tween decks. and is specially ventilated.

Now, in consequence of the unprofitable nature of outward freights, the only way to get a shipowner to do it, is to run in ballast from Cardiff, taking on board coals for the entire voyage, of which she would need approximately 500—600 tons, at a cost of about 10s. 6d. per ton in Cardiff. She would occupy eighteen days on each passage, and would take three days to be discharged in London, and four days to go to Cardiff, and away from there. Her expenses here would be approximately £70, you could add to this the expenses and delay in Jamaica, and make a calculation for yourself.

The hire of such a ship would be approximately £20 per day, and that would cover a commission of 2 per cent. on the hire money.

We forget how many bunches she carries, but the people at Baracao can easily tell you what a ship of 950 tons gross (or 650 tons net, which is the same thing), is able to carry.

Yours, &c.,

TATHAM, BROMAGE & Co.

COCCIDÆ OR SCALE INSECTS.—VII.

By T. D. A. COCKERELL, Professor of Entomology at the New Mexico Agricultural College.

(33). *Ceroplastes albolineatus*, Ckll.—see p. 7.

It was surmised that this species had been introduced into Jamaica, but when writing before, no other locality was known. Dr. H. Von Thering now sends five specimens of it from Sao Paulo, Brazil, where it infests *Baccharis, Schinus,* &c. These new specimens show that the insect grows as large as *C. ceriferus,* and the horn may be tolerably well developed; but it will always be very easily distinguished by its pinkish colour (*ceriferus* being white), with the two white lines on each side.

Genus *Inglisia;* the Glassy Scales.

In this genus the animal resembles a *Lecanium,* but is covered by a fragile glassy scale Thus the normal female of *Inglisia* resembles a good deal the little glassy male scales of *Lecanium,* and the latter might possibly be mistaken for the former on superficial examination. *Inglisia* is a genus of New Zealand and Australia, but one species is found in Trinidad.

(35). *Inglisia vitrea.*—Ckll. (The Trinidad Glassy Scale).

Diagnosis.—A small oval moderately convex scale about an eight of an inch long, white and glassy, but skinny red-brown when the glassy scale is removed. With a lens it is seen that the glassy scale is divided into plates, tortoise-like.

Distribution.—Only known from Trinidad, where it was found by Mr. Urich.

Food-plant.—*Acacia* sp.

Destructiveness.—It would be troublesome if abundant, but at present it is apparently quite a rarity.

Enemies.—It has an undetermined parasite.

Genus *Vinsonia;* the Star Scales.

Only one species of this genus is known. It is covered with a glassy scale something like an *Inglisia,* but is very easily recognised by the seven glassy rays, giving it a star-like appearance. The central portion is convex and reddish-brown.

(36.) *Vinsonia stellifera,* Westwood (The Star Scale).

Diagnosis.—See above under the genus.

Distribution.—Known from both hemispheres; in the eastern, from the Island of Rénunion, and believed to occur also in Siam; besides which, Mr. E. E. Green informs me that he has found it in Ceylon. In Europe, it is sometimes found in hothouses. In the neotropical region, it has been found in Demerara, Jamaica, Barbados (on coconut, specimens received through Dr Plaxton in 1892,) St Kitts (Barber), Montserrat (Barber), Antigua (Barber), Trinidad (Urich), and Grenada (Smith).

Food-plants.—Very various. In Kingston, Jamaica, it is very common on the leaves of mango, and likewise on various orchids. On Aug. 2, 1892, Dr. Henderson gave me a leaf of *Broughtonia sanguinea* which had come from the hills in Jamaica, and on it were 20 scales of *V. stellifera*, all along the midrib on the under side. Prof. Townsend sent me specimens found in Kingston, Jamaica, on Jambolana (J. J. Bowrey) and Sapodilla (Dr. Plaxton). In St. Kitts it was found on *Araisia polycephala* ; in Trinidad on a fern ; in Grenada Mr. G. W. Smith collected it on nutmeg. In Barbados it was on coconut.

Destructiveness.—Not as a rule considered troublesome, but I have sometimes seen it in such numbers as to be decidedly injurious.

Genus *Conchaspis*; the Limpet Scales.

Very small white scales, looking like little limpets, radiately ridged or ribbed. Two or three forms have been found, but it seems almost impossible to distinguish them as separate species.

(37.) *Conchaspis angræci*, Ckll. (The Orchid Limpet-scale).

Diagnosis.—See above under the genus.

Distribution.—Found in Hope Gardens, Jamaica, June, 1892. At Eaton Hall, Chester, England, was found a scale on plants from Trinidad, which Mr. Newstead described as *Pseudinglisia rodriguesiæ*; this is certainly a *Conchaspis*, and Mr. Newstead thinks, after comparing it with specimens of *C. angræci* which I sent him, that it is the same species. I am now inclined to think so too, though I at first believed that Mr. Newstead's insect was a second species of the genus. Finally, Prof. Townsend has found a *Conchaspis* on *Hibiscus* at Tampico, Mexico, which I also now refer to *C. angræci*, though it represents at least a distinct variety.

Food-plants.—The typical form, as the name indicates, is found on orchids of the genus *Angræcum*.

Destructiveness—Not destructive, unless perhaps injuring very choice orchids, in which case it could easily be cleaned off the plants.

Genus *Pulvinaria*; the Cottony Scales.

These resemble the soft flat or moderately convex species of *Lecanium*, but are at once distinguished by the fact that they produce a cottony ovisac which often projects for a considerable distance behind the animal.

(38) *Pulvinaria cupaniæ*, Ckll. (The Akee Cottony-Scale).

Diagnosis.—Green oval scales, producing a loose white cottony ovisac; length with ovisac somewhat less than a quarter of an inch.

Distribution.—Extremely abundant in Kingston, Jamaica (for example along East St.), but not yet known out of Jamaica.

Food-plants.—It is most frequently found on the leaves of the akee, but also on guava and other plants. In Jan., 1893, Mr. O. Marescaux sent me some from Cherry Garden, on leaves of Cape Jessamine.

Destructiveness.—From its abundance it is a decidedly important pest.

Enemies.—Fortunately it suffers a good deal from the attacks of Dipterous parasites.

(39). *Pulvinaria dendrophthoræ,* Ckll. (The Mistletoe Cottony-scale).

Diagnosis.—A small elongate-oval greenish scale, producing a white cottony ovisac. Unfortunately with one exception all the specimens of this insect examined were without ovisacs and somewhat immature. It is by no means certain, notwithstanding some small differences observed, that this is anything more than a slight variety of *P. cupaniæ.*

Distribution.—Only known from Cinchona, Jamaica, where it was collected by Mr. Fawcett.

Food-plants.—Found in great numbers on *Dendrophthora cupressoides.*

Destructiveness.—Of no observed economic importance.

(40). *Pulvinaria urbicola,* Ckll. (The Capsicum Cottony Scale).

Diagnosis.—An oval skiny pale brown scale; producing a white ovisac which is depressed, parallel-sided fairly firm, somewhat inclined to be longitudinally ribbed,—instead of being convex, loose and fluffy as in *cupaniæ.* Length with ovisac over a quarter of an inch.

Distribution.—The only known locality is the yard of Manchester Cottage, Kingston, Jamaica, where it was found first in September 1892.

Food-plants.—It occurs on *Capsicum* infesting the stems and under sides of the leaves.

Destructiveness.—Apparently of very small economic importance.

Enemies.—Like *P. cupaniæ,* it suffers severely from Dipterous parasites. From only four *P. urbicola* I bred, in December 1892, thirty-two *Diplosis coccidarum.*

(41). *Pulvinaria simulans,* Ckll. (The Trinidad Cottony-Scales.

Diagnosis.—A small species, with a snow-white, depressed, parallel-sided, closely felted, not ribbed ovisac. Smaller than the last species.

Distribution.—Only known from Port-of Spain, Trinidad, where it was found by Mr Urich.

Food-plants.—Found on the leaves of a tree not identified.

Destructiveness.—Not known as a serious pest.

Enemies.—It has a chalcidid parasite.

Subgenus *Protopulvinaria.*

This subgenus was proposed for the reception of *P. pyriformis,* which is a small, flat, pyriform or subtriangular reddish-brown scale, producing only enough cottony matter to project as a sort of fringe round the hind margin of the scale.

(42). *Pulvinaria pyriformis,* Ckll (The Primitive Cottony-Scales).

Diagnosis.—See above under the subgenus.

Distribution.—Found in St. Ann's, Trinidad (Urich), in the Botanic Gardens, Grenada (Broadway), and at Mr Schloss's Pen at Half-way Tree, Jamaica.

Food-plants.—In Trinidad on guava; but in Grenada in some quantities on leaves of cinnamon. Also on cinnamon in Jamaica, the latter specimens being formerly recorded in error as *Lecanium mangiferæ,* which is common in Jamaica, and which they much resemble.

Destructiveness.—It may prove troublesome on cinnamon.

KOLA ; THE BISSY NUT OF JAMAICA.

By Fred. B. Kilmer, *Pharmaceutical Chemist, New Brunswick, N. J., U. S. A.*

What the West Indian native calls the "Bissy Nut" is known as "Kola" by the rest of the world.

The tree from which the Bissy Nut is obtained is a native of Africa, and has been transplanted and naturalised in many tropical countries ; in the West Indies, in Cuba, Jamaica, Porto Rico, in the Leeward and Windward Islands, as far as Trinidad, in Brazil, the Guianas about Venezuela, on the islands and coasts of Costa Rica, Nicaragua and Honduras. While in Africa there are several varieties of the Kola plant, in the West Indies only the *Cola acuminata* appears to have found a home.

Until recently, it has been propagated in the West Indies by self-sowing or here and there planting by the natives. Since it has become recognized as an article of commercial value, its cultivation has assumed importance. Many West India Governments furnish seeds and young plants in large quantities Some even give bounties for its cultivation.

A few years ago, Bissy Nuts were a petty trade in the markets. Now these islands consume and ship many tons during the season. Under favourable conditions its yield is very large ; a tree will yield from one hundred to one hundred and fifty pounds per year This yield at a low market price would bring the owner £2 or £3 a year for each tree,

It seems to grow on any kind of soil, except that which is marshy and lands liable to be overflowed. Elevations above 3,000 feet are not favourable to it. No attention or care is given to its cultivation, nor does it seem necessary. However, plenty of rain hastens the time of fruiting, and this condition, together with ridding the ground of "bush and care for growing trees, gives a greater yield of larger and more solid nuts. This is shown particularly in Trinidad and some French islands, where attention has been given to cultivation ; the nuts from these sources are from two to five times the size and weight of these grown wild.

The Bissy gatherer has little knowledge concerning the constituents of nuts or for what uses they are required in far-off lands. Those gathered for his own or for home medical use are sorted and prepared with considerable care, but those intended for export receive very little attention ; he fixes them so that anything that will pass in the market goes.

The nuts sent to the market are frequently mildewed, mouldy and partially decomposed. The volatile constituents, glucosides and other principles, have become dissipated and transformed ; the delicate ferment power has acted to a greater or less degree ; fermentation and bacterial diseases have set in and produced marked changes. Finally, the whole has dried into a lump of vegetable horn, bitter and rank to the taste, and with but little virtue aside from the varying amount of caffeine it contains.

It is not a matter of wonder to me after living among such collectors, that a delicate drug like Kola should prove disappointing when it reached the American practitioner. Bissy Nuts, containing as they do sensitive glucosides, alkaloids and volatile principles, require intelligent handling, if they are to be preserved in their original form without loss of efficiency.

Some difference of opinion exists among the natives as to the relative value of Kola raised in different localities ; variation in size and form of the flower and seed. There is no actual difference. White and red seeds are found in the same pod. The white seeds are often the largest and generally the heaviest. The real mark of superiority is in favour of those which are cultivated, properly gathered and cared for.

Chemical Constituents of Bissy Nuts.

On cutting or breaking the skin by even so light a puncture as a pin point so as to admit air, a yellow spot is immediately formed, changing rapidly to brown wherever the air has penetrated. This colouration forms more rapidly in the sunlight ; this change also takes place upon drying the nut, even when care is taken to keep the skin unbroken. This action is due to a splitting up and oxidation of the glucosidal constituents, and is hastened by the action of the ferment of the Kola.

Within the nut is a mucilaginous substance, The entire cotyledon is solid and tough, consisting of starch cells surrounded by cellulose walls. Extraction of the fresh Kola with chloroform gives an extract consisting of traces of resinous matter, tannin and fatty matter. Upon diluting with hot water, a faint aromatic odour resembling cacao butter is evolved, due to the presence of an essential oil. Some colouring matter is found, but only when the operation is not conducted with proper precautions.

Alkaloidal Contents.

The amount of alkaloids obtained by direct extraction of fresh Kola by chloroform ranges from five one hundredth to one-tenth of one per-cent. free caffeine, In nuts not fully mature the first extractions only give traces of alkaloid, and it is questionable if any free caffeine exists in unripe Bissy Nuts.

The caffeic constituents of Kola in the undried nuts reside in a glucosidal body. By the decomposition of this glucosidal body in the ripening and subsequent handling and drying, caffeine is formed.

If the free alkaloids are all extracted from the ripe, but undried Kola by proper solvents, there still remains a principle which has the same physiological effects as attributed to the use of Kola. This body is known as Kolanin or Kola Red. It is a glucosidal body, very easily decomposed in water, acids and alkalies, and among the bodies evolved in its transformation is caffeine. It contains in some instances as high as 83 per cent. of what is called nascent caffeine. It is the real component principle of Kola, and if preserved from change represents Kola in its most active form.

There is also present in Kola a ferment body which I separated in a recent visit to the West Indies and named "Kolazym." This ferment is a diastasic or starch-converting and glucoside-splitting enzyme.

The office of this ferment in the plant economy is somewhat obscure, but it probably has to do with the change that takes place in the ripening nut whereby the carbohydrates and nitrogenous elements are transformed into glucosides and eventually alkaloids and glucose. This ferment within the nut, with the air excluded either from the natural conditions which surround it, or from some other cause, acts very slowly. But in contact with the air or in suitable media, its action is more or less rapid, and during its action products are formed which seem to be suitable soil for air and mould germs so that these last finally seem to overcome the action of the Kolazym or, at least to inhibit it, and these mould germs carry on a farther decomposition of the gums, starch cells, the glucosides and alkaloidal constituents present. The presence in the fresh nut of this glucoside and enzyme explains the changes which take place when the nut is chewed The taste of the nut when first bitten into, is rather astringent and bitter. This, under the action of saliva, probably aided by this action of the Kolazym rapidly changes to a sweet. Thus it can be reasoned that in the native process of mastication the glucoside is broken up or partially so, and glucose and alkaloids are evolved.

This slow transformation of the Kola by the breaking up of the glucoside marks the diffierence and probable superiority of Kola over other caffeic drugs which contain only free caffeine.

Kola as a Crop.

Kola Nuts are abundant in Africa from whence nearly three million pounds are exported annually. There is also a large and increasing crop being gathered in the West Indies from year to year. In Jamaica, where large crops could be obtained if desired, I saw tons which had gone to waste for the want of somebody to gather them. The most that goes into the Jamaica market is carried in little bundles on the heads of the natives. As long as this is the case very little return can be expected from Kola.

To become a profitable crop, Kola must be taken care of and gathered and handled in a large way like coffee or other similar products. As long as the gatherers are content to carry and sell it by handfuls, profits will be small; but when gathered and sold by the donkey-load, cart-load and ship load, it will amount to something. To sell Kola in Jamaica or anywhere, it must be handled in a large way and sold cheap, If this is not done, buyers will obtain their supplies from other markets.

In Africa and many of the West India Islands, Kola is a profitable product. It can be sold at less than the price of coffee and yield a better revenue. At even one-half the price of coffee, Kola is several times the more profitable crop. It has been estimated that a thriving Kola plantation would yield £500 per acre.

Kola Nuts have hitherto been sent to the market in a dried state; but so dried and handled as to be practically valueless, for most medicinal purposes, Their value would be greatly enhanced with more care given, (1) in the cultivation, (2) in the gathering and drying of the nuts.

The best suggestions I can offer are to pick the nuts from the trees, not wait for them to drop off. There is no harm, so far as I know, in shaking or breaking them off. They should be gathered just before the pod breaks open. The exact time is when the pod is beginning to split. If they are to be dried, remove the seed from the pod and take the yellow fibrous covering off the seeds and throw them in cold water and wash thoroughly. Use plenty of water; let a stream of water run over them. If convenient, keep them in cold water and have it fresh until ready for drying. To dry them, do not split open the "halves" or cotyledons, but wipe them dry with a cloth, and further dry them in the sun or in a warm, not *hot* oven, or artificial dryer. Turn them over frequently while drying, but while they are fresh do not bruise them any more than can be helped The quicker they are dried, the better; too much heat will injure them; the sun cannot. however. They should not be left out over night or in stormy weather. If it rains, use artificial heat or dry them or keep them in cold water until the weather clears.

One manufacturer of medicine in the United States uses undried Kola.

I shall be pleased to send instructions to any person who desires to ship it in this way and tell them how to handle it.

Finally, I would say that West India people are very sensible in using Kola as they do in a very large way as a food and drink. The chewers of Bissy and drinkers of Kola are far superior, intellectually and physically, to those who indulge in tea, coffee or rum. The most vigorous, healthy and graceful people, whether black or white are those who "go in for Kola."

Another than myself has said of them.

"No cleaner, civil or gentler people can be found. Certainly no happier, contented, care-free people live on the face of the earth. Their physique, health, power to resist disease, longevity, fertility, virility retained to advanced age; their civil, moral and physical development under existing conditions are very notable.

"I will not presume to claim that the use of Bissy brings about all these fine physical conditions; frugal living, race crossing, climate, healthy, out-door labour; all conditions and surroundings contribute to its fulfilment. But the use of Bissy has a great share in keeping them in harmony with tropical nature."

NOTES ON PROF. JORGENSEN'S "MICRO-ORGANISMS OF FERMENTATION."

By Percival H. Greg.

During the last ten years a great reform has been effected, and is still working its way, among those industries in which the activity of Micro-organisms plays an important part.

The essence of this reform consists in the recognition of an individuality among cellular organisms of an apparently similar structure; while the reform itself is the perfection of those methods of isolation and subsequent cultivation of these organisms in a state of absolute purity by which this individualism has come to be recognised as an established fact.

In no other industries has such a reform been effected as in the arts of Brewing and Spirit-making. To give a comprehensive review on the most salient points of the system of fermentation by pure yeast as originated by Pros Emil Christian Hansen of Copenhagen; to furnish an important and convincing testimony of the great practical benefit to be derived from the introduction of the reform into the Brewing and Spirit industries all over the world; and finally to form a manual of instruction not only for the Student, the Chemist, or the Physiologist, but also for the practical Brewer and Distiller, in the science of Fermentation, is the aim of the "Micro-organisms of Fermentation" by Alfred Jörgensen of Copenhagen.

This book which has now passed into the 3rd edition in the German, and into the 2nd in the English language, besides being we hear in the course of being translated into French, comprises about 230 pages (German Edit.). It is profusely illustrated and furnished with a complete index, and is divided into six chapters. Chapter I. treats of the methods employed in the preparation of absolutely pure cultivations, of the sterilisation of instruments, apparatus, of liquid and solid nutrient-media. Chapter II. treats of the methods to be employed in the examinations of the Micro-organisms suspended in air and water, with special reference to aerial contamination in Breweries. Chapters III. and IV. on the most commonly occurring forms of Bacteria, Moulds, Mucors, etc. Chapter V. which is the longest in the book and in which the greatest interest will probably be awakened, is concerned with the discussion of the true alcoholic ferments. Chapter VI. which contains a special description of the two machines devised by Hansen & Kühlé and Jörgensen & Bergh, for the introduction of pure yeast on a large scale into Breweries & Distilleries, concludes with a review of the reception accorded to Prof. Hansen's system by eminent Technologists, and the practical results attained in the large Breweries and Distilleries in Europe.

I cannot too earnestly recommend this book to the very careful consideration of all those interested in the manufacture of Jamaica Rum. From what I have seen of the system of Fermentation practiced in Distilleries in this country, I am convinced that much may be done, with comparatively speaking small expenditure, to improve not only the quantity of spirit from a given volume of wash of a given saccharine strength, but also to improve the quality of the rum. Natural advantages count for a great deal, but in these days of competition—and of late years Jamaica rum has suffered considerably from it, the victory will ultimately fall to those who know how to combine the benefit conferred by natural advantages with the power to be derived from scientific enlightenment.

TEAK.

The small plantation of Teak at Hope Gardens was set out in 1874, just 21 years ago, the seeds having been received from Kew Gardens from Sir Joseph (then Dr.) Hooker. In little more than a year, the young trees had attained a height of ten or twelve feet. In three years they were 20 feet high. Since that time the increase in height has been gradually slower, but the actual increase of wood has been going on as quickly, and is equal to that of trees growing in their natural forests in India under similar conditions of soil, elevation and rainfall. The heart-wood is of good proportion, and splendid gate posts have been obtained from a few trees that were cut down to form the Vinery. Colonel Malcolm, of Knockalva, was so impressed on a recent visit with the value of the wood even of trees only of 21 years of age, which could be thinned out of a regular plantation, that he has asked to be supplied with a bushel of seed for sowing on his property.

Teak seems to grow well on any soil, provided the sub-soil is dry and the drainage perfect ; but it appears to be most vigorous on sandstone, limestone and soil produced by the disintegration of granite or basalt.

The climate of Jamaica is well suited for it. The mean annual temperature which suits it best lies between 72° F. and 81°, but it can withstand much lower temperatures

It succeeds perfectly in southern India on the hills, as high as two thousand five hundred feet, and although it is found as high as 4,000 feet, it is generally of poor growth above 3,000 feet.

The average annual rainfall at Hope is nearly 53 inches. Teak will thrive with an annual rainfall anywhere between 50 and 120 inches, and will grow even with as small a rainfall as 30 inches.

The best way to germinate the seeds is to sow in beds under shade at the beginning of April, lightly covering with soil to a depth of nearly $\frac{3}{4}$ of an inch, and then placing over the bed straw to retain the moisture. The seed should be steeped in water for 24 hours previous to sowing. If there is no rain the beds must be watered. The seed should germinate in 10 to 20 days.

When a tree is cut down, numerous shoots spring up, and grow at first much more rapidly than seedlings. Some of the Teak forests in India consist only of coppice wood.

As a timber its commercial value ranks next to mahogany.

Gamble in his "Manual of Indian Timbers," says. "The sapwood is white and small ; the heartwood when cut green has a pleasant and strong aromatic fragrance and a beautiful dark golden yellow colour, which on seasoning soon darkens into brown mottled with darker streaks. The timber retains its fragrance to a great age, the characteristic odour being apparent whenever a fresh cut is made. It is moderately hard, exceedingly durable and strong, does not split, crack, warp, shrink or alter its shape when once seasoned, works easily and takes a good polish."

CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY.

Bulletin Royal Gardens, Kew Nos. 96-8. Decr. 1894-Feby. 1895. [Kew.]
Bulletin New York Agri Exp. Station. Nos. 75, 78, 79, 80, 81. [Director.]
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Chemist & Druggist. Nos. 772-779. Feb.-Mch. [Editor.]
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Proc & Trans. of Nova Scotian Institute of Science Vol. I. Pt. 3. [Institute.]
Experiment Station Record. Vol. V. No. 12. Vol. VI. No. 4 & 5. [U. S. Dept. of Agri.]
Supplement to the Leeward Islands Gazette on Muscovado Sugar. [Govt. Chemist].

PLANTS.

From Botanic Gardens, Trinidad.

Lucuma sp. "Penny Piece."	Mimusops dissecta.
Chione glabra.	Mutisia cordata.
Omphalea diandra.[1]	Flacourtia Ramontchi.
Nicaraguan Guava.	Pimenta acris.
Lonchocarpus sp.	Copaifera officinalis.
Theobroma angustifolia.	Cynometra cauliflora.
" pentagona.	Lagerstroemia Flos-reginae.
" Cacao, (Trinidad white seeded).[1]	Carolinea sp.
" Nicaraguan Creole.	Sterculia carthagensis.

From Messrs. Reasoner Bros. Florida.

Justicia carnea
" coccinea.
Bambusa viridi-glauca.
Anona " Beriba."
Coccoloba floridana.
Meyenia erecta.
Cocos coronata.
Polypodium Phyllitidis.
Pittosporum Tobira.
Gelsemium sempervirens.
Triphasia monophylla.
Thuja occidentalis.
Phœnix sylvestris & canariensis.
Olea americana.
Glaziova insignis.
Retinospora plumosa
Florida Own Peach.
Angel Peach.
Manzanilla Olive.
Nerodilla "
Picholine "
Scuppernong Grape Vine
Thomas " "
Galphimia
Thuja aurea
Libocedrus decurrens
Aucuba Japonica
Raphiolepis ovata.
Thuja compacta.
Chamaerops humilis x hystrix.
Nerium atropurpureum.
" " plenum.
" flavum duplex.
" Savort Pere.
" Single Salmon-pink.
" carneum.
" Henry Mares.
" Mme. Grand.
" M. Leon Brun.
" Jeanne d'Arc.
" Marcel.
Chamaerops hystrix.
Eucalyptus rostrata.
" robusta.
" resinifera.
Cinnamon.
Olea fragrans.
Jasminum pubescens.
Magnolia fuscata.
Goldfussia anisophylla.
Strobilanthes Dyerianus.
Bougainvillaea glabra.
Caesalpinia nitida.

From Col. Griffith, Cheltenham.

Dendrobium nobile
" barbatum.
" eburneum.
" Dalhousienum.
Calanthe Veitchii.

From Senor Pedro Corena, Bogota.

Lycaste sp.

Seeds.

From Botanic Gardens, Grenada.

Grenada Orange.

From Botanic Gardens, Melbourne.

Acacia crassiuscula.
" cyanophylla.
" conostephiodes ?
" decurrens.
" farinosa.
" juniperina.
" longifolia.
" pendula.
" pycnantha.
" salicina.
" saligna.
Angophora intermedia.
" lanceolata
" subvelutina.
Anigosanthus flavida
" rufa.
Eucalyptus longifolia.
" macandra.
" platypus.
" punctata.
Geitonoplesium cymosum
Goodia lotifolia
" medicaginea
Grevillea robusta
Hakea acicularis
" elliptica
Hardenbergia monophylla alba
Hibiscus heterophyllus
Hymenosporum flavum
Kennedya drostrata
" rubicunda
Leptospermum scoparium

From Botanic Gardens, Melbourne (contd.)

Baloghia lucida
Billardiera scandens.
Boronia megastigma.
Bossiæa cinerea.
Brachysema subcordatum.
Callistemon rigidus.
" phoeniceus.
Carumbium populifolium
Cassia phyllodinea
Casuarina distyla
" quadrivalvis.
Clianthus puniceus.
Coprosma Baueriana.
Doryanthes Palmeri
Entelia arborescens.
Eustrephus latifolius.
Eutaxia empetrifolia.
Eucalyptus calophylla.
" ficifolia.
Leucopogon lanceolatus
Lomatia fraxinifolia
Indigofora australis
Melicope ternata
Morinda jasminoides
Notelœa microcarpa
Oxylobium Callistachys
Pittosporum crassifolium
" phillyroides
" tenuifolium
" rhombifoiium
" undulatum
Solbya heterophylla
Sophora tetraptera
Swainsonia galegifolia
Tecoma australis
Veronica Hulkeana
Viminaria denudata

From Botanic Gardens, Adelaide.

Acacia dealbata.
" decurrens
" melanoxylon.
" ornitophora.
" pycnantha
" sophora
" longifolia.
" pinnifolia.
" albicans.
" mollissima.
Araucaria Cunninghami.
Bursaria spinosa.
Callistemon rigidus.
Casuarina torulosa.
Clerodendron glabrum.
" tomentosum
Clianthus Dampieri.
Cordyline superbiens.
Cyathea medularis.
Dammara australis.
Deeringia celosioides
Dracæna australis.
" Draco.
Eucalyptus amygdalina.
" calophylla.
" bicolor
" citriodora.
" cornuta.
" corynocalyx
" diversicolor.
" ficifolia.
" fisilis.
" gigantea.
" Globulus.
" gomphocephala.
" goniocalyx
" Gunnii.
" haemastoma.
" hemiphloia.
" leucoxylon.
" obtusiflora.
" patens.
" pilularis.
" piperita
" polyanthema.
" robusta.
" rostrata.
" saligna.
" siderophloia.
" Stuartiana.
" viminalis.
Elæodendron australe.
Ficus macrophylla.
" (australis) rubiginosa.
Fourcroya longæva.
Frenela columdlaris.
Grevillea chrysodendron.
" Hilleana.
" robusta.
Hakea acicularis.
" laurina.
" uliginosa.
Heptaplurum venulosum.
Hymenanthera angustifolia.
Hymenosporum flavum.
Lophostemon australe.
Nephelium leiocarpum.
" tomentosum.
Panax elegans.
Pittosporum bicolor.
" Colensoi.
" crassifolium.
" nigricans.
" rhombifolium.
" rubiginosum.
" undulatum.
Scolopia Brownii.
Spondias Solandri.
Sterculia acerifolia.
" heterophylla.

From Botanic Gardens, Adelaide (contd.)

Eucalyptus Lehmanni.
" macrorrhyncha
" marginata,
" microcorys.
" miniata.
" obliqua.
Stenocarpus sinuatus.
Syncarpia laurifolia.
Tecoma australis.
Toxicophlæa.
Tristania conferta.

From Botanic Gardens, Hong Kong.

Pinus Massoniana.

From Botanic Gardens, Bangalore.

Hibiscus ficulneus.

From J. C. Harvey, Los Angeles, California.

Spathodea speciosa
Cerasus
Tristania conferta
Dombeya natalensis
Dahlia imperialis
Hippobromus alatus
Gmelina asiatica
Calpurnia lasiogyne
Milletia caffra
Flacoutia Ramontchi
Bauhinia sp. (Hawaii)

From Botanic Gardens. Rockhamptom. Queensland.

Cupania anacardioides
" nervosa
Cedrela australis
Grevillea Banksü
Geijera salicifolia.

From Royal Botanic Gardens, Trinidad,

Aristolochia gigas. var. Sturtevantü

NOTE.

The Director will be at the JAMAICA INSTITUTE on the morning of the first Friday in every month between the hours of 10 and 1 o'clock for the purpose of giving information to those who may wish to consult him.

New Series.] JUNE, 1895. Vol. II. Part 6.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Twopence.

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, Gordon Town P.O.

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JAMAICA.

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BOTANICAL DEPARTMENT.

New Series.] JUNE, 1895. Vol. II. Part 6.

COFFEE PEELERS AND HULLERS FOR HAND POWER.

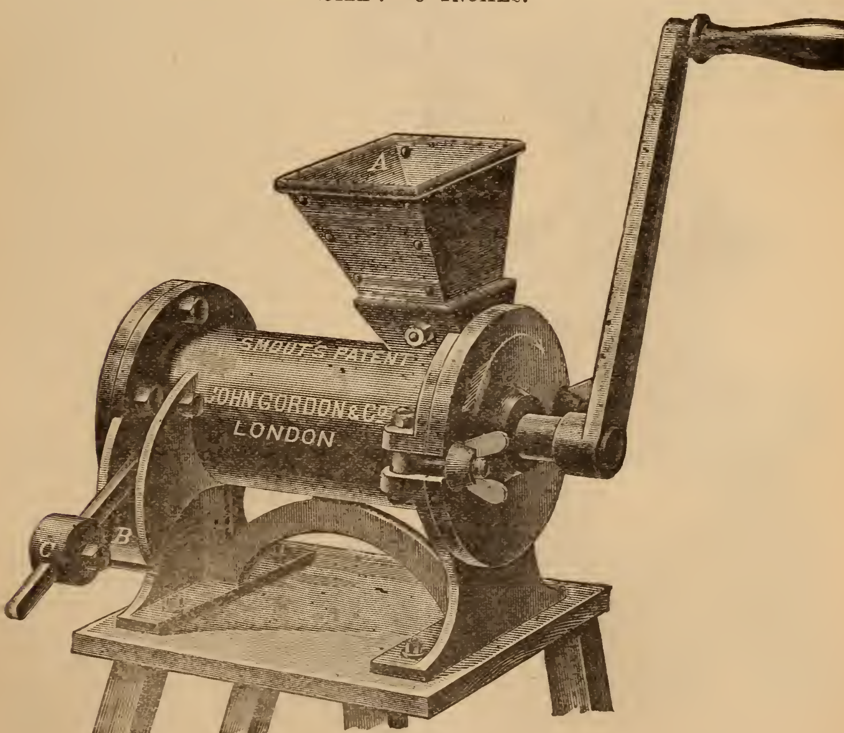
In the Bulletin for last January information was supplied with reference to cheap pulping machines for coffee to be worked by hand, and suitable for the requirements of small planters

The following description of a Peeler and Polisher for hand power has been supplied by Messrs. John Gordon & Co., who have kindly sent a machine as a sample. This machine will be placed in the Office of the Superintendent of the Parade Gardens, Kingston, and those who are interested are invited to inspect it, and test it by passing through some parchment coffee.

For coffee dried in the cherry, without using a pulper, a special machine has been designed, a description of which is given below.

SMOUT'S PATENT HORIZONTAL COFFEE PEELER AND POLISHER.

SIZE :—9 INCHES.

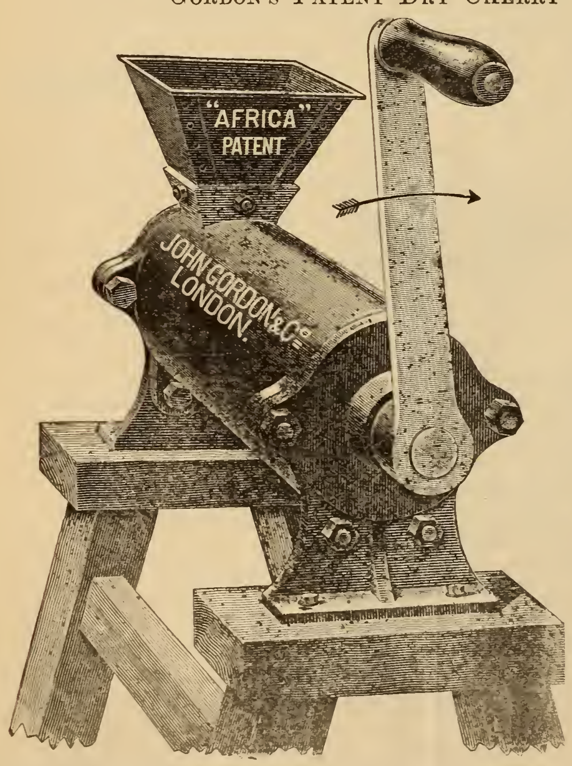


"The above engraving represents a small Coffee Peeler and Polisher for hand power. This machine is identical in principle to the larger Horizontal Power Peeler and Polisher of Smout's Patent, and produces equally excellent results. It is a very substantial machine and having no complicated parts cannot get out of order. The pressure required to remove the parchment and silver skins from the beans is produced by the adjustable weight C put on the lever of the discharge door B and if it be found that any beans are delivered imperfectly shelled, additional pressure must be put on the lever until the coffee is discharged quite clean : it is, however advisable to use as light a weight as possible, as the power required to work the machine increases in proportion to the weight on the lever; and it is sometimes preferable, instead of adding to the weight, to pass the coffee through the machine a second time. As the machine will not perfectly shell the coffee until it is quite full, the quantity discharged during the first few minutes after commencing to work, must be again placed in the hopper. Smout's Patent Coffee Peeler possesses the great advantage over all other Peelers of being able to perfectly clean parchment coffee without *breaking a single bean*; and, as it requires no adjustment beyond the weight on the lever, it is impossible for the coffee to be damaged by a careless workman.

"This small machine will clean 36lbs of parchment coffee per hour. It weighs 40lbs nett, and when packed for shipment 56lbs gross.

"Price, packed for shipment, F. O. B., London £8."

Gordon's Patent Dry Cherry Huller.



"This engraving illustrates Gordon's 'Africa' Patent Huller; which has been specially designed to take the place of the very primitive methods usually adopted on small plantations, and to prevent the great damage and loss which now result through the breakage of the beans by the use of such obsolete appliances. This Huller is a most excellent machine for the purpose and will be found most satisfactory in every respect. It is extremely simple in its construction, and consists of an interior revolving cylinder, and an exterior casing the under part of which is fitted with a grid having graduated openings, through which the shells, and clean coffee are *separately* delivered. The revolving cylinder is the only moving part of the machine, and owing to its extreme simplicity cannot get out of order. The capacity of this Huller when worked by one man is from 50 to 80lbs of dry cherry coffee per hour. It is suitable for the treatment of both Arabian and Liberian Coffee; but when intended to clean the latter, it is necessary to have a special grid; on account of the Liberian beans being so much larger than the Arabian. Purchasers should state in their orders, which kind of coffee it is intended to treat; although the machine can be supplied with two grids if desired, so that both kinds can be cleaned. The cost of the extra grid is 7/6.

"Price, packed for shipment £10.

"The machine itself weighs 80lbs: but when packed for shipment the gross weight is 104lbs.

"This Huller is also made in larger sizes, suitable for being worked by animal, steam, or water power."

SUGAR CANE DISEASE AND EXHAUSTION OF SOIL.

The diseases to which the Sugar Cane sometime succumbs, depend very often on weakened vitality, which may be due to various causes, such as planting tops of unhealthy canes; planting the cane of the district always in the same place without ever getting an exchange of tops from a distant estate; exhaustion of soil, which is the subject of this note.

Dr. T. L. Phipson, the well known authority on the chemistry of the Sugar Cane, gives the following as the rough average composition of the ash of the ripe cane and its leaves:—

Silica	...	43.0
Phosphoric acid	...	6.0
Sulphuric acid	...	8.0
Chlorine	...	4.5
Lime	...	10.0
Magnesia	...	6.5
Potash	...	18.0
Soda	...	2 0
Oxide of Iron, manganese, and loss in analysis		2.0
		100.0

It is generally supposed that, as the geological map of Jamaica shows that the greater part of the surface formations consist of limestone, there is an abundance of lime in the soil, and no need to apply it as manure, but it should not be forgotten that while the rain carries off large quantities of lime into the rivers, another portion is used up by the cultivation of plants, until the soil becomes exhausted of lime, which is an essential part of plant food. The exhaustion of the lime may be taken as an index of exhaustion in other elements of plant food. But manuring with lime alone will be found advantageous, mechanically in improving the texture of heavy clays, and chemically in unlocking stores of plant food at present insoluble and so incapable of being utilised.

Dr. Phipson has come to the conclusion that the "degree of exhaustion which a cane soil has undergone can, to a great extent, be ascertained by comparing the relative amounts of lime and magnesia yielded on analysis." He gives four examples "from the same estate in British Guiana, from various portions of which the sample were taken :—

		Cultivated.	
		10 to 15 years.	Upwards of 60 years.
Lime (per cent).	...	0.44–0.64	0.11–0.40
Magnesia	...	0.32–0.50	0.36–0.51

It will be noticed how the lime has disappeared (from the same soil) by prolonged cultivation of the cane, whilst the magnesia has remained pretty much as it was." Dr. Phipson concludes that : "when the quantity of lime has diminished so much by prolonged culture as to be present to the extent of only 0.1 per cent., and then only one-third that of the magnesia present (knowing that in the origin the lime was not only equal to, but higher than the magnesia), we may rest assured that the crops of cane on this soil will fall off year by year, and that the most careful system of manuring will be necessary to place it again in its former lucrative condition."

Dr. Griffiths in his "Treatise on Manures" discusses the value of magnesia in addition to lime. He says, "The office of magnesia is to assist in the starch-forming process and the development of chlorophyll, and its presence is necessary to healthy growth and colour. Magnesia forms a very important constituent in all soils in which the French vine resists the attacks of Phylloxera vastatrix. We find, also, that the American vine flourishes best in those soils containing a high percentage of magnesia. The amount of magnesia in the ash of the Styrian vine, according to an old analysis, is 6.55 per cent. Therefore, from soils deficient in this ingredient, it is impossible to obtain full or healthy crops. Probably the ravages of the Phylloxera may be traced to the growth of sickly plants season after season, the unhealthy nature being due to the want of small quantities of such mineral ingredients in the soils cultivated as iron and magnesia. Magnesium sulphate has also proved a beneficial manure for clover and potatoes, as well as for corn crops. It would be well for agriculturists to try the use of magnesium sulphate along with nitrates of soda and phosphates for corn crops. By this means, most likely, many crops may be saved from the attacks of parasitic mildews. The author has found this to be so in the case of wheat grown with small quantities of iron sulphate.

"It has also come to the author's notice that many of the sugar cane soils in British Guiana and the West Indies suffer more or less exhaustion from an insufficient amount of magnesia and lime. Both lime and magnesia play an important part in the growth of the sugar cane. Sulphate of ammonia has been, and is, largely used in Demerara as a manure for the sugar-cane, but its action is the production of a juice very deficient in sugar. This is no doubt due to a too liberal supply of nitrogenous manure, and the non-application of lime and magnesia. Let cane-growers note that a good soil for their purpose should contain at least 0.97 per cent. of lime and 0.3 per cent. of magnesia."

It is important to notice that if the magnesia occurs in the soil in the form of silicate of magnesia, it is not available for plant food, and the compound is rather an index of the want of fertility of the soil. This is pointed out in the following letter by Dr. Phipson, which appeared in the *Sugar Cane* for last February :—" For a long time past I have made analyses of the West Indian cane soils, with the view of ascertaining their respective values for cane growing, and the treatment they should undergo in certain special cases. It results from the examinations that the clay in which the sugar cane grows is so fertile naturally that were proper tillage always available, nothing more would be necessary to ensure ample crops of healthy cane. It is, perhaps, not too much to assert that a couple of centuries of cane growing will not exhaust many of these soils.

" I find exactly the same nature of clay in Barbadoes, Jamaica, and British Guiana, showing how intimately, in this respect, the islands are connected with the main land, in spite of the distance. Those clays in which the amount of lime soluble in acids is higher than that of the magnesia are usually the most productive of sugar, and, generally speaking, have been worked for a shorter period of time. The magnesian element, in the shape of a partially weathered silicate of magnesia, is the chief enemy to fertility in these soils ; when it happens to abound the soils give decidedly poorer crops, and this is a fact well worth knowing to those who are about to purchase canefields, or are thinking of taking in new land. I have also found in many of these clays a slight amount of vanadic acid, a substance which was first made known by me in many English and foreign clays *(Journal of the Chemical Society, 1863)* Wherever vanadic acid is found in clays there is generally much phosphoric acid also."

Ulbricht last year again points out the value of a mixture of magnesia with lime, but adds a caution against magnesium carbonate. According to him, burnt lime poor in magnesia, heavily applied (710 lbs. per acre), decidedly delayed the ripening of oats, while a similar application of gray lime produced much less marked results, This difference is ascribed to the high percentage of magnesia in connection with lime in the gray lime. Caustic magnesia (burnt magnesia), as well as magnesia carbonate, had a highly injurious effect on oat plants, proving actually poisonous in large amounts.

This injurious effect was not always prevented by simultaneous applications of caustic lime or calcium carbonate. Barley was more resistant to the injurious action of the magnesia than oats.

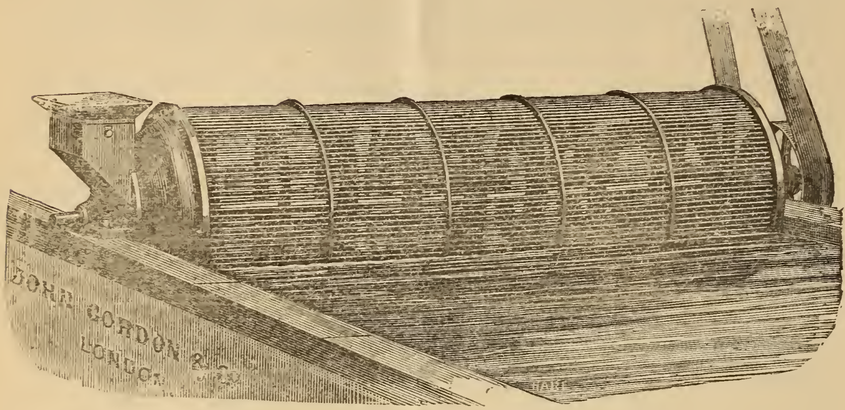
COFFEE SEPARATING MACHINES.

In the article on Liberian Coffee in Bulletin for January, 1894, a mistake was inadvertently made on page 5 in the insertion of the wrong illustration of separator.

The following descriptions and illustrations of separators for pulped and milled coffee may be of use to those who are setting up machinery.

CYLINDRICAL SEPARATOR,

For Pulped Coffee.



"The annexed engraving represents a machine for separating the pulped from the unpulped coffee after it has been discharged from the pulper.

"This machine is very simple and complete, and only requires to be fixed on two wooden beams over a tank containing water, with a dividing board at the discharge end.

"The cylinder should be immersed in the water to the depth of about four inches.

"It is substantially constructed of very stout iron rods, securely fixed in wrought iron rings, as shown; the hopper, bearing and mouth piece at the feed end being in one piece.

"The cylinder is also fitted with an internal worm or screw for propelling forward the unpulped coffee.

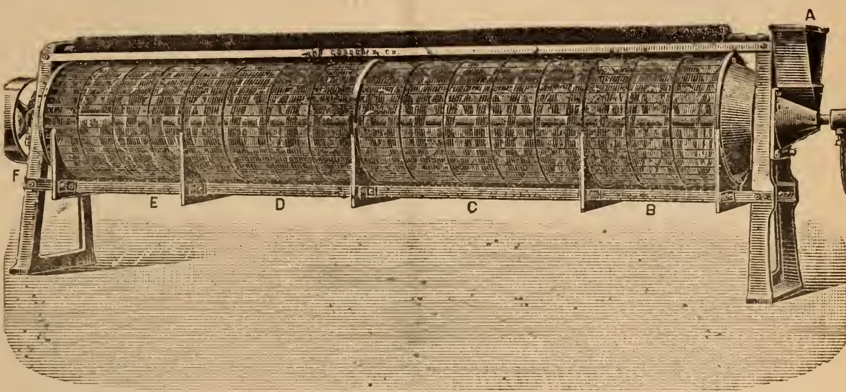
"It is made in the following sizes, and can be supplied either thoroughly well painted or galvanized:—

Length in feet.	Diameter in inches.	Painted.	Galvanized	Revolutions per Minute.	Gross Weight.	Weight for Freight.
5	18	£11 10 0	£14 0 0	20	360 lbs.	10 cwts.
5	24	17 10 0	21 0 0	15	560 lbs.	18 cwts.
10	18	21 0 0	26 0 0	20	600 lbs.	18 cwts.
10	24	32 0 0	39 0 0	15	917 lbs.	34 cwts.

"*The above prices include Packing for Export in one case.*

"The ten feet Cylinders can be supplied in halves, for convenience of transit, at an extra charge as follows:-

"For the 10 ft., × 18 in., £1 15s. extra. For the 10 ft., × 24 in., £2 10s. extra.



COFFEE SEPARATOR.

"This is an improved Machine for effectually cleaning and separating Coffee. It possesses the following advantages over all others:—The meshes are divided by machinery with unfailing accuracy to the proper mesh for each separation. Great durability is insured by doing away with all binding. The wires after being placed in notches are riveted, by which the frequent displacement so much complained of in hand-made and shifting-wire separators is entirely obviated.

"Cast steel wire is used, which, being smaller, allows of a greater screening surface than that of any other machine. The hopper "A" is fitted with a feed regulator adjusted to the screening power of the machine, which together with the internal worm or screw, gives an efficient and equal distribution to the beans in passing into and through the Machine, whilst the revolving brush on top keeps the wires perfectly free from beans The whole is mounted upon strong cast iron standards, making the machine complete in itself. It can be taken to pieces and put together again with ease."

Capacity per hour	10 cwt.	15 cwt.	20 cwt.	25 cwt.
	£ s. d.	£ s. d.	£ s. d.	£ s. d
Price	26 0 0	39 0 0	52 0 0	65 0 0
Packing for Export extra	1 16 0	2 10 0	3 10 0	4 0 0

ANALYSIS OF THE ORANGE TREE.

The following chemical analyses of different parts of the Orange Tree are taken from a paper on the subject by Messrs. Rowney and How. They are the percentage of the ash after deduction of the unessential constituents, carbonic acid, and charcoal.

It will be seen that potash, lime and phosphoric acid are very important; and whenever it is considered necessary to apply chemical manures, it would be well to mix superphosphate of lime with a potash manure such as Kainit.

ROOT.

Potash	...	15.43
Soda	...	4.52
Lime	...	49.89
Magnesia	...	6.91
Sesquioxide of Iron	...	1.02
Chloride of sodium	...	1.18
Phosphoric acid	...	13.47
Sulphuric acid	...	5.78
Silicic acid	...	1.75
		100.00

STEM.

Potash	...	11.69
Soda	...	3.07
Lime	...	55.13
Magnesia	...	6.34
Sesquioxide of iron	...	0.57
Chloride of sodium	...	0.25
Phosphoric acid	...	17.09
Sulphuric acid	...	4.64
Silicic acid	...	1.22
		100.00

LEAVES.

Potash	...	16.51
Soda	...	1.68
Lime	...	56.38
Magnesia	...	5.72
Sesquioxide of iron	...	0.52
Chloride of sodium	...	6.66
Phosphoric acid	...	3 27
Sulphuric acid	...	4.43
Silicic acid	...	4.83
		100.00

FRUIT.

Potash	...	36.42
Soda	...	11.42
Lime	...	24.52
Magnesia	...	8.06
Sesquioxide of iron	...	0.46
Chloride of sodium	...	3.87
Phosphoric acid	...	11.07
Sulphuric acid	...	3.74
Silicic	...	0.44
		100.00

SEED.

Potash	...	40.28
Soda	...	0 92
Lime	...	18.97
Magnesia	...	8.74
Sesquioxide of iron	...	0.80
Chloride of sodium	...	0.82
Phosphoric acid	...	23.24
Sulphuric acid	...	5.10
Silicic	..	1.13
		100.00

PIMENTO AND ITS INSECT FOES.

The publication of the following correspondence may be useful in calling the attention of those who are interested in pimento to the attacks of insect pests. Inspector Alexander reports that orange trees are also attacked in a similar manner.

Mr. Arthur Townend to Director of Public Gardens and Plantations.

Devon Side, Laughlands, P. O., 8th May, 1896.

"Your letter or the 3rd received, and also the Bulletins for which many thanks. I send you and also the Curator of the Institute, samples of the grub and the chrysalis by this post, I hope they will reach you safely as I have packed them in pimento saw dust. When I discovered the grub and wrote you last week, I had no idea of the fearful amount of Pimento trees that are being destroyed by this grub in this district. On making enquiries I heard that they were losing a lot of trees at Tripoli and Cardiff Hall, so, yesterday I drove to Tripoli (which is between here and Dry Harbour) to see if it was from the same cause. Mr. Miller, the Overseer, told me that he was losing his Pimento trees by the hundreds but did not know the cause. On riding out with him I showed him the small holes in the trunks about the size of a pea. It was interesting to see the trees of all sizes dead and trees in full bloom with a few holes in them, showing that it will not be long before they die like the rest. I did not go to Cardiff Hall as I heard that Mr. Purchas, the Overseer, was not at home but I saw the dead trees in the distance and Mr. Miller told me that they were losing a lot. Needless to say that Mr. Miller was most profuse in his thanks for my visit and is very anxious to know what he had better do to save those trees that are not yet attacked. I have requested Inspector Alexander to ascertain if it exists in other parts of the parish, which he has promised to do. He is also reporting the matter to the Government. As soon as I get a perfect insect from the chrysalis I will send it to you. Would a coat of white lime or tar protect the trees? I hear that the grub has been seen in old pimento trees, but never has it become such a plague and attacked young ones. I rode this morning to Richmond and Coolshade and found the grub in some of the Pimento trees on both properties, but not to any great extent. Every one about here is quite surprised at my discovery and all are in dread of losing their Pimento."

Curator, Jamaica Institute to Director, Public Gardens.

Institute of Jamaica, 17th May, 1895.

"I do not at present see any other method than the one you suggest of attacking the pimento borer. I imagine the insertion of the wire would be better than pouring in any fluid or powder to kill them. We shall require to know the full life history. so that the creature may be attacked at some efficient stage. We received from Mr. Townend several specimens of the chrysalis, and from one of them a large moth has just been hatched."

Director of Public Gardens and Plantations to Hon. Colonial Secretary.

Gordon Town, 21st May, 1895.

"I have been in communication with Mr. Arthur Townend, and with the Curator of the Institute, with reference to the grub attacking Pimento trees. I can suggest no better plan for getting rid of the pest than inserting a copper wire into the holes made by the grubs in the trunk of the Pimento, and so killing them. It appears that more than one kind of insect attacks the Pimento. When the life-history of the insect, or insects, is better known, some other plan may possibly suggest itself. Meantime it is most important that steps should be taken by proprietors to prevent the spread of the pest.

"It is the larva of the insect which bores its way into the stem, and does the mischief. By thrusting a wire into the hole, the active larva or the inactive pupa may be reached and killed. It is advisable that proprietors should obtain a larvæ or pupæ, and carefully note the appearance of the perfect insect when it emerges, so that it may be recognised and killed whenever possible When the perfect insect is allowed to escape from the burrow in the Pimento, it lays a large number of eggs which later on will increase the pest.

"Observations are necessary as to whether the insect attacks the branches which are lying on the ground broken off in harvesting the crop. If so, these should be burnt. If any trees are completely infested by the pest, it would be prudent to cut them down and burn them, taking care that no insect escapes."

Prof. Townsend, formerly Curator of the Institute, wrote the following note on a "Pimento Borer" in 1893:—

"In October, 1892, some pimento sticks were sent to the Museum by Mr. A. E. Husband, of Manchester. They were infested with longicorn larvae, and were placed by Mr. Cockerell in a jar to breed. The following July, the sticks having remained in the jar undisturbed during the interim, tt was found that several specimens of a small and elongate light coloured longicorn beetle had issued from them. These beetles on being sent to Dr. Riley in Washington, were prononnced to be *Cyrtomerus pilicornis* Fab. The species is new to the Jamaican lists.

"As the Pimento or allspice is considerably cultivated in Jamaica, this borer may prove a serious pest. The sticks sent to the Museum show rather wide, more or less sinuate or irregular, shallow channels in the hard wood immediately beneath the thin bark. The channels are very solidly packed in places with a fine and hard frass. Their general direction is lengthwise of the branch, but they sometimes wind around it, or rarely turn backward at an acute angle. At intervals, in the sticks are seen small deep holes penetrating obliquely downward or upward into the hard wood towards the heart of the branch. These are narrower than the outer superficial feeding tunnels, but are still flattened, and doubtless are the cells where the borers undergo the pupal change to the adult state. The bark being removed shows the tunnels to extensively cover the outer surface of the sticks, indicating that these borers are active ones and capable of doing much injury.

"The only remedy for such borers in living trees is to search for infested branches, detect the tunnels before they become extensive, and kill the grubs by using a probe of wire or other material. Probing is simple in this case because the borers work just beneath the bark until ready to pupate."

HINTS FOR COLLECTING AND DRYING PLANTS.

As many correspondents are good enough to send specimens of plants required in the Herbarium, and others forward flowers to be named, it is important to point out the best way of drying plants for both these purposes. Flowers or seed vessels alone are worthless, they should always be gathered attached to twigs with leaves, and should be as large as will conveniently go between the drying papers.

The following hints were issued by a Committee appointed by the Royal Society and the British Association for the purpose of reporting on the fauna and flora of the West Indies :—

"In preserving plants for permanent collections, the object is to prepare specimens in such a manner that they may be thoroughly dried, the colours as far as possible retained, and such a degree of pressure given that they do not curl up in drying. For this purpose a quantity of paper is necessary, brown or stout grey, moderately absorbent, of ordinary demy size (17 inches by 11) when folded.

"Two boards (or better stout frames of wire grating) are requisite, of the size of the paper, one for the top, the other for the bottom of each mass of papers. Pieces of mill-board placed between the papers, if the specimens are numerous or particularly thick or woody, are very useful. For pressure nothing is better than a heavy weight on the topmost board, or, while travelling, two leathern straps and buckles to bind the boards and papers transversely. Thus provided, gather your specimens—if small, root and stem ; if large, cut off portions of the branches, a foot or rather more in length, always selecting those in flower and in a more or less advanced state of fruit. Long, slender plants, as grasses, sedges, and many ferns, may be doubled once or twice. Place them, before they wither, side by side, but never one upon the other on the same sheet, taking care that the thick parts of the specimens are, as far as possible, distributed to different parts of the sheet, and lay over the specimens one, two, three, or more sheets of paper, according to its thickness or the thickness of your plants ; and so on, layer above layer of paper and specimens, subjecting them then to pressure. In a day or two, according to the more or less succulent nature of the plants, or to the nature of the climate, remove them successively into fresh papers till the moisture is absorbed, and dry the spare papers in the sun or by a fire for future use.

"When sufficiently dry, the specimens should be put into papers, one sheet (more if the specimens be thick) between each layer of plants; and thus a great many may be safely arrauged in a small compass, and are ready for transport covered with oil-cloth or packed in boxes. Mosses and other cryptogamic plants may be generally dried in the common way, those which grow in tufts being previously opened out, so as to form neat specimens. Most seaweeds require a slight washing in fresh water, and the more delicate kinds should be floated out on sheets of writing paper before being subjected to pressure."

INSTRUCTION IN THE CULTIVATION OF COCOA, COFFEE, &c.

Hope Gardens, 7th May, 1895.

Mr. W. Cradwick to Director of Public Gardens.

Sir,

I beg to forward herewith report on my lecturing tour in the Parish of St. Mary.

April 30th, Tuesday:—Lectured at Quebec Plantation to 20 people, including Mr. Simonds the Proprietor, demonstrated on pruning and sowing seed, also pointing out the mistakes in Mr. Simond's plantation, the proper method of planting, the mischief of planting too close by showing how the trees were destroying one another, the evil of jumbling up coco-nuts, breadfruits, mangoes and other miscellaneous trees instead of planting regularly so that the trees might protect the cocoa.

Visited Llanrumny, the property of the Honble. J. E. Kerr, in the afternoon, and practically demonstrated to the Overseer the evils of neglecting the plantation while in a young state.

Also visited Mr. Francis' ground, and showed him and six or seven other people how to prune young cocoa and coffee, and strongly impressed upon them the necessity for deep thorough cultivation, and the proper draining of this rich and exceedingly fertile but rather heavy soil

My visit to this gentleman I consider one of the most opportune and useful visits I have ever made. Between himself and his brothers they appear to have to the best of their knowledge about 50 acres of excellent land in bananas, all planted through with cocoa and coffee from 1½ years to 3 years old, but from their ignorance of the proper methods of treating heavy land, the use of the fork, the importance of drainage and the proper way to plan the drains, also how to prune the cocoa and coffee trees, the whole cultivation bids fair to be a perfect wilderness in the course of two or three years. These men were very grateful for my timely advice.

May 1st., Wednesday;—Port Maria was on the itinerary for May the 1st, but the people were not aware of the alteration of the date, and consequently no audience was obtainable.

I however, visited the Public Park at the request of Mr. Cocking, the Clerk of the Parochial Board, St. Mary, and gave him advice on several points in connection with the management of the plants there ; also how and when to plant Eucalypti, which he is anxious to establish.

I also overhauled the sugar canes which were sent from the Hope Gardens for the Public Park. The majority of them have died, and the remainder were in such poor condition that they were hardly recognisable, with the exception of two varieties. One of them, the "Po-a-ole," was in really fine condition, and again helped to prove that this is really a splendid cane for the northside of Jamaica, and I think the Department would be doing the peasantry particularly a good turn if it would help them to get this cane and persuade them to plant it. It could get hardly less care anywhere than it does in the Public Park at Port Maria and yet it was flourishing luxuriantly.

May 2nd, Thursday :—Carron Hall School House. A good and appreciative audience of 40 adults (and in addition nearly a hundred school children) were lectured to in the School-house.

People about here grow coffee and cocoa, but very rudely, having no knowledge of either how to grow the plants or cure the produce when obtained, the land is rich, heavy, but inclined to be wet, and a long hard day was spent in showing them how to fork and prepare the land, how to make drains and the proper way to make the drains run according to the contour of the land. Demonstrations were also given in pruning coffee and cocoa in the grounds of David Tucker, Mr. Walker and Mr. Stanton.

May 3rd, Friday :—Highgate School House. This would no doubt have been the best centre of the lot, but unfortunately the Clergyman, Mr. Graham, by some oversight was not informed of the alteration in the date. He apparently takes great interest in the advancement of the people, and expressed himself deeply grieved and a good deal annoyed to think that the opportunity was lost to a good many of his people who he said were looking out for me for a long time. However, a very appreciative audience of over 50 people turned out, and were full of intelligent questions. I lectured to them on cocoa and coffee, and demonstrated as to pruning, planting and caring the young plants ; also on the importance of kola, many of them having trees of the latter but to which they pay very little attention, as they have no idea of the value of the product.

May 4th, Saturday :—Lewis' Store School House. A very appreciative audience of about 50 people were lectured to in the School-house on cocoa, coffee and kola. I also visited the fields of three growers and demonstrated on pruning and planting, the importance of selecting good seed, the evils of overcrowding, the importance of drainage, etc. The people here were highly interested and particularly anxious to know when I should return.

On the whole the people seem more wide awake than the people in Portland, but the heavy retentive soil of St. Mary wants a lot of intelligent hard work put into it.

CONTRIBUTIONS TO THE DEPARTMENT.

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Seeds.

From Royal Gardens, Kew.

Eucalyptus bicolor
" polyanthema
" siderophloia
" macrorhyncha
" rostrata
" robusta
" leucoxylon
" Globulus
" corynocalyx
" calophylla
" crebra
" cornuta
" amygdalina
" saligna
" obtusiflora
" gomphocephala
" citriodora
" miniata
" microcorys
" hæmastoma
" hemiphloia
" marginata
" Stuartiana
" Gunnii

Eucalyptus viminalis
" fisilis
" piperita
" Lehmannii
" diversicolor
" gigantea
" goniocalyx
" pilularis
Acacia longifolia
" Sentis
" pityoides
" molissima
A. pycnantha. A. decurrens
A. sophora. A. dealbata
A. melanoxylon
Pittosporum crassifolium
" undulatum
" nigricans
" Tobira
" bicolor
" sp.
Callistemon rigidus
" coccineus
Clerodendron glabrum

From Royal Gardens, Kew, (contd.)

Clerodendron tomentosum
Ficus rubiginosa
Panax elegans
Lophostemon australe
Sterculia acerifolia
" heterophylla
Dracæna Draco
" australis
Syncarpia laurifolia
Cyathea medularis
Scolopia Solandri
Heptapleurum venulosum
Tristania conferta
Frenela rhomboidea
Hakea laurina
Acokanthera Thumbergii
Citrullus Colocynthis.

From Botanic Gardens, Durban.

Agapanthus umbellatus, var. albus
Antholyza spinosa
Calpurnia lasiogyne
Crotolaria globifera
Dais cotinifolia
Gompohcarpus sp.
Jatropha sp.
Kniphofia modesta
Littonia modesta
Oncoba Kraussiana
Momordica involucrata
Plectronia spinosa
Sopubia Dregeana
Scilla rigidifolia var nervosa
Solanum—duplo—sinuatum
Streptocarpus sp.
Tephrosia elongata
" macropoda
Tulbaghia acutiloba, var. major
Vigna luteola
Vitis humilis
Zanthoxylum capensis

From Messrs Damman & Co., Italy.

Coccinia moghar
Cucumis Vilmorinii
Cyperus Papyrus
Lagenaria sphærica
" vulgaris sylvestris
Luffa acutangula
" cylindrica
Melothria abyssinica
" Gartneri
" pünctata
Momordica charantia chinensis
" involucrata
" muricata.

From Baron Sir F. Von Müeller, Melbourne.

Eucalyptus capitellata
" calophylla
" rostrata
Eucalpytus rudis
" tereticornis
Melaleuca leucadendron

From Botanic Gardens, Trinidad.

Erythrina umbrosa

From Botanic Gardens, Saharanpur.

Swertia paniculata
" chirata
Clematis Buchaniana
Cratæva religiosa
Clerodendron sp.
Casuarina equisetifolia
Cassia fistula

[SAHARANPUR.]

Dalbergia lanceolaria
Deeringia baccata
Dillenia indica
Dioscorea versicolor
Ehretia acuminata
Erythrina tuberosa
Euphorbia glabra
Albizzia stipulata
Anogeissus latifolia
Bauhinia variegata
Bischoffia javanica
Aganosma marginata
Bauhinia purpurea
Acacia arabica
Albizzia lucida
" Lebbek
Berberis asiatica
Glycosmis pentaphylla
Ficus indica
" glomerata
Garuga pinnata
Gmelina parviflora
Hedychium spicatum
Flemingia semialata
Heterophragma adenophylla
Inula sp
Ilex dipyrena
Ixora parviflora
Jatropha Curcas
Gmelina arborea
Gleditschia ferox
Lagerstroemia parviflora
" reginae
Lilium lancifolium

Jasminum humile
Kydia calycina
Melia azedarach
Moringa pterygosprma
Mimosa rubicaulis
Murraya exotica
Poinciana pulcherrima
" regia
Pongamia glabra
Polyalthea longifolia
Premna integrifolia
Putrangiva Roxburghii
Rhamnus virgatus
Rubia cordifolia
Smilax sp.
Symplocos sp.
" serrata
Wrightia tinctoria
Nierembergia gracilis alba
Pentstemon Watsoni
Polygonum multiflorum
Tulipa praecox; and 45 packets of Vegetable Seeds.

From Botanic Gardens, Bangalore.

Argyreia tiliaefolia

From R. F. Perkins, Claremont.

Mahoe.

From S. Fisher, Mahogany Hall

Forsteronia floribunda.

From His Excellency Aristakes Azarian, Constantinople.

Spiraea Thunbergii
Ilex macropoda
Cratægus sanguinea
Rosa moschata
Rhodotypos herrioides
Ginkgo biloba
Hammelis japonica
Akebia quinata
Magnolia hypoleuca
Acer japonicum

From Messrs. Herb and Wulle, Naples.

Acacia vera
" laurifolia
Agave americana fol. aur. pict.
Asclepias sp.
Atriplex vesicarium
Bellinia procumbens
Bumelia ambigua
" lyciodes
Centaurea cyanus Victoria
Cineraria hybr.
Crocus Thomasii
Coleus hybr.
Cephalandra palmata
Dolichos unguiculatus
" " fructo verdo
Heimia salicifolia
Helianthella sp.
Digitalis lutea
Hortensia sibirica
Astragalus glycyphyllus
Iris alata
" Helena
" maricoides
Lonicera canescens
Opuntia Aillenia
" missouriensis
" Psuedo-Tuna.
Fritillaria libanotica
Muscari racemosum

PLANTS.

From Reasoner Bros., Florida.

Nymphæa zanzibarensis
" odorata
" alba
" flava
" Marliana rosea
Limnocharis Humboldtii

From Col. Griffith, Hodges, Black River.

Broughtonia lilacina
(Læliopsis domingensis).

DEPARTMENT OF PUBLIC GARDENS AND PLANTATIONS, JAMAICA.

NOTES ON CURING COCOA FOR SMALL SETTLERS.

By W. Cradwick, Superintendent of Hope Gardens.

The first important point to be observed when about to cure Cocoa is that it must be quite ripe, but not over-ripe. The pods must have attained their full colour whatever it may be, but if the beans shake about easily then the pod is over-ripe. The reason is that if the beans are not ripe, the mucilaginous matter covering the beans is not properly developed into the stage when it will readily ferment. If left to get over-ripe, the mucilage commences to liquefy.

The best vessel in which a small cultivator can ferment Cocoa is an ordinary flour barrel. To prepare this for the reception of Cocoa beans, first bore about a dozen holes, each half an inch in diameter, in the bottom of the barrel, then place about ten inches of banana trash in the bottom of the barrel. Line the sides also thickly with trash, and have a sufficient quantity on hand to cover the beans when placed in the barrel. When the barrel is ready, break the whole of the pods and place the beans in the barrel, covering with the banana trash. The beans must be left to ferment for two days, then remove one third of the beans and lay them in a heap on the floor and mix them thoroughly. Remove the balance of the beans and mix them also, but do not put the two heaps together. After placing fresh trash in the barrel, put the beans which were at the top back into the bottom of the barrel and those which were at the bottom, place at the top. Cover with trash in the same way as before and leave for two more days, when the beans should be treated in exactly the same way as before. They should then be left for two more days, when they are to be taken out and washed thoroughly. On the day the beans are finally removed from the barrel the work should be commenced very early in the morning, so as to get all the sun possible on the first day, for the beans mildew very quickly. They should be washed immediately they are taken out of the barrel as this helps to keep them plump.

The proper amount of Cocoa to ferment in one barrel is the quantity of beans obtained from 1,000 ordinary sized pods. If many more than this number are put into one barrel, the fermentation is too great and the beans turn black.

If a less quantity, say below 700 pods, are to be fermented, the green trash and more of it must be used, and a weight not exceeding 28lbs. placed on the top which helps the fermentation.

When the Cocoa is being dried, it is not advisable to expose it after the first two days to the extreme heat of the mid-day sun, it is better to take it in about 9 o'clock, and then put it out again between three and four o'clock. Those who use evaporators are warned against an excessively high temperature.

Great care must be taken when removing the pods from the trees that they be cut off with a good sharp knife, not pulled off. If pulled off, the little knob at the base of the stem of the pod is injured, and the tree will not bear from the same spot the following year. If the pods are cut off carefully, the tree goes on bearing from the same spot year after year.

June, 1895.

Ne Series.] JULY, 1895. Vol. II. Part 7.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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1895.

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] JULY, 1895. Vol. II. Part 7.

PRICES OF VEGETABLES IN NEW YORK MARKETS.

The following letter from Messrs. Gillespie Bros. & Co., New York, gives reliable particulars about ordinary market values of vegetables during the Winter Season.

"We think the vegetables which can be most profitably grown in Jamaica to meet the American winter markets are, tomatoes, cucumbers, egg plants, onions, potatoes and cabbage.

"The prices obtainable are as follows: Tomatoes $3 to $5 per carrier of 6 baskets; Cucumbers $4 to $5 per carrier of 6 baskets. These must not be less than 6 to 10 inches long and straight shaped and green colour. Egg Plants must be of the purple variety and would bring from $3 to $6 per carrier or $6.00 to $10 per bbl. Onions, if from red Bermuda seed packed in crates of 32lbs. each from $2 to $2.50 per crate. They are crated in sizes, No. 1 and No. 2. Potatoes, graded No. 1 and No. 2. No. 1 bring from $6 to 8.00 per bbl. No. 2 $4 to $5.00. Culls or very small potatoes not wanted. Cabbage, packed in bbls. is worth $2 to $4 per bbl. which should contain from 60 to 70 cabbages each of medium size, about 3 to 4 lbs, each.

"We are prepared to receive consignments of vegetables and fruits, for sale on this market, and as to quantity we think any amount within reason, which Jamaica is likely to produce, will find a market here, providing it is shipped during the winter months, say from December to April. Onions sell best from January to March, Potatoes from January to April, and Cabbages from March to May.

"The success of such shipments entirely depends on the care and selection in packing and shipping. They come here at a time when native grown vegetables cannot be obtained and only the more wealthy classes can afford to indulge in their use, therefore they must be of desirable quality and appearance or these people will not purchase them.

"In regard to packages, the carriers which contain 6 baskets, can be purchased complete in knock-down shape for shipment at $18 per hundred sets if ordered in lots of 500 or 1000.

"By next steamer we shall be sending to Messrs. Emanuel Lyons and Sons, Kingston, a sample carrier and they will, we feel sure, be pleased to show them.

"All the vegetables we have mentioned should preferably be packed in these carriers, except egg plants which can also be packed in bbls. Potatoes should be packed in bbls. and onions packed in special crates.

"Any bruised or defective fruit should not be shipped as it not only spoils the appearance but is likely to lead to the ruin of the balance of the shipment."

NOTES ON VEGETABLES FOR THE AMERICAN MARKETS AND HOME USE.

By W. Harris, *Superintendent of the Hill Garden.*

Beet Root.

Make monthly sowings from the beginning of August to January, to have beet fit for market from November till April or May. The seed is sown in drills where the crop is to grow, in a sandy, open situation. 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 seed should be soaked in luke-warm water for about 12 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 one chain 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 varity, from 6d. to 2/ per ounce, and American seed from 10 to 20 cents per ounce.

Carrots.

Sow same months as Beet, in the open where the crop is to grow. They 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.

Cabbages.

Sow seed once a month from the beginning of August to January to have Cabbages from beginning of December to May.

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, Landreths All the Year Round, Bloomsdale Early Dwarf Flat Dutch, Redland Early Drumhead.*

Prices of seed.—English, 4d. to 1s. 6d. per ounce; American 25 to 50 cents per ounce, according to variety.

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 3½ 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 sticked, and as soon as the tendrills 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 sticking, 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 does not come up at all, or so weakly as to be of no count.

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, Ne 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.

CUCUMBERS.

Plant seeds once a month. or once a fortnight from beginning of September to February, to have Cucumbers from end of November till May. Messrs. Landreth & Sons state that *Fresh Southern Cucumbers appear in Philadelphia the last of November and command $1 to $2 per dozen. Towards Christmas the price rises to $2.50 per dozen after which the price declines to $4 or $5 per box of eighty-five to ninety fruit. By last of May the price goes down to $1 per dozen, after which shipments are unprofitable.*

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.—Carters' 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.

Kidney Beans.

(*American Dwarf*, or *Bush Beans.*)—Sow fortnightly from beginning of September to second week in January to have beans for market from early part of November to middle of March. Messrs. Landreth and Son state that *Beans generally sell well, but by 1st April decline to $3 to $5 per crate, and subsequently fall lower by reason of injury in transportation.*

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, Flageolet 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.

Turnips.

Sow seed at intervals of a fortnight from beginning of September to beginning of March, to have table turnips from November to May. 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 seldon fails to produce good turnips, it is, therefere, 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 the seed 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, such as *Early White Milan* which is 30 cents per ounce

Garden Eggs.

Sow early in August and again in September to have fruit from January till May. Strictly speaking Garden Eggs, Tomatoes, Melons, Cucumbers, etc., are fruits, but they are usually cultivated, and classed among vegetable crops.

The following information was given in *Bulletin No. 37* :—

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 100 plants.

Planting.—The plants are set out at 3 feet apart in a row, 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 fruit 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.

(8) *Large Round White.*—Similar to No. (7) but white in colour.

Nos. 1 to 6 can be obtained from *Messrs. Vilmorin, Andrieux & Co., 4, Quai de la Mégisserie, Paris,* and Nos. (2), (4), (7) and (8) from *Messrs. Landreth, 21 South Sixth St., Philadelphia, U. S. A.*

On Prices.—Commission Merchants in Philadelphia pay the market gardener about on an average one-and-a-half cents per fruit. The highest prices are eight and ten cents per fruit.

Florida fruit arrives in Philadelphia the latter part of November, and commands $6 to $8, per barrel crate. Earlier in the Autumn the market is supplied by fruit from Jersey. Towards Christmas the price of Florida Egg plants rises to $10 per barrel crate, and then declines by

April to $6 to $8, and by May to $5, after which they are likely to arrive in a damaged condition and be worthless.

Prices of seed.—American 30 to 60 cents per ounce; French 3d. to 1/ per ounce.

TOMATOES.

Sow seed at the beginning of each month from August to January, to have fruit for shipping from end of October or beginning of November till the following April

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.

Messrs. Landreth and Son's state that "*Southern Florida Tomatoes reach Philadelphia in February, and command $4 to $6 per bushel. By April the rate declines to $3 to $5, and continues to decline to June, after which they fail to meet the cost of transportation.*"

This would probably prove to be one of the most easily managed and profitable crops that can be raised here during the winter months, but great care and judgment would need to be exercised in picking, packing and forwarding, to ensure the fruit arriving at its destination in first class condition. Immense quantities of tomatoes are consumed in the United States, and during the winter months shippers of good fruit might rely on meeting a ready and profitable market.

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,* (new variety). *Carter's Blenheim Orange* (described by the late Mr. Shirley Hibberd as "the Queen of tomatoes"), *The Mikado, Table Queen, Ponderosa, 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.

MUSK MELONS.

Plant seeds at beginning of each month from August to January, to keep up a supply of fruit from November till the following April.

Messrs. Landreth, and Sons, state that "*Philadelphia Commission Merchants pay as a highest price $1.50 to $2 per bushel. As an average price 40 to 50 cents per bushel.*"

Messrs Peter Henderson, and Co., give the following as the American method of cultivation :—"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 shovelfuls 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 quicker."

Quanty of seed.—One ounce for 60 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.

Water-Melons.

Plant at same time as Musk-Melons. Messrs Landreth and Sons state that "*Philadelphia Commission Merchants pay for Prime Melons, as a highest price $40.00 per hundred. As an average price $10.00 per hundred.*"

In the United States Water-Melons are very extensively grown, and very highly esteemed. 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.

Squash.

Plant once a month from beginning of Angust to beginning of January, to keep up a supply till April.

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.*

Priee of seed.—American, 10 to 25 cents per ounce.

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.

Okra.

Plant beginning of August, October, December and February to keep a supply of young pods from October to May.

Okra is extensively grown in the Southern States, its young pods being used in soups, stews, etc., as with us. It thrives well in any modderately 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, Lanareth's Long Green, Landreth's Long White.

Price of seed.—American, 10 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.

Messrs. Peter Henderson and Co. give the following as the method followed in growing *Table Corn* in the United States :—

"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.

Messrs Landreth and Sons state that "*The average price paid by Philadelphia Commission Merchants is one dollar per bushel. The highest is about $3 per bushel and the lowest sixty cents.*"

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.—Not a true Sugar Corn, but a hybrid between a Sugar Cane and Adam's Early, and 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 market gardeners more baskets of marketable ears to the acre than any other variety in cultivation. Plant at distances of 4½ feet between the rows, and 3 feet from plant to plant in the rows. Price of seed 20 cents per quart.

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 ¾ of an ounce of seed will be needed.

Varieties.—Carters' 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.

Lettuce.

Sow once a fortnight from beginning of August to beginning of February to keep up a succession of lettuce from October to April.

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 plant 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 week 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.

Radish

Sow once a fortnight from beginning of September to end of January to have radishes from October to March. 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 4 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.

Peppers.

Sow early in August to get fruit in November or December, and onwards. They should be planted about 2½ feet apart in rows, and the latter should be about 3 feet asunder in good mellow soil.

Messrs. Landreth, and Sons, state that "*Under good cultivation 200 to 350 bushels should be grown to the acre. The best prices for Peppers are obtained after frost. Commission Merchants pay 40 to 50 cents per bushel for first picking, but later on the price increases.*"

Quantity of seed.—Half an ounce of good seed should produce sufficient plants for five rows of one chain each, planted at 2½ 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 flavcur; colour yellow, seed, 5 cents per packet, 25 cents per ounce.

Parsley.

Sow early in August and again November for a succession. It 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. Carters' Ferned-leaved, price 1/6 per ounce, *Carters' 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.

Mustard and Cress.

Sow once every 10 days from beginning of September, to end of February, to keep up a continual supply.

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.

Varieties. Mustard. *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—*Carters' Cut and Come Again, Australian.*

Prices of Seed:—English, 3d. and 4d., per ounce; American, 10 to 15 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 or 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 in 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 experiments.

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 one 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 4½ 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 bottoms 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 2½ 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 deeay 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 to 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 to northern markets during the winter months are those known as "new potatoes"—the various kinds of Kidney potato—*Carters' First Crop.* A re-selected stock of the earliest, most prolific and best Kidney in cultivation. Price 5/ per peck (14 lbs), per ½ cwt., or bushel 17/6.

Carters' Improved EarlyAshleaf.—The first early White Kidney. Price 4/6 per peck (14 lbs), per ½ 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 market, and it is probably the most certain early-cropping Kidney in commerce. Price 2/6 per peck (14lb), per ½ cwt. or bushel 8/6.

Victor (Sharpe). Several seasons' trial have fully comfirmed 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 ½ 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 ½ cwt; or bnshel, 10/6.

Early Norther—This variety seems to do well everywhere. Its table qualities connot be excelled, cooking dry and floury, whether baked or boiled. Price 70 cents per peck, $2.25 per bushel.

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 shipping during the coming season; 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 at the right time and 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 Beat-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, High Holborn, 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 and477 N. 5th St., Philadelphia, Pa* A remitance to cover costs of seeds and postage should accompany orders to ensure prompt attention.

In "*Market Gardening and Farm Notes*" by *Burnet Landreth*, the following interesting and useful information on the packing, &c. of vegetables for market is given. "All vegetables and fruits generate heat and moisture, and to an increasing extent as the temperature rises. A rapid removal of these exhalations, as they are in the open air while the fruit or vegetable remains growing, preserves them in good condition, but to keep the vegetables in a close, confined atmosphere hastens fermentation and decay. The packages should be small, as bulk is an hindrance to ventilation. Barrels are bad packages; better use double sized flat crates with a partition. Costly refrigeration is not necessary if thorough ventilation can be obtained, and it cannot be doubted that ice cold refrigeration ruins the flavour of fruits and vegetables.

"When packing vegetables or fruit for market, do not use close boxes, or even ordinary slatted boxes. Well-made ventilated fruit and vegetable packages can be purchased in every section of the country where market gardening is pursued. Of course, some forms of packages are better than others. Light packages save freight and insure more careful handling.

"The sorting of vegetables or fruits for shipment demands so much care that every imperfect specimen should be rejected. The packing should not be done under a broiling sun, but under a shed or tree, so that the goods may be cooled off by every passing breeze, for, if packed in a temperature of 90° or 100°, they will when put into close cars soon develop a temperature 20° to 30° higher, consequent upon a fermentation which might otherwise be avoided, or certainly deferred.

"Pack snugly, using just enough force to place them sufficiently tight to prevent shifting, avoid baskets as top weight injuries specimen at bottom. See to it particularly that every package contains uniform specimens. Do not mix culls or secoud grade stock with first class, for by so doing the contents of a full package is rated at the market value of the lower grade which it contains.

"Outwardly, packages should be neat and attractive, as first appearances influence values. Every thoughtful shipper of vegetables or fruits is not only led to pack uniformly throughout his crates, but to ship in crates bearing his name, so that what reputation he makes for himself may benefit him through dealers knowing his name and address. Oranges and vegetables from certain parties in Florida have brought much better prices and met with quicker sales than equally good products from other parties, simply because the brand on the package was a positive guarantee of quality.

"The shipper must not imagine that *his* goods are to receive special attention from transportation companies or from commission men. The companies care little for his individual interest, and the commission men, if doing business of any volume, have no time to look to special cases, but endeavour to deal equally with all who look to them as agents.

"*Early shipments* are always profitable when the fruit is properly developed, but quality should be aimed at by the grower, rather than early, large, or extensive shipments.

"Qualities should never be sacrificed to quantity, either in the production of enormous yields to the acre, or in the production of monstrous specimens, as so often is the case in cabbages and cucumbers.

"The grower of garden vegetables for shipment should plant a variety and not confine himself to one, as cucumbers, cabbage or tomatoes, for he never knows when the market will be glutted, and if it be of that sort on which he has built his expectations of profit he may be sadly disappointed. In shipping, it is better to ship continuously to three or four established markets than to attempt to follow high quotations from various sources, as the conditions which regulate the prices may change daily, and points offering highest prices one day may be lowest the next.

"It is a mistake to divide a limited quantity of fruit or vegetables between many commission merchants, as the returns in small consignments are eaten up by the expenses of cartage and handling."

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.

LIBERIAN COFFEE.

In the Bulletin for January, 1894, the subject of Liberian Coffee was brought to the attention of planters, with the result that the applications received for plants have been larger than the Gardens have been able to deal with, on account of the notice being short; one planter has ordered 40,000 plants. It is expected that all orders can be satisfied in time for the October rains, but applications should be sent in at once, and will be dealt with strictly in rotation. In consequence of the large number of plants ordered all at one time, the price has been reduced to ½d. each plant, or 4s. per 100. The following information about the market value of this kind of Coffee in New York was furnished to the Governor by Messrs. Gillespie Bros. & Co :—

"We are in receipt of your letter of the 8th inst., asking for information as to the prospects of Liberian Coffee in this market, and beg to report as follows:—

"The article is coming more into use of late, and from what we can gather, supplies which at present come to this market are well competed for. It is a grade of coffee noted for its large bean, which is a very desirable feature for this market. The great and vital objection to its general use, however, is its very strong and rank flavour. This, to anyone of cultivated taste, is most objectionable. The principal consumption here has been in the Southern and Western States, where tastes are less exacting, and it is there used to add to the appearance of unattractive samples, or to strengthen the flavour of others.

"So far, the demand has kept up and been rather in excess of supplies; but whether its use will extend when these become more ample, as they promise to, is a very doubtful question

"The article arrives here from several quarters chiefly from Africa and Java. The African is considered the genuine, and is of a less sightly appearance, stronger flavoured than that coming from Java, where the soil seems to have especially modified the flavour. In Java it has been grown most successfully on land which had been exhausted by ordinary coffee. Four years ago, the crop there was about 500 piculs; this year it is expected to reach 9,000 piculs; and as cultivation is being extended in four years from now it is expected to reach 72,000 piculs.

"The value to day of ordinary African Liberian coffee is 18½c. to 19c. per lb.; of Java Liberian coffee 20c. per lb. To-day's value of ordinary Jamaica is 16½c. to 17c. per lb. We have found it difficult to ascertain the exact receipts in this country, for the reason that supplies come both direct and via London; but brokers who deal in the article estimate last year's receipts at about 10,000 bags.

"We have no doubt the article can be successfully grown in Jamaica, as it is reported to be a very hardy plant, thriving in low-lying soil; but whether its production on a large scale would prove a commercial success depends largely on what effect the soil has on it. If it modifies its natural rank flavour, and at the same time the beans are large, well formed, and sightly, no doubt it would meet with favour in this market; but until this has been ascertained we cannot give a positive opinion. We doubt very much if the ordinary rank flavoured growth will increase very much in general favour, but until its production is considerably extended, so as to overtake the present demand, it may be considered a staple article."

MANGROVES.

The question of cutting down the mangroves round the coast of Jamaica for the purpose of supplying a tanning material has been discussed, and although at the present rate of cutting no harm is likely to happen, the following correspondence supplies a warning which requires very careful consideration before cutting on a large scale could be permitted

The Secretary of State for the Colonies to the Governor of Jamaica.

Downing Street, 9th May, 1884.

Sir,

I have the honour to transmit to you the enclosed copy of a despatch addressed to Lord Granville, by Mr. Corbett, Her Majesty's Minister at Rio de Janeiro, together with a translation of parts of a pamphlet respecting the alleged injurious effect on the climate, etc., of the Bay of Rio of the wholesale destruction of the mangrove forests on its banks.

I have, etc.,

Derby.

Mr. Corbett to Earl Granville.

Petropolis, March 15th, 1884.

My Lord,

I have the honour to enclose to your Lordship copies of a pamphlet which has been recently published at Rio de Janeiro by Senhor Pedro Soares Caldeira, a very well-informed person, calling attention to the deplorable effect on the health, climate, and fisheries on the Bay of Rio of the wholesale destruction of the mangrove forests on its banks. He states that when the mudbanks were covered with mangrove trees, yellow fever and other disorders of an epidemic kind were unknown.

I have caused certain parts of the pamphlet, which show most clearly the evil effects of the destruction of the mangrove, and the supposed presence of yellow fever in consequence, to be translated, and have the honour to enclose them.

It has occurred to me that the contents of this pamphlet may have a special interest in those tropical British colonies where, in some degree no doubt, similar climatical circumstances exist as in Brazil, and where perhaps the mangrove forests have been as recklessly destroyed as in this country.

If attention has not been called to the effect of such destruction on the public health, it may be useful that it should be known in such places what the result of the destriction of the mangrove forest in the Bay of Rio is believed to have been.

I have, &c.

Edwin Corbett.

The Cutting of the Mangroves.

Far different is the present state of the shores of the vast Bay of Rio de Janeiro to what it formerly was. Up to the third part of this present century those shores, as well as those of the innumerable islands of the Bay, were bordered by vast quantities of these trees, which covered immense muddy lakes. Now, the inner part of the Bay at low water has the appearance of an enormous bank, of a black and repugnant colour.

Formerly that most extensive border of trees, embracing an area of many square kilometres formed a real martime forest of trees, in which predominated *tannin* ; and which, directly and indirectly, fostered the life of prodigious quantities of fish and shell-fish, and every species of inhabitant of the sea.

This tree is the mangrove ('mangue') It is a vegetable that spreads over the place in which it is planted, and is, for many reasons, marvellous. It solidifies the mud where it vegetates, and raises it; for every thing that adheres to the aforesaid trees held by its shoots, which are on a level with its roots, and by a thin and consistent vegetation, which has the appearance of asparagus, and which the trees throw out.

From the leaves, bark, and seeds which fall from the mangrove the mud used to receive an immense amount of tannin, a powerful antidote against putrefaction. Solidifying the superficies of the mud by the astringent nature that characterises it, the precious shrub prevented the spreading of the mud, and at the same time rendered difficult the procreation of the immovable shell-fish, and consequently facilitated that of the others. I refer to the crabs, which were the greatest consumers of organic remains or matter deposited on the banks. This most useful tree did not cease in its work of conquest over the water. It advanced day by day, hour by hour, sinking its roots, gaining on the resistance of the mud, raising it higher, and converting it little b y little into solid ground. If, in consequence of bad weather, a portion of the mud was brought to join the area conquered, the untiring workman was not long in covering it and making it wholesome; if a part of the conquest was torn away by the current, the pertinacious roots did not remain long without material to fix upon." * * * *

If the mangue had been preserved, it would tend to raise up the immersed part of the borders of the Bay and Islands, and thus, limiting the space over which the waters extend, would give them greater depth.

At the same time that the mud swamps of the majestic bay were covered with the spontaneous growth of this tree (mangue), yellow fever was unknown among us, as were other disorders of an epidemic character, the breaking out of which it would be erroneous to impute to the increase of the population. * * * *

The aspect of every thing has changed. The population of Rio de Janeiro, as well as that of Nictheroy and the sea coast, has increased considerably during the last 40 to 50 years; navigation has become developed, numerous industries have also become developed, the necessities of living have also multiplied. Up to a certain period of time, nature was sufficient of itself to repair the damage caused by the destruction of the marine forest; spontaneous nature was more than sufficient to recoup the damage caused by using the vegetable as combustible. This damage was very small; and the number of trees, whose power of reproduction is known to be prodigious, is incalculable. The new industries, in great want of cheap and easily obtained combustible, deeply disturbed by destruction that spontaneous gift of nature. * * * *

The quantity of tannin that our waters failed to receive is incalculable.

Men disturbed the conditions created by nature for the equilibrium of her force, and these could not be disturbed with impunity.

The whole of the extensive area occupied by the mud is now laid bare, nor can the day be far distant in which the last sample of this provident tree shall have disappeared.

From such destruction it resulted that, when the tides are low, either from want of constant rain, or chiefly from the impediment offered by the northerly winds (which prevail in some years during the whole summer) to the entry of the waters of the ocean through the bar, the mud banks become exposed to the great heat of the sun, which, encountering a good conductor of heat in the colour of the said mud banks, throws out such a heat as few living things can bear. The water which the receding tide leaves in the pools on those vast mud banks, and which could only be calculated at some hundreds of millions of 'litres,' is decomposed by the excessive heat; enormous quantities of fish, oysters, mussels, mollusks of various kinds, especially the 'samanguaia', of which the powers of reproduction exceed all the bounds of verisimilitude All the water very frequently evaporated by the heat of the solar rays, and the mud becomes entirely dry, taking a dark grey colour, and cracks on the surface. Upon the return of the tide the layer thus cracked detaches itself from the under part, floats away, and is deposited on the shore, where it forms small hillocks and finishes the incipient fermentation.

In the lumps of dried mud are carried off myriads of shell fish and mollusks of every kind in a putrid state A stronger tide than usual dissolves these little hillocks of organic matter ('detruits'), draws them out at the fall of the tide, and scatters them about everywhere.

Each day in summer on which the winds are adverse to the entry of the waters of the ocean through the bar, the phenomenon is repeated thereby poisoning the atmosphere, and saturating the waters of the bay with poisonous elements.

The mortality of the fish and shell-fish of every kind and variety exceeds everything that the imagination can represent in numbers. It is in this ambient, infected, and deadly fluid that the fish of various qualities, as well as the shrimps, move about, and upon which we feed, and the greater part of which are taken in a sickly state. To the elements of the decomposition of animals, of the roots of extinct mangroves, and marine vegetation, are added that coming from the the rivers, brooks, and canals.

In some summers the immense mud plains are like colossal cemeteries, embracing an area equal to that of the great number of the largest cemeteries of the world united together. In the human cemeteries the bodies lie some metres below the surface of the ground. In the vast cemetery of which we speak, myriads of organic creatures exposed to the sun are going through all the phases of chemical decomposition which commences with death ; and it is there upon the rising tide that the fish and shrimp (or prawn) come to seek their food, and which in their turn serve as food for us. When the tide runs out it carries with it a part of that residuum in which predominates bromine, iodine, and the terrible phosphorus; and this part of the residuum goes and spread itself about the waters of the bay. While the same causes exist, the series of phenomena recommences on the mud banks, which must spread over them lifeless organism. There are years in which this colossal chemical laboratory of decomposition does not cease its work for one, two, or three months.

The writer was contemporary with the marine forests, which, although they had already entered upon their decline, still resisted, through the spontaneous compensation afforded by nature, the devastation of which it had commenced to be the victim. He saw the devastation in its march, and now he does not meet with a sample of the useful tree in places where formerly flourished an innumerable quantity of trees which shaded vast sheets of mud. At the time when the marine forest existed, the yellow fever had never shown itself in the city of Rio de Janeiro. At all events, it is a coincidence to be noted. * * *

The author of so many publications in the "Jornal do Commercio' (Sr. Albuquerque) attributed yellow fever to the diffusion throughout the atmosphere of acid of bromuret from the decomposition of marine organisms; and as I, since 1859, have become convinced that the bareness of the mud banks, and consequent mortality among the crustacea mollusks, gives rise not only to the diffusion of that acid, but also to other products more noxious for example, phosphorus disseminated on a great scale, the terrible malady comes to us. Will the symptons of poisoning by phosphorus in small quantities bear a perfect similitude to icteroid typhus? I shall limit myself to this question, which only competent persons can answer in a positive manner. * * *

During the late hot season through which we have passed, at more than one period, and during consecutive days, the tides were so weak that even at their highest rise they did not cover the mud-banks. The latter dried up immediately; they cracked on the surface, and the whole phenomena, already pointed out, followed. In the last months of 1882, and especially in the beginning of 1883, the mortality of the shell-fish was frightful, to which circumstance all the fishermen and other maritime labourers can bear testimony. On the shoals and banks where the mussel had accumulated to the thickness of some centimetres, the destruction from the effect of the solar rays and the previous presence of fresh water was complete. The 'samanguias,' and other organisms existing on the surface of the uncovered shoals, had the same destiny. The echinidi were totally destroyed, doubtless from the fresh water predominating over the salt in the Bay; the latter being repelled by the prevalent winds, could not enter the bar in a sufficient quantity to re-establish the equilibrium or regain its empire. The residuum of the dead inhabitants of the waters in the Bay, or the organic animal matter given up to decomposition, would require to be reckoned at many thousands of metrical tons. The withdrawing of the waters of the ocean was such in the foregoing months that it became sensible even on the outside of the bar. On the small islands and banks near the coast the extraordinary mortality of the shell-fish, especially of mussels, produced exhalations so repugnant as to provoke vomiting.

In epidemic seasons of former years the same facts have occurred. The fever has shown itself whenever the mass of organic matter already in a state of putrefaction on the vast banks is greater. * *

It may be mere conjecture, but at all events it would be well to consider all these matters which I pointed out, and investigate them, not only in Rio de Janeiro, to the bay of which I limited my observation, but to every place at which the terrible malady manifests itself periodically. The investigation may point out the right path—which seems to us well marked out by studying what takes place in Rio de Janeiro

The yellow fever has appeared in Para; while at Maranhao, Ceara, Rio Grande do Norte, and Parahiba we are not aware that such a disease has shewn itself. Does this discrepancy proceed from the beach in the three former provinces being sandy, and the mangroves intact in the last.

Are there in Para uncovered mud-banks which are the cause of analagous putrefaction to that of the bay of Rio de Janeiro? Does the mangrove exist there? Has it been devastated on a large scale?

The yellow fever has shown itself at Pernambuco, Bahia, Santos, and after 1870 at Paranagua. At Sta. Catharina and S. Pedro do Sul such a scourge is unknown. Why is it that some parts of the sea-board of Brazil should be attacked and others not? Why do not near provinces in identical atmospherical conditions import and export the scourge from one to the other? If it is true that we import yellow fever, how is it that we do not export it to Sta. Catharina and Rio Grande do Sul, at so few days voyage from hence? Why did not Pernambuco export it to Parahiba, and so on successively?

Everything conspires to show how there is a cause on the sea-side, and how the difference of the nature of the coast rules, or not, the fever. The resistance offered to it by the interior of the country is a proof of this. The cause, in our opinion, is the devastation of the marine forest, the cutting down of the precious trees, in which observation has shewn us an error of fatal consequence. * * *

It is not necessary to proclaim the beneficial influence of forests cultivated in the neighbourhood of the great centres of population. Nevertheless, we never even heard speak of our marine forest; and we possessed a splendid one, rich, and eminently appropriated to the rendering of the city of Rio de Janeiro healthy. That forest afforded us for long years combustible which appeared to be inexhaustible; but the good quality of its wood aided to abbreviate the term of its destruction. * * *

Whether or not it be mere conjecture, it is a certain fact that as long as we had a marine forest we had no yellow fever. The advent of the latter coincided with the disappearance of the former. If this be not sufficient to determine the relation of the cause with the effect, it certainly constitutes an element which is not to be despised." * * *

The yellow fever has not yet invaded the interior of Brazil, and it has shewn itself in some places, and not in others. of the coast; it has prevailed for many years, and at more or less too short intervals for the contagion to have amplified the area (in case it found localities hitherto exempt from it) and the means adapted for planting the seeds of the malady.

Therefore it is from the mud of the sea that the cause ought to be sought; and as the scourge did not, for long years, attack all the inhabited places washed by the ocean, it is to be inferred that such a cause is not virtually in the waters, but in the conditions which modify them, saturating them with morbid elements. * * *

In concluding, I would say that no conviction was ever more profound, or even calmly formed, than that which I have manifested. It is now

15 years since I had formed the opinion respecting the maritime forest which I only now publish, but which, in the meantime, I have made known to many persons.

In these 15 years, I have gathered together a mass of observations made by myself, I have collected numberless data, gathered information; and my mode of appreciating the influence which the devastation of the marine forest has upon the medical constitution of Rio de Janeiro is each day stronger.

MANURES FOR BANANAS.

In the Bulletin for May, 1893, information was supplied as to the kinds of manure which should be used for trial with bananas, and the method of carrying on the experiment.

The following notes have been supplied by Mr. Henry Cork. The manure "A. G." referred to is Albert's Horticultural Manure and "P. K. N." is Albert's Tropical Manure. The Horticultural Manure contains nitrogen in the form of nitrates and of ammonia salts, potash, and phosphoric acid all in a soluble form, hence a "complete manure." The "P. K. N." differs from "A. G." in containing less nitrogen, but much more phosphoric acid and potash, especially potash.

It is satisfactory to find that "nine-hand" bunches are produced where bananas before only gave "six hands," and that the useful manures appear to be the mixture of nitrate of soda and chloride of potassium, and a complete manure of the same composition as Albert's Tropical Manure.

"I have great pleasure in sending you a report on the results obtained by the experiments with the Banana Manures.

"The manures were duly weighed and mixed with dry earth in accordance with the formula sent me. The ground was slackened with the fork, the manure sown broadcast and slightly covered with firmly pulverised earth. The P. K. N., and a mixture of Nitrate of Soda and Chloride of Potassium were the only ones that made any improvement in the crop. These did well. It would be suicidal to manure bananas unless a bulk of rotten vegetation be added either in the shape of grass, rubbish, dry leaves, stable or cow pen manure, but with these the above may be used with a most decided advantage. The A. G. manures were no good.

"Rainfall from 1st Feb. '94, to 22nd Dec. '94, was 101.81 inches during time manures have been in ground.

"The average temperature ranged from 70° to 85° F. during the 24 hours, but the lowest temperature was 59° and the highest 94°.

"Artificial manures will increase the size of Banana bunches in a sufficient ratio to pay for their application. Several of my experiments are now growing nine hands where only six hands were grown before. I am working on my own account on some bad patches in my old fields with most decided results. But of course you will readily understand that the soils vary much in this country and therefore a good deal of technical knowledge is necessary to be successful.

"I am afraid you will not be able to get a general manure to suit all

Banana Growers; each property will require its own special manure in the same manner that canes do. * * * *

"If you take nine hand bunches at a value of £9 per hundred as an average price the year round, it would shew the difference between the value of the crops, and deducting the cost of manure would shew the value to the planter of applying same. There were 11 square chains tried here, this at 14 ft. square would give about 250 trees as near as can be in a field cultivation. I have spent about £150 in manures since trying the Government samples and believe I am getting near the correct manures to use here. I shall at any time be glad to place any portion of my fields at the disposal of the Department and will find all the labour required."

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Seeds.

From Botanic Gardens, Bangalore—
Sterculia villosa.

From Botanic Gardens, Trinidad—
Eperua falcata

From Mr. Arthur George, Kingston—
Ceratonia siliqua.

From Mr. Jas. Allwood, Kingston—
Aristolochia ringens.

New Series.] AUGUST, 1895. Vol. II. Part 8.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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BULLETIN

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A CONTRIBUTION TO THE STUDY OF THE PRODUCTION OF THE AROMA IN RUM.

By Percival H. Greg.

This account of some experiments which I have been making in this direction, and which I venture to submit to readers of the Bulletin in general, and to Planters and Distillers in particular, pretends to be simply what it is entitled—*a contribution*—the question indeed is a wide one and may be approached from many sides.

The aroma of rum may be said to be mainly due to five causes, 1st the nature of the plant from which rum is made, the sugar cane; 2nd the soil on which it is grown; 3rd the fermentation; 4th the distillation; and 5th the storage in cask, at the high temperature prevalent in the tropics. My researches as will be seen, deal exclusively with the aroma developed during fermentation, with special regard to the influence exercised in this direction by a particular variety of a peculiar type of yeast. They were suggested to me by the brilliant results attained by Prof. Hansen in his employment of pure yeast in the manufacture of beer. Following out Prof. Hansen's ideas as to the great influence exercised by the type of yeast on the nature and resulting products of the fermentation, my work at first consisted in isolating and cultivating pure, according to Prof. Hansen's method, as many different varieties and species of yeast, as I could obtain from the materials, molasses and dunder, sent to me from Jamaica, and instituting with such cultures trial fermentations on a small scale. I gave a preliminary account of these researches in the "Sugar Cane" of Nov. 1893, in which I stated that I had isolated a considerable number of varieties of Jamaica yeast, possessed of very different properties.

One yeast in particular seems to me to have a special bearing on the production of the aroma in rum. It belongs to the type known as "top fermentation" yeast, i. e., it throws up a "head" on the surface of the fermenting liquid, which, in molasses and dunder, is of a beautiful golden colour and very tenacious in character. The progress of the fermentation is a slow one, varying, according to the composition, concentration and temperature at which the wash is fermented, from 10 to 14 days The fermentation of the liquor is a very quiet one, the gas being given off slowly in small bubbles, and at some stages fermentation is hardly noticeable. During fermentation, although there is a somewhat "fruity" smell, a definite aroma cannot be said to be produced, but after the fermentation is concluded, if the liquor be allowed to remain quiet, say from 24 to 36 hrs. a delicious aroma can be distinguished. In order to prove without a doubt, that the aroma produced was due to this germ, the following experiment was performed. A certain quantity of molasses and dunder and water, mixed together in suitable proportions, was taken and sterilised by boiling. It was then allowed to cool in contact with air previously freed from all germs, and when a sufficient amount of air had been absorbed the liquid was equally divided between two fermenting cylinders which had also been previously sterilised. One cylinder was set in fermentation by means of this particular yeast, which I call No. 18, and the other cylinder was fermented by another Jamaica yeast which I will call No. 4. The two cylinders were then placed under exactly the same external conditions, and fermentation allowed to proceed. The appearance of the two cylinders during fermentation was characteristic. No. 18 was covered with a thick golden buttery head, and fermentation was slow, while in No. 4 cylinder the yeast remained entirely at the bottom, and the fermentation was rapid, and was what is technically called a "champagne" fermentation. At the end of 5 days fermentation was entirely at an end in No. 4 cylinder, while in No. 18 it was still in progress. No 4 cylinder was allowed to stand 36 hrs. *No aroma was developed.* Eventually fermentation was finished in No. 18 in 12 days, and the wash allowed to stand 36 hrs.,—*a heavy fruity aroma was developed.* This experiment clearly shews that the aroma in question was due to the influence of No. 18 yeast, since the two washes fermented were identical in composition, and were fermented under exactly the same external conditions. It raises too a point of some practical importance to which I would call the attention of estate owners and distillers. There seems to be a general unanimity of opinion among planters that in order to produce a fine rum, the "wash" must be allowed to "die down" thoroughly. To accomplish this however necessitates in many cases building larger still houses, which many estates in these hard times are unable to do. But does it not seem evident from my experiment that the amount of benefit to be derived from the enlarging of the still house and thus giving the liquor room and time to attenuate thoroughly *will vary very much according to whether an aroma or non-aroma producing yeast has the mastery in the vats?* So far we see the problem must be approached from two sides. The case however presents other points of interest. How far in the experiment under discussion was the aroma due to No. 18 yeast? Did the yeast excrete the aroma, so to speak, or did it form it from, or by transforming, certain substances in the liquid? In order to settle this question, I fermented separately, by means of No. 18 yeast, refined cane sugar, dextrose, cane juice, and molasses, leaving the liquor to stand 36 hours after the completion of fermentation: *in no case was the aroma developed.* I repeated these experiments, but the results were the same. I need hardly add, that where necessary, yeast nutriment was added in order to produce a normal fermentation. This puzzled me for some time. Dunder and molasses and No. 18 yeast gave the aroma, but molasses and nutrient salts and No. 18

yeast did not: therefore the aroma must have been produced from No. 18 yeast acting on some substances in the dunder. But dunder is simply the residue of wash which has been previously fermented and distilled, and is in fact the residue of cane juice, and skimmings and molasses. But neither cane juice, which contains those substances which eventually go to form skimmings, nor molasses, gave the aroma. Perhaps then it was due to the process of boiling in the still? Accordingly pure cane juice and molasses were allowed to undergo fermentation and were then distilled, and fresh wash set up with the resulting dunder, but no aroma was developed: it was evident then that dunder, as dunder, had nothing to do with the formation of the aroma in question. I must here make a short digression. While I was engaged in Europe in isolating different yeasts from the materials (molasses and dunder) sent to me from Jamaica, I searched for a long time in vain for a yeast capable of producing a definite aroma. With this object I must have made certainly not less than two hundred pure cultivations. One yeast only attracted my attention as seeming to be able to produce a faint aroma, certainly more than the rest. This yeast therefore I examined more closely. On testing the mixture of dunder and molasses which I was fermenting with this yeast, it was found to be exceedingly acid. It was thought therefore that such a great acidity was injurious and might probably interfere with and prevent the yeast from exercising its physiological functions to the full. I accordingly partly neutralised the acidity of the dunder with a few drops of caustic soda, and put the liquid which No. 18 yeast had nearly finished fermenting, away to stand. *After standing for about three days and when fermentation was at an end the characteristic aroma was developed.* This yeast I afterwards named No. 18 and is the one used in these experiments. I had not time then to proceed any further with the question, and remained satisfied with the explanation I have adduced. When however my experiments in Jamaica led me to see that the aroma could not be produced from fresh cane juice or molasses, or even from cane juice and untreated skimmings, or from molasses and untreated skimmings, but yet could be produced by the help of the dunder acted upon by No. 18 yeast and bearing in mind my former experiment in Europe, of partially neutralizing the dunder, which had resulted in the production of the aroma, I bethought me of the treatment which the cane juice undergoes in the boiling house.

This as a general rule in Jamaica consists in treating the cane juice with caustic lime. I determined therefore to try the experiment of fermenting cane juice which had undergone this treatment. But as an alkaline medium is unfavourable to alcoholic fermentation, and as the alkaline skimmings from the boiling house are brought down, whenever possible, on acid dunder, I determined in order to test the efficacy of the treatment and at the same time to provide a favourable fermenting medium for the yeast, to neutralise the alkalinity of the treated cane juice with sulphuric acid, using a sufficient excess to produce a slight acidity: dunder of course could not be used in this experiment. A portion of fresh cane juice was therefore taken and divided into three parts I, II and III. No. I was made alkaline with caustic lime, No. II was not treated and served merely as control experiment, while No. III was not treated with temper lime, but was faintly acidulated with sulphuric acid. This last also served as a control experiment, as it might be argued, that should any aroma be produced in No. I sample, it might have been caused, not by the treatment with an alkali, but to the subsequent liberation of aromatic vegetable acids, or volatile vegetable acids, capable of forming fruit ethers perhaps by the stronger acid sulphuric. I must add that in order to preclude the possibility of action of germs other than No. 18 yeast, which would of course be naturally present in the cane juice, that the three portions of liquid were sterilised before being fermented. No. I. was sterilised (boiled) after the treatment with lime, in order to imitate the treatment to which the skimmings are subjected in the boiling house, and the sulphuric acid added just before the fermentation. No. III. was boiled before the treatment with sulphuric acid in order that if volatile acid should be liberated that they should not be driven off by the heating, that is that the maximum effect if any, due to their presence, should be obtained. No. II. sample was of course simply boiled without any addition. After these three samples had been boiled and allowed to stand in contact with sterilised air for a sufficient length of time, an equal quantity of No. 18 yeast, in a state of absolute purity was added to each portion and the liquid allowed to ferment, the outside temperature being the same in each case. *In No. I. sample, which had undergone the treatment with lime, the characteristic aroma was developed. In samples II. and III. the aroma was not developed.* It is but fair to state that the aroma produced was not very strong, *but there was no denying its presence.* Here then we have the four factors necessary for the production of the aroma in question. First the germ, No. 18 yeast; secondly, the medium skimmings or cane juice; thirdly, the treatment of the liquid —heating with caustic lime, or caustic alkali; fourthly, the question of time—the wash must stand 24 to 36 hours after fermentation has been completed. Be it borne in mind that the absence of any one of these 4 factors, will result in the non-production of the aroma in question. I expressly state here of the "aroma in question" because it is not contended that no other aroma can be produced by any other germ or germs which may be active in the fermentations. Indeed the treatment with lime for reasons which I shall show at another time, has an effect upon the flavour of the resulting spirit, independent of the action of any particular germ In order however to make quite sure that the activity of 18 yeast is necessary in treated cane juice to ensure the production of the aroma, treated cane juice was fermented by several other Jamaica yeasts, *but no aroma was produced.* My researches hitherto have been directed to show that a certain aroma can be produced by a particular type or variety of yeast, which cannot be produced by other germs in my possession, but that though the activity of this yeast is *essential*, certain other conditions are equally essential. In other words the aroma produced during fermentation is the resultant of more than one force, but that the type of yeast employed plays a very important part in the matter and the probability is that this remark applies to any other aroma produced during fermentation. I have in this case been able to isolate and identify these forces, which is advantageous as shewing how No. 18 yeast may be employed to produce the aroma, with its *maximum* effect. But it will be seen that so far I have touched on the matter somewhat superficially. I have yet to shew what is the substance or substances which are acted upon by the caustic lime in the cane juice and the way in which No. 18 yeast acts upon them to produce an aroma, and I have yet to shew why the effect of the lime is not rendered nugatory by the after addition of sulphuric acid. This however would make my paper too long. and as I am still engaged in investigations on these points, I must defer any explanation for the present. One thing however further experiments have taught me with absolute certainty, that in order that the treatment with lime be efficacious in its influence on the flavour of the rum—and this applies equally, whether 18 yeast is used or not—the *skimmings* must be *thoroughly* heated in the syphons after the treatment with lime.

THE JAMAICA YEASTS.

By Percival H. Greg.

In a collection of papers from the Demerara *Argosy* entitled if I remember rightly the "Planters Manual" 1889, there is a very interesting article on "How to make German Rum, by a Jamaica Distiller." Among other things the author mentions that the liquor throws up a thick golden head, that fermentation is very slow, and that no particular characteristic aroma is produced until after fermentation has been concluded. This corresponds so exactly with the behaviour of my No. 18 yeast during fermentation that I am inclined to think that the yeast forming the golden head or "Rum fat" as he describes it, is the one which I call No. 18. The author after stating minutely the methods to be employed in the manufacture of this German Rum, confesses that this recipe is not always attended with successful results, inasmuch as that some estates, trying all they can, never produce German Rum, while other estates produce it without any apparent effort. Very interesting it would have been if the author had stated, which as far as my recollection serves me he did not, how much importance he attached to the presence of this "rum fat" in producing the aroma, and as to whether this characteristic fermentation was absent or at least not permanent in those estates which tried to produce German rum, and failed. There would be nothing very startling if this were so. All the most recent researches go to show that the influence exercised by the particular organism active in the fermentations on the flavour of the resulting aroma of the Beer, Wine or Spirit has up to within recent years been in many cases under-estimated or indeed not taken into account at all. I have seen an organism which out of pure sugar was able to produce liquor which smelt like pure pineapple essence, and I have in my possession, two varieties of the type Saccharomyces anomalus which produce a distinct pineapple flavour in molasses. Thus in Hansen's *Untersuchungen us der Praxis der Gährungsindustrie*, which translated freely signifies "experiments in practical fermentation," mention is made of the results attained by a Dr. Nathan in Rottweil in the use of selected types or varieties of yeasts in the preparation of fruit wines. The experiments were carried out on a large scale, and are therefore the more important. The conclusion to be drawn from them was that the quality and whole character of the fruit wines. is much more dependant on the character of the yeast which plays the leading part in the fermentation than is the case with grape juice. If (writes

Nathan) I examine the 40 fermenting vats which I had filled with one and the same Must (fruit-juice) whether it was from berries or apples or pears, and then afterwards infected each with a different kind or type of yeast, the products of the fermentation differed from each other in such an extraordinary manner that no one would have believed that he had to do with one and the same material. While some types of wine yeast gave for example the apple-must a very pronounced winey taste and smell, others shewed themselves able to alter the material but little. Some yeasts gave a very disagreeable after-taste to the must. Other examples could be given shewing that the flavour of cream, butter, the ripening of cheese, the aroma of tobacco, etc., are due to the activity of special types or varieties of micro-organisms. Returning again to the subject of the Jamaica yeasts, there is another point to be discussed. In my last article I mentioned another fermentation which I obtained with a Jamaica yeast which I called No. 4. I showed that there were two apparent differences between the two yeasts, one the difference in the resulting products of fermentation, i.e., the aroma, and the other the time required by the two yeasts to ferment the same quantity of the same mixture of molasses and dunder, i.e , No. 4 requiring 4-5 days, and No. 18, 10-14 days. Here we see then that *the kind of yeast employed is one of the deciding influences in what is a most important point in the Still House, viz., the question of time.* It may not be out of place here to give a list of some of the Jamaica yeasts which I have isolated and proved in fermentations in my Laboratory.

Yeast No.	Time of Fermentation.	Attenuation of Wash.	Alcohol. vol. per cent.
No. 1	3 days	21–5 Brix.	6.6
No. 4	3–4 days	21–5 "	7.6
No. 5	4–5 days	21–5 "	6.6
No. 7	4–5 days	21–5.3 "	6.6
No. 8	3 days	21–4.8 "	6.96
No. 14	4–5 days	21–4.8 "	6.90
No. 17	5–6 days	21–4.6 "	7.4
No. 18	12 days	21–4° "	7.2

To translate Brix into Jamaica Saccharometer multiply by 1.33. Thus 21-5 Brix=27.9—6.65. In considering these figures they must be regarded in the light of a comparative rather than an absolute test of the capabilities of the various yeasts. In this experiment the yeasts were compared together *under exactly the same conditions* and therefore the differences shewn can only be due to specific differences existing among the yeasts themselves. It is quite possible that the differences might become still more marked under different conditions such as for instance an increase in the initial density of the liquor. Thus with No. 17 I have under favourable conditions obtained an attenuation of 36.4–8=28.4 degrees attenuation (Jamaica Saccharometer) in from 5–6 days, but it does not necessarily follow that all the other yeast in my list would under those conditions give corresponding results. As it is, however, the differences shown in time of fermentation, amount of attenuation, and the quantity of alcohol produced, are worthy of attention. As regards the attenuation it must be noted that the Brix saccharometer was used instead of the one in use in Jamaica, and that if judged by the latter standard the number of degrees representing the attenuation would be greater. The amount of alcohol obtained is expressed in percentage, i.e., in the number of volumes of absolute alcohol present in 100 volumes of the wash. The greatest difference in the amount of alcohol produced is between either of yeasts, Nos. 1, 5, and 7, and No. 4. Thus on 100 gallons of wash the difference is 1 gallon of absolute alcohol—10 gallons per 1,000 gallons of wash. Other differences which are not indicated in the table were also observed among the yeasts. Thus some started fermentation quicker than others, some reproduced themselves more than others; and some formed a deposit which adhered tightly in a hard pasty mass to the bottom of the fermenting vessel, while others formed a deposit which was easily disturbed. With the exception of No. 18, and No. 19, which I have not included in the list, the yeasts were all of the "low" fermentation kind, i.e., remained at the bottom of the liquid Nos. 18 and 19 are of the "top" fermentation kind i.e., throw up a "head" on the surface of the liquor during fermentation. With the exception of No. 18 the difference in the flavour of the resulting distillates was not very marked but the quantities operated upon were too small to enable a correct judgment to be formed, and of course the influence of storage in cask had to be left out of account. These results be it observed are results obtained in the Laboratory. If it be asked what results would be obtained by working with such and such a yeast in the Still House? The answer is that that this can be best determined by direct experiment in the Still House. There is however very little doubt that the comparative differences shewn here would also obtain in the Still House. No. 18 yeast for instance will always be by comparison a much slower fermenting yeast than No. 1, and will produce a more aromatic spirit. While No. 4 will be sure to produce more alcohol from a given weight of sugar than Nos, 1, 5 and 7. The object of this paper has been to shew that characteristic differences exist among Jamaica Yeasts which are active in the rum fermentation, that these differences are worthy of study, and may if placed under control be used with great advantage in the Still House. The principle which is advocated here is the selection by systematic experiment of that particular type or variety of yeast which is best suited for the kind of work it has to do and the cultivation and propagation of it in sufficient quantity for use on a commercial scale. i.e., for fermentation in the Still House. If this were not possible our interest in the question would be confined to its scientific aspect, but pure selected types of yeast are now in use in large numbers of Breweries and Distilleries. There seems no reason then to doubt that the introduction of selected types of yeast into Distilleries here would also be attended with advantage and in my opinion this forms the *basis* of a solid improvement. At any rate this reform seems worthy of a thorough trial on a practical scale, and I append here a description of the apparatus by which the yeast desired may be grown absolutely pure in sufficient quantity for this purpose. I would however strongly advise all those who may take an interest in this subject to purchase "Micro-organisms and Fermentation" by Alfred Jörgensen published by F. W. Lyon, Eastcheap Buildings, London, a short review of which by me appeared in the "Bulletin" for May. Illustrations and descriptions of the two

"Propagating" apparatus are given in it. The prices of the apparatus are approximately as follows :—

Apparatus Model Hansen and Kûhle, 1 sterilizing and one fermenting cylinder ... ... *1,600 Krones.*

Air pump and air chamber for propagating apparatus with stop valve safety valve and Manometer ... *800 Krones.*

Apparatus Model Jorgensen and Berg. ... *1,350 Krones.*

The prices are given in Danish Currency, the value in English pounds sterling will be found approximately by dividing the number of Krones by 18. (18 Krones – 20 shillings).

COLOCYNTH.

The colocynth, or bitter apple, which provides in its dry pulp a a well known purgative medicine, grows abundantly on the maritime plain that lies between Palestine and the eastern shore of the Mediterranean. It is found from below the city of Gaza on the south, to the base of Mount Carmel on the north. Consul Wallace, of Jerusalem, says that the dwellers along this plain pay little attention to the plant, and spend neither time nor labour in its cultivation. It grows without cultivation, the soil and climatic conditions producing it without the help of the husbandman. With some attention the plant would undoubtedly bear a larger and richer fruit—richer in that pulp which makes the colocynth valuable. But there is no object in thus improving the plant and its yield, as Nature alone now supplies far more than the natives can find a market for. The soil of this maritime plain is a light brown loam, very rich, and almost without a stone. In places where the loam has been mixed with sand the colocynth plant seems to thrive best. Very little rain falls on parts of this plain, but the plant does not suffer from this lack of moisture. The climate is warm all the year round and during the summer months the heat is intense, so that the conditions necessary for the successful raising of the Colocynth seem to be a good soil somewhat sandy, a warm climate, and little moisture. The plant itself resembles a common cucumber, but its fruit is globular, about the size of an orange, and of a light brown colour. Its rind is smooth, thin and parchment-like. It is known as the Turkish colocynth, and is superior to the Spanish and Morocco varieties in the amount of pulp its fruit contains. The pulp constitutes 25 per cent. of the fruit, and the rind and seeds are valueless. The fellaheen, or peasants, gather the fruit in July and August, before it is ripe. It is sold to Jaffa dealers, who peal it and dry the pulp in the sun : it is then moulded into irregular small balls, packed in boxes and shipped chiefly to England. The average annual shipping in 1894 is 20,000 pounds, though the shipment in 1894 amounted to only 6,000 pounds. This quantity could be increased indefinitely if there were more demand for it and a price were paid that would make it an inducement for the peasants to gather and prepare it. The price now paid for the colocynth pulp, prepared, packed for shipment, and delivered on board the steamer in the port of Jaffa, is about fifteen pence a pound. (*Journal of the Society of Arts*).

REPORT ON TANNIN FROM AN EXUDATION OF PTEROCARPUS DRACO, LINN, AND KNOWN IN JAMAICA AS DRAGON'S BLOOD.

By Henry Trimble, Ph. M., Professor of Analytical Chemistry in the College of Pharmacy, Philadelphia.

The origin of this product was described in the *Bulletin of the Botanical Department, Jamaica,* No 45, July, 1893. As there stated the tree is about 30 feet high, and when an incision is made in the bark drops of red sap ooze out which flow slowly down the bark and gradually harden.

The sample received by me from Mr. Fawcett was in small garnet-red pieces, transparent at the edges, and breaking with a resinous fracture. It much resembled the eucalyptus kino received from Australia.

On account of its solubility in water, the product closely resembled some other varieties of kino, as well as the one just mentioned from Australia.

Warm water dissolved 95.95 per cent of it, the insoluble portion 4.05 per cent. consisted chiefly of adhering bark fibre.

The ash amounted to 2.36 per cent., and was found to consist of potassium, calcium, magnesium, and sulphuric, carbonic and phosphoric acids. There were found 34.95 per cent. of tannin and 25 40 per cent. of moisture, which would indicate 46.71 per cent. of tannin in the absolutely dry substance. The balance consisted chiefly of gum. A complete statement, therefore, might be made as follows:

Tannin	...	34.85	per cent.
Moisture	...	25.40	"
Ash	...	2.36	"
Insoluble	...	4.05	"
Gum, etc.	...	33.34	"
		100.00	

The tannin was separated from the gums with great difficulty, because of the ready solubility of each in water, and because the tannin caused some of the gum to go into solntion in absolute alcohol, and also in a mixture of alcohol and ether. Agitation of the water solution with acetic ether, even in the presence of common salt, did not serve to separate the tannin from the gum, as the latter substance seemed to withhold the former. The close association of the two principles was finally broken up to some extent by agitation of the coarsely powdered sample with sand and acetone.

Upon allowing the mixture to rest, the gum separated as a jelly-like mass. The acetone solution, when separated and the solvent recovered by distillation, left the tannin in a porous condition, but still admixed with some gum. From this residue the greater part of the still adhering gum was separated by treatment with absolute alcohol. The solution was filtered from the gum left undissolved by that solvent and distilled to dryness, and the residue rendered porous by solution in a mixture of alcohol and ether and subsequent rapid vaporisation of those solvents by distillation under reduced pressure.

The ultimate composition of the pure tannin will be seen by the following average of three analyses :—

Carbon	...	58.92 per cent.
Hydrogen	...	4.80 "
Oxygen	...	36.29 "
		100.00 "

An aqueous solution of the tannin gave the following reactions :—

Lime Water ...	Purplish-pink color, becoming a brownish ppt.
Bromine Water	Yellow ppt.
Ferric chloride...	Green ppt. and color.

The composition, as well as the reactions indicate it to be very closely related to oak bark tannin, if not identical with it. The sample does not agree in composition or properties with the dragon's blood from the East Indies; it does, however, closely resemble the kinos, and should more properly be classed with them.

It will no doubt, if found in sufficient quantity, have some use in medicine as a kino, and it might be used, in case its price should warrant it, in the manufacture of leather, although such substances containing gum usually make a soft leather.

TILLAGE OF THE SOIL: ITS PARAMOUNT IMPORTANCE.

Questions are often asked about the application of manures to soil, especially of artificial manures. The answer to such questions from small settlers generally should be,—have nothing to do with chemical manures, use the natural manures especially on the higher parts of your land, but till your land over and over again, before you plant, and while growth is going on. Let *tillage* be your watchword.

Lazy people may say that there is no use in tilling, for heavy rain washes away the soil. But rain will not wash away as much as if you do not till. Tillage loosens the soil to some depth, the rain sinks in and does not carry away so much as when the ground is quite hard below. Besides tillage is always making new soil, and there is no deterioration. In the article on "Nitrogen" in this *Bulletin*, it is pointed out what a vast amount of work is done by microbes in making bad soil into good, fit for plant food, but these microbes must be assisted by the planters to do their work.

Experiments have been carried on with various soils in different parts of France by Mr. P. P. Dehérain, and his results, published in several numbers of the *Experimental Station Record* of the U. S. Department of Agriculture, show clearly the paramount importance of constant tillage. He sums up all his work in the following paragraphs :—

"The experiments reported [in the preceding articles] clearly demonstrate that those agriculturists who have long attributed to cultivation of the soil a decisive influence on nitrification have held a correct view of the subject. This influence is, in fact, much greater than might be supposed. A soil properly stirred and aërated is capable of producing much greater amounts of nitrates than are required to sustain the most abundant crops.

"The enormous reserves of nitrogenous matter which arable soils contain are therefore not destined to remain indefinitely inactive. We will not always be reduced to the necessity of paying cash down for assimilable nitrogen and of importing each year large amounts of nitrogen compounds to make up the deficiency in the production of assimilable nitrogen in the soil. Nitrogen compounds are found in profusion in the soil, and the experiments which we have reviewed show that the transformation of inert organic matter in nitrates may be greatly accelerated by cultivation of the soil.

"The most important part of the cultivation of the soil is done [in Europe] in October or November. The soil broken up by the plough and rendered absorbent, stores up the rain water of winter, which would flow off the surface of a soil hardened by dryness or compacted by rain. The first cultivation is very well performed by the plough, but this implement does not do more than turn over the sod without breaking it, and arrange it in parallel strips. There is no pulverisation, and this is an advantage if the soil is to remain uncovered during the winter, since pulverisation promotes an active nitrification, which is very undesirable under these conditions, the nitrates formed in a soil without vegetation being irrevocably lost.

"When the time of seeding approaches, however, as thorough pulverisation as possible is desirable. The harrows and cultivators which are commonly used, do not answer the purpose, since they stir the soil very imperfectly. Our efforts should be directed toward improving these implements in this respect. The advantage of perfect cultivation, in the soil is seen among the French peasants. They cultivate their fields [with spade, fork, &c.] again and again in different ways, and without knowing it, promote a very active nitrification. Cultivators of sugar beets know that the weight of roots harvested increases with the number of cultivations to which the crop is subjected.

"From the earliest times cultivation of the soil has been considered as labour *par excellence*. The man who performs it, is known as "*the* labourer." Slowly and laboriously through the ages he has perfected his implements. From the piece of wood hardened in the fire and drawn by an ass, he has passed to the plough drawn by oxen or the more powerful implement driven by steam. But further efforts are still necessary in order to utilise the immense reserves of the soil. The plough is the emblem of agriculture only until we are able to find a better. The soil is a niggardly mother who distrusts her wasteful children and refuses at first to give up her treasure, but yields finally to the supreme force of the world—work."

IMPORTANCE OF SELECTION OF SEED.

Ripe Seeds.

Prof. J. C. Arthur, Botanist of the Indiana Station in the United States has been experimenting since 1889 on the use of unripe tomato seed, and how far this is an advantage in causing the plants to produce their fruits earlier, and in making them more productive. Comparisons were made with plants grown under the same conditions from quite ripe seed taken from the same parent. The author arrives at the following conclusions :—The principal deviations arising from the use of immature seed are : (1) A loss of vigour, shown in the smaller percentage of germination, weakness of the seedlings, and greater number of plants that die before maturity ; (2) failure to recover lost vigour, although the plants may, and usually do, produce an abundant harvest, and one acceptable to the cultivator ; (3) The increase of reproductive parts in proportion to the vegetative parts, resulting in a greater number of fruits and (seeds although individually smaller) and more rapid ripening than in similar plants from mature seeds.

In Jamaica there is no winter season to interrupt cultivation, and there is no difficulty in sowing seed so as to produce a crop at any season, if a proper amount of water is supplied. We need not therefore force nature to shorten the time of maturing, at the expense of a total larger crop, and larger fruit. The seed should be quite ripe.

Large Seeds.

The same author investigated the reciprocal relation between the vegetative (leaf stem, and root) and the reproductive (seed and fruit) part of plants under varying conditions of growth. The generalisation is reached that :

A decrease in nutrition of an organism favours the development of the reproductive parts at the expense of the vegetative parts. The decrease in nutrition may be brought about by poor soil, bad tillage, slow germination, etc., all leading to the same general result. But it was pointed out that while partly starved plants are as a rule proportionately more productive, i. e., per unit of vegetative part, the reverse is true of plants grown from large and small seeds, for 'large seeds produce stronger plants with a greater capacity for reproduction than small seeds of the same kind.' These conclusions, which are supported by experimental data, strongly emphasize the necessity of using only the largest seeds (that is, screening out and discarding the small seeds) for sowing, in order to secure not only the largest yield of grain and fruit but also to retain the vigour and permanency of the race under high tillage.

The lesson to be learnt from all these experiments is, that cultivators in Jamaica cannot be too careful in selecting seed for sowing : it should be perfectly ripe, and of the largest size.

REPORT ON DISEASE IN SUGAR CANE.

Director of Public Gardens &c. to the Honourable Colonial Secretary.

28th May, 1895.

SIR,

I visited last February three sugar estates on which I was informed there was some disease in canes.

2. On one estate, Savoy and Danks, in Clarendon, the moth borer only could be detected. This insect pest has been fully described and discussed by Prof. Cockerell in the Bulletin of this Department for April, 1892. It was by no means serious, and can probably be kept under without much difficulty.

3. It was noticed also that tops brought from a distant estate for planting were infected with the same borer. Although it is an excellent practice to plant tops brought from other districts and thus encourage vigour in the canes, yet care should be taken in seeing that such tops are not infected with any disease. In the article in the Bulletin, the recommendation made for dealing with tops is to immerse them in water at a temperature of 130° F. for 48 hours, to which may be added, as an additional precaution, a one per cent. solution of carbolic acid.

4. The other two estates, Cave Valley and Greenock in St. Ann's, are a considerable distance from the first but adjoining one another. I took specimens of diseased canes with me to Kew last June, and the fungus was determined to be the root-fungus (*Colletotrichum falcatum.*)

5. Mr. Massee suspected this fungus to be only a form of the rind-fungus (*Trichosphæria sacchari*) but at that time I had not seen the rind-fungus on these estates. His conjecture has proved to be correct, for experiments at Kew have shown that the root-fungus is only another form of the rind-fungus.

6. Some canes on Greenock were affected, but not many. On Cave Valley, however, a very great deal of damage has been done by the root disease; for instance, on one piece of nine acres, the canes which were "first ratoons" had only given 6 hogsheads, and then died out. On several pieces the plant canes had not ratooned, though some had sprung to the height of about two feet 6 inches, and then died. On another piece which had already been cut, the canes that were lying with the trash were badly diseased with the rind-fungus and also with the shot-borer. Generally speaking the root-fungus seemed to be more deadly than the rind-fungus, and the latter was seen only in mature ripe canes.

7. The root-fungus showed clearly where it was doing its deadly work by the stunted, short-jointed appearance of the cane, and the yellowish look of the leaves. When the plants were dug up, the roots were in some cases all dead, and the plant was living on the small store of nourishment already existing in the short cane, and pushing out new shoots which only hastened the inevitable end. In other plants the roots were still living but the other portions were decayed.

8. The rind-fungus appeared, in some cases at any rate, to have developed, not from the disease in the roots, but from the infection in the top, for the joints in the lower part of these canes seemed to be of the normal length and not stunted.

9. The appearance of the rind-fungus is well-marked and characteristic. Minute punctures are seen in the rind of the cane, filled with a sooty-black stuff which eventually protrudes and becomes dry and hard. A very small portion of this black stuff rubbed up in water and examined under the microscope shows that it is composed of spores. The exceeding smallness and lightness of the spores allow them to be carried by every breath of wind, and in this way one diseased cane is quite sufficient to infect a whole estate. From experiments made at Kew, it appears that these spores are able to germinate on, and attack, the tender cane-top, but wherever either the moth-borer or the shot-borer exists, the tunnels they make from the outside all through the cane, give ready access to the spores, and this constitutes their peculiar danger wherever the fungus-disease exists. When a spore germinates, it gives rise to long thread-like growths which penetrate the tissue of the cane and fill up the cells, feeding on the sap, and so preventing proper growth. Eventually these threads form spores again in numerous spots which burst through the rind and multiply the chances of disease by many million-fold.

10. The root disease seems to be propagated in the first instance by planting tops of canes already diseased with the rind-fungus. Its danger is in the infection of the soil where the plant is growing, for it forms peculiar spores, called "resting-spores," which remain in the ground for an indefinite period, resisting decay. As soon, however, as the growing rootlet of a cane comes in contact with them, they germinate and penetrate the root. It is not known how long these resting spores can remain in fallow ground without decaying, but probably for years.

11. A nematode worm was noticed in a minute portion of soil attached to a rootlet. These worms and the root-disease may mutually assist one another.

12. The Bourbon Cane which had for years given large crops in Cave Valley will soon be exterminated there by the disease, while the Black Cane is not attacked. This circumstance points to some cause or causes, antecedent to the fungus, affecting the Bourbon and not the Black Cane. The Bourbon has been the " Cane of the Valley" for many years. and its weakness of constitution which leaves it liable to the attacks of the fungus, may be due to exhaustion of some of the constituents of the soil necessary for plant food, or to the planting of weak tops, or to planting the same canes over and over again on the same estate.

13. It is a difficult matter always to suggest remedies, for, though they may be effectual on a small scale, it may be quite out of the question to apply them on a large scale for various reasons, such as expense, or want of labour. But it is still more difficult to advise, when the causes are complicated, and all the data—for instance, analysis of soil—necessary for a decided opinion are not before us. However, from the consideration of such facts as have been stated, it is obvious that certain

courses of action, or some of them, might be tried with advantage by sugar planters who are troubled with the fungus disease.

14. To prevent the dissemination of the disease by the spores from the rind-fungus, all the canes and the trash affected should be burnt. The canes infested by the borer only may be ground, and the megass burnt.

15. Canes from other estates where no disease exists, should be used for planting.

16. Only healthy tops of strong canes should be used as seed-canes.

17. To avoid any chance of the fungus existing unnoticed in the tops, they might be steeped in a solution of sulphate of iron (one ounce powdered in three gallons of water) for a few hours, especially if they are pierced by the borers.

18. The infection of the ground by resting spores is a very difficult matter to deal with, for it is impossible to say how long these may last, and there may be no use in allowing the ground to lie fallow for a few months. Whilst studying this subject at Kew, Mr. Bovell, the Superintendent of the Botanic Station at Barbados, gave the interesting information that he had grown sorghum on infected ground, and so rid it of the disease. As a matter of fact the sorghum appears to have acted as a trap for the resting spores, they germinated and attacked the young sorghum, which was then pulled up by the roots and given as food to cattle. If this process were repeated two or three times, it is possible that all the resting spores would have germinated. If careful watch is kept, and the sorghum pulled up before the fungus had run its course, there would be no spores produced to renew the disease. It was ascertained at Kew that there was some danger in using corn (maize) as a trap, for the disease ran its course very quickly, and might produce spores before it is noticed.

19. If exhaustion of the soil is the cause of the weak constitution of a cane, then deep ploughing may be very useful, allowing the roots of the cane to penetrate to a greater depth than before, and making use of fertile soil hitherto untouched. If the soil is very deep, and there is no fear of bringing up unfertile subsoil, then a subsoil plough may be used, bringing up to the surface virgin soil. This practice would also have the effect of burying any nematode worms which may possibly be injuring the rootlets, for they cannot live below a depth of 8 inches from the surface.

20. Manure may be used to strengthen the canes, and so enable them to resist the disease. It is stated that more sunshine and less rain since my visit has had a good effect in checking the disease, but as the weather cannot be altered to encourage the crops, the desired strength may be given by a judicious application of manure. It should be ascertained by chemical analysis what percentage of lime there is in the soil, and if this is below 1 per cent. lime should be applied. This will check fungus diseases. Sulphate of iron is a good manure. It should be applied as a top-dressing during showery weather, at the rate of ½ cwt. to the acre. It will destroy fungi. Deep ploughing is the most important point to be observed in the cultivation.

W. Fawcett,
Director of Public Gardens and Plantations

INSECTS IN NUTMEGS.

Information has been sought as to the best method of dealing with nutmegs so as to prevent loss through the nuts being destroyed by insects. It is mainly a question of care in the first instance of picking out and rejecting the nuts that are already attacked, and then in drying them properly and finally in dusting them with lime so as to prevent fresh attacks.

In Banda and the Straits Settlements the insect is said to be a weevil which lays its eggs in the outer fleshy parts of the fruit,, causing a small black discoloration at the spot. The "worms" or larvæ that come from the eggs, feed on the fruit until it splits, and then make their way into the soft nuts which they eventually destroy.

The method of drying the nuts over slow wood fires for 2 or 3 months, turning the nuts every second or third day, is likely to discourage the presence of the weevil during the time of curing. The kernels should be well looked over when taken from the shell, to avoid packing up any that are "worm-eaten." The refuse nuts are converted into the "nutmeg butter" or "mace-oil" of commerce.

Now that plantations have been made in Jamaica on a large scale, the greatest care should be taken by everyone that owns even a single tree to see that the insect is destroyed whenever noticed, and is not allowed to increase so as to become a pest.

The following extract from Dr. Nicholls' *Tropical Agriculture* is a useful summary of the process of curing :—

"In the east, there are usually three crops a year, and the ripe nuts take a little over six months to grow from the flower. The fruit is picked up every morning after it has fallen to the ground, or, if the trees are not too high it is gathered by means of a hook attached to a long stick ; the mace is then stripped off and the nuts are dried in sheds, in wickerwork trays, raised about ten feet above the earthen floor on which smouldering fires are kept up all night and put out during the day time. The heat should not be more than 140° Fahrenheit. The nuts are turned in the trays occasionally ; and, when they are thoroughly dry, the shells are broken with wooden mallets, and the nuts are rubbed over with sifted dry lime to prevent worms attacking them, and then packed in tight casks for export. It is well to smoke the inside of the packages and then to white-wash them. If boxes are used for shipping the nutmegs, the seams must be stopped up, for every precaution is to be taken to prevent the nuts from becoming worm-eaten."

ASSIMILATION OF NITROGEN BY PLANTS.

A great deal of attention has lately been paid to the origin of nitrogen in the soil and its assimilation by plants. At first sight the subject seems to belong to the domain of agriculture, but it has such a deep bearing upon the physiology of plants, and the discoveries recently made in connection with it, throw so much light upon the chemical processes which are accomplished on a grand scale in nature, that the chemist, the botanist, the agriculturist, and the student of bacteriology are equally interested in it, and discuss it from their own special points of view. Perhaps it is the more necessary, therefore, to consider the whole matter under its general aspects.

The questions at issue are plain enough. A seed has been put in the soil; there it grows first on the food that has been stored up within the seed itself by the mother plant. Later on the seedling sends its rootlets in search of food in the soil, while its leaves, waved in the air and bathing in sunshine, absorb another part of the necessary food from the atmosphere. The mineral matters required by the plant are found in a soluble state in the soil, or may be easily supplied to it, while oxygen, hydrogen, and carbon are borrowed either from the atmosphere or from the air and water which permeate the soil, and both contain some carbonic acid. But with nitrogen which is as necessary for the life of the plant, as it is for the life of the animal, the difficulties come in. There is plenty of it both in the atmosphere and in the soil, but it cannot be absorbed from the atmosphere by the leaves, and out of the nitrogen contained by an unmanured soil only an imperceptible amount is in such state that it can be taken in by the roots. Whence, then, does the plant take it?

That plants do not absorb free nitrogen from the air through the leaves was proved fifty years ago by Boussingault, and still more decisively in 1861, by J. B. Lawes, Dr. Gilbert and Dr. Pugh. Their memoir upon this subject has become classical, and it at once won a world-wide reputation to the then modest farm of Rothamstead. They established beyond doubt that the higher plants—with the exception. perhaps, of the *Leguminosœ* or *Papilionaceœ* (peas, vetches, lupins and so on)—borrow their nitrogen supplies from some other source than the atmosphere. And yet G. Ville, another agriculturist of great repute, has not ceased during the last fifty years to bring forward no less conclusive experiments, proving that in some way unknown small quantities of nitrogen always find their way from the atmosphere into a vigorous plant. Even when the plant is grown under a glass bell, and the soil is thus prevented from receiving the small amount of nitrogen which might be brought down by rain in the shape of ammonia or nitric acid formed in the atmosphere after a thunderstorm—even then some nitrogen of the air penetrates into the plant. Both sets of experiments are equally conclusive, and for fifty years their contradictory results remained unexplained.

A similar difficulty was experienced with regard to the nitrogen in the soil. Of course there is plenty of it, even in a poor soil: the previous generations of plants have laid it in stock. There is so much of it that at a time when Liebig's chemical theories ruled agriculture he could teach in some such terms as these: "Never mind the nitrogen" he said. "The small amount of it which you introduce into the soil with your stable manure is nothing in comparison to what the soil already contains of it. Mind the mineral salts which you take away with each crop and return them to the soil." And yet the farmer's experience and scientific experiments alike stood against Liebig. No amount of phosphates, or lime, or ashes, could produce, even in a soil already rich in nitrogen, the effects produced by stable manure. The latter gave vigour to the plants and seemed to vivify those very nitrogen compounds which already were stored in the soil. There the debate stood when light was thrown upon it from a quite unexpected quarter. Phenomena of life found their explanation in life, not in chemistry.

The fascinating achievements of chemistry during the first half of our century had created the tendency to explain all phenomena of life by such simple chemical re-actions as we perform in our laboratories. Animals and plants were treated like simple glass balloons, in which any reaction may be provoked by adding some acid or some alkali. However the old teachings of Leeuwenhoek and Cagniard Latour have not been totally lost. Schwann—the father of the cell theory—was already reconstituting life to its real importance; and when Pasteur came forward with his epoch-making res arches into the chemistry of the micro-organisms, he found science already prepared to accept his teachings. At the present time, we know that no animal or plant, with the exception of the lowest unicellular beings, can be considered as *one* being—that each of them is a colony of multitudes of micro-organisms; and while we are more and more persuaded that chemical processes which are going on within complex and unstable compounds are the real basis of life, we know that the seat of these processes must be looked for in the infinitesimal component parts of the organism and the microscopical inhabitants of its organs. The study of these unseen beings and of the chemical processes due to their activity has already given the clue to many a scientific problem, and it also has finally shown the way out of the above-mentioned contradictions.

It is a well known fact that, if a field has been left uncultivated the percentage of nitrogen in the soil goes on increasing, and even becomes greater than it was in the very plants which have grown upon the soi It has now been demonstrated by Mayer, Post, and Kostycheff that the. increase is due to the lower fungi and micro-organisms which develop in prodigious quantities in decaying vegetable matter. They live in it and as they eliminate carbonic acid they increase the percentage of nitrogen in the vegetable mould. To their activities we are indebted for the considerable amounts of nitrogen stored in the superficial layers of the earth, and until lately man has been chiefly living upon the treasuries accumulated by the invisible workers.

However, the nitrogen of the soil is of no direct avail for the plant if it is in the shape of such organic compounds as are bound within the vegetable mould. Plants cannot assimilate them. Nor is it available if it is in the shape of those insoluble ammoniacal salts which are easily formed in a clayey soil, The best case for the plant is when it appears in the shape of nitric acid (a compound of one atom of nitrogen with one of hydrogen and two of oxygen) or of nitrates—that is, of salts of this acid. But nitric acid is only formed with great difficulty in the soil, because nitrogen does not combine directly with oxygen unless the latter is transformed into ozone; therefore, even the soils which are rich in nitrogen usually contain but infinitesimal quantities of nitrates. All is thus against the plants. But here the microbes come into their aid. Already in 1877, Schlösing and Müntz had demonstrated that a *living* ferment is necessary for the production of nitric acid and nitrates in the soil; but it took full thirteen or fourteen years of laborious researches before it became proved by Professor Percy and Mrs Grace Frankland, Mr Warington and especially by Winogradsky, that the process of converting ammonia into nitric acid, is really performed by special microbes, and that two different bacteria are required to accomplish the full process. One of them decomposes ammonia, and transforms it into water and nitrous acid; whereupon the other intervenes for further oxidising this acid and transforming it into nitric acid. The two bacteria have finally been isolated by Warington and Winogradsky, and they proved to be quite different, although each of the two seems to be represented by several species, characteristic of different localities. Like all other bacteria, they multiply very rapidly, and it is sufficient to introduce in a mould the slightest amount of a soil which has already contained the nitrifying bacteria to provoke in it a transformation of its nitrogen compounds into nitric acid It is also most remarkable that the second bacterium was only discovered by Winogradsky when he investigated a sample of soil from Quito—that is from a region not very distant from the great saltpetre layers at Chili and Peru, and that altogether the soils taken from South America, and South Africa, act as powerful ferments, while European soils seem to contain but smaller quantities of the bacteria of nitrification.

The scientific and practical importance of this discovery cannot be overrated. Without the two microbes, which continually prepare fresh nitric acid in the soil, while the previous stocks of it are washed downwards into the subsoil by rain-water, agriculture would remain in a precarious state. Moreover, when we import nitrate of sodium from Chili and spread it over our fields, we not only increase their stock of assimilable nitrogen, we also import the nitrifying microbe, which will help to mantain the fertility for some time to come. Of course, we also may manure with costly nitrates prepared in the manufacture. Artificially prepared nitrates also exercise a splendid effect upon vegetation, while phosphates admirably aid the plant in the development of its younger parts. But if chemical manure is vivified by the living ferment, it only becomes the better for it, the more so as it has been proved that, contrary to all provisions, the nitrifying organisms flourish in liquids which contain no traces whatever of organic matter. Like green plants, they can build up their protoplasm out of carbonic acid, oxygen, water and ammonia.

One of the two questions mentioned at the beginning of this chapter has thus received a definite solution. As to the second question, relative to the assimilation of nitrogen by plants, it offers some additional difficulties, Already, in the earlier Rothamsted experiments, previous to 1861, it had been remarked that while higher plants, as a rule, absorb no nitrogen from the air, the leguminosæ manage somehow to get some of it from this source as well. It was also known to practical agriculturists that if a leguminose crop had been grown, and instead of being taken away in the autumn, it had been ploughed into the soil as a manure, the contents of nitrogen in the soil were increased by the amount of it which the plants have absorbed in the air, even though it was certain that they do not absorb it through the leaves. Berthelot, who was investigating these and related questions for years, came, as early as in 1883, to the conclusion that lower microscopical plants must be instrumental in this assimilation; but it was only through the researches of of Wilfarth and Hellriegel that the enigma received its full solution. They discovered that that roots of the leguminosæ, grown in fertile soils, become covered with nodules, originated from agglomerations of bacteria (*B. radicicola*), which enter into a sort of symbiotic association with the plant. They borrow from the plant the necessary hydrocarbons, and they supply it with nitrogen which they assimilate from the air circulating in the soil. Minute as they are, they really feed the the plant with nitrogen; and if they have been destroyed by previously calcinating the soil, the plant will never attain its full vigour. On the other hand, the same calcined and sterilised soil soon becomes fertile, and the plant soon regains its forces, if ever so minute quantities of the precious germs are introduced into the soil. Wonderful as this discovery seemed to be when it first became known, there is no longer any doubt about its accuracy, the same experiments having been repeated by Kossowitsch and Nobbe, as well as by Dr. Gilbert and Sir John Lawes at Rothamsted. At a conversazione of the Royal Society one could himself appreciate the effects of the microbe by comparing the portraits of leguminose plants cultivated with its aid and without it. By this time the bacteria of the nodules have already been carefully studied, and it appears that each species of leguminosæ has its own bacteria, especially appropriate for entering into a mutual benefit association.

If the two just mentioned discoveries stood quite isolated they would have been of an immense value. In science they have solved enigmas of long standing, and to the practical agriculturist they promise a new method for improving the value of the soil by watering it with liquids containing the necessary microbes. Once inoculated into the soil, the nitromonade (or *Nitrosomonas*) of Winogradsky and the *Bacteria radicicola* of the leguminose nodules will continue their precious work. A new chance is thus given to the agriculturist. However, the chief value of the above discoveries is in their connection with subsequent discoveries. The fact that the nitro-monade, although devoid of chlorophyll, is capable of making the synthesis of organic compounds out of purely mineral matters, coupled with the fact that it thrives best in a medium devoid of organic matter, is of an immense importance in the economy of nature. Other bacteria accomplish a similar task. Some of them, previously investigated by Winogradsky, oxidise sulphuretted hydrogen and transform it into sulphur and sulphuric acid. And, finally it has just been proved that if the Black Sea is totally devoid of organic life at depths below the hundred fathoms level on account of the considerable amounts of sulphuretted hydrogen dissolved in its water, this is again due to the activity of similar organism. The Odessa bacteriologists have now succeeded in isolating the bacterium which renders the depths of an immense interior sea uninhabitable for higher plants or animals. It decomposes the mineral deposits, chiefly gypsum, accumulating at the bottom of the sea; and as the shallowness of the Bosphorus prevents the general circulation of water from touching the deep layers of the Black Sea cavity, the sulphuretted hydrogen exhaled by the bacteria accumulates and poisons the deeper layers. Quite a new page in the geology of the great interior basins of Eurasia is thus opened. At the same time, a series of new bacteria some of which aid in the production of ammonia in the soil, while others destroy the work of the nitro-monade, are now discovered, and new discoveries are foreshadowed.

On the other hand, the benefit derived by higher plants from the lower plants is not limited to the above association with bacteria in the nodules of the leguminosæ. Recent experiments by Th. Schlösing, junior, and Em. Laurent, have proved that various mosses, and especially minute algæ (*Confervæ, Oscillariæ, Nitzschea*) which usually develop on the surface of the soil, also absorb nitrogen from the air. In experiments made in pots, it was sufficient to cover the surface of the mould with a layer of calcined sand to prevent their growth. and at the same time to stop the absorption of nitrogen from the air; but where no such precaution was taken, nitrogen was absorbed by the algæ and the mosses, and after having been assimilated to the soil it went to higher plants. It is also very probable that the leguminosæ are not the only plants which can utilise free oxygen from the air with the aid of certain bacteria. Thus, Nobbe and his pupils have lately proved that a shrub of our garden, from quite a different family, nearly akin to the laurel family, namely the *Elæagnus angustifolia*, also has the same nodules as the leguminosæ, which give shelter to bacteria absorbing nitrogen from the air of the soil. The little micro-organism is, however, different from the *Bacteria radicicola.*

Nitrogen is as necessary a food for plants as it is for animals. An animal is starved if it does not receive a sufficient supply of nitrogen and its vitality is lowered if it does not have it in an easily assimilable form. The same is true of plants. Insectivorous plants are known to decay when they cannot catch insects; and the tendency of the day is to recognise that most plants require the aid of some lower organisms for assimilating nitrogen. Thus, B. Frank, who has been working for years in that direction, has proved that the beech can thrive only when a mantle of Mycorhiza-fungi develops over its roots, and that these fungi are not parasites living upon the substance of the roots but real feeders of the beech. They obtain their food from the soil, and while so doing they yield a part of it to the roots of the tree. Further experiments of the same botanist have now shown that the same is true for the pine, which can only thrive in a soil already containing germs of the little fungi, and when its roots become covered with the mantle of fungi, while it leads but a precarious existence in the opposite case.

All these are evidently but separate instances of a much more general fact, which only recently became known under the general name of 'symbiosis' and appears to have an immense signification in nature. Higher plants depend upon lower fungi and bacteria for the supply of that important part of their tissues, nitrogen. Lower fungi associate with unicellular algæ to form that great division of the vegetable world the lichens. More than a hundred different species of algæ are already known to live in the tissues of other plants and even in the tissues and the cells of animals, and to render each other mutual services. And so on. Associations of high and low organisms are discovered every day; and when their conditions of life are more closely examined, the whole cycle of life changes its aspect and acquires a much deeper signification.

(P. KROPOTKIN, in *Nineteenth Century*.)

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PLANTS.

From Royal Gardens, Kew—
Otaheite Potato
Gloxinia maculata
Achimenes pedunculata
Phædranassa gloriosa

From his Honour Judge Nathan, Trinidad—
Coryanthes sp.
Gongora sp.
Rodriguezia secunda
Catasetum sp.
Cattleya sp.

Oncidium ampliatum majus
" papilio
" Lanceanum
Stanhopea eburnea
Paphinia cristata
Cynoches chlorochilum

From Botanic Gardens, Grenada—
Black Pepper (Piper nigrum)

SEEDS.

From Royal Gardens, Kew—
Aristotelia racemosa
Chrysophyllum magalis-montana
Berkleya cristata
Ipomæa crassipes
" sp. (large purple flowers)
Cucumis (perennial)
Heritiera littoralis

From Botanic Garden, British Honduras—
Hæmatoxylon campechianum
Palmetto Palm

From Botanic Gardens, Rockhampton—
Bauhinia Hookerii
Livistona sp (W. Australia)
Macrozamia Mooreii

From Baron Sir F. Von Mueller, Melbourne—
Candollea serrulata, var alpina
Eucalyptus tereticornis
" punctata
Denhamia obscura
Tecoma jasminoides
Randia Fitzalani
Marsilea Drummondi
Brachychiton populneus
Acacia sp.

From Dr. Comes, Italy—
14 varieties of Tobacco
H. E. Aristakes Azarian

From H. E. Aristakes Azarian Constantinople—
Carica Cundamarcensis

From S. Fisher, Stewart Town—
Forsteronia floribunda

From R. K. Tomlinson, Lacovia—
Nelumbium luteum

From Miss T. Moulton-Barrett, Brown's Town—
Zizyphus Chloroxylon, (Cog wood).

NOTE.

The Director will be at the JAMAICA INSTITUTE on the morning of the first Friday in every month between the hours of 10 and 1 o'clock for the purpose of giving information to those who may wish to consult him.

New Series.] SEPTEMBER, 1895. Vol. II. Part 9.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

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.

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ESSENTIAL OILS OF THE ORANGE TRIBE.

Oil from Flowers.

Oil or Essence of Neroli is the essential oil distilled from the flowers of the Orange. It derives its name from Anne Marie, wife of Flavio Orsini, Prince of Nerola, who about the year 1680 employed it for the perfuming of gloves, hence called in Italy *Guanti di Neroli.*

It may be prepared from the flowers of any of the Orange tribe, but that from the Seville or Bitter Orange is more aromatic and more abundant. The yield is about 0.6 per cent. of oil from flowers of the Seville Orange, and about half that percentage from the Sweet Orange. The fresh flowers are distilled with water in small copper stills. The oil is removed and the water that remains is known under the name of Orange Flower Water. The following notes are taken from Sawer's *Odorographia*, & Flückiger & Hanbury's *Pharmacographia* :—

The usual time for beginning the collection of the orange-flower crop in the south of France is the last week in April, and the gathering lasts about a month or five weeks. The quantity gathered is at first rather small, but gradually increases, and after May 10, reaches its full proportion. One of the principal centres of this industry is Vallaurie. There are fifteen distilleries of orange-flowers in this town. The crop is said to average a million kilogrammes (about 1,000 tons). The yield of Neroli varies with the season when the flowers are collected. Those gathered at the beginning barely produce half a gramme to the kilo, while near the end of May they afford one gramme or more. The buds are picked when on the point of opening, by women, boys, and girls, who make use of a tripod ladder to reach them. These villagers carry the flowers to an agent, who weighs them and spreads them out in a cool place, where they remain until 1 or 2 a.m ; then he puts them into sacks and delivers them at the factory before the sun has risen. They are then taken in hand at once. On exceptional days as many as 160 tons are so treated in the whole province. At the factory the flowers are spread out on the stone floor of the receiving-room, in a layer some 6 or 8 inches deep. The sepals are then separated by girls, and such of the petals as are destined for the production of orange-flower water and Neroli are put into a still through a large canvas shoot, and are covered with water, which is measured by the filling of reservoirs on the same floor. The man-hole of the still is then closed, and the contents are brought to boiling-point by the passage of superheated steam through the coils of a surrounding worm. The water and oil pass over, are condensed, and fall into a florentine receiver, the oil floating on the surface thereof and the water flowing through the bent tube from below. A piece of wood or cork is placed in the receiver to break the force of the stream flowing from the condenser. This gives time for the small globules of oil to cohere and prevents them being carried away by the downward current.

The first portions of the water coming from the still are put into large tinned-copper vats holding about 500 gallons, and there stored, to be drawn off as occasion may require into glass carboys or tinned-copper bottles.

Oil From Peel.

The oils from the peel or "zeste" of the citrine fruits are manufactured in large quantities in the north of Italy and in the south of France, the fruit being taken when in a barely ripe state—the oil of the Bitter Orange being by far more valuable than that of the Sweet. They are extracted by processes called the *Eponge* and the *Ecuelle-à-piquer*, and are termed *Essence de Bigarade au Zeste* and *Essence de Portugal au Zeste*, the Bigarade referring to the Bitter, and the Portugal to the Sweet orange. The oils obtained by distillation are very inferior, and are termed *Essence distillée* of Bigarade or of Portugal respectively. The same terms apply to Bergamotte, Citron, Lemon, and to all the Citrine fruits.

The process called the *Eponge*, as applied to the lemon in Sicily and Calabria, is briefly as follows:—In the months of November and December the small irregular-shaped fruits, which have but little value for export, are selected, preferably whilst still green, as they are then more rich in oil than when perfectly ripe.

The workman first cuts off the peel in three thick longitudinal slices, leaving the central pulp of a three-cornered shape with a little peel at either end. This central pulp he cuts transversely in the middle, throwing it on one side and the pieces of peel on the other. The latter are allowed to remain till the next day and are then treated thus:—the workman seated holds in the palm of his left hand a flattish piece of sponge, wrapping it round his fore-finger. With the other he places on the sponge one of the pieces of peel, the outer surface downwards, and then presses the zest-side (which is uppermost) so as to give it for the moment a convex instead of a concave form. The vesicles are thus ruptured, and the oil which issues from them is received in the sponge with which they are in contact. Four or five squeezes are all the workman gives to each slice of peel, which done he throws it aside. Though each bit of peel has attached to it a small portion of pulp, the workman contrives to avoid pressing the latter. As the sponge gets saturated the workman wrings it forcibly, receiving its contents in a coarse earthen bowl provided with a spout; in this rude vessel, which is capable of holding at least three pints, the oil separates from the watery liquid which accompanies it, and is then decanted.

The yield is stated to be very variable, 400 fruits affording 9 to 14 ounces of essence. The prism of pulp and the exhausted pieces of peel are submitted to pressure in order to extract from them lemon juice, and are said to be also subjected to distillation. The foregoing is termed the sponge-process; it is also applied to the orange. It appears rude and wasteful, but when honestly performed it yields an excellent product.

Essence of lemon is prepared at Mentone and Nice by a different method. The object being to set free and to collect the oil contained in the vesicles of the peel, an apparatus is employed, which may be thus described: a stout saucer or shallow basin of pewter, about 8½ inches in diameter with a lip on one side for convenience of pouring. Fixed in the bottom of this saucer are a number of stout, sharp, brass pins, standing up about half an inch; the centre of the bottom is deepened into a a tube about an inch in diameter and five inches in length, closed at its lower end. This vessel, which is called an écuelle à piquer, has therefore some resemblance to a shallow, dish-shaped funnel, the tube of which is closed below.

The workman takes a lemon in the hand, and rubs it over the sharp pins, turning it round so that the oil-vessels of the entire surface may be punctured. The essential oil which is thus liberated is received in the saucer whence it flows down into the tube; and as this latter becomes filled, it is poured into another vessel that it may separate from the turbid aqueous liquid that accompanies it. It is finally filtered, and is then known as *Essence de Citron au zeste.* A sort of écuelle on a large scale, capable of operating on six or eight fruit at a time, or about 7,000 per day, is used for extracting Bergamotte oil. It consists of a metal vase perforated with small holes at the bottom, and is provided with a heavy rotatory lid communicating by cog-wheels with a handle. There is a channelled groove round the inner circumference, for the reception of the fruit; the inner surface of the lid and the groove are fitted with short metallic blades projecting about one inch and a quarter. The rapid rotation of the lid, which presses on the fruit, causes them to revolve and become lacerated at all points, and the liberated oil flows through the perforated bottom into a receiver. A small additional produce is sometimes obtained by immersing the scarified lemons in warm water and separating the oil which floats off.

A second kind of essence termed *Essence de Citron distillée* is obtained by rubbing the surface of fresh lemons, or of those which have been submitted to the process just described on a coarse grater of tinned iron, by which the portion of peel richest in essential oil is removed. This grated peel is subjected to distillation with water, and yields a colourless essence of very inferior fragrance, which is sold at a low price.

Sawer states that the Government Chemist in Jamaica supplied him with samples of oils of the Seville and Sweet Oranges, which although very fine for distilled products, are not equal in fragrance to those obtained by the cold process in Europe; and that on an average 580 oranges will weigh 180 lbs., and yield 12 ozs. of oil.

Oil from Leaves.[1]

The Oil of Petit-grain was formerly made altogether by distillation from the small unripe Orange fruits about the size of a cherry, which fall from the tree shortly after the flowers; they are called "orangettes." The name "petit-grain," or small seed indicates this origin of the term. At present the oil of petit-grain is also made on a large scale from the leaves and young shoots of both Bitter and Sweet orange, the former being much more odorous than the latter, and worth twice the price.

The leaves are gathered in districts of the Mediterranean where there are large plantations of Citrons. Citrons are generally grafted on to orange-stocks (seedling orange-trees), and these stocks during the summer put forth shoots which are allowed to attain the length of a few feet; they are then pruned off, tied up in bundles, and sent to the distiller. The strongest shoots are frequently reserved to make walking sticks.

In Montserrat there are very extensive plantations of the West Indian Lime belonging to a Company formed for the main purpose of extracting lime-juice from the fruit. But a very fine essential oil is also obtained from the peel by the écuelle process, a "neroli" from the flowers, and a "petit-grain" oil from the leaves and young twigs by distillation.

NOTES ON THE CULTIVATION OF CHOCOLATE, OR COCOA, FOR SMALL SETTLERS.

By W. Cradwick, *Superintendent of Hope Gardens.*

Soil.—Land to plant Cocoa on should be rich and good. If the soil is very wet and clayey it must be drained, as Cocoa will not grow in sour land. If the land is almost flat, the drains can be made straight down the slope so as to carry off the water as quickly as possible. If the land is steep the drains should be made across the slope of the land to stop the wash which carries away the soil.

Best Kinds.—The long wrinkled yellow or red pods should always be grown. A tree of the little round smooth kind takes up as much room as the best variety ; but the pods do not hold many seeds, and the seeds are much smaller, and therefore the crop is not so heavy.

Selecting seeds.—The large ripe pods should be cut for seeds from the main stem of the tree, and only from a tree that *always* bears well; then pick out the largest seeds as they always make the strongest plants.

Raising young plants.—Unless great care is taken with young plants, it is better to sow the seeds where the plants are to remain, putting only one seed in each hole. When two or three seeds are put in close together and all left to grow, the plants never thrive, because they crowd one another. Few seeds fail to grow, and if a seed does fail it is easy to supply them Take care not to put the seeds too deeply into the ground ; if they are covered to the depth of an inch that will be sufficient.

Planting between other crops.—It is necessary that some kind of crop be on the land where Cocoa is to be planted, to provide shade for the young plants.

We will first take land which has already been planted with bananas. If the bananas have been thoroughly cultivated with the fork and are growing well, the land will need little further preparation before planting with Cocoa. A circle in the centre of the space between every four roots of bananas should be thoroughly turned up with a fork. In the centre of this prepared circle the seed or the young plant whichever it is decided to plant, should be placed.

If Cocoa is to be planted between yams, and a second crop of yam is desired from the same piece of land, then the seed or young plant should be planted at the base of a yam hill that the roots may freely push their way into the soil of the yam hill. But if it is decided not to plant more yams, put the young plants into a circle between the yam hills prepared in the same way as described for planting between bananas. When planting Cocoa through land covered with the miscellaneous crops so often seen, and which are simply kept clean with the hoe, the plants should always have a place forked up for them as already described.

Never put Cocoa plants between sugar canes or sweet potatoes; the canes form too thick a shade, and the roots bind the land so much that the roots of the Cocoa plants cannot penetrate it. Sweet potatoes cluster round the young Cocoa plants so much that they might as well be growing under bush.

Distance apart.—If it is desired to cover a piece of land with Cocoa trees, they should be planted from sixteen to twenty feet apart, according to the quality of the land. It is better, however, to plant a little too far apart, than too closely.

Never plant Cocoa near Coco-nuts; nor within twenty feet of strong growing trees such as mangoes.

If Mangoes, Breadfruit, Star-apples, etc., are growing near the Cocoa, take care that all the lower boughs of such trees are cut off; the trees then do not harm the Cocoa but help it by keeping off the sun and wind, without keeping away such air and light as is necessary for the Cocoa plant.

Pruning Cocoa.—The trees always bear the finest pods on their trunks, or the large main branches; pods borne on the smaller branches are always inferior in size and quality.

There is no tree which so well repays careful pruning as Cocoa. When the young plants have attained a height of from two to four feet they will naturally form a sort of crown from which they send out several branches, usually four or five; these branches should be thinned out leaving only three to grow, always leaving the three which balance the best. These three are to be allowed to grow to their full length, but the side shoots should be removed to within about two feet of the centre of the tree; then the side shoots should be regulated so that they grow about eighteen inches apart, as it must be remembered that these are to form the large main branches on which the tree bears many of its pods. If these are allowed to become crowded they will grow weak and spindly and the tree will not produce good crops.

If the young trees do not commence to branch by the time they are four feet high, the shade has been too thick, and they mu t be given more light. Be careful never to allow any young shoots to grow on the main stems. Young shoots appear all over them, growing straight up; these must be cut off close to the main stem before they are three inches long or they will weaken the tree and prevent it bearing.

Cutting off the pods.—The flowers and pods of the Cocoa tree are borne every year from the same eye; if the eyes are injured in any way it prevents the tree from ever bearing from them again; and as the trees do not form new eyes on the old wood that part of the tree is spoiled. Always cut the stalk of the pod half way between the end of the pod and the eye. Never remove the pods by screwing them round or pulling them down. If they are screwed round, the eye is often removed with the pod, and if pulled off, the bark is slit down the stem, long pieces often clinging to the pods. In either case the eye is destroyed, and permanent injury is done to the tree.

CULTIVATION OF THE COCO-NUT.

Soil and Climate.—A moist tropical climate, with good and somewhat sandy soil, near the sea, is the best for the growth of the Coco-nut palm. If the tide rises so that the sea may flow in daily over the plantation, so much the better, but drains must then be made, so as to allow the water to run off freely.

Sowing.—Ripe dry nuts only should be used, and the very largest that can be obtained. Nuts for seed should be gathered from trees that are mature but not too old, and kept dry for five or six weeks before planting. The nursery-bed should be made under slight shade such as that of the Coco-nut palm; it should be thoroughly dug to a depth of two feet, and the soil well mixed up with ashes and coarse salt. At the beginning of the season's rains the nuts are put into this seed-bed on their side, at a distance of one foot apart, and so that about two inches appear above the surface. The nursery-bed should be kept damp, but not too wet. It is a good plan to transplant them into other beds at two feet apart when they are from two to six months old.

Transplanting.—When the seedlings are from six months to two years old they may be transplanted to their permanent positions in the plantation, at distances from each other of twenty feet. Pits should be dug for them, as large as three feet every way in poor soil; ashes and salt are useful additions to any soil, and it may be necessary to give also a top-dressing of manure which should not be dug in. They should be shaded by bananas or plantains for two years.

Tillage and Manuring.—The Jamaica Nuts are very small and do not give much "meat" as compared with those from Central America, India and Ceylon. This may be due partly to unfavourable conditions of soil, climate, etc., but much might be done to improve the fruit by careful selection of nuts for seed, and a liberal treatment of the trees in the plantation by tillage and manuring. It is calculated that in India there are 480,000 acres under the Coco nut, and the cultivation is attended to carefully. In Bombay, for instance, after the seedlings are planted out, they are watered every day or two for the first year, every two or three days for the second and third years, and every third day for the fourth and fifth year. "During the rains, from its fifth to its tenth year, a ditch is dug round the palm and its roots cut, and little sandbanks are raised round the tree to keep the rain-water from running off. In the ditch round the tree, 22 pounds of powdered dry fish manure is sprinkled and covered with earth, and watered if there is no rain at the time. Besides fish manure the palms get salt-mud covered with the leaves of the croton-oil plant, and after five or six days with a layer of earth; or they get a mixture of cow-dung and wood ashes covered with earth; or night-soil, which on the whole is the best manure." (*Watt's Dict.*)

In the tropics of the old world generally, it is customary when the plant is one year old to dig round the roots and apply ashes once a month; when the tree is two years old to open up every year at the beginning of the rains the roots to a distance of four to six feet from the stem, to apply ashes and dry manure to the roots, and leave the opening until the end of the rainy season, then to fill in again the soil which had been removed, and level the ground. During the time the roots are exposed, the older worn-out rootlets may be cut away and the roots of other plants removed. Cattle should on no account be allowed in the plantation, as it is most hurtful to the tree to have the leaves bitten, and if the unfolded leaf is injured the tree dies.

Yield.—A tree in good condition yields from fifty to one hundred nuts every year, but good climate, soil, and cultivation may bring the yield up to as many as 200 nuts.

IMPROVEMENT OF SUGAR CANE BY CHEMICAL SELECTION OF SEED CANES.

Mr. Wibray J. Thompson, Calumet Plantation, Patterson, La., has sent a pamphlet in which is detailed a series of experiments carried on by Mr. Hubert Edson, the resident chemist, with the object of discovering whether it is possible to increase the output of sugar by means of a chemical selection of the canes used for planting.

A good deal has been said lately about the importance of careful selection in connection with the question of liability to disease, but these experiments are of special importance in the present struggle against Beet Sugar, for it is shown as the result of one year's selection only that for a crop of, say, 25,000 tons there would be added to it 180,000 pounds of sugar.

'Seed' Selection of Sugar-cane.

"During the autumn of 1890, after grinding was well under way, a series of single stalk analyses were made in the laboratory for the purpose of testing whether sugar canes would transmit to their offspring the relative higher or lower sucrose content which they themselves possess. By repeated experiments a transverse section of the cane was found that represented very accurately the quality of the whole cane, this part was cut out, analysis made of its juice, and the remainder of the cane saved for seed. This section was the third one from the bottom when the canes were cut into four pieces of equal length. Below is given a table of analyses made to test the matter :—

Longitudinal Halves of Samples.			Third Quarter from Bottom of opposite Halves of Samples.		
Solids.	Sucrose.	Purity.	Solids.	Sucrose.	Purity.
14.7	11.9	80.9	15.4	12.8	83.6
15.1	12.3	81.4	15.2	12.3	80.9
16.1	13.8	85.7	16.1	13.9	85.3
16.1	13.6	83.9	16.5	13.8	83.6
17.1	15.4	90.1	17.1	15.3	89.4
18.3	16.5	90.2	18.2	16.4	90.1
16.4	13.3	81.1	16.4	13.7	83.5
16.1	13.3	82.6	16.1	13.5	83.8
16.2	13.8	85.2	16.4	14.0	85.4

"I have since thought that for different years the section which represented the quality of the cane might be different, but as it has been found out since that a selection of this kind is not necessary, I have made no further experiments. Selections were first made with the Brix spindle, by which means all canes containing a medium amount of solids in the juice were discarded, leaving only the extremes of the rich and poor canes. The juice from these latter was taken into the laboratory for further analysis, and all canes of low per-centage of solids in the juice and having a purity under eighty-five, were planted as representing the poorest canes to be found. In like manner the richest canes were selected from those containing a high per-centage of solids and having a purity over eighty-five.

"Both extremes were taken in preference to one, because it was thought that if anything was to be gained by this line of experimentation it would be shown much quicker by watching the progeny of vital opposites instead of comparing only one extreme with an average, which, to say the least, would be veiy difficult to obtain. In fact, selecting the extremes was the only way a comparison could be made. If only the richest canes had been selected there would have been no standard by whlch to judge whether anything had been accomplished. With the extremes if there is a difference in their offspring, there must, also of necessity, be a difference between each of their offspring and the mean. We have, then, if we find that the richest canes which can be selected produce a cane richer than that from the poorest canes selected, proven that this resulting cane is also richer than the average of the lot of cane from which the selections were made would have produced, had the canes of medium sucrose content not been thrown out. . . . .

"In reviewing also what continually is coming under our notice I cannot either see any reason why disbelief should exist as to some good being accomplished by this line of investigation. Rich and poor canes are continually coming to our notice from the same part of a field and where the conditions for their development seem to be as favourable to one as to the other. Anyone who has made a great number of single stalk analyses, as has been done here, is especially aware of this. It is also evidenced by the almost total impossibility of getting samples from a piece of standing cane which will accurately represent the whole plat. The extent of this variability can perhaps be better appreciated by comparing sugar cane with sorghum, a plant which has had a very unenviable reputation as regards the vagaries of its individual stalks. . . . .

"There is a belief among the Creole planters that the Ribbon cane as commonly known in this State reverts to the Purple, though no scientific observations have been made to test the truth of the belief. Dr. Stubbs, at the Experiment Station, has had, I believe, some difficulty in securing a pure stock of these two varieties, but has not attributed his trouble to one cane changing to the other. If there is any truth in the belief, it would suggest the probability that many of the existing varieties were derived in the same way instead of by *sudden* bud variation. If this were so it would add another link to the chain of suppositions which led me to believe that the plant could be educated to meet our wants. Variation in fact seems to be the only law that we can depend on with safety at the present time. Why, then, can we not take advantage of this continual change and train it to meet our wants? If we cannot bring it to excel its original qualities, cannot we, at least, keep its standard up to the quality of its present best individuals? If three-tenths of one per cent of the weight of cane is added to it in sugar, a crop of 25,000 tons of cane would give 150,00 additional pounds of sugar, five-tenths of one per cent. would give 250,000 pounds additional, and one per cent. would add 500,000. . . . . .

"At Calumet 780 single stalks were examined, 424 of which were discarded by the Brix sprindle work as being canes of medium richness, and the remaining 356 analysed, giving about an equal number of the extremes of rich and poor canes. The canes from these analyses planted but two rows 575 feet long, while seed from the same number of stalks of sorghum would have planted many acres. We can see by this the Herculean nature of the task undertaken, and therefore the necessity for extreme care that the experiments be not lost. The average analysis of the rich canes planted here was solids 16.6, sucrose 14.7, purity 88.6; of the poor canes, solids 14.9, sucrose 11.9, purity 79.9. This gives a difference in the analyses of 1.7 solids, 2.8 sucrose, and 8.7 purity. This difference was not, perhaps, inherently as great in the canes examined as the analyses would indicate, for many of the stalks were no doubt influenced greatly by their environments and after removing them from these, the peculiarities themselves would in considerable part disappear. These peculiarities, due to environment, would, probably, all be eliminated in time by continued planting of canes from selected plats. During November 1891, at intervals of a week, the plats were twice sampled. Samples were taken from directly opposite points of the two rows, and every stalk growing in the space sampled was cut. The analyses of each in the laboratory were, of course, made by identical methods. These analyses were as follows:—

High Sucrose Plat.

Analysis of November 20.—Solids 15.2, Sucrose 11.6, Purity 76.3.
Analysis of November 27.—Solids 14.4, Sucrose 10.7, Purity 74.3,
Average.—Solids 14.8, Sucrose 11.2, Purity 75.7.

Low Sucrose Plat.

Analysis of November 20.—Solids 15.1, Sucrose 11.1, Purity 73.5.
Analysis of November 27.—Solids 14.4, Sucrose 10.7, Purity 74.3.
Average.—Solids 14.8, Sucrose 10.9, Purity 73.6.
Difference.—Solids 0.0, Sucrose 0.3, Purity 2.1.

"There was also undoubtedly a less yield of cane from the poor sucrose seed. This was so very evident that it did need the authority of actual weights to confirm it.

1892 Results.

"In discussing the data secured the present year on this subject, I have divided it into two phases, both of which seemed distinct and important enough for separate remarks. These are the results obtained from last year's selection and so have had but small opportunity for reversions, if such are to occur, and the other the results obtained from two plats, the original parents of which were from selected seed, the one from poor canes and the other from rich ones—but in which they had been allowed to grow one year without any intermediate selection. This latter, then, has been subjected to only the one original selection, but each plat kept free from intermixture with the other.

"The canes were planted two in a row without any lap and the tops and butts of the planted canes were kept opposite so as not to have the general growth of the cane in the row affected by the varying germinating qualities of the diffierent sections of the cane.

"The method used in selecting the rich and poor canes was somewhat different from that employed the first year. Then as a preliminary part of the work a number of tests were made to determine what section of the cane would represent the whole stalk, and having found this section, it was used for the analysis, But what has rendered this kind of work easier it was also found that from the point of comparing one cane with another any given section could be used, provided this section only was used in all the tests. So, acting on this knowledge, we have used in our selection the butt quarter of the cane, and while this does not give the sucrose content of the cane planted, it gives an accurate comparison of the quality of the canes used. The test of quality is also made solely with the Brix spindle, This is amply sufficient with sugar cane when the cane tested all comes from one plat. I have hundreds of analyses on my books at Calumet, which it would be but an incumbrance to print here. showing without exception, that under such conditions a high per cent. solids invariably means a correspondingly high sucrose, and, in a vast majority of cases, a higher purity than the lower solids. The average per cent. solids of the richer canes planted was 19·5, and of the poorer 17·2, a difference of 2·3. It was a noteworthy fact that nearly all the richer canes were also the larger ones, and the joints were longer than in the poorer canes. This would have, as the plats were the same length, given a larger number of eyes to the poor canes, and so should have given a larger number of canes, but from some cause it did not.

ANALYSES OF CANES FROM SINGLE STALK SELECTION.

Rich Cane Seed.				Poor Cane Seed.			
Date.	Solids.	Sucrose.	Purity.	Date.	Solids.	Sucrose.	Purity.
Oct. 24 –	17.0	14.0	82.3	Oct. 24 –	16.6	13.2	79.5
Nov. 1 –	17.5	15.2	86.9	Nov. 1 –	16.1	12.6	78.3
Nov. 5 –	17.1	13.9	81.3	Nov. 4 –	16.6	13.9	83.7
Nov. 7 -	16.4	13.4	81.7	Nov. 7 –	16.0	13.0	81.2
Nov. 8 –	16.3	13.2	81.0	Nov. 8 –	15.7	12.8	81.5
Nov. 11 –	16.1	13.1	81.4	Nov. 11 –	15.9	12.6	79.3
Nov. 12 –	16.6	14.3	86.2	Nov. 12 –	16.5	13.3	80.6
Means –	16.7	13.9	83.2	Means –	16.2	13.1	80.9

"In the spring, after the canes had begun to appear in considerable numbers, they were counted in each row, aud this counting was continued weekly till the number of canes either remained practically stationary or began to decrease, and, finally, another count was made in the fall just before grinding. The last mother canes in each plat appeared during the week ending May 15th. The rich canes seem to have given their progeny a little the better start, as there were 371 mother canes against 350 for the poor canes, and this slight advantage in the number of canes continued into August, but at time of harvest the amount of canes in each plat was almost identical, the plat from rich seed having 875 canes against 870 in the other. Fourteen of the canes in the rich seed plat died before reaching maturity, and seven in the poor seed plat. In point of number of canes grown or those lost before reaching maturity no preference can be given to either plat.

"I will now call attention to the relative amount of cane from the two plats. It will be remembered that last year, while no actual weights were made, it was remarked that the cane from the rich seed gave a larger, healthier-looking stalk, this being so very pronounced that there was no mistaking it. This present year all the samples brought in were weighed, and as the same number of canes were taken from each plat at every sampling, and these samples extended through the whole length of the rows, a very good idea can be formed of the relative quantity of cane This is best expressed by giving the average weight per stalk. For the cane from poor seed this was 2·58 pounds, and for the cane from the rich seed 2.42 pounds, a showing against the rich cane seed. While it may be that each year we will have a return in quantity similar to this, I am at present inclined to think that the rich cane will in the end prove the larger one

"It is true that with sorghum and beets the medium-sized plant is the most satisfactory one to grow for sugar; yet I believe that it could not in the same way be said of these that the smaller or medium sized *seed* are as satisfactory for planting as the large ones, containing, as they would, a much greater amount of starch to be transformed into food for the young plantlets. So, I believe, it will be with sugar cane, and that the larger healthier stalks will, in a series of years, produce the thriftiest canes, for I have continually noticed that in the selections the rich canes are the larger and better stalks. In three of the samples taken the weight of cane from the rich seed exceeded that from the poor, the other four samples giving opposite results. Also it was noticeable that at one end of the rows one plat contained the larger looking cane, and at the other end the other plat did, and the samples taken corresponded to this appearance. Certainly, from the limited trials made here, it would not be the part of wisdom to assert positively whether the rich cane seed will give a larger or a smaller cane, as the two years' results have been contradictory in this particular. Such contradictions, however, are to be expected in field agricultural experiments, and it will take the average results of a number of years to furnish ultimate proof.

"We now come to the most important part of the work in judging of its utility, viz., the analytical results. Seven sets of analyses were made, and then it had become so late in the fall that it was deemed expedient to make the selections for planting, and as this took all the canes it stopped further analyses. The last analyses were made on November 12th. These samples were, with one exception, taken from directly opposite parts of the two rows and contained the same number of canes. The one sample taken differently was during the time the selections for further planting were being made, and consisted of every thirtieth cane as the plat was being ground. This method of cutting out sections of the row in sampling standing cane for comparison of different plats I have found to be the most satisfactory tried. It is much better than going through the whole plat and trying to select average canes.

"There is in these analyses but one case, that of November 4th, where the cane from the poor seed could be said to be better for sugar-making than that from the rich seed. The average of the analyses shows the cane from the rich seed to be eight-tenths of one per cent. higher in sucrose and 2·3 points higher in purity. Now let us see what such a difference in analyses means in sugar-making. Allowing 10 per cent. marc, about the average in Louisiana, there would be a difference between the plats of 14·4 pounds of sugar in each ton of cane. This difference divided by two, because one plat was as much below the average cane seed as the other was above, will give 7·2 pounds of sugar per ton as an increase in planting rich cane for seed, instead of the average cane, had it been planted

"For a factory grinding 400 tons of cane per day this would add 2,880 pounds of sugar to the cane of a day's working, and for a crop of 25,000 tons would give 180,000 additional pounds of sugar. One hundred and eighty thousand pounds of sugar at five cents per pound is worth $9,000, and $9,000 would pay for 2,000 tons of cane at the price of $4·50 per ton, and 2,000 tons are nearly one-twelfth of the entire crop. This, it must be borne in mind, is the result of one year's selection. There is still another added value in the cane from the rich seed of which it is more difficult to give the exact value; this is the higher purity of 2·3. We know that a high purity is more desirable than a low one, but no one yet has been able to tell what a rise of a point in purity will add to the sugar output. To form some estimate we can take a given per cent. solids and figure what per cent. sucrose the two purities would give. Taking thus the average per cent. sucrose of the juice from the rich cane seed we will have the sucrose as given in the table of analyses for the cane from rich seed and 13·5 per cent. would have been secured on the cane from the poor seed plat had the per cent. solids been the same as in the other. There is, then, a difference of four-tenths of one per cent. of sucrose due to purity alone. Halving this for the same reason as given before we would get two tenths of one per cent. extra sucrose over the average, or 3.6 pounds per ton. This then should be added to the actual gain in sucrose made, aside from the question of purity, and would give instead of the 7·2 pounds, 10·8 pounds additional sugar per ton of cane. Carrying this out in figures the same way as before we would have for a day's work of 400 tons an increase of 4,320 pounds of sugar, and on a crop of 25,000 tons 270,000 pounds. This, at five cents per pound, amounts to $13,500 and would at the rate given before buy 3,000 tons of cane, which is but little less than one-eighth of the entire crop. Expressing this gain in another way it would give an abundant amount of money to pay the sugar-house labour for manufacturing the crop. This result was obtained from planting canes the average per cent. solids of whose juices differed by 2·3 points, thus making the richer canes better than the average would have been by 1·15 per cent. It is undoubtedly a remarkable showing.

Original Seed Selection Work

"We turn now to the other phase of our subject in which one year had intervened without selection since the original selection was made.

As explained, this was because the cane was too small to analyse a part and still have some left for planting. It will be seen then that the canes analysed this year while of pure bred stock from the original rich and poor canes has not the added value that another year's selection might have given. The results, however, should be expected to be very interesting in having a bearing on the question of the stability of an improvement once made. This will of course be one of the most important phases of the subject, for, should any improvement made revert to the original state after one year, the work would be in vain, as enough cane cannot be selected in one year to be of any great value.

"The first year's work with these plats gave a difference of three-tenths of one per cent. of sucrose between them and of 2.1 points in purity. This of itself was a decided improvement, but as the cane was so small I placed no great reliance in the results, thinking that an accidental cause might have occasioned it. But during the present year the cane from the seed these plats furnished grew excellently and was well cared for, so we are thus given an excellent means of judging what one year's selection will do under continued propagation."

CANE FROM 'SINGLE STALK SELECTIONS.'
Grown two years without additional selection.

Rich Cane Seed.				Poor Cane Seed.			
Date.	Solids.	Sucrose.	Purity.	Date.	Solids.	Sucrose,	Purity.
Nov. 3 –	18·0	16·0	88·9	Nov. 3 –	17·6	15·5	88·1
Nov. 8 –	17·7	15·4	87·0	Nov. 8 –	16·8	13·5	80·3
Nov. 14 –	17·1	15·3	89·5	Nov. 14 –	17·5	14·5	82·8
Nov. 19 –	17·5	16·3	93·2	Nov. 19 –	17·5	16·2	92·6
Nov. 25 –	17·6	16·0	90·9	Nov. 25 –	17·9	15·8	88·3
Dec. 6 –	18·8	17·0	90·4	Dec. 6 –	17·8	14·8	83·1
Means –	17·8	16·0	89·9	Means –	17·5	15·1	86·3

"The average sucrose of six samples from the plat planted with rich cane seed was 16·0 and the purity 89 9. The cane from the poor seed gave a sucrose of 15·1 and a purity of 86·3. The samples were taken in the same manner as in the other plats and, as will be noticed, give a more favourable showing than they did for seed selection. I will not extend the figures as I did before, for their magnitude must already be so apparent that further discussion would be useless.

"A most important point these two plats show is that the higher sucrose from the rich cane seed is not an early forced maturity, The analyses extend up to December 6th, and there is as marked a difference in the latter ones as in the earlier. I cannot but believe then we have proven that under the same conditions for each kind of seed, no difference what these conditions are, a rich cane will produce a better progeny than a poor one.

"Having established the fact that the sugar-cane can be improved by systematic seed selection it is necessary to inquire how this can be made of practical value to a large cane grower. The results obtained have been with small experiment plats. How can such work be done for hundreds of acres? This must be the true test of the utility of the results. for could not the large field profit by them they might as well have never been made.

"There are two possible ways, it seems to me at present, that the knowledge acquired by these experiments can be put to practical use. The first of these is by systematically sampling the cane growing on different sections of the plantation, and planting the richest for the ensuing crop. In this case, however, the conditions giving the richness are not perfectly known; the soil, fertilizer applied, better drainage or cultivation may, one or all, have had an effect in giving the result, instead of an inherent quality in the cane itself, and that which is in reality poorer might be selected in one year's work as the better. In a number of years, though, it is more than probable that a selection of this kind would be of material benefit. The return would, in any case, be slower than the method I will now call attention to.

"A chemist can take ordinary unskilled white labourers and teach them to make the necessary Brix readings in a very short time, and by single stalk work I estimate, from the work done here, that in a month at least three acres could be planted with a high quality of seed, using only a single hand-mill to extract the juice. This work done during grinding would entail no loss, as all juice extracted and canes not selected could be used in the factory. These three acres should produce the next year at the rate of twenty tons per acre, or a total of sixty tons. At the end of one year, then, sixty tons of a high grade seed would be on hand. This, planting at the rate of four tons to the acre, would seed 15 acres and, with the three acres of stubble, would, at the end of two years, give 18 acres of pure-bred seed. The 15 acres of plant cane would give 300 tons, at the rate of 20 tons per acre, and the three acres of stubble, at 16 tons per acre, would give 48 tons, a total of 348 tons, which is enough to have at the end of the third year, with the 15 acres of stubble, 92 acres of pure-bred seed. This does not take into account the additional selections that could be made each year and which by three years would at the same rate as above give twenty-one additional acres. Oue hundred and thirteen acres would, in round numbers, plant 550 acres, and this is nearly as much as our largest plantations plant in one year. By the end of another year, or the fifth crop harvested since the selection was begun, there would be nothing but improved cane on the place. This would be accomplished, too, by using only the additional labour of perhaps four men during the grinding season.

"Of course continued selections, that is, selections from selections, could be going on in small plats all the time and as these became of sufficient value could be transferred to the field in the same manner as the other.

"Feeling thus so thoroughly assured that the selection of 'high sucrose' canes will give a plant which is also of a superior quality, it might be well to speculate as to how far this improvement can be carried. Is it to be stopped at the end of three or four years, or is it to be continued indefinitely? If for the shorter period how much of an improvement can we expect?

"We know that propagation from cuttings will produce plants much truer to their mother species than those grown from seed. This is exceptionally true of those plants that can be grown in either way. As, for example, all fruit trees are budded, potatoes are grown from the eyes of the potato, not from the seed, and in the last few years when tropical cane seeds have been secured many distinctly different plants were, according to Professors Bovell and Harrison, grown from one parent seed head. Beet investigators, also, realising this fact, have been making experiments in growing beets from what are practically cuttings, instead of from seed as heretofore, though their work is being done to preserve true varieties rather than to have any immediate effect upon the sucrose content. Then, having accepted the fact that cuttings breed truer to the parent than seeds, is not the conviction forced upon us that an improvement inherent in the plant can be developed more quickly in cane than in seed producing sugar plants. I do not mean by this that large quantities of a pure stock could be secured more quickly, for I have already explained why this cannot be done, but that with an equal number of stalks a plant true to its parent stock will reach its maximum sucrose content sooner, and breeding only from the best, we are more apt to get the best. We will not have to contend with the difficulty of variation from our accepted best value. It is, also, doubtless true from the same reason that we are more limited in our ultimate improvement since we cannot expect accidental variations that will be of more value than their original parent. We cannot, either, secure any of the benefits of crossing that are obtained from seed bearers. That there are occasional variations, however, anyone familiar with the investigations of naturalists of the present day cannot very well doubt; indeed some have actually been observed in ordinary culture, and are now being grown at the Sugar Station in this State, but it cannot be hoped even by an extreme visionist in natural selection that there would be much betterment in cane by watching for such variations. My own work, no further than it has gone, has led me much against my will to fear that the chanee for continued improvement from single stalk selection is not as great as could be desired. I do not find nearly the variation in the plats which have already been subjected to one selection that I did in my original selection from the field. Where the first year the difference in per cent. solids of the two plats planted was 2·2, the selections gave but slight individual variations in either plat, and they were in each case practically the same number of canes examined. All the canes from the high sucrose plats were correspondingly high and those from the poor plat correspondingly poor. There was not in the rich plat a single stalk that I could think was distinctively richer than its associates from any quality in itself; in fact, there were none at all that were markedly superior canes to those adjoining them. I do not think the same reasoning could be held as good in regard to the cane from poor sucrose seed, as some single cane might be unusually low in sugar from an accidental cause, such as becoming wounded during cultivation, &c. . . . .

"It is my belief, then, that with a given amount of plants the improvement in sugar cane by seed selection will be more stable than in sorghum or beets, and will, on the whole, approach its maximum more rapidly, but that the limitations to its ultimate improvement are greater than in either of these. Nature, however, may aid it in the fact that the prodaction of sugar is a function incident to the plant, while with beets and sorghum this is an educated quality. Time only can tell which of these three will ultimately excel in the world's sugar production, but whatever the outcome will be it is certain cane can take a great stride in the race, now that it has been found that seed selection will aid it."

CONTRIBUTION TO THE STUDY OF THE PRODUCTION OF THE AROMA IN RUM.

By Percival H. Greg.

II.

The Fruity Acid.

In the March issue of the *Bulletin* under the head of "Rum Analysis," I mentioned the existence of a fruity acid in Rum, and promised some information as to its occurrence in nature. The existence of fruity acids in Rum is mentioned by Herzfeld; whether this fruity acid which I have under notice is the same, it is impossible to say with certainty, but probably it is. The smell of this acid or acids, (for I have not yet attempted to prepare it in a state of absolute purity) is extremely agreeable, and confers on rum, when dissolved in it, a fruity smell more resembling that of raisins than anything else I can think of. It is however in the state of fruit ether, i.e., when chemically combined with alcohol, that it exercises the greatest influence on the aroma of rum.

The smell of the fruit-ether is very delicious, reminding one somewhat of acetic ether and perhaps somewhat more remotely of the smell of the essential oil of limes, but it is exceedingly difficult to characterise an aroma in words and perhaps it would be safer to call it simply "fruity." The aroma however differs from the ordinary fruit-ethers in not being so "fiery" and is of a softer and less penetrating nature.

I first discovered the presence of this acid in old dunder in which it was present in large quantity. This dunder when put up in the vats at the end of crop did not, as far as I could ascertain by smell, contain any of this fruity acid. As time went on an acetic fermentation took place, and large masses of "mother of vinegar" were discovered in the liquid. After a time the smell of vinegar became less distinct, owing no doubt to the partial evaporation of the acetic acid and partly no doubt to the further combustion of the acetic acid into carbonic acid and water, and the fruity smell became very distinct. An extraction of the dunder by means of petroleum ether was undertaken. and a fruity smelling residue was left behind on the evaporation of the solvent. A minute drop of caustic soda was added and the smell instantly disappeared, but reappeared on the addition of a slight excess of sulphuric acid. It is evident therefore that this substance is of an acid nature The question now was, how did this acid come into the dunder? It was not there when the dunder was put up in its fresh state, but it was found and was evidently present in considerable quantity on the conclusion of an acetic fermentation. The first idea which occurred to me was, that it was formed by some kind of bacterium peculiar to Jamaica, but to have proved this would have necessitated a laborious series of pure cultivations, which, in the case of bacteria, is attended with considerable difficulty. The other possibility was that the fruity acid was originally present in the dunder as a salt, and had been set free from its combination with a base under the influence of nascent acetic acid, which would enter into combination with the base in the place of the "fruity" acid, that is, *that an acetic acid fermentation had played an essential part in its formation.* Now remembering that "dunder" is the residue of cane juice, it was highly probable that if this acid was present in the dunder in the manner I have suggested, it must also be present in the cane juice.

If then an acetic acid fermentation played the part which I have indicated above in the production of the "fruity" acid, it followed that a slight acidification of cane juice with dilute sulphuric acid would effect the same result, i. e. sulphuric acid being the strongest acid known would turn out the fruity acid from whatever base it might be combined. When however I added *dilute* sulphuric acid in the cold to the cane juice *I was not able to detect the presence of the fruity acid.* At first sight then it would appear as if the fruity acid was not present in the juice. Remembering however that dunder is the residue of cane juice we must also take into account the treatment which the cane juice undergoes in the Boiling House, *i. e.*, the heating with temper lime in the cyphons and coppers. I accordingly heated the cane juice with temper lime and then acidulated with sulphuric acid : the fruity smell made its appearance and an extraction by means of petroleum ether left behind a residue which had exactly the same smell as the fruity acid extracted from the dunder. I think we may therefore conclude that we have here to do with the same acid in each case, and my explanation of the formation of this fruity acid in the dunder would therefore be, that the fruity acid is present combined with some alcohol in the cane juice, that on the treatment with lime, a decomposition known in chemistry as "*saponification*" takes place, the lime salt of the acid is formed with the simultaneous liberation of the alcohol and that this lime salt of the acid on a subsequent acetic fermentation in the cane juice, or if not here then in the dunder is decomposed, the fruity acid being set free and acetate of lime being formed. As to the physical properties of the combination in which the fruity acid is originally present in the cane juice, I am unable at present to say positively. Perhaps it is present in the form of a wax or oil, and perhaps this would explain the energetic measures which are required to decompose it. There is no doubt that it could be decomposed direct by strong sulphuric acid without the previous treatment with lime and heat but since this process is not carried out in the Still House, and since an acetic fermentation cannot possibly work so energetically as strong sulphuric acid, it seems evident *that the treatment of the juice with lime plays an important and essential part* in enabling the fruity acid to be present in a form in which it may subsequently serve as a source of aroma. The fruity acid in whatever form of combination it may be, is present in a volatile form. This seems to me an important point because if the heating with lime be carried out too energetically this volatile salt will be driven off in the form of vapour, without being decomposed. That this is really able to take place the following experiment proves. Some dunder was taken and tempered to distinct alkalinity, in fact a considerable amount of alkalinity was present, and distilled, about a quart of liquid was used and it was therefore quickly heated to boiling. The vapour was condensed and collected, and this on re-heating with strong alkali and subsequent acidification with sulphuric acid shewed presence of the fruity acid, while an extraction of a fractional part of this distillate without the treatment with alkali and acid left no fruity acid residue, shewing that any fruity acid already present in the dunder in a free state had not escaped neutralization by the alkali added to the dunder. I have also been able to produce the fruit-ether of this acid in rum by treating it with alkali and sulphuric acid which would seem to indicate that some of the salt of this acid often escapes decomposition altogether. It would therefore seem to be indicated that in order to decompose this "salt" into a form in which it may afterwards be capable of furnishing a source of aroma that the cane juice should be heated for a fairly long period at a temperature say not exceeding 80 Centigrade; in order to effect the preliminary necessary saponification this is in many cases fulfilled by heating the juice with lime in the cyphons. That the same decomposition will also take place in the coppers is also evident, but if the fire is brisk the probability is that a considerable portion of the salt will be driven off with the watery vapour and will thus escape decomposition. So far however the fruity acid will not be able to play its part in influencing the aroma, it is "locked up" so to speak in the form of a lime salt, and requires an acidification by sulphuric acid or by an acetic fermentation to set it free. It is evident therefore that it will depend very much on the treatment which the liquor subsequently undergoes in the Still House as to as to whether this is done or not. If the "common or clean" (the last adjective must evidently be used in a comparative sense) process is used, and a quick purely alcoholic fermentation takes place, and if the liquor be run, as it often is in this process before it is thoroughly dead then the fruity acid will not be set free and the aroma due to the fruity acid will be lost. If however the skimmings before being set up be run on to a so called "dirty cistern," i.e., a cistern filled with cane trash, and be there allowed to undergo a preliminary "souring," and this will certainly comprehend an acetic fermentation, then the fruity acid will be set free *provided that the heating with lime in the Boiling House has been efficiently carried out.*

It is probable also that the nature of the aroma produced will vary with variations in the management of the trash cistern. Thus if the liquor already present in the trash cistern be fermented low down, that is, if it contain much alcohol, and if the fruity acid be set free by a simultaneous acetic fermentation (and there is no doubt that many kinds of fermentation go on at the same time in the trash cistern) it will tend in its nascent form, i. e. at the moment at which it is set free, to combine with the alcohol to form its characteristic fruit ether, whereas if little or no alcohol be present it will probably come into the rum in its free state and the aroma will be different. We shall also understand how if the salt of the fruity acid escapes decomposition in the mixing cistern, the fruit ether may still be formed by letting the liquor die down in the fermenting cistern until a "creamy" head appears. The conditions at the conclusion of an alcoholic fermentation are eminently favorable, in tropical countries, to an acetic fermentation, which then plays the part I have indicated. I have on several occasions microscopically examined these creamy heads and find them to be largely composed of acetic acid bacteria. It is evident also that if the trash cistern is to be used with its *maximum* effect as regards the production of the aroma, i. e., for producing really aromatic rums, that two cisterns must be used, that the juice must be allowed to sour for at least 24 hours and the juice of one souring *must on no account be mixed immediately previous to fermentation, with freshly tempered skimmings.* That the juice should rest for a considerable period in the mixing cistern is evident, because the object is in this case to develop acidity, and that it should not be mixed with freshly tempered skimmings seems equally evident because *the excess of temper lime present in the skimmings would neutralise the fruity acid if any had been sent free,* and so just lock up the aroma again. As to the amount of influence to be ascribed to this fruity acid or its ether in producing high class rum it is almost impossible to say but I have often been able to detect its presence by mell in good rum. It seems however a perfectly just inference to draw since it is present in considerable quantities in cane juice, and since it can be set free by the ordinary processes of the Boiling House and Still House, that it *does* in many cases influence the character of a rum considerably It would be exceedingly interesting to know if this fruity acid is present in the cane juice from different soils and from different canes. It might be that the same cane grown in different soils or different kinds of cane grown in the same soil might prodnce different aromatic acids. Thus in some rums I have been able to detect and extract by means of petroleum ether a sm ll exactly resembling new leather, and it may be that this new leather smell is caused *by the presence in the rum, of an acid possessing this aroma.* This can only be decided with certainty by a chemical examination of the cane juice from estates producing a new leather smell in rum The new leather smell however may be an artificial flavoring because there is a certain wood which grows in Jamaica which has a smell very much resembling that of new leather, and which is capable of giving up its aroma to rum when it is soaked in it.

FERNS : SYNOPTICAL LIST—XXIX.

Synoptical List, with descriptions of the Ferns and Fern-Allies of Jamaica, by G. S. Jenman, Superintendent Botanical Gardens, Demerara, (continued from Bulletin I, 6.)

TRIBE IX. ASPIDEÆ.

Sori elliptical, circular or sub-reniform, rarely much larger than a pin's head, usually smaller ; receptacles punctiform or elongated, dorsal or terminal on the veins; sporangia compressed, stipitate, arched by an incomplete jointed vertical ring, splitting transversely when mature; involucres orbicular, shield-like, and attached by the centre of the disk, or subreniform and attached eccentrically in the sinus of the auricles, or elliptical-oblong, and attached through the centre; the edges in all cases free; tumid or flat, naked or ciliate, persistent and shrivelling with age or deciduous at maturity, sometimes rudimentary; venation variable, pinnate and free, or with opposite branches uniting, or copiously reticulated with free included veinlets, cutting and size very variable. Five genera of very unequal size represent this tribe in this Flora. Grisebach in his Flora of the British West Indian Islands; following Mettenius and the older botanists, includes all but one in the genus *aspidium.* The different generic divisions here adopted are based on the form of the sori and involucres in conjunction, partly, with venation and habit. In *Aspidium* proper these organs are generally completely circular in the three following genera they are orbicular-reniform, of which *Nephrodium* embraces the great majority of species; while in the last, a monotypic genus, the sori are much larger, and double like a horse shoe, with a very deep sinus. The majority of the hardy and coarse obtrusive, wayside ferns belong to this tribe, though as many are equally seclusive and retreat-loving. The distribution is universal in tropical and temperate regions, entering both the arctic and antarctic zones.

Sori circular, involucres pellate-orbicular, free round the entire edge.—*Aspidium.*

Sori circular or punctiform, involucres cordate-orbicular, attached by the sinus.—*Nephrodium.*

Sori and involucres reniform, the latter attached by the sinus, terminal on the veins.—*Nephrolepis.*

Sori and involucres reniform, the latter attached by the sinus, oblique with the veins, near the base or distant from the margin.—*Oleandra.*

Sori and involucres large, folded, with a deep sinus, the shape of a horse shoe.—*Fadyenia.*

Genus XXI Aspidium, Swartz.

Sori orbicular, rarely orbicular-reniform; receptacles dorsal, medial, compital, or terminal on the veins; involucres superior, the same shape, centrally or eccentrally attached, deciduous or persistent at maturity; venation free, branches anastomosing, or copiously areolated; fronds widely variable in form, texture and size.

This genus forms the smaller of the two principal generic divisions of the tribe; it numbers over a hundred species which range round the world in the tropical and temperate zones, two or three extending to the arctic and antarctic regions. The majority are of hardy accommodating constitution, and frequent open and half shaded situations with equal success and freedom. In the greatly preponderating and typical form of the sori, the involucres are quite free around the circular edges, and are eventually shrivelled up in the centre of the sorus or are quite dislodged by the matured sporangia, in which latter case the plants resemble and might be mistaken, as they often have been, for true Polypodia. In some species however, there is a manifest tendency in the form of the sori and involucres to the reniform condition which characterises true Nephrodia.

a. Veins free.

b. Fronds entire or 1—pinnate.

Fronds entire, or with the base only lobed. 1. A. Plaschnickainum.

Fronds entire at the top, the base bipinuate. 2. A. rhizophyllum.

Fronds pinnatifid or pinnate, the pinnæ adnate at the base. 3. A. glandulosum.

Fronds pinnate, pinnæ quite entire. 4. A. semicordatum.

Fronds pinnate rachis densely paleaceous. 5. A mucronatum.

b. b. Fronds pinnate or bipinnate. 6. A. triangulum. 7. A. tridens. 8. A. viviparum.

Fronds uniformly bipinnate, segments awn-tipped but not mucronate, 9. A. aculeatum.

Fronds oblong, lowest pinnæ not enlarged 10. A. Christianæ.

Fronds deltoid, lowest pinnæ largest. 11. A. capense

a. a. Veins united.—Sp. 13—17.

Veins copiously areolated.—14-16.

Fronds usually 3—5 foliate. 12. A. trifoliatum.

1. *A. Plaschnickianum*, Kunze.– Stipites densely tufted from a short upright or oblique scaly and fibrous rootstock, slender, pale coloured fibrillose, 4–7 in. l.; fronds erect, 4–5 in. l. ¾–1 in. w., linear-oblong, rounded and broadest at the base, from that tapering to the blunt retuse viviparous apex; subentire, or sinuate, or more or less lobed in the lower part, sometimes with a pair of quite free rounded segments at the base; coriaceous; upper surface dark-green and nearly or quite naked, under pale and slightly fibrillose, especially along the midrib; margins faintly crenulate, especially toward the base; veins in groups, repeatedly forked, flabellate in the lobes; sori medial on the veins, in one or more rows, appearing scattered when plentiful; involucres peltate, orbicular, deciduous.—Hook. Sp. Fil. vol. 4. t. 211.

Common in forests and on shady wayside banks, and rocks above 4,500 ft. altitude; united by Grisebach with the next species, from which it differs definitely however by its erect habit, coriaceous, entire or little cut fronds, The bud at the end of the midrib is at first clothed with scales, subsequently little circular petioled fronds are produced and blackish fibrous roots. Occasionally the fronds are furcate at the apex, each branch viviparous. While young the plants are fibrillose-scaly throughout, on both sides of the fronds, the stipites very freely so. Species 8 seems to connect this with the triangulum group.

2. *A. rhizophyllum*, Swartz—Stipites cæspitose from a small very scaly fibrous rootstock, slender spreading, light coloured, freely fibrillose, ½–1½ in. l.; fronds prostrate-spreading, chartaceous or sub-coriaceous, 4–6 in. l. ½–¾ ths. of an in. w., with a long tapering linear-acuminate entire upper part, viviparous and radicant at the tip, and a pinnate lower half or two-thirds in which the pinnæ are quite free, sub-distant, ovate-oblong rounded, usually at both ends, or the base sub-cuneate, 4–6 li l., 2–3 l. b.; faintly crenulate or even-margined; rachis very slender light coloured, channelled, slightly fibrillose; under surface paler than the upper and slightly scaly; veins forked, pinnate in the segments; sori in 1–2 rows, usually confined to the upper entire part, but sometimes also appearing on the pinnæ; involucres peltate, orbicular, at length dropping away.—Hook. and Grev. Icon. Fil t. 59.

In well drained stony woods, on rocks and boulders, up to 1,000 ft., altitude or more; St. Mary, at the top of the wooded hill opposite Castleton Gardens, other eastern parishes. No doubt this is closely allied to the preceding, having similar vestiture, yet it is very distinct. The fronds are quite prostrate, and spread all round on the surface upon which the plants are growing. The entire upper part of each one is very much attenuated, and not more than ½–1l. w., at the proliferous tip. The buds are similar in character to those of the preceding bnt smaller, and the plant is altogether weaker than that species.

3. *A. glandulosum*, Hook. & Grev.—Rootstock short, erect, fibrous and very densely clothed with light coloured, bright, delicate scales;

stipites $\frac{1}{4}$–1 in. l. cæspitose, clothed freely like the root-stock; fronds erecto-spreading, lanceolate or oblong-lanceolate, 5–12 in l. or over, 1–3 in. w. acuminate but bluntish at the apex, tapering at the base, pinnatifid to a slightly margined rachis or fully pinnate at the base, chartaceo-herbaceous, pellucid-dotted; pale green naked of scales, but densely glandulose on both sides as is also the rachis; pinnæ very numerous, spreading, fully adnate and decurrent at the base, dwindling downwards to small deltoid auricles, rather apart, $\frac{1}{2}$–$1\frac{1}{2}$ in. l. 2–6 l. w., blunt or rounded at the point, rather auricled on the upper side of the base; the margins dentate-crenate or more or less sinuate-lobate and dentate in the largest states; veins pinnate, branches very oblique, 1–3 times forked, anterior branch longest and fertile; sori medial forming a row on each side of the middle rib, distant in the larger fronds; involucres peltate, orbicular, deciduous or not.—Hook & Grev, Icon. t. 140.

On rocky banks and skirts of forests from 1,500—3,000 ft. altitude; plentiful in one place at least between Gordon Town and Guava Ridge. A pretty and distinct plant; usually small, but occasionally with fronds over a foot long and three inches wide. Densely viscid while green. The colour is a very light green, that becomes pale brown in drying. In small fronds the sori are confined to the outer part of the segments, and often to the upper half of the fronds.

4. *A. semicordatum*, Swartz.—Rootstock stout, upright, fibrous, the crown densely clothed with long dark-brown fibrillose scales; stipites cæspitose, 4–-8 in. l., strong, freely coated like the rootstock; fronds pinnate to the apex with a similar terminal pinna, lanceolate, 2–3 ft. l. 6–9 in. w.; dark-green, glossy on the upper side; naked; sub-coriaceous; pinnæ very numerous, alternate, spreading horizontally, close or subdistant linear oblong and acuminate, 3–5 in. l. 5–8 li. w., base free, cordate, the lower side auriculate, sessile, lower ones gradually reduced; margins even or sub-crenulate; rachis strong, sub-angular, naked or more or less fibrillose; veins close, spreading at a wide angle less than right, 2–3 times forked; sori close in 1–3 contiguous parallel rows on both sides the midrib; involucres firm orbicular and peltate, dark coloured, quite embracing the sori, deciduous with age.—Cyclopeltis, J. Smith.

Frequent on banks and limestone rocks both fully exposed and in shade, below 2,000 ft. altitude; very abundant on the Manchester mountains and in other parts of the Island. A fine well marked species. The sori as well as the involucres drop away with age. In some cases the pinnæ dwindle to mere half-round or deltoid auricles $\frac{1}{4}$ in. deep, which extend considerably down the petiole, and in others they are not less than 2 in. l., and remote from the base of the stipe. The auricle at the base of the pinnæ overlaps the rachis, There is a form with the pinnæ pinnatfid and another in which they are furcate at the end, fish-tail like.

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Plants.

From Royal Gardens, Kew.—

Adansonia sp. Accra
Allamanda Williamsi
Alphitonia excelsa
Anthurium Bakeri
Anthurium Andreanum (seedlings)
Antiaris innoxia
Aristolochia gigantea
Atalantia monophylla

Bougainvillæa glabra, Sanderiana
Cæsalpinia echinata
Camoënsia maxima
Coffea sp. Lagos "Abeokuta"
Coffee, Hybrid Mocha
Didymosperma distichum
Irvingia Barteri
Macaranga sp. Gambia
Myrialepis Scortechini
Pandanus pacificus
Pritchardia Thurstoni
Smilax sp. Lagos
Solanum Wendlandi
Strobilanthes Dyerianus
Tacca pinnatifida
Thunbergia grandiflora, var. alba
Vanilla sp. Lagos (? V. africana)
Acorus gramineus, variegatus
Agapanthus umbellatus, variegatus
Alpinia calcarata
Amorphophallus sp. Ceylon
Anthurium Scherzerianum
Astilbe japonica, compacta
Bambusa arundinacea
Begonia "Gloire de Sceaux"
" Olbia
" "Pres. Carnot"
" Sandersii
" sceptrum
" semperflorens rubra
Beschorneria yuccoides
Bomarea patacocensis
Buddleia Colvillei
Callipsyche aurantiaca
Canna "Alphonse Bouvier"
" "Mad. Crozy"
" "Mons. Massot"
" "Paul Lorenz"
" "Queen Charlotte"
" "W. Pfitzer"
Carex brunnea
" " variegata
" Marrowi
Carludovica latifolia
Centaurea crassifolia
Ceropegia Sandersonii
Crinum giganteum
Curcuma sp. Calcutta
Doryanthes Guilfoylei
Eurycles Cunninghamii
Fockea sp. Mashonaland
Hæmanthus Kalbreyeri
" Katherinæ
Hedychium spicatum
Hymenocallis senegambica
Liriope graminifolia
Macrozamia spiralis
Mischanthus sinensis, variegatus
Musa sumatrana
" textilis, "Manilla Hemp"
Pereskia Bleo
Richardia æthiopica "Little Gem"
" Pentlandi
Sauromatum guttatum
Tupistra macrostigma
Cryptanthus Beucheri
Sanseveria sp. (Buchanan)
Renealmia calcarata

From T. L. Mead, Florida—

Crinum virginicum
" sp. from Assam
" Kunthianum
Crinum Cappedum (hybrid)
" Kircape (hybrid)
Hymenocallis littoralis, from Africa

SEEDS.

From Dr. Lorenzo G. Yates, F.L.S. California—

Echinocactus cylindraceus
Opuntia basilaris

From Messrs. Machado, Kingston—

Tobacco.

NOTE.

The Director will be at the JAMAICA INSTITUTE on the morning of the first Friday in every month between the hours of 10 and 12 o'clock for the purpose of giving information to those who may wish to consult him.

New Series.] OCTOBER, 1895. Vol. II. Part 10.

BULLETIN

OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

CONTENTS:

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JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] OCTOBER, 1895. Vol. II. Part 10.

REPORT OF THE DIRECTOR FOR THE YEAR ENDED 31st MARCH, 1895.

The Royal Finance Commissioners in their Report stated that, "in a purely agricultural country like Jamaica a well organized Department of Gardens and Plantations is invaluable, not only for introducing and propagating such plants as are most suitable to the climate and soil, but also for the dissemination of the knowledge requisite to cultivate the products of the island to the best advantage."

This is the work which has occupied the Director and his staff of trained Gardeners since the establishment of the Department by Sir Anthony Musgrave in 1879.

The first part of our duties is reported upon under the following headings:—

The second part is reported on under the following headings:—

At Hope Gardens, seven and a half acres are devoted to various economic plants, of which three acres are under a collection of about 90 different varieties of Sugar Cane; two and a quarter acres are devoted to the Nursery, where several thousand plants are always in stock; about three and a quarter acres are under ornamental borders; and six under lawns. There are also five or six acres under Teak.

Altogether there are about twenty acres that require constant unremitting care and almost daily cultivation. It is absurd to compare the work necessary in a Garden with field cultivation, and it is not just or fair to make comparison of the expenditure in the two cases.

The question of water-supply is one to which I have called attention on several occasions. In my Annual Report for the year ended September, 1887, I said that it was "advisable to try sinking the Egyptian

Driven Wells. Springs occur along the base of the hills, and it is possible that a large quantity of water might be tapped at no great depth." But the uncertainty of the supply may at any time cause serious trouble in Kingston and the neighbourhood, which might be avoided by the construction of more reservoirs. It is now well known that secondary reservoirs into which the water passes from the receiving reservoirs are extremely valuable in allowing of a more complete removal of noxious germs. The extension of the reservoirs would not only be useful in this way but would also provide for the storage of water which during most months of the year goes to waste down the Hope River. My original plan for the laying out of the Hope Gardens, included the formation of a small lake for the storage of water for the Gardens, and for growing water-lilies and other aquatic plants; and this had been determined on by the Committee of the Legislative Council that sat in 1886. The funds hitherto at my disposal have not allowed any steps to be taken in this direction. It might be gradually done year by year at a moderate cost.

Reference is made later in this Report, and also in the Superintendent's Report (in the Appendix) to the cultivation of various economic plants, such as Canes, Cocoa, Liberian Coffee, Nutmegs, Ramie, Alfalfa. The growth of these plants has been most successful. The area under their cultivation is small, and though sufficient for ordinary purposes, is certainly not large enough to enable any separate account to be kept of expenditure under separate headings. I do not think myself that this is a matter of much importance for practical men, but if it is considered desirable by the Legislative Council, they will no doubt vote the money necessary for the increased cultivation.

The plantation of Teak, just 21 years old, has been a great success, splendid gate posts having been cut from the timber. No irrigation has been applied, and it is apparent that even with the small rainfall of the Liguanea plain, Teak is a most valuable addition to our native woods, and can be grown where naseberry-bully and other hardwoods will not flourish. An article appears in the Bulletin on this tree.

The reduction of the vote for the year caused a suspension of any extension of the Gardens, but no loss occurred in plants already established.

The instruction given to the boys of the Industrial School is dealt with further on.

Castleton Gardens continues to be a place of great resort both for the inhabitants of the Island and for visitors to our shores.

The success of the plantation of Liberian Coffee there, and the fact that machinery has now been invented for pulping it, have induced many planters to start a new cultivation, and it is probable that it will be found useful to the colony as a partial substitute for the cultivation of the Sugar Cane. The plantation has been considerably extended.

At the Hill Garden the seedlings of forest trees are doing well, and the growth of fruits suited to the hills is continued, but experiments are crippled through the reduction of the Vote. No work has been done on the Cinchona plantation proper for some years with the exception of keeping some of the principal roads open.

The King's House Gardens and Grounds have been maintained in their usual good condition, and demonstrations given there by Mr. Thompson on Grape Culture.

The additional entrance gates on the east and west sides of the PARADE GARDEN, and at the corners where the fountains are situated have caused a very great increase in the numbers of people passing through. The consequence is that the grass lawns which ought to form such a delightful feature of all gardens, and especially of those in cities, are here very much trodden down, and have become unsightly. I recommend that provision be made on the estimates for low fences to be placed round the lawns as is done in St. James' Park, London, and in other city gardens. Thus while free passage would be still maintained, the eyes of passers-by would be gladdened and refreshed by the sight of the green lawns.

BATH GARDEN has been immensely improved in consequence of the expenditure of the larger amount voted for it. A new iron fence has been erected, labels placed on all the plants, and other improvements effected.

I was absent on leave from the island for six months, nearly the whole of which time was devoted to work in connection with this Department.

I have to record my obligations to Mr. Thistleton-Dyer, Director of Kew Gardens, for the facilities afforded me for study at Kew, where I spent a considerable time during my stay in England. I have also to thank him and Dr. Morris for a great deal of most kind personal help in agricultural matters relating to Jamaica.

Some weeks were spent in constant daily work in the Bacteriological Laboratory of King's College, London; and some weeks also in Copenhagen, studying in Prof. Jörgensen's Laboratory. I also visited Berlin. Whilst in England I interviewed a number of merchants in London on points relating to economic products of Jamaica, and went to Sawbridgeworth in Hertfordshire to see Mr. Rivers on the subject of Orange and other fruit trees.

Special attention was given to the diseases of plants and I had favourable opportunities at the Jodrell Laboratory in Kew Gardens for studying the Sugar Cane Rind and Root Disease under the guidance of Mr. Geo. Massee, Assistant at Kew for Fungi. Prof. Frank in Berlin, and Prof. Rostrup in Copenhagen, who are well known in connection with plant diseases, have excellent collections of illustrative specimens, which they were good enough to go over with me. The Bacteria which are connected with the diseases of plants have not been so fully investigated as those which are hurtful to animal life, though Prof. Arthur in the United States has shown that Pear Blight is due to the attacks of a Micrococcus. Bacteria are also concerned in healthy physiological processes, and it is only quite lately that it has been shown of what immense importance to agriculture some kinds are in accumulating nitrogen from the air for the use of certain plants.

In Copenhagen I studied different yeasts which produce fermentation, and the wild yeasts and other microbes which prejudicially affect the quality of fermented liquors, which form in fact their diseases.

The discoveries of Pasteur embodied in his works, *Etudes sur le Vin* and *Etudes sur la Bière*, proved clearly the dependence of the process of fermentation on yeast-plants; but it remained to Hansen in Denmark to invent a method for obtaining a pure culture of each yeast-plant, and so enable brewers and others to grow the particular yeast desired in order to obtain a special product.

Prof. Hansen is still continuing his researches at Carlsberg, near Copenhagen, and a former pupil of his, Mr. A. Jörgensen, is the Director of a Laboratory in the same place where students from all parts of the world come to learn the technical methods of investigation of yeasts.

There is nothing certainly known as yet about the fermentation of Rum,—the morphology of the yeast-plants or other microbes that cause the fermentation, the cause of the general superiority of Jamaica Rum, and the reasons for different qualities of that spirit on neighbouring estates.

The investigation is likely to prove intricate from the necessity of cultivating separately each kind of microbe to be found during the fermentative process; and the difficulty is enhanced by the possibility that forms that appear exactly similar under the highest powers of the microscope may prove to differ widely in their life-history and the products to which they give rise. It may take years to thoroughly work out the problem, but it is an interesting one both from the scientific point of view, and also from the practical bearing it may have on the manufacture of rum.

Mr. P. H. Greg, from Jamaica, studied under Prof. Jörgensen for some months, and is continuing his studies here. My object was to gain an insight into the subject, so that I might be able to give advice or help to any planters or students working at it in the island.

Whenever opportunities occurred, I took note of Institutions for the advancement of Agricultural Science, or for education and training in Agriculture.

Although Denmark is a comparatively small and poor country, large sums of money are devoted to the furtherance of agriculture. There is an excellent Agricultural College in the capital, Copenhagen.. The veterinary branch includes three large buildings with stalls for horses suffering from various diseases on which a veterinary surgeon demonstrates to the students. There are large Gardens and Grounds: a Botanic Garden for the illustration of lectures in Systematic Botany with a special area for economic plants; an Arboretum for the culture of forest trees; a Fruit Garden where various Apple and Pear Trees are grown trained as espaliers in different ways, and where varieties of strawberries, etc., are cultivated. The influence of various manures is illustrated by a collection of plants growing in large flower pots. There are large and well-equipped laboratories for the study of the physiology of plants and of chemistry. Amongst the collections of plants there is a fine seri s illustrating the diseases of plants consisting of dried specimens of woods attacked by fungi, and of plants in the herbarium, and of others preserved in alcohol. There is a large staff of Professors who lecture on the theory and practice of agriculture.

In Copenhagen itself, and at other places on the Continent, there are Institutions founded and supported in many cases by the liberality and enthusiasm of private individuals; they are known as Experimental Stations and are designed for the scientific study of some particular branch of Agricultural Science. A good example of such an Institution exists at Copenhagen, founded by Mr. Fjord, for the study of milk and its products,—butter and cheese. The principal officer in this establishment, Mr. Storch, devotes himself to studying the bacteria of butter and cheese, and the results of their activity in giving the best flavours and even the proper consistency. Instruments and methods are also designed for determining special points, e.g., the exact percentage of butter in a small sample of milk,—simple enough to be used by the dairy farmer as a test of the capabilities of each of his cows, and by the maker of butter and cheese in determining the price to be paid for the milk purchased from the farmers according to its richness in cream. To the influence exercised by this Institution the high quality of Danish butter and enormous increase in its export, is principally due. One farmer is doing business in growing pure cultures of special bacteria, which are sold to butter-makers, for the purpose of ensuring the best flavoured product. There is a trade also in "pasteurised" milk, that is, milk heated to the degree that ensures the killing of germs, that produce various diseases in human beings, and generally those also that would cause the milk to sour.

In Germany there is an Experimental Station, and sometimes two, in each province. The chief objects are the study of the physiology of plants and animals in its direct bearing upon agriculture; the control of certain trades in connection with agriculture for the protection of farmers, e.g., the sale of artificial manures and of food for cattle is controlled by the chemical analysis of samples,—the supply of sound seed by seed-merchants by testing the seeds for percentage of germination; experiments in feeding cattle with certain foods to test their digestibility, their value as flesh-formers, milk producers, etc.

As an example of these Stations I may instance that at Bernburg. This Experiment Station was founded by the Association of the Sugar Beet Industry of the German Empire, though it is now under the immediate control of the Ducal Government of Anhalt. The entire Station, with its appliances and apparatus for plant experiments and the equipment of the Laboratory, cost between 120,000 to 130,000 marks (£6,000 to £6,500). The Bernburg Station is of special interest to all students of agricultural science from the fact that there Professor Hellriegel and his associates discovered the relation between micro-organisms and the acquisition of atmospheric nitrogen by plants.

There are also other kinds of experimental stations, e.g., in Berlin, one for distillers, another for brewers, another for the beet-sugar industry. The students in these stations are either practical men who attend to get a certain amount of theoretical training, or agricultural students who have passed through the ordinary curriculum at the Schools. The courses of lectures and demonstrations generally last from 6 to 12 months; and it is evident that where every large farmer grows great quantities of potatoes, which are used to make into spirit with a residue of "cake" for cattle-food with the ultimate object of providing manure, the theoretical training even of six months must be of great value.

There are three grades of agricultural schools in Germany, one grade is for the children of the poorer peasants open during the winter season; another grade is for richer peasants who are encouraged to pass well by the resulting privilege of only serving one year in the army; and thirdly the High Schools of Agriculture in connection with Universities. Besides these, there are special Schools for the study of Forestry and of Veterinary Surgery.

I visited the Botanic Gardens, Herbaria and Museums under the kind guidance—at Copenhagen of Prof. Dr. Warming, and at Berlin of Prof. Dr. Urban, Dr. Schumann, etc. and was able to discuss many points of interest in connection with the flora of Jamaica and the West Indies. Prof. Warming has visited the West Indies and is naturally interested in the flora of the islands belonging to Denmark. Prof. Urban is devoting himself altogether to a study of the flora of the whole of the West Indies, assisted in his work by Consul Krug. The Herbaria in Kew Gardens and the British Museum have, of course, very important collections from Jamaica and the other West Indian Islands, which are always accessible for consultation. Sir Hans Sloane's general collections constituted the British Museum in its early days, and the dried plants which he collected in this island are in as good preservation as they were two hundred years ago, and can now be even more readily studied by botanists.

EXPERIMENTS IN CULTIVATION AND PREPARATION OF PRODUCTS.

Bananas and Plantains.—There are several varieties of these plants at Hope Gardens. Though only one variety, the large Jamaica banana, is suitable for the United States markets, there are others which, though smaller, are of a better flavour, and might be more appreciated in English markets. When in London last year, I was told by Messrs. J. B. Thomas, Fruit Brokers in Covent Garden, that large bunches of bananas, well selected, well packed, and arriving in good condition obtain a price varying from 18s. to 35s. per bunch. I was also informed by Ship Brokers, that if planters would guarantee cargoes at stated intervals they would arrange for steamers direct to London. Fruit is now sold in London by samples, there are no charges therefore for carting from the docks.

Efforts were made whilst I was in Europe, to find out whether machinery could be had for drying and preparing waste bananas and plantains as meal, etc. The Moko plantain is probably the best for meal, if cultivation for this purpose alone were carried on; but the chief problem is the utilisation of the enormous quantity of small bunches of bananas that are at present valueless.

The subject of manures for bananas has been dealt with, and speaking generally, it appears to me that of the three most important plant foods that have to be supplied to crops, viz. nitrogen, phosphoric acid and potash, the last named is the most necessary. But soils vary so much that each planter must experiment on his own land, and work out the problem for himself. A common idea appears to be that all that is wanted in this connection is a chemist to analyse the plant and the soil, that he can then tell exactly what substances should be used as manures and in what proportions. This is a fallacy. A chemist cannot tell whether the substances already in the soil are available for plant food, although he may indicate that there is an insufficiency of certain elements. The need for experiment by the planter himself has been amply proved by the results of more than 50 years' experiments by Lawes and Gilbert at Rothamsted.

COCOA.—In wet districts where Cocoa grows best there is a difficulty very frequently in drying it on account of a damp atmosphere and absence of sun. It is therefore a matter of necessity to obtain a drying machine constructed on thoroughly sound scientific principles. I am not satisfied with those which I have seen and know to be in use in the Island. The temperature should never be higher than that of the direct rays of the sun, but in the ordinary dryer the lower side of the bean next the wire mesh of the tray is over heated, and the upper side is not sufficiently so, while the general temperature of the dryer may be correct. Several Cocoa planters have most kindly given me their ideas on the size, etc., necessary for a dryer. I have corresponded, and had interviews, with Messrs. John Gordon & Co. in London, and they have designed a Cocoa dryer which causes the beans to present every surface equally to the heated air, and it is to be hoped that this machine will be found to be an improvement on those now in use in the island. Nearly 3,000 plants have been distributed from the Gardens, besides large quantities of seeds.

COCO-NUT.—Enquiries are sometimes received asking for information about Coco-nuts and products made from them. The market price quoted for Coco-nuts in New York is often more than double what a planter can sell them for here, but the bulk of the nuts in the market are of a larger size than the Jamaican, coming from San Blas, San Andreas, and Bocas del Toro, where the conditions are more favourable to the production of large nuts.

Copra.—Copra is merely the white "flesh" of the ripe nut taken out of the shell and dried in the sun. It is only imported in London and Liverpool from the East, and the prices ruling would scarcely warrant any export from the West Indies.

Oil.—Coco-nut oil is extracted from Copra by machinery which must be so constructed as to exert great pressure in order to extract all the oil, and consquently is very expensive. The "cake" left after expressing the oil is a good Cattle-food. But this industry requires a large capital to carry it on successfully, and the supply of nuts must be certain, constant and probably larger than Jamaica could supply.

Coco-nut oil is imported into New York from Ceylon, Cochin, etc., at a lower rate than it is sold locally for in Jamaica. The natives in the East Indies use rude hand-mills for the crushing of the copra, the nuts are very abundant, and labour exceedingly cheap. It is used in the United States almost entirely for soap-making. In this island the fresh oil is used for cooking and other purposes, and therefore fetches a higher price than if it were imported from New York.

Dessicated.—Coco-nut is cut up and dessicated in England and the United States for confectionery purposes, but it is extremely doubtful whether it could be treated in that way in tropical climates, as a very white product is required, and here the colour would probably turn, and the nut become rancid very quickly.

Fibre.—Capt. L. D. Baker of the Boston Fruit Co., has sent me samples of fibre which he has prepared from the Coco-nut as a substitute for horse-hair in stuffing mattresses, cushions, etc. If it can be supplied cheaply, it would probably take the place of horse hair.

COFFEE, ARABIAN.—The best plan in dealing with settlers' coffee is to adopt the principle of central factories by which one man buys up the whole of the settlers' coffee in a large district and cures it in one set of works. But the greater number of settlers, instead of selling their coffee in cherry, prefer to cure it themselves, however imperfectly, the result being that "ordinary" Jamaica coffee has a bad name. To remedy this state of things, not only has an Instructor been sent into some districts to show what might be done to improve the quality, but good machinery suitable for small settlers has been sought out, and recommended in the Bulletin.

Coffee, Liberian.—In the Bulletin for January, 1894, information on this subject was supplied to planters, and as a consequence, many have commenced planting, and I look forward to a very large area being planted with this strong and free-bearing coffee shrub.

I am experimenting with the budding of Arabian or common coffee on Liberian, If this experiment prove a success, it would be the means of greatly extending the area on which it is profitable to grow common coffee. Over 12,000 plants have been distributed, besides large quantities of seeds.

Eucalyptus.—I consider that the planting of Eucalyptus throughout the Island, so far as it has gone, has been fairly successful. More than two thousand plants have been distributed during the year. These trees prove useful in malarial districts. Reports on plants supplied from the Gardens are given in Appendix II, page 235.

Fodder Plants.—*Sacaline.*—Experiments have been made both at Hope and at the Hill Garden in growing the plant called here Sacaline (*Polygonum Sachalinense*), which was said to be so promising in Europe as a fodder plant. Whatever may be its value elsewhere, I cannot recommend it for cultivation here.

Alfalfa.— Alfalfa has been successful at Hope Gardens, and with several who have carefully attended to its cultivation. The following letter from a correspondent is a contribution that may be useful. "I notice in your last Report accounts of a good many trials of Alfalfa (Lucerne), and the majority of them appear to be failures. Now, I have found it a remarkable success, and consider it a most invaluable fodder plant. I believe the chief reason for its failure in so many cases is the imperfect preparation of the land, for I believe that if the soil is well worked so as to make a good seed bed, and the subsoil is fairly porous, it is certain to do well. I have cut from the same bed three times within four months from sowing.

"I prefer to sow it broadcast, as in every instance when I have sown it in drills, it has been more or less a failure, in fact, I have seen it a total failure. My plan is to get the land ready in large square beds, when the weather is showery, and when I notice the rain setting up, I hurriedly go over the beds with a coarse rake and scatter the seed. I think most people in Jamaica, if told to sow in drills, make their drills too deep, and so the seed rots instead of growing.

"Several of the places mentioned in your Report are well known to me, and I am sure, provided the seed was good, that Alfalfa would grow well there if properly sown.

"I am daily expecting a supply of seed from America, and intend sowing it in two places in St. Andrews, three miles from Kingston, in opposite directions. I will let you know the result."

In the Argentine Republic it has for many years been known as a valuable crop, but it is only recently that the large ranche-owners have begun to cultivate it extensively for the fattening of cattle and sheep for export; for instance, one *estanciero* recently put 6, 500 acres under alfalfa for the purpose of supplying fat cattle and sheep regularly for shipment to England. Five cuttings are said to be obtained from it in a year, yielding 12 tons of hay per acre, without manure or irrigation, and it is calculated that fat cattle of 700 lbs. carcase weight, can be delivered in England at £12 a head. The great drawback hitherot has been the uncertainty of fattening cattle on the natural pastures, which are liable to become short of food from drought. On other farms an equal area is under alfalfa for the purpose of supplying hay; on one of them 1,500 bales are every day put up and compressed by machinery.

In dry districts like the plain of Liguanea, irrigation would doubtless be necessary to ensure constant crops. It should succeed in the district where water from the Rio Cobre Irrigation Canals can be utilised. It would be valuable as hay to be given to horses and cattle throughout the island, and especially in times of drought. Ensilage can only be conveniently used on the place where it is made, but dry, compressed hay can readily be carried long distances.

Seed can be obtained from Messrs. Peter Henderson & Co., 35 Cortlandt St., New York, at a cost of $16 per 100 lbs., freight not included. About 12 lbs. per acre are necessary.

Forestry.—It is encouraging to find that nearly 13,000 trees have been distributed. Those who wish for any large number of trees should give two or three years' notice. Attention is directed to the value of Teak, which has succeeded admirably at Hope Gardens, and has provided excellent gate posts for the entrance gates, though the plantation is only 21 years old.

Grapes.—The Vines planted by Mr. Thompson in the King's House Gardens have been removed to Hope. They will be submitted to various experiments in order to simplify as much as possible the cultivation in the tropics.

Kola or Bissy.—This is a product which has a great future for it. It is a food like Cocoa, a stimulant like Tea, and has great value as a therapeutic agent in affections of the nerves, heart, &c. More than six thousand plants have been distributed, besides large quantities of seeds.

Oranges.—Twelve hundred seedling orange plants have been distributed. These have been grown from seed of fruit of the finest quality.

Experiments in budding have been continued, and the boys of the Hope Industrial School have been successful under the tuition of Mr. Cradwick in budding a large number of plants.

In order to supply probable demands in the future for budded stock, it will be necessary to grow trees in a permanent orange garden for the production of buds. This garden should be situated at an elevation and locality where the finest fruit is produced, and where it can be worked with the resources of the Department at present available.

The best way to improve the quality of oranges exported, is to encourage cultivation, proper picking, selection, careful curing and packing, together with the placing of distinctive marks on the packages. The value of the marks will soon be as well known on the markets as those of the best coffee. Carriage in specially adapted steamers will come as a natural result when the export is sufficiently large.

The presence of Scale Insect in some places on the orange trees is due most likely to some unhealthiness in their condition ; forking and manuring should be tried before spraying with insecticides.

Ramie—A Bulletin was published on the subject of Ramie, as it was occupying a good deal of attention in the beginning of the year. But planting was not encouraged until a machine conld be recommended for the preparation of the fibre.

Plants were put out in the various Public Gardens, and the experience gained will be found in theReport by the Superintendent of the Hope Gardens. The green leafed variety is evidently the best for low elevations, and that with the white under surface to the leaves is the best for the hills. In the Hill Garden this variety is growing 10 and 12 feet high.

As soon as a suitable machine or process is invented for the cheap and ready production of fibre, roots will be available for distribution. Until such machine is shown by practical tests to be capable of doing good work, no encouragement will be given to any one to plant Ramie.

Sugar.—The improvement in yield and quality of sugar from canes may be looked for in two directions, selection of the best canes on an estate for planting, as determined by chemical analysis or otherwise, or by growing some of the new seedling canes of proved high sucrose content.

In the Bulletin for January, 1894, a list of seedlings was given which had been received from Mr. Jenman, Superintendent of the Botanic Gardens in Demerara, and are now growing at Hope. Specimens were sent to Dr. Stubbs, Director of the Louisiana Sugar Experiment Station, and the following communication has been received :—

"I send you herewith the analysis of the canes which survived with us. From them you will find that No. 95, the richest cane, is far ahead of anything that we have had during the past year. We have here seventy odd varieties, besides our home cane, and this is fully 25 to 33 per cent. better than the best of those. I am this year propagating it quite largely, and will try to have enough to make a thorough test in the sugar house next year. I would be glad if you would send me by mail samples of Nos. 74, 78, 102, since these are reported by the Botanical Department and Experimental Stations as being as rich or richer than our No. 95. I am greatly encouraged by the results of this cane, and hope that in this way I may be able to obtain what I have failed in every other direction, that is, getting a cane with a high sucrose content."

Analysis of Seedling Canes sent.

No.	Brix.	Sucrose.	Glucose.	Remarks.
LXI.	15.3	12.1	1.67	2 stools ; 11 stalks in one, and 8 in another.
LXIX.	15.1	12.1	1.50	1 stool, 13 stalks.
LXXIV.	15.1	12.2	1.20	1 stool. 5 stalks.
XCV.	16.8	15.2	.67	1 stool, 10 stalks.

The disease so fatal in Barbados and other parts of the West Indies has not spread much in this Colony, but precautions should be taken against it.

IMPORTATION OF SEEDS AND PLANTS.

As usual a large number of seeds and plants have been received from Botanical Gardens all over the world, and from private persons both in the Island and abroad, and I have to express now, generally, my grateful thanks to the donors for their kind assistance. Details are given in the Monthly Bulletin.

From the Royal Botanic Gardens, Kew, have been received during the year 172 plants in Wardian Cases, and 206 packets of various seeds.

Among the species may be specially mentioned the following :—

Coffea stenophylla. —This is the narrow-leaved, " wild," " bush," or " native coffee" of Sierra Leone. It grows very freely, and appears to yield quite as much as the Liberian, but is somewhat longer in coming into bearing. Both the natives and French traders at Freetown say that it has a superior flavour, and prefer it to the Liberian.

Rhus succedanea and *Rhus vernicifera.*—Japan Wax is the produce of the first-named species, which is a small tree, with smooth branches and pinnate leaves, whilst *R, vernicifera* yields the famous lacquer so extensively used by the Japanese for lacquering various articles of furniture and small ware. It exudes from wounds made in the tree, and is at first milky white, but becomes darker and ultimately black on being exposed to the air.

Dracœna Draco - This tree derives its common name from a resinous exudation known in commerce as dragon's-blood. The resin has been found in the sepulchral caves of the Guanches, and has hence been supposed to have been used by them in embalming their dead. It appears at one time to have formed a considerable branch of export from the Canaries, and has never wholly fallen into disuse.

Citrullus Colocynthis.—This is the *Bitter Cucumber* or *Colocynth* which furnishes the well-known drug. The pulp in the interior of the fruit is light and spongy, and very bitter ; from it a watery extract is made, which is much employed as a purgative in the form of pills. An oil is extracted from the seeds for burning in lamps.

Copaifera Mopane —This is an African tree and is called " Ironwood." The heart-wood is dark, heavy, and very durable.

From the Royal Horticultural Society's Garden, Chiswick, London, 15 packets of varieties of Tomato seeds.

From the Botanic Gardens, Georgetown, Demerara, 108 cane tops, 4 parcels seeds, and 280 large seeds of Carapa guianensis.

Carapa guianensis.—This is a large tree, 60 or 80 feet high, growing plentifully in the forests of Guiana. The bark of the tree possesses febrifugal properties, and is also used for tanning. Its timbers called Crab-wood, is used in Demerara for making articles of furniture, for shingles, and for the mast, and spars of vessels. By pressure the seeds yield a liquid oil, called Carap or Crab oil, suituble for burning in lamps, and which the natives use for annointing their hair.

From the Royal Botanic Gardens, Trinidad, 17 parcels of various seeds, black pepper cuttings, and 76 plants. Amongst the latter were : Nicaraguan creole cacao, Trinidad creole white-seeded cacao, Monkey cacao, Alligator cacao, etc.

From the Botanic Gardens, Grenada, 5 packets, seeds.

From Messrs. Reasoner, Bros., Florida, 38 packets of various seeds and 87 plants, such as peaches, olives, grape vines, and a fine collection of Neriums.

From Messrs. J. B. Beach, Florida, 1 case Strawberry plants, (all dead on arrival) and 6 palms.

From the Royal Botanic Gardens, Calcutta, packets of seeds were received, among which were :—

Santalum album.—the White Sandal Wood tree of India, which is so much valued for a variety of domestic purposes. The essential oil forms the basis of many of the ottos distilled in India, and alone has a peculiar fragrance, much valued by the natives for toilet purposes. Sandalwood carving is an established industry in some parts of the country. Richly carved boxes, cabinets, work tables, &c., are made of the wood, and are much valued both by natives and Europeans.

From Botanic Gardens, Mysore (Bangalore) 7 packets of seeds. From the Botanic Gardens, Saharanpur, 33 packets of various seeds. From the Agri-Horticultural Society of Madras, 15 packets of seeds. From the Royal Botanic Gardens, Ceylon, 2 packets of seeds. From the Botanic Gardens, Singapore, 3 packets of seeds. From the Botanic Gardens, Cape Town, 12 packets of various seeds. From Superintendent St. George's Park, Port Elizabeth, 1 packet seed. From the Botanic Gardens, Durban, 31 packets of various seeds were received. From Botanic Gardens. Hong Kong, seeds of Pinus Massoniana. From the Colonial Botanist, Brisbane, Queensland, 33 packets of seeds. including a fine collection of Eucalypti. From the Superintendent Botanic Gardens, Rockhampton, Queensland, 10 packets of Eucalypti and other seeds were received. From the Botanic Gardens, Adelaide, South Australia, 93 packets of Australian seeds, including fine collections of Eucalypti, Acacias, Pittosporums, etc. From Baron Sir F. Von Mueller, K.C.M.G., Melbourne, 48 packets of seeds of useful trees and plants. From the Director of the Botanic Gardens, Melbourne, 69 packets of seeds, such as Acacias. Casuarinas, Eucalypti, Callistemons, etc., From the Botanic Garden, Dunedin, New Zealand, 6 packets of seeds. From the Southern California Acclimatising Society, 37 packets of various seeds were received.

Plants, bulbs, or seeds have also been received from the following :—

His Honour Judge Nathan, Trinidad ; Mr. J. C. Harvey, California ; Mr. T. L. Mead. Florida ; Mr. H. Caracciolo, Trinidad ; Prof. Max Cornu, Paris ; Messrs. T. Christy & Co, London ; Mr. C. W. Meaden, Trinidad ; Mr. W. D. Keppell, Samoa ; H. M. Consul, Smyrna ; Mr. H. W. Dihm, Trinidad ; Hon. E. Parsons, Cayman Islands ; Mr. P. M. Corena, Bogota ; Miss Fanny Burke, Miss Maclaverty, Mr. S. Soutar, Mr. R. K. Tomlinson, Revd. H. H. Isaacs. Mr. H, P. Deans, Mr. W. E. Clarke, Mr. Joseph Myers, Mr. S. J. Batson, Mr. L. Sutton, Col. J. E. Griffith.

DISTRIBUTION OF PLANTS AND SEEDS.

The distribution of plants in the Island from the various Gardens amounted to the following numbers :—

Economic	...	...	45,464
Ornamental	...	..	19,054
	Total	...	64,518

The seeds distributed are from Hope, 5 bushels Teak; from Castleton, 3,600 Kola, 128 quarts of Liberian Coffee, seeds of Nutmeg, Cocoa, etc.; and from Hill Garden, numerous seeds of the following: Tea, Lemon, Cho-cho, Cherimoyer, Himalayan Blackberry, Tree Tomato, Cinchona and other miscellaneous.

Free grants of plants have been made for the following Church-yards:—

Old Harbour, Castleton, Franklin Town, All Saints, Montego Bay, Crofts Hill, St. George's, Kingston, Enfield, Hampden; also for Constabulary Quarters, at Kingston and Morant Bay; Hospital Grounds at Camp, Kingston and Buff Bay.

As it is well occasionally to look back and see by comparison what progress has been made, I quote the following paragraphs from my Annual Report of three years ago:—

"During the past 12½ years from the time that Mr. Morris was first made Director to 31st March, 1892, about 220,000 plants have been distributed from Castleton, besides seeds which would produce at least as many plants. This gives an average for a year of 17,600 plants, and includes those sent to Hope for distribution from that centre.

"Of those plants, about half the number were such as may be termed strictly "economic" such as cocoa, nutmeg, cloves, cinnamon, Liberian coffee, vanilla, oranges, East Indian mangoes, cardamom, kola.

"The remainder were palms, roses, ferns, orchids, and miscellaneous trees and shrubs, among which are included timber trees.

"I stated in my last Report for the year 1887-88 that although it was not the mission of a Botanic Garden to undertake the work of a Horticultural Establishment, and supply the public with ornamental plants, I thought it right to do as much as possible in that direction, so long as there was no probability of interfering with private enterprise.

"But the danger of interfering with trade seems remote, and the demands on the part of the public are positive and are increasing. There has been an annual demand for some 8,000 or 10,000 ornamental plants, and even more than the Department can supply with its present means. The question may sometimes arise, is the Government right in fostering this demand, is it a legitimate one,—is any great end served by the necessary expenditure, and the attention to the numberless details that it implies?

"It appears to me that the question only needs to be stated for all intelligent persons to answer it in the affirmative. Bacon recognises a love for gardening as an index of a nation's advance in civilisation. He says (Essay 46), 'God Almighty first planted a Garden, and indeed it is the purest of human pleasures. It is the greatest refreshment to the spirits of man, without which buildings and palaces are but gross handy works; and a man shall ever see, that where ages grow to civility and elegancy, men come to build stately, sooner than to garden finely, as if gardening were the greater perfection.'

"The plants, cuttings and seeds, both economic and ornamental, are distributed all over the Island by means of the Coastal Steamer, the Railway and the Post Office.

"The increase in the variety of cultural products, and the humanising influence of ornamental plants are matters of appreciation in every part of the country, from the mountain to the sea coast. Every person who obtains plants and grows them, from the sugar planter who makes trial of different varieties of cane, to the small settler who grows a nutmeg plant, is making experiments which are of direct benefit to himself, and indirectly to his neighbours and to the District.

"Parochial or other local associations can do a great deal to help the work by meeting periodically to discuss all matters connected with agriculture. The sympathy felt between those engaged in kindred pursuits, the feeling of rivalry aroused to attain better results, the mutual aid obtained by interchanging ideas, are all most valuable in the improvement of agriculture He who undertakes the laborious task of starting such an association in his own district, though he may find few at first to join him, yet by perseverance, with even only one or two sympathizers will eventually meet with his reward. Such an association and this Department can render mutual assistance to each other in many ways, with results that will be of general benefit to the whole Island."

The average number of plants distributed annually (exclusive of Cinchona plants) during the previous 12½ years was 17,600, during the year ended March 1892 the number was about 40,000; and during the past year the number was 64,518, besides seeds which would produce as many more plants. This increase is satisfactory, considering the grave difficulties that exists in sending plants all over the country. I hope that when the Agricultural Society has started branches in the different parishes as foreshadowed in the last paragraph quoted above, it may be possible to arrange that these local associations shall become depots for the reception of plants and centres of distribution into the surrounding districts. Such a system will facilitate the distribution of plants on a very much increased scale.

Plants have been sent abroad to:—

Kew Gardens, Botanic Gardens Demerara and Trinidad, Judge Nathan, (*Trinidad*) J. Beach and T. L. Mead, (*Florida.*) Hon. E. Parsons, (*Cayman Islands*) Col Cauldfield (*for Sierra Leone.*)

Seeds have been distributed to Botanic Gardens in the following places:—

EUROPE. *British Isles*, Kew; *Turkey*, Constantinople.

ASIA. *India*:—Seebpore, Calcutta, Saharanpur, Mungpoo, Darjeeling, Lucknow, Cawnpur, Bangalore, Poona, Madras, Bombay; *Ceylon*; *Straits Settlements*; *Hong Kong.*

AUSTRALASIA. *Australia*:—Sydney, Brisbane, Melbourne, Rockhampton, Adelaide; *Tasmania; New Zealand*:—Dunedin, Wellington, Invercargill, Napier.

AMERICA. *W. Indies*:—Demerara, Trinidad, Grenada, Antigua, Dominica, British Honduras; *Brazil*:—Rio de Janeiro.

AFRICA. Lagos, Gambia, Cape Colony, Mauritius.

Also to Messrs. Beach, Reasoner, (*Florida*) Dammen and Co. (*Italy*) Vilmorin-Andrieux, (*France*) Harvey, Franceschi (*California*) Keppel, (*Samoa*) Caracciolo, Dihm (*Trinidad*), Elliott (*Dominica*), Baron Sir F. Von. Müller (*Victoria*).

DISSEMINATION OF INFORMATION.

Correspondence.

The correspondence is an important item in the business of the Department.

Information sought has been on the following subjects:—cultivation of economic plants, and their preparation; manures; pests, fungoid and insect; machinery; native plants; on Jamaica from correspondents abroad wishing to settle; etc.

Printed Matter.

Information of a general character is provided for by the issue of a Bulletin once a month, and by occasional leaflets. By this means the burden of correspondence is lessened in a marked degree, and besides, intelligence is conveyed to many who would not take the trouble to write for it. Bulletins are not issued broad cast, but to those who apply for them.

The Bulletin deals with subjects coming under the following heads:

(1) Cultivation and curing of agricultural products in general.
(2) Tools and Machinery.
(3) Fibre and Fibre Machinery.
(4) Vegetables and Fruits.
(5) Fodder Plants.
(6) Economic Plants.
(7) Manures.
(8) Diseases of Plants.
(9) Forestry.
(10) Ornamental Plants.
(11) Botanical Notes.

I have also to thank the Editors of newspapers for their courtesy in inserting notices from time to time.

Lectures for Small Settlers.

A lecturer is not sent to give demonstration unless there is good evidence that a large number of people in a certain district are anxious to have the benefit of his services, and actually ask that he should be sent amongst them. If the Governor considers that it is clear that there is a real need for a lecturer's services which justifies his being called away from his duties in the Gardens, arrangements are made for the demonstrations to take place. I believe that by this means good work is being done.

My experience of the small settler class is that wherever they have been trained from childhood upwards on properties where careful and thorough work has been insisted upon by the resident owner or manager, they have learnt not only to appreciate the value of such work, but they have followed out the good example on their own "grounds";—in fact very often these grounds bear marks of greater care and give better results than large properties, because they constantly receive attention from the eye of the owner to a greater extent than is possible over a large area.

Training of Boys in Agriculture.

Education should be a combination of a training of the mind with a training of the eye, the hand, and the whole body. If the day of instruction is divided between the purely mental, and the bodily work, each is carried on with more spirit and attention, and therefore with greater and more lasting results. The youth on leaving school will not consider it a degradation to engage in manual labour, if he has been accustomed to take a pride in it just as much as in learning to read and write. This is the method followed at present in the Hope Industrial School. All the boys attend school for two hours daily and also a demonstration by Mr. Cradwick in the Gardens for more than half-an-hour, learning pruning, budding, methods of cultivation and curing of various products, reasons for the various operations of tillage, manuring, etc., etc. The boys show an aptitude and liking for the instruction imparted in this way which is very encouraging. It is not easy to find a plan for maintaining these same boys as apprentices at the Gardens after the age of 16, when their time is up. But it is of very great importance that some arrangements should be made. Children who have been looked after as carefully as is necessary in an Industrial School are at a great disadvantage when they are suddenly thrown on their own resources at an age when they are just becoming adults. If they could be apprenticed so that more freedom could be given them, but strict supervision still maintained, it would greatly aid in the formation of habits of self-control, and in a development of character.

Herbarium.

This is a collection of plants, carefully dried, mounted on paper, named and arranged in regular order in cabinets. It is an essential element in every Agricultural Department, and it was recognised as such in the early days of the Botanical Department in Jamaica, for one of the chief duties assigned to the Island Botanist was "to collect, class and describe the native plants of the Island."

If a plant is known to have an economic value, it is necessary to describe, class, name it, and keep dried specimens for ready reference.

A collection of those plants only that are known to possess useful properties is not by any means sufficient. These species may be so similar in appearance to closely allied, but worthless, species, that it requires careful comparison to enable one to state their distinguishing marks. A complete Herbarium is required for the study of economic botany; and it must be added to indefinitely.

Duplicate sets of Jamaica plants are of great value for the purpose of exchanging with the other West Indian Islands and with other Botanical Establishments. A plant may be used for some purpose in one island and its economic value may not be known elsewhere. An interchange of plants among the Islands is therefore of importance. Collections are made in various parts of the Island as opportunities offer.

It is evident that the chief value of the Herbarium is for the use of the Director. Duplicates are however prepared for the convenience of students and deposited in the Institute. Small Herbaria could also be placed at each of the Gardens, if there were any demand for them on the part of students.

Mr. Wm. Harris, the Superintendent of the Hill Garden, has not only been of the greatest assistance in the general work of the Department, but has especially devoted himself to the work of the Herbarium.

He has been indefatigable in collecting, and as a result the following is a list of species and varieties new to science, and a list of species known before, but new for Jamaica. Prof. Dr. Urban, Assistant Director of the Botanic Gardens in Berlin, and his coadjutors are working out the flora of the West Indian Islands, and I have to record my cordial thanks to them for determination of plants.

Species and Varieties new to science, found in Jamaica.

Rutaceæ.

Zanthoxylum Fadyenii, Kr. & Urb.

Ilicineæ.

Ilex Harrisii, Loes.

I. sideroxyloides, Griseb. var. jamaicensis, Loes.

Celastrineæ.

Maytenus jamaicensis, Kr. &Urb.

M. Harrisii, Kr. & Urb

Anacardiaceæ.

*Mosquitoxylum jamaicense, Kr. & Urb.

Myrtaceæ.

Calyptranthes Fawcettii, Kr. & Urb.

C. umbelliformis, Kr. & Urb.

Eugenia Fadyenii, Kr. & Urb.

E. Fadyenii, var. glabra, Kr. & Urb.

E. sulcivenia, Kr. & Urb.

E. Harrisii, Kr. & Urb.

E. Harrisii, var. grandifolia, Kr. & Urb.

E. monticola, DC., var. latifolia, Kr. & Urb.

Myrsineæ.

Myrsine acrantha, Kr. & Urb.

Ardisia densiflora, Kr. &. Urb.

Gentianeæ.

Macrocarpæa Hartii, Kr. & Urb.

Boragineæ.

Cordia Fawcettii, Kr. & Urb.

Solanaceæ.

Saracha antillana, Kr. & Urb.

Laurineæ.

Persea Harrisii, Kr. & Urb.

Orchideæ.

Pleurothallis uncinata, Fawc.

Epidendrum tridentatum, Fawc.

Bromeliaceæ.

Caraguata Plumieri, Mez.

Guzmania Harrisii, Mez.

Catopsis Berteroniana, Mez.

Tillandsia Harrisii, Mez.

Vriesea paniculata, Mez.

Species already described, but not found before in Jamaica.

Malpighiaceæ.

Malpighia glabra, Linn., var. acuminata, Juss.

Rutaceæ.

Zanthoxylum Martinicense, DC.

Z. Culantrillo, H. B. K.

Myrtaceæ.

Eugenia glabrata, DC.

E. confusa, DC.

Compositæ.

Vernonia anthelmintica, Willd.

Xanthium orientale, Linn.

Myrsineæ.

Myrsine Rapanea, Rœm. et Schult.

Oleaceæ.

Mayepea domingensis, Kr. et Urb.

Solanaceæ.

Solanum persicifolium, Dun.

Laurineæ.

Persea Krugii, Mez.

P hypoleuca, Mez.

P. americana, Mill.

Ocotea Portoricensis, Mez.

Nectandra Martinicensis, Mez.

N. sanguinea, Rottb.

Scitamineæ.

Alpinia Allughas, Rosc.

Bromeliaceæ.

Guzmania monostachya, Rusby.

Tillandsia pulchella, Hook.

T. Deppeana, Steud.

T. polystachya, Linn.

T. utriculata, Linn.

T. vestita, Cham. et Schlecht.

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* A new genus.

Library.

The Library is quite as essential for carrying on the work of the Department as the Herbarium. It is not intended for the use of the Public, though, as a matter of fact, such works as can be spared are loaned to planters and students, and the catalogue of books added to the Library each year is published in the Annual Report for general information.

The Library of the Jamaica Institute contains a large collection of books on Agriculture. These works are always accessible to the Public, and there is therefore no need to have a duplicate set in Kingston. Each Garden has already a small Library in the Superintendent's office, and these books are available for consultation by visitors. If it is thought desirable, these collections can be added to, and provision made for such increase on the Estimates. The following is the catalogue of the works placed in the Library during the year in addition to those already acknowledged as contributions in the Monthly Bulletins:—

Balfour (Prof. I. B. and others). Annals of Botany. Vol. VIII. Nos. XXX, XXXI, XXXII. London and Oxford, 1894. 8vo.

Brown (James and J. Nisbet). The Forester: A Practical Treatise on the planting and tending of Forest Trees and the general management of Woodland Estates. By J. Brown. Sixth Edition. Enlarged. Edited by J. Nisbet. 2 Vols. London 1894. 8vo.

Green (J. R.) On the Germination of the Castor Oil Plant (*Ricinus communis.*) (Extract.) *Proc. Roy. Soc. XLVIII.* 1890. 8vo.

Jackson (B. D. and Sir J. D. Hooker). Index Kewensis Plantarum Phanerogamarum. Compiled by B. D. Jackson under the direction of Sir J. D. Hooker. Part III. Oxford 1893-4. 4to.

Journal of the Royal Agricultural Society of England. Third Series. Vol. V. Pts. 1 and 2. London. 1894. 8vo.

McNab (James). On the Propagation of the Ipecacuan Plants. (Extract) *Trans. Bot. Soc. Edinb. X.* Edinburgh. 1870. 8vo.

Rowney (T. H. and H. How). Analysis of the ashes of the Orange Tree. (Extract) London. 1847. 8vo.

Sargent (C. S.) The Silva of North America. Vol. VI. Boston and New York. 1894. Fol.

Ulrich, (Dr. W.) Internationales Worterbuch der Pflanzennamen in Lateinischer, Deutscher, Englischer, und Französischer Sprache. Leipzig. [nd.] 8vo.

Vines. (Prof. Sidney H.) A Student's Text Book of Botany. (First Half). London and New York. 1894. 8vo.

Ward (Prof H. M.) On the Tubercles on the roots of Leguminous Plants. (Extract). *Proc. Roy. Soc. XLVI.* London. 1889. 8vo.

W. Fawcett,

Director of Public Gardens and Plantations.

APPENDIX I.—HOPE GARDENS.

The following Report is by Mr. W. Cradwick :—

Extension, Borders, &c.—" The work of *extension* of the Gardens was not proceeded with in consequence of the reduction of the vote. But a new border has been made at the back of the tropical African and Madagascar section. The border is fifteen chains long and fifteen feet wide and has had water laid down the entire length by means of a 2 inch pipe. It is designed to act as an experimental border for ornamental and economic plants and shrubs, but it is not yet planted. The border was trenched throughout the entire length to a depth of from eighteen to twenty four inches, according to the depth of soil.

" The palms and other plants put out in the African and Madagascar section have all done well, with the exception of the Camoensia which has grown very slowly although it now appears to be about to make a start.

" The following palms have been planted out, large holes five feet in diameter and five feet deep being dug for their reception and the hole filled with one half manure and one half fresh soil to give them a good start :

Raphis flabelliformis, Ait.
Stevensonia grandifolia, Duncan
Cocos botryophora, Mart.
Phœnix rupicola, T. Anders.
Astrocaryum mexicanun, Liebm.
Caryota urens, Linn.
Livistona chinensis, Mart.
Elæis guineensis, Jacq.
Pritchardia Thurstoni
Archontophœnix Alexandræ, H. Wendl. & Drude
Licuala grandis, H. Wendl.
Licuala peltata, Roxb.
Bactris major, Jacq.

" The lawns, and beds made last year have all been maintained in good order, but the hedge of Aralias which was planted by the side of the division fence between the gardens and the water works was nearly all eaten down by the cows which infest the water works pasture.

Grape Vines.—" All the young vines at King's House, nearly 300 in number have been removed to Hope, this has necessitated the formation of borders 1,036 feet in length and has entailed a great deal of labour.

"In consequence of its being necessary to have the vines in a position where they can be watched unceasingly when bearing, it was necessary first to remove three rows of the Teak trees and then make a suitable border. The Vine border was made by removing the top soil and then the sub-soil to a depth of three feet. The top soil was then replaced, and the deficiency caused by the removal of the gravelly subsoil was made up by the addition of cow manure (a cart load to every two plants) and fresh soil.

" *Sugar Canes.*—The whole of the canes have been planted afresh. Two rows each about a chain and a quarter long, of plant canes of each variety, both of the old canes and of the new ones from Demerara, have been put out. The best of the tops only were used, and if any of these grow up at all weakly, they will be removed and their places filled by the most vigorous roots only. By this process of selection it is hoped that the quality of the canes will be considerably improved. Endeavours are also being made to manure them highly and keep them well watered.

"There are now ninety varieties of Sugar Cane, the area occupied being about four acres.

"*Pines*—The old pine ground near the High School has been abandoned as the pines were always stolen, and a new pinery, one and a half acres in extent has been made at the bottom of the vine garden. Some of the suckers were very poor, but we hope in the course of the ensuing year to improve them by good cultivation.

"The *Bananas and Plantains* have not done well owing to lack of water, but the supply has been considerably increased lately and better results are hoped for during the ensuing year.

"The Banana from Kew, Musa sapientum, var. rubrum, has been removed from the lawn. Seven suckers were obtained from it, which have been planted on the piece of land below the nursery in the shelter of the Divi-Divi trees.

"Three other new varieties have also been received from Kew; namely, Grundy, Basjoo, and Martaban. These were weakly suckers and were not likely to fruit for some time. The banana plantation occupies 16 chains.

Economic section.—In the old economic area the cocoa trees continue to bear well, and the Liberian Coffee and the nutmegs have vastly improved since receiving water regularly.

"It is proposed to extend the planting of Liberian Coffee, Arabian Coffee, Nutmegs and Cocoa on this piece of land, and also through the Bananas lower down. This piece of land is now fourteen chains in extent.

"*Oranges*—Two of the sweet oranges which were budded on lime stocks have commenced to fruit. The fruit on the tree which commenced to bear first was such an object of curiosity that from frequent handling it all dropped off. The fruits on the other tree are however going on favourably. Many more Orange seedling plants have been budded and the results of this work are given under the head of the Industrial School.

"*Mangoes.*—Attention continues to be paid to the propagation of East Indian Mangoes, but the inarching is a slow tedious process and attempts at budding and rooting by the circumposition process have failed.

"*Orchids.*—Many of the good varieties of Cattleyas having been grown on blocks for a long time, the blocks had become rotten and the plants were in consequence deteriorating fast. They have been carefully removed and placed some into pots and some into baskets. Dendrobium Phalaenopsis of which five plants were given me when at Kew last year, have flowered beautifully,—in fact this orchid is a grand addition to our collection.

"Cattleya Leopoldii from Sanders and Co., St. Albans, has also grown beautifully and is just commencing to flower.

The protection of the glass house during heavy rains has been very beneficial, but the orchids have nearly all had to be turned out to make room for seeds for all the smaller of which the shelter of the glass roof is indispensable.

"*Pot plants* have hardly kept up the high standard of last year, but the iron fern house, the tree ferns and the rockeries are all in the same condition.

"*Fences.*—Fifty two and a half chains of fence running parallel with the Public Road have been repaired, new posts being put throughout.

"*Fodder plants, Alfalfa.*—The piece of Alfalfa sown in the Cane land in September, 1893, has grown fairly well. It is established now so that it does not require weeding. It was cut down and irrigated, and, growing up, commenced to flower again in twenty seven days. The crop was cut on a quarter of a chain and weighed giving 62 lbs. This would be an average of 2,480 lbs., or more than a ton, to the acre.

"*Nursery.*—A total of 56,086 plants have been distributed, and in addition about 3,000 Sugar Cane Tops representing 6,000 plants, five bushels of Teak Seeds and 73 quarts of Liberian Coffee seeds.

"The out-put of plants has almost doubled itself in two years and if plants of Nutmeg, Kola, Oranges and Liberian Coffee had been equal to the demand of this year, it would have more than done so.

PLANTS DISTRIBUTED :—

	Sold.	
Economic Plants :—		
Liberian coffee	... ...	11,982
Sisal Hemp	... ...	7,306
Kola	... ...	3,665
Cocoa	... ...	2,856
Oranges	... ...	1,200
Ramie	... ...	700
Nutmegs	... ...	587
Blue Mountain Coffee	... ...	268
Rubber plants	... ...	102
Miscellaneous	... ...	512
Trees, (Timber, Shade and Fruit)	...	2,775
		31,953
Ornamental plants	... ...	9,707
	Free Grants.	
Eucalypti	... ...	2,122
Trees, (Timber, Shade and Fruit)	...	7,956
Ornamental plants	... ...	4,358
Number of economic plants distributed	...	42,021
Number of ornamental plants distributed	...	14,065
Total number of plants distributed	...	56,086

"The stock of plants in the Nursery is now much below what it should be, but we have about 30,000 of the Citrus family in the seed beds, about the same quantity of Liberian Coffee, many Cocoa, Shade and Timber trees; large quantities of cuttings of all kinds are being put in and also quantities of seeds especially Eucalypti. I hope by strenuous exertions during the next few months to bring the Nursery up to a strength equal to the increased demand which I think it is only reasonable to expect during the ensuing year, considering the way the demand has gone on increasing during the past three years.

RAMIE.

Experimental Plot No. 3.—"Five rows were planted 9 inches between the rows, 9 inches between the plants in the rows, with an ample supply of good cow manure. Two rows consisted of the white variety and three rows of the green variety. The white variety was transplanted from bamboo pots, the green variety was propagated from roots received from Castleton. These were watered every other day for the first month, but got no water during May, were watered on June 11, July 4th and August 22nd.

"The whole of the plot was weeded on April the 17th, May 12th, June 8th, July 6th and August 16th.

"The white variety started to grow first and soon forged ahead until at one time it was twice the height of the green variety, but after the rains came, the green variety soon beat the white, and whereas the green variety grew in some instances to a height of between ten and eleven feet, the white only reached a height of about five feet. The green variety at Hope produces with similar treatment as that accorded to the white about double the number of canes per root.

"Five rows were planted nine inches between the plants in the rows and eighteen inches between the rows, these were treated exactly as the first five rows and no difference was visible.

"Five rows were also planted, nine inches apart each way, but no manure was given them, they were watered and weeded exactly as the others, with no apparent difference in the result.

"Five rows were also planted, nine inches apart between the plants in the row and eighteen inches between the rows, not manured, but watered and weeded similar to the others, no difference was discernible in the growths.

"Five rows were planted nine inches apart each way, neither manured nor watered; quite half of the plants died out, but the survivors as soon as the rains set in, soon made up for their slow initial progress and caught up the others.

"Five rows were planted nine inches between the plants and eighteen inches betweeu the rows, no manure, no water. Many of these plants died out as in the preceding plot, in fact the growth of the two lots was identical, the dying out of the plants was perhaps due more to their indifferent quality than to the want of water.

"The manure made no apparent difference, the water caused the plants to start into growth quicker than those that received no water, but as soon as rain fell those which had no artificial watering soon caught up those which had.

"The soil was good and was well ploughed up previous to planting the Ramie.

Plot No. 2.—Twenty rows of green Ramie were planted April 4th, with good strong plants, eighteen inches apart, thoroughly manured and irrigated. The balance of the plot was planted nine inches between the rows, the latter being planted closer as they were poorer plants. These had no manure. The first twenty rows grew to an average height of five feet, six inches, the remainder only reaching an average of four feet. Many of the poorer plants died, the inferior growth aud the death of many of the plants is attributable more to the poor plants than the want of manure.

"This plot was also watered twice a week up to the end of April, and it received water also on May the 11th; it was weeded on May 10th and 26th, June 11th, July 6th and August 16th.

Plot No. 4. "Green Ramie only—Planted April 2nd with very fine strong roots, in fact the best of the lot, and on the best piece of ground, planted eighteen inches apart each way with no manure. This was the slowest of all the plots to start growing, but grew by far the most vigorously, being at the time it was fit to ret of an average height of seven feet, some of the stems ultimately growing to between ten and eleven feet in height and averaging fully twelve canes to a root.

"Watered twice a week to end of April and on May 15th and July 6th.

"Weeded May 25th, June 8th, July 4th and August 13th.

Plot No. 1—"Planted April 6th on poor stony land with the steepest slope, these were weakly plants and this combined with the adverse condition of the soil made this plot very nearly a failure. The plants received water twice a week up to end of April and on May 12th, June 12th and July 5th.

" Weeded May 1st, May 17th, May 28th, June 11th, July 9th, and August 15th. No manure.

Plot No. 5—" Planted April 19th eighteen inches apart each way, with fairly good roots, grew to an average height of three feet six inches.

" The white variety growing in the same plot but in the shade, averaged a height of five feet, but whereas the green variety averaged 7 inches to the root, the white only averaged three.

" This plot had no manure but was watered twice a week to end of April, and on May 15th, June 13th and July 7th.

" Weeded May 23rd, June 8th, July 4th and August 11th.

Plot No. 6.– " Planted April 24th in rows two feet apart and one foot between the plants in the row fairly good plants which grew very well indeed, averaging 7 feet in height, received no manure, but the soil was good, watered twice a week to the end of April and on May 12th, July 11th and August 13th.

" Weeded May 22nd June 7th, July 4th and August 10th.

Plot No. 7.—" Planted April 26th 3 feet apart each way on good soil, no manure, roots only fair at time of planting, these grew to an average height of four feet 6 inches averaging ten canes to a root.

" Watered twice a week to end of April and on June 11th July 4th, July 11th and August 13th. No record was kept of the weeding of this piece.

" The average height and the number of canes per root were all calculated at the end of September when the Ramie was fit for reaping. From the fact of the machine not appearing on the scene, the trial of the Ramie as regards the time it would take to produce a second crop was spoiled, for it was not cut down as soon as ripe, as it should have been, but the old canes were kept waiting for the machine. Had it been cut down before the October seasons set in a second crop would have been ready for retting by the end of November but it was not cut down until February, when the weather was very dry and has continued to be so.

" No 7 piece was however ready for reaping by May 14th, the growths however averaged barely 3 feet in height. This was due in a great measure I now believe to the way in which it was cut down in February. The stalks then were all spoiled by being over grown and no care was taken in the cutting of the crop it being billed off with a cutlass. The majority of the stalks were cut off about 4 or 5 inches from the ground, and these old stalks shot out from near the tops. But receiving instructions from the Director to propagate Ramie in large quantities, I went over this piece again and rooted all the ends of the cane out in order to plant them for the production of young plants. A small digger or spud was used and the canes were grubbed from half an inch to an inch below the surface of the soil, throughout the whole piece. Then the whole of the piece was well flooded with water, and the next day a quarter of an inch of rain fell and within the next two weeks four inches of rain fell, and the result was that 46 days after cutting down there was a beautiful crop of stalks two and a half feet high, averaging fully twenty four canes to the root.

" The ground on which the whole of the Ramie was planted was thoroughly well ploughed and broken up, and with the exception of the piece of land on which No. 1 was planted was good rich land.

" From experience gained in this planting I think there is little reason to doubt that the best part of the plant to propagate from, is the bottom of the ripe stem. If a field is being reaped, and it is desired to increase the area then, the canes should be reaped, cutting them to within two inches of the ground. Some one should then follow and grub out the remainder of the stalk going low enough if possible to secure a little root on it. This will generally give a piece about four inches long and this inserted into the ground with about half an inch left above the surface will make a strong plant in an incredibly short space of time in favourable weather, and the old plants will be all the better for the removal of the stems for propagating. In the event of not wishing to propagate, care should be taken to cut the stems as low as possible, as the plants grow much stronger than they do when the old stumps are left five or six inches above ground.

"The best distance to plant is twelve inches apart in the rows with eighteen inches between the rows on fair land, but on strong land eighteen inches to two feet would be quite close enough. If planted nine inches apart they have to be hand-weeded when young, which is very expensive whereas at eighteen inches or two feet they can be hoed through.

"If the land is fairly rich and they are kept clean while they are young, they will grew so thickly even at two feet that very little weeding is required, except perhaps after the cutting of crops of stalks in about the same way that sugar canes require to be looked after.

"The piece which was planted three feet apart is now so thick as almost to prevent any weeds growing except when the crop is reaped.

Hope Industrial School.

"The boys of the Industrial School have received instruction in the following practical work – pruning cocoa; sowing seeds of cocoa and coffee; potting seedlings; pruning coffee; planting ramie; planting pines and potatoes (Irish), growing tomatoes, carrots, turnips, cucumbers and ochras, weeding and cleaning land, manuring.

"In vine culture they have been instructed how to propagate vine plants from cuttings, how to make a proper border in which to grow the plants, how to plant out young and old vines, how to prune old vines, how to disbud old and young vines, how to stop old and young vines, how to train old and young vines. As there were only two bunches of grapes, they received very little instruction as to the proper method of thinning bunches of grapes.

"They have also been taught when to water and how to water vines, and what is quite as important, when not to water. This is the first year that we have had an opportunity of giving them any instruction in grape culture, and as the vines were all removed from King's House we could not allow them to fruit.

"They have also had lessons in budding, an art in which they quickly got interested. After about six weeks' continuous patient instruction in the methods employed to remove the scion from its parent and to place it on the stock, they budded 90 orange plants out of which they got exactly half to grow – a very good result, considering how very awkward they were at first.

"The theoretical teaching has been on the subject of budding and grafting;

Roots, Stems, Leaves } their work and the relation of one another in the economy of the trees;

Selection of fruit in relation of progeny;

Propagation by other means than by seeds.

"Of the boys Burke continues to make the most progress, next to him come Murray, Nathan, Reid and Salmon.

"Burke is better educated than the other boys and can now write labels nicely; he can propagate fairly well and is very useful in many ways.

"Murray is rather slow but very neat fingered; he is perhaps the best budder of all.

"Reid takes great interest in the grapes.

"Burke and Murray are both anxious to be apprenticed, and Reid is also anxious to continue in the gardens after his term expires."

Correspondence. The number of letters received—2,899; the number of letters despatched—3,581.

The elevation of the Garden above sea-level is 600 feet.

The average annual mean temperature is 70°4 F., and the average annual rainfall 52.55 inches for 14 years.

The amount of rain that fell during the year was 52.43 inches.

January, February and March were the driest months, and May and October the wettest.

The mean temperature was 75°4 F. The meteorological tables for the different months are given in Appendix V, page 246.

CASTLETON GARDENS.

The following Report is by Mr. E. Campbell, for nine months from April to December:—

"Four drums containing about ten hundred weight of Albert's concentrated Horticultural Manure were procured, and two drums were put out on the rose beds, croton borders, special trees, pot plants, etc.

"The largest Amherstia got a good supply of the Albert's manure and the tree has improved considerably. For the last four years I have given this tree my special attention but it has never shown such a vigorous growth as now.

"Several of the smaller palms in the Palmetum have also been supplied with this manure with good results.

"Several large holes were dug about the Palmetum and planted with Borassus Palm seeds.

"A new path, 16 chains long has been made. It commences at the water lily tank, then up through the old cocoa field, crosses the spring and runs along the hill-side overlooking the lily tank and palmetum, it then turns downwards ending at the crossing of the spring by the nursery and fernery. All the walks throughout the garden have been kept constantly weeded and raked and gravel put on them.

"In the lower garden a new drain has been made to carry off rain water which damages the walks, all other drains throughout the gardens have also been cleaned out.

"In the year 1886 a number of orange and lemon plants were imported from Messrs. Rivers and Son, England, which did not grow well. Sixteen of the oranges were removed to a better place to the best end of the lower garden near the new pinery and they were planted with plenty of manure and even in two months time they made good growth.

"One hundred Liberian coffee plants have been planted out near the old field, and one acre of land on the hillside was prepared and is also being planted with Liberian coffee.

"A number of plants of the West Indian Dragon's Blood (*Pterocarpus Draco*) have been propagated, also 500 Sarsaparilla.

"The following plants have been planted out in the Garden.

2 Kigelia pinnata, DC.
2 Brosimum alicastrum, Sw.
2 Lucuma mammosa, Gaertn. f.

Nearly all tbe Ramie plants at Castleton have been forwarded to Hope.

"The Superintendent's house is in good repair, but a new stable for the garden stock is very much required.

"A new cart shed 20 feet by 12 was put up and about 200 feet of one inch piping leading water from the lily tank to the nursery was laid by the Public Works Department.

"Eighteen cuttings of black pepper were received from Trinidad but unfortunately several of them died off.

"Some new indestructible enamelled labels were imported for all the important trees in the garden and for those palms that were not labelled last year."

The following Report is by Mr. W. Thompson for three months from January to March :—

"The ground about the entrance to the gardens was frequently in a muddy state in wet weather, and in order to remedy this the turf has been taken off and from six to nine inches of stones put down and the turf relaid.

"As it was considered that there was too much gravel on the walks the roughest of it has been carried off.

"About 100 yards of narrow walk has been made two feet wider. The small bridges on the walks are a constant expense. Teak wood has been carted up from Hope Gardens to renew two of the bridges which will now be much more lasting.

"A number of large roots of trees had grown across some of the walks, these, where they could not be taken out altogether, have been cut down level with the walks.

"Several heaps of gravel that had been washed from the walks on the grass have been removed.

"The Lily-tank has been cleaned out, and the lilies replanted. The tank requires repairing.

"In the fern-house a new roof has been put on, windows let in, and new staging erected and the ferns have been repotted.

"It is proposed to make a new plant-house in a more open part of the Garden.

"The beds in the nursery have been reformed, all the ground levelled so that the pots may stand upright, new bamboo fixed through the beds, etc. Several big trees in the nursery have been pruned to admit light. A fence has been run round the Nursery and a gate fixed at each end. A gate has been placed leading from the Nursery to the road to facilitate the removal of plants to carts.

"The potting shed is not large enough for a wet place like Castleton. At present it is difficult to keep dry the potting soil, bamboo pots, moss, peat, orchid-baskets.

"About a square chain of low lying land has been fenced in, cleaned by forking, good soil carried on and the ground raised from 6 to 18 inches, to form a propagating ground.

"All the lawns, Liberian Coffee land, Banana land, Cocoa land, etc., have been billed and cleaned once.

"Most of the younger palms and trees that were not doing well have been trenched and manured.

"The large trees and shrubs had grown into each other very much to the disadvantage of the smaller ones, so much so that many small plants have died out. A great deal of time and labour has been taken up in pruning the trees and shrubs that needed it, so as to let light and air in.

"Most of the borders have been well dug and manured.

"Most of the climbers about the garden have been thinned and pruned.

"A number of old shrubs have been removed from one border, and roses planted in their places.

"Fifteen plants of a new kind of Coffee (*Coffea stenophylla*) raised from seeds received from Kew have been planted in different places about the Garden and are doing well.

"Three old worn-out Ixora bushes that used to impede visitors in the Rose garden have been dug out.

"The row of large Dillenias on the economic side of the garden has been cut down as they kept the sun off the lower part of the garden for several hours in the day at certain times of the year.

"Two large clumps of bamboos have been cut down as their roots and the shade caused by them were preventing valuable trees from growing.

"The Bananas about the garden have been thinned to about one third of their number as they were much too thick.

"Some of the Cocoa trees have been pruned, but it will take a long time before they can be got into good condition.

"The large drain running along the side of the Liberian Coffee field, has been cleaned out and made deeper to drain off the water better.

"The Liberian Coffee has borne a very heavy crop. The young Coffee plants have been thoroughly weeded.

"A large number of old tree stumps have been taken out from about the borders.

"Three large palms have been transplanted, several good sized palms have been planted out.

"A collection of Eucalypti has been planted in different parts of the Garden.

"Many worn-out shrubs have been thrown away, and young ones planted in their vacancies.

"Several large plants have been transplanted.

"Some of the large creepers have been taken off the arches in the Rose-garden, and climbing roses planted to take their place.

"The two largest Kola trees have had the ground about them forked and manured and all the branches of other trees cut away from them so as to get them to start growing. They are now making good growth.

"Several flowering and shade trees have been planted in suitable places about the garden. The usual attention has been given to the walks, lawns, etc.

"The number of plants sent from here to Hope Gardens in the three months has been 13,719, such plants as Roses, Economic plants, palms, climbers, ferns, trees (shade and fruit), shrubs, begonias, ginger, Liberian Coffee, etc., etc., also 11 bushels of Liberian Coffee seed.

PLANTS DISTRIBUTED.

Economic Plants.—Kola	...	...	1416
Liberian Coffee	...	...	231
Nutmegs	...	...	188
Fruit Trees	...	...	152
Trees	...	...	26
Miscellaneous	...	...	305
			2,318
Total number of Economic Plants		...	2,318
Total number of Ornamental Plants		...	3,491
Total number of Plants sold		...	5,809

Plants sent to Hope Gardens	...	29,362
Ramie Plants sent to Hope	...	14,000
Total number of Plants sent to Hope	...	43,362

Seeds sold from the Gardens.—Kola	...	3,602	
Nutmegs	...	186	
Liberian Coffee	...	128	qts.
Cocoa Seeds	...	12	qts.
Cocoa Pods	...	21	
Miscellaneous Seeds	...	51	pkts.
Mace	...	1	lb.

Correspondence.—No. of Letters received, 697. No. of Letters despatched, 982.

The elevation of the Garden above sea-level is 580 feet.

The average annual mean temperature is 76°2 F., and the average annual rainfall 114.96 inches for 23 years.

The amount of rain that fell during the year was 104.15 inches. January, March and August were the driest months, and February, May and October the wettest.

The mean temperature was 74°4 F.

The Meteorological tables for the different months are given in Appendix V, page 245.

HILL GARDEN.

The following Report is by Mr. W. Harris :—

" *Roads.*—The principal roads through the plantation were cleaned, drains re-opened, obstructions removed, ruts filled up, and altogether kept in good order.

" *Pastures.*—These were billed and cleaned twice during the year, and kept in good order.

" *Fences.*—These require constant attention. All necessary repairs were immediately attended to, and, on the whole the fences are in fair order.

" It is difficult to obtain good hardwood posts in the hills; wild Juniper (*Lyonia jamaicensis*) and Bilberry (*Vaccinium meridionale*) are generally used, and when they can be procured of a good size are very lasting. Ripe Juniper Cedar (*Juniperus Bermudiana*) or Logwood would probably last 20 to 30 years in this climate, but they would be very expensive when delivered on the spot.

" *Garden.*—The usual operations were carried out during the year. Digging, manuring, hoeing and raking, cutting grass, pruning, sowing seeds, and transplanting seedlings, propagating nursery stock, potting and watering. Owing to a very dry summer the work of watering young and tender plants entailed a considerable amount of extra labour and expense. The Rockery in the Fern house has been considerably extended, and planted with rare and delicate Ferns, and the marked improvement in the growth and appearance of the plants since being planted out is very encouraging. Not only have the plants thriven better in their new quarters, but the work of watering once or twice daily, and of re-potting at least once a year is avoided. All that is now necessary is to sprinkle or syringe the plants occasionally, and give them a light top-dressing when required. Owners of large collections would not fail to appreciate the saving of labour in this matter. The Green house was kept bright and showy throughout the year with Geraniums, Pelargoniums, Gloxinias, Fuchsias, Amaryllis, Bermuda Lilies, etc., and cool orchids such as, Odontoglossum, Lycaste, Stanhopea, Arpophyllum, Epidendrum, Masdevallia; whilst outside, the beds and borders always contained plants in flower of Roses, Fuchsias, Bouvardias, Abutilion, Arum Lilies, Agapanthus, Amaryllis, Sprekelia, Galtonia candicans, Carnations, Dahlias, Geraniums, Anemones, Spiræas, Azaleas, Iris, Pleroma macranthum, Gaillardias, Phlox, Dianthus, annual Chrysanthemums, Verbenas, etc. A fine plant of Doryanthes Palmieri flowered during the year, also a giant plant of the variegated Agave americana. Two more plants of the latter are now throwing up flower spikes. Magnolia fuscata, Libonia floribunda, Gynura aurantiaca, Corallobotrys acuminata, and several other plants received from Kew in 1892 have flowered freely. On the fences, Mandevilla suaveolens, Trachelospermum jasminoides, climbing Fuschsias, etc., flowered profusely, whilst amongst larger things may be mentioned Grevillea robusta, Gordonia anomala, various Eucalypti, Banksia integrifolia, several Callistemons, etc.

"*Fruit trees and Plants.*—A small consignment of Apples, Pears, Peaches, Prunes and Currants was received from a Canadian nurseryman last year, and the plants so far look promising.

"Rubus racemosus.—The Himalayan Blackberry is quite at home here; it grows vigorously and fruits abundantly. It is an excellent desert fruit, and, in the hills, might be largely grown for market, where it would be certain to find a ready sale. Once planted it requires little or no cultivation.

"Rubus ellipticus (R. flavus).—This is also growing vigorously but has not yet fruited. The fruit is described as "yellow with the flavour of a raspberry; in the Himalaya it is eaten either raw or made into a preserve, and is certainly one of the best wild fruits of India. It is offered for sale at most of the hill stations, and is regularly shown at the Horticultural Society's Shows at Simla."

"Tree Tomato (Cyphomandra betacea).—This fruit is quite at home here, but the taste for it does not appear to be on the increase, which is rather strange, as it is an excellent fruit both uncooked and stewed, and makes a delicious preserve.

"Peaches.—These bore a fair crop of good fruit.

"*Fodder plants.*—Experiments have been continued with the fodder grasses, etc., mentioned in last Report. On the whole perhaps Kentucky Blue Grass is the most promising. "Sacaline" (*Polygonum sachalinense*) is of slow growth and does not spread as we were led to expect. One root of this plant was transferred to Hope and it has there grown much more vigorously than at Cinchona.

"*Burnt Soil*—As our soil is stiff and clayey it was decided to try the experiment of burning portions of it as is often done in England. The surface soil was removed and the clayey subsoil dug up and made into a heap with fire wood, branches and garden rubbish to burn the whole. The following information on the subject may be of interest:—'The work is done when the soil is dry, by breaking up the clay and heaping masses of it on to fires of coal or brushwood in large heaps. The temperature ought to be sufficient to cause a dull red heat, and this produces a crumbling black material which is then spread over the surface of the field. The effect is to lighten the soil, and make it more like ordinary loam, and as a consequence the field is easier to work and grows better crops for a long series of years, Important mechanical and chemical effects result from burning clay, or at least from subjecting it to a certain amount of heat. The mechanical effects are to render the clay more porous and less tenacious, so that it will readily crumble after exposure to the action of the weather. From its greater porosity it affords access to air and moisture, and more free passage for the roots of plants. The chemical changes produced by the burning of clay are greater solubility of its constituents in water and acids; clay slightly burned has been found to contain more than three times the quantity of soluble potash that it does in its natural state. When clay is burned, the heat should not be too great; and the burning should be effected by a smouldering process, somewhat resembling that in making charcoal. The clay should never be so far baked as to be reduced to a hard red brick substance; but on the contrary, the lumps of burned clay should crumble readily.'

Plants distributed.—"The number of plants sold during the year amounted to 512, and of Tree Tomato fruits $72\frac{1}{2}$ dozens, weighing 314 lbs.

"The numbers are as follows;—

Sold.—Economic plants (including Fruit)	...	61
Ornamental ...	...	451
Free Grants—Economic	...	64
Ornamental ...	...	1,047
Total Economic plants distributed	...	125
" Ornamental " "	...	1,498
Total number of plants distributed	...	1,623
Seeds distributed.—Chocho fruits	...	72
Grias cauliflora ...	...	50
Tea Seeds ...	...	350
Lemon Seeds ...	...	900
Miscellaneous Seeds	...	50 pkts.

"The elevation of the Garden is 4,900 feet above sea-level. The average annual mean temperature is 62° 7 F., and the average annual rainfall 105.31 inches for 24 years. The amount of rain that fell during the year was 117.87 inches; April, May, September and October being the wettest months, and March and August the driest.

"The mean temperature for the year was 61.4 F. The meteorological tables for the different months are given in Appendix V, page 248.

The number of letters received—625, despatched—900."

KING'S HOUSE GARDEN AND GROUNDS.

Mr. W. Thompson was in charge of this Garden from April 1st, 1894 to January 8th, 1895, and the following is his Report for that time:

"A length of six chains of the driving road has been dug up, soil and gravel carted on and it has been raised from six to eighteen inches higher to prevent water settling on the road as it had previously done.

"Other parts of the road, have been dug up, re-metalled and the whole road has been well rolled. The sides of the road have been kept clear of weeds.

"A length of sixteen chains of the border that used to be too high has been dug out, the sub-soil taken out and carted away, and the good soil lowered from one to two-and-a-half feet to bring it down on a level with the rest. Six chains of border have been raised from six to twelve inches higher.

"Two hundred of the smaller palms and trees about the garden and grounds have had the soil about them trenched and manured.

"Several palms and trees have been planted in the Palmetum and Arboretum.

"The walk running parallel with the dining hall has been widened two feet and some parts of it have been lowered and other parts raised.

" A large Ficus tree that was near the house has been cut down, roots dug out and a palm planted in the vacancy.

" A piece of ground behind the Bungalow has been levelled, trenched and planted with shrubs and Bahama grass.

" Twelve large trees have been cut down on the Lawns and Pastures to allow of better views of the hills.

" Five large groups of Crotons and Hibiscus have been planted on the Lawns.

" The new Rose Garden has become well established and 40 more kinds of roses have been planted. Climbing roses have been put out to be trained on the iron fence. The ground on either side the entrance to this garden has been dug up and planted with Bahama grass.

" The usual attention has been given to weeding, rolling, manuring, billing and dressing the Lawns.

" Portions of land in different parts of the garden amounting to one acre have been trenched and planted with Bahama Grass.

" Six of the beds on the road to the West gate have been trenched, manured and planted with different kinds of shrubs. The lawns along the same road have been dug, trenched and planted with Bahama grass.

" The borders in the avenue have been ploughed, manured and cleaned as often as required. The plants in these borders have been pruned, transplanted and young plants put in when required.

" The walks about the garden have been kept in the usual order.

" Three hundred feet of piping and 12 taps have been added to the stock of piping, also several taps and lengths of piping have been removed to more convenient places. Six hundred feet of $\frac{5}{8}$ hose has also been bought.

" A new set of cart wheels and a good stock of all tools needed have been purchased during this period.

" The hay grass in the Arboretum, behind the borders has been frequently cut, and some hundreds of small trees been dug out.

" All the pastures have been billed and cleaned twice. Some thousands of stumps have been dug out of the pastures.

" The fence has been repaired, including the renewal of 100 posts, and it is now in good order.

" The usual clearing has been done about the Bungalow, laundry, stables, &c.

" A clump of five Ficus trees has been planted in the centre of No. 1 pasture, and a row of the same has been planted on the south-east side of this pasture.

" Several young Guango and Mango trees have been established in No. 2 pasture.

" The usual attention has been given to the pot plants, Ferns, Orchids, decorating the House, and Ballroom, gathering flowers, &c.

" Nine demonstrations on Grape Vine Culture were given in April and May, 1894, eight at Collins Green and one at King's House Garden.

" On the 8th January, 1895, I returned to Castleton after having been away for four years and nine months. During that time I laid out the garden and grounds attached to the Jamaica Exhibition Building, and superintended the daily work there until the Exhibition closed. At King's House Garden I formed the borders of the Aveuue, extended all the inner garden, formed two new rose gardens and two new ferneries, increased the stock of pot plants and orchids by two-thirds, planted a large number of plants, shade and ornamental trees, climbers, clumps of plants on Lawns, and transplanted a large number of palms and trees to more suitable places, and replanted the Lawns. Most of the walks have been widened, the main walk extended and new walks made in rose-gardens. All the smaller palms, shade trees and ornamental trees on Avenue Lawns, Arboretum, Pastures, etc., have been trenched and manured.

"About 2.000 feet of piping have been laid down and some dozens of taps fixed; the plant houses have been fitted up with tanks to hold large quantities of water for watering. A new potting and tool-house has been erected. Two vine borders have been established. A fence has been run round two sides of the large pasture and all the bush, stumps and useless trees taken out of it. All the pastures have been put in a clean condition, rows and clumps of shade and ornamental trees have been planted in all the pastures."

The following Report is by Mr. E. Campbell for three months, from January to end of March :—

"I resumed charge of this establishment on the 8th of January last, and carried on the work, as given in this report, for three months only.

"Since the year 1890 the garden has been extended considerably, in fact, it is now more than twice the size.

"The work of supervision is also very much increased. All garden work is being done by ordinary labourers and they must have constant instruction and watching from the Superintendent himself.

"Seven and a half chains in length of the border on the Avenue have been dug up, the ground was trenched two or three feet deep and the Ficus roots picked out, then it was well manured, made level with the road and re-planted. Wherever this is done, the plants show great improvement, it will therefore be necessary to continue this work from time to time. The other borders in the garden around the house require thorough handling and remodelling. The several beds of Crotons mixed with Hibiscus about the Lawn have a good effect, but scale insects trouble the Hibiscus much.

"The new Rose Garden is in fairly good condition and flowers in profusion, but the strong and arid south wind causes much damage to the blooms and half the flowers never open from the bud stage.

"Tennis and other Lawns were kept in order as usual, seven and a half square chains of hay grass have been hoed off, the land ploughed, levelled and made ready for planting Bahama grass.

"Verges have to be kept cut continually.

"The entrance drive to King's House, is, from the East Lodge Gate to front steps, forty-six chains, and from the West Lodge Gate to junction by Croton bed, fifteen chains, making a total of 61 chains long and 22 feet wide. All this road has been kept constantly hoed and raked.

"All the hay grass common pastures have been cleaned and several hundred stumps dug out.

"Some portions of the several sub-dividing pasture fences have been repaired with new posts and the wire restrained.

"Pot plants for house decoration have been duly attended to. The demand for them is ever increasing.

"Ten tree ferns have been added to the old number.

"The plant of Beaucarnea recurvata growing near the dining room is now fifteen feet high; this plant was introduced by Dr. D. Morris from New Orleans. The Champac tree (*Michelia Champaca*) growing on the Lawn is twelve feet high and has flowered this year.

"A plant of *Amherstia nobilis*, which is being grown in a large flower pot until it is strong enough to stand planting out in a prominent place, is now four feet high, and looks quite healthy and well. This grand flowering tree will, in time, be a beautiful object in the garden.

"*Pachira aquatica* is also growing fairly, but unfortunately it is not so handsome in its flowers or foliage as it is at Castleton.

"The several Palms about the ground need constant attention and manuring.

"The Orchid collection numbers 220, in baskets and on blocks.

"The roof of the glass-house, was repaired and the staging altered and extended by the Public Works Department. The Superintendent's house is badly in want of some repairs and requires to be painted throughout.

"A tank for growing water-lilies and other aquatic plants is very much wanted in the garden.

"Six hundred feet of armoured and plain rubber hose have been bought for the garden and the cost paid out of the Vote for general maintenance.

"The piece of ground that was used for growing Grapes (the Grape Vines being sent to Hope) has been planted with 200 Pines.

"The number of letters written by the Superintendent and sent from this Office is 207.

"The letters received number 127."

The elevation of the Garden above sea-level is 400 feet.

The average mean annual temperature is 78°7 F., and the average annual rainfall 48.51 inches for 15 years.

The amount of rain that fell during the year was 47.26 inches. January, March and June were the driest months, and May and October the wettest.

The mean temperature was 75°8 F. The meteorological tables for the different months are given in Appendix V, page 247.

PARADE GARDEN.

The following Report is by Mr. John Campbell :—

"In the past year the general work of the Garden has been carried on. The borders and beds have been forked throughout and they have all been thoroughly manured. The trees and shrubs have been pruned and thinned and the plants are in excellent condition. The flowering plants are almost in continuous bloom. The edges and verges were kept cut and trimmed. The ornamental shade trees have been relieved of dried boughs, and the largest,—Ficus Benjamina and Ficus lucida, have been manured and moulded and have greatly benefitted.

"The Triplaris americana bloomed profusely this year. The aquatic plants in the tank are in good order.

"The Lawns have been kept clean of weeds; they form one of the chief features of the garden, but the unsightly tracks from all corners spoil their appearance.

"The benches require repairing and painting. Thirty-two benches have been sent by the City Council to be placed in the Band Stand enclosure. The railed enclosure requires repairs.

"Although there have been some infringements of the Garden Regulations they have been quickly dealt with at the Police Court.

"Various seeds were collected in the garden and forwarded to the Hope Gardens for propagation."

The elevation of the Garden above sea-level is 60 feet.

The average annual mean temperature is 79° F., and the average annual rainfall 36.39 inches for 25 years.

The amount of rain that fell during the year was 35.99 inches. January, March, April and June were driest months, and the heaviest rains fell in the months of May and October.

The mean temperature was 78°8. The meteorological tables for the different months are given in Appendix V, page 244.

BATH GARDEN.

The following Report is by Mr. A. H. Groves :—

"A change took place in the appearance of this Garden in the first quarter of the year from a visit by the Director in the early part of May with a view of removing some of the shade so detrimental to the other bearing trees, consequently we had 14 of the trees to remove by cutting down each tree and carrying away same to the river course, and after, removing roots, etc., from out of the ground, so as to enable us to prepare land for flower beds, etc., with flowers and crotons. The former were supplied by a few local friends, and the latter by the Director. These thrive well in some parts of the Garden, but in other spots do not look healthy, the cause being too much shade, and this cannot be remedied as some of the shade trees are very valuable Palms. But taking into consideration that the Garden has only been under improvement a few months, I have but little cause for complaint. I however have to report that one of the Pimento trees near where the new gate now stands should be removed, as it prevents the flowers from thriving. This is the second time I have planted the spot.

"We have made 20 chains of new walk around the Garden, costing about 6s. per chain and raised the ground round the "Talipot" Palm, circling the same with large stones and growing lilies.

"The re-establishment of the old well with a windlass, rope and bucket for watering purposes has proved of great benefit to the Garden in the dry months; also for drinking purposes for the inhabitants of the town, as many are to be seen drawing water all day.

"I have found it requisite to cut out a few trenches to relieve the plants of too much water when a heavy shower of rain occurs. And indeed more drains around the Garden are still required.

"Now that the Parochial Board of this Parish has put the west and south lanes in order and deepened the trenches to carry off the overflow from the Garden, it is left for me to take advantage of the same, and cut more drains when in funds to do so.

"I have to report the erection of a new wire fence of six strands: 6 of which are round wire, and 1 barbed wire—with mesh wire around the entire fence to prevent trespass by small stock—all of which has iron standards, droppers, etc., except at the gate where 2 wooden posts were required. The whole of the fences was erected by Mr. F. H. Lindo of Bath, with the new gate standing opposite the Fountain Road, as previously decided on by the Director.

"I am sorry to say that the Manilla Hemp suckers forwarded to this Garden have not all proved successful, as out of the dozen sent, I have but three growing. The chief cause is too much shade; and I need not say that all such plants require good, rich soil; so that instead of throwing away the rubbish as before, I have established a manure depot at the extreme east end of the Garden where all rubbish, etc., is deposited to decay, and as soon as decomposition ceases, I intend to apply it through the entire Garden.

"I must again call attention to the shade of this Garden, and would suggest that where we have 2 or 3 trees of the same kind we should retain but one and remove the others. I chiefly allude to timber trees and pimento trees.

"I have to report that labels have been placed on nearly all the trees in the Garden, giving their names.

"A few more large Spathodeas should be removed; but I find it expensive to cut down the limbs of the trees first, and then the body, to prevent damage to other trees, etc., in the Garden. For instance there is one very large Spathodea near the Talipot Palm which requires to be cut in small quantities, so as to prevent any injury to the Palm. This tree of itself to cut down and remove would cost 15 to 16 shillings; and in fact all the trees that require to be dealt with in the same way would cost as much."

APPENDIX II.—REPORTS ON EUCALYPTUS PLANTS.

Col. Brown, Up-Park Camp.—The majority of these plants seem to be very good and adapted to the purpose for which they were planted, with the exception of the *corymbosa, tereticornis* and *crebra.* They are all thriving very well bnt the three specimens above-named do not appear to grow very fast—all these are planted in the gully that takes all the drainage from Camp. [E. citriodora].

Mr. W. R. Thomas, Kingston.—The plants have done remarkably well, One is now 18ft. high and is about to blossom. I consider the growth extraordinary as compared with other trees planted at the same time. [E. microtheca].

Mr. M. M. Alexander, Kingston.—The plants sent me last July and the others have grown at my residence "Mentmore," Kingston, and are a perfect picture to look at. I shall be glad to show them to you at any time. They are in my garden and I must say I never gave them much attention. They have grown very high and are much admired.

Dr. G. J. Neish, Plantain Garden River.—The Eucalyptus plants put in at Hordley Hospital are not doing well, the hill-side being rocky and soil very shallow. About six appear to be growing fairly well. Four of the number which I planted about my house in dry alluvial soil are thriving and growing very tall and strong. [E. rostrata].

Mrs Hall, Manchioneal.—I regret to say that only three of the 24 lived. Those three are now about 5 feet high and quite strong. I attribute their deaths to my ignorance in the totally different system of cultivation needed in Jamaica to that of England. Now that I have learnt this, the last 48 lately planted are quite a success. [E. microtheca].

Mr. W. C. Groves, Bath.—The Eucalyptus robusta are doing well.

Mr. R. P. Simmonds, Port Maria.—Eucalyptus citriodora 20 feet, planted about six months before the others. Microtheca 13 to 18 feet. Robusta 8 to 14 feet high. All growing well.

Rev. C. Barron, Annotto Bay.—The Eucalyptus plants arrived safely, and in due time were transferred to the ground from the Bamboo pots. Unfortunately however, a dry season followed the planting, which resulted in the loss of a large number of the plants. [E. citriodora].

Several of the survivors are growing splendidly, and others are more slow in growth. I had hoped to raise a large number for distribution around the Bay but in this unfortunately I am disappointed.

Mr. W. G. Nunes, St. Ann's Bay.—I regret to say that every one of the Eucalyptus plants you sent me were destroyed, I believe by crabs which infest the swampy land near the sea beach in St. Ann's Bay in which I planted them.

Mr. M. Hart, Laughlands,—Of the twelve Eucalyptus plants supplied in 1894, seven are growing all strong and healthy, six are about six feet high and one quite 12 feet, this one may be accounted for by being planted in rather marshy soil. [E. microtheca].

Mr. A. J. Webb, Laughlands.—Most of the plants died during the drought of last year, but a few are left and are now growing well. [E. acmenioides].

Mr. J. A. Bowen, Guys Hill —The Eucalyptus plants sent me in 1893 have done remarkably well. One has attained a height of 20 feet, another 12 feet, and the rest an average of 9 feet. These last are not in very favourable situations. I am convinced that with a little care at the outset Eucalyptus would flourish luxuriantly in the soil and climate of this district. [E. robusta].

Mr. F. Edmond, Ocho Rios.—With regard to the Eucalyptus plants sent me in April, I am pleased to say that ten out of twelve are doing very well. We are having few showers of rain just now so that the plants are not growing quite so quickly as they should. I am of opinion that they need a firm, moist soil, as some I have planted in the shade and damp have grown twice as tall as those planted in the open ground. [E. microtheca].

Mr. G. E. Barrett, Pedro.—Three of the Eucalypti have reached a height of 12 to 15 feet. The others vary, down to 4 feet. The larger leaved kind grow best, the smaller leaved kind seem more delicate. But my trees are fenced with pinguin, a very bad fence for plants.

Mr. D. M. Mendez, Old Harbour.—I received 24 plants. I gave away 4, two of that number died. Five of those kept by me are not thriving as well as I should like, being planted in dry and arid spots, but the remainder doing well and stand from 15 to 25 feet high. I find that they thrive better on moist ground [E. microtheca and robusta].

Dr. Neish, Old Harbour.—The Eucalyptus trees (E. microtheca) supplied to me by your department have thriven beautifully. Only one out of the dozen plants failed to grow. The tallest measures 30 feet in height and the circumference of the trunk is 19 inches. Another measures 27 feet in height and 18½ inches in circumference. My finest tree is in blossom at the present moment. Their propagation as timber trees would, I think, prove most valuable. I do not know of any tree in Jamaica which has such rapid and erect growth.

Mr. G. C. Lindo, Old Harbour.—Every one has done well; except one of 15 feet which has died off. [E. microtheca and robusta].

Rev. J. J. Kendon, Linstead.—The six plants sent, were put in close to our dwelling on the brow of a hill in very clayey soil. We dug holes and filled them with loamy soil. Two of them died but four are doing well. One (the best growing of all) retains the rough surface and sweet smell of the leaf, another up to the present does the same but is not thriving so well. Two others are growing nicely but have lost all roughness and nearly all smell. I suppose from what I have seen since getting the plants we made a mistake in planting them on the hill top. [E. citriodora].

Dr. R. C. Gibb, May Pen.—Those I sent to Parnassus have grown well—also at Moneymusk and one at Experiment Pen. [E. microtheca and robusta].

Mr. H. McRae, Chapelton.—Two are alive and doing well, although they have not grown as rapidly as I have seen them do in other places, the others are dead.

Mr. R. U. Brandford, Mandeville.—The two dozen Eucalyptus plants received. I am fortunate with them, they are all growing very nicely and are between 20 and 24 inches high. I have not lost one out of the number. [E. tereticornis].

Mr. S. J Batson, Mandeville.—The E. robusta are doing well. Three I kept for myself are growing beautifully, standing about 6 feet tall. Others I gave away to friends are thriving nicely, one of them was about 7 feet high and is now attacked by grubs of some sort, but is not in any way hopeless.

Mr. E. S. Falden, Siloah.—The Eucalyptus plants which you kindly sent in 1893 are most of them doing well. I have distributed them out to people who I think are in need of them, some died from a little carelessness, but what I have seen growing are very promising, varying from 6 to 16 feet in height. [E. robusta].

Mr. W. V. Edwards, Balaclava.—The trees were planted at Raheen near the One Eye River; but I regret to say the fences of many of them were destroyed by the Cattle rubbing against them; the animals were then able to reach over and crop off the tops, thus destroying them. Some of the trees have grown very well—15 feet high. The rich alluvial soil at an elevation of about 450 feet evidently suits them. [E. robusta].

Clerk Parochial Board, Black River—I received several Eucalyptus plants from Hope Gardens—of the lot several died before they were planted (they seem to have been too long in the bamboos). Several planted in very swampy grounds grew to about 4 feet in height and then withered and died. Those planted near the morass in Black River were destroyed by crabs. I have reared only one in my yard, but it has made up for all the losses nearly. It stands close on 30 feet in height and is a beauty.

Mr. C. D. Leyden, Black River.—The plants all died except one which is thriving very well. I am inclined to think the dry weather killed the others. The one living was planted near the house and was watered. All the plants supplied in 1893 are thriving well and are now good sized trees. I did not loose one out of the lot. [E. melliodora].

Mr. G. A. Malcolm, Sav.-la-Mar.—Out of the 24 Eucalyptus plants ordered 20 only came safely, the others got injured on their way, these 20 consisted of 12 E. robusta and 8 E. microtheca. Out of these I gave a friend in the neighbourhood 6 plants, 2 robusta and 4 microtheca. These as well as mine were planted immediately and in the same soil, it was in the midst of the dry season (with us) so they required daily watering. Out of my 14 I lost five and strange to say 4 of these consist of microtheca and 1 robusta so I have lost all my microtheca. The remaining 9 robusta are growing very rapidly; when I got these they were about 8 inches high, it is now about 2 months and they are about 19 to 20 inches high. The same applies to those I gave away 1 has died, microtheca, the growth is about the same as on my property.

Mr. B. W. Norton, Sav.-la-Mar. – Of the 12 Eucalyptus plants received from your department, after putting them in their permanent places, only 4 fairly struck, and are doing well, they are not too tall but branch out plentifully and are promising. [E. citriodora].

Mr. H. E. Ibbott, Sav.-la-Mar.—You sent me 12 Eucalyptus plants in bamboo pots; on their arrival I found three withered, of the remaining 9, 5 failed to thrive. The balance have got on handsomely, the tallest is 22 feet, the next 20 feet the other 2 much shorter but well branched. From 2 of them sprouts or suckers are thrown out from above and below ground. [E. robusta and microtheca].

Mr. P. M. Burke, Sav.-la-Mar.–The Eucalyptus plants you sent me are growing well. [E. platyphylla].

Mr. W. H. Farquharson, Retreat.—A few of the Eucalyptus plants are growing nicely, but most of them are dead, they arrived in poor condition, seemed to have had bad treatment somewhere, and I remember well that I did not expect them to do much when I planted them. The ones that are growing are about 2 feet high. [E. melliodora]

Revd. A. Thomson, Montego Bay.—I beg leave to inform you that the two dozen Eucalyptus shrubs, which you kindly forwarded to me have all been planted throughout my property—"Prospect Hill," and to all appearance, they are doing well. [E. rostrata].

Mr. J. Nash, Montego Bay.— Only two of the Eucalyptus plants sent me have grown—These look healthy but grow very slowly.

Mr. L. C. Shirley, Falmouth.—Four of the Eucalyptus plants are alive and about 5 to 6 feet high; the rest are all dead. [E. microtheca].

Mr. J. Shearer, Duncans.—Although the plants were wiry and delicate, a few are thriving very well both at Arcadia and Cave Valley. [E. citriodora].

Mr. E. L. Purchas, Dry Harbour.—With the exception of 35 which arrived dead, the Eucalyptus plants received this year are, so far, doing well.

Mr. L. D. Baker, Port Antonio.—I have to report that all of our Eucalyptus are planted on Bound Brook flat land, a portion of the Bog Estate adjoining the town of Port Antonio where the new Railroad station is being built. This flat land is laid out in a plan as a town, with 50 feet streets, 30 feet of it being the driveway and ten feet on each side of the driveway being sidewalks. We have planted these on the near side to the driveway, so that people walking on the sidewalk, the trees will be between them and the driveway. This land is alluvial deposit, ranging from two to six feet deep, inclined towards the sea. The plants seem to have taken well. We are planting a post near by each one, as a protection and as a support to it, and every care will be taken to make them grow successfully. We would like to have about 200 more when it is convenient for you to give them to us. [E. rostrata].

Mr. A. J. Hart, Sav-la-Mar.—I have to report that the Eucalyptus plants received in 1893 are thriving well but those with the small tapering leaves [E. microtheca] grow much quicker here than the other kind [E. robusta]; a couple trees are about 25 feet in height.

Mr. R. H. Tomlinson, Lacovia.—The Eucalyptus are growing well, four of them have made hardly any growth being still 3 to 4 feet high and very spindling, owing to my planting them in shady places. Of the other 9 plants their dimensions are as follows:—E. robusta 30 ft., 16 ft., 10½ ft. high. E. citriodora 13½ ft., 9½ ft., 10½ ft. high. E. rostrata 24 ft. high. E. microtheca 14½ ft. and 10 ft.

Mr. H. B. Walcott, Richmond.—1 received the plants from Castleton in January of this year. Owing to the very dry weather I lost quite half the number in transplanting. But I have a good number now well started and promising to do well. A few I gave to neighbours who report that they are growing nicely. [E. citriodora]

Dr. Manners, Bull Bay.—The Eucalpytus plants I got from you, 12 in number, 9 have grown well and are now 20 feet high. You can almost see them grow. [E. robusta and microtheca.]

Parochial Board, Hanover.—The plants supplied in 1893 have continued to grow, some are now from 6 to 8 to 9 feet high, look healthy and will now do well.

Mr. A. A Green, Milk River.—Only three of the lot in November, 1893, are growing. The plants were not so strong as the first lot supplied and the very severe drought was sadly against them ; some of the former ones are 25 ft high and are flourishing. [E. melliodora.]

APPENDIX III.

Reports on Free Grants of Plants.

Inspector General of Police, Kingston.—I potted out the best of them in large pots and they are doing nicely.

Surg. Lt. Col. C. W. Moore Keys, Camp.—The plants are all doing as well as the high wind of Camp will permit. They are tended carefully and watered regularly, and not stinted in manure. Many of them have made excellent progress, a few of them have died, not through want of care, or want of health, but by under-ground and over-ground pests. The Crotons and Hibiscus varieties have done best I think, and all of the Aralia, The three varieties of Panax—dissectum, plumatum, and excelsum ; have thriven remarkably well, and been free from attacks of the scale insect.

Revd. C. P Muirhead, Camp.—Of the 150 plants received for the Franklin Town Mission Chapel, the greater number are doing well. Some from the beginning did not thrive, others were cropped by goats. Though the grounds are fenced with barbed wire and wire netting two feet high, yet these pests slip in through the gates when an opportunity offers, and plants do not thrive when once cropped by them.

Revd. H. Nethercott, Stony Hill.—I have much pleasure in stating that all the plants received from your department at Castleton took root, thrived, and were really doing well when unfortunately some were destroyed by persons cleaning the burial ground. The destruction of the plants was purely accidental, and in no way intentional. The plants when received from Castleton were all in a healthy, vigorous condition and did not suffer in any way from being transplanted. Three or four Crotons, all of the same kind, lost their leaves but soon got new ones. None of the other plants shed their leaves. I am glad to report that the plants were in every way satisfactory.

Revd. W. Y. Turner, Castleton.—In answer to your enquiry I may say that the plants are all doing well and are being kept weeded, etc.

Revd. S. Graham Shrimpton, Old Harbour.—Of the 200 plants which I received from the Gardens in 1895, I am glad to state that now after about 15 months they are thriving nicely. All of them took but the dry weather was very trying and I lost about 6 of them —two Casuarinas and four Roses. This free gift of plants has been a great boon and now my Churchyard presents quite a pleasing appearance.

Mr. A. C. Kennedy, Bluefields.—Most of the plants for the Bluefields Church were put out and did well, but horses got among them and broke some which are springing again; Poinciana and Guango, I did not plant, many of the plants being about and in the Churchyard, I had proper holes dug and filled in with earth, sand and cow dung before I put out plants; I am going to put in some Crotons and Hibiscus from the Bluefields garden. A want was felt as I did not know if plants grew to tree size or shrubs and I am afraid in time some must be cut out. For want of co-operation and interest on the part of most of the members of the Church, it will require steady perseverance to get the plants established all over.

APPENDIX IV.

Reports on Onion Seed.

Mr. W. Chisholm, Halfway-Tree.—The seeds I got from you were divided in two lots; the first was sown in September or October (I think the latter month) but all the plants were destroyed by the very heavy and constant rain we had last year. In November I put out the balance of seeds and after the plants were about 6 inches high I transplanted every one with the result that the onions were quite a success both in size and quality. We had onions of all sizes some measuring over 11 inches in circumference and were praised by all who tasted them.

Mr. W. A. Sabonadiere, Cedar Valley.—The onion seed planted early in 1894 did not come up very well, a few came in too quickly and none were more than 2 or 3 ozs. in weight, in the autumn some were transplanted which are doing much better and will soon be fit for use. The eed sown in December 1894, came up much better and the young onions looked promising. Of those transplanted one onion just gathered weighed 1 oz., and 6 one quarter of a pound.

Mr. F. H. Barker, Retreat.—These seeds were sown on 11th Dec., 94, and grew very well and would have produced a good crop but for the unusual dry weather since Decr., 1894. The crop has not yet been taken out of the ground but there are some very good sized onions among them.

Mr. Alex. Hopwood, Brown's Town.—The crop of onions this year is very poor, very small in size, and only fit for pickling. The seeds were planted and treated the same as the previous lot, which yielded onions up to $\frac{3}{4}$lb each. Cannot account for the failure. The seeds were sown a month earlier than the previous year, otherwise the cultivation was the same. The seeds of the Indian Onion grew beautifully, but the onion from them are very small. This description of onion has never done well with me.

Mr. Costa, Brown's Town.—The onion seed that you kindly supplied last year have given a good return of onions and particularly the red onions. I planted my onion seeds last year in Nov. and did not transplant, the soil was ploughed up with a hoe, a small quantity of manure added, and little furrows $1\frac{1}{2}$ to 2 inches in depth made with the point of a stout stick into which the seeds were sown, soon as the onions began to bulb they were moulded. From the results of my experiments I conclude Octr. and Novr. are the only months in which it is advisable to plant onions. For the past two years I have done so well with the small quantity of seed supplied me from the Gardens, that I am thinking of going in for the cultivation to some extent.

Miss. Barrett, Brown's Town.—The seed was sown too late; and on poor soil—12 onions weighed ¾ lb. If sown earlier on better soil, there would be every chance of an excellent crop. I should be glad to have sufficient seed for half an acre.

Mr. C. L. Walker, Walker's Wood.—The Indian Onion seed came up rapidly, made perfect heads, and were smooth and perfect but small about 14 to the lb., flavour perfect. I am of opinion that the Indian Onion is the best for Jamaica. They came to perfection in 9 weeks, and were then fit for the market.

Sergt. Carr, Cave Valley.—I have the honour most respectfully to report for your information that the Bermuda Onion seed which I received some time in last year were delivered to some of the small settlers, and they throve most beautifully with some of them, and they are now getting ripe. But the people want to know if the same produce can be replanted as they get no seed from what were sown.

Mr. T. Kemp, Cave Valley.—The Indian Onion seed I received in dry weather, and sowed it in the open ground watering the bed every evening. The seeds sprang beautifully, and grew rapidly until about 4 inches high. We then had very heavy rains and the ground through expansion rose 2 or 3 inches leaving only the tops of the leaves above ground, this seemed to put a check to their growth as they grew very little afterwards, and when ripe were only fit for pickling. The Bermuda Onion seed I sowed in a box and when about 2 ins. high transplanted them into a prepared bed, they grew very rapidly and came to a good size, the best weighing 8 bulbs to a pound. I am convinced that had the Indian seed been treated in the same way, and had the Bermuda seed been sown earlier better results would have been obtained. In transplanting I put the plants 4 inches apart so that per acre they would yield a very good return.

Mr. J. H. Mills, St. Ann's Bay.—I am glad to report that the onions turned out all that could be desired; so much so that I intended writing to ask you where I could get seeds of the description you sent me to buy—I bought seeds in Kingston but they were not good—I got from the seeds you sent me single onions weighing 14 ozs.

Mr. B. E. Fullerton, Duncans.—I have to report most favourably on the onion seeds you sent last year. They were sown in October in a well prepared bed made on a spot where I had previously made some farm yard manure: the sprouts came forth freely and healthily, transplanting was done at the end of November on the few early days of December; and a splended crop reaped in March—bulbs well formed as you will see from samples sent you herewith. I think from the results of my experiments for the three successive years past I am in a position to pronounce the locality well adapted to onion culture. Of course as is the case with most objects of culture, much trouble, attention and care are needed to secure satisfactory results—not to mention favourable seasons.

Mr. R. N. Heming, Davis Town.—The seeds you sent me have turned out very successful. Some very fine large bulbs have been grown and on the whole the returns received are very much better than the previous year.

Mr. J. H. Bonello, May Pen.—I am glad to state that the onion seeds grew nicely and would have given a splendid return had it not been for the drought which took them.

Mr. H. Jackson, Mandeville.—I have much pleasure to report that the Bermuda onion seeds I got from you turned out a success—I grew them on red soil highly manured with ashes and stable manure mixed. Some I manured with stable manure alone, but those did not turn out as well as the others with the mixture. I find they thrive best on land that has been previously cultivated ; I drilled seeds about a foot apart, and sowed an inch apart in each row. When the seedlings attained the height of 4 inches I thinned them, thereby giving them a space of about 3 inches. After this I did nothing in the way of cultivation, except keeping the soil free from weeds. I had to water freely on account of the severe drought we had at the time I planted. Most of my onions weighed ½lb. but they averaged about 6 ozs. Seed was sown first week in November and bulbs were taken up in March. I would like a few more seeds if you can spare them to make another trial.

M. A. G. Heron, Cross Keys.—The Bermuda onion seed you sent me were planted last October and sprouted fairly well, but owing to the dry weather commencing with me from middle of December until March 1895 the bulbs were very small taking 50 to 60 to the pound. The Indian onion seeds you sent me were planted in Oct. last, but did not sprout so well, a good deal of the seeds must have been bad. Owing to the dry weather, being several months without rain, the bulbs were very small, but of a good flavour, aud rather finer than the Bermuda onion.

Mr. A. C. Martin, Cross Keys.—Both the Bermuda and East Indian onion seeds were sown in Oct. 1894. The Bermuda sprouted well and the bed was thinned out, seedlings pulled up were transplanted into another bed, altogether 152 square feet was planted out and by the end of March 1895, I gathered 44 lbs. of well cured onions some of which I exhibited at the Mandeville Flower Show in May and obtained first prize.

The East Indian seed did not sprout well and in consequence I did not thin out seed bed. From 57 sq. feet of land I gathered 14¾ lbs of well cured onions by end of April, 1895. The bulbs were not very large but of fair size and on the whole there were not many small onions. From my experience I think the month of August, September and October best for sowing seed I find the seedlings stand transplanting well and this should be done when they are about 4 inches high, when kept until they are taller they die more readily. I have tried to induce the small settlers in my neighbourhood to cultivate onions offering them seeds and plants, but it seems to be a difficult matter to get them to attempt anything new. I will be glad to get more onion seeds as soon as you have any.

Mr. C. P. Nosworthy, Newport.—The onion seed was sowed last October and came up very regularly, but the extreme drought ever since has rather perished them—they are however now beginning to recover strength and after a little more rain I will transplant all the thinnings.

Mr. C. T. Dewar, Duncans.—I have seen a bed of onions in Duncans grown by the Schoolmaster Mr. Fullerton. They are really good and if always as successful they would be a very paying item in a market garden If you have any seed would you kindly let me have some and I will try and get my tenants here to try them.

Mr. J. R. Reece, Pedro.—My first lot of onions failed owing to too much rain, the second, owing to drought.

Mr. John Davidson, Bellevue—I have been very successful with the onion seeds you sent me; there are a *few* smallish ones, but they measured in circumference as a rule 7, 8, 9, 10, 11, and 11½ in. The crop is (for quantity of seeds) a large one and taste and flavour absolutely delicious.

Mr. R. A. Walcott, Mandeville—I gave Mrs. Swaby about a quarter of a pint of the onion seed you imported for me. She sowed them at Newark in Manchester in October last. The rains washed out a very considerable portion of the plants, but for all that she reaped a crop of 186 lbs. of fine onions in February this year, and she readily sold them in Manchester at 6d. per lb. The onions were not very large, but of fair size and excellent flavour. The rest of the seeds went to Mr. M. H. M. Farquharson, of Middle Quarters, when he bought my pen "Hopeton" in Westmoreland from me. I may add, however, that a small patch of onions planted at that place April of last year also succeeded very well indeed. This shows that they are not particular either as to season or locality.

APPENDIX V.

Kingston Public Garden.—Elevation 60 feet.

Month.	Pressure.		Temperature Degrees Fahrenheit.					Dew Point.		Humidity.		Wind.		Rainfall—Inches.
	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Max.	Min.	Range.	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Direction.	Force–Miles.	
1894.	In.	In.	°	°	°	°	°	°	°					
April ...	30.030	29 971	72.8	82.1	85.7	69.8	15.9	66.9	69.2	82	65	SS E	85.8	0.61
May ...	29.943	29 902	76.7	82.3	85.3	72.4	12.9	70.0	72.5	80	72	SS E	101.7	10.65
June ...	30.023	29.972	78.6	85.2	88 3	73.1	15.2	70.5	73.0	76	67	S E	123.4	0.70
July ...	30.049	30.005	79.5	85.4	89.2	72.1	17.1	69 4	72.7	72	66	S E	103.4	1.21
August ...	30.031	29.973	77.9	86.5	89.8	72.9	16.9	69.1	71.8	74	62	SS E	92.4	1.31
September ...	29 960	29.910	77.0	86.0	90.1	73.8	16.3	70 3	73.4	80	66	S E S	91.1	1.55
October ...	29.926	29.875	74.6	83.2	86.7	71.8	15.2	70.8	73.0	88	72	S by E	80.5	12.78
November ...	29.996	29.928	73.2	84.5	88.2	71.1	17.1	69.3	72.4	88	68	S E S	73.7	2.07
December ...	29.994	29.938	69.1	80.8	85.1	67.7	17.4	64.2	69.2	85	68	S by E	88.8	2.43
1895.														
January ...	30.041	29.979	67.7	83.2	86.2	66 7	19.5	62.8	69.1	84	63	S E	97.4	0.05
February ...	30.041	29.909	68.7	82.5	85.3	67.0	18.3	62 6	69 6	81	65	S E	104.2	2.20
March ...	30.050	29.992	69.8	82.3	85.4	67.9	17.6	64.6	69 2	84	65	S E	99.9	0.43
Means ...	30.007	29.946	73.8	83.6	87.1	70.5	16.6	67.5	71.2	81	66	South Easterly	95.1	35.99
					Mean 78.8									Total

Castleton Gardens—Elevation 580 Feet.

Month.	Pressure.		Temperature Degrees Fahrenheit.					Dew Point.		Humidity.		Rainfall—Inches.
	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Max.	Min.	Range.	7 a.m.	3 p.m.	7 a.m.	3 p.m.	
1894.	In.	In.	°	°	°	°	°	°	°			
April ...	29.62	29.61	68.0	78.7	83.1	64.7	18.4	66.2	71.2	93	78	4.31
May ...	.55	.53	73.8	78.2	83.4	67.2	16.2	66.4	73.1	76	84	19.38
June ...	.62	.62	72.1	82.4	86.7	67.3	19.4	70.0	74.5	93	79	4.30
July ...	.66	.66	71.3	80.7	86.3	67.0	19.3	70.4	73.8	96	79	10.11
August ...	.63	.66	70.4	82.3	86.9	66.8	20.1	69.3	75.7	96	82	2.64
September ...	.56	.55	70.7	80.6	86.1	67.8	18.3	69.2	75.2	91	85	9.78
October ...	.51	.51	69.0	79.2	83.9	67.2	16.7	68.1	73.2	96	82	16.41
November ...	.60	.58	69.9	79.1	83.6	67.3	16.3	67.4	71.8	90	79	5.12
December ...	.59	.58	65.9	75.0	78.8	63.8	15.0	61.0	68.6	84	81	10.80
1895.												
January ...	.63	.62	62.9	76.4	80.0	61.5	18.5	60.6	68.7	93	78	3.18
February ...	.62	.61	62.3	77.2	81·5	61.7	19.8	60.4	69.0	93	76	17.62
March ...	.63	.63	63.3	79.7	84.1	61.2	22.9	61.6	69.6	96	71	0.60
Means ...	29.60	29.59	68.3	79.1	83.7	65.2	18.4	65.8	72.0	91	79	104.15
					Mean 74.4							Total

Hope Gardens—Elevation 600 Feet.

Month.	Pressure.		Temperature. Degrees Fahrenheit.					Dew Point.		Humidity.		Rainfall—Inches.
	7 a.m.	3 p. m.	7 a. m.	3 p. m.	Max.	Min.	Range.	7 a. m.	3 p. m.	7 a. m.	3 p. m.	
1894.	In.	In.	°	°	°	°	°	°	°			
April ...	29.20	29.22	70.9	78.5	83.8	62.0	21.8	66.3	70.0	84	74	4 76
May ...	.17	.19	74.6	79.7	84.7	64.3	20 4	70.4	73.6	84	82	11.20
June ...	...	...	75.8	84.7	87.6	66.5	21.1	71.0	75.9	93	79	2.98
July ...	.82	.80	75.8	83.5	88.4	67.1	21.3	69.9	73.3	81	69	2.34
August ...	...	...	75.1	84.1	89.0	67.8	21.2	69.5	73.4	84	69	5 51
September ...	.24	.26	74 3	81.3	88.0	68.5	19 5	70.3	76.2	87	88	4.25
October ...	.25	.26	75.2	81.5	85.9	67.3	18 6	67.1	73.4	76	74	10.11
November ...	.25	.27	72.6	82.7	88 1	64.8	23.3	69.4	74.1	87	74	2.60
December ...	.23	-25	67.6	78.3	83 7	62.4	21.3	65.7	70.6	91	79	4.20
1895.												
January ...	.28	.31	67.5	82.0	85.9	61.0	24.9	62.6	68.9	84	67	1.70
February ...	.28	.31	67.8	80.3	85.5	60.9	24.6	63.9	69.0	87	69	1.03
March ...	.28	.31	67.0	81.7	86.7	61.9	24.8	61.7	70.1	84	67	1.75
Means ...	29.30	29.31	72.0	81.5	86.4	64 5	21.9	67.3	72 3	85	74	52.43
	Means for 10 months.				Mean—75 4							Total

King's House Garden—Elevation 400 Feet.

Month.	Pressure.		Temperature. Degrees Fahrenheit.					Dew Point.		Humidity.		Rainfall—Inches.
	7 a.m.	3 p.m.	7 a.m.	3 p.m.	Max.	Min.	Range.	7 a.m.	3 p.m.	7 a.m.	2 p.m.	
1894.	In.	In.	°	°	°	°	°	°	°			
April ...	29.79	29.73	70.4	82.3	87.2	58 6	28.6	66 6	77.6	96	87	2.31
May ...	.71	.76	72 8	80.7	86.3	61.9	24.4	70.5	77.5	90	93	11.32
June ...	.76	.74	73.7	85.8	88.0	64.2	23.8	70.5	81.3	90	85	1.10
July ...	.82	.89	72.8	84.0	88.4	...	...	69.3	79.3	87	84	4.75
August ...	.80	74	73 1	85 3	88.9	67.8	21.1	69.7	80.3	90	85	2.37
September ...	.75	.71	73.1	85.9	89.7	68.5	21.2	70.1	81.9	90	85	3 41
October ...	.73	.69	71.7	83 5	87.1	67.6	19.5	69.6	80.0	93	87	14 20
November ...	.82	.75	70.8	85.4	88.6	66.7	21.9	68.5	82.0	93	90	1 50
December ...	.81	.78	68.5	82.0	85.1	63.6	21.5	65.1	74.9	88	79	4.05
1895.												
January ...	.82	.72	65 7	85.9	88.9	61.2	27 7	62.6	80.9	90	85	0.00
February ...	.80	.75	66.3	84 5	87.8	60 2	27.6	62.8	74.8	90	71	1.25
March ...	.81	.76	68.1	85.4	88.3	62.7	25.6	63.2	73.2	84	67	1 00
Means ...	29.78	29.74	70.5	84.2	87 8	63.9	23.9	67.3	78.6	90	83	47.26
					Means for 11 months—75.8							Total

Hill Garden and Cinchona Plantation—Elevation 4,907 Feet.

Month.	Pressure. 7 a.m.	Pressure. 3 p.m.	Temperature–Degrees Fahrenheit. 7 a.m.	3 p.m.	Max.	Min.	Range.	6 Feet Under-Ground. 7 a.m.	6 Feet Under-Ground. 3 p.m.	Dew Point. 7 a.m.	Dew Point. 3 p.m.	Humidity. 7 a.m.	Humidity. 3 p.m.	Wind. Direction.	Wind. Force—Miles.	Rainfall—Inches.		Newhaven Gap, Elevation 5,000 feet. Rainfall—Inches.		Blue Mountain Peak—Elevation 7,423 Feet. Date of Observation.	Time of Observation.	Temperature.	Max.	Min.	Rainfall—Inches.
1894.	Ins.	Ins.	°	°	°	°	°	°	°	°	°											°	°	°	
April	25.341	25.322	59.1	61.1	65.7	54.5	11.2	59.0	59.0	52.8	58.2	80	89	E	26.6	12.50	...	20.50	...	30. 4.94	10.15 a.m.	58	68.9	–	9.10
May	.315	.286	60.5	62.9	66.2	58.3	7.9	59.2	59.2	55.0	59.9	80	89	E	41 4	22.52	...	40.32	...	1. 6.94	10 "	54	70.9	42.8	18.20
June	.405	.377	62.3	65.7	69.8	57.2	12.6	59.7	59.8	55.0	60.8	77	84	SE	47.8	6.66	...	1.20	...	30. 6.94	11 "	68	70.9	45.3	6.60
July	.412	.404	61.8	65.1	70.0	57.3	12.7	61.7	61.7	54.1	59 8	75	83	E	53.3	3.57	...	3.25	...	31. 7.94	11 "	52	68.9	44.8	6.70
August	.394	.373	62.6	67.2	71.3	58.0	13.3	62.4	62.4	55.3	61.6	75	84	E	39.3	0.50	..	2.08	...	31. 8.94	11.15 "	62	69.9	44.8	1.72
September	.346	.332	63.0	64.3	68.9	58.2	10.7	62.5	62.5	56.5	62.2	80	93	E	46.3	12.09	...	10.52	..	29. 9.94	10 "	58	66.9	43.8	7.60
October	.281	.262	60.3	63.9	67.5	56 8	10.7	61.9	61.9	57.2	61.5	89	93	E	38.0	22.56	...	32 25	...	31.10.94	12.30 p.m.	56	61.9	45.8	18.35
November	.345	.333	60.0	64 6	68.3	56.7	11.6	62.0	62.0	56.2	60.1	86	83	E	49.1	8.39	...	19.50	...	30.11–94	2.30 "	50	61.9	43.8	19.40
December	.308	.287	55.7	61.1	64.5	52.7	11.8	61.4	61.4	52.0	58.1	86	89	N E	63.0	11.68	...	33.7	...	31.12.94	11.30 a.m.	54	64.9	36.8	22.60
1895.																									
January	.334	.320	53.8	61.1	65.0	51.9	13.1	60.6	60.6	48 8	55.6	83	83	E	37.4	3.79	...	5.10	...	31. 1.95	1 20 p.m.	50	65.9	34.8	4.20
February	.350	.328	54.3	60.7	64.5	51.5	13.0	60.0	60.0	50.1	57.3	85	86	E	18.9	10.09	.	20.15	...	28. 2.95	1.45 "	59	64.9	38.8	21.28
March	.363	.354	56.2	62.7	66.7	53.1	13.6	59.0	59.0	49.4	58.2	77	83	E	29.4	3.52	...	6.40	...	1. 4.95	11.30 a.m.	57	63.9	40.8	4.40
Means ...	25.349	25.330	59.1	63.3	67.3	55.5	11.8	60.7	60.7	53.5	59.4	81	86	Easterly.	40.8	117.87 Total	...	190.34 Total.	...	...	...	56.6	66.6	38.5	140.15 Total
					$\underbrace{}_{\text{Mean } 61.4}$																		$\underbrace{}_{\text{Mean } 52.5}$		

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OF THE

BOTANICAL DEPARTMENT, JAMAICA.

EDITED BY

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

Director of Public Gardens and Plantations.

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BULLETIN

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BOTANICAL DEPARTMENT.

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THE ORANGE TREE IN JAMAICA.—I.

BY J. E. DUERDEN, *Curator of Museum, Jamaica Institute.*

Complaints have been made to the Botanical Department and to the Museum, that the sweet orange trees; *Citrus Aurantium*, Linn, are being attacked by some insect, the final result being a destruction of the inner wood. Examples of the three stages—larva, pupa and imago—in the life history of the pest have been forwarded to the Museum by Mr. A. Townend, of Devonside, St. Ann, and Inspector Alexander, and show that the mischief, in the first instance, is largely due to the borings of the larva of a longicorn beetle. The different stages of the beetle have been sent to Prof. C. V. Riley,* of the United States Department of Agriculture, and he has kindly indentified it as *Oreodera glauca*, Linn., stating in addition that it is recorded from Mexico, Nicaragua, Guatemala, Panama, Guiana and the Amazon, but no one of the thirty seven species of the genus has so far been recorded from the West Indies. It is in accordance, however, with the laws of geographical distribution to find it in Jamaica.

Investigations carried on in St. Ann and elsewhere, show that a great number of the orange trees are in an imperfect condition. It is principally the old trees which are suffering, and to such an extent that nearly one-half of the trees in any orange grove are either hollow or becoming so. Further enquiries have elicted the fact that this is the general condition throughout many of the principal orange growing districts of the Island. By direction of the Board of Governors of the Institute of Jamaica, I investigated the district around Laughlands, especially at Devonside and Tripoli, and have obtained for the Museum specimens of the insects, and of the affected trees. Other correspondents have rendered valuable assistance. Inspector Alexander writes that a number of trees are suffering in the Pedro District between Concord and Pedro River. Mr. A. Townend has sent me larvæ from Wales in Trelawny. The Rev. G. E. Henderson records the same hollowness in the orange trees around Brown's Town, and Mr. Hall for Manchester, while I have also seen it at Mountain Spring, St. Andrew. Strange to say, the

* All entomologists are regretting the loss by death of this celebrated worker in Economic Entomology, which occurred between the writing and publishing of these notes.

closely allied Seville or bitter orange, *Citrus Aurantium, var. Bigaradia*, is never attacked, but always though on the same ground exhibits a much more vigorous growth than the sweet orange. In every case the characteristics appear to be the same. The trees are more or less hollow, in extreme cases supported by only from one-half to two-thirds of the bark with little of the inner wood remaining. This removal of the wood extends also to the larger branches.

It appears that the principal destruction and removal of the wood is being carried out by means of the different kinds of ants, principally the white or Duck ants (Termites) and the black ants. The ants however in all probability are not the primary cause of the damage; the trees are first exposed to their activity by the removal of the bark, due to the action of the larvæ of the longicorn beetle, and also, as mentioned below by the careless destruction of the branches.

Description of the Beetle.

The beetle is one of the tribe of the Longicornes recognised by their long antennæ, and by their large broad heads. This species is distinguished by the light silvery colour of its dorsal surface, and by having three small dark tubercles on the dorsal surface of the thorax, The wing covers have two small protecting spines at their posterior angles, the outer one being the larger; a small dark area produced into a line divides each transversely into an anterior two-thirds and a posterior third.

The larva is about half an inch in length, of a very light cream colour, except the jaws and first segment, which are a dark horn colour. The body is broadest in front, narrowing gradually behind, and slightly thickening again towarks the end. The dorsal part of each segment has an oval area differing from the remainder. The sides of the body have numerous fine hairs.

The pupa is of the well-known longicorn form, somewhat resembling the adult, but light in colour, and with the large antennæ at first folded backwards down the sides of the body, but again turned and lying on the ventral surface.

The action of the beetle is as follows:—

The female lays her eggs upon the bark of the tree—the time of the year when this occurs, and other details still require investigation. When the larvæ are hatched, they eat their way through the bark to the outer part of the wood. It is here, between the bark and the new wood, that the boring larva lives for a considerable time and undergoes its changes into the pupa which finally gives rise to the perfect beetle.

The borer makes long tortuous shallow tunnels inside the bark and in the new wood, giving rise to a great amount of dry powdery matter. The effect of this tunnelling and destruction of the tissues between the bark and the wood is that the former very readily separates from the trunk. Quite large patches of the bark can be easily stripped off, when the larva itself and its resulting shallow channel in the superficial part of the wood can be observed.

In some places the larva has made oval depressions in the wood and in these the pupa stage is passed through.

It is doubtful however, to what extent this exposure by the *Coleoptera* of the wood to the ants is serious as compared with the wilful damage to large stems in gathering the oranges. It would appear in many cases that the ants commence their activity from the broken ends of branches, working their way right down the centre of the trunk.

Remedies.

It is fortunate that notwithstanding all this, the trees are regarded as suffering very little in their fruit-producing capacity, so that up to the present, the necessity for any remedy has not been felt. There is no doubt, however, but that if all the wood and bark remained uninjured, the trees would live much longer, probably grow larger, and have a better yield. It is useless to suppose that trees largely hollow throughout, with only a portion of the bark and wood remaining for support and passage of nutrition from the soil, can yield the same amount as those in perfect condition.

Considering the great importance to which the orange industry seems likely to attain in Jamaica, it is very desirable that our planters should endeavour to bring about a different condition of affairs, and be able to obtain the utmost value from the trees. Up to the present, one reason has been that the orange cultivation has yielded practically no returns; now, however, when there appears to be the prospect of establishing a permanent trade with the United States and perhaps with Great Britain, it will no doubt be well worth the trouble of planters to keep the trees in good condition.

Much can certainly be done by taking proper care of the trees, which are indeed possessed of wonderful vitality. Ants or borers are not to be greatly feared if the trees get any care at all, but they have not got this up to the present.

Whenever the wood of a tree becomes exposed either by decortication or by the breaking off of some branch, the wound should be covered with some substance to prevent ants and other wood-destroyers effecting an entrance. A coating of tar is generally employed for this purpose, but diluted carbolic acid has also been found to be an excellent repellant.

This latter has also proved itself, in experiments conducted for the Institute by Mr. A. Townend, to be of use in ridding a tree of ants once they have established themselves. Jeyes' Disinfectant is used with success by some; while the addition of a little arsenic to the nest of the white ants is often used as a means of destruction of the whole colony.

For the destruction of the boring larva of the beetle, the trunk of the trees should be coated with a thick lime-wash to which arsenic has been added in proportion of one part of the arsenic to one hundred parts of the limewash. Wood ashes or some of the alkalies may with advantage be added to the limewash.

At present there is danger of Orange Trees in Jamaica becoming affected by the various species of scale insects, which in Florida and elsewhere have caused such serious damage. It is to endeavour to prevent this being brought about through the introduction of plants already suffering from the disease, that the Governor has issued the Proclamation prohibiting, except under certain conditions, the introduction of orange plants into the Island. Both the Botanical Department and the Museum have however received from planters in Jamaica specimens of orange trees, and also of the fruit, already attacked by scale insects, and are now engaged in investigating these.

"SELECTED" YEASTS AND GENERAL CONSIDERATIONS.

By Percival H. Greg.

In considering the question of the adaptability of the "selected yeast" system to our Jamaica Still Houses, a system which has found such favourable acceptance in other countries, we must first of all consider what are the requirements of the manufacturer of rum and the conditions under which he labours. I may say without fear of contradiction that wherever by *previous systematic experiment and by a careful study of the circumstances of the case, the right type or variety of yeast has been found*, that the application of the system has been an unqualified success: and that the right type or variety of yeast exists and may be found with the expenditure of a reasonable amount of energy is proved by the ever increasing numbers of Breweries and Distilleries working with selected yeast.

It would however be a mistake to assume that this has been accomplished in a day, or that the principles when first enunciated by Emil Christian Hansen were favourably received. Far from it! The advocates of the system had to encounter indifference, ridicule, and active opposition. It would however be beyond the scope of this paper to enlarge on these points, and would indeed be superfluous, since now that an English translation of Hansen's "Untersuchungen aus der Praxis der Gärungsindustrie" has been issued, those interested in the matter may drink in knowledge from the fountain-head. It is sufficient to say that the first success on a commercial scale was obtained by Hansen in the Old Carlsberg Brewery in the year 1883 or 12 years ago, and that since then the application of the system has not only grown steadily in the department in which it was first introduced, but the principles upon which it is based have found a successful application in many other directions. It seems natural therefore to question whether what has been so successful elsewhere may not succeed in Jamaica. At the first glance it seems evident that there is one very great difference to be distinguished as regards the application of selected yeasts between the manufacture of rum from pure cane juice and the manufacture of beer or spirit from cereals. In the case of beer, the "wash" or "wort" as it is called, i.e., that infusion of malt and hops which on being fermented yields beer, is after a lengthened period of boiling in the "wort" copper, and subsequent cooling on the refrigerators or "coolers", brought into the fermenting tuns in a more or less sterile condition. Of course experiments have shewn that a certain amount of aereal contamination invariably takes place, but in this case the germs are in a dessicated state, and it is pretty certain that by far the greater number of them find such a strongly hopped medium as ordinary beer-wort unsuitable for their growth in any considerable measure, at any rate during the primary fermentation; and of course great care is taken to "pitch" the wort, i.e. add yeast to it, immediately that oxygen in sufficient quantity has been absorbed, and a favourable temperature for fermentation has been reached. If then the wort be pitched with a selected and suitable type of pure yeast in sufficient quantity, there is very little to fear from the competition of foreign yeasts, i.e. yeasts other than the type intentionally employed.

In well-conducted Distilleries the case is practically the same, though here an intentional lactic acid fermentation in the yeast-mash is caused, in order that the antiseptic properties of the lactic acid which is formed, may protect the yeast from hard usage at the hands of other bacteria. After a sufficient amount of lactic acid has been produced however the lactic acid bacteria are killed, or at least rendered "*hors de combat*" by warming the yeast-mash up to 60° Reaumur. The mash or "wash" which serves for fermentation is also rendered sterile for all practical purposes by conducting the "saccharification process" at a comparatively high temperature, so that here again the desired type of yeast has the field practically to itself. But in the case of the fermentation of sugar cane juice the case is somewhat different. If we wish to give ourselves an idea of the results to be expected in the application of selected types of yeast in the fermentation of *fresh* cane juice, we must examine the results obtained in the application of this system in the preparation of wine, i. e., in the fermentation of the juice of the grape.

Grape juice and cane juice possess the property in common of entering into fermentations "spontaneously"—if left to themselves they begin to ferment without the addition of yeast.

Pasteur proved many years ago, see "Studies on Fermentation," an English edition of which is published by Macmillan & Co. London, that this was caused by the yeast cells which are found adhering to the skin of the grape, and on the crushing or squeezing of the grape come into immediate contact with the juice, and cause it to ferment. Recent researches have shown that the same process obtains by the cane. We can easily see therefore, that in order to obtain successful results, we must either get rid of the yeasts naturally present in the cane juice, or we must be certain in advance that in innoculating the juice with such and such a yeast, that we do it *with that particular yeast which is absolutely adapted for the work it has to perform and which will find the medium in which it has to ferment in a'l respects a suitab'e one.* If not, then we run the risk, that the struggle for existence which invariably ensues will ultimately end in "the survivel of the fittest," which may not perhaps give the kind of fermentation we desire. The following translation of an abstract of a lecture by Julius Wortmann, delivered before the 13th Congress of the Wine Trade in Mainz may prove interesting. This article is taken from the "Centralblatt für Bakteriologie und Parasitenkunde," and the title of this article is (translated). "The practical results obtained up to the present time with pure yeasts, and the practical lessons to be learnt with regard to the selection and application of the same."

"While the brewing and Spirit-Making industries have long ago made use on a practical scale, of the favorable results which were obtained in the Laboratory by Hansen's system of fermentation, it is only lately that these magnificent results have attracted the attention of those engaged in the manufacture of wine. It is but a few years back that the first attempts were made, to ferment grape juice by selected yeasts from the Laboratory. Up to then no attention had been paid to the yeast in grape juice fermentation, which was simply brought about by means of impure races of yeast which were derived from the grapes to which they were fortuitously attached. Such a fermentation by means of these races of yeast of unknown source, along with the simultaneous growth of all manner of moulds and bacteria, it is now attempted to displace by an addition of pure cultivated yeast to the "Must" (grape juice) and to bring about in its place a purer fermentation of a previously known character. Further it is desired by this means to do away with the products of decomposition of the organisms originally present in the Must, which frequently exert a disagreeable influence on the taste and aroma, and by this means obtain a purer tasting more even-charactered wine. After experiments in this direction, in the Laboratory of the Research Station at Geisenheim had led to favourable results, attempts were made on a practical scale with selected races of yeast, cultivated pure. Since as already mentioned the yeast which was added to the "Must" had to enter into competition with the organisms already present there, the pure yeast must be added(1) in sufficient quantity(2) in active fermentation,(3) and when possible should be added to the Must before it has begun to ferment. These conditions however, especially point 3, were in the latter end of the warm and dry Autumn of 1893, very diffiicult to attain. Because in consequence of the warm weather the yeasts attached to the grapes were very strongly developed, and thus swarmed in the expressed juice in large numbers, and at the same time the temperature being high, fermentation began quickly so that in by far the greater number of cases, the pure cultivated yeasts could only be added to the Must when it was already in a state of fermentation. In order to insure that the pure cultivated yeasts were not added to the "must" in a too weak fermentating or even partially inert state, the Research Station did not give the same to the wine-makers in accurately measured quantities sufficient to ferment a fixed quantity of must, but every fermenter received the freshy cultivated yeast in a few litres (1 litre=1.37 pints) of previously sterilised must when this must had nearly finished fermenting. According to instructions given with this, he (the fermenter), had then to cause this yeast to multiply by gradually adding to it larger and larger quantities of must, until he had by this means obtained a quantity of yeast sufficient for the whole quantity of must to be fermented. This method wass omewhat detailed for the fermenter. but he obtained by this means a sufficient quantity of yeast in active fermentation. In those cases in which it was possible by this method to bring the yeast into the must so that it obtained the upper hand from the commencement, favourable results were not wanting. Almost without exception the musts fermented by the pure cultivated yeasts were distinguished from the musts fermented in the ordinary manner, *by a quicker and more intensive fermentation and a more pronounced bouquet. . . . . .*"

The italics here are my own. In regard to what Wortmann writes concerning the state of activity of the yeasts naturally present in the grape juice, we may I think logically conclude that the same will be the case in a greater degree in cane juice, owing to the high temparatures prevalent in the Tropics: in fact my own experiments in this direction confirm his views. Indeed it is very much a question in my mind, whether, taking these difficulties into account, the "game would be worth the candle." This point however can only be decided by a course of *experiments* on a large scale. But the real fact of the matter is, that the total amount of fresh cane juice fermented in this country represents but a small fraction of the total amount of liquor which passes through the distillery. By far the greater bulk of the wash, as is well known, consists of skimmings, molasses, and dunder. But it is precisely for this reason that I consider that *systematically selected* types of yeast might be of such great service. In the first place, the "tempered" cane juice will, on the generality of estates, have been steamed in the Syphons, and though bearing in mind the resisting power of "spores" towards heat and the fact that the skimmings contain a large amount of wax which might enclose and protect some of the spores from the full effect of the heat employed, and further bearing in mind that we have no rigid experimental *data* to go upon in this particular instance, yet there seems very little doubt that their subsequent growth and development will have been retarded. As regards the molasses I have satisfied myself by microscopical examination, that in the generality of cases the micro-organisms present consist principally of Torulæ which possess but a slight fermentative power, and bacteria. These last might probably be very much diminished in number if proper attention was paid to keeping the sugar coolers and molasses hole clean. As regards the dunder this must evidently be sterile when taken from the still, and when not allowed to stand for any great length of time after having cooled down is probably but little altered.

It would seem then that as regards these liquids any particular cultivated yeast which we might desire to employ would not have to meet with any extraordinary opposition from other germs.

The subject naturally falls under two heads: First the effect of selected types of yeast in imparting (a) an increased regularity to the progress of the fermentations, (b) in giving the type of fermentation desired—slow or fast, and (c) in obtaining a greater yield of alcohol from a given weight of sugar; second, the effect of selected types of yeast on the flavour and aroma of the resulting products of fermentation, i.e., on the rum. In a previous paper (The Jamaica Yeasts Bulletin for August) I shewed in some tables that *other things being equal*, the whole character and nature of the fermentation varied with the kind of yeast employed. We may therefore dismiss questions a, b and c as not requiring discussion but before doing so we must consider *in how far the character of the fermentation produced by a given type of yeast may be modified by circumstances.*

It is obvious, since yeast is a living organism, that unless the medium in which it has to live is suitable to it, that it will not exercise its functions completely, i.e., will not assimilate or feed, will not grow and consequently will not ferment in the same degree which it could if the conditions were entirely favorable. It must not therefore be hastily assumed, that by using pure cultivations of selected types of yeast that a mere mechanical regularity in the fermentation will be assured, without any attention being paid by the Distiller to the nature and composition of his washes. But it is evident that by working with a *known quantity*, as we should do when working with a selected type of yeast, which has been originally grown from *one single cell*, that we are able to study the conditions or sets of conditions which may be favorable or the reverse to the yeast in question *in advance*, and thus we shall know what to *aim at and what to endeavour to avoid* in our practical operations. Whereas in working with a mixture of yeasts, we are working with an *unknown quantity.* What we can say therefore is this, that *other conditions being favorable,* the fermentation and the yield will be much more regular by the use of *one type or variety of yeast* than by the use of *a mixture of yeasts.* Thus supposing for the sake of illustration, that we have as a mixture of yeasts No. 4 and No. 18, one of which ferments in 3-4 days and the other in 12; the one producing comparatively speaking but little aroma and the other producing a very strong and definite aroma, it is obvious that we want the one and only the one of these two yeasts *according to the relation existing between the working capacity of our Still House and Boiling House and according to the character of the rum we require to produce.* If in comparison to our boiling and grinding power our Still House is large, we can afford to work with a slow fermentation, and there being no particular object then in emptying our vats quickly, we should no doubt be desirous of taking advantage of the aroma-producing power of No. 18 yeast. Suppose that we do so desire, but that instead of working with 18 yeast cultivated pure, we work with a mixture of No. 18 and No 4. What *guarantee* have then that at some future time No. 4 may not obtain the upper hand over No. 18, and that instead of working with a slow aromatic fermentation, we may suddenly find our "washes" attenuating with startling and unwelcome rapidity, and the aroma produced by fermentation decreasing? Or suppose exactly the opposite case: that we have a large crop good boiling and grinding power, but a small Still House. Here we are forced to work with a quick fermentation, and we desire a yeast giving a quick attenuation such as furnished by No. 4 yeast. Would it not then be very inconvenient to suddenly find our washes covered with a thick golden head, and lying apparently "lifeless" in the vats, with the density say at 20 arnaboldi? Yet I have seen and heard of such cases occurring in Jamaica Still Houses. *What in one Still House may be a perfectly normal and desirable fermentation may be quite abnormal and undesirable in another.*

We now come to the consideration of the second division of the subject. What would be the effect of pure selected types of yeast on the *quality* of the rum? In other words, granting that there would be an increase in the regularity of the fermentation, and in the yield of rum from a given weight of sugar, and that we might produce a slow or quick fermentation at will. Would the quality of the rum deteriorate? Should we in fact by this method manufacture not rum but *spirit?* The answer to this question will depend to a certain extent as to whether we are working with the methods at present employed to make "quality" rum, or "common or clean."

In my second "Contribution to the Study of the Production of the Aroma in Rum" which appeared in the September Bulletin, I shewed that my experiments led me to believe that a preliminary "souring" in the "trash" cistern was capable of playing an important part in the production of the Aroma in rum. And the trash cistern has long been considered as a sine quâ non by prrctical men in the production of high flavoured rum I have already stated that yeasts exist which are capable of influencing the aroma, and among the Jamaica yeasts which I have isolated there is one No. 18 yeast, which not only influences the aroma in a very marked degree, but it is also capable of inducing a normal alcoholic fermentation. It is an open question therefore whether an aromatic rum might not be produced by an absolutely pure yeast, without the intervention of a "trash" cistern at all. But nothing but *rationally conducted experiments in the Still House* can decide this question. Even if this should be proved to be possible, it would not be sufficient; the whole question has to be considered, to a certain extent, from a *commercial* point of view. Experience goes to shew that it is not only necessary to produce an aromatic rum to gain a good price, but to produce rums of *different* aromas. As far as I can understand, a particular kind of rum, which for a few seasons may command a high price, may afterwards lose the price *even though the character and quality have not deteriorated.* I believe "pineapple" rum and "new leather" rum are instances in point.

Therefore it behoves us to look at the matter in this wise. *Can the selected yeasts system and the "trash" cistern be worked in conjunction? Does the one method render the other impossible?* In other words we must consider the question with reference to *all* the means by which it is possible to produce aromatic rums, My own opinion is that taking into account the manner in which the duty is levied by the Excise, that not only can this be accomplished, but that the introduction of a methodically selected yeast into a Still House may be a great help to the efficacy of the working of the "trash" cistern. Quite otherwise might it be under another set of conditions : thus in Germany a longer period of fermentation than *three days* is not allowed.

What is the general opinion among practical men regarding the "trash" cistern? That it produces good rum but "slows" the fermentation! And the result of this? That good rum can only be produced on estates making small crops in comparison to the size or working capacity of the Still House. There is another consequence of the trash cistern, viz, that the *yield* is poor. This is so well known that it has come to be a generally accepted axiom, that quality and quantity cannot be produced simultaneously. This is certainly true under the existing state of things. It is possible that it will be true under any system of fermentation, but I doubt very much whether it need be true *to the same extent* under an improved system of fermentation, by means of selected yeasts working in *conjunction* with the trash cistern.

Why does the trash cistern slow the fermentation? I will answer it by another question. What are the *changes* which take place in the trash cistern? Says the practical man, "the liquor rots," "ripens" or, "decomposes" in it, which is very true—only rather vague? What does take place beyond a donbt is a production of acidity. But is not an acid medium favourable to yeast? It depends entirely *on the nature and extent of the acidity produced.* This is obvious. As I have already stated, in the production of spirit from 'Cereals" *lactic acid* is intentionally produced in the yeast mash or "good," because it has been found by experiment that lactic acid is an antiseptic and favours the yeast by surpressing by its presence the growth and development of other bacteria which are distinctly harmful to yeast. But though lactic acid may to a certain extent be produced in the trash cistern, acetic and butyric acids are also largely produced. That acids such as acetic and butyric exert an unfavorable influence upon the growth and development of yeast has long been known for a fact in Europe; that the same obtains here I have myself proved in the Laboratory. Some extent of the damage done may be inferred from the following figures which are taken from Mærckers Handbuch der Spiritus fabrikation (Handbook of Spirit Manufacture) p. 461.

Butyric Acid per cent. in Fermenting liquor.	Vol. per cent. Alcohol formed during the fermentation.
0.00	6.01
0.01	6.21
0.05	6.42
0.10	0.56
0.50	0.00

It will be seen that up to $\frac{5}{100}$ of 1 % the amount of alcohol formed is slightly increased from the case in which no butyric acid is present, in this case the increase in the amount of alcohol amounts to $\frac{2}{5}$ of 1 %, but when the butyric acid present amounts to something between $\frac{5}{100}$ and $\frac{1}{10}$ of 1 % the production of alcohol is *nil* for practical purposes. It will be noticed that these figures refer only to the influence on the yeast of the life products of the bacteria, but there is a special influence exercised by the bacteria themselves irrespective of the various acids which they produce. It is not the place here to enter into a discussion on this point, it is mentioned only to shew that the evil could not be remedied by neutralizing any excess of acidity which might be produced. Taking into account then the influence exercised by bacteria and their products, it is easy to understand that if we depend upon the trash cistern to furnish us with a supply of vigorous yeast to produce a fairly rapid and satisfactory attenuation, we shall be disappointed. The yeast will have been already weakened in its fermentative and reproductive capacities, and consequently the fermentation will be slow, that is to say the *rate* of attenuation and the yield of alcohol will be unsatisfactory. I am fully aware that trash cisterns are worked with the result of giving a fair average attenuation and yield viewed from the Jamaica standpoint, but then they are worked more on the lines of a "mother" cistern, i.e. are prevented from going radically sour by being always kept alive by periodical doses of molasses and dunder; but in these cases I have not seen real high priced rum produced. But when we understand that a *great deal* of the unsatisfactory nature of the fermentation may be referred back to the weakened yeast, we are inclined to enquire whether this cannot be remedied. Supposing that we cannot when working with the trash cistern have a fermentation which would compare in rapidity of attenuation and dercentage yield of alcohol with an ideally pure alcohol fermentation, what *amount of slowness* is necessary for the production of good rum? Is it absolutely necessary that the fermentation should last 2 or 3 weeks, or could it not be reduced, let us say, not to be too ambitious, down to 7-10 days without injuring the quality of the rum? And supposing that the yield *must* suffer what is the *limit of the amount* of quantity to be sacrificed to quality? In other words, may we not to a great extent be following the example of the ancient Chinese in the fable, in *that we are burning down our house to roast our pig, when the same thing could be done just as effectively with the expenditure of a less amount of valuable material!*

It must be remembered that this acid fermentation in order to produce an aromatic spirit is not peculiar to Jamaica. The bouquet "Whiskies" which have no doubt played a part in diminishing the consumption of Jamaica Rum are manufactured very much on the same lines. A certain portion of the "mash" mixed with dunder is allowed to undergo a 20 hour's "souring" but the yeast is grown sep rately in a specially favorable liquid, before being required to ferment the "soured" mash. The whole thing is worked on a perfectly intelligible and rational theory, which has been evolved from experiment. Having produced a giving amount of acidity it is desired to stop it, and to produce alcohol. But how can this be done when the mash contains a large amount of volatile acids and bacteria which are distinctly harmful to yeasts? It has been found by experiment that the stronger and better nourished a yeast cell is the better is it able to resist a disease. Therefore by growing the yeast first in a separate favorable liquid and employing it when its development is approaching its maximum, we give it the best possible chance of overcoming the bacteria. We are also able by this means to introduce the yeast in large numbers into the mash because having been kept separate from the bacteria in its reproductive stages, it has been able to reproduce itself fully.

Therefore by introducing the yeast in sufficient quantity and in a high state of physical efficiency even into a mash which is swarming with bacteria after having undergone a 20 hours "souring," it has been found possible to induce a very fairly rapid and satisfactory alcoholic attenuation.

The *average attenuation* in one of the biggest Distilleries in America where these so called sour mash whiskies are produced is: period of fermentation 4 days and attenuation 19° Balling down to 4°, the dunder used having a density of 4° to start with. This in Jamaica figures would be approximately 25.27—5.32=19.95 degrees attenuation. Now it suggests itself that the same principle might with advantage be applied here, that is to say one vat or ground cis ern might be started in good fermentation by means of pure fresh cane juice, and as fast as it was "cut" out into other cisterns, filled up with a suitable mixture of pure molasses and dunder, so as to keep it always alive meanwhile the souring process might go on in the trash cistern. This is very much the "modus operandi" that would be followed if a yeast propagating apparatus was used, the *general* method of working it being, to take the yeast or the fermenting liquor from the apparatus and set up a vat with it, the liquor of which should be as pure as practical considerations will allow, and then to "cut" from this vat into other vats. When this No. 1 vat as I may call it gets exhausted or impure, it is cleaned out with scrupulous care and a fresh supply of yeast from the propagating apparatus is put in and so on. As to the advantages which we possess in working with a yeast producing a fermentation of a *previously known character* in comparison to working with mixtures of unknown yeasts, present in unknown and varying proportions, as would be the case if we started our No. 1 vat with cane juice, instead of yeast from the apparatus, I have enlarged on in the earlier portion of this paper, and I can only add that the surest way to attain perfection in a manufacture which is *admittedly* subjected to unaccountable and unlooked for changes, lies, *in the elimination of the uncertainties, unknown quantities and potential causes of variation* as far as lies in own power, It might therefore be possible by the selected yeast system working in conjunction with the "trash" cistern or working by itself not only to obtain a greater control over the progress of our fermentations to make "quality" rum at a less sacrifice of time and material, but to alter the character of the resulting rum to a *certain* extent at will. Thus further search might reveal the presence of other aroma producing germs besides No. 18. We mightt herefore in the future be able to produce an aromatic rum by a pure fermentation of 18 yeast or some other aromatic germ without the trash cistern. Again we might set to and manufacture an aromatic rum by means of No. 18 yeast working in conjunction with the trash cistern, or again a different charactered rum by any of yeasts No. 1, 4, 5, 7, 8, 14, 17 or 19 working in conjunction with the trash cistern according to circumstances. So muchf or the case where it is desired to produce an aromatic rum. With regard to the production of common clean rum it would seem as if the introduction of a selected yeast giving a rapid attenuation and big yield could not fail to be of great service. It might prove of great value in producing a purer and more even charactered rum containing less bye-products which might be fit for speedier or *direct* consumption and by this means the consumption might be stimulated.

As to this and all other questions raised in this paper I would impress up on those whom these matters may concern, that mere theorising is of no use at all. Laboratory experiments are *indispensable* in shewing whether there is an á priori *possibility* of an improvement being effected or a reform carried out in these matters, but the deciding word can only be spoken after *systematic experiments in the Still House itself have shewn whether the reform is practically possible.* At the same time I am of opinion that much *may* be done in Jamaica Still Houses, and this is a very important point in these days, at a very much smaller expenditure of money than would be required to effect an equal improvement in our Sugar manufacture. In the old days when the sugar crops were smaller in proportion to the working capacity of the Still houses, "spontaneous" fermentation could be trusted to do the work, but now-a-days, owing to the sugar crops having increased, a great many estates *habitually* run their liquors before they are "dead" and the consequence is an inferior product all round, is put on the market; and the consumption of rum, though certainly not exclusively owing to this cause, has de creased. Greater demands therefore are made on the fermentating agent, i.e, on the yeast, and therefore greater attention and care must be bestowed on the yeast question than has hitherto been bestowed.

NOTES OF THE CULTIVATION OF VEGETABLES.

By W. Harris, *Superintendent of the Hill Gardens.*

The Jamaica Agricultural Society has decided to distribute free, small quantities of seeds of the Vegetables named below, to small Settlers who will undertake to report to the Secretary on the results obtained. The following short notes on cultivation should be carefully attended to.

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 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 hoe. 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 the depth of half an inch, or an inch.

The best time to sow seeds and transplant young plants is during showery weather.

Beet 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 12 hours before sowing, then taken out, allowed to drain, and sown whilst still damp, and covered to a depth of 1½ or 2 inches.

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 distance 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.

Carrots.

Carrots require a good light soil which has been previously well dug and manured.

Sow in drills at a distance of 12 inches between the drills. 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. The young plants taken out may be used to supply vacancies, or to plant elsewhere, but these carrots are never so good as those which are not disturbed.

Cucumbers.

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 hills, 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.

Egg Plants.

Sow in nursery beds, and plant out when strong enough at a distance of 3 feet apart in a row, the rows being 5 feet apart.

A good rich soil is necessary, plenty of thoroughly rotted short stable or cattle manure should be dug in and a good plan is to place a shovelful or so of ashes round the stem of each plant. A sheltered position should be chosen, where abundance of water can be given.

If well-grown, large fruits are desired, only a small number should be allowed to each plant. The ends of the branches should be pinched off when the fruit is ripening.

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.

Leeks.

The Leek prefers a light rich soil, and an open situation.

Well rotted stable manure should be applied to the land some months before the plants are put out.

The seeds should be sown thinly in a box, or in shallow drills in a seed bed, and lightly covered with fine earth. If the plants come up too thickly they should be thinned to about an inch apart. Trenches 1 foot wide, 9 to 12 inches deep, and about 18 inches apart, should be dug and the soil taken out should be heaped up between the trenches for future use. The soil in the bottom of each trench should be broken up fine. When the seedlings are about as thick as a goose quill they should be planted out in the trenches, allowing a space of 9 to 12 inches from plant to plant. Transplanting should be done in showery weather, and the seedlings should not be planted deeper than they were growing in the seed box or bed. As the plants increase in size they should be earthed up occasionally with the soil from between the trenches to make them turn white.

Lettuce.

The soil for Lettuce should be well manured with good rotten manure. The seed should be sown in boxes, and as soon as the young plants are large enough to handle, they should be thinned out. The plants removed in thinning should be transplanted at a distance of 12 inches apart in rows 15 inches apart. After transplanting it will be necessary to water 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.

Bush Lima Beans.

The soil for these should be light and open; if stiff and wet, the seed rots without germinating.

Plant in drills 2 feet apart, and the seed about 6 inches apart in the rows. Cover the seed to the depth of 1½ inches. Hoe occasionally between the rows to kill the weeds and keep the surface of the soil open.

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 insure 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.

Radishes.

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 4 feet wide, and the surface lightly raked over after sowing. In dry weather the beds should be watered early in the morning.

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 transplanted 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 side growths to throw all the strength into the main stem. The Tomato is a gross feeder and should be liberally supplied with mulching material and irrigated freely till the fruits begin to ripen, when they should be kept rather dry at the roots.

Turnips.

Turnips succeed best in a light sandy soil that had some months previously been well manured; soil that has just produced a crop of potatoes, or peas, suits turnips very well.

Stiff retentive soils never produce good, well flavoured turnips.

Drills should be drawn about 2 inches deep and 12 inches apart, and the seed sown thinly. As soon as the young plants are large enough to handle, 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 should at all times be kept open, and free from weeds.

Water Melons.

Melons thrive best in a rich light soil; the hills should be from six to twelve feet apart each way, according to the richness of the soil. Previous to planting, mix well with the soil in each hill a couple of shovelfuls of thoroughly rotted manure; plant four or six seeds in each hill, and when well up, thin out leaving only one strong plant. Pinch off the leading shoots as the plant 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 quicker.

THE BERMUDA LILY.

By W. Harris, Superintendent of the Hill Gardens.

The Bermuda Lily, is so called because it is cultivated as a field crop in Bermuda to supply the New York Market with bulbs to produce flowers for decorating Churches at Easter time,—a purpose for which the beautiful pure white blooms are admirably suited.

This Lily is a native of Japan and China. It is the variety *eximium* (choice) of *Lilium longiflorum,* though it is known in Bermuda as *Lilium Harrisii.*

Propagation. The species of Lilium are increased by seeds, by off-sets, or by detaching some of the scales from the outside of the bulbs. The scales may be placed in boxes, or in open ground and covered with soil after the manner of sowing seeds. If the scales are carefully detached from the bulbs, the latter are not in any way injured, and may be used for planting again.

The usual method of propagation, however, is by off-sets, which are generally freely produced round the old bulbs.

Cultivation in a Garden. Lilies are herbaceous perennials. The stems should not be cut down but allowed to die down after flowering. No signs of growth are visible till early in the following year. Autumn, when the stems have died off, is the best time to take up the bulbs, in order to detach the off-sets or scales. Then replace as soon as possible.

Lilies like a light, well-drained soil, which should be highly manured, and situated in a sheltered, partially shaded spot. The bulb should be planted about six inches deep.

As soon as the flower-buds are sufficiently advanced to be seen, a heavy mulching of rotten manure, with plenty of water during dry weather, greatly assists in developing fine blooms.

Pot Culture. These Lilies make splendid pot plants, and last in bloom for a considerable time. The bulbs should be potted in the autumn, when at rest, in a mixture consisting of good loamy soil, rotten manure and sand. The method which we adopt, and which has been very successful, is to lay only a couple of inches of the potting mixture over the drainage in a 6 or 7 inch pot, on this place our bulb, which should be sound and plump, and fill with sufficient potting material to slightly cover the bulb. The soil in the pot is kept just moist till growth commences, which will be indicated by the formation of a shoot in the centre of each bulb. As the shoot develops, the pots are gradually filled up to within half an inch of the top, with thoroughly rotten manure, and water is freely given.

Field Cultivation in Bermuda. The system of field cultivation followed in Bermuda is stated to be as follows :—

The land is prepared by being ploughed, harrowed, etc , and very richly manured as the Lilies are very heavy feeders, having a set of roots from the stems as well as from the under part of the bulb. They are planted in drills rather deep. The crown of the bulb should be at least 6 inches under ground. This way of planting however, is adapted to light soils. If the soil is heavy the bulb should not be planted quite so deep, but a better shaped bulb is always obtained by deep planting ; when they are shallow they split up and do not make good bulbs.

FERNS: SYNOPTICAL LIST—XXX.

Synoptical List, with descriptions of the Ferns and Fern-Allies of Jamaica, by G. S. Jennan, Superintendent Botanical Gardens, Demerara, (continued from Bulletin II, 9.)

TRIBE IX. ASPIDEÆ.

5. *Aspidium mucronatum*, Swartz.—Rootstock usually upright, stout, fibrous and very densely paleaceous and fibrillose; stipites strong, spreading, cæspitose, 3–10 in. l., thickly clothed like the rootstock; fronds spreading around, pinnate, 1–2½ ft. l. 1½–3 in. w., acuminate, reduced at the base; very coriaceous, glossy dark green above and nearly or quite naked, beneath pale and slightly rusty ciliate, the rachis strong, channelled, and densely rusty-fibrillose; pinnæ sessile, very numerous, spreading horizontally, close and often imbricated. sub-distant in the lower part, 1–1¾ in. l., 4–5 l. b., truncate and auricled on the upper side of the base, the inferior shortly cut away and often hollow, tapering outwards, the apex acuminate and mucronate, margins cartilaginous-edged, sub-entire or more or less deeply crenulate-serrulate, teeth rounded, or appressed and slightly mucronate; veins obscure, very oblique, 2–3 times forked; sori copious, uniserial on each side, nearer the margin than midrib; involucres circular peltate, deciduous.—Hook. Sp. Fil. vol. 4. t. 216.

A. var. *pinnatifidum*, fronds 4–5 in. w. pinnæ ½ in. w. lobed or deeply pinnatified, lobes sharp and mucronate.

Abundant in dry stony woods and on shady and open banks, from 4,000–6,000 ft. altitude. Remarkable for its dark colour and copious ferruginous vestiture of the crown and main rachis, that of the former, ascending the petioles. The vestiture is of a mixed character,—large paleæ, which are often tinged black, and fine fibrillæ or tomentum. The sori become dark brown with age, often blackish. It is sunk in the surface, which is papillose on the upper side. The lower reduced pinnæ are generally barren. The veins are pinnate in the basal auricles, and the sori in a double series. There is a fasciated form, gathered by Mr. Nock, that is repeatedly furcate. It is a well individualised species, much more robust, and not nearly so variable as the next.

6. *A. triangulum*, Swartz.—Rootstock usually upright, fibrous, clothed with glossy, blackish, brown-margined scales; stipites tufted, rather slender, clothed, especially at the base, with dark brown paleæ, above this deciduously fibrillose as is less so the rachis, 3–9 in. l.: fronds 9-18 in. l. 1–2½ in. w., erect, or spreading, pinnate, acuminate, not proliferate, usually somewhat reduced at the base; very coriaceous, naked or the underside slightly filamentose-scaly light green; pinnæ spreading often rather falcate, very numerous, close above and subdistant below, ½–1 in. l. 2–6 l. w., deltoid, lanceolate, or ovate-lanceolate, the base expanded and auricled on the upper or both sides, the lower usually obliquely cut away, the auricles and point mucronate, *margins* subentire, or dentate-spinescent, *rachis* rather slender pale brown, naked or fibrillose; veins close, very oblique, 2–3 times forked, pinnate in the auricle; sori forming a nearly medial row on each side of the midrib; involucres circular peltate, deciduous.—Hooker aud Baker, Syn. Fil. p. 250. Gr. Fl. B. W. I. p. 689.

a. var. Size and form of the type, but apex of the fronds retuse and viviparous.

b. var. Pinnæ $1\frac{1}{2}$ in. l deeply inciso-dentate and spinulose, the auricle deep but not free.—*Polystichum laxum*, J. Sm.

c. var. Pinnæ not reduced at the base of the frond, stipitate, ovate, $\frac{3}{4}$–$\frac{1}{4}$1 in. l. 6–7 li. w. above the auricle, which is fully connected or more or less free, forming an ovate segment, margins freely spinulose dentate.

Common on rocks and dry banks from 2,000–6,000 ft altitude, general in elevated districts all through the country. A very variable species The variations, speaking only of the forms here associated with the type occur in the size of the frond; the size and shape of the pinnæ, and the degree of their spinescent dentation. There is a small prostrate state, with few pinnæ, only 2 or 3 in. l. hardly spinulose at the angles. In some forms the pinnæ are flat; in others they are undulate with the spiny teeth projecting at different angles, which give the leaflets a very holly-like aspect. In this species too, the sori often turn black at maturity. Variety b is Fig. 1 of Sloane's History t. 36. Some of the following plants, associated here with this species might well. seen above, be regarded as distinct, but the numerous links show that they are only modifications of this type. One or two of them run almost into *aculeatum*, from which the rigid texture is about the most reliable distinguishing character.

7. *A. tridens*, Hook.—Rootstalk oblique or upright, densely clothed with blackish scales; stipites densely tufted, slenderish, 3–6 in. l. the upper scales becoming brown; fronds pinnate or bi-pinnate spreading, linear-lanceolate, acuminate, base not reduced, 6–12 in. l. 1–2 in. br. very rigid; pinnæ very numerous, cuneate-stipitate, tri-partite the central segment much the largest and inciseo-dentate at the base, as also are the spreading lateral ones in the larger fronds, the parts sharply spinulose.—*A. tridens*, Hook. sp. Fil. vol. 4 t. 215.

On dry banks in the Port Royal Mountains from 2,500–4,000 ft. altitude; gathered near Arntully Gap, 2,500 ft. alt. a peculiar, pretty plant, usually very uniform and definite in its characters, still varying somewhat, and very distinctly of the triangulum group. In small fronds the pinnæ are nearly trifid, but in the larger they are fully tripartite, the lateral segments being free and cuneate at the base. Occasionally a plant is found in which the segments on the underside are much reduced, showing a closer passage to or from triangulum.

8. *A. viviparum*, Hook.—Rootstock stout, erect, densely clothed with large blackish-brown scales; stipites cæspitose, 4–6 in. l., erect-spreading, strong, clothed at the base like, the rootstock, above fibrillose or naked; fronds rigid, lanceolate, or oblong lanceolate spreading, bi-pinnate, tapering at the apex to the blunt viviparous summit; pinnæ spreading, very numerous, acute, oblong-lanceolate, 2–3 in. l. $\frac{1}{2}$–$\frac{3}{4}$ in. br., fully pinnate within, the outer part pinnatifid; segments close, rather imbricating ovate, mucronate, the interior one on the superior side enlarged, more apart and free than the rest, 4–6 li. l. 2–3. li. w. their margins even; rachis strong deciduously fibrillose; sori copious, biserial. —*Polystichum viviparum*, Fée. Mem. p. 21. Tab.3.

a. var. Fronds exactly similar, but pinnæ only serrate or inciso-serrate, the auricled base on the upper side sometimes separated into a free spinulose- pointed, ovate free segment.—Sloane's Hist. t. 36, Fig. 5. *Aspidium trapezioides*, Swartz.

Common in light stony woods and on similar shady banks at 2000-3000 ft. altitude; the sub-type in St. George, Portland Parish, gathered at Clydesdale, and the variety in the western Parishes, Clarendon, Manchester and St. Elizabeth. A strong robust plant, very coriaceous the two states described being each very uniform in itself; in the former the fronds gracefully arch over and root at the apex, and the pinnæ are uniformly pinnate-pinnatifid along both sides, the segments ovate, crowded and sharply spinulose at the point; in the latter the fronds are not radicant and the pinnæ are only serrated, or lobed only at the upper base. This latter is often mistaken for *A. mucronatum*, Sw.—which in form it closely resembles, but differs from in its paler colour, and chiefly, the absence of the dense rusty vestiture which clothes the rachis of that species.

sub. sp. *rhizophorum*.—Stipites slender, slightly scaly, spreading. 3-9 in. l.; fronds horizontal or erect-spreading, 6–10 in. l. 1–2 in. w. pinnate, not or somewhat reduced at the base, the apex of the barren one terminating in a slender pliant, often thread-like, radicant tail several inches long; pinnæ contiguous or more or less apart or distant, auricled at the base, the margins even, crenate or dentate, but not much spinescent; rachis slender.

a. var. bipinnatum,—Stipites a foot or less long, slender, scaly at the base; fronds a foot or more l. uniformily fully bipinnate, passing into a short slender straight radicant tail at the apex; pinnæ apart, spreading the outer part dentate lobate, spinulose; segments spathulate, 2–5 li l 1–2 w. spinescently acute

Frequent on the Red Hills near Kingston and extending through the western Parishes. This resembles *Polypodium reptans*, Sw. in habit. the fertile fronds being erect, devoid of a tail, as a rule, and with petioles twice as long as those of the barren ones. In the latter the upper pinnæ become gradually more distant to the uppermost of all, terminating abrubtly. The roots are reddish—villose. This is somewhat different from *Polystichum ilicifolium*, Fée, Wright n. 829 Cuba, in which the fronds are narrower, the pinnæ as broad as long, and very spinulose at the angles. Wright n. 828 is near our plant. The variety *a* found in the Western Parishes, differs only from *A. aculeatum*. Sw. by the tailed apex and its coriaceous texture, and is a nearly complete final link in the series of forms passing from typical *triangulum* to that species.

sub sp. caudatum.—Stipites 4—8 in. l. scaly at the base, cæspitose, springing from a decumbent or upright rootstock, fronds spreading or prostrate, lanceolate or oblong lanceolate, tapering gradually upwards and terminating (both the barren and the fertile alike) in a 1—2 in l. naked stiffish tail, with a scaly bud at its summit; pinnæ numerous, horizontal, apart but contiguous, the lower ones hardly or little reduced 1—1½ in. l. ⅓—1½ in. w bluntish or acute, serrulate or lobulate, not at all spinulose. *A. caudatum*, Jenm. Journ. Bot. vol. 8. p 260.

Frequent in the western Parishes, Manchester, Clarendon, &c., above 1,500 or 2,000 ft. altitude. In this, as a rule, the rigidity and spinulosity of the type are quite wanting, but odd fronds present indications of these characters. The pinnæ are oblong lanceolate, the upper base being parallel with the rachis and somewhat auricled, the underside cut away. The upper part of the rachis is flat and margined, the short straight tail being also margined, terminating in a scaly bud or young plant.

sub. sp. *latipinnum.*—Stipites 4–8 in. l. deciduously scaly brown; fronds pinnate, pinnatifid in the upper part, not tailed, terminating in a retuse, viviparous apex, erect spreading, 8–12 in. l. $1\frac{1}{2}$–$2\frac{3}{4}$ in. b. the base truncate; pinnæ 1–$1\frac{1}{2}$ in. l. $\frac{1}{2}$–$\frac{3}{4}$ in w., margins plain or with shallow appressed teeth, the acute point mucronate; complete row of sori medial, 1–2 incomplete outer rows; rachis fibrillose or naked when dry. *A. triangulum,* Sw. var. *latipinnum,* Jenm. Jour. Bot. vol. 8 p. 260.

Arntully Gap, 2,000 ft. altitude. This in its dark colour and dark vestiture diverges somewhat from the group, but the affinity is all the same quite unmistakable. It is further marked by its flat rhomboidal pinnæ and lobed or only pinnatifid proliferous upper part In the smaller states the upper part is subentire, suggesting very strongly the connection of *rhizophyllum* and *Plaschnickianum* with the group. A small plant in the British Museum, marked by me var. *Wilesianum,* probably, speaking from memory and my notes, belongs here.

9. *A. aculeatum,* Swartz.—Stipites cæspitose from an upright densely paleaceous rootstock, 6—15 in. l. thickly clothed with ovate or lanceolate brown scales at the base, fibrillose upwards; fronds lanceolate, or ovate-lanceolate, narrowed often more or less abruptly upwards, and acuminate, 1—2 ft. l. 3—8 in. w. firm chartaceous or subcoriaceous, rachis and costæ reddish-fibrillose, the latter margined, upper surface glabrous, glossy, green, under rather fibrillose, or naked, and paler, broadest in the lower part; pinnæ distant or sub-distant below, close above, spreading, oblong or lanceolate, blunt or acuminate, the lowest not, or little reduced, $1\frac{1}{2}$—4 in. l. $\frac{1}{2}$—$1\frac{1}{4}$ in. w., pinnate; pinnulæ close, ovate-rhomboidal, the base on the upperside truncate and subauricled, cut away on the under, 3—8 li. l. 2—3 l. w., upper and outer margins crenate-dentate, the teeth and point aristate; veins repeatedly forked or pinnate; sori medial, uniserial on each side, or duplicated in the auricle; involucre orbicular, deciduous, Pl Fil. t. 37. Eat. Fer. N. Am. p. 62.

Common in shady and moist situations above 4,000 ft. altitude, very variable. I have included two forms which seem to pass gradually one into the other. The smallest state of all is 1–$1\frac{1}{2}$ in. w. and bipinnate only at the base. The larger is *A. Phegopteridium,* Baker. This and the next have an evident connection with the *triangulatum* group, but the habit is more lax the texture thinner, and teeth not rigid. In the minor form the pinnæ are cuneate at the base and ovate-oblong, or in some instances, subspathulate and the texture is herbaceous. The larger state varies a good deal in the size of the pinnules. That with the broadest and flattest is *Polypodium platyphyllum,* Hook. (*Aspidium,* Willd., *Phegopteris,* Mett.) Syn. Fil. p. 310. which is generally found without involucres. From one-third to half the upper part of the frond is simply pinnate in even the larger states, and tapering. Spread in varying forms throughout the tropical and temperate regions of the globe and entering the arctic zone.

sub. sp. A. *Moritzianum*, Klotzsch.—Rootstock stout upright densly paleaceous; stipites 1½–2 ft. l. clothed like the rootstock at the base and fibrillose upwards, and is also the rachis and costæ; fronds 2½–3½ ft. l. 1½ 1¾ ft. br, oblong, suddenly and shortly acuminate at the top; pinnæ spreading horizontally, contiguous above, distant or subdistant below, sessile, linear—oblong.—*A. Moritizianum*, Kunze. *A. ordinatum*, Kl. in Linnæ 20 p. 361. *Polystichum giganteum*, Fée.

Common on the banks of streams in forests at 4,000-6,000 ft. altitude; also ascribed to Trinidad. A much larger plant than the type, of a uniform width from the base upwards, shortly or abruptly but finely acuminated at the the top, and densely paleaceous. The auricle forms a free segment in the basal pinnules and the vestiture of the rachis and costæ sticks to the surface of drying paper like cobweb. *Polypodium rigidum*, Hook & Grev. Icon. t. 163 is this without involucres. From Mexico to Venezuela, Brazil and Peru, it is a very common but as variable Cordillerian type.

CONTRIBUTIONS TO THE DEPARTMENT.

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West Indian & Commercial Advertiser. July, 1895. [Editor.]
Times of Ceylon. Nos. 28-33. July & Aug., 1895. [Editor.]
Return. British Museum, 1895. [Director.]

SEEDS.

From Royal Gardens, Kew—
Howea Belmoreana
Hedyscepe Canterburyana
Juania australis
Pedalium murex
Aristotelia racemosa
Uncaria Gambier
Seeds from Somali land.

From Botanic Gardens, Brisbane—
Acacia Farnesiana
Albizzia odoratissima
Barklya syringifolia
Bauhinia alba
" Hookeri
" purpurea
Brunfelsia latifolia
Buckinghamia celsissima
Cassia mimosoides
" pistaciæfolia
Cocos plumosa
Datura cornigera
Diplothemium maritimum
Dombeya mollis
Dracæna Draco
Eucalyptus Baileyana
" corymbosa
" hæmastoma
Excœcaria sebifera
Ficus Cunninghamii
" macrophylla
Gleditschia triacanthos
Grevillea robusta
Hibiscus tiliaceus
Hæmatoxylon campechianum
Juniperus Bermudiana
Lafœnsia punicæfolia
Lagerstrœmia flos-Reginæ
Livistonia australis
Myrospermum Pereiræ
Macadamia ternifolia
Ochna atropurpurea
Panax elegans
Phaseolus Caracalla
Pseudotsuga Douglasii
Rhaphiolepis indica
Sabal Blackburniana
Schotia latifolia
" speciosa

Stenocarpus sinuatus
Sterculia acerifolia
Tectona grandis
Terminalia Arjuna
Thuya pendula
Trachycarpus excelsa
Taxodium distichum.

From Botanic Gardens, Odeypore—
Clitoria Ternatea, alba
Duranta Ellisia
Gleditschia ferox
Kigelia pinnata
Santalum album.

From Botanic Gardens Bangalore—
Mimusops Elengi.

From Botanic Gardens Trinidad—
Brosimum Aubletii.

From Botanic Gordens, Grenada—
Dypsis madagascariensis.

From Botanic Gardens, Demerara-
Souari nuts.

From Mr. T. Christy, 25 Lime Street, London—
Maragogipe coffee.

From Havana Board of Agri. Industry & Commerce—
Tobacco.

From Hon. J. W. Fisher, Stewart Town—
Breadnut.

From Mrs. Wynne, Mandeville—
Brunfelsia jamaicensis.

From F. Kemble, Esq., Kingston—
Moringa aptera.

From Sir H. H. Hocking—
Manilla Mango.

From Geo. Nash, Esq., Mandeville—
Dipteryx odorata.

BULBS.

From Govt. Botanist, Victoria—
Eurycles Cunninghami.

PLANTS.

From J. W. Edwards, Esq., Ramble—
Broughtonia lilacina
Brassavola sp.
Oncidium luridum.

NOTE.

The Director will be at the JAMAICA INSTITUTE on the morning of the first Friday in every month between the hours of 10 and 12 o'clock for the purpose of giving information to those who may wish to consult him.

New Series.] DECEMBER, 1895. Vol. II. Part 12.

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EDITED BY

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

Director of Public Gardens and Plantations.

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NOTES ON COFFEE FROM LABORIE'S COFFEE PLANTER.

SITUATION.

Climate.—Coffee trees delight in the cool climate of the mountains, up to 4,500 feet, where the rain is abundant all the year round, alternating with bright sunshine. On the lower mountains, especially where they are subject to dry sea breezes, the berries will often be empty, mildewed, or scorched, and the tree short-lived.

Soil.—The best soil is a free, open virgin soil, four or five feet deep. On steep slopes the soil should be firm, but not clayey, mixed with a proportion of sand, gravel, or small stones through which water may easily pass. Even on white limestone, if the climate is rainy, coffee will flourish where the rocks are mixed with deep soil.

The indigenous vegetation is useful as a guide to richness of soil. As a rule, where the trees are large, high, and numerous, and the underwood luxuriant, the soil is good, but the exceptions are mahogany, hardwoods, and the cabbage palm, which may indicate poverty of soil. It is important to have plenty of running water.

Aspect.—In low and hot places, the best aspects are the north and west, because they are cooler. On the contrary, the east and south are the best in the highest situations. Strong winds are very injurious.

CULTIVATION.

Distance.—The quality and aspect of the ground ought to be the ruling guides to determine the distance of the trees from each other. The general rules are as follows :—

(a) The richer the soil, the aspect being the same, the more distant must be the trees.

(b) The cooler the aspect, the quality of the soil being the same, the further asunder the trees must be planted.

(c) If on the north and west the ground is good, plant still farther. If, on the contrary, in the east or south it is light, plant still nearer. In both cases there is a double reason, namely, the quality and the aspect.

Accordingly, if to the south and east you plant at six feet, the quality of the ground being the same, plant at seven to the west and north, if the descent is steep ; or at six by seven if it is easy, (the greater distance being between the rows), for where the descent is steep, the higher trees cast a longer shade upon those below.

(d) Where the wind blows strong it is an additional reason to plant at a still greater distance, because in that case the trees must be topped lower, and of course will spread out more in width.

[The distance at which coffee trees are planted in the mountains is 8 feet by 8, 7 feet by 7, or 6 feet by 6, but at lower elevations it may be 5 by 5, or even 4 by 4 feet].

Lining.—To mark off the ground for planting, take a line of convenient length and divide it at the chosen distances of 6, 7, or 8, feet with small scraps of scarlet cloth.

Commence by getting two men to stretch the line along the ground at the top; drive in pegs, 18 inches long, at each spot marked by the scrap of scarlet.

Next move the line down to the distance determined on, either 6 or 7 or 8 feet, measuring this distance, by sticks of the proper length, at both ends and in the middle. Put in pegs at the scarlet scraps; and so on, through the whole ground.

Holes.—Holes should be dug at the pegs 9 to 12 inches in diameter, and 15 to 18 inches deep.

Nurseries.—Plants should be raised from seed in nurseries. The most level piece of ground should be selected, where the soil is crumbly. Make shallow trenches about 6 inches apart, put in the seeds about one inch from each other, and lightly cover with soil. The seeds should be quite ripe and fresh and be taken out of the cherry. The nursery should have two oblique gutters made above it to carry off the rain. It must be kept very clean of weeds, and no corn nor anything else grown in it. April is the best month for sowing.

Removal from Nursery.—When the seedlings are about a year old, and have 4 little branches, they may be taken up to plant out. If possible, they should be dug up with a ball of earth, so that the roots are not disturbed, and so planted in the holes. But if they have to be carried a long distance, the balls of earth make them too heavy. In this case put a spade deep below the roots, and raise the earth, take the seedling by the stem, and carefully remove the earth. Cut about an inch off the tap-root, a little also off the other roots, [and about half off the leaves.] If the seedlings have to be kept before planting can be carried out, lay them in a shady place, cover the roots with moist earth, and lay plantain leaves over all.

Planting.—The earth taken out of the hole, and placed on the slope below it, is not to be returned to the hole, but the soil is scraped up from all round, and put into the hole about 4 or 5 inches deep. Then the plant is taken with the left hand and placed in the hole so as to just touch the soil at the bottom with the tap-root. With the right hand scrape up the soil round and fill into the hole to the depth of 6 inches, taking care that the roots are spread out in a natural position. Then lightly press down with both hands. Soil is again filled in, and again pressed down more strongly, but with care that the plant be not hurt, nor placed crooked. Three or four inches of the hole are left open, which will be filled in naturally, as weeding goes on. The plant must be so placed that its two lower branches are rather below the level of the ground. The peg is to be placed at the upper edge of the hole, as a fence against stones rolling down, and as a mark if the plant should happen to die.

Shade during first year, &c.—In order to shade the young plants during the first year, corn should be sown beforehand in the middle between the rows and a row of beans on each side between the corn and the coffee. Plantains may be planted at the bottom sides of the roads, at distances of 6 to 8 feet apart, taking the place of the coffee at those spots. Sugar canes may be planted along the road-sides between. These will keep up the roads. The top sides of the road may be planted with cabbages, parsley, &c., but not with turnips, carrots or beets which have to be dug out. No tobacco should be allowed, as it seeds very freely, and exhausts the ground. No ground provisions, yams, sweet potatoes, &c., should be planted as they loosen the ground too much. (For permanent shade, see "Accidents, *e*").

Weeding.—Weeds take so much nourishment from the coffee, that perhaps half the crop will be lost, if the weeding is not attended to, and eventually the coffee tree dies. If the land is steep, and the earth soft and crumbly, weeding should be done by hand, and not with the hoe. The weeds should be heaped up above the trees between a tree and the one above it. The weeding should be done in good time so that the weeds are not allowed to seed. [Young coffee should be weeded every 6 or 8 weeks. Prime coffee at least 4 times a year. It is a good plan especially with old and neglected coffee to cut grass and lay it on, or thatch, the surface of the ground, as it keeps down weeds, makes the soil cool, and forms manure.]

Accidents.—(a) If, in weeding, the young coffee trees are seen to be withered, the vacancies must be supplied with larger plants with balls of earth round their roots, planted in wider and deeper holes, adding some manure. [Nurseries of the smaller plants should be made in new fields for supplying the following year].

(b) If any plant is found broken or twisted, it must be cut close to the ground in a sloping direction, the cut surface facing the north. Suckers will shoot up from this, of which only the best should be preserved.

(c) When, after a light shower of rain towards noon, the sun comes out strong, the young plants may be blasted, or the green berries mildewed. The only remedy is to plant afresh.

(d) Often and especially when the trees are 18 or 20 months old, the leaves become yellow and withered. The cause may be a premature crop of berries. These should at once be stripped off entirely, If after few days it does not begin to recover, it is probably eaten at the roots by a large white grub. The tree must be taken up and the grub removed; a larger hole should be made which should be left exposed to the sun for a fortnight, and planted again.

(e) In hot situations, banana and plantain trees are mixed with the coffee trees for the purpose of shade and coolness. These are usually placed at every fourth or sixth row, as the trees are more or less distant and the place more or less hot. If the bananas are placed in the intervals between the coffee, they are too close, and become entangled with their boughs, and the fall of the bunches and even of the leaves may break and hurt them. It is better therefore that a banana be placed instead of a coffee tree, and that the rows be alternately banana and coffee.

(f) If on the contrary, from the extreme coolness of the place, the trees lose their leaves, and the ends of the boughs wither, the situation must be examined. If the evil arises from the actual situation, there is no other remedy but pruning freely, but this never happens except when trees are fully grown up. Sometimes, however, such accident arises from woodland on neighbouring heights, casting its shadow over the plantation. In such case nothing will answer but to clear away the wood.

(g) Where the climate is exceeding cool and damp, the trees grow well, but do not bear, though the soil is good. This happens where the country is covered with wood, and the trees only become productive when the climate has been changed by cutting down the woods.

(h) Sometimes ants do mischief, and ashes may be spread at the foot of the tree to keep them off.

(i) When the season has been especially dry, the berries are liable to be blasted, either empty, and though large and red, to have no seed in them, or mildewed (blackburnt) before they are ripe. There is no remedy. But this only rarely happens in the mountains.

Wind.—Strong winds are hurtful to coffee trees, affecting the leaves, flowers, and berries; and sometimes they so shake the trees that the trunk works a hole all round it, in which water becomes stagnant, and causes the roots to rot. If this has happened, the earth must be well broken up, the hole filled, and the tree either propped or cut near the ground.

In such windy situations, the trees should be planted at wider intervals, and topped lower.

When a tree is propped, the stake should be high enough to act as a a good support, and the tree should be tied to it with the dry skin of the plantain.

The precaution may also be taken to plant shelter-belts of trees, if it can be done without shading the coffee.

Pruning.

Natural growth.—In order to understand the art of pruning the coffee tree, it is necessary first to be well acquainted with the manner of its natural growth. Notice how the seedling bears its leaves, two on opposite sides of the stem, the second pair being on different sides from the first pair, and so on. When the young plant is 12 or 15 inches high, the first branches begin to make their appearance, each one in the eye just above the leaf. All these branches which spring from the main trunk are distinguished as *primaries*. The primary branches also bear leaves in the same manner, opposite to one another in pairs; and from the eyes above these leaves, other branches shoot out, which are known as *secondary* branches, and these in their turn again bear *tertiary* branches according to the same plan; and so on. Thus, all the branches grow in pairs, furnishing the tree all around without incumbrance, spreading out horizontally and with a direction, in some measure, towards the circumference. In the natural state no branches grow upwards or downwards nor more than one from the same leaf, but all in a regular and symmetrical manner.

If the tree is allowed to grow to its full height of 15 or 18 feet, it will lose its lowest branches, and bear the berries on the branches near the top of the tree.

Advantages of Topping.—For many reasons it is considered profitable to cut off the top of the tree, whilst still young. It is an advantage to top it, because by doing so, it loses none of the lowest branches, which are more productive than the topmost boughs ; it is stronger and more vigorous both above and below ground ; it is not so much exposed to damage by winds ; there is no fear of breaking the branches in pulling them down to pick the berries—and this is important, for a primary branch never shoots again, but is destroyed if broken.

Height.—The height at which trees should be topped, varies ; but it should never be greater than 5 feet in the most fertile soil and the best sheltered spot.

If the soil is not very fertile, the tree may be topped at 4 feet, 3 feet or even 2 feet in very poor soil.

If the situation is exposed to wind, the trees should be topped lower than in well-sheltered spots.

When it has been decided to top at a certain height, the point should be nipped off with the fingers, while still green, when it has grown just beyond that height, taking care to remove it immediately below a knot, where the leaves spring.

Opening or clearing.—Branches which grow straight up, from under the primary branches (called *gormandisers*), or from the knots on the primaries (called *riders*) must be picked off with the fingers, while still young and green.

If more than two buds appear at each knot, one above each leaf at opposite sides, they should be picked off, leaving only the strongest, which are growing outwards in the right direction.

Besides removing these, all the two secondary branches next to the trunk of the tree must be picked off, to allow the sun to penetrate and prevent the growth of moss.

If opening or clearing be well attended to, there will be scarcely any need for pruning, and as more vigour is given to the bearing branches, the crops will be larger. Opening should be attended to at every weeding, and any neglect made good after every crop. For instance, if any of the branches have been left that should have been picked whilst still green, they must now be cut off with a sharp knife.

If the head is spoiled, it must be sawn off.

If a bough has been broken by accident, and if any bough has become withered through bearing too many berries, they must be cut off.

Reproduction of boughs.—When a primary branch has been cut away as above, it is necessary to so manage that a new one shall take its place. This is done as follows :—The primary branch should be cut off just above a knot where two secondary branches spring. Cut off one of these secondary branches just above the lowest leaf where a bud or a tertiary branch is appearing. This bud, or tertiary branch will then lengthen out, and take the place of the part of the primary branch that had been cut away.

Umbrella trees.—If opening or clearing has been neglected, a mass of small branches is formed at the top, shutting off light from the lower boughs which consequently die and drop off. The tree becomes an "umbrella tree." bearing only a few berries near the top. The best means of dealing with such a tree is to cut it down close to the ground, and allow a fresh sucker to spring up and form a new tree.

Necessity for full pruning.—Sometimes the tree loses its leaves, the ends of the branches wither, and scarcely any berries are produced. This is due to neglect of opening, and the only remedy is full pruning.

Half pruning.—Pruning consists in cutting off what does not agree with the natural shape of the tree, and in preserving what corresponds with it. In warm situations and on good soil, nothing is really necessary but opening, but if this has been neglected "half-pruning" must be employed.

First, whatever is rotten, withered, or broken, must be taken off, always remembering the method of "reproduction of boughs." Next, the gormandising, vertical and cross branches, as well as those which are too numerous and those which do not grow in natural directions, must be plucked off, or cut, if too strong. If the head is rotten or spoiled, it must be sawed off, but only just to where it is sound. The top and the centre must be particularly laid open to admit the sun and air Lastly, if the tree is still too thick, some secondary bra ches, those which diverge most from the natural direction, must be taken out, for the primary boughs ought not to be touched.

Full Pruning.—Full pruning must never be employed except in cool situations. Trees which require this process are usually so thick and intricate, especially at the top, that the pruner is at a loss where and how to begin. The top must first be cleared by plucking all the small branches that abound in every direction. Next, crooked large branches as they are met with, must be cut. Lastly, if the head is rotten, it must be sawed, without sacrificing the least portion of what is sound.

The whole tree is then easily seen, and what is to be preserved or cut, will not escape notice.

All the primary boughs which have kept their natural direction must be preserved, for this reason, that once cut, they never grow again. However, if they are entirely broken or spoiled at their rise, they must be cut off, or if they have taken a wrong or cross direction at their origin, they must be removed, if it is quite certain that they can be spared. If there is a single knot sound and well directed, and still more, if there are two or four, these must be preserved. If the farthest knot has a good secondary branch it must be treated as explained under "reproduction of boughs". If it has not, it must still be left, for it will bear several twigs, the best of which may be chosen, in the next operation, to make up the main bough. Thus all the boughs must be examined from above downwards, and treated as required.

Lastly, where the situation is exceedingly cool, and the trees are decayed into barreness, from the great overload of wood, all the boughs must be stripped of their secondary branches, both with a view to renew the fruit-bearing ones, and to give a stronger direction to the sap ; as also, if the extremities of the boughs are withered, as happens in the trees stripped of their leaves, from severity of cold, or if they interfere withthe neighbouring trees, they must be pruned and shortened.

Feathering or Nipping—A few days after the pruning has been performed, crowds of small twigs appear all over the wounded surfaces; and the excess must be removed, or the last state of the tree will be worst than the first, and it will be unable to support the luxuriance of growth. The nipping off the young growths must be guided by the knowledge of the natural shape of the tree. Thus, only two branches should be allowed at each knot; in all cases taking care to prefer such as have the most natural and horizontal direction. The knife should not be used now, but if any twigs have escaped notice which should have been removed, they can be cut off after 2 or 3 months, when they are 5 or 6 inches long.

Manure.—It is necessary to provide manure to help those trees that show signs of decay.

The dung of all kinds of animals, the sweepings of pens, houses, kitchen, poultry and pigeon houses; the leaves and trunks of banana and plantain trees; the weedings, and especially the pulp of coffee, should be collected in pits with puddled clay at bottom and sides. These pits should be protected against rain by some roofing, and against the wash of rain along the ground by making sloping gutters above. All this refuse is gradually changed into a black mould, which makes an excellent manure.

Decay of the Trees.—The decay of coffee trees may be *partial* from constitution, accident, or disease; or *general* from worn-out soil or the age of the trees.

The accidents to young trees have already been considered, and reference is now made to those of mature growth. Even when the soil is not yet exhausted, several trees may show signs of decay, and may require treatment according to different plans.

(a) The tree must be first well pruned, *half* or *full* pruning according to the state of decay. Next a trench must be dug all round, a foot or more wide, as deep as possible, and at the distance of a foot from the trunk. If any of the roots are found to be injured, they must be cut off; the others must be cleared and shortened with a sharp crooked knife. Then the pit must be filled again with the soil well broken up and mixed with a fourth or fifth part of well rotted manure. The surface is then to be beaten or trampled even and smooth. If the ground is very steep, some trunks of bananas should be laid down, and pegged, to prevent the ground from giving way.

(b) If the trees or branches are in a worse state than above, they may be sawn off near the ground, or near their point of origin, and when the shoots are advanced, the best and lowest in situation should be chosen and supported by a prop, the others being pulled off. The roots, too, must be dug round, pruned and manured, as above.

(c) If a tree is dead, another must be planted. The largest and healthiest plant must be taken from the nursery with the ball of earth round its roots. A hole as big round as a flour-barrel must be dug, and the soil well broken up and manured; the young tree carefully planted, and its safety secured by trunks of bananas.

Tools.—The tools necessary for pruning are a small handsaw, about 2 inches broad at the handle; and a strong knife, at most an inch broad and 5 inches long, besides the hook which must be pointed. The blade ought to be of one piece with the handle.

Rules for use of tools.—The saw should be used with one hand, while the trunk is held fast with the other. The trunk must be cut very sloping, with the cut facing north, so that sun and rain will injure it as little as possible.

If the boughs are too large to be cut with the knife, they must also be sawn, but it is better to bend down the bough gently and make a cut with the knife upwards with a quick even stroke.

As the saw tears and notches the bark round the edges of the cut, both wood and bark must be smoothed off with the knife.

In order to cut a branch, it must be gently bent, and held firm with one hand and with the other the knife applied forwards, and drawn steadily and quickly.

The cut should always be made very close; thus, where a secondary branch is cut, let it be done very close to the mother bough : and if it is desirable to provent the shoots from rising up in crowds, cut a little of the bark off the mother bough round the cut.

The knife and saw must be kept very sharp by means of the grindstone and triangular file.

Curing.

Coffee, properly cured, is perfectly dry, very hard and brittle if bitten with the teeth, of a fine deep green colour, and a strong pleasing smell.

The berries should be as ripe as possible before being picked.

When once picked, it should not be left more than 24 hours before it is pulped, or the berry will turn brownish.

[After passing through the pulper the parchment coffee is left to ferment for 48 hours or more till the gum will wash off the parchment easily.] Water is then turned on into the tank, where it is thoroughly washed by turning and tossing it with a rake. The light seeds float on the surface, and should be removed and dried separately as *heading coffee.*

The skin rejected from the pulper make excellent manure for the coffee trees, and should be kept for that purpose.

From the tank the parchment coffee is taken to a draining barbacue, spread out, and allowed to drain for an hour or two, then put on barbacues, and, if possible, put up that night in a hut.

When once the sun has shone on the parchment coffee, it must never be allowed to get wet with rain or dew.

As soon as rain threatens, and also every evening before the dew begins to fall, the coffee must be pushed by wooden shovers, or rakes, into barbacue huts.

Every morming, after the barbacues have been well swept and are warmed by the sun, the coffee is spread out again, and the drying process continues until it is perfectly dry and hard, and horn-green in colour. When it is in this condition, it may be taken still warm from the sun into the coffee-store.

The parchment coffee will keep for 12 months, if necessary, in a dry store, until it is convenient to mill it.

When it is to be milled, sufficient coffee is taken out of the store, according to the capacity of the mill, and spread out very thin on a warm barbacue for 2 or 3 hours. It is then milled, winnowed, polished and sized, then placed on tables, and all black and broken beans picked out, which go as *triage.*

[Coffee, properly cured, is worth 3d. or 4d. a pound more than if it is not well cured. Calculate how many pounds your crop weighs, and then how much money is lost by not curing it properly. For instance for every 100lbs. at least 25 shillings is lost, if the coffee is not cured.]

COMMONLY USED BUDDING KNIFE.

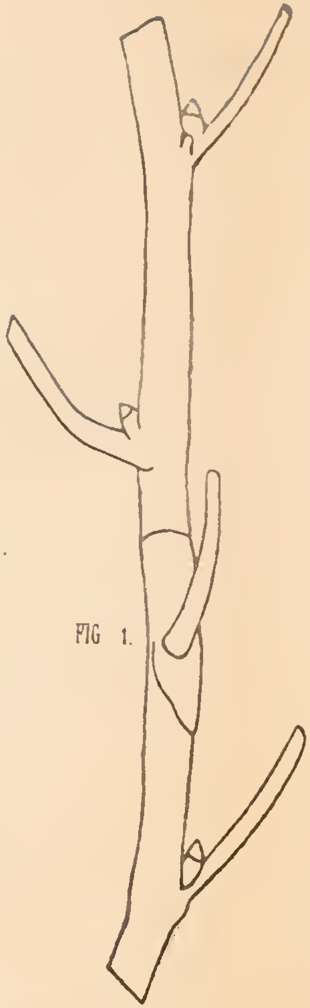


FIG 1.

A STICK OF BUDS.

FIG 2

INCISION READY FOR BUD.

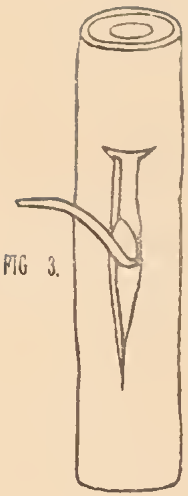


FIG 3.

BUD IN POSITION.

BUDDING ORANGE TREES.

By W. Cradwick, Superintendent of Hope Garden

The Preparation of Large Sour Orange Trees for Budding.

Large sour orange trees before they can be budded, must be cut down to a height of three feet above the ground. They should be sawn level, the cut made quite smooth and covered with a good coating of tar; ordinary coal tar mixed with an equal bulk of grease should be used, as the mixture does not readily crack or peel off in the hot sun.

The proper time to cut down the trees is when it is certain that the seasons' rains, either in October or May, have set in: October for preference, as the trees will then throw out young shoots readily; on these young shoots the sweet orange buds have to be placed.

If the trees send out a large number of shoots, the shoots must be reduced to six, selecting the six strongest nearest the top of the stump, and at fairly equal distances from one another. These young shoots must grow to be about as thick as one's finger or three quarters of an inch thick at the base, before they are ready to be budded on; if the trees are cut down about the beginning of October, this will be about February, which is also the best time for budding, as the buds then start to grow in the fine weather, and the May seasons help them along after they have commenced to grow. Persons anxious to start orange cultivation with budded trees should take seeds from the sour trees and raise seedlings at once, as these take two years from the time of sowing the seeds to grow into plants fit to bud on; these will eventually make better trees than the old sour stocks. If the sour trees are injured or in poor health from any cause, do not attempt to bud them.

Condition of Trees from which the Sweet Orange Buds are to be taken.

Sweet orange buds must be taken from young wood only. The proper sized growths are those about as thick as a lead pencil. If the tree from which it is desired to take buds have no young growths of this description, the tree should be cut back. If few buds are desired, then only some of the branches need be cut, but if large quantities of buds are required, the tree should be cut back all over. Cut back the branches about a third of their length, but not more; this will cause them to send out the young shoots. Unless shoots on both sweet and sour trees are in the condition described, the budding will not be successful.

Budding is done as follows, as soon as the growth on both sweet and sour orange trees are in the right condition.

Cut one of the young shoots from the sweet tree quite close to the old wood, and then with a very sharp knife cut off a piece of the bark and wood, about an inch and a quarter long, with the bud in the centre, as shown in the illustration (Fig. 1). If a leaf is growing with the bud, cut it off leaving the stalk attached to the bark as shown in the illustration (Fig. 1): never break nor pull it off.

The buds at the very bottom of the shoot on the round wood are the best so long as there is the requisite length of bark attached, whether a leaf is growing on the joint, or not, does not matter in the least.

Make a horizontal cut about a third of the way round one of the shoots of the sour orange tree about two inches from the bottom, and a perpendicular cut to form the letter T (as shown in Figure 2.) Make the cuts so that the bottom of the perpendicular cut is as close to the bottom of the shoot as possible. The cuts should go clean through the bark, but care must be taken not to cut the wood. Insert the end of the budding knife under the bark at the top of the cut and loosen the bark on both sides, from top to bottom, so that the bud may be easily pushed under the bark.

Take the sweet orange bud carefully and remove the piece of bark containing the bud off the piece of wood which was cut off with it by gently pushing the end of the budding knife between the bark and the wood; this is done with the greatest ease if the shoot is of the right age. Push the piece of bark with the bud down to the bottom of the T shaped cut, taking care to insert it so that the bud is looking upwards as it was when growing, (as shown in Figure 3).

Care must be taken in all the operations that neither the bark containing the bud, nor the bark of the sour shoots is injured, or the operation will probably be a failure.

When the bud is in its proper place at the bottom of the T cut, it must be tied firmly to make it stick close to the wood of the shoot, and also to prevent the bark of the sour shoot from shrivelling and turning back, leaving the bud to dry up. Knitting wool, or other soft materials should be used, tying it rather tighter than can be borne on one's finger. Take care to cover the whole of the wood on which the T cut has been made, and at the same time not to cover the bud.

It is necessary that the trees be inspected every two weeks after budding to be sure that the wood has not swollen so as to tighten the woollen thread and hinder the flow of the sap. It must be seen too that the string be renewed if it breaks, for if this should happen, the bark of the shoot will turn back, and the bud will die.

The shoot on which the bud is placed should be cut back to within a foot of the bud. When the bud has grown about three inches, cut the sour shoot back to within three inches of the bud; when the bud has grown a foot, cut the sour shoot back close to the top of the bud, so that no buds are left on the sour shoot.

If the sour tree after being cut back, should not send out shoots near the top, the stump should be cut back to where it is shooting, before the shoots grow long, or it will be very difficult to tie the buds. Six shoots may be budded on each stump, all shoots not budded must be rubbed off or they will take all the sap and starve the sweet orange buds.

A proper budding knife similar to the one illustrated is almost indispensable; an ordinary knife may be used, but it is necessary to exercise more care if the steel blade is used to loosen the bark of the bud or of the T cut, than when using the handle of the budding knife.

PACKING ORANGES.

The Pierpont Manufacturing Company, Crescent City, Florida, U. S. A., in introducing their Orange Boxes to the shippers of Jamaica, call attention to the advantages to be gained by the use of boxes over the old method of shipping in barrels, which experience taught the shippers of Florida to discard years ago, and make a few suggestions regarding the packing of oranges.

Oranges shipped in barrels arrive in bad order, chiefly because of the bulk, which of its own weight injures the fruit, causing decay. The capacity of a box is about one-half that of a barrel, and when it is considered that the centre-head divides the bulk in two, there is only one-quarter the fruit in a mass to heat and decay. Besides this, a box can be packed with greater rapidity and ease than a barrel, makes a neater package, and sells for more money proportionately.

The *standard* size of the Florida box, measures $12x12x26\frac{5}{8}$ inches outside, has a centre-head or partition, and contains exactly two cubic feet of fruit. The heads and shooks are dressed on both sides.

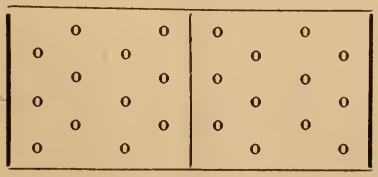
Oranges exported to the United States of America must pay an import duty of eight cents per cubic foot. A barrel is charged as five cubic feet (40 cents), while the same amount of fruit will pack in two standard boxes and will only have to pay a duty on four cubic feet (32 cents), thus effecting a saving of eight cents on every barrel by packing in standard boxes.

There is also an ad valorem duty of thirty per cent. on the boxes or barrels. This is *saved* by buying materials, which have been duly registered and recorded in compliance with the United States Tariff Act which allows the return of boxes or barrels of United States manufacture *free of duty* when so registered and recorded.

Following are a few Suggestions on Packing Oranges.

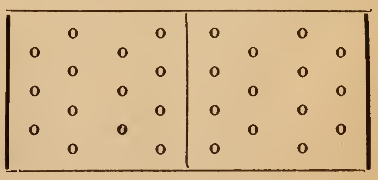
Oranges should be cut from the stems, not pulled. Before packing, the fruit should be thoroughly dried and carefully assorted and sized, rejecting all bruised and imperfect fruit. Don't ship bright fruit and dark coloured fruit in the same box. The oranges should be wrapped in tissue paper, and the boxes neatly and strongly strapped with three good straps.

In order to give a clear idea as to the manner in which the standard sizes are packed, the following is submitted:—



A B

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



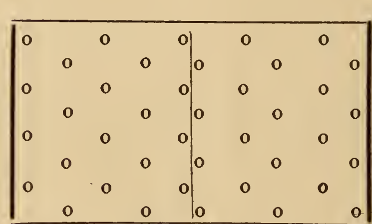
A B

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

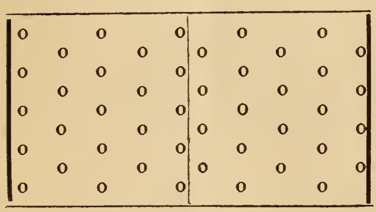
A B
3—Packing 126 to the box; first, third and fifth layer as in A, and second and fourth layer as in B.

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

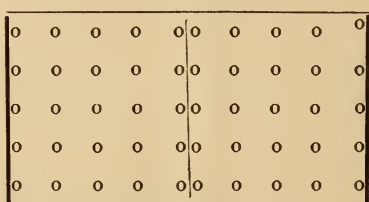
A B
5—Packing 176 to the box; first, third and fifth layers as in A, and second and fourth layers as in B.



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



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



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

Each layer should fit tightly, and the last layer in each box should extend one-half inch above the box, then put the cover on, gently pressing the fruit down. This makes all tight and firm, and prevents the oranges from tumbling about in the box and getting bruised.

These boxes can be obtained in Kingston.

FERNS: SYNOPTICAL LIST—XXXI.

Synoptical List, with descriptions of the Ferns and Fern-Allies of Jamaica, by G. S. Jenman, Superintendent Botanical Gardens, Demerara, (*continued from Bulletin* II, 11.)

TRIBE IX. ASPIDEÆ.

10. *Aspidium Christianæ,* Jenm. n. sp.—Rootstock erect or decumbent, stout, densely clothed with large ovate-lanceolate black scales; stipites cæspitose, erect, 1–1½ ft. l., channelled, clothed at the base like the rootstock, and upwards with appressed, rather matted, tomentum; fronds erect, bitripinnate, oblong-acuminate, chartaceous, light green, naked, or the under surface glabrescent, 1½–2 ft. l. 9–12 in. w., not, or little, reduced at the base; rachis chanuelled, flat and margined in the upper part, terminating often in a scaly bud, and with the channelled and flattish costæ clothed with deciduous pale appressed tomentum; pinnæ numerous, 5–7 in. l. 1½–1¾ in. w., spreading, oblong-lanceolate, serrate-acuminate, rather apart, or the lower ones sub-distant, stipitate, pinnate; pinnulæ numerous, apart but contiguous, 1–1¼ in. l. 5–7 l. w., ovate-oblong, acute or bluntish, obliquely cuneate-stipitate, pinnatifid along both sides, or only on the upperside within, the opposite underside cut away the outer part lobed and the point dentate; segments oblong, rounded, the end faintly crenate, the interior one or the upperside the largest and deepest, and 3–5 l., l. 1½–2 l. w.; lobes and teeth of the outer part of the pinnules awned; veins repeatedly forked; sori terminal on the lowest or lower veinlets, biserial in the larger lobes and outer part of the pinnulæ; involucres orbicular, deciduous.

Common in woods on the Manchester mountains at 2,000 ft. altitude. The pinnulæ are much larger and laxer than in the preceding, and the teeth are not aristate. The involucres fall away early, and the sporangia are mixed with scales. Mr. Baker unites this with his *Nephrodium patulum,* a plant also common in Jamaica and clearly distinct. Though the vestiture is striking and abundant, it is deciduous, and specimens often appear quite naked. It is very near in form and cutting to *N. mexicanum,* Hook. This may be *Polypodium miser,* Heward, collected by him in the Manchester and St. Elizabeth mountains during 1823-6 and published by him in 1838 in the Magazine of Natural History.

11. *A. capense,* Willd.—Rootstock creeping, stoutish, densely clothed with reddish scales; stipites apart, strong, subpendent, faintly channelled, densely scaly at the base, and deciduously fibrillose upwards, 6-13 in. l., fronds nearly deltoid, 1-1½ ft. l. 9-15 in. b., widest at the base, thence tapering to the serrate acuminate apex, fully tripinnate; coriaceous, of a glossy pale colour, rachis and costæ stramineous, deciduously fibrillose, bichannelled; pinnæ approximate, lanceolate, or the lower ones elongato-deltoid, the lowest pair deeper on the inferior side, and 6-9 in. l. 4-6 in b., serrate-acuminate as are those above, petiolate, ½-1 in. l.; pinnulæ stipitate, ovate or lanceolate, the larger pinnate and serrate-acuminate, the smaller acute subentire and serrate; tertiary segments ovate or lanceolate and dentate, the larger bluntly lobed at the base, ½-1 in. l. ¼-½ in. b. glabrous, of a glossy pale colour; veins immersed, several times forked; sori medial on the lowest anterior

veinlets, forming a row on each side close to the midrib; involucres orbicular, large, deciduous, at first cup-shaped. *Aspidium coriaceum*, Griesb. Fl. Br. W. Ind. p. 690. *Polypodium*, Sw.

Frequent on decaying logs in shady and open places, and in coffee fields, at 2000-4000 ft. altitude; well marked by the prostrate creeping rootstock, pale, deltoid, and very coriaceous fronds, and large sori and involucres, which turn black with age. A stiff plant but of rather pendent habit, widely in both America and Africa and through the whole south temperate zone.

12. *A trifoliatum*, Swartz.—Stipites tufted from the crown of a short oblique or decumbent orbicular, flat headed, rootstock, erect, 1–1½ ft. l., dark bright brown, channelled, naked, or fibrillose at the base; frond ½–1½ ft. l. 5–10 in. w. membrane-chartaceous, pellucid, naked or puberulous, dark green trifid, tripartite or with 2–3 pair of opposite, erect-spreading, lateral pinnæ, of which the lowest are largest and petioled ½–1 in. l., distant from the next pair above; 5–9 in. l. and nearly as wide at the both sides lobed base, above which they are entire, sinuate lobed or pinnatifid; superior pinnæ equilateral, plain sinuate or lobate, acuminate, free or adnate at the base, which is usually not much enlarged if at all; the terminal pinnæ plain, lobed or tripartite; main veins costate, flexuose, about ½ in. apart, usually stramineous or brown, as are the costæ; areolation fine, with diverging free included veinlets; sori forming a single series on each side of the primary veins; involucres flat, peltate orbicular, repand, persistent.

Common at low elevations in woods and forests, variable in cutting in the different stages of growth. It may be gathered in full fruit from the small entire unlobed state to that with three pairs of free pinnæ and a pair not free which form the basal divisions of the trilobed terminal pinnæ, and all more or less lobed or pinnatifid. In the larger fronds the basal pinnæ are lobed on both sides and form a miniature of the whole frond.

Aspidium heracleifolium, W. Pl. Fil. t. 147; is a sub-species, of which I have beautiful Jamaica specimens, differing in its firmer texture, often several pairs of pinnæ, all free and petioled, glossy polished stems and rachises and dark green shining surfaces. Probably Pl. Fil. t. 149, which is a span or less long and wide in the frond and simply trifoliate, is a small variety, of the same glossy bright colour, free petiolate divisions, and copious sori.

Genus XXII—Nephrodium, Rich.

Sori punctiform, orbicular reniform, in parallel series with the final ribs; or scattered receptacles merely thickened points, dorsal or terminal on the veins; involucres superior, the same shape as the sori, attached by the sinus, free around the edge, often deciduous or only rudimentary and disappearing as the sori mature; veins free or anastomosing; fronds varying from a few inches to several feet in size, and from subentire to decompound.

This is one of the largest genera, numbering over five hundred species in its general distribution, of which about a seventh or eighth are represented in this Flora. Some of these exist in great individual abundance, and form a large proportion of the vegetation of the country, especially of waysides and other open or half-open situations, the majority being of a hardy sun-bearing character. Several species that in every other character agree with this genus, are, by the entire absence of the involucre, or its rudimentary character which prevents its being observed in any but the earliest stage of the sori, placed, according to the varying views on genera of authors in *Polypodium*, *Phegopteris*, and *Goneopteris*.

a. Veins free.—Lastrea.

b. Fronds bipinnatifid, or fully bipinnate in part, rarely simply pinnate.

c. Pinnæ gradually reduced in the lower half of the frond to small auricle or mammillose glands.

1. N. basiattenuatum, Jenm.
2. N. sanctum. Baker.
3. N. caribæum, Jenm.
4. N. Nockianum, Jenm.
5. N. negligens, Jenm.
6. N. rigidulum, Baker.
7. N. oligocarpum, Hook.
8. N. Kaulfussii, Hook.
9. N. conterminum, Desv.
10. N. Sprengelii, Hook.
11. N. limbatum, Desv.
12. N. Sherringii, Jenm.
13. N. resinofœtidum, Hook.
14. N. Jenmani, Baker.
15. N. nimbatum, Jenm.

c c. Lower pinnæ not or little shortened.

16. N. velleum, Baker.
17. N. firmum, Baker.
18. N. crenulæum, Jenm.
19. N. stipinlare, Moore.
20. N. Filix mas, Rich.

b. b. Fronds decompound, more or less deltoid or triangular, the lowest pair of pinnæ largest and deeper on the inferior side.

21. N. hirtum, Hook.
22. N. pubescens, Desv.
23. N. ochropteriordes, Baker.
24. N. denticulatum, Hook.
25. N. effusum, Baker.
26. N. mexicanum, Hook.
27. N. ascendens, Donnell Smith.
28. N. Grisebachii, Baker.
29. N. amplum, Baker.
30. N. villosum, Presl.

b. b. b. Fronds decompound ovate or oblong-lanceolate, lowest pinnæ smallest.

31. N. patulum, Baker.
32. N. nemorosum, Jenm.

a. a. Veins more or less connected, the lowest one or more opposite pairs united, thence running to the sinuses or to the crenaturm between the lobes or lobules of the margins.—Ennephrodieus.

b. b. b b. Fronds conspicuously and uniformly narrowed towrad the base, pinnæ evanescently shallowly or deeply lobed.
33. N. strigosum, Jenm.
34. N. incisum, Baker.
35. N. Wrightii, Hook.
36. N. scolopendrioides, Hook.
37. N tenebricum, Jenm.
38. N. calcareum, Jenm.
39. N. Jamaicense, Baker.
40. N. deltoideum, Desv
c. c. c. Pinnæ deeply lobed.
41. N. Serra, Desv.
42. N. Sloanei, Baker.
43. N. patens, Desv.
44. N. molle, Desv.
45. N. guadalupense, Baker.
c. c. c. c Pinnæ less deeply lobed.
46. N. usitatum, Jenm
47. N. venustum, J. Sm.
48. N. unitum, R. Br.
c. c. c. c c. Pinnæ entire with appressed marginal teeth to the evanescent lobules or shallowly cut.
49. N. serrulatum, Jenm.
50. N. asplenioides, Jenm.
51. N. brachyodon, Hook.
b. b. b. b. b. Fronds heterophyllus.
52. N. bibrachiatum, Jenm.
a. a. a. Veins areolate (except in N. pedatum. Hook in which they are free) Sagenia.
53. N. pedatum, Hook.
54. N. cicutarium, Desv.
55. N. apiifolium, Hook et Arn.
56. N. macrophyllum, Baker.

CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY.

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Papers on the Sugar Cane by H. C. Prinsen Geerligs, Java. [Author.]
The Flora of Porto Rico, Pts. 1 & 2 by Don Domingo Bello y Espinosa. [Dr. Morris.]

PLANTS.

From Messrs. J. Veitch and Sons, Chelsea, London.

Angræcum sesquipedale
Anguloa Clowesii
Ansellia Africana
Cattleya Bowringiana
" Gaskelliana
" Gigas
" labiata
" Mendelii
" Mossiæ
" Schroederæ
" Skinnerii
Cœlogyne Dayana
" Massangeana
Cymbidium Lowianum
" eburneum
Cypripedium Chamberlainianum
" Lawrenceanum
" Spicerianum
" superbiens
" Lathamianum
" Leeanum
" Sedeni candidulum
Dendrobium densiflorum
" thyrsiflorum
" Devonianum
" Phalænopsis
" Wardianum
Epidendrum O'Brienianum
Lælia anceps
" glauca
" purpurata
" tenebrosa
Masdevallia Harryana
Maxillaria grandiflora
Miltonia vexillaria
" spectabilis
Odontoglossum crispum
" Harryanum

Odontoglossum odoratum
" grande
" triumphans
Oncidium macranthum
" sphacelatum
" tigrinum
" incurvum
Sophronitis grandiflora
Vanda Amesiana
" Bensoniæ
" teres

SEEDS.

From J. V. Calder, Esq., Malvern—
Grape Fruit.
From M. E. Muirhead, Esq., Mandeville—
Grape Fruit.
From R. F. Perkins, Esq., Claremont—
Orange.
From Botanic Gardens, Demerara—
Thrinax barbadensis
Sapium biglandulosum
Mouriria guayensis.
From Botanic Gardens, Melbourne—
Eucalyptus Globulus
E. macrandra
E. crebra
E. rudis
E. ficifolia
E. platypus
Acacia decurrens
Pittosporum undulatum
Cordyline australis
Pittosporum Ralphii
Kennedya rubicunda
Doryanthes Palmieri
Tristania conferta
Coprosma Baueriana
Sterculia diversifolia
S. acerifolia
Solanum aviculare var. linarifolia
Entelea arborescens
Albizzia lophantha
Cassia phyllodinea
Viminaria denudata
From Colonial Botanist, Brisbane—
Eucalyptus Staigeriana
From Botanic Gardens, Shibpur, near Calcutta—
Santalum album
Phœnix paludosa
From St. Georges Park, Port Elizabeth, Cape Colony—
Bauhinia Galpinii
Dimorphotheca cuneata
D. Ecklonii
Harpephyllum caffrum
Gardenia globosa
Gardenia Thumbergü
Lachenalia racemosa
Lachenalia aurea.

NOTE.

The Director will be at the JAMAICA INSTITUTE on the morning of the first Friday in every month between the hours of 10 and 12 o'clock for the purpose of giving information to those who may wish to consult him.

INDEX TO VOL. II.