

# ANNUAL REPORT

ON THE

# ROYAL BOTANIC GARDENS

FOR THE YEAR 1898.



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By J. H. HART, F.L.S., Superintendent.

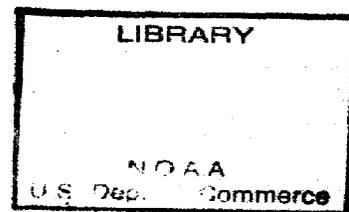
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## ROYAL BOTANIC GARDENS.

### Annual Report of the Superintendent Royal Botanic Gardens for 1898.

Council Paper No. 23 of 1899.

M. P. No. 1132/1899.

SIR,

I have the honour to submit for the information of the Government, the Annual Report on the working of the Botanical Department for the year ending December 31st, 1898. This Report forms the twelfth of the series submitted during my tenure of office 1887-1898.

#### ESTABLISHMENT.

The Assistant Superintendent Mr. W. Lunt after four years service, was promoted to the Curatorship of the St. Kitts Botanical Station in the Leeward Islands, and left for his appointment in October. Mr. Millen formerly Curator of the Botanical Station Lagos, West Coast of Africa was appointed Curator of the Botanical Station about to be established at the expense of the Imperial Government in the Tobago Ward of Trinidad, and arrived here in November. He has been attached to the Department as acting Assistant Superintendent, until a proper site has been acquired, on which to commence operations, and in order that he might gain an insight into the working of this establishment before proceeding to Tobago.\* Mr. Millen's African experience has already proved of service in connection with both rubber and coffee.

#### METEOROLOGY.

There is little to note of more than general importance in connection with the Meteorological service for 1898. The tabulated records will be found in the usual place at the end of this Report. We have however to record the institution by the United States Department of Agriculture, Weather Bureau Division, of an Observatory of the best class, in the Town of Port-of-Spain.

I am informed that it is necessary for the station or observatory to be in close proximity to telegraph offices, as messages are sent twice daily, and more frequently on urgent occasions, to head quarters. By the courtesy of the Observer in charge Mr. E. T. Giers, we have been enabled to include a summary of his results in our monthly returns, during the latter portion of the year.

Allowing for the difference in elevation, the situation of the instruments, the contiguity of buildings, and the difference in the hours of observation; the records show a minimum of variation with those taken at the Gardens which the circumstances allow, while securing strict accuracy of observation.

Taking the month of October, a comparison of the readings proves the accuracy of the observations taken at both stations:—

	<i>Trinidad Record.</i>	<i>United States Record.</i>
Barometer 7 a.m. ...	29.956	29.961
"    8 p.m. ...	29.921	29.90
Temperature—Mean max. ...	87.9	87.6
"    Mean min. ...	68.0	72.4
"    Extreme max. ...	92.0	92.0
"    Range ...	24.	22.
"    Dew Point ...	71.4	72.3
Relative humidity ...	80.	88.
Vapour pressure ...	772.	792.
Rainfall ...	6.15	8.03
Number of days on which Rain fell ...	20.	17.

The Department Station is 130 feet above Sea level, while the United States Observatory is 40 feet only.

At the close of the year it was intimated to me by Authority, that the Secretary of State, had sanctioned the purchase of one of the new instruments which had been devised for recording the occurrence of earthquakes. By a similar instrument a record of the great Japan earthquake was obtained in England at Carisbrook Castle, Isle of Wight—(see British Assoc. Report, 1896).

It is intended that the instrument should be set up on the new grounds at St. Clair to which establishment all the Meteorological instruments will shortly be moved for convenience of registration.

#### HERBARIUM.

Steady work on the Trinidad flora has been the rule in this section throughout the past year. One or two novelties have been brought in by native collectors. One of these is a new *Dioclea*, *D. megacarpa*. The shiny green barked tree, so noticeable in the vicinity of Port-of-Spain and of which good examples are to be seen in front of the Queen's Park Hotel and the Government buildings or "Red House," North entrance, has been determined by the Kew Authorities as *Pithecolobium Bertainum*, Benth. A tree known as the "Contravent" a fine hardwood, belonging to the order *Sapo-*

\* Mr. William Leslie has been appointed successor to Mr. Lunt (March 2nd, 1899.)

*taceæ* has been determined as a new species and named *Lucuma Hartii*, Hemsley. A fern new to the collection was found in the neighbourhood of Blanchisseuse and was referred to *Asplenium sub-hastatum*, Hk. In this reference, my colleague Mr. G. S. Jenman concurred, but subsequent specimens were brought in showing an intermediate stage between it and *A. salicifolium*, Linn. var. *neo-granatense*, Fee., so that *sub-hastatum* can no longer stand as a distinct species, as it is seen to be nothing more than a depauperated form of the variety, *A. neo-granatense*, Fee., with which it was found growing side by side. What will probably prove to be a new *Pteris* was found by Mr. Lunt while on a short collecting expedition to the Aripo district.

A certain disease among Cacao pods has claimed considerable attention. In the latter half of the year several specimens of diseased pods were sent in by planters for examination and complaints were made that considerable loss had been suffered on several large estates. From a set of pods sent in by the Warden of Tacarigua it was seen, that they were covered with the spores of a parasitic fungus. Experiments on healthy pods proved that these organs were capable of reproducing the rotten condition in all stages of the growth of the pod, those nearing maturity being as susceptible, as those of younger growth. This condition was produced by direct inoculation, but it has since been observed that healthy pods not inoculated, may become infected from diseased material in their immediate vicinity. On visiting estates I found that the pod disease was most prevalent in the neighbourhood of the breaking places (*i.e.*) places on plantations where the beans are taken from the pods and where usually the empty pods are allowed to lie and rot upon the ground, without further attention. It was seen to be clear that this practice afforded a certain means of disseminating the disease, and the recommendations made to prevent this, were, first, the careful gathering and destruction of all diseased pods; secondly, the removal and entire destruction or burial of all empty pods; and thirdly, the dressing of all badly infected trees with sulphate of copper solution.

There is evidence that this disease or something of a similar character has existed for many years on the Trinidad plantations, but the special destruction it caused, was not particularly noticeable until the year under report, as evidenced by the number of complaints which arose. Planters state that they suffer most from the blackening of the pods during the latter portion of the year, and always in the dampest areas of a plantation. It is to be noted however, that it is generally the lower areas which cover the breaking places. In contradistinction to this, I have to put on record an observation where the disease was observed on a dry ridge, on trees under which breaking had been carried on, and the pods allowed to rot upon the ground.

The chief remedies which appear to be necessary are, cleanliness and tidiness, in and about the plantations. The disease cannot, up to the present time, be in any way characterised, as being of a virulent type, and the amount of damage suffered so far as my observations extend, do not appear to be of serious moment. The chief danger to be apprehended is, that through want of attention the disease may spread, and become epidemic in character; but I am of opinion that there is little danger of its becoming so, if proper measures are taken.

Planters state that the beans in pods which have blackened, just previous to ripening, are not damaged sufficiently to affect their value for cured cacao. This opinion has not been confirmed by experiments which I have carried out. These show that although to the naked eye, the beans appear to be sound, yet when fermented by themselves, a very high percentage will be found thin, light, and of very inferior quality, and if found when the produce had passed the drying floors, their condition would probably be attributed to other causes. I forwarded a full Report on the subject of this disease to the Government in December, 1898.

Two Orchids new to the Trinidad Herbarium were collected; the first was brought in by Mr Lunt, and the latter by D. Alexander, a native collector. The first has been named *Rolfea elata*, Zahl. and is a pretty terrestrial orchid. It was previously collected by Prestoe in Trinidad, and by Jenman in Demerara. The latter has been named by the Kew authorities *Huntleya albido-fulva*, Lem. (Ill. Hort. 15, t. 556.) By a local authority this plant has been referred to *Zygopetalum*. It is however practically immaterial to which genus it is referred, so long as the author's name is appended. The name *Huntleya* is used in the Kew Index.

A fungus which destroyed a large *Araucaria*, has not as yet been fully determined. In a climate like that of Trinidad the parasitic fungi are strongly developed, and very many of the native as well as imported trees suffer largely from their attack. A few years ago their action in the disintegration of woody tissue was little understood, even by prominent botanists; but in the light of later days, it is now found that a high percentage of deaths in the vegetable world are to be accounted for through the attack of various microscopic fungi.

Since cutting the above tree, another has died out, overcome by a species of the genus *Polyporus*, which is one of our common Fungi.

#### CORRESPONDENCE AND DISTRIBUTION OF INFORMATION.

Last year I reported a large increase in the correspondence registered outwards, of some 500 numbers. This year I have again to report an increase of some 700 numbers. The total registered was 4,866. The Bulletin of the department was regularly issued quarterly, and an extra number on Rubber was issued in August. The latter was much appreciated, the Chamber of Commerce having formally thanked the department for its preparation.

A lecture on Agricultural topics was delivered at Tunapuna which was fairly attended. This was printed and circulated through the kindness of the proprietor of the *Mirror* newspaper.

A very large proportion of our letter writing is devoted to answering enquiries on agricultural topics, and scientific matters, and has of necessity to be done by the Superintendent personally. The issue of the Bulletin quarterly and the annual report is included in the total number of communications given above, and amounted to about 1,500 numbers. A full report on the results obtained in the field with seedling sugar canes (season 1897-98) was issued in May, 1898.

### FLOWER GARDEN AND PROMENADE GROUNDS.

The upkeep of a garden in the tropics is work which requires continuous supervision. Unlike gardens in temperate climates, the plants are always growing more or less, and necessarily require constant and regular attention. To the observant eye however, there are short periods of rest taken by tropical plants, but this occurs at various periods and not at the same season each year, as in the winters of the temperate zone. The cultivator is sometimes hardly aware that a tree has taken a period of rest, until he discovers it shedding its leaves, an operation which is generally accomplished in a very few days. The shedding of leaves is a sign that rapid growth will shortly recommence, as trees remain bare a few days only before again becoming covered with foliage; in fact, in many cases new growth has actually commenced ere the old leaves began to fall.

A notable example is the "Cannon ball tree" *Couroupita guianensis* which has been known to shed its leaves during one week and before the next had ended, to be again covered with foliage. A large *Araucaria*, mentioned in the last section, had to be removed to make way for the erection of a stand for the use of the Police Band which plays in the Garden twice a week, Sunday's and Wednesdays. This tree however, had for a long time been in bad health, and when cut it was found to be decayed from the base upwards, some twenty-five feet; the centre of the trunk being discoloured and partly rotten. Examination proved it to be infested with the mycelium of a microscopic fungus. These fungi appear to play a most important part in maintaining the balance of plant life, and few indeed are the cases of decay in which their action cannot be traced. Weakness of constitution, generated by various causes, appear to invite the attack of *parasitic* fungi capable of killing the tree, and then the vegetable material of which it is composed is finally disintegrated by the *saprophytic* forms of this class of vegetable organisms.

The routine work of cleaning and repairing roads, walks, drains, &c., &c., and the decorative work has been carried out as in previous years. The number of plants loaned to the public being somewhat less than usual.

At the close of the year, two large concrete pillars carrying electric lamps were erected at the main entrance, and the basin of the larger fountain was removed.

### NURSERIES.

This section of the establishment has in part been removed to the new grounds at St. Clair; all plants of an economic character being now kept at the latter place for distribution and sale. The total sales for the year under report realized a sum of £397 7 9½ which is larger than the receipts for any previous year, and exceeded the estimated income by nearly £100 sterling. This was principally due to a large sale of *Castilloa* Rubber plants and seeds. From our largest trees of *Castilloa* a fine crop of seed was harvested, which sold at the rate of thirty shillings per thousand by public auction.

Plants of *Castilloa* over a year old sold at auction at an average of a little over 7 cents each, or three pence half-penny per plant. Seedlings in boxes realised about 4/- per hundred at two months old.

Our oldest tree of *Hevea brasiliensis* produced a crop of over 2,500 seeds, a large proportion of which were grown on for sale to planters. It has been found that when seed is rare and valuable, it is better in the interests of the Colony, to keep it in hand and distribute plants only; as planters have not the facilities which are at our disposal, and suffer considerable loss in the operation of growing from seed. Valuable seeds thus lost, are a loss not only to the individual but to the Colony, as it retards the progress of an industry when avoidable failures occur.

The record of distribution for the year will be found in the following tables:—

TABLE I.—DISTRIBUTION OF PLANTS AND SEEDS IN EXCHANGE, 1898.

Where distributed.	Plants.	Countable.	SEEDS.	
			Packages.	
To places abroad ...	1,157	8,300	...	52
To places inland ...	2,237	...	...	...
Total ...	8,894	8,300	...	52

TABLE II.—PLANTS AND SEEDS RECEIVED IN EXCHANGE, 1898.

Whence Received.	Plants.	Packages of Seeds.
From places abroad ...	417	271
From places inland ...	...	8
Total ...	417	274

TABLE III.—PLANTS, SEEDS, AND FLOWERS, PURCHASED AND SOLD, 1898.

PURCHASED.				SOLD.			
Plants.	Pkgs. of Seeds.	Countable Seeds.	...	Plants.	Bouquets, &c.	Countable Seeds.	...
120	86	100	...	27,794	5	4,098	...

TABLE IV.—TOTAL NUMBER OF PLANTS, SEEDS, AND FLOWERS DISTRIBUTED BY SALE AND EXCHANGE, 1898.

Plants,	...	Countable.	...	Packages.	...	Bouquets, &c.	...
31,188	...	12,398	...	52	...	5	...

## BULLETIN.

The Departmental Bulletin has been issued as usual at quarterly intervals, with the addition of an extra number in the month of August (No. 16) dealing with Rubber and Rubber coagulation. An appendix has been added containing original descriptions of West Indian and British Guiana Ferns.

The following is the list of subjects treated upon:—

270.—Ferns of the British West Indies and Guiana.

Genus 1.—*Hymenophyllum*.

Genus 2.—*Trichomanes*.

270A.—Lecture on Minor Industries.

271.—Fermentation.

272.—Parasitism in *Scrophularineæ*.

273.—Botanical Notes.

No. 27.—*Ustilago Maydis*, D.C.

274.—Oranges (the Bitter and the Sweet) and variation from seed.

275.—Cocoa. An estimation of the character of three varieties.

276.—The Agricultural Exhibition.

277.—Ferns of the British West Indies and Guiana. (Conspectus.)

278.— Do. Do. Do.

## CYATHEACEÆ.

Genus 3.—*Alsophila*.

Genus 4.—*Hemitelia*.

Genus 5.—*Cyathea*.

277A.—Rubber. (Notes and Extract.)

278A.—Rubber Coagulation.

279.—Vanilla. (Notes and Extract.)

280.—Chemistry and Agriculture. (Extract.)

281.—Preserving Lemons. (Extract.)

282.—Natural History Notes.

No. 59.—The Soldier Ant.

283.—Cacao v. Chocolate.

284.—Botanical Notes.

*Lucuma Hartii*, Hemsley, n. sp.

285.—The Botanical Department of the West Indies.

The notes on the Fern Flora of the British West Indies and Guiana are written by my colleague Mr. G. S. Jenman who has specially devoted much of his leisure to their study. The form chosen for the printed matter, is taken from the Synopsis Filicum, edited by J. G. Baker, Esq., F.R.S., of the Royal Gardens, Kew. Mr. Baker has been good enough to express his appreciation of Mr. Jenman's labours and has welcomed the publication as useful to himself, and to all students of the Fern Flora of this part of the world. The Chamber of Commerce has seen fit to record its appreciation of the value of the Bulletin, and has recorded it in Section 23 of their Annual Report as follows, and I take this opportunity of thanking the members for the encouragement which this recognition has given:—"Mr. J. H. Hart has been good enough to forward regularly the Bulletins issued from his department. In regard to Bulletin No. 16, the thanks of the Chamber were conveyed to Mr. Hart with an expression of the appreciation of the members of the valuable information contained therein regarding rubber."

## RED HOUSE GROUNDS.

The lawns and roads around and about this establishment have been duly maintained. The care of the grounds around the Audit Offices, &c., have been added to this duty, and they have received the requisite attention.

## ECONOMIC SECTION.

This section is now—in the main—transferred to the Experiment Station and trial grounds at St. Clair. As stated in my last Annual Report, a piece of land some thirty-three acres in extent was handed over to this department at the end of 1897, for the purpose of forming Nurseries, for Economic Plants and providing experimental plots for the culture of various products, as well as for general Agri-Horticultural work, practical as well as theoretical. Work was commenced on 17th January, and the western and eastern sections were at once fenced off. The land is divided into three chief sections, the first, or eastern section, is intended to be devoted to the culture of selected fruit trees; the centre section is intended for the culture and trial of plants of Scientific and Botanical interest; and the third or western section is to be devoted to Economics almost exclusively, and Nurseries, &c., included. An area of some two acres was planted up in seedling canes in April and May. An area was planted in Central American Rubber, (*Castilloa*), in July, others in Cacao, Yams, Tobacco and Coffee, following. A mango hedge, intended as a wind break, was planted from seed on 23rd June. Spaces were prepared for trials of "black-pepper," "vanilla," &c. A tool house was erected in April, a potting shed in June and a glass shed for raising seeds in

July. Stables for the garden horses were erected in August, a watchman's hut in November, and a shed for carrying out the seedling experiments in December. The Nursery was fenced in with iron hurdles, laid out into sections and well gravelled, early in March. Over two and a quarter miles of drains have been dug, the main drains six feet in depth and others in proportion, and over these concrete bridges have been built, where found necessary, as the work progressed. Nearly a mile of grass plantation roads have been formed, which are being macadamized in the most frequently used portions as time permits, with gravel taken from the bed of the Maraval river, which forms the western boundary of the establishment. Over 600 loads of gravel was laid on the roads, and some 70 more used for foundations and floors of the buildings. The fencing erected on the boundaries to the south, measures about 1000 feet. It is constructed with balata posts with five wires and is backed up by a hedge of Euphorbia, which when grown will form an almost impassable barrier to either man or beast. It has been found absolutely necessary to have the fences well secured, in consequence of the contiguity of the Government Stock Farm. The larger proportion of the Nursery Stock formerly kept at St. Ann's was in place at St. Clair at the close of the year, and will stand there for sale in future. The principal items of economic interest which have received special attention during the year, are as follows :

**SUGAR CANE.**—The experimental cultivation of the Demerara and Barbados seedlings has been continued at St. Clair. A large number of both have been deleted, but the Demerara seedlings have so far proved the better of the lot. A report on the results of the trials, was published in May, 1898, but as these results properly fall into the work of the year under report a recapitulation of the principal points is given.

The Sugar Cane year in Trinidad does not end until April or May, and the returns of course cannot be given until the crop is harvested. The experiments under report therefore are those of canes planted in April, 1897, and reaped in April, 1898. The next crop to be reported on will be reaped in April, 1899. A few observations on the growth of this lot since planting from cuttings in April, on 1898, are given while the full report on the latter will be given as usual, after harvest. Some 2000 seedlings were raised in the season 1896-7, out of which only 126 stools were selected for test, the remainder having to be discarded; as naturally follows, where selections from seedlings is being carried on. Most of the 126 have been grown on for a second years trial, for harvest in 1899. It has been found that there was a marked likeness to the maternal parent in many of the canes grown from seed. Those from D 95 gave stools having a high sugar value. The same feature appeared among seedlings raised from D 102, and in vegetative characters also, these closely resembled their maternal parent. The sugar value of canes raised from "Caledonian Queen," considered by Harrison & Jenman to be synonymous with "White Transparent" is considerably lower than either of the foregoing. Canes raised here from seed harvested in Demerara (4) were of low sugar value. The highest sugar value was obtained from a cane raised in Trinidad (T 111) from seed of D 74, grown in Trinidad. The percentage of available sucrose in this cane was 21.3. Another cane T 2 gave 18.2 %; while the original D 74 gave 18.2 %. T 77 gave 18.3 %. T 19, 20 %: T 211, 18.8 %; T 62, 18 %; and T 43, 18.2 %. The best of the Demerara lot, so far as our experience goes appears to be D 74—D 78—D 115—102—and D 116. D 95 is the sweetest cane, but in vigour of growth and capability of resisting rust and other diseases, it is not equal to some of the others. I received at the end of the year three selections from the Demerara raisers, and six from Barbados. These will be grown on for comparison with those previously raised, and as guides to the value of our own seedlings. Plots of one twentieth of an acre of the best Demerara kinds are now standing at St. Clair and shew clearly the well marked characters of each variety.

In cane growing, as in nearly every other cultivation, every grower has his fancy. In Barbados growers appear to prefer yellow canes, and the prejudice against a coloured cane is somewhat marked. In Trinidad also, the same view holds good on several large estates. Most of the Demerara seedlings of the first sets raised, are coloured more or less, but later acquisitions of the yellow strain, have now been secured. It would be very convenient if growers could furnish a reason for the preference of yellow over dark coloured. Of the Trinidad canes the best, so far is T 2 a coloured cane raised from Barbados seed. In our first selection from seedlings, 20 varieties gave an average return of available sucrose of 18.6 % while standard varieties grown on the same ground, gave 14.7 % only. Our seedlings raised from seed harvested in 1897, have grown well, and we have now some 3000 on the ground, and selections from these will be tested in April and May next. It is considered, that if two good canes per thousand are secured the work is all that can be desired, and if only one good cane in every 5000 is secured, the work is highly successful; for if the end in view is ultimately attained—namely, the raising of a hardy cane which will give a twenty per cent. field return, the growth of a thousand canes more or less, is a matter of little moment. So far the growth of the plant canes from the seedlings of 1896-7 is all that could be desired, but it is not expected that more than one-tenth of these will be considered fit to pass on for the 3rd year's trial, through the absence of qualities which go to make up a "good all round" cane.

Number T 111 the cane showing highest available yield of sugar has done fairly well, and will stand for its second examination in April next, and will then go on for its third year's trial. Whether it will prove good enough to pass on for further trials is a question for the future; for every cane in the selectors hands must stand or fall on its own merits, otherwise there would be no regularity, and the tests would be of no value. No matter how much a cane may strike the eye, it must go to the manure heap, unless it can successfully pass repeated trials.

The seedlings of 1897-98 (*i.e.*) seedlings raised from seeds sown in November, 1897, were late in being planted, owing to the press of new work on hand, and many of them have not had a

D Demerara.

B Barbados.

T Trinidad.

chance to make sufficient growth to show their characters well during the coming harvest. The canes on certain of the first planted areas however, show sufficient character to enable us to judge them qualified to pass their first field test, and will come on for examination in April.

The later growth however, must await the following season. Not more than 5 per cent. of loss occurred from planting out the young seedlings in the field, as we took great care to well harden them previous to planting. They were attacked however by mole crickets and many were cut when over two feet in height. A remedy was devised however to stop this loss. It consisted of placing a collar of bamboo over the plant and pressing it slightly into the ground, allowing the plant to grow through, until it obtained sufficient strength to resist the attack.

The crop of seed harvested in November, 1898, was very small, owing principally to the transfer of the work from the old establishment, but a good germination took place and we have quite sufficient for the year's work, some 3,000 plants.

The varieties received from the Barbados station were B 147, B 347, B 306, B 208, B 156, and B 254. Of these B 147 is very highly spoken of. It is a yellow cane of the Bourbon type, and all the others possess similar characters.

I obtained seeds of the Bourbon Cane from various planters during the season November, 1898. In all some forty bags were received, but with all this material, not a single plant was raised. Our experience goes to show that the Bourbon planted by itself is infertile.

Close observation of the seedling canes show that they have a period of ripening, differing with each kind. Some require as much as twelve months to ripen, some fifteen months, while not a few are ready for the mill in nine or ten months of good weather. D 74—planted in April arrowed (flowered) and produced fertile seed in November and will be fully ripe at twelve months old. D 61, on the contrary, will not be ripe until over fourteen months old, being quite grassy up to six months old; and T 2 is of a similar character. The Bourbon, as usually planted, takes some fifteen months; in fact it is the rule to plant in the months of October and November for the crop to be reaped fifteen months afterwards. The cane crop in Trinidad commences some time in January, but often is not general until February and often continues until April or May.

If a cane could be raised that would come to maturity regularly in ten or twelve months, it should be of great advantage to the sugar planter, and even if one could be obtained which would ripen in nine months, it would in many ways be a boon to the planter. Some say that this would be no advantage, as during the months previous to taking off crop, labour would be wasted if they had no planting to do; and that it is better to grow canes for fifteen months before cutting them. It would appear but reasonable however that where growing and manufacturing are separated, it would be better, and to the advantage of the farmers, to get their crops to maturity as quickly as possible. I find that many of the seedlings show a precocity for ripening early, and a watch will be kept to secure if possible any variety which may be valuable for this reason.

A very curious kind of cane has been received from Kew called the Japanese Cane. The growth so far is decidedly weedy, but it shows strong vitality, and it may be found useful for bearing seed for experiment. Its sugar content will be tested in April.

To prevent applications being made to which we are unable to respond, it is to be noted that we have only a single plant of a seedling the first year, and some eight or ten the second year but during the third season, moderate numbers will be available for distribution. When plants of the best kinds are available, they will be duly advertised, but it would not be in any way a wise proceeding, to take plants on a first, or even on a second analysis, as subsequent trials might find them completely unable to maintain any superiority which they might have shown on the first or second occasion.

CACAO.—(*Theobroma Cacao* and other species.)

I have to report the first fruiting of a tree of *Theobroma pentagona* in Trinidad. This species it may be remembered, was introduced from Nicaragua in 1893, on my return from a visit to that country. Plants were distributed to various Cacao Planters and in answer to a circular of enquiry recently sent out, I find that while a few have done well, the majority are either dead, or doing badly. The following however was received from an experienced planter:—

"The beans are very large, the skin is rough, thin and soft. There are some thirty pods of all sizes on the tree, but what is most remarkable, is that every *chirero* (young pod) that comes out, keeps healthy, and up to now I have not been able to find a single pod of any size blighted. The tree is strong and healthy, and from appearance very hardy, in my opinion will answer well here. I shall take great care to save every pod I can for plants."

This letter confirms our own experience. The tree has fruited at the Gardens, where it may be seen at any time. It has proved a very acceptable addition to the kinds known in Trinidad and when better known, and more widely distributed, I have little fear but that it will be very favourably thought of. Sufficient plants for an experimental row at St. Clair were raised from the one pod which was ripened, and these are now making healthy growth. Other rows of the White seeded Creole, the Ocumare strain of Forastero, the Ceylon Red, and several grafted varieties, are under trial at that establishment also.

The idea for improving the class of Cacao produced is, to search out the varieties which give the largest crops and the best class of dried produce, and to propagate these by grafting. I am glad to be able to put on record (I believe for the first time) successful results of our Cacao grafting experiments, carried out during 1898.

The operation presents no unusual difficulty. Grafting is effected by approach, or inarching, a method which is by far the safest for all tropical plants, and so far it has been found that the

D Demerara.

B Barbados.

T Trinidad.

union takes place in Cacao grafting with greater facility than with the Mango or other trees. Grafting now makes it possible to propagate one desired variety, and to have that variety and nothing else upon an estate; instead of depending solely upon seedling plants which are known to vary in so large a degree, and are known to produce at times varieties which spoil the samples of the better class of produce. It would not be a difficult matter to show that an estate planted with superior grafted varieties selected from first class estates would produce samples of Cacao that would be of the highest possible excellence; at least that is the general result in other cultivations where the practice of grafting is pursued, and it would not be easy to see, why it should not be so in Cacao. The process of grafting is easily learned and lessons will be given by the Department during the ensuing year, if application is made by persons willing to give proper attention to the matter. I anticipate that in the future, many an intelligent man will find remunerative employment on Cacao estates, if he takes pains to perfect himself in the simple art of grafting.

Cacao disease has been discussed in the section relating to the Herbarium, but I may supplement this, by a few other remarks. The Cacao pod disease is not the only thing which will blacken and destroy the pods, as there are several other causes which cause them to assume this appearance. It must not be assumed therefore, that because a pod, goes black, that it has an infectious disease. Neither is it to be assumed—at least for the present, that there is any connection between the Cacao disease of Ceylon, and the Cacao disease in Trinidad, as this cannot be ascertained until the organization of the two fungi have been studied by expert Botanists skilled in the examination of microscopic fungi. It is quite possible however that they may be identical.

The Trinidad disease, so far, is in no wise a serious matter, and the Trinidad planter may congratulate himself that it is no worse, and if it only enforces habits of cleanliness and watchfulness, and induces better cultivation, it may prove in reality to be a blessing in disguise.

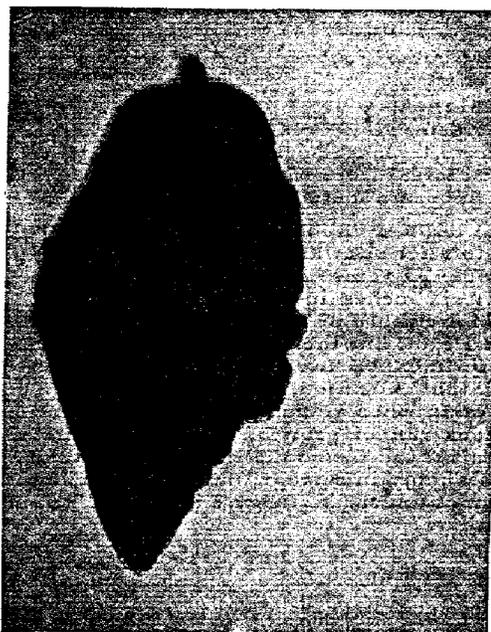
The planter when treating these diseases must not trust to his eyesight alone, for that is not a sufficient or sure guide, as the character of the organisms causing such diseases, cannot be detected, without the aid of a compound microscope of high power.

A figure of a pod of Nicaraguan Alligator Cacao, *Theobroma pentagona* is here given to shew the difference in the form between it and the pods of *Theobroma Cacao*. It will be seen that there are five distinct ridges or angles to the pod which justifies the name *pentagona*.

In 1893 I found *Theobroma pentagona* growing upon Cacao estates in Nicaragua, and on my return to the colony I brought back a case containing plants of this species, *Theobroma bicolor*, and the ordinary Red, or Creole Cacao of Nicaragua. Some of these plants were distributed to cacao planters, and others were kept at the Gardens for stock purposes. Trees of *T. bicolor* and *T. pentagona* have produced pods from which plants have been raised for the experimental grounds at St. Clair, and sufficient seed will, it is hoped, be harvested during the coming season to make a further distribution to planters. While the produce of *T. bicolor* does not enter into the markets in the form of prepared Cacao, the produce of *T. pentagona* makes Cacao of high value for manufacturing Chocolate and Cacao powders.

RUBBER. — (*Castilloa elastica*, Cerv.) Rubber cultivation has been taken up with considerable energy during the year 1898. The principal kind used for planting was *Castilloa elastica*, Cerv. Auction sales of seeds and plants of this Rubber were well attended and good prices were realized, as there was considerable competition.

At the experiment station a small area was planted in July. Among the *Castilloa* has been planted at wide intervals, the larger and slower growing *Hevea brasiliensis* with the view to their becoming the permanent occupants of the ground; it being the intention to bleed the *Castilloa* trees very hard for certain experiments, under which many may succumb.



POD OF THEOBROMA PENTAGONA.

Another area has been planted out under the shade of standing trees, in what is called the old cottage grounds. It has been found that where *Castilloa* is well shaded their growth is much more rapid and vigorous than in the open. To grow *Castilloa* without a certain amount of shade and shelter, would in my opinion be to invite a succession of slow and stunted growths. In its native countries it is always found in sheltered and protected lands and always become stunted in the open vega. Trees planted in Trinidad under standing shade have been found to thrive well, and soon become the picture of healthy growth. At the experimental station it was necessary to shade with Banana, Cassava, &c.

and under these conditions, the plants have also grown well. In the Nurseries at St. Clair are several thousands of *Castilloa* plants in bamboo pots; a large proportion of which are already

ordered for the next planting season. *Castilloa* under favourable conditions in Trinidad makes rapid growth and is probably better suited to the climate than any other class of Rubber, as it comes to maturity earlier, and can be handled with a minimum of previous planting experience. Specimens of the Rubber sent to England for valuation prove that our *Castilloa* trees are the best *kind* in cultivation. The large crops of seed now obtainable from *Castilloa* will make it possible at an early date to grow stems for the purpose of extracting Rubber from them in their young state. Stems of a year old have been found to contain some 8 % of their dry weight in Rubber, and this amount has been extracted in the Laboratory. Whether the same percentage can be extracted in actual practice, remains to be seen.

**HEVEA BRASILIENSIS, "Para Rubber."**—This tree produces Rubber of the finest quality, for which, the demand is very regular. As a tree it is of slower growth than *Castilloa*, but grown for a permanent crop, it will probably exceed that tree in value. The tree proves itself to be hardy, it can be handled with ease, and grows freely; although it takes a number of years before the trunk becomes large enough to bleed regularly. Growing at the old Gardens the tree is seen to make itself at home on the hard and barren soil which there obtains; showing that although it is a tree fond of water and delighting in frequently flooded valleys, it will also grow in other situations. Specimens of Rubber made from these trees have been examined in London and valued at high rates.

I have noted that seeds of this kind of Rubber are being offered in France at a rate of over £40 per thousand or 10d. each; and in Ceylon rates of £3 per thousand on the spot—packing cases, and freight extra—are being charged. The vitality of *Hevea* seed like that of *Castilloa* is very fugitive, and great risk is run by planters in obtaining seeds from a distance. Our seed harvested in November was of excellent quality and fully 99 % germinated.

A tree of *Hevea confusa*, *Hemsl.*, formerly known as *Hevea Sprucei* also bore fruit. The distinguishing characters of the seed are its large size, its angular form, and the softness of its outer covering, when compared with those of *Hevea brasiliensis*.

What is apparently another *Hevea* has been presented to the Experiment Station by His Excellency the Governor, who obtained it from Dr. Carl Bovallius who was recently exploring the territory of the Amazon, S.A.

These when handed over, were in bad condition, as I proved by cutting a sample lot before sowing. Out of 170 seeds only some five seeds germinated, and only two plants promise to survive. This *Hevea* has seed not more than half the size of those of *H. brasiliensis*, and of much darker colour.

*Kicksia africana* or *Iré Rubber*, is obtained from a newly introduced African tree. A small section was planted out in November and so far as we can judge in so short a time promises to do well. This Rubber has been seen in the African forest by Mr. Millen my acting Assistant who states that our plants are quite true to name. Mr. Millen has shown me samples of material collected by himself from trees in the African interior which shows this rubber is little, if at all inferior to the best "Para." A parcel of seed sent to us by Kew, did not germinate so well as did the first lot received, and but few plants were obtained from it. Every endeavour will be made to extend the culture of this species, as it appears to be of great promise and well suited for growth in Trinidad.

A report reached us from German sources to the effect that *Kicksia africana* does not produce rubber at all. Mr. Millen's evidence, however satisfies us upon this point. In addition however it may be recorded that we have trees sufficiently large to bleed on a small scale, and from these trees we have recently procured latex, from which a small piece of excellent rubber was produced, which proves the report to have been a mere trade rumour.

**MANIHOT GLAZIOVII OR CEARA RUBBER.**—Some demand has set in for seeds of this rubber. These demands, we have had to refer elsewhere, as we have no supply. There is one tree in the Garden which is said to be some 25 years old, which bears a few seeds annually, but although of this age, its stem is but barely six inches in diameter. Some of our correspondents however are quite sanguine as to its value for culture in Trinidad. Some few trees were planted a few years ago at the Chaguanas Convict Depot, but their condition is far from convincing proof of its suitability for our climate. My own experience, the Ceylon records, and various other sources of information tend to convince that *Castilloa*, *Hevea*, and *Kicksia* are all preferable to *Ceara* for cultivation in this Island. *Ceara*, when young, grows rapidly, and induces the cultivator in many cases to believe in a continuous run of growth, which often proves disappointing. It has been reported by some who have visited the *Ceara* districts that the trees never grow to a large size. It may possibly be grown with economy in some of our mountain lands, unsuited for other products, but as a rubber producer I cannot undertake to give it a high recommendation. The rubber produced is however of good quality.

**LANDOLPHIA AND CEROPEGIA.**—African and Ceylon Rubbers. These are both under cultivation, but at present there does not appear to be sufficient inducement to plant them extensively.

**TABORNAMONTANA CRASSA.**—This tree is a reputed rubber producer, and was grown on trial in these gardens for the past few years. Having a tree which had attained a large size, it was bled freely, and the latex was treated in different ways with a view of producing co-agulation without success. Eventually a substance was produced which resembled in appearance a lump of chalk, or compacted starch, quite brittle in character, and certainly not rubber.

**SAPIUM ACUPARIUM.** This is an indigenous tree which produces large quantities of mercilessly sticky gum or latex. This material can be handled only, when immersed in water, or with wet hands and tools and is scarcely likely to become a competitor with the better classes of rubber. So far we have been unable to co-agulate it successfully.

**COFFEE.**—The trees of the new coffee (*Coffea stenophylla*) have again borne excellent crops for the second season. The seed has been much in demand, but I am sorry to say our local planters have not as yet taken any general interest, and most of our crop has gone abroad. The tree bears a small purple berry of the Moka type, and the flavour of the coffee is excellent. A small area has been planted at St. Clair. Our seedling plants when about six inches high met very wet weather and were badly attacked by *Cercospora coffeicola*, a leaf disease which is generally present among seedlings. Curiously enough this fungus was mistaken by a French buyer for the deadly *Hemileia* of Ceylon and considerable scare was caused in consequence. *Hemileia* however has not yet been seen in Trinidad.

**MARAGOGIPE COFFEE,** or Brazilian coffee, a variety of *Coffea arabica* has produced a large crop of beans for the first time, a fine coffee, of vigorous habit and has a much larger leaf than ordinary *C. arabica* with beans of nearly double the size. Vilmorin of Paris, calls it *Café géant du Brasil*, and it is certainly deserving of the name.

**ABBEOKUTA COFFEE.** This coffee is of the Liberian type and resembles it in vegetative characters. It was found in the district of Abbeokuta on the way to the interior from Lagos, west coast of Africa. A small patch has been planted for trial at St. Clair.

**CONGO COFFEE.**—This is a coffee similar in appearance to the last, and was received from Kew under this name. It is said to be a valuable kind, but the plants are yet too small to indicate what type or character they will finally assume. They are growing well.

**MINERVA COFFEE.**—For some years we have had under cultivation a variety of *Coffea arabica* which has been hitherto called "narrow leaved." This has now proved itself to be a very early fruiting and prolific variety, and has been named "Minerva Coffee" for convenience of nomenclature. The beans are of large size and possess a very fine flavour.

**MEXICAN COFFEE.**—This is another of the interesting introductions which are always being received through the Royal Gardens Kew. It is a variety of *Coffea arabica* and has proved itself to be a very prolific variety, and one possessing a strong constitution.

**GOLDEN DROP COFFEE.**—This is a variety received in exchange, but about which we have received no definite information. It is evidently a variety of *Coffea arabica*. It will be tried on the new grounds at St. Clair.

The culture of coffee in Trinidad is certainly extending, somewhat slowly it is true, but still extending. The Botanical Department has sold large numbers of plants at, four for a penny, which should be cheap enough to encourage planting. There is however a general disinclination to cultivate coffee for itself, and it is usually looked upon as a plant for the hedges, and odd corners. Some few are now commencing on different lines, and it is to be hoped that others will soon follow their example.

**ORANGES.**—Our work in connection with orange growing has been to raise seedlings of the various kinds for sale, and for use in grafting. Hitherto special or marked kinds have not been available, but importations have now in part remedied this. Plants imported from Florida, as recorded in my annual report for 1896, have done well and are now planted to form an avenue on the main road near the entrance to the new grounds. The following is the list of kinds from the gate downwards or westwards:—

1st pair	Homosassa.	9th pair	King.
2nd "	Majorca.	10th "	Lamb's Summer.
3rd "	Parson Brown.	11th "	Tangerine.
4th "	Tardiff.	12th "	Navel.
5th "	St. Michael's Blood.	13th "	Jaffa.
6th "	Ruby.	14th "	Pineapple.
7th "	St. Michaels.	15th "	Mandarin.
8th "	Sandford's Mediterranean.		

Some of the above have fruited, (viz.) the 2nd, 3rd, 4th, 6th, 11th, and 12th, and all prove to be a fine class of orange. Numbers 6 and 12, being very fine indeed.

In Trinidad the class of oranges hitherto grown, are mostly of the St. Michael's type, together with numerous varieties of *Citrus nobilis* (i.e.) the oranges of the "Mandarin" and "Tangerine" type. There is a considerable trade between Trinidad and the Portuguese Colonies, which is probably partly owing to a large settlement of immigrants from those places some years ago, who, there can be little doubt brought the better class of Sweet Orange with them. The Botanic Garden has also distributed seedlings raised from seed grown on isolated trees for many past years. The result is that a really sour orange can hardly be found, if we except the bitter or seville type of fruit, which is not common.

I mentioned in my last annual report, the variation from seed of a variety of *Citrus nobilis*, as a proof of its origin, and as a proof of the variation which naturally occurs in this genus, as well as in others. The trees then referred to, have shown during 1898, more clearly than during the previous year; that the variety of orange known as the "Grenadine" or *Gros peau*, is merely a large variety of *Citrus nobilis*.

Several trees planted by my predecessor of which no name or record can be found, have this year produced fruit for the first time. Among these is a seedless or nearly seedless orange, which corresponds to the description of a kind popular in Florida, known as the "Washington

Navel." It is noted for the marked protuberances which appear on the apex of the fruit, and is certainly an orange of a first class type. As soon as our preliminary arrangements are complete at the Experiment Station, I hope to be able to graft a large number of these kinds yearly for local distribution.

A disease, which is fatal alike to large and small trees, but more often to the Mandarin than any other kind; made itself apparent during the wet season. It first shows itself by the leaves turning yellow. An examination of the root proves that these are effected by fungus growth, and when the trees are badly attacked they die out in a few months. With small seedlings the case is not hopeless, for it having been noticed that the fungus makes its attack during periods of excessive moisture, the plants may be brought under cover and saved; and if young plants are removed from the soil and situation where they were growing when attacked, and planted in fresh soil they will generally rapidly recover. It should be noted that this fungus attacks trees growing on well drained land, perhaps more frequently than those on land which has not been drained too freely.

Continued wet weather and a sodden condition of the soil are the conditions which tend to the spread of this fungus among the roots of orange trees, but as the first signs of the disease is the dropping the leaves, it is generally too late to apply remedial measures to trees growing in the open ground, after this is seen to occur.

The character of the fungus is being investigated at Kew, where specimens have been sent.

In connection with the attack of the common *Coccid Chionaspis citri*, *Const.*—it may be mentioned that in two separate places in the Gardens, rows of the common Lime were badly attacked. After an application of an abundant top dressing of fresh stable manure, these insects entirely disappeared and have not returned. I have observed many instances of the same class, in which, if the inducing cause is removed (in this case poorness of soil) the attacking insect disappears. The common mealy bug of the English plant houses and stoves is no pest here, and does no practical harm though always present, simply, I am of opinion, because the surrounding conditions are not such as to encourage a rapid rate of increase. On the other hand it is also found, that although insect pests may be killed out again and again with insecticides, &c., yet they will reappear time after time, apparently endowed with renewed vigour for the attack.

There can be little doubt that an enervated or weak condition of health, invites the attack of parasitic enemies, both in the vegetable as well as in the animal kingdom, and also allows of a rapid rate of increase; while vigour of constitution wards off attack, and even if attack is made, prevents a rapid spread.

The coconut scale is another instance of the same class. Wherever the land is exhausted, or poor, or deficient in any constituent necessary for the growth of the coconut; the trees are liable to succumb to the attack of scale and other insects, and it is also liable to similar attack if there is a superabundance of growth or abnormal vigour, either state corresponding to the half starved and the highly fed animal.

If plants are in a perfect state of health and the surrounding conditions are also perfect, they are generally able to ward off or withstand the attack of either insect, or fungoid pests; but where an enfeebled, depauperated, or abnormal condition occurs, attack is invited, and the after spread is rapid.

Notwithstanding this, it may be freely admitted that there are insect enemies of a *depredatory character*, which kill by force of numbers healthy and unhealthy plants alike; and also vegetable organisms which act in a similar way. With this state of things there is nothing to be done, but to wage a continuous war against the intruder by every known means in our power; but to put our trust wholly in insecticides and remedies, while neglecting to remove the first or inducing cause of the attack, is certainly an unwise as well as an unscientific proceeding.

The "San Jose" scale, according to all accounts of it, is an insect of the depredatory class, and has been reported a pest wherever found. Everyone should therefore join in the present endeavours to prevent its introduction into Trinidad. It is not at all clear however, that it would become so serious a pest in the humid tropics of Trinidad, as it has with our friends of the temperate zone, but this should not prevent reasonable endeavours to keep it from appearing; for it is quite certain no harm can be done by it, if kept at a proper distance from our shores.

Later observations on the characters of the variation produced by seedlings of *Citrus nobilis*, lead to the conclusion that there is very ample evidence of a very wide range, caused by the constant variation from seed. Some of the varieties of this species are very superior, while others have nothing to commend them whatever. It will be a task for this Department in the future to secure all the best kinds by the process of grafting so that they may be available for future use.

The orange, generally commences to ripen in Trinidad in the last month of the year, but many kinds are not really well ripe until February, while some are even later, and some earlier than this.

In cultivating from seedlings, it is highly probable as in other fruits, that the range of variation in the period of ripening will be a considerably wide one; and a decided advantage may accrue from this possibility, when oranges are cultivated for export.

It is evident that if growers can get their fruit upon the market six weeks or a month previous to the growers of another country. It will tend in no small measure to increase the profits made, in fact it will enable cultivators to "collar" certain markets, where at present they have no chance of competing.

**GRAPE FRUIT OR PUMELO.**—The prices accredited to consignments of this fruit in the American markets has led to numerous enquiries for plants. A tree standing in the orchard grounds has recently fruited and the produce has proved to be the finest of its class.

In this class of fruit as well as in other members of *Citrus* tribe, variation is well and widely defined. There are grape fruit which would almost serve as lemons or limes, on account of their acid character; and there are others as sweet as some of the best oranges, and as richly perfumed. Many are absolutely worthless, while others are deserving of the highest recommendation as dessert fruit.

There is no record as to whether our tree has been imported or whether it is a chance seedling, in any case, it is of excellent quality. The estimate which had been formed of its value has recently been confirmed by Mr. D. G. Fairchild, an American Botanist travelling on behalf of the Department of Agriculture of the United States, who recently visited our Establishment. He declared that our tree produces fruit of the class so much in demand in the American Markets. Mr. Fairchild's opinion will have due weight, when it is known that he is specially charged with a mission for introducing new classes of fruit trees and other plants to the United States, and in making a tour of the world for that purpose.

**BAMBOO STAVES.**—The bamboo staves in demand for lance shafts for the army have again been under attention and at the time of writing this report there is a large number of staves of our own growth which are being prepared for the examination of experts. There can no longer be any doubt as to our having the right kind under cultivation, as our plants have given staves which are identical in every respect with the pattern sent on to us from the war office. (Ordnance Department.)

A sample sent on from India by Mr. O. Warner proved to be much smaller in size than the specimen forwarded from the Ordnance Department, but Colonel Blake an old Indian Cavalry Officer, who was lately on a visit here states, that the smaller sizes are most used, and that the staves grown in Trinidad are the kind required. It only remains therefore to plant large areas of this bamboo so as to put the produce forward on a scale which will induce the attention of the home authorities. A good stave is worth in England three shillings, and it would appear, that at this price, growing bamboo should prove a very remunerative industry.

**YAMS, *Dioscorea* species.**—The experiments in connection with this class of plants have been continued at St. Clair, and the improvement of the quality of the tubers grown in the new ground is so marked, as to be patent to the veriest novice.

The kinds grown were as follows:—

Yellow Yam	<i>Dioscorea cayenensis.</i>
White Yam	„ <i>alata.</i>
Negro Yam	„ <i>alata, var.</i>
Red Yam	„ <i>alata, var.</i>
Horn Yam	„ <i>alata, var.</i>
Water Yam	„ <i>alata, var.</i>
Chinese Yam	„ <i>batatas.</i>
Afoo Yam	„ <i>lutea.</i>
Cush-cush or Indian Yam	„ <i>trifida.</i>

*Dioscorea bulbifera*, is so evidently inferior that its culture has not been continued.

The Devil Yam, which is taken to be a very coarse variety of *D. alata*, has also been discarded as useless.

The “Negro Yam” is by far the best of the white yams grown.

The “Yellow Yam,” is also a good table kind very sweet and wholesome and much liked by American and European visitors.

The “Cush-cush” or “Indian Yam,” also known as “Yampee,” gives but very small tubers and there are three or more marked varieties.

1st. Red “Cush-cush”; 2nd white “Cush-cush”; 3rd Demerara “Cush-cush.” The last mentioned kind has larger tubers than the others, testiculate in form, and generally of excellent quality. It has been found that the return made by varieties of this species, is much less than from any other, but it is probably superior to any for the table of the better classes, although it would not be profitable to grow, where a cheap supply of food stuff was required.

The Chinese Yam, as I know it, is one of the best. Well grown and well ripened, it is of fine quality for table, and probably comes nearer in flavour to a good potato than any other variety.

The Afoo Yam, is the most inferior of all. This name however is sometimes applied to the Yellow Yam, so that one may get the worst as well as the best yams under the same name, so little is local nomenclature to be trusted.

The yield of yams given in former reports has been more than maintained. White Yam gave over 20 lbs. weight to a plant. Negro Yam 17 lbs., Chinese Yams 19 lbs., Yellow Yam 12 lbs., and Cush-cush 7 lbs. Yams grown from serial tubers (*i.e.*) tubers which develop on the vines gave 19 lbs. per root. White Yam yielded at the rate of 13 tons to an acre. If twenty-five per cent. is deducted from this for waste and for planting again, there is still a crop of ten tons per acre to be registered, as the crop for the year 1898.

UNCARIA GAMBIE.—A single plant out of the many sent us by Kew has survived and is growing fairly well. It flowered during the year but produced no seed.

DURIAN—*Durio zebethinus*.—This plant appears to require much care in our climate, as only one has grown at all freely out of the many which have been planted. This is now some thirty feet in height but has not produced fruit and is not in a vigorous condition.

PENNISETUM TRIFLORUM, Edge.—A patch of this grass has now been grown continuously for ten years. It has proved to be well suited to our climate as a fodder grass—all classes of stock eating it readily. It grows easily from seed, or by division of the roots, and is very hardy, standing well in either wet or dry weather. A certain area has now been planted at St. Clair and next year it is hoped to ascertain its value, in comparison with the popular Para Grass, and the still more popular *Panicum maximum* or Guinea Grass.

GUINEA GRASS (*Panicum maximum*).—An area of about three quarters of an acre has been planted at St. Clair to provide fodder for the horses kept by the department. An extended experiment was carried out with this grass during 1898—a full record of which was published in the Bulletin of the department for January, 1898. The main points were as follows:—

#### FOOD VALUE AND YIELD OF GUINEA GRASS.—(*Panicum maximum*.)

In order to ascertain the food value of this well known forage plant, a plot of ground one-tenth of an acre in area was planted during the year 1897.

After four cuttings have been taken off, it was determined to weigh the crop of a cutting, to ascertain what was the yield per acre when freshly cut. The grass obtained at the first cutting weighed 3,012 lbs., or at the rate of 13·4 tons per acre.

The above result led to the determination to keep a year's record.

In order, however, to obtain correct values several deductions were made.

It is a well known fact to all who use it, that a very large proportion of this grass is wasted by animals, and not consumed, (*i.e.*) wasted as food, but serves as bedding, and eventually becomes available to the agriculturist as manure, but when we are considering food value simply, the waste must be properly ascertained.

In order to discover how much loss actually occurs a known weight of freshly cut grass was taken, and all the waste portions carefully removed by hand, so that its value might be compared with fodders where the waste is comparatively trifling. The average waste of two samples of 100 lbs. each, was nearly thirty-three per cent., so that the actual weight of undried fodder, per acre, at the one cutting, is 8·98 tons.

Compared with English or American Hay at four or five tons to the acre of dried material, we obtain a fair idea of its value. The yield of 8·98 tons when reduced to "air dry" weight is lessened by 5·65 tons, leaving 3·33 tons as a crop. The air dry weight of the European analysis is always less than the air dry weight of the Tropics, and this must be taken into account when attempting to ascertain the relative value of any kind of fodder. The "air dry" weight of Guinea grass will therefore be more in proportion, than the air dry weight of Hay ascertained in Europe. How much is to be allowed for this, cannot be ascertained until we have an analysis of European or American Hay made in the Tropics.

In the Tropics there is little or no real cessation of growth, and the rest of plants is generally taken in the dry season when there is less growth than at any other time of the year, the rate being regulated by the rainfall. Hence, from the tenth of an acre of which we write, no less than six crops were obtained during the year 1898, cut at the time detailed in the following table:—

February 12th	...	...	...	...	...	3,012 lbs.
April 2nd	...	...	...	...	...	2,120 "
July 15th	...	...	...	...	...	3,761 "
September 5th	...	...	...	...	...	3,569 "
October 22nd	...	...	...	...	...	2,682 "
December 9th	...	...	...	...	...	1,659 "
						16,803 lbs.

The cuttings were made when the grass was fit to cut, (*i.e.*) when in a proper condition for horse feed, and the total weight reaped during the year, as seen by the table was 16,803 lbs., or at the rate of 168,030 lbs. or 75 tons per acre.

The loss in weight by air drying, proved by actual experiment was at the rate of 63 lbs. per 100 lbs.; so that the total dry weight of the crop grown upon our piece of ground was 62,180 lbs., or 27·75 tons per acre, annually, making the reduction of 33 per cent. for unedible portions, we have a total of 18·60 tons of air dry Guinea grass as the return per annum from one acre.

The piece of land used for the experiment had for several previous years been used for the growth of vegetables, in fact, until it had become quite "sour" and useless for this purpose; as little or nothing would grow upon it, either with or without manure, lime, &c., &c.

It had had, during the time vegetables were growing upon it, frequent applications of manure, but no heavy dressings, and no manure at all was applied for some time previous to its being planted with Guinea grass, and during the growth of the Guinea grass no manure of any kind whatever was applied. It was situated adjoining a field supplying grass to Government House, and little difference was to be observed between the growth on the measured patch and the ordinary field, which was cut at similar intervals during the year.

It will therefore be seen that the yield obtained is from ordinary ground without extra tillage or manure.

On the last crop being taken the grass roots were removed, the ground having again become "sweet" and suitable for the cultivation of vegetables, &c.

The analysis of Guinea grass as grown in Trinidad at the cattle farm, is given by Mr. Meaden in the Proceedings of the Agricultural Society as follows:—

	Moisture.	Albumenous Compounds.	Carbonaceous Principles and Woody Fibre.	Mineral Matters.	Ash.
Guinea Grass ... ..	18.90	7.80	58.32	14.97	—
Clover Hay ... ..	11.67	7.80	72.03	9.01	4.14
Vetch ... ..	*	8.25	86.07	5.68	6.3
Bahama Grass ... ..	15.50	6.59	65.94	11.95	—
Para Grass ... ..	15.50	5.24	69.97	9.28	—

\* See moisture of Vetch in Church's analysis below.

It is not stated in the analysis whether the moisture in the Guinea grass is that of the air-dried product, but it is evident that were less moisture present, it would compare more favourably with other fodders, the analysis of which is given in the table.

In Church's "Food grains of India," the analysis of the Vetch differs considerably from that of the table given—

VETCH ( <i>Vicia sativa</i> L.)					
Water	...	...	...	...	10.10
Albumenoids	...	...	...	...	31.50
Starch	...	...	...	...	47.60
Oil	...	...	...	...	.90
Fibre	...	...	...	...	6.70
Ash	...	...	...	...	3.20
					100.00

Church also remarks that the albumenoids in Indian vetches are rather high, the average European sample giving 27.5 per cent. only.

It would appear therefore that the food value of Guinea grass is not so high as has been commonly supposed, although as a fodder plant, it must always take first place on account of the large and continuous crops which it affords.

Mr. Meaden records that he put manure upon his land, in a well rotten condition to the depth of eight inches, and that he grew Guinea grass at the rate of 118 tons to the acre\* harvested at one cutting, and in the dry season. This would be accounted for by the fact that during the dry season the grass is actually heavier, owing to the larger quantity of woody fibre, the removal of which would probably give a loss of some sixty to seventy per cent. instead of the average I have taken of some thirty-three per cent.

Guinea grass, and in fact, all grasses when cut at the proper time, (*i.e.*) when the flower spikes are fully formed, contains much more nutriment than when cut young, and seeing the large percentage of water in Guinea grass when freshly cut, it is no wonder that in Trinidad we hear statements that it renders animals liable to colic, diarrhoea, &c., &c.

If the grass is left to become too "bony" there is again great waste, for it has been seen above what a very large percentage of it in this condition is unfit for animal consumption. Cut at the right period it makes first class hay; but in the climate of Trinidad it is a very difficult matter to secure weather suitable for the operation, as when the grass is plentiful, there is little fine weather, and when the weather is suitable, there is little grass. Guinea grass however is, all things considered, the most economic of all the grasses for feeding purposes for both horses and cattle. I am fully aware that there is considerable prejudice against its use for milking cattle. It is asserted that it causes cows to "go dry." Probably this idea would prove on examination to be merely insular prejudice, but personally I cannot either affirm or deny the proposition. I know, however, that in Jamaica, cows are fed upon Guinea grass, and the question naturally follows, if in Jamaica, why not in Trinidad? The subject of the food value of the different grasses is one which should have due attention, in face of the opinion held by some that our lands are not generally suited for stock raising. A look at the Government Stock Farm, formerly a sugar estate, proves that cattle can be raised of the best quality, and in an economic manner. What can be done in one establishment can certainly be done in another if the proper means are employed, and the experiments are carried out under proper management.

**TOBACCO.**—A small area of one-twentieth of an acre was planted with the best kind of Havana tobacco in exceptionally good growing weather and it grew so fast as almost to create surprise. It had three dressings of artificial manure which evidently proved too much, as we obtained luxuriousness at the expense of quality. It is now being cured and promises better than

\* About 6.7 lbs. per square foot.

was at first expected. It will when sufficiently cured form a mild flavoured "*filler*" tobacco. Another planting which followed has every appearance of giving quality as well as quantity Tobacco in Trinidad should evidently be planted so as to be ripened and cured in dry weather *i. e.* in the earliest months of the year which are always the driest.

STYRAX BENZOIN.—These trees which were favourably reported upon last year, must again be noticed for the progress made. They have grown very freely and some of them are now twelve feet in height.

AGAVE RIGIDA VAR SISALANA.—"Sisal Hemp" our plants of this have grown well and many of them have flowered or "poled"—It has been planted near the Convict Establishment at Carrera's Island where the fibre grown is being utilized for making mats, ropes, hammocks &c., &c. The plant has proved itself to be well suited to the climate of Trinidad.

J. H. HART, F.L.S.  
Superintendent Royal Botanic Garden.

To the Honourable  
THE COLONIAL SECRETARY,  
Trinidad and Tobago.

## APPENDIX I.

### Plants and Seeds Distributed.

Plants and Seeds were distributed to the following correspondents during the year:—

Royal Gardens	...Kew	Vilmorin Andrieux & Co.	...Paris
Botanic Gardens	...British Guiana	Thos. Christy & Co.	...London
" "	...Jamaica	A. Turner	...Santa Martha
" "	...Grenada	Commissioner	...Tobago
" "	...St. Lucia	J. W. Moir	...Central Africa
" "	...St. Kitts	Dr. Trenb	...Java
" "	...Dominica	Madinya	...Ecuador
" "	...St. Vincent		
" "	...Accra		
" "	...Lagos	Forres Park Estate	...Trinidad
" "	...Port Darwin	George White, Esq.	... "
" "	...Gambia	R. de Verteuil	... "
" "	...Fiji	Mr. Schoener	... "
" "	...Antigua	Railway Station (Government)...	... "
" "	...British Honduras	H.M.S. Renown	... "
" "	...Dominica	Hon'ble N. Nathan	... "
" "	...Martinique	Public Works Department	... "
" "	...Sydney	St. Ann's Reservoir	... "
" "	...Java	House of Refuge	... "
" "	...Brisbane	Mr. Patterson	... "
" "	...Singapore	H.M.S. Geier	... "
" "	...Melbourne	Venezuelan Consul	... "
" "	...Mauritius	Mrs. Senior	... "
" "	...Adelaide	Schock & Co.	... "
Exp: Station	...Baton Range, Louisiana	Llanos & Co.	... "
		Dr. Rodriguez	... "
Damman & Co.	...Italy	Mrs. Stollmeyer	... "
Haage and Schmidt	...Germany	J. Marcano	... "

## APPENDIX II.

## Plant and Seed Exchange.

Plants and seeds were received from correspondents according to the following list, which forms annually a permanent record of introductions made, and is also an acknowledgment to our correspondents in the various institutions which favour us with exchanges, and present similar returns:--

NAMES.	NAMES.
<p style="text-align: center;"><b>From Royal Gardens, Kew.</b></p> <i>Kickxia Africana</i> <i>Aphelandra nitens</i> <i>Artocarpus</i> sp. <i>Asplenium Nidus</i> <i>Cephaelis Manni</i> <i>Coffea</i> n. sp. Congo <i>Draacena Godseffiana</i> " <i>Sanderiana</i> " sp. O'Calabar " <i>Phrynoides</i> <i>Demonorops propinquis</i> <i>Eulophia Colea</i> <i>Ficus altissima</i> " <i>Parcelli</i> " <i>pilosa</i> <i>Garcinia ternophylla</i> <i>Gardenia</i> sp. Trop. Africa <i>Hæmatostaphis Barteri</i> <i>Ixora lutea</i> <i>Malpighia coccigera</i> <i>Mysore Cardamoms</i> <i>Pandanus pacificus</i> <i>Papaya Changona</i> <i>Ruychia souroubia</i> <i>Raphia vinifera</i> " <i>Sustain</i> Orange <i>Tacca pinnatifida</i> " <i>viridis</i> <i>Pritchardia Thurstonii</i> <i>Begonia Bonmanni</i> <i>Arisæma fimbriatum</i> <i>Begonia Gloire de Lorraine</i> " <i>Rex</i> , 6 vars. <i>Crinum podophyllum</i> " sp. Accra " sp. Saharanpur <i>Encephalartos Barteri</i> <i>Eucomis punctata</i> <i>Euphorbia bupleurifolia</i> " <i>meloformis</i> <i>Haemanthus Lindenii</i> <i>Musa alba-indica</i> (Seedling) " <i>Livingstonea</i> " <i>rosea</i> " <i>vittata</i> <i>Myrmecodia Antoinii</i> <i>Phyllocacti</i> (named) <i>Pitcairnia cærulea</i> " <i>ferruginea</i> <i>Sansevieria Ehrenbergii</i> <i>Sprekelia formosissima</i> <i>Testudinaria elephantipes</i> " <i>sylvatica</i> <i>Musa sumatrana</i> Olivia sp. <i>Villebrunea integrifolia</i> Assana <i>Uapaca Kirkiana</i> <i>Toxicodendron capense</i> <i>Phoenix canariensis</i> <i>Pitcairnia ferruginea</i>	<p style="text-align: center;"><b>Botanic Gardens, Ceylon.</b></p> <i>Pahudia javanica</i> <i>Canarium Zeylanicum</i> <i>Lysidice rhodostigia</i> <i>Sapindus erectus</i> <i>Tabernamontana dichotoma</i> <i>Dillenia retusa</i> <i>Vitex trifolia</i> <i>Doona Zeylanica</i> <i>Derris dalbergioides</i> <i>Malotus Philippinensis</i> <i>Lasianthus strigosus</i> <i>Flemingia strobilifera</i> <i>Cassia nodosa</i> <i>Exacum Zeylanicum</i> <i>Eugenia Mooniana</i> <i>Memeeylon umbellatum</i> <i>Turpinia ponifera</i> <i>Astodes Zeylanica</i>
<p style="text-align: center;"><b>From Botanic Gardens, British Guiana.</b></p> <i>Solanum</i> sp. Cucumber special kind	<p style="text-align: center;"><b>Botanic Gardens, Sydney.</b></p> " <i>Yellow Cedar</i> " <i>Rhus rhodantha</i>
<p style="text-align: center;"><b>Botanic Gardens, Grenada.</b></p> <i>Dereis scandens</i> <i>Prestoea montana</i>	<p style="text-align: center;"><b>Botanic Gardens, Singapore.</b></p> <i>Cycas Rumphii</i> <i>Albizia Moluccana</i> <i>Mezoneurum ferruginea</i>
<p style="text-align: center;"><b>Botanic Gardens, Jamaica.</b></p> <i>Chrysalidocarpus futescens</i>	<p style="text-align: center;"><b>Botanic Gardens, Calcutta.</b></p> <i>Ficus altissima</i> <i>Sterculia alata</i>
	<p style="text-align: center;"><b>Botanic Gardens, British Honduras.</b></p> Mahogany Seeds
	<p style="text-align: center;"><b>Botanic Gardens, Bangalore.</b></p> <i>Sterculia alata</i> <i>Careya arborea</i> <i>Trespesia lampas</i> <i>Momordica balsamina</i>
	<p style="text-align: center;"><b>Botanic Gardens, Brisbane.</b></p> <i>Eucalyptus diversicolor</i> " <i>siderophloia</i> " <i>saligna</i> " <i>marginata</i> " <i>planchoniana</i> " <i>tereticornis</i> " <i>obliqua</i> " <i>pilularis</i> " <i>resinifera</i> " <i>homastoma</i> " <i>maculata</i> " <i>trachyphlora</i> " <i>Creba</i> " <i>globulus</i> " <i>eugenioides</i> " <i>corymbosa</i> <i>Tristania conferta</i> <i>Geitonoplesium cymosum</i> <i>Sarcopetalum Harveyanum</i> <i>Morinda jasminoides</i> <i>Phipogonum album</i> <i>Entriphus Brownii</i> <i>Vitis hypoglauca</i> <i>Acacia</i> sp. <i>Callitris robusta</i> <i>Myrsine variabilis</i>

## APPENDIX II.—Continued.

NAMES.	NAMES.
<b>Botanic Gardens, Dominica.</b>	<b>Botanic Gardens, Lagos.</b>
Durio zibethinus	Lonchocarpus cyanescens Abeokuta coffee.
<b>State Gardens, Baroda.</b>	<b>Botanic Gardens, Nagpur.</b>
<p>Casuarina Ficus religiosa Anona squamosa Bassia latifolia Hæmatoxylon campechianum Terminalia glabra Dalbergia sissoo Ixora bracteata Ficus indica Bauhinia purpurea Cassia sumatrana Phoenix dactylifera Tectona grandis Albizia Lebbek Sapindus saponaria Poinciana pulcherrima lutea Cordia Myxa Azadirecta indica Trophis aspera Poinciana pulcherrima Acacia alata Thespesia populnea Cordia sebestina Poinciana regia Duranta (blue) Butea frondosa Jatropha multifida Nephelium Lit-chi Ehretia aspera Emblica officinalis Guatteria longifolia Pongamia glabra Adenanthera pavonina Cassia tora Acacia farnesiana Clerodendron viscosum Agati grandiflora Mimusops Elengi Conocarpus latifolius Wrightia tinctoria Bixa orellana Millingtonia hortensis Santalum album</p>	<p>Zizyphus jujuba Hibiscus species</p>
<b>Botanic Gardens, Buitenzorg, Java.</b>	<b>Botanic Gardens, Durban.</b>
<p>Cassia Temorensis D.C. Daemonorops melanocbaetis Chrysalidocarpus lutescens Canthemum glabrum Canarium kepela Dammara alba Intsia amboinensis Cassia fistula, L. Sindora, sp. Pterocarpus santalinus Ormosia sumatrana Spathodea stipulata Livistona Horgendorpii Peltophorum dasyrhachys Zanonia macrocarpa Acacia sphaerocephala Pinanga Kuhlji, Bl. Melia arguta, D. C. Cedrela serrata Calophyllum inophyllum Livistona oliviformis Peltophorum ferruginum Cassia Javanica, L. Cassia glauca, L.</p>	<p>Nerine pancratioides Begonia geranioides Nerine flexuosa</p>
<b>Experiment Station, Baton Rouge, Louisiana, United States America.</b>	<b>Botanic Gardens, Old Calabar.</b>
Dolichos multiflorus	<p>Raphia vinifera " Hookeri Monodora tenuifolia</p>
	<b>African Lake Co-operation, Glasgow.</b>
	Strophanthus Emini
	<b>Botanic Gardens, Lal Bagh.</b>
	Argyrias, sp.
	<b>H. W. C. Dihm, Esq.</b>
	<p>Kentia Wendlandiana Licuala peltata Euterpe stolonifera Nymphaea stellata Ficus elastica var. variegata Licuala peltata</p>
	<b>H. Kernahan, Esq.</b>
	Criollo cacao
	<b>Miss Huggins.</b>
	Canna (brick red)
	<b>Hon. N. Nathan.</b>
	Cœlogyne sp. and other orchids
	<b>Messrs. Vilmorin Audrieux &amp; Cie, Paris.</b>
	<p>Chamærops Birro Ravenala Madagascariensis Manihot Glaziovii</p>
	<b>Mr. Esme Howard.</b>
	Widdringtonia Whytei Rendl
	<b>M. Nollet.</b>
	Holcus saccharatus
	<b>Messrs. Veitch &amp; Sons.</b>
	<p>Madame Isaac Pereire Catherine Mermet Safrano Adrienne Christophle Sou-de S. A. Prince Queen of the Bourbons Prince Marie Henriette Safrano de fleur rouge Amazone Cheshunt Hybrid Etoile de Lyon Isabelle Sprunt Bridesmaid Francisca Cruger Celine Forestier George Fober Duc de Magenta</p>

APPENDIX III.

ROYAL BOTANIC GARDENS, ANNUAL RAINFALL, 1862 TO 1898, INCLUSIVE.

YEAR.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	Total Rainfall in each year in Inches.	Decades.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.		
1862	0.00	.66	.77	.25	1.41	8.47	10.36	9.57	11.97	6.60	10.06	3.03	63.15	In the decade 6 years above and 4 years below 30 years average.
1863	1.54	2.71	1.45	.85	1.26	9.12	10.12	10.53	12.11	6.24	4.30	6.57	66.80	
1864	2.51	.53	.36	.04	8.15	4.96	7.17	12.06	8.04	6.53	5.94	6.61	62.90	
1865	2.62	3.20	1.07	7.98	3.22	5.64	10.35	14.83	7.32	14.62	4.81	9.62	85.28	
1866	2.24	3.91	1.44	1.09	1.45	6.59	7.83	12.34	5.87	10.11	8.17	6.82	67.86	
1867	1.31	6.36	.83	1.32	2.33	5.30	12.20	15.21	10.45	7.87	.67	2.71	66.56	
1868	2.06	.82	3.20	.64	4.17	7.78	11.35	6.73	5.46	4.66	8.31	1.03	56.21	
1869	.08	.93	.74	.41	.69	5.52	10.17	8.74	8.86	5.15	6.30	5.87	53.46	
1870	2.61	.56	1.46	1.51	4.65	8.81	11.91	9.00	10.63	3.98	5.94	8.29	69.35	
1871	6.62	1.40	2.89	.92	3.97	8.84	11.73	12.97	7.87	4.37	10.73	3.27	75.58	
1872	1.45	.07	.74	.39	3.14	7.09	5.45	10.82	3.07	4.80	9.89	3.04	49.95	In the decade 4 years above and 6 years below 30 years average.
1873	1.78	1.08	1.98	.53	0.00	4.31	5.04	8.37	5.80	10.34	3.48	1.31	44.02	
1874	3.47	1.96	3.67	5.16	2.51	12.28	12.28	11.20	9.38	6.42	3.66	4.29	76.28	
1875	3.39	.91	.56	.42	2.61	4.15	12.62	7.22	11.95	10.85	3.74	2.48	60.90	
1876	3.26	1.03	1.78	1.67	6.65	11.17	12.23	15.18	12.03	7.04	5.95	3.96	81.95	
1877	2.14	0.00	7.46	3.38	3.19	8.43	8.35	12.94	6.39	6.68	7.66	5.48	72.10	
1878	3.44	.70	0.00	3.22	4.99	5.78	5.42	8.88	11.15	5.89	8.72	3.05	61.24	
1879	1.52	2.76	4.56	3.03	3.08	14.92	6.86	10.35	6.15	3.54	4.28	4.38	65.43	
1880	11.72	6.53	.67	2.32	3.90	7.83	6.30	17.39	7.47	5.74	10.51	1.96	82.34	
1881	.57	.65	.23	1.60	4.66	11.05	7.82	10.90	10.59	3.36	12.06	2.23	65.72	
1882	1.33	2.38	.73	1.57	3.74	6.33	5.93	8.40	4.93	5.86	10.29	1.50	52.99	In the decade 4 years above and 6 years below 30 years average.
1883	1.56	.71	.26	3.37	5.89	10.91	13.66	10.26	5.53	3.99	6.06	8.30	70.50	
1884	3.43	2.50	4.40	1.51	2.91	6.84	5.71	8.70	5.03	5.05	5.14	5.66	56.88	
1885	1.30	.89	1.49	.43	5.27	3.44	5.87	4.56	6.08	4.08	5.37	4.44	43.22	
1886	3.32	1.97	3.27	3.83	4.49	9.70	17.48	8.15	6.73	12.59	8.54	6.75	86.82	
1887	2.69	1.46	1.67	1.08	3.98	7.40	5.51	9.93	5.07	5.84	7.60	11.86	64.09	
1888	8.37	1.79	2.41	2.28	3.46	11.92	6.89	7.02	5.53	5.06	7.76	2.95	65.44	
1889	0.94	0.85	4.16	1.05	6.34	11.66	12.14	11.73	3.76	6.30	7.38	7.48	73.79	
1890	7.76	0.51	2.09	7.62	5.14	9.68	12.39	11.65	3.37	10.98	5.93	5.28	82.90	
1891	3.17	0.92	0.03	1.44	2.54	5.54	11.88	4.26	7.44	5.77	6.66	4.09	53.74	
Avg. Monthly Rainfall for 30 years, 1862-'91	2.94	1.69	1.87	2.03	3.65	8.04	9.45	10.32	7.53	6.67	6.86	4.81	*65.91	
1892	1.93	2.19	1.85	7.59	11.55	16.26	15.55	9.21	3.57	11.49	5.40	4.69	91.14	
1893	3.43	1.85	0.19	3.61	11.35	10.19	13.28	16.32	11.73	5.47	7.84	7.23	92.49	
1894	3.22	2.36	3.12	1.22	2.69	3.26	4.63	12.06	5.48	3.93	7.28	3.16	52.31	
1895	2.52	1.33	2.27	2.52	2.11	5.00	2.87	4.86	5.69	10.89	15.15	7.32	62.23	
1896	7.08	.88	1.59	2.33	1.62	10.29	6.35	7.86	6.46	6.06	9.81	6.33	66.45	
1897	1.67	.75	3.96	.26	5.58	11.19	13.88	7.90	9.83	8.87	9.39	4.40	77.68	
1898	3.05	2.18	.88	1.17	1.49	6.46	5.87	10.55	7.13	6.15	9.13	3.57	+57.63	

\*Average Annual Rainfall for 30 years—1862 to 1891 = 65.91 inches.  
 †Average last 7 years—1892 to 1898 = 71.42 "

J. H. HART, F.L.S.,  
 Superintendent Botanical Department.

## APPENDIX IV.

## METEOROLOGICAL RESULTS FOR 1898, TAKEN AT THE ROYAL BOTANIC GARDENS.

MONTH.	BAROMETER.		THERMOMETERS.										Humidity.	Tension of Aqueous Vapour.	Rainfall.	Dew Point, 7 A.M.	Dew Point, 3 P.M.
	REDUCED READINGS.		DRY & WET BULBS.				Maximum.	Minimum.	Mean Temperature, Blackened Bulb in Vacuo.	Mean Temperature, Thermometer on Grass.							
	7 A.M.	3 P.M.	7 A.M.		3 P.M.												
	Bar.	Bar.	D.	W.	D.	W.											
January	29.993	29.944	70.0	69.1	82.3	76.0	85.6	67.4	154.7	65.1	82.	734	3.05	68.41	71.78		
February	29.964	29.923	69.1	68.0	82.3	74.7	85.7	67.0	154.7	64.7	80.	697	2.18	67.15	69.61		
March	29.979	29.899	72.5	70.6	82.6	74.3	85.9	69.5	154.9	65.5	76.	708	2.10	69.18	68.74		
April	30.010	29.945	73.0	71.3	85.5	75.6	88.7	68.6	158.3	63.5	74.	720	1.17	70.05	69.17		
May	29.994	29.933	74.0	72.2	88.9	77.0	92.3	71.1	159.8	69.4	71.	746	1.49	70.89	69.51		
June	30.008	29.960	74.8	73.1	84.3	76.6	88.8	70.8	156.0	65.4	78.	785	6.46	71.88	71.52		
July	30.008	29.950	73.7	72.4	84.4	77.2	88.8	70.8	157.8	69.4	78.	772	5.87	71.46	72.45		
August	29.985	29.943	73.1	72.1	81.2	76.4	86.6	70.3	157.0	69.5	84.	785	10.55	71.36	73.14		
September	29.964	29.917	73.3	72.3	82.9	77.5	87.7	70.3	156.0	68.9	86.	812	7.13	71.56	73.89		
October	29.956	29.921	73.7	72.4	84.4	77.1	87.9	68.0	157.0	69.7	80.	772	6.15	70.52	72.29		
November	29.918	29.849	72.4	71.7	82.1	77.0	86.8	67.9	153.2	67.6	86.	799	9.13	71.18	73.59		
December	29.988	29.936	71.4	70.3	82.9	76.1	86.7	68.3	154.1	64.4	82.	746	3.57	69.47	71.55		
Monthly Average for year	29.980	29.928	72.6	71.6	83.6	76.3	87.6	69.2	156.2	66.1	80.	755	4.80	70.26	71.44		
Mean daily height of Barometer	29.954 inches.		Mean Annual Temperature				78.4				Total Rainfall		57.63 inches.				

## ROYAL BOTANIC GARDENS, MEAN ANNUAL RECORDS, 1887 TO 1897, INCLUSIVE.

YEARS.	Barometer. Mean Daily Register.	THERMOMETER.		Mean Annual Temperature	Mean Annual Relative Humidity.	Rainfall.
		Mean Maximum.	Mean Minimum.			
1887	29.844	85.9	69.0	77.4	79.	64.09
1888	29.835	87.5	69.7	78.6	81.	65.44
1889	29.947	87.7	70.1	78.9	79.	73.79
1890	29.964	86.1	69.0	77.5	79.	82.90
1891	29.954	87.8	70.1	78.9	76.	53.74
1892	29.954	87.2	70.2	78.7	80.	91.14
1893	29.954	87.4	68.5	78.1	80.	92.49
1894	29.971	87.8	69.1	78.4	78.	52.31
1895	29.962	87.8	69.5	78.6	76.	62.23
1896	29.956	87.8	70.3	79.0	80.	66.45
1897	29.962	87.9	70.3	79.1	80.	77.68
Mean	29.936	87.3	69.6	78.4	79.	71.10

## APPENDIX V.

RAINFALL FOR THE ISLAND OF TRINIDAD FOR THE YEAR ENDING  
31st DECEMBER, 1898.

No. of Station.	Diame-ter of Gauge.	STATIONS.	January.	Feb'y.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Total.
1	In.	St. Ann's—Royal Botanic Gardens ...	3.05	2.18	.88	1.17	1.49	6.46	5.87	10.55	7.13	6.15	9.13	3.57	57.63
52	8	Port-of-Spain—Police Station ...	3.12	2.17	.90	2.11	1.23	6.12	5.65	8.52	8.31	3.43	10.86	4.46	56.88
64	8	Royal Gaol ...	2.67	1.81	1.93	.94	.97	7.07	4.07	7.13	6.72	3.76	8.18	2.98	48.23
4	5	St. Joseph—Warden's Office, Queen-st. ...	...	...	...	...	...	...	...	...	...	...	...	...	...
5	5	St. Joseph—Police Station ...	3.39	1.38	2.10	.54	2.84	6.56	4.95	11.20	9.15	5.64	11.66	3.42	62.83
6	...	Colonial Hospital ...	1.89	...	...	...	...	...	...	...	...	...	...	...	...
44	...	Arouca—Bon Air ...	4.06	2.15	1.68	1.39	2.08	12.04	8.98	13.99	9.65	4.61	11.96	5.20	77.79
9	...	Cumuto—Santa Teresa ...	6.98	7.65	6.15	3.05	3.77	13.12	8.42	16.52	11.78	5.51	12.93	12.02	107.85
7	5	Arima—Warden's Office ...	...	...	...	...	...	...	...	15.27	...	2.27	11.82	6.48	...
11	5	Toco—La Resulla ...	6.14	2.93	4.69	1.39	2.09	9.72	10.49	15.99	8.94	10.32	8.76	7.74	89.70
10	5	Toco—Police Station ...	4.78	2.67	4.20	1.78	1.95	8.09	9.29	13.60	7.89	9.53	11.60	8.42	88.80
14	5	Conva—Exchange Village ...	2.95	3.48	1.87	.59	1.09	5.37	5.30	9.92	5.69	2.97	8.12	4.80	51.25
15	5	Conva—Police Station ...	2.91	3.72	2.27	.82	1.49	5.99	6.91	8.57	7.79	4.80	9.60	5.15	60.02
19	5	Montserrat—Torbuga Estate ...	...	...	...	...	...	...	...	...	...	...	...	...	...
20	...	La Reunion Estate—Caroni (Arima) ...	5.04	3.51	5.20	2.97	1.73	12.65	9.30	13.78	12.06	2.70	16.43	8.03	83.46
18	5	Montserrat—Police Station ...	2.95	3.87	2.97	.36	2.02	8.17	7.33	12.97	9.88	2.77	12.29	5.21	70.30
25	...	Oropuche—Police Station ...	2.65	3.96	3.16	.50	2.67	4.59	6.12	11.71	7.15	5.08	10.85	5.30	63.74
28	8	Savanna Grande North—Elswick Village ...	3.66	5.22	5.51	1.15	2.19	9.27	5.97	14.76	10.52	3.73	17.92	8.17	87.97
27	5	Cedros—Police Station ...	8.08	3.90	1.77	.92	1.97	5.49	4.93	4.27	2.15	6.43	10.99	10.06	60.95
74	...	Torrivella—Arima ...	4.91	3.64	3.29	1.53	3.91	11.24	9.10	19.16	10.32	4.35	13.94	6.46	92.35
2	5	Tucker Valley ...	2.49	1.82	2.77	1.69	...	...	...	...	...	...	...	...	...
21	8	Savanna Grande—Sta. Estrella Estate ...	3.44	3.91	8.71	3.75	3.53	12.43	9.69	13.58	11.74	.07	16.33	10.81	108.19
22	5	Princes Town—Police Station ...	2.45	3.73	22.42	.78	2.64	10.64	9.08	10.47	14.28	3.62	18.99	6.02	105.12
23	...	Arouca—St. Clair Estate ...	3.56	2.61	2.10	1.00	1.71	11.87	6.90	14.61	11.77	5.52	11.63	5.17	78.35
48	8	Princes Town—Lengua, Los Naranjos ...	7.90	4.30	5.58	1.39	3.16	5.95	9.63	14.74	9.23	3.98	21.15	6.59	93.31
49	5	Warden's Office—Conva ...	2.37	3.31	1.61	.33	...	...	...	...	...	...	...	...	...
16	8	Claxton's Bay—Mt. Pleasant Estate ...	...	...	...	...	...	...	...	...	...	...	...	...	...
37	5	Concord Estate—Naparima ...	...	...	...	...	...	...	...	...	...	...	...	...	...
32	5	Mayaro—Police Station ...	4.48	5.07	4.57	2.44	3.92	9.40	6.20	11.23	5.33	4.45	12.09	7.91	77.14
12	5	Chaguanas—Police Station ...	2.96	2.78	2.02	.74	2.72	5.59	5.96	9.80	13.72	4.08	8.89	5.00	64.26
13	...	Point Galera Light House ...	3.50	2.44	2.69	.97	1.18	6.76	6.93	12.70	5.50	6.31	8.14	6.67	63.84
60	...	Columbia—Cedros ...	16.50	6.80	4.25	1.30	4.33	6.66	8.45	8.37	2.53	8.22	17.27	10.49	95.12
61	...	*Forres Park—Claxton's Bay ...	1.65	2.55	1.64	.11	.87	3.98	7.93	8.66	7.96	3.93	9.37	3.36	52.01
8	5	Tumpuna—Police Station ...	2.19	1.68	2.25	.98	.94	5.13	3.47	6.50	3.43	1.25	5.53	3.46	36.76



APPENDIX V.—Continued.

RAINFALL FOR THE ISLAND OF TRINIDAD FOR THE YEAR ENDING 31st DECEMBER, 1898.

No. of Station	Diameter of Gauge.	STATIONS.	January.	Febry.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Total.
77	In.	Caroni—McLeod Plain Estate	...	...	...	...	...	...	...	...	...	...	...	...	...
78	5	Caroni—Frederick Estate	861	277	204	61	338	938	652	1277	1156	473	1019	405	7206
79	...	Orange Grove Estate—Teariguna	892	244	174	116	820	1543	1157	2317	1090	892	2278	640	11163
80	8	Siparia—Rest House	415	660	480	250	113	645	870	1847	825	640	1340	1081	9166
81	8	St. John's—Cedros	...	...	...	...	...	...	...	...	...	...	...	...	...
82	8	Chacachacare Light House	278	104	344	147	137	...	464	506	627	265	1022	133	...
83	8	Carenage—Police Station	316	209	198	307	49	660	791	1452	723	266	1801	295	7069
84	8	Gnapo—Adventure Estate	466	512	421	297	192	850	555	952	810	729	1039	695	7518
85	8	Fairfield Estate—Princes Town	...	...	...	...	...	...	...	...	...	...	...	...	...
86	8	Lothians—Princes Town	194	317	333	74	234	616	627	1056	661	286	1295	395	6088
24	8	Maraval Reservoir	313	265	326	303	95	537	558	1511	596	364	1139	316	6323
67	8	St. Ann's Reservoir	375	163	204	130	132	440	468	1360	571	481	842	354	5520
87	8	Cronstadt—Bocas	...	178	144	116	162	447	577	630	522	548	1122	285	...
88	8	Cedros—Perseverance Estate	781	409	232	101	144	420	461	404	186	726	1126	929	5909
89	8	Savonetta—Esperanza Estate	227	359	208	32	116	505	582	726	680	342	860	431	5068
90	8	La Gloria Estate—Gran Couva	370	492	337	39	237	831	576	1512	954	363	1539	418	7668
91	8	Dabadie	511	314	609	98	140	1363	766	1254	1278	394	670	600	7997
92	...	Unupia—Mon Plaisir Estate	...	...	...	...	...	...	...	...	...	...	...	...	...
93	...	Arouca—Laurel Hill Estate	320	220	204	70	246	834	750	1413	803	467	1015	357	6699
94	...	Naparima—Philippine Estate	205	295	364	63	209	577	733	1484	747	328	1019	461	6445
95	...	Naparima—Corinth Estate	205	315	210	120	190	625	650	990	655	180	1310	535	5985
96	8	San Juan—Aranjuez Estate	354	183	211	39	225	784	464	1201	1036	509	950	876	6331
97	8	Woodbrook	270	150	123	77	132	642	486	757	766	439	703	328	4893
98	...	Port George Signal Station	439	204	...	144	38	194	582	987	575	492	928	353	...
99	...	North Post "	403	192	490	398	95	662	872	1106	736	685	1837	711	8157
100	...	Perseverance Estate—Couva	231	402	147	10	103	495	544	961	660	282	736	507	5078
101	...	Camden Estate—Couva	157	275	...	...	90	390	...	807	573	436	907	460	...
102	...	La Juanita—Matura	...	...	399	...	...	...	...	...	...	...	...	...	...
103	...	St. Augustin—Tunapuna	...	...	...	...	157	744	543	954	1046	...	...	...	...
104	...	Ben Lomond Estate—S. Naparima	265	313	163	122	59	571	650	1079	1065	168	1278	611	6344
105	...	Woodford Lodge Estate	...	...	...	...	...	...	...	...	...	...	...	...	...
106	...	Palmists Usine	164	282	213	109	206	525	578	1347	738	400	1083	485	6130
107	5	Carrera's Island	242	131	145	142	141	451	517	650	448	516	1137	304	4794
108	...	Bronte Estate—Naparima	232	341	478	45	150	471	598	1123	739	338	1522	460	6492
109	...	Diego Martin Water Works	358	224	557	184	152	635	887	1505	757	735	1979	523	8556
110	5	El Rosario Estate, Pool	...	...	...	...	...	...	...	...	...	...	...	...	...
111	...	Endeavour " Chuguanas	...	...	...	...	...	...	...	...	...	...	...	...	...
		Monthly Average, and Mean for year } all Stations	379	346	374	126	197	740	700	1197	811	471	1256	598	7321

Mean Rainfall for year at 72 Stations, ... 7321 inches. } Received too late—not included in average  
 \* Forras Park Estate  
 \* Byerona Estate